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LAO PDR HYDROPOWER STRATEGIC IMPACT ASSESSMENT

FINAL REPORT

November 2004

Prepared by **NORPLAN** 
for Lao PDR Ministry of Industry and Handicrafts
and the World Bank

WORLD BANK

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STRATEGIC IMPACT
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EXECUTIVE SUMMARY

1.1 Hydropower Sector

Lao PDR is situated in the Lower Mekong Basin. The country has the largest hydropower potential in the region but only a small percentage of it has been developed to date.

A policy objective of Government of Lao PDR is to develop its hydropower resources for the benefit of the country in order to:

- *Provide reliable and affordable power to cover the national demand and thereby promote economic and social development.*
- *Develop part the hydropower potential to generate export income for the country by selling power to neighbouring countries.*

1.1.1 Demand Forecasts

The domestic demand has been increasing at a high rate the last decade even though there was a period of economic recession in the region. This high level of growth is expected to continue over the next 15 years with a slight decrease at end of this period. The demand forecast used as a basis for the Power Sector Development Plan is shown in Table1 and is based on the governmental policy of providing electricity to 90 % of the households by 2020. The rather high growth rate for the period of 2002 to 2005 is mainly due to the assumed start up of the Xepon copper mine (40 MW) and the cement plant at Mahaxai (20 MW), both of which will require considerable power. Irrigation schemes are estimated to reach a load demand of 10 MW in 2020.

Table 1. PSDP Energy and Peak Demand Forecast (Meritec et al 2004)

	Unit	2002	2005	2010	2015	2020
Energy Consumption	GWh	937.0	1,924.5	3,061.0	4,026.4	5,332.8
Av. annual growth	%		27%	10%	6%	6%
Peak Load (MW)	MW	186.4	378.3	548.6	721.8	956.1
Av. annual growth	%		27%	8%	6%	5%

Export power demand cannot be modelled in the same way as the national demand, since external factors and uncertainties are too great for any precise prediction of the long-term demand or optimization of sequencing and timing. Some determining factors will be:

- The future cost difference between hydropower and other energy sources
- Progress in regional transmission systems and power grids
- Availability of capital
- Progress in competing hydropower plans in neighbouring countries

The PSDP presents two development scenarios for export projects: a base scenario and an optimistic scenario (Table2).

Table 2. Export Generation Scenarios (Meritec 2004)

	Base Export Scenario	MW	Optimistic Export Scenario	MW
2006				
2007				
2008	Theun Hinboun Ext.	150	Theun Hinboun Extension Nam Mo	150 100
2009	Nam Mo	100		
2010	Nam Theun 2	1000	Nam Theun 2 Xe Kaman 3	1000 250
2011	Xe Kaman 3	250		
2012				
2013			Xe Kaman 1	468
2014	Xe Kaman 1	468		
2015			Xe Kong 5	348
2016				
2017	Xe Kong 5	348	Nam Ngum 3B	580
2018				
2019			Nam Ngum 2B	183
2020	Nam Ngum 3B	580		
	Total capacity	2796		2979

The sequence of the scenarios shown above is based on the professional judgement of the consultant, taking into consideration the following factors:

- Project profitability and quality of the site
- Substance and sincerity of the sponsor
- Market conditions, including demand growth, reserve margin and political support for power trading
- Capacity of Lao institutions to manage the current implementation of multiple projects

Export projects dominate the 15-year development plans in Lao PDR. The total projected capacity demand of the export projects is about three times the modelled national demand for the same period. Taking into consideration the uncertainties in the development of export projects, it is very challenging to determine the overall generation scenarios for hydropower development in the country.

1.1.2 *Hydropower Project Development Plans*

The hydropower sector is one of the most thoroughly planned sectors in Lao PDR from an economic and technical point of view. Over the last decades a number of studies have been carried out to establish a realistic list of projects and the most economic viable sequence for their construction. The definition of what is a feasible project and the principles of project ranking have, however, been constantly changing. A large number of potential hydropower projects have been identified in Lao PDR, but both the projects and their technical specifications included in

these “long lists” have changed over the years due to the collection of additional data and changing socio-economic and technical frame conditions.

In addition to EdL’s own ranking of projects (Electricité du Lao Generation Expansion Plan, 2005–2020) the following 6 hydropower ranking studies have been carried out in Lao PDR over the last 7 years:

- Hydropower Development Plan for Lao PDR (HDP) in 1997
- Power System Planning in the MIH (PSP) in 1997
- Nam Theun 2: Study of Alternatives (NT2SOA) in 1998 (Lahmeyer & Worley)
- Se Kong, Se San and Nam Theun River Basins Study in 1998 (Halcrow et al.)
- Hydropower Development Strategy Study (HDSS) in 2000 (Worley & Lahmeyer)
- Power System Strategy Study (PSSS) in 2002 (Electrowatt & PA)
- Power System Development Plan (PSDP) in 2004 (Meritec & Lahmeyer)

The list of projects analysed in this study (Table 3) are partly based on projects for domestic consumption ranked by EdL and partly on the most promising export generation projects from the PSDP ranking. It thus contains the projects that are considered the most likely to be built in the next 15 year in Lao PDR.

Table 3. EdL Generation Expansion Plan (2004-2020) for domestic projects and the most promising export projects (PSDP).

No.	Project	Year of commissioning	Installed capacity (MW)	Level of study
1	Nam Mang 3	2005 (domestic)	35	FS
2	Xeset 2	2006 (domestic)	76	FS
3	Nam Lik	2007 (domestic.)	100	FS
4	Xepon	2008 (domestic.)	74	I
5	Theun Hinboun Ext.	2009 (export)	105	MoU / FS
6	Nam Mo	2009 (export)	100	CA /FS /EIA
7	Nam Theun 2	2009 (dom./exp.)	75 + 1000	CA /FS /EIA
8	H. Lamphan Gnai	2010 (domestic)	60	I
9	Xe Kaman 3	2010 (export)	250	Constr./MoU/FS
10	Nam Ngum 5	2012 (domestic)	90	PFS
11	Thakho	2013 (domestic)	36	MoU /PFS
12	Xeset 3	2014 (domestic)	20	FS
13	Xe Kaman 1	2014 (export)	468	CA / FS
14	Nam Ngum 4A	2015 (domestic.)	55	I
15	Nam Kong 3	2016 (domestic.)	25	I
16	Nam Pot	2017 (domestic.)	38	I
17	Xe Kong 5	2017 (export)	248	MoU / I
18	Nam Bak 2B	2018 (domestic.)	116	MoU / I
19	Nam Ngum 4B	2019 (domestic.)	56	I
20	Xe Xou	2020 (domestic.)	59	I
21	Nam Ngum 3E	2021 (export)	580	CA /FS /EIA
22	Nam Ngum 2B	2022 (export)	183	CA / I (FS)

MoU=Memorandum of understanding, PFS=Pre-Feasibility study, CA=Concession agreement; I=Initial study.

1.1.3 *Financing and Development Sequence*

There is a growing acceptance that the capital required to expand the power systems in order to keep pace with demand are far higher than the financial capacity of both the Lao PDR Government and the multilateral or bilateral financial institutions. So far only two privately financed hydropower projects based on a Build-Own-Operate-Transfer (BOOT) agreement have been built in Lao PDR, the Theun-Hinboun and the Houay Ho hydropower plants.

A number of MOUs between the Government of Lao PDR and private developers have been signed both before and after the Theun-Hinboun and Houay Ho were initiated. Only a few of these have yet reached the stage where it is possible to foresee a time schedule for implementation. The most advanced project in terms of preparation is the Nam Theun 2 where financial closure is expected in 2005.

The involvement of private investors, as is the case in Lao PDR, has resulted in a partial breakdown of the system of ranking and selection of projects for development by least cost criteria, as promoted by the World Bank and the Asian Development Bank and modelled in the recent Sector Development Plans. In the system of public and donor financing, least cost planning is able to allocate investments to the "best" projects. With the private investors in the lead such scheduling has manifested itself as being very difficult to apply, as governments have little influence on project preparation and financing processes.

1.2 **Legal and Administrative Setting and the Implementation of Environmental and Social Safeguard Measures**

The Environmental Protection Law (1999) is the most important piece of environmental legislation in the country. It was further elaborated by an implementation decree in 2002. A general framework entitled "Regulation on Environmental Assessment in Lao PDR" was issued in 2000. Based on this regulation the Department of Electricity of Ministry of Industry and Handicraft (MIH) developed and issued their own environmental and social assessment regulations in the period 2001 - 2003. These regulations are broadly consistent with international safeguard regulations and guidelines.

The environmental and social safeguard institutions responsible for the hydropower sector at central level are the Social and Environmental Management Division (SEMD) of the Department of Electricity in MIH and the Department of Environment under the Science, Technology and Environment Agency (STEA). Of these two, STEA, through the provisions in the Environmental Protection Law, has an overall responsibility for the environmental safeguard system and thus the duty to oversee all issues in relevant sector ministries, including MIH. The Social and Environmental Management Division in MIH is more directly involved in the supervision of the different EA processes. The Division is involved at an early stage in determining the level of assessment needed, in the development of ToRs for Initial Environmental Evaluation and in review and approval of the various EA and EIA documents.

A comprehensive and modern system of addressing environmental and social impacts of hydropower development in Lao PDR is now in place. The implementation of this advanced set of environmental and social regulations for the hydropower sector is, however, dependent on the capacity and competence of SEMD and STEA as well as on their administrative and political "strength" to bring their influence to bear on developers and the promoters of hydropower projects in the Government. Presently staff capacity and resource scarcity within these two institutions appears to be the most urgent constraint to address when it comes to

securing appropriate implementation of environmental and social safeguards in the hydropower sector.

1.2.1 *EIA Experiences*

A brief assessment has been made of the quality the EIAs for 3 completed projects, Theun Hinboun, Houay Ho and Nam Leuk, and their adequacy compared to today's requirements. Most of the experiences with environmental and social assessment in connection with hydropower development are from a time when the national standards were not yet in place. The NT2 is a special case where the EIA processes started more than 10 years ago and has continued throughout a period where the EIA regulations both in Lao PDR and in the International Funding Institutions have been constantly strengthened.

In summary, it may be concluded that the EIA reports have assisted the planning for "better" projects, identifying needs for mitigation and compensation, and increasing the general understanding and knowledge of the environmental and social situation in Lao PDR. However, several shortcomings and problems were identified. The most important of these are:

- Crucial information and analysis were only available after the construction had started or PPAs signed so that project design and operation could not be modified as a mitigation measure.
- In general EIA studies have tended to underestimate both environmental and social impacts and their mitigation costs.
- The negative impacts in connection with influx of workers and camp followers have in general been inadequately addressed and planned for.
- Consultation and public involvement processes have for the most part been inadequate in relation to the present internationally accepted safeguard procedures.
- Compensation and resettlement needs were underestimated and insufficiently planned and budgeted for.

1.3 **Potential Environmental and Social Impacts**

The study has made an assessment of the combined impacts of the 21 hydropower projects planned for implementation before 2020.

Some of the assumed impacts and impact indicators for the studied projects are summarised in Table 4.

Table 4: Summary of project characteristics and key impacts.

Project	Installed capacity MW	Type of project	Active storage Mill m ³	Inundated land Km ²	Resettle-ment: No. people	Interference with protected areas
Nam Mang 3	35	S	45	9.5	750	
Xeset 2	76	RoR	0	1.5	0	Close to forest CA
Nam Lik	100	S	826	42.2	0	
Xepon	75	S	361	29.5	1500	Close to NBCA
Theun Hinboun Ext.	105	S, IT	2870	126	1220	Inside prop. NBCA
Nam Mo	100	S	264	10.8	0	
Nam Theun 2	1074	S, IT	3510	450	6224	Border of NBCA
H. Lamphan Gnai	60	S	89	3.5	0	Inside prop. NBCA
Xe Kaman 3	250	S	109	5.2	0	
Nam Ngum 5	90	S	252	14.6	300-500	
Thakho	36	RoR	0	0	0	In important bio-diversity area
Xeset 3	20	RoR	0	1.3	0	
Xe Kaman 1	468	S	3340	222	>800	In NBCA
Nam Ngum 4A	55	S	332	14.5	1470	
Nam Kong 3	25	S	299	36.9	1550	
Nam Pot	38	S	71	6.1	0	
Xe Kong 5	248	S	2210	70	980	In NBCA
Nam Bak 2B	116	S, IT	119	4.8	0	
Nam Ngum 4B	56	RoR	0	0.5	0	
Xe Xou	59	S	1710	113	500	In NBCA
Nam Ngum 3E	580	S	983	26.5	500	
Nam Ngum 2B	183	S	150	7.5	1000	
Total	3,849		17,540	1,195.9	>16,700	

Legend: S = Seasonal Storage, RoR = Run-of-River, IT = inter basin transfer

It is likely that the negative impacts on primary forest and unique wildlife found in the mountainous areas of Lao PDR will be significant. Three of the short-listed projects are located inside NBCAs and 2 others are located in areas that have been proposed as NBCAs. In addition, some projects are located close to areas of documented biodiversity value thus contributing to increased pressure on these vulnerable areas.

A characteristic feature of most of the planned projects is the long distance between the intake at the reservoir and the discharge point back into the river; 9 projects have a diversion distance of more than 5 km and 14 more than 1 km. River-based biodiversity and fisheries will thus be lost and water use for irrigation, water supply, transport, etc., may become severely restricted.

In general the dams proposed are high. Only Xeset 2 and Thakho have dams or intakes of a height less than 15 m while 14 projects have dams of more than 50 m and 8 with more than 90 m. This implies that dam safety is an issue for most projects and that the dams will effectively stop all upstream migration of fish.

According to available information the total land area that will be inundated in connection with the construction of reservoirs and intake headponds adds up to approximately 1200 km². The majority of the projects have reservoirs of small or moderate size, with Nam Theun 2 (450 km²), Xe Kaman 1 (222 km²), Theun Hinboun Extension (126 km²) and Xe Xou as (113 km²) being exceptions.

The available studies indicate that 12 of 21 projects will include resettlement, adding up to a total figure of more than 15,000 people. It should be noted that this is likely to be a minimum figure. Some of the data are old and the populations will have grown and, in addition, there is a general tendency to underestimate resettlement needs in the initial phases of project preparation. In 12 projects the number of resettled people will exceed 200 and thus trigger a demand for a Resettlement Action plan according to both World Bank and Lao PDR guidelines.

Most of the projects are located in the higher reaches of the river basins where the majority of the local people belong to ethnic minority groups. Given their dependence on the natural resource base and their general low degree of integration into the mainstream economy, ethnic minority groups tend to be more vulnerable to the effects of hydropower development than other population groups. It is likely that the development will accelerate the ongoing process of integration of ethnic minorities into the mainstream Lao culture. The loss of waterfalls is mentioned as a feature of 2 of the planned projects, but is likely to be a feature of more projects. To what extent this is considered a loss of a potential tourist attraction is not known. Most of the projects are located far from areas presently visited by tourists. The experience from the Nam Ngum 1 reservoir shows that, in this country which is deficient in natural lakes, reservoirs might be of significant value as tourist and recreational sites. The most likely candidates for attracting tourists will be Nam Theun 2 and the Theun-Hinboun Extension (Nam Theun 3).

Except for Nam Mo all proposed hydropower development projects are located on rivers draining into Mekong, thus having a potential of impacting on the reach shared with Thailand, the downstream areas in Cambodia and the Mekong Delta in Vietnam. The determining parameter for the downstream changes in river flow is active storage, which, for the total of all planned Mekong Basin projects in Lao PDR, will be about 17,400 mill. m³.

1.4 Recommendations

There are actions that can be taken to avoid, minimize or compensate for potential negative impacts of planned hydropower schemes. In general these include mitigation and compensation related to construction and operation and to compensatory programmes. Environmental flow and construction of erosion prevention structures belong to the first category while compensatory programmes includes, forestation plans, catchment protection programmes, fisheries development plans and social development plans, including Ethnic Minority Development Plans (EMDPs) and Resettlement Action Plans (RAPs).

The experiences gained from the Nam Theun 2 Project should be of great value for the development of future compensation and management arrangements for large hydropower projects in Lao PDR. An audit of the lessons learned in the preparation of the NT2 safeguard plans and of the experiences gained in implementation should thus be carried out. This would enable future studies to be more streamlined and more focussed on key problems and challenges. The experiences with Nam Theun 2 will also support refinement of existing regulations and guidelines, especially in the field of consultation, compensation and resettlement.

Certain issues should be addressed specifically in order to enable better safeguarding of the biodiversity and social values in connection with hydropower development. These are listed in the table below. Adequate human and institutional capacity is implicit as a pre-requisite in most of these issues in terms of having qualified personnel with the right understanding and appreciation of the issues and with the ability to make scientific assessments and informed decisions.

Table 5: Recommendations

Issues	Recommendations
Construction and Operation	
Oxygen depletion in reservoir water	<ol style="list-style-type: none"> 1) Clearing of vegetation in the reservoir prior to inundation. 2) Construction of aeration structures.
Downstream riverbank and reservoir erosion	<ol style="list-style-type: none"> 1) Riverbank protection structures. 2) Appropriate discharge and operational regime.
Reduced water flow	Construction of weirs in the river.
Loss of fisheries	Fish breeding and propagation of local species for stocking of reservoirs avoiding introduction of exotic species.
Environmental flow	<ol style="list-style-type: none"> 1) Inclusion of specific assessment of minimum flow requirements in the EIA. 2) Development of guidelines by responsible authorities for setting environmental flow requirements.
Erosion and land slides	Construction of erosion structures, re-vegetation and landscaping.
Dust, noise, air and water pollution	Incorporation of “best professional practice” in concession and contract documents.
Management Programmes	
NT2 experiences	<ol style="list-style-type: none"> 1) Close follow up of NT2 Programmes to make use of experiences and “best practice” examples for refining and developing existing regulations and guidelines. 2) Ensure provision of funds for monitoring and follow up. 3) Utilisation of the SEMFOP to make the case for funding of biodiversity and conservation initiatives by hydropower developers.
Integrated Water Resource Management	
Integrated water resource planning	<ol style="list-style-type: none"> 1) Carefully evaluate experiences with ongoing Nam Ngum test project and development of a realistic and methodological approach to be implemented nationwide. 2) Building of capacity for IWRM.
Intact River Protection	<ol style="list-style-type: none"> 1) Carry out an investigation of natural qualities in remaining untouched rivers in Lao PDR resulting in recommendations as to which rivers qualify for protection from major physical changes. 2) Assessment of present status values versus potential development values as a basis for reaching final decision on protection. 3) Clarification and putting in place of legal requirements for intact river protection with administrative protection as a preliminary measure if necessary.
Assessment of Hydropower Development	
Least-cost implementation system	<ol style="list-style-type: none"> 1) Implementation of a least cost strategy for hydropower development through simulation of a least cost development plan and introduction of competitive bidding. 2) Alternatively introduce competitive bidding before simulation studies to generate a least-cost development plan.

Award of MOUs	<ol style="list-style-type: none"> 1) Preferably abandon the MOU awarding system based on negotiations and introduce competitive bidding to secure more transparency and better integration of EIA findings and technical planning. 2) Alternatively standardise the content MOUs to include environmental and social requirements. 3) As a minimum develop a comprehensive document outlining environmental and social requirements in laws and regulations for up-front presentation to prospective Developers.
Award of Licences	Standardisation of concession licenses to include social and environmental requirements in order to ensure that they are legally binding for the Developer.
Enforcement of regulations	<ol style="list-style-type: none"> 1) Ensure that STEA is fully invested with regulatory powers to enforce environmental and social obligations on the part of the Developer and other responsible parties. 2) Develop and ensure the capacity of STEA to take on enforcement responsibilities.
Resettlement planning and implementation	<ol style="list-style-type: none"> 1) Identify and develop clearer criteria for assessment of loss of livelihoods and assets for the project-affected population. 2) Incorporate and utilise the experiences provided by the NT2 Resettlement Process and Plans in the work to develop supplementary and more detailed resettlement guidelines and standards.
Development Opportunities	The Government should take the lead in linking social and economical development plans to hydropower planning to create benefits for local communities.
NBCA status	<ol style="list-style-type: none"> 1) Investigate the present state and biodiversity values of the parts of NBCAs planned for hydropower development and decide if the areas are eligible for total protection. 2) Carry out a zoning of all NBCAs to identify all areas that should be classified as "Total Protection Zones" where hydropower is ruled out.
Definitions of Impact Zones	Develop clear guidelines for defining impact zones, especially for downstream impacts.
Environmental and social monitoring systems	Establish databases and support systems for data storage and dissemination, both for reporting on the general state of the environment and for special issues, such as hydropower project assessments.
Monitoring of environmental performance	Establish a clear system of indicators and criteria for good environmental and social practice against which implementation results can be measured.
Consultation and public involvement	<ol style="list-style-type: none"> 1) Develop more elaborate and comprehensive guidelines to secure a standardisation of consultation and public involvement processes. 2) The guidelines should pay special attention to prescribing consultation procedures for ethnic minorities to ensure real participation

Training and Capacity Building	
Funding mechanisms	<ol style="list-style-type: none"> 1) Ensure sufficient and adequate resources for STEA and SEMD to enable them to carry out their assigned tasks and duties through prioritization and GOL – donor agency cooperation. 2) Consider the setting up of a fund for capacity building to facilitate and speed up necessary training and institution strengthening.
Capacity building focus	<ol style="list-style-type: none"> 1) Improve over-all knowledge of environmental subjects and review of EIA documents and plans for STEA and SEMD staff. 2) Training on management, monitoring and reporting skills for staff involved with monitoring and implementation of mitigation measures on central and province/district level. 3) Improvement of English language skills for all staff involved with review of EA documents and implementation of social and environmental plans. 4) Training of planners and implementers on gender sensitive and participatory working approaches. 5) Training of planners and implementers on ethnic minority concerns and culturally sensitive approaches.
Training Methods	<ol style="list-style-type: none"> 1) Arrange workshops for well-defined and limited topics. 2) Conduct on-the-job-training with local and international experts for more process oriented tasks like development of EIAs and monitoring methods and procedures. 3) Arrange in-service courses with utilization of Internet based courses and tailor-made courses in cooperation with national and regional learning institutions.

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LIST OF ABBREVIATIONS/ACRONYMS

ADB	Asian Development Bank
AIDS	Acquired Immunodeficiency Syndrome
ASEAN	Association of Southeast Asian Nations
BDP	Basin Development Plan
BOOT	Build, Own, Operate and Transfer
BP	Bank Procedures
CA	Concession Agreement
CDB	Convention on Biological Diversity
CIA	Cumulative Impact Assessment
CITES	Convention on International Trade in Endangered Species
DOE	Department of Electricity
DSM	Demand Side Management
EA	Environmental Assessment
EdL	Electricité de Lao
EGAT	Electricity Generation Authority of Thailand
EIA	Environmental Impact Assessment
EMMU	Environment Management and Monitoring Unit
EP	Environmental Programme
EPL	Environmental Protection Law
GHG	Greenhouse Gasses
GMS	Greater Mekong Sub-Region
GOL	Government of Lao PDR
GWh	Giga Watt hour
HDP	Hydropower Development Plan for Lao PDR
HDSS	Hydropower Development Strategy Study
HIV	Human Immunodeficiency Virus
HPO	Hydropower Office in MIH
EE	Initial Environmental Examination
IFIM	In stream Flow Incremental Model
IP	Independent Power Producer
IMMU	Integrated Water Management Unit
IWRM	Integrated Water Resources Management
kV	Kilo Volt
kWh	Kilo Watt hour
LNMC	Lao National Mekong Committee
m a.s.l	Meter above sea level
MAF	Ministry of Agriculture and Forestry
MIH	Ministry of Industry and Handicraft
MoU	Memorandum of Understanding
MPH	Ministry of Public Health
MRC	Mekong River Commission
MRCS	Mekong River Commission Secretariat
MTPC	Ministry of Transport, Post and Communication
MW	Mega Watt
NBCA	National Biodiversity Conservation Areas
NEA	Nepal Electricity Authority
NEC	The National Environment Committee
NGO	Non Governmental Organisation
NT2	Nam Theun 2 Hydropower Project
NT2SOA	Nam Theun 2: Study of Alternatives
NTPC	Nam Theun 2 Project Company
OD	Operational Directive
OP	Operational Policy
PFS	Pre-Feasibility study

PSDP	Power System Development Plan
PSPC	Provincial State Planning Committee
PSSS	Power System Strategy Study
RAP	Resettlement Action Plan
RDO	Rural Development Office
RoR	Run of River hydropower project (no storage)
SDP	Social Development Plan
SIA	Strategic Impact Assessment
SEM	Strengthening Environment Management
SEMD	Social and Environmental Management Division
Sida	Swedish international development cooperation agency
SPC	Special Purpose Companies
STD	Sexually Transmitted Diseases
STEA	Science Technology and Environment Agency
STEO	Provincial Science Technology and Environment Offices
STENO	Science Technology and Environment Organisation
TA	Technical Assistance
WBG	World Bank Group
WRCC	Water Resources Coordination Committee
WUP	Water Utilisation Plan

1 BACKGROUND

1.1 Introduction

Strategic Impact Assessment (SIA) is a tool that allows for analysis of broader environmental and social issues not covered comprehensively by a project specific EA and supports integration of environmental and social concerns into long term planning.

Development of the Lao Hydropower Sector has significant environmental and social impacts and benefits, and their management is currently constrained by policy, regulatory and institutional weaknesses. The Lao Hydropower Sector SIA was prepared to identify, at the sector level, the numerous strategic opportunities to avoid impacts and improve environmental and social management. It complements hydropower sector planning under the recently updated Power System Development Plan by providing recommendations to Lao PDR Government institutions, donors, private investors and other stakeholders, to further improve decision making, develop mitigation measures and improve policy, legal and institutional aspects of the sector. It is also intended to complement the preparation of the proposed Nam Theun 2 Hydropower Project, a large project that may have sector-wide implications and provide ideas, lessons and precedents for improvement in the sector.

1.2 Nam Theun 2 Project

The Government of the Lao People's Democratic Republic (Lao PDR) seeks to undertake the proposed Nam Theun 2 Hydropower Project (NT2) in cooperation with Nam Theun 2 Project Company (NTPC),

The proposed project is being considered for financial support from the World Bank Group (WBG) and the Asian Development Bank (ADB) thus bringing their institutions environmental and social safeguards principles into play.

The Nam Theun 2 Project is located in Khammouane and Bolikhamsay provinces in Central Lao PDR. As currently configured, the project includes the development, construction, and operation of a thousand-Megawatt hydropower facility primarily for export of power to Thailand. The project includes a 450 km² reservoir on the Nakai Plateau and will divert water from the basin of Nam Theun to the Xe Bangfai Basin.

1.3 Environmental and Social Studies

1.3.1 *Project-specific Environmental and Social Studies*

Over a planning period of more than 10 years several studies have been prepared to evaluate the project-specific impacts and risks of the NT2 Project. These studies form the basis for a comprehensive environmental and social mitigation and compensation program. The main components of the program are: (i) the resettlement and restoration of livelihoods of more than 6,000 people from the reservoir area; (ii) the provision of funding for the management and protection of the Nakai-Nam Theun National Biodiversity Conservation Area (NBCA) and the adjacent Corridors; (iii) mitigation programs for the downstream effects, particularly in the Xe Bangfai area; (iv) environmental monitoring and management measures including the operation of the dam and wildlife management on the Nakai Plateau.

1.3.2 *Cumulative Impact Assessment:*

A Cumulative Impact Assessment (CIA) is being undertaken to assess the impacts of the NT2 Project combined with the potential impacts of existing, planned and proposed developments in the NT2 Project area and in the Greater Mekong Sub-region. The purpose of this study is to identify impacts beyond the ones covered in the project specific impact assessments and to enable Lao PDR and other countries in the region to effectively enhance the benefits and reduce the negative impacts from such developments.

1.4 **Hydropower Sector Planning**

A number of development plans and strategy documents have been prepared for the Lao PDR power sector over the last 10 years (see Chapter 4). Many of these studies have incorporated environmental and social criteria in choosing alternative plans and have made recommendations for strengthening environmental and social aspects of the development. An update and revision of these studies is currently underway with World Bank assistance. The Power System Development Plan for Lao PDR (Meritec and Lahmeyer 2004) outlines an ambitious program for addressing energy supply, power generation and strengthening of the legal, regulatory and institutional framework.

1.5 **Strategic Impact Assessment**

Both the hydropower development plans, and the proposed Nam Theun 2 Project will have sector-wide implications including environmental and social impacts. A strategic approach to management of environmental and social impacts in the sector has therefore been asked for. Consequently, the Strategic Impact Assessment (SIA) has been prepared in order to consolidate, update and expand previous work related to hydropower and environment and to clarify the broader issues faced on account of planned hydropower development in Lao PDR. The purpose is to advise GoL Ministries, Local Governments, donors, regional institutions, private sector developers and others, in their efforts to improve environmental and social aspects of hydropower projects. Recommendations are given for strategic actions for improvement of environmental and social management.

The Strategic Impact Assessment will cover planned hydropower developments in Lao PDR in a 20-year perspective. The SIA will contribute to the understanding of the impacts of hydropower development in Lao PDR and recommend measures strengthening the sector in order to reduce impacts and manage the sector in an environmentally and socially sustainable manner.

The report is organised similar to a regular EA report. Chapter 2 gives an overview of the relevant legal and administrative framework; Chapter 3 summarises experiences of EIA processes for 3 hydropower projects on Lao PDR; Chapter 4 describes the hydropower development situation and existing development plans; Chapter 5 gives a general description of the environmental and social conditions in the regions where hydropower development is planned; Chapter 6 gives a summary of assumed combined social and environmental impacts of the proposed development plans. Chapter 7 discusses alternatives to hydropower development and alternative hydropower strategies; Chapter 8 summarises the conclusions and gives recommendations for mitigation, management improvements and training; and finally Chapter 9 gives guidance to environmental and social monitoring.

2 LEGAL AND INSTITUTIONAL SAFEGUARD FRAMEWORK

2.1 International Law and Treaties

A number of international laws and treaties impinge on hydropower development in Lao PDR, imposing limitations on how transboundary water resources can be utilized as well as demanding measures to avoid and limit the negative environmental effects of hydropower development.

2.1.1 *International Law*

The “UN Law of the Non-Navigational Uses of International Watercourses” is of relevance to hydropower development as it seeks to regulate a state’s use of its trans-boundary rivers and water courses in terms of water extraction for hydropower, irrigation etc. As a member country of the United Nations, Lao PDR is obliged to abide by its 3 main principles:

- to do no significant harm to other states, and to mitigate damages arising from exploitation.
- to use the water resources of an international watercourse in an equitable and reasonable manner taking into account the interests of other riparian states.
- to give prior notification to other riparian states when utilization may have adverse transboundary environmental effects.

As a general principle the Law demands that a State should exercise caution in any activity that it is contemplating, unless there is scientific certainty about the outcome of its actions. It should be noted that one of the implications of this precautionary principle is that it imposes the burden of proof on the project developer. In a hydropower context this implies that transboundary effects on flow regimes and water availability should be included as a part of the studies carried out as a part of the Environmental Impact Assessment.

2.1.2 *Mekong River Commission*

Lao PDR is one of the four signatory parties to the 1995 Agreement on the Cooperation for Sustainable Development of the Mekong River Basin and one of the members of the Mekong River Commission (MRC). The primary purpose of the Agreement is to promote economic and social well-being of the people in all the riparian countries through the protection of the environment, improvement of navigation and the cooperation in the maintenance of flows and intra- and inter-basin diversions. MRC has initiated several basin-wide planning and research programmes, including the Water Utilisation Plan (WUP), the Environmental Programme (EP), the Basin Development Plan (BDP) and the Fisheries Programme.

2.1.3 *ASEAN Membership*

Lao PDR became a member of the Association of Southeast Asian Nations (ASEAN) in 1997. One of the ASEAN initiatives is the agreement on the Conservation of Nature and Natural Resources. However, the agreement has been ratified by only three countries since it was adopted in 1985, and is therefore not in force and unlikely to have any significant impact. ASEAN also has provisions to assist member countries to establish transboundary nature reserves. This has relevance for future hydropower development, as establishment of joint protected areas

may have bearing on the conditions for construction projects in nature reserves and other protected areas.

2.1.4 *International Conventions and Treaties*

Convention on Biological Diversity (CDB)

Lao PDR acceded the CDB in 1996 and followed up its obligations by putting in place necessary legislation and establishment of a system of National Biodiversity Conservation Areas (NBCA). The convention is legally binding and aims to protect whole ecosystems and all their various forms of life. The Convention recognizes that ecosystems, species and genes must be used for the benefit of humans but prescribes that this should be done in a way and at a rate that does not lead to the long-term decline of biological diversity. In relation to hydropower development the Convention thus puts demands on limitation and mitigation of negative effects on terrestrial and aquatic ecosystems in the project influence area.

Convention on the protection of World Cultural and Natural Heritage

This Convention was ratified by GOL in 1987. The convention addresses the protection of both cultural and natural objects and sites of high national and international value. The Convention thus puts limitations on the use and exploitation of culturally valuable areas, including exploitation in connection with hydropower development.

Convention on International Trade in Endangered species (CITES)

Hydropower development can open up a previously remote area, and lead to an influx of people. This may contribute significantly to an increase in illegal hunting and trade of wildlife. Lao PDR's ratification of CITES in 2004 obliges the GOL to take measures against illegal trade of wildlife. It should be noted that prior to the ratification of the Convention the Ministry of Agriculture and Forestry (MAF) issued a regulation that banned all hunting for trade.

International Convention on the Elimination of All Forms of Racial Discrimination

Lao PDR acceded this convention, which obliges member countries to work to abolish all forms of discrimination, in 1974. In connection with hydropower development it has relevance as areas inhabited by ethnic minorities are often affected.

International Covenant on Economic, Social and Cultural Rights

Lao PDR is a signatory to this covenant (2000), which calls for the preservation of social and cultural integrity for the various ethnic groups within a country. It thus has a bearing on the way resettlement and livelihood restoration in connection with hydropower development is carried out.

2.2 **Safeguard Policies of International Financial Institutions**

In addition to the more general requirements international laws and treaties impose on Lao PDR, involvement of international financial institutions in hydropower development brings with it another set of more specific environmental requirements. This means in practice the safeguard policies of World Bank (WB) and the Asian Development Bank (ADB) as these are the international funding institutions presently active in the hydropower sector. Other financial institutions that in the future might get involved are likely to adopt environmental requirements similar to those of WB and ADB.

In the following an overview of the most important safeguard policies is given. It should be noted, however, that only an indication of their purpose and content

can be provided in these brief summaries. A more complete overview with the full text of the policies can be found on the websites of the World Bank and the Asian Development Bank.

2.2.1 *World Bank Safeguard Policies*

The World Bank's set of safeguard policies consist of a number of Operational Policies (OP), Operational Directives (OD), and Bank Procedures (BP) which are considered to be particularly important in ensuring that Bank supported projects are environmentally acceptable and that negative environmental and social impacts are minimised or mitigated.

Environmental Assessment (OP/BP 4.01)

This is considered to be the umbrella policy for the Bank's safeguard policies and sets out specific requirements for environmental and social investigations that must to be carried out in connection with large infrastructure projects including hydropower development. The policy requires Environmental Assessment to be undertaken of all supported projects in order to ensure that they are environmentally sound and sustainable, and to improve the basis for decision making.

Natural Habitats (OP/BP 4.04)

The policy aims to ensure that projects apply a precautionary approach to natural resource management to ensure opportunity for sustainable development, prevent significant impacts to critical natural habitats and minimize or compensate for losses in natural habitats.

Pest Management (OP 4.09)

The Pest Management Policy supports promotion of biological or environmental methods of controlling pests and reduced reliance on synthetic chemical pesticides in Bank financed projects. The policy has a relevance for hydropower development as pesticides may be used to control disease vectors in reservoirs, for clearing of vegetation and for agricultural activities in connection with resettlement.

Cultural Property (OP 4.11)

The policy aims to ensure that projects contribute to the preservation of cultural property and seeks to avoid their elimination. If projects cannot avoid affecting cultural property negatively the policy requires mitigation activities to be undertaken to limit the adverse impacts as far as possible.

Involuntary Resettlement OP/BP 4.12

The policy aims to avoid involuntary resettlement where feasible and to minimize it where it cannot be avoided. If resettlement is necessary the policy seeks to ensure that the whole process is designed and implemented as a sustainable development program, providing sufficient investment resources to enable the persons displaced by a project to share in its benefits.

ensure that people affected by a project have their standard of living improved, or at least maintained on the same level.

Indigenous Peoples (OD 4.20)

This operational directive is intended to ensure that indigenous peoples and ethnic minority groups are consulted and benefit from WB funded operations in a culturally appropriate way, and that adverse impacts on them are avoided, or where not feasible, minimized or mitigated.

Forests (OP 4.36)

The Forestry Policy aims to harness the potential of forests to reduce poverty in a sustainable manner, integrate forests effectively into sustainable development and protect the vital local and global environmental services and values of forests.

Safety of Dams (OP/BP 4.37)

For large dams (15 meters or more) it is a requirement that the borrower adopts and implements certain dam safety measures for the design, bid tendering, construction, operation and maintenance of the dam and associated works.

International Waterways (OP/BP 7.50)

The policy seeks to ensure that all concerned and affected riparian countries on an international waterway, are notified about hydropower development and other water-use projects and invited to express their view on the project for the Bank to consider.

Public Disclosure

While the safeguard policies prescribes that the key stakeholders are systematically identified and involved in project planning and implementation the World Bank Policy on Disclosure of Information seeks to secure that all interested parties can access information on specific projects.

2.2.2 *Asian Development Bank Safeguard Policies*

The ADB social and environmental and social safeguard system contains many of the same elements as in the WB system.

The Environment Policy

The recent environmental policy was approved in 2002 and aims to incorporate social and environmental considerations in all ADB operations.

Indigenous People

The ADB Policy on Indigenous People aims to ensure that indigenous peoples have opportunities to participate in and benefit equally from development projects funded by the Bank and that negatively affected indigenous peoples and ethnic minority groups are adequately compensated.

Involuntary Resettlement

The ADB Policy on Involuntary Resettlement dates from 1995 and aims at minimising the need for resettlement and to secure that in cases where population displacement is unavoidable proper compensation for loss of assets and livelihood is provided.

Environmental Assessment Guidelines

ADB's Environment Policy is further elaborated in the new Environmental Guidelines that were issued in 2003. The guidelines provide practical requirements for the EIA process in connection with hydropower development.

2.3 National Safeguard System for Hydropower Development.

2.3.1 Legal Framework

A number of laws, regulations and decrees, some general and other more specific, impinge on, and impose demands for, environmental and social safeguarding in connection with hydropower development in Lao PDR. They have all been passed or issued since the middle of the 1990s up till present. Together they constitute a comprehensive set of requirements for environmental and social impact assessment and mitigation planning for the hydropower sector.

The Forestry Law

The Forestry Law of 1996 gives general provisions for management of all forest related resources, including all plants, wildlife, watercourses, etc. It thus regulates logging of reservoir areas and provides the legal basis on which the GOL, through the Department of Forestry, Ministry of Agriculture and Forestry, allocates the use of forest land for hydropower development.

The Electricity Law

The Electricity Law of 1997 contains a number of clauses that in general terms sets out environmental requirements for the hydropower development process. Article 14 requires the Developer to submit environmental and social studies and management plans. Article 15 deals with conditions for approval of licences for hydropower development and states that hydropower projects should not adversely impact the environment. In Article 18 obligations of the licensee are specified. However, the environmental requirements are only stated in general terms.

The Water and Water Resources Law

The Water and Water Resources Law was adopted by the by the National Assembly in 1996 and became effective in March 1997. The Law seeks to ensure sustainable use of water resources and defines 3 categories of utilisation: small, medium and large scale. Hydropower projects that seriously disrupt watercourses fall in the large-scale category, whereas run-of-the-river projects involving no inter-basin transfer of water might be classified as medium-scale use. Micro- and mini-hydropower projects normally fall in the medium-scale category.

Article 18 specifies that projects in the large-scale category require a feasibility study, an EIA and management plans defining mitigation measures. Article 19 states that Developers of hydropower shall obtain GOL approval in the form of a licence as defined by the Electricity Law. Article 24 requires that Developers contribute to the cost of watershed management and protection while Article 25 demands that hydropower projects must be planned and built in a manner that protects the environment. The Law also demands that the Developer must fund and assist in resettlement of people replaced by the project. Finally, logging in catchments is, according to Article 31, prohibited for individuals, juristic entities or organisations.

The Land Law

The Land Law of 1997 provides the legal basis for allocating land and awarding deeds and titles for resettlers in connection with hydropower development. The Ministry of Agriculture and Forestry are responsible for administering the Law.

The Environmental Protection Law

The Environmental Protection Law, passed by the National Assembly in 1999 and further elaborated by an implementation decree in 2002, requires that all projects and activities that have an impact on the environment, including social impacts,

goes through an assessment process prior to approval and implementation. Article 8 deals with EIA procedures and requires that relevant line ministries develop their own EIA guidelines and standards. These guidelines are to be followed up and approved by the Science and Technology Environment Agency (STEA). Late 1999 STEA advised the Ministry of Industry and Handcraft (MIH) that it should develop and implement EIA regulations for hydropower projects.

Article 15 deals with biodiversity issues. Disaster protection is dealt with in Article 19. It obliges owners of dams and managers of reservoirs to maintain safe structures and cooperate with the National Disaster Protection Committee in planning and executing responses to disasters.

Article 24 to 28 deals with mitigation and restoration of the environment while environmental management and monitoring are described in article 35 to 41. However, the provisions are not detailed and are kept in a general form so that it is unclear how they apply to the hydropower sector.

Article 30 and 31 provides the basis for the setting up of an Environmental Protection Fund with “development projects” including hydropower projects as prospective funding sources.

Regulation on Environmental Assessment

In line with the provisions in the Environmental Protection Law, STEA issued a Regulation on Environmental Assessment in 2000 followed by an Implementation Decree in 2002. The Regulation provides guidelines and standards for the carrying out of environmental assessments and provides a framework within which line ministries can develop their own set of standards and guidelines for EIA procedures.

Prime Minister’s Decree No. 164

PM Decree No.164 was issued in 1993 and provided the legal basis for the establishment of the National Biodiversity Conservation Areas in Lao PDR. The Regulation on Management of National Biodiversity Areas, Aquatic and Wild Animals (2001) gave more detailed guidelines for directions for management of the areas and the wildlife. The administrative responsibility for the management of the NBCAs was placed at the Ministry of Agriculture and Forestry (MAF). A number of NBCAs are situated close to, or have existing or planned hydropower projects within their boundaries.

Decree on the Establishment and Management of Protected Areas and Wildlife in Lao PDR

This Decree supersedes Decree No. 164 and gives more specific definitions of protected areas. The term National Park is introduced and considered to be synonymous with the term National Biodiversity Conservation Area. It is furthermore stated that protected areas, including NBCAs, may be divided into zones to accommodate differing management priorities within a single protected area. The different types of zone are identified in the Forestry Law as: “Total Protection Zone”, “Controlled Use Zone” and “Corridor Zones”. Controlled Use Zones are further sub-divided into 4 categories including a “Permit Zone” which in the Decree is described as a zone within which designated non-extractive commercial activities are permitted. Tourism and hydroelectric project facilities are mentioned as examples of commercial activities.

National Resettlement Policy

The National Resettlement Policy was first issued in 1997 as a draft, later to be followed by a Draft Regulation. The Policy states that losses shall be compensated for at replacement cost and that consultation with and participation of the affected population in planning shall be an integral part of the resettlement process. All land loss shall be compensated by provision of equivalent areas of land. The Policy also prescribes that all impacts resulting from project activities are the responsibility of the project developer. The Resettlement Regulation specifies the surveys and data collection that must be carried out in connection with compensation and resettlement.

Decree on Resettlement and Compensation

This Decree dates from June 2003 and builds on and complements the previously issued National Resettlement Policy and Resettlement Regulation. Its stated objectives are to:

- help integrate social dimensions and mitigation measures into development projects with special focus on vulnerable groups;
- ensure that provisions for mitigation measures in other applicable laws, decrees and the national policy on resettlement and compensation are adhered to, and;
- ensure that the project affected population share in the benefits of the development project and that their livelihoods and living standards are restored to at least pre-project level.

With regard to ethnic groups and their culture the Decree states that their cultural and religious practices shall be respected and that the restoration development options and benefits they are offered shall be in accordance with their cultural preferences.

Environmental Assessment Guidelines for Electricity projects

A number of documents make up the environmental assessment guidelines and standards for Electricity Projects. These documents were issued by the Department of Electricity over the period 2001-2003 subsequent to STEA's request to MIH in late 1999. The EA Standards consist of the following documents:

- The Power Sector Environmental Policy (MIH/DoE, 2001)
- Regulation on Implementing Environmental Assessment for Electricity Projects in Lao PDR (447/MIH, 2001)
- Environmental Management Documents for the Department of Electricity (582/MIH.DOE, 2001)
- Department of Electricity Environmental Records Management (583/MIH.DOE, 2001)
- Environmental Impact Assessment for Electricity Projects (585/MIH.DOE, 2001)
- Environmental Management Plans for Electricity Projects (584/MIH.DOE, 2001)
- Environmental Management Standard for Electricity Projects (366/MIH.DOE, 2003).

Together the environmental assessment documents for electricity projects constitute a comprehensive and partly overlapping set of guidelines that in quality and scope are compatible with the standards and safeguard regulations of the World Bank and the ADB.

2.3.2 Institutional Framework

The 2 primary institutions in Lao PDR with regard to environmental assessment and safeguarding associated with hydropower development are; the Social and Environmental Management Division under Department of Electricity (DOE), Ministry of Industry and Handicraft (MIH); and the Department of Environment under the Science Technology and Environment Agency (STEA). A more limited role is played by the environmental Management Unit under the Electricité du Lao (EdL).

STEA

STEA is an agency under the Prime Ministers Office and its Department of Environment is responsible for evaluating and approving IEE's and EIAs for hydropower development projects.

STEA consists of 5 departments plus one research institute. The Department of Environment has responsibility for environmental assessment in connection with all infrastructure projects including hydropower development projects. Presently the Department of Environment has a staff of 16 persons divided between 6 divisions whereof 7 persons are working with environmental and social assessment. These are divided between the EIA (5 staff) and SIA (2 staff) divisions.

Over the last few years provincial Science Technology and Environment Offices (STEO) have been established in all provinces. These offices are charged with follow up of environmental regulations and monitoring of hydropower development projects inside the province boundaries

MIH/DOE

The Department of Electricity under the Ministry of Industry and Handicraft is responsible for initiating and overseeing the environmental assessment process in connection with planning and construction of new hydropower projects. DOE acts through its Social and Environmental Management Division (SEMD) which is composed of 4 units as shown in Figure 1.

The SEMD is thus the most crucial institution for the implementation of the prescribed EA process for hydropower projects. Having been created in 2002 it is still in the process of being built up and finding its role. It presently consists of only 5 staff that have responsibility to follow up the relatively large number of hydropower projects already underway and planned in the near future.

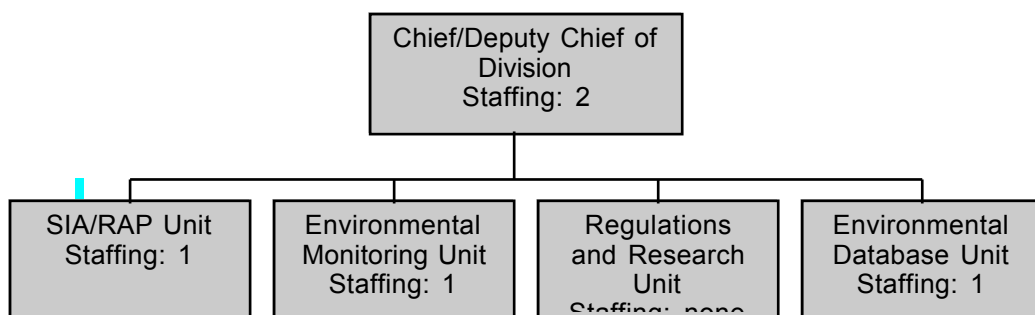


Figure 1: Organisational Setup and Staffing of Social & Environmental Management Division of Department of Electricity

EdL

The state enterprise Electricité du Lao under the MIH, is also involved in the environmental assessment and implementation of action plans through its Environmental Management and Monitoring Unit, officially formed in 1999. Its limited number of staff takes part and assists in socio-economic and asset surveys as well as in implementation and monitoring of resettlement activities.

2.4 EA Process for Hydropower Development Projects

The DOE initiates the environmental assessment process by an initial screening of a hydropower project's potential environmental impacts. The screening is done on the basis of a Project Description and used to decide if the potential impacts are significant enough to warrant further environmental assessment. This exercise is normally conducted at a project's identification stage. If the project according to a set of defined criteria is found to have impacts that warrant further EA the Project Owner is obliged to carry out an Initial Environmental Examination (IEE). If the project is expected to have "immeasurable or insignificant environmental impact" an IEE is not required. DOE subsequently submits this decision to STEA and STEA issues an Environmental Certificate for the project.

If deemed necessary by the DOE the Developer carries out an Initial Environmental Examination (IEE) and subsequently an Environmental Impact Assessment (EIA) as required by the EA guidelines and the severity and magnitude of project impacts. The decision whether an EIA will be needed or not depends on the outcome of the IEE. An EIA cannot proceed without an IEE. If DOE decides that an EIA will not be required an Environmental Management Plan (EMP) is worked out and submitted to STEA for approval along with the IEE. If STEA approves both DOE's decision and the IEE/EMP an Environmental Certificate for the project is issued.

If DOE decides that an EIA is necessary a Terms of Reference (TOR) for the EIA studies and investigations is worked out on the basis of the IEE and submitted to STEA for approval. It is a requirement that the EIA is carried out by independent experts, either local or international. When a project is expected to be controversial the Project Owner/Developer, in consultation with STEA and DOE, is obliged to establish an independent advisory panel to monitor all aspects of the EIA.

When the Developer has conducted the EIA, and DOE has endorsed it, the EIA is submitted to STEA for approval. If it is found to be of sufficient quality and scope, STEA approves the EIA along with its EMP and issues an Environment Certificate. If not satisfactory STEA may reject the EIA report or require further studies. The EA process is illustrated in Figure 2

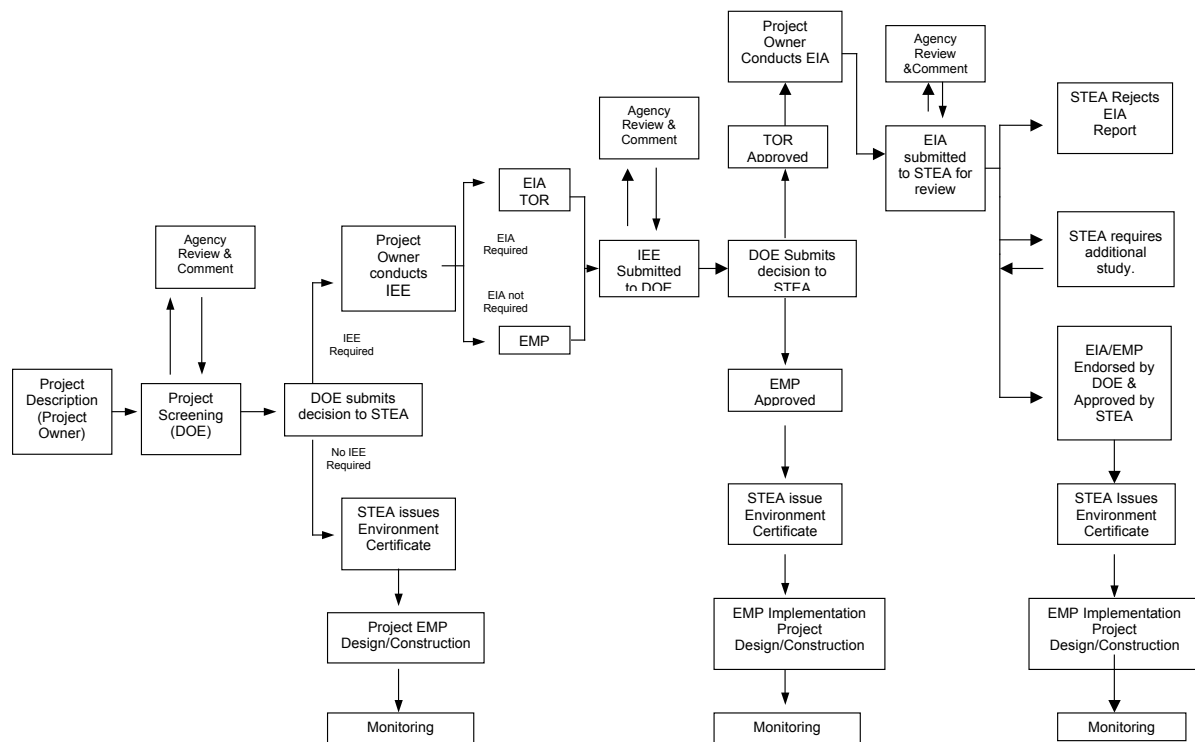


Figure 2: Environmental Assessment Process for Electricity Projects

2.4.1 Comprehensiveness of Legal Framework

The legal framework that underpins the environmental safeguard system for hydropower development in Lao PDR today appears sufficiently comprehensive and covers most eventualities and environmental issues that may arise. There are a number of clauses in the Electricity Law, the Environmental Law and the Water and Water Resources Law that oblige Developers to carry out environmental investigations and to propose mitigation measures in connection with hydropower development projects. While the environmental requirements in the basic laws are kept in general terms more detailed provisions are given in the environmental standards and guidelines issued by the Department of Electricity. These are comprehensive and specific enough to meet international standards and requirements for environmental and social safeguard documents. There are, however, still a few areas and shortcomings that may have to be looked into and amended by supplementary regulations. These are taken up and discussed in Chapter 8.

2.4.2 Implementation Capacity

Given the many existing and planned hydropower projects in the country it appears that STEA and SEMD are under-resourced and understaffed in relation to their mandates and tasks. For the hydropower sector the understaffing in the SEMD is most crucial as the Division bears the main burden of following up and ensuring the quality of the EA process and the EIA documents that are produced.

Concerning staff capacity and qualifications it appears that both STEA and the SEMD are constrained in their activities and operation by the fact that the staff have limited experience and background in environmental assessment and subject matters. For instance, the majority of the SEMD staff have a technical education background. Therefore, considerable training and capacity building in the field of

social and biological issues appears to be necessary to enable the staff to properly carry out their tasks. The strength of STEA and SEMD is that most of the staff has university degree background, something that indicates ability and readiness to receive and absorb training.

Once the environmental and social mitigation plans required according to the EA guidelines have been established, government agencies at provincial and district level will, to a large extent, be responsible for their implementation. The capacity and competence of these units is crucial for an acceptable outcome of social and environmental mitigation activities. Experiences from hydropower projects already completed indicate that lack of both technical and managerial capacity is a constraint for appropriate implementation. Few of the managerial and technical staff have any background in environmental and social issues. Managerial and administrative qualifications have also proven to be a constraint.

Recommendations in relation to institutional capacity and function are given in Chapter 8.

2.5 Consultation and Public Involvement

2.5.1 Consultation with Project Affected People

Consultation with project affected people and communities are a basic prerequisite for incorporating their concerns and preferences into project plans, most importantly resettlement plans, including livelihood restoration and development strategies. Consultations with affected communities can also provide inputs and data that enable planners to minimise environmental and social impacts through choice of technical solutions and modifications of design. To make this possible consultations have to be undertaken at an early stage of project planning – preferably as early as the pre-feasibility or feasibility stages.

Early participation of the project affected population does not only increase their influence on planning outcomes but it will also contribute to better implementation outcomes through fostering a sense of ownership to programmes and activities. Finally, from the perspective of human rights, consultations are fundamental as the UN Universal Declaration of Human Rights articulates and emphasises the right to self-determination and the right to consultation in matters that affects peoples' lives.

2.5.2 Involvement of Other Stakeholders

In addition to the active involvement of the affected population in project planning, consultations in connection with hydropower development also encompasses the public sphere where other stakeholders need to be informed about environmental and social impacts of a project at the local, regional, national and international levels. Public consultation and disclosure may thus include a number of groups and interested parties such as community based and civil society groups and NGOs. Involvement of these groups has an important transparency and control function in hydropower project planning and implementation.

The national safeguard documents in Lao PDR requires consultations to be carried out in connection with hydropower development and gives some directions as to how and when they should be carried out

The “Regulation on Implementation Environmental Assessment for Electricity Projects in Lao PDR” allocates responsibilities for carrying out consultations and public involvement processes. In its Article 7: “Public Involvement Procedures” it is stated that public involvement activities is the responsibility of the project owner

during the IEE and project implementation stages while STEA and the project owner, with the assistance of the Department of Electricity, shares the responsibility during the conduct and approval stage of an EIA.

Public involvement is furthermore specified to include the following activities:

- Notification of affected parties,
- Dissemination of information about the project and its impacts,
- Consultation with affected parties regarding their opinions,
- Responding to the affected parties' concerns during project planning and implementation,
- Opportunity for public comment at the time of project approval, and
- Participation of affected parties in the implementation of the project.

Finally, Article 7 states that public involvement shall be conducted in accordance with approved criteria (standards/guidelines) developed for the implementation of Public involvement activities.

Some more directions are given in "Environmental Impact Assessment for Electricity Projects" (585/MIH.DOE), which requires that in undertaking an EIA a public involvement process shall be undertaken and that the process shall be scoped during the Initial Environmental Examination (Requirement 9). It is furthermore emphasized that the public involvement process needs to be flexible and adapted to each project situation. However, the above-mentioned general requirements to the public involvement include:

- The involvement of all stakeholders including all project affected peoples (directly and indirectly), village and community groups, Lao Women's Union, government ministries, departments and organisations, provincial governments, district and village administrations, Non Government Organisations working in the project area or have an interest in the project or the type of project, and project donors, business community and service providers;
- Formal and informal activities to involve all stakeholders to ensure they are adequately informed and able to participate in the consultation and decision making processes; The activities shall be adapted to the stakeholders identities and backgrounds as well as the type of projects and its potential impacts and may include; Participatory Rural Appraisals, surveys, displays and exhibits, public hearings, notifications, village committees, household and individual meetings and discussions, workshops and briefings, etc.

Furthermore, it is required that the EIA determines and identifies the further public involvement activities required during the projects implementation phases (construction, operation and closure).

Public involvement is also briefly addressed in "Environmental Management Standard for Electricity Projects (366/MIH.DOE) which refers to the safeguard documents mentioned above and specifies the minimum information to be included in a RAP.

Finally, the Decree on Resettlement and Compensation addresses consultation and public participation in Article 13 and 14 which briefly states that a consultation process shall be carried out so that all stakeholders are fully informed, and that a grievance mechanism and grievance redress committee shall be established by the project proponents.

Although consultation and public involvement are covered to some extent in the national safeguard documents it must be concluded that the directions given are not very extensive and detailed as specifications and requirements in total are contained on less than 2 pages. In addition, as referred to above, the directions are general and it is left relatively open as to what type of methodology and approach shall be used during consultations. Little is said about the scope and extent of consultations other than that they shall provide “adequate opportunity to provide their opinions on and input into the planning and implementation of the project”.

Recommendations concerning consultation and public involvement process are given in chapter 8.

2.5.3 *Civil Society Development*

As mentioned above other stakeholders than the project-affected population have an important role to play in hydropower planning. Public involvement is intended to contribute to more accountability and transparency in the planning and decision processes for hydropower projects. Civil society and independent organisations can speak on behalf of the wider society and represent the interests of social groups that otherwise would not be heard and taken into consideration. As stakeholders that are not directly affected the present safeguard documents mention village and community groups, government agencies on the central, provincial and district levels, party mass organisations, NGOs working in the project area, development agencies, the business community and service providers. However, it cannot be claimed that these groups represent genuinely independent organisations. Because the right to free association is restricted in Lao PDR civil society is presently underdeveloped and national NGOs do not exist. There are, however, a few local NGO-type organisations.

2.6 **Vulnerable Groups and Cultural Integrity**

The issue of vulnerable groups and hydropower development is related to a number of factors. Firstly, most of the potential hydropower development sites are located in relatively isolated, mountainous or forested areas where many of Lao PDR's ethnic minorities are located. Given the fact that hydropower development may bring about rapid change in the communities it impacts, minority groups may experience considerable social, cultural and economic change. One should consider:

- Reliance on natural resources in a project area may be threatened by population influx from outside and resource restriction policies in catchment areas. Attention should be paid to land use and conservation issues in NBCAs.
- The degree of integration of some ethnic minority groups into the mainstream economy is limited and sudden changes from a primarily subsistence economy to market economy may be disorienting and lead to exploitation by other groups and potentially a marginalisation or further marginalisation of minorities.
- The dominant lowland Lao culture (*Lao Loum*) tends to spread rapidly into areas where large infrastructure projects are carried out, such as hydropower or roads, leading to exposure to different cultural values, such as Buddhism, Lao language, different social systems, different attitudes to women and other aspects.
- A lack of familiarity with many of the aspects of hydropower development and the larger Lao society as well as a lack of political representation make it challenging for minority groups to participate in consultations and influence

project design and to become project beneficiaries on an equal level with their lowland neighbours.

- Most vulnerable groups and ethnic minorities are illiterate and special provisions and efforts will be necessary to address language issues, including literacy programmes, consultations in minority languages and training in skills and management to encourage participation in decision-making (capacity building earmarked for specific groups).
- Special provisions are also needed to address cultural heritage issues in order not to negatively impact local communities – these may include allowances for conducting necessary rituals and ceremonies in relation to relocation, moving religious structures, changing the landscape and disturbing grave sites.

2.7 Development Opportunities and Benefits

Beyond ensuring that resettlement and compensation for directly affected people are carried out in an appropriate and socially responsible way, the present policies and thinking among international financial agencies encourages national governments and developers to share benefits with affected and local communities through various development programmes. The World Commission on Dams Report (WCD, 2000) also emphasizes the development aspect of hydropower development and identifies “recognizing entitlements and sharing benefits” as one of the 7 strategic priorities for future dam projects.

Examples of benefits for local communities often associated with hydropower development are; local electrification, expanded irrigation, improved road access, safe water supply and improved social services. An important rationale behind treating hydropower development as a development opportunity for local communities is to compensate for the impoundment of a local resource that pre-development was freely accessed. Another aspect is compensation for the inconveniences and social changes hydropower development entails, such as increased traffic and risk for vehicular accidents, increased in-migration and higher exposure STDs, increased pressure on social services, higher crime rates etc. Finally, creation of long-term social benefits for local communities also plays an important role in legitimizing and justifying hydropower development, making it more acceptable and countering the negative image hydropower development has suffered from in the past.

In Lao PDR hydropower sponsored development for local communities has only been carried out to a limited extent. Only in recent years has the idea of sharing of benefits with local communities led to concrete plans for wider social and economic development programmes. The most relevant example here is the Nam-Theun 2 Project that incorporates a regional health programme and plans for basic irrigation structures that will enable a larger scale development if additional funding becomes available. The Social and Environment Management Framework and Operational Plan (SEMFOP) for the Nam-Theun Watershed, with its focus on agricultural and social development can also be seen as a programme designed to distribute benefits locally.

3 HYDROPOWER PROJECT EIA – LAO EXPERINECES

With the relatively recent establishment of national regulations and guidelines, their adequacy and efficiency in producing international standard EA processes and mitigation plans has yet to be properly tested out. So far, they have been applied to only a few hydropower projects, none of which has yet been completed. The Xe Kaman 3 Hydropower Project currently under preparation with Vietnamese funding will, provide one important test case.

Experience with environmental and social assessment in connection with hydro-power development before the national standards were put in place, has been linked to projects where international funding have been involved.

In the following are presented in some detail the EIA processes and experiences related to three already commissioned hydropower projects in Lao PDR.

3.1 Theun-Hinboun

3.1.1 *Project Description*

The Theun-Hinboun Hydropower Project was the first private sector Build-Own-Operate-Transfer (BOOT) hydropower development in the Lao PDR. It is located on the Nam Theun River, approximately 100 kilometers upstream of the confluence of the Mekong and the Nam Kading/Nam Theun River. Construction of the Theun-Hinboun project commenced in November 1994 and electricity generation started in April 1998.

3.1.2 *EIA Process*

An Initial EIA was prepared in 1993 concluding that the head pond would not involve resettlement and that the construction of the powerhouse, switchyard, transmission line and tailrace canal would involve limited compensation for loss of agricultural land only. No negative health impacts were foreseen. The report highlighted positive aspects such as potential improved fisheries, improved agriculture, better navigation, improved services and infrastructure and employment opportunities. Initially it was agreed that the developer should pay one million USD to cover all social and environmental mitigation measures, including construction of the regulating pond and other infrastructures.

Due to public pressure and NGO criticism a new series of studies were commissioned in 1995 in order to re-examine social and environmental impacts. The assessment occurred after ADB financing had been approved and construction was one and a half years advanced and was therefore too late to influence design, although recommendations were incorporated into mitigation measures. The findings highlighted the impacts on fish migration and the loss of vegetable garden along both the Nam Hai and within the head pond area.

Further studies in 1999 proposed a rural development plan for irrigation in the Nam Hai to offset negative impacts in that region and to enhance benefits from the available water in the tailrace canal. Furthermore, a study was commissioned to produce a final compensation and mitigation plan in an attempt to redress the shortcomings of previous studies.

3.1.3 *Resettlement and Consultation Process*

Even if the Project did not involve any relocation of people the follow up-studies identified several negative impacts on the local communities. These included the loss of fish in downstream areas, the loss of dry season vegetable gardens and the lack of adequate drinking water. The fact that the original EIA did not report potential losses and assumed that there would be an increase in fish catches proved to be an obstacle for proper mitigation of the impact. Original estimates on mitigating social impacts were seriously underestimated and there was a lack of good baseline data for fish migration in particular. In general, downstream of the dam impacts were not considered until operation commenced and impacts were felt on downstream communities. Without baseline data it has been impossible to estimate impacts and, thus, difficult to mitigate these impacts and reach closure in terms of budget, monitoring and compensation.

Moreover, the consultations process and the handling of the influx of population and internal movement of population within the project area provide some important lessons for future hydropower development in the country. The consultation process was initially carried out only for determining the extent of compensation and not in terms of possible development benefits or identification of indirect or possible long-term impacts. Compensation for rice fields lost was the main concern and there was only a very limited dialogue with villagers for this. Only after it became apparent that there were many other types of impacts as mentioned in the paragraph above did meaningful consultation commence in earnest.

At the start of construction there was considerable movement of population within the project area to roads and to project camp areas. This spontaneous movement of people caused many practical problems of hygiene and traffic congestion as well as several vehicular accidents. There was no overall plan to handle this and a 'reactive' rather than a 'preventative' approach was adopted at first. However, it did not take long before project management realized that this was not achieving results, and hence a change of attitude took place that resulted in communal water supply systems, security patrolling, setting up an organized camp followers area, setting up a school and other measures were adopted.

3.2 **Houay Ho**

3.2.1 *Project Description*

The Houay Ho Hydropower Project is located on the Boloven Plateau, 160 kilometers east of Pakse and 30 kilometers northwest of Attapeu. The catchment of 191.7 km² is located on the eastern side of the Plateau. A dam across the Houay Ho River creates a reservoir that covers an area of 37.5 km². Turbined water is released into the Xe Kong River, leading to the drying up of the Houay Ho for some four kilometers downstream of the dam. One village (Ban Than Ngao), about 8 kilometers down-stream has been severely impacted by the loss of water and fishing opportunities.

3.2.2 *EIA Process*

The developer, Daewoo, conducted the pre-feasibility study in April 1994 (Report on Environmental & Socio-Economic Studies, Houay Ho Hydropower Project), noting the major environmental and social impacts of the project and suggesting probable mitigation measures. However, statistics on socio-economic conditions were too general for planning and it appears that no information was gathered from the impacted villages or the surrounding areas. The Preliminary EIA also recommended a Resettlement Plan, watershed management and environmental monitoring. Only the first recommendation was followed up by the GOL. One obvious

shortcoming is that the Preliminary EIA was conducted after construction had commenced, eliminating the possibility of integrating mitigation measures in project design and participatory planning with the affected communities.

3.2.3 *Resettlement and Consultation Process*

The Preliminary Environmental Impact Assessment identified the two impacted villages that were recommended for relocation: Ban Thang Ngao due to loss of fisheries and Ban Nam Han due to inundation. However, the resettlement plan as it was implemented deviated substantially from the recommendations of the Houay Ho EIA. In the end all villages in the Houay Ho catchment area, together with all of those in the catchment of the adjacent proposed Xe Pian-Xe Namnoy hydropower scheme, were relocated to a resettlement site at Houay Kong, some 30 kilometers to the west of the Houay Ho dam. This major resettlement effort resulted from a GOL designed plan to combine its Focal Zone development strategies with the resettlement of affected villages in connection with the Houay Ho and the Xe Pian-Xe Namnoy Hydropower Project. The Focal Zone strategy combines the aims of reducing shifting cultivation with relocation of villages to the proximity of roads to provide services and to promote national integration. The Pakxong District Focal Zone came into effect after the project had already been designed and it appears that the provincial government attempted to utilize project funds for establishing coffee plantations on the Boloven Plateau. The Provincial Rural Development Committee drew up a Resettlement Action Plan outlining major strategies for relocation, land allocation, infrastructure and service improvements and the promotion of coffee production, utilizing approximately 57 percent of the Rural Development Funds for the whole province.

The resettlement involved the relocation of 12 Nya Heun villages into an area adjacent to Lavaen villages. The mixing of these groups has created tension and conflict over land. The Nya Heun is a very small ethnic group (4,200) and have been classified as 'vulnerable' due to their small population, relative isolation and reliance of forest resources for subsistence. Relocating them outside of their traditional forests has had a significant negative impact on their culture and traditional way of life. The consultation process was weak and involved discussions with leaders only – most people did not want to relocate and leave their homes unnecessarily.

Lack of adequate funds and planning resulted in food shortages that were only remedied by food donations by an international NGO. There were inadequate provisions for potable water and capacity building for local authorities, and an over-reliance on cash compensation, cash crop production and providing services and infrastructure.

Despite the recommendations of the EIA consultants and the fact that livestock rearing has been a key element of their livelihood systems, no provision for livestock or grazing areas were made at the new resettlement sites, in the hope that villagers would sell off their animals. Animals remain in the catchment area near original villages.

3.3 **Nam Leuk**

3.3.1 *Project Description*

The Nam Leuk Hydropower Project is located within the Phou Khao Khouay National Biodiversity Conservation Area. It involved the construction of a 45.5 m high rock-fill dam on the upper reaches of the Nam Leuk, and the diversion of a small tributary of the Nam Leuk, the Nam Poun, for the creation of a storage reservoir of 12.8 km².

Construction work commenced in late 1996 and start-up of electricity generation was in April 2000. Nam Leuk was constructed to meet national power demand with some future export opportunities.

3.3.2 *EIA Process*

Efforts were made from the start to make the Nam Leuk Hydropower Project into a model for future hydropower planning and implementation in the Lao PDR. The objective of minimizing environmental and social impacts, by respectively limiting the acquisition of land and by claiming no resettlement, was highlighted from the beginning. An EIA was prepared in 1996 and a Social Action Plan was produced in 1997 after the original EIA was rejected in 1992 by the ADB due to a number of shortcomings.

In the 1996 EIA, the developers claimed that there would be no resettlement as no villages were located within the future reservoir. However, additional investigations addressed the issues of compensation and land acquisition for the powerhouse site. A plan for the relocation of the Hmong village of Ban Nam Leuk (16 households) was also produced. The reason for the relocation was primarily loss of swidden land as a result of the construction of the reservoir.

3.3.3 *Resettlement and Consultation Process*

The Project opted for cash compensation in instalments and this created some confusion and a misunderstanding about how compensation was to be paid out. This practice did not conform to World Bank guidelines as these advise against cash compensation for purchasing land.

Resettlers were informed about the move in 1997, shown various sites and given payments to arrange for their relocations and the building of houses. Purchasing of land at the new site did not occur as planned due to a slow release of budgeted funds and the escalation of land prices.

Consultations were held at several points during the planning and implementing stages of the project but there was not a specific overall plan. Stakeholders involvement occurred at various times depending on the perceived needs of the project.

The project allowed the resettlers to choose their own locations but did not investigate the viability of that choice in relation to livelihood and the host communities' use of existing resources. No upgrading or improvement of the capacity of governmental institutions responsible for resettlement and livelihood restoration was undertaken.

3.4 **Common Characteristics and Lessons Learned**

3.4.1 *Timeliness*

One of the most important aspects of an EIA is to enable the Developer to modify design in order to minimise resettlement, and social and environmental costs and impacts. The experience with the EIA process described above is that the EIA studies appears to have had little influence on the project design and technical solutions. This was due to the fact that important EIA plans and studies were concluded after the start of construction. Both in the case of Theun Hinboun and Nam Leuk additional investigations of social impacts were undertaken one year after start of construction activities. For Hoay Ho standard procedures for conducting EIA and resettlement planning were followed, but only after dam construction was nearly completed and after resettlement of the affected people.

3.4.2 *Comprehensiveness*

In general the EIA studies have tended to underestimate both environmental and social impacts and their mitigation costs. In the case of Theun-Hinboun social impacts were underestimated in the initial EIA. Social planners were thus unable to introduce preventative measures and enhance benefits, having only enough funds for compensation of losses. Effects on livelihoods in terms of loss of fisheries and vegetable gardens along both the headpond and downstream areas were only recognised as significant negative impacts after the commissioning of the hydropower plant.

The negative impacts in connection with influx of workers and camp followers have also in general been inadequately addressed and planned for. As noted under 3.1.3 the Theun-Hinboun construction activities attracted a considerable number of people and led to social problems including poor sanitary conditions and vehicular accidents. These impacts were not addressed in any pre-existing plans and had to be dealt with as they arose and became too severe to ignore.

3.4.3 *Consultation and Public Involvement*

Consultation and public involvement has been a part of the EIA process in all 3 projects but has for the most part been inadequate in relation to the present internationally accepted safeguard procedures. The Houay Ho resettlement process, which was handled and planned by the Government involved only consultations and discussions with community and village leaders. In connection with the Nam Leuk Project a number of consultations were held but no overall consultation plan was developed. One positive aspect with this consultation process was that people were given the opportunity to choose their own locations at the resettlement site.

In the case of Theun-Hinboun consultations were initially carried out to determine compensation needs and limited to those farmers that lost paddy land. A more comprehensive consultation was only carried out when it became clear that the Project would entail wider impacts.

In terms of a more comprehensive involvement of interested parties and organisations none of the 3 projects carried out any process of public consultation. However in the case of Theun-Hinboun international NGOs engaged themselves and pushed for better assessment and planning thus helping to ensure that environmental and social issues and concerns were properly addressed. In that way NGOs played a role in ensuring fair compensation and accountability.

In terms of transparency and follow up external monitoring has been a part of both the Theun-Hinboun and the Nam Leuk resettlement and compensation processes. It did not feature as an integral part of the follow up of the environmental and impacts of the Houay Ho Project, resulting in considerable negative criticism by some international NGOs and development agencies.

3.4.4 *Resettlement Planning and Implementation*

A common characteristic of all 3 EIA processes referred above is that compensation and/or resettlement needs were underestimated and insufficiently planned and budgeted for. This has resulted in compensation and resettlement processes that were inadequate and not in conformity with international safeguard standards.

The Houay Ho EIA lacked proper socioeconomic baseline data and the Developer did not take responsibility for any part of the resettlement planning and implemen-

tation, leaving it to the Government to both plan and finance the resettlement. which was integrated and combined with the creation of a new Focal Zone for which there was insufficient government funding. The outcome was therefore unsatisfactory including increased danger for assimilation and disappearance of a small ethnic group (the Nya Heun) poor livelihood development planning disregarding present reliance on livestock and non-timber-forest-products and with an over-reliance on uncertain cash crop production (coffee). In addition planning did not consider household composition and splitting, such that 20-30 percent more house lots were needed than foreseen or financed.

In the case of Nam Leuk the resettlement arrangements involved cash compensations in instalments that because of delayed release of funds created problems for the resettlers with respect to purchase of land and building materials for the new houses.

Given the past track record on resettlement and hydropower, it appears that much needs to be done in terms of policy development and capacity for planning, implementing and monitoring of resettlement as a viable, sustainable and transparent process.

4 LAO PDR HYDROPOWER DEVELOPMENT

4.1 Lao PDR Power Development Priorities and Goals

Lao PDR is the country in the Lower Mekong Basin with the largest hydropower potential. Only a small percentage of this potential is yet developed. In addition the country has significant undeveloped coal resources.

The policy of Government of Lao PDR is to develop these resources for the benefit of the country through the two primary strategies:

- *To provide reliable and affordable power to cover the national demand and thereby promote economic and social development.*
- *To develop part of the hydropower potential to generate export income for the country by selling power to neighbour countries.*

As for the national demand Lao PDR is still in an early stage of development. The Government's ambitious policy is to increase the electrification of households from the present 35% to 90% in 2020. The provision of inexpensive electricity is assumed to increase the competitiveness of the industry and commerce and to improve the livelihood of urban and rural communities.

Bilateral trading of power is already well developed in the region and Lao PDR has been a "pioneer" in this trade by already having two export oriented power plants in operation. Agreements have also been reached on future delivery. Intergovernmental MOUs have been signed between Thailand and Lao PDR for the supply of 3,000 MW of power by the year 2010, between Vietnam and Lao PDR for supply of 1,500 MW – 2,000 MW of hydropower by year 2010, and between Cambodia and Lao PDR for power sector cooperation in the areas along their common border.

However, the prospect of Lao PDR being able to benefit from further export of electricity, based on its vast hydropower resources will depend on; the general regional economic development situation; the competitiveness of hydropower generation in Lao PDR compared to other alternatives for power generation in the region; and the ability to attract foreign investment needed to develop these resources.

4.2 Power Use and Demand Forecasts

4.2.1 National Power Demand

In Lao PDR the growth in energy consumption was maintained at high rates throughout the years of economic recession in the late 1990's, even though the overall economic growth was reduced from 6-8% per annum to only 4-5% per annum.

The prime basis for the preparation of demand forecasts has been the governmental goal to increase the electrification ratio from today's 35% to 90% in 2020. This goal is supposed to be met by a combination of off-grid developments and grid extension programmes. In addition the plan included the expected demand resulting from planned industrial development in the central part of the country (served by Central II grid).

The high level of growth is expected to continue in the next 15 years, with a falling tendency towards the end of the period. The demand forecast used as a basis for the recent Power Sector Development Plan (PSDP) is shown in Table 1. The extreme growth indicated for the period 2002 to 2005 is mainly caused by the assumed start-up of the electro winning process at the Xe Pon copper / gold mine (40 MW) and the cement plant at Mahaxai (20 MW). Irrigation schemes are estimated to reach a load demand of 10 MW in 2020.

Table 1: PSDP Energy and Peak Demand Forecast (Meritec and Lahmeyer 2004)

	Unit	2002	2005	2010	2015	2020
Energy Consumption)	GWh	937.0	1,924.5	3,061.0	4,026.4	5,332.8
Av. annual growth	%		27%	10%	6%	6%
Peak Load (MW)	MW	186.4	378.3	548.6	721.8	956.1
Av. annual growth	%		27%	8%	6%	5%

4.2.2 Export Power Demand

The export power demand cannot be modelled in the same way as the national demand. The external factors and the uncertainties are too large for any precise prediction of the long-term demand or optimization of the sequence and timing of projects. The determining factors will be i.a.:

- The future cost difference between hydropower and other energy sources.
- Progress in regional transmission systems and power grids.
- Availability of capital.
- Progress in competing hydropower plans in neighbouring countries.

The PSDP presents two development scenarios for export projects; one base scenario and one optimistic scenario (Table 2).

Table 2: Export Generation Scenarios (Meritec and Lahmeyer 2004)

	Base Export Scenario	MW	Optimistic Export Scenario	MW
2006				
2007				
2008	Theun Hinboun Extension	150	Theun Hinboun Extension Nam Mo	150 100
2009	Nam Mo	100		
2010	Nam Theun 2	1000	Nam Theun 2 Xe Kaman 3	1000 250
2011	Xe Kaman 3	250		
2012				
2013			Xe Kaman 1	468
2014	Xe Kaman 1	468		
2015			Xe Kong	348
2016				

2017	Xe Kong 5	348	Nam Ngum 3E	580
2018				
2019			Nam Ngum 2B	183
2020	Nam Ngum 3E	580		
	Total capacity	2796		2979

The sequence of the scenarios above has been based on the professional judgement of the consultant and on the following factors:

- Economic of the project and quality of the site.
- Substance and sincerity of the sponsor.
- Market conditions including demand growth, reserve margin and political support for power trading.
- Capacity of Lao institutions to manage the implementation of multiple projects.

Taking into consideration the uncertainties of the development of export projects the tables above show that the export projects dominate the 15 year development plans in Lao PDR. The total projected capacity demand of the export projects is about 3 times the modelled national demand for the same period (956 vs. 2796 MW).

4.2.3 Distribution Networks

The power system in Lao PDR comprises four major networks (Table 3). The area-wise distribution of the country's power demand forecasts are summarised in the same table.

Table 3: Lao PDR Sub-regional Requirement, in MW (MRCS 2001).

Supply Area	Peak Load 2000	Share of load demand %
Northern Area	4.2	2
Central Area I	120	70
Central Area II	29	17
Southern Area	19	11

These networks are not interconnected. At present, 36% of the population is connected to one of these networks. In addition to these systems there also exist a number of smaller isolated systems.

The Central Area I accounts for 70% of the consumption, of which the municipality of Vientiane alone consumes close to 60%. Central Area I with Vientiane and Luang Prabang will in the planning period continue to dominate the country's demand, but to a lesser degree than before. The other areas show increasing shares, reflecting lower initial degree of electrification and the Government's electrification policy, and in the case of Central 2, industrial development.

4.3 Regional Power Demand Growth

As mentioned above the export projects form the largest part of the total power development plans in Lao PDR. Thus the development and policies of the neighbouring countries are of great importance.

Various forecasts for the Greater Mekong Sub-region (GMS) as a whole and for the countries individually have been prepared in the past. As expected, there are variations between the forecasts.

Table 4: Regional Power Demand Forecast (MW)

Year	2000	2005	2010	2020
Yunnan	5 257	7 554	10 227	16 231
Cambodia	114	280	529	1 156
Lao PDR	167	280	442	784
Thailand	14 918	21 222	28 912	51 359
Vietnam	4 890	7877	12 589	28 739
Total demand	25 346	37 213	52 699	98 269

Source: Norconsult 2002.

The demand development figures shown in Table 4 are very high. The reason for this is a large, unsatisfied need for more energy in Thailand in particular. The increased demand is planned to be served mainly by new thermal power plants fuelled by gas and coal. Gas fuelled power plants in Thailand today provide for 64% of the total installed capacity, whereas hydropower contributes 13%. For all other GMS countries hydropower is the dominant source of electricity. New hydropower plants will be valuable for peak power generation for Thailand.

The majority of the populations in Vietnam, Lao PDR and Cambodia are still without access to electricity.

Measures like demand side management are cost-effective means of easing the situation. However, in a situation where only a part of the population today has access to electricity, there will inevitably be a growth as long as the electrification programmes are effective and the electricity tariff is low.

It should be remembered, however, that the forecast includes system losses, which are very high in the region, and that there are significant inefficiencies and overuse in households, irrigation, as well as in industry and commerce. There is, therefore, large potential for savings by reducing system losses, applying more energy-efficient equipment and processes within the countries and by using a tariff differentiation as a tool to promote energy savings. This potential should be considered as "a source of supply" alongside investments in new generation capacity. Increased system and user efficiency will have implications for the demand for power in general, including the need for developing hydropower, which, is often used to meet peak power requirements where the potential for savings can be significant.

4.4 Existing Power Production in Lao PDR

The dominating generation source of the 4 power systems in Lao PDR is hydropower. In addition a number of small diesel plants are used in the isolated sys-

tems and some small areas in the Central and Northern parts are supplied with imports from Thailand and Vietnam.

For domestic supply the main hydropower plants are Nam Ngum (150 MW) and Nam Leuk (60 MW) in the Central Area I and Xeset 1 (45 MW) in the South. See map No 1 showing the major existing hydropower plants in Lao PDR. In addition there are three small hydropower projects; Selabam (2 MW), Nam Phao (1 MW) and Nam Dong (1 MW). There are 13 diesel plants, the biggest being Sokpaluang in Vientiane (8 MW). The total installed capacity of these diesel plants are 14 MW, but the annual production is small, only 2.8 GWh, whereas the hydropower plants supply about 1450 GWh/yr. The installed capacity in different regional supply areas is presented in Table 5.

Table 5: Installed Capacity in each Region (MRCS 2001)

Region	Load Centres	Hydro		Diesel	Total
		Domestic MW	Export MW	MW	MW
Northern	Phonsaly, Lpang, Namtha			1.4	1
Central I	Vientiane, Luang Prabang	222	200	11.1	22.5
Central II	Savannakhet, Thakek			1.0	1
Southern	Champassak, Savane	57	148	0.9	51
Total		279	348	14.4	642

Hydro generation exceeds domestic demand most of the time and excess generation is exported to Thailand. An implication of this is that imports from Thailand to other areas in Lao PDR can be viewed as “power wheeling”. In addition there are two power stations dedicated to exports to Thailand: Theun Hinboun (run-of-river, 210 MW) and Houay Ho (storage, 150 MW). Lao PDR has a right to withdraw 1.5 MW from Houay Ho and 10.5 MW from Theun Hinboun for domestic consumption.

4.5 Existing Transmission Lines and Development Plans

As mentioned there are four separate distribution networks within Lao PDR. However, there are several interconnections with the Thai grid for local supply in Lao PDR.

In addition to the short medium voltage interconnections there are 5 high voltage lines (115/230 kV) crossing the border and transmitting power to Thailand from the existing hydropower projects Xeset, Houay Ho, Theun Hinboun, Nam Leuk and Nam Ngum. All these lines are linked to the EdL distribution network for local supply.

Between Lao PDR and Vietnam there are two isolated connections on medium voltage level, one in the northeast and one in the south.

The future construction of transmission lines depends on the implementation order of the hydropower projects. The projects are located somewhat concentrated in three major basins and therefore the following interconnections might be expected:

- A 500 kV line from NT2 towards Savanakheth and further into Thailand. Later this line might be extended in different directions, towards Vientiane, towards Vietnam and to the south, linking the main demand centres in Lao PDR.
- A 230 kV line will be constructed from Nam Mo towards Vietnam.
- A 500 kV line will be constructed from the sub-station Na Bang close to Vientiane. From this sub-station there will be several 230 kV transmission lines towards Nam Ngum 2, Nam Ngum 3 and Nam Ngum 5 and one towards Thailand.
- If the Hongsa lignite power plant is developed there will be a separate 500 kV line towards Thailand.
- Further north the 500 kV transmission line from Yunnan will pass through Lao PDR.

4.6 Power Production and Development Situation in the GMS

The existing power generation capacity in the Greater Mekong Sub-region is based on a number of energy sources. The dominant sources are gas (mostly imported) and hydropower. Table 6 gives an overview of installed capacity at the beginning of 2001.

Table 6: Installed Generation Capacity in the GMS Countries (Norconsult 2002)

Source	Installed Capacity (MW)						
	Thailand	Lao PDR	Cambodia	Vietnam	Yunnan	Myanmar	GMS Total
Hydro	2886	628	1	3291	5150	360	12316
Coal				645	2419		3064
Lignite	2625						2625
Fuel oil	238		71	573		815	1697
Gas	13941			1338			15279
Diesel	230	14	57	828		65	1194
Small Power Plants	1613						1613
Import	340						340
Total	21873	642	129	6675	7569	1240	38128

4.6.1 Generation Expansion Alternatives

The Indicative Master Plan on Power Interconnections in GMS (Norconsult, 2002) discusses the alternatives for expansion of the generation capacity in the region. The presentation below is extracted from this study.

The main candidates for future supply in Thailand are:

- Import of hydropower from Lao PDR, Yunnan Province of PRC and Myanmar.
- Thermal plants based on imported coal.
- Combined cycle gas plants based on domestic and imported gas.

Environmental concerns make the use of coal questionable. With gas as the most realistic thermal alternative, Thai generation would depend heavily on gas by for

about 75 to 90 % of its installed capacity in 2020, the level depending on the contribution of imports, primarily of hydropower.

- In Cambodia the assumed sources for satisfying the power demand are:
- Oil and gas based thermal generation in Phnom Penh and Sihanoukville
- Development of the hydropower potential in west and north-east
- Import of power from Vietnam and Thailand

In Cambodia there are some projects that might be suitable for export to Vietnam, notably Lower Se San 2 and the 465 MW Sambor diversion project. In the south-western part of Cambodia, close to the border between Thailand and Cambodia, there are also a few promising hydropower projects.

In Vietnam many alternatives for future generation are available: hydro, coal, oil and gas and geothermal heat. Vietnam also contemplates the use of nuclear power in the last part of the planning period. Most of the hydropower capacity is located in the north of the country and import from Lao PDR and Cambodia is planned for delivery to the southern part.

Yunnan province, PRC, is rich with energy resources. Presently only 5 % of the estimated 400 TWh hydro resources have been exploited, leaving a huge development potential.

Of this potential, 15,500 MW is planned for development in the lower and middle reaches of the Lancang (Mekong) River with an estimated average annual generation of 73.8 TWh. Important projects for export are Jinghong (1500 MW) and Nuozhadu (5500 MW) on the Lancang River, and Malutang (460 MW) close to the border with Vietnam. In addition an alternative is generation based on the considerable coal resources in Yunnan.

Myanmar is also rich in energy resources, comprising some coal, oil, gas and hydropower. The main source for future generation is hydropower. In addition the intention is to build some gas-based generation plants. Information on the situation in Myanmar is limited. However, the 3600 MW Tasang hydropower project is planned for export to Thailand.

Apart from Myanmar and the northern part of Vietnam most of the hydropower potential is found in the Mekong River Basin. The total theoretical potential for hydropower production in the Mekong basin is estimated to be about 53,000 MW. Of this the potential in the four Lower Mekong countries is estimated to be about 30,000 MW, where 13,000 MW has been identified on the Mekong's mainstream and the remainder is found on the tributaries mainly in Lao PDR.

Compared to the huge theoretical potential for hydropower production only a minor part has been developed so far. Only 5 percent (some 1,600 MW) of the Lower Mekong's hydro potential has been developed. All of these projects are on the tributaries. There are great differences between the countries. While Thailand has developed most of its potential on the tributaries, Lao PDR has developed only a few of its many possible projects. Cambodia has yet to construct its first hydropower project within the Mekong basin. Vietnam has prepared plans for a full development of its hydropower potential, and the first in a series of plants has recently been commissioned. PR China has ambitious development plans for mainstream projects.

As for the structure of the future power generation system in GMS the Master Plan Study (Norconsult, 2002) assumes that the countries are likely to increase

their share of renewable energy. This expectation is based on the requirements of the Climate Change Convention, which is signed by all GMS countries. Also increased energy efficiency will become highly prioritized in the countries.

Norconsult concluded that there is a great potential for saving in total investments and for reduced system operating costs in the region through a co-ordinated development of the transmission system, connecting all major load centres to the areas of existing and potential larger generation facilities. It seems probable that the long term development of the power sector in South-east Asia will follow a path of integration, but the pace of progress will depend on political decisions and, not least, models and sources for financing and operation of the main transmission lines between the countries.

A central question of importance for the development of hydropower projects in Lao PDR will be whether regional large-scale generation will be dominated by each country's own sources or by more cost efficient sources in other GMS countries.

4.7 Hydropower Sector Plans and Strategies

4.7.1 General

The hydropower sector seems to be one of the most thoroughly planned sectors in Lao PDR from an economic and technical viewpoint. It can be observed, however, that over the last two decades the definition of what is a feasible project and the principles of project ranking have changed substantially. It seems for instance that the original plans for cascades of large power plants on mainstream Mekong are no longer considered realistic options, and none of the potential Lao/Thai projects on the joint mainstream reach are expected to materialise. At the moment Lao PDR has one mainstream project in the pipeline. This is Thakho, a small run-of-river project, which plans to utilise a minor part of the water flow in the Khone Falls, near the border to Cambodia.

4.7.2 Long List of Projects

Over the years a large number of potential hydropower projects have been identified in Lao PDR. Both the projects and the technical specifications included in these "long lists" have changed over the years. As the planning process proceeds to the next level more technical data are collected. Together with changes in economic conditions this is likely to result in new technical alternatives or modifications. Hence, project identified several years ago are today often found not to be environmentally and economically feasible. Thus the changing lists reflect the changing economic and technical conditions and the social and environmental concerns at the time when the lists were prepared.

4.7.3 Development Plans and Strategies

In addition to EdL's own ranking of projects (Electricité de Lao Generation Expansion Plan, 2005–2020) the following 6 hydropower ranking studies have been carried out in Lao PDR over the last 7 years:

- Hydropower Development Plan for Lao PDR (HDP) in 1997
- Power System Planning in the MIH (PSP) in 1997
- Nam Theun 2: Study of Alternatives (NT2SOA) in 1998 (Lahmeyer & Worley)
- Se Kong, Se San and Nam Theun River Basins Study in 1998 (Halcrow et al.)

- Hydropower Development Strategy Study (HDSS) in 2000 (Worley & Lahmeyer)
- Power System Strategy Study (PSSS) in 2002 (Electrowatt & PA)
- Power System Development Plan (PSDP) in 2004 (Meritec & Lahmeyer)

The latest of these studies included environmental and social parameters as factors in ranking and sequencing of the projects.

The NT2SOA and the HDSS used the same system of multi-criteria ranking based on a scaling and weighting (MOSES) methodology. The following “disciplines” were covered, each with a set of issues or indicators: social, regional development, environmental, technical, economic, financial and state of preparedness. The weight factor given to the three first disciplines (environmental aspects in the broad sense) is 41% out of 100 percentage points.

The PSSS comments on the general weaknesses of multi-criteria decision support models, as used in the NT2SOA and HDSS and underlines the lack of transparency and problems of weighting disciplines and indicators. Thus, as a contrast the PSSS adopts a simplistic approach for integrating environmental and social issues. In the PSSS an overall environmental ranking is given to each individual project based on two measurable indicators:

- km² inundated land per produced GWh, and
- relocated people per produced GWh.

Recognising that this method can only give a first impression and that more studies are needed at a later stage, they conclude that these indicators give a good and easily understandable sense of the potential environmental impacts. The classification of social and environmental impacts based on these indicators was used to modify the ranking based on production cost alone.

The PSDP applies a very ambitious method for including environmental and social aspects in ranking. By addressing about 1200 parameters (SESAMEE model) using different techniques of determining the costs and benefits in monetary terms the “Global Market Net Project Value” and the “Local Market Net Project Value” is translated into a value in million of USD for each project. It is difficult to judge the quality of this method as only the final summary figures have been published and the uncertainties in the basis data are not discussed.

The ranking in these studies have some similarities: Nam Theun 2, Nam Mo, Xe Kaman 3 and Nam Ngum 2 are in all studies among the highest ranked export projects. The Theun Hinboun Extension (which includes NT3) has also a high ranking in the latest studies. In earlier studies NT3, as a stand alone project, came out with a lower rating.

According to EdL’s ranking of the domestic projects Nam Mang 3, H. Lamphan Gnai and Xeset 2 seems most promising.

4.7.4 *Projects for Analysis in SEA*

The list of projects analysed in this study (Table 7) is partly based on projects for domestic consumption ranked by EdL. The most promising export generation projects is taken from the PSDP ranking. The list contains the projects most likely to be built in the next 20 year in Lao PDR.

Table 7: EdL Generation Expansion Plan (2004-2020) for Domestic Projects and the most Promising Export Projects (PSDP).

No.	Project	Expected year of commissioning	Installed capacity (MW)	Level of study

1	Nam Mang 3	2005 (domestic)	35	FS
2	Xeset 2	2006 (domestic)	76	FS
3	Nam Lik	2007 (domestic.)	100	FS
4	Xepon	2008 (domestic.)	74	I
5	Theun Hinboun Ext.	2009 (export)	105	MoU / FS
6	Nam Mo	2009 (export)	100	CA /FS /EIA
7	Nam Theun 2	2009 (dom./exp.)	75 + 1000	CA /FS /EIA
8	H. Lamphan Gnai	2010 (domestic)	60	I
9	Xe Kaman 3	2010 (export)	250	Constr./MoU/FS
10	Nam Ngum 5	2012 (domestic)	90	PFS
11	Thakho	2013 (domestic)	36	MoU /PFS
12	Xeset 3	2014 (domestic)	20	FS
13	Xe Kaman 1	2014 (export)	468	CA / FS
14	Nam Ngum 4A	2015 (domestic.)	55	I
15	Nam Kong 3	2016 (domestic.)	25	I
16	Nam Pot	2017 (domestic.)	38	I
17	Xe Kong 5	2017 (export)	248	MoU / I
18	Nam Bak 2B	2018 (domestic.)	116	MoU / I
19	Nam Ngum 4B	2019 (domestic.)	56	I
20	Xe Xou	2020 (domestic.)	59	I
21	Nam Ngum 3E	2021 (export)	580	CA /FS /EIA
22	Nam Ngum 2B	2022 (export)	183	CA / I (FS)

MoU=Memorandum of understanding, PFS=Pre-Feasibility study, CA=Concession agreement; I=Initial study.

The PSDP is based on a least cost expansion priority and partly adjusted to the domestic demand (size of project). The result of the study is a prioritised list of about 30 projects.

The priority list of domestic projects found in EdL’s plan differs somewhat from the least cost ranking of the PSDP. Although least-cost expansion might be the best strategy in macro-economical terms, the ranking list of EdL is a more practical list as it is based on level of planning and financing. In short, a list with a higher probability of realization.

In the cases where the evaluation is based on a pre-feasibility study or only a reconnaissance study there might be a long way to go before the project is constructed. As mentioned in the PSDP, an effective planning process is difficult to achieve if the government lacks control over the financing and implementation processes.

4.8 Technical Description of the Major Projects

The main technical features and economical parameters related to the projects planned for the next 20 year in Lao PDR, are presented in Table 8 and their location is shown in Map 1.

The data are to a large extent based on the “Project Catalogue” published as an annex to the Hydropower Development Strategy Study (Worley and Lahmeyer 2000). This annex is again based on a number of sources of varying detail and focus from inventory to feasibility study level. Consequently the quality of the information and the issues covered are not on an equal level for all projects. An additional problem is the constant change in project layout and operational mode pre-

scribed for some projects. The figures for energy production must therefore be read with caution. There might have been significant changes in the production estimates depending on, e.g., which assumptions have been made earlier regarding upstream development, and on updating of hydrological records.

The data have been checked with the technical data presented in the later PSSS report (Electrowatt, 2002) and, in order to get updated economical data, the specific cost is based on the PSDP-study (Meritec & Lahmeyer, 2004). The specific costs are also presented including the estimated local and global environmental cost.

It is important to recognize the uncertainties in the technical specification, estimated time of commissioning and consequently the social and environmental impacts of the individual projects and of the combined hydropower development. The description is based on the latest overall development plans but the plans, conditions and priorities are constantly changing.

Key environmental impacts are presented in Chapter 6 and Table 11.

Map 1: Existing and Planned Hydropower Projects in Lao PDR

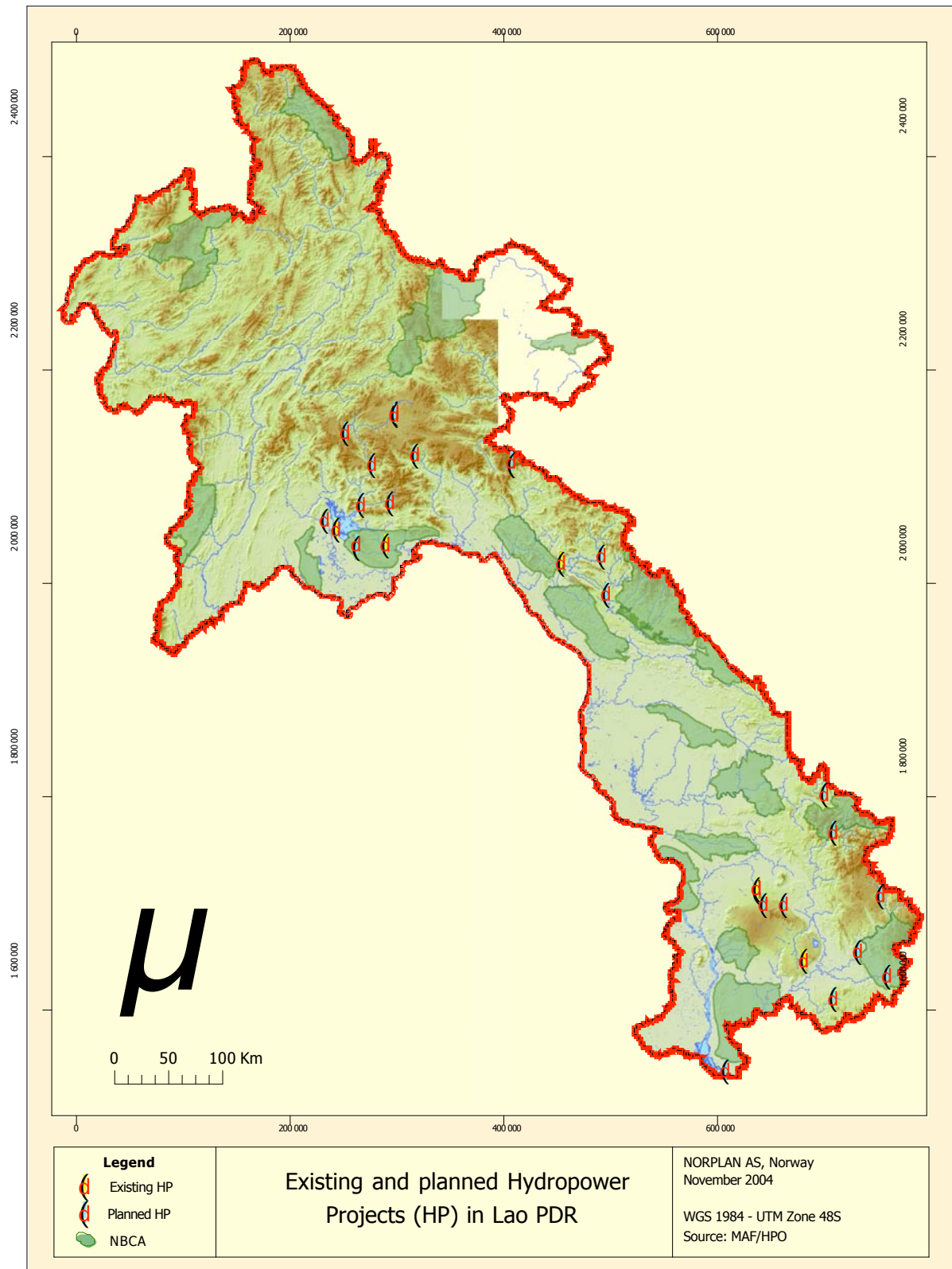


Table 8: Summary of Key Technical and Economical Data (incl. Local and Global Environmental Cost).

Ref. No. Map	Power plant	Average inflow	Total storage	Full supply level	Min. reserv. Level	Surface at FSL	Dam height	Waterway		Access road	Transmission lines	Net Head ¹	Design flow ¹	Plant capacity	Energy	Weighted generation cost ²			
								Tunnel	and penstock							PSSS techn.	PSDP techn.	incl. local	incl. global
		m ³ /sec	Mm ³	m a.s.l.	M a.s.l.	km ²	m	m	m	km	km	M	m ³ /sec	MW	GWh	¢/kWh	¢/kWh	¢/kWh	¢/kWh
1	N Mang 3	4	59	749	742	9.8	22	900	3200	40	28	529	8	35	134	4.38			
2	Xeset 2	14	9	813	812	1.5	16	7600	1200	15	17	263	14	76	252	8.02	8.30		
3	N Lik	89	1206	300	270	42.2	99	90	270	45	81	63	180	100	390				
4	Xepon	17	405	580	560	29.5	36	8700	650	21	127	273	30	74	301	6.2			
5	Theun Hinb. Ext	110	4870	540	510	125.6	119	5200	900	28	86	228	55	105	908		1.88	2.44	2.46
6	Nam Mo	10	291	1320	1280	10.8	82	5500	1300		44	830	14	100	581	2.54	2.47	2.75	2.77
7	N Theun 2	240	3910	538	525.5	450	48	2000	500	84	130	342	330	1074	5936	1.48	1.49	1.56	1.65
8	H. Lamphan Gnai	10	100	840	800	3.5	65	3400	1000	28	44	672	10	60	354	4.02	3.46	4.00	4.10
9	X Kaman 3	35	141	960	925	5.2	99	6000	1090		33	478	63	250	983	3.55	2.69	2.75	2.77
10	N Ngum 5	23	318	1100	1060	14.6	97	6200	860	32	77	292	36	90	430	4.17	4.95	5.41	5.33
11	Thakho	6704	-	74	74	-	-		25	2	144	17	240	36	290	5.37	5.18	7.19	18.74
12	Xeset 3	9	-	1022	1022	1.3	11		4900	15	20	165	14	20	72	8.03	8.50		
13	X Kaman 1	161	17400	280	250	222	184	400	250	33	33	170	319	468	1925	2.82	2.75	3.10	3.32
14	N Ngum 4A	27	443	1040	1010	14.5	65	3600	200	21	28	158	40	55	250	6.44			
15	N Kong 3	34	320	540	520	37	62	400	120	Na	64	77.5	37	25	142	8.24			
16	N Pot	2	79	1145	1127	6.1	38	1100	2900	22	14	706	6	38	97	5.47	3.42	4.59	5.13
17	X Kong 5	86	4750	500	462	70	205	290		40	11	195	147	248	1183	4.28	3.10	3.22	3.30
18	N Bak 2B	15	186	1030	1000	4.8	77	8000	1400	45	24	624	20	116	563	5.11	5.40	5.62	5.75
19	N Ngum 4B	29	5.6	880	880	0.5	33	10000	310	35	13	155	40	56	256	6.61			
20	Xe Xou	77	2750	180	160	112.9	62	360	90		61	58	118	59	277	6.18			
21	N Ngum 3E	106	1320	720	660	25.6	217	10000	320	68	165	322	270	580	2654	3.88	4.05	4.12	4.15
22	N Ngum 2B	189	>150	280		7.5	90		200			66	320	183	830	3.15	2.82	3.29	3.35

Notes: 1) Estimated based on gross head and normal losses. If not available, the power plant flow has been estimated based on installed capacity, net head and normal efficiency.
2) Weighted technical cost from Power System Development Plan (PSDP). Environmental cost are included by i) local environmental cost and ii) global environmental cost

4.9 Project financing

4.9.1 *Private Financing of Hydropower Development*

There is a growing acceptance that the capital required to expand the power systems to keep pace with demand is far higher than financial capacity of both the Lao PDR government and the multilateral or bilateral financial institutions. The only alternative has been to rely on private financing in one way or another.

Only two privately financed hydropower projects have so far been realised in Lao PDR and both are based on a Build-Own-Operate-Transfer (BOOT) principle. The projects are:

Theun-Hinboun, a 210 MW run-of-river project on the Nam Theun River, and

Houay Ho, a 150 MW seasonal storage project on a tributary to the Se Kong.

Both projects are owned and operated by special purpose companies (SPCs) established for the projects. EdL is a shareholder in both companies, with a 60 % share in Theun-Hinboun Power Company Ltd. and 20 % share in Houay Ho Power Company Ltd.

Theun-Hinboun is based on project financing, which means that the future revenue of power sales from the project secures the loans. Houay Ho was funded by balance sheet financing, meaning that the investor was able to finance the whole project directly through their bank account or credit. The project financing used in Theun-Hinboun proved, as experienced elsewhere, to require a time consuming preparatory process. In the end however, it has led to what appears to be a financially successful project. The balance sheet financing used for Houay Ho allowed for a much shorter preparatory phase. The construction actually started during project preparations, on the basis of incomplete and uncertain technical, environmental and financial information. As a consequence, the project will provide the Government of Lao PDR with less foreign exchange earnings than originally expected.

A large number of MOUs between the Government of Lao PDR and private developers have been signed both before and after the Theun-Hinboun and Houay Ho were initiated. Only a few of these have so far reached the stage where it is possible to foresee a time schedule for implementation. In most cases, problems in putting together financing packages have delayed the projects.

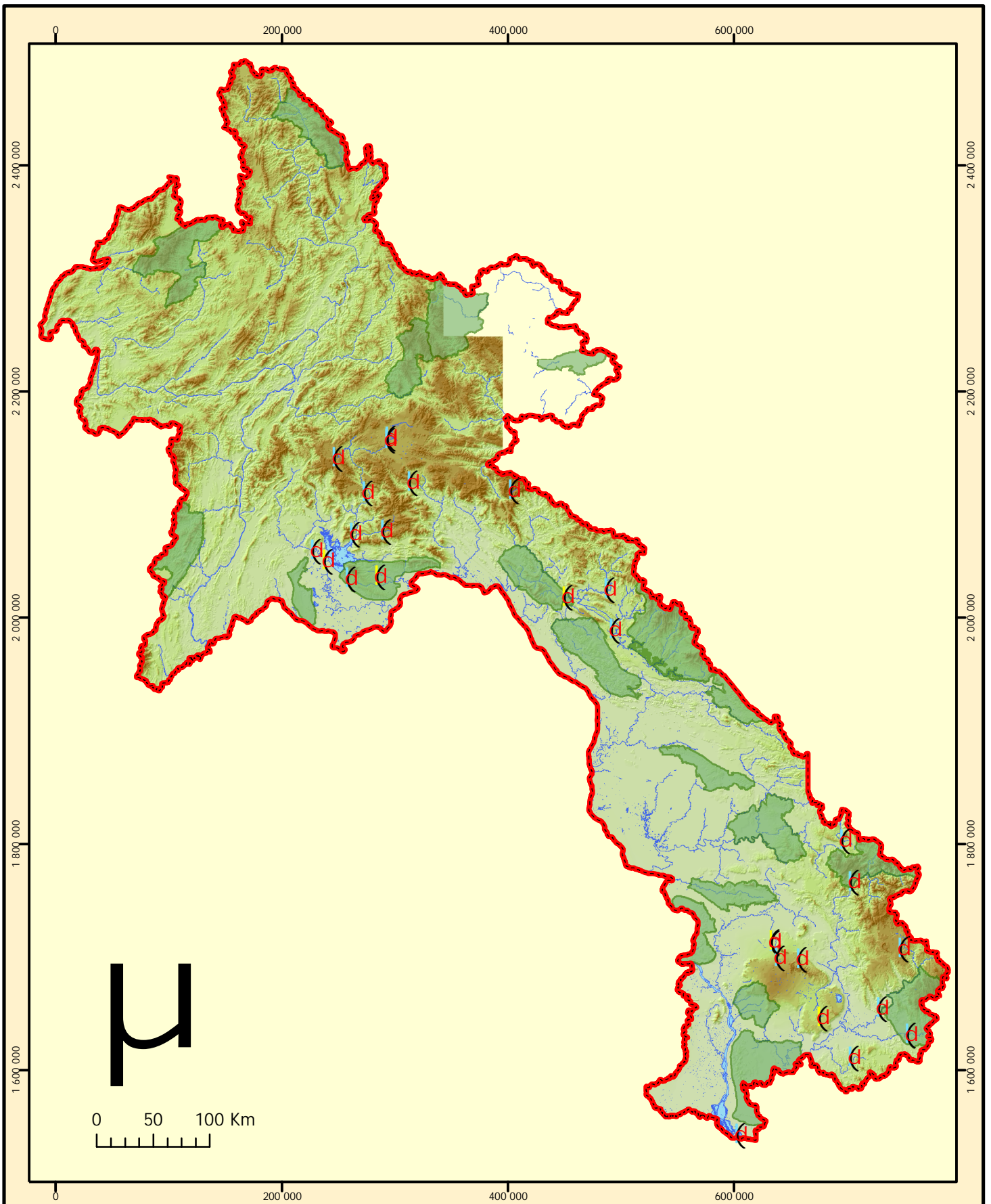
The present status of IPP mandates in Lao PDR is shown in Table 9. It should be noted, however, that this list is constantly changing. Several MOU are inactive and might eventually be cancelled or taken over by other developers. Also in the active projects the project sponsor might change or new development consortia be established. As can be seen from the table, there is little resemblance between the projects contained in this list and the project short-listed for development according to the PSDP.

Table 9: Status of IPP Mandates in Lao PDR (Meritec and Lahmeyer, 2004)

Project	Type of agreement	Signing date	Project sponsor	Status
Theun Hinboun	CA	13.10.94	THPC	Operating
Houay Ho	CA	23.09.93	Tractabel	Operating
Nam Ngum 3	PDA	15.11.97	GMS Power	MOU superseded by PDA
Nam Ngum 2	CA	17.03.98	Shlapak	MOU superseded by CA
Nam Mo	PDA	18.11.99	Mahawong/Harza	MOU superseded by PDA
Nam Theun 2	CA	16.11.98	NTPC	EGAT PPA negotiated
Xe Kaman 3	MOU	25.07.03	Viet-Lao PDR	Feasibility study submitted
Xe Kong 5	MOU	0.04.00	Sondel S.P.A.	Inactive MOU expired
Nam Tha 1	MOU	07.10.95	SPD	Inactive
Xe Pian-Xe Namnoy	CA	17.08.94	K&L	MOU re-assigned
Xe Kaman 1	CA	15.11.97	ALP Mgt / ANSCAN	In process of cancellation
Nam Theun 3	PDA	01.08.94	THPC	Concession transferred to THPC
Nam Theun 1	MOU	11.11.94	Gamuda. (Malaysia)	Transferred
Nam Ou 8	MOU	11.11.94	Pacific Rim Energy	Inactive
Don Sahong	MOU	23.08.01	EP (Malaysia)	MOU Extended
Nam Ngum 5	MOU	10.09.96	Melkyma	Intention to cancel notified
Xe Kong 4	MOU	21.01.94	Modular	Intention to cancel notified
Nam Pha	MOU	29.08.02	Statecorp Holding P/L	Feasibility study ongoing
Nam Bak 2B	MOU	1997	Engineering Con.	Survey Planned
Nam Beng	MOU	16.12.02	International Blaster	Feasibility study ongoing
Nam Ngew	MOU	29.11.02	Hongkham Construction	Feasibility study ongoing
Nam Sim A	MOU	15.0.03	Energy Development	Feasibility study ongoing
Nam Ngiep 1	MOU	09.05.03	Nippon Koei	Active
Houay Lamphan Gnai	EOI	2003	Ratchaburi/EdL	

4.9.2 Developers and Investors

Internationally, two types of developers have shown interest in BOOT projects for financing of hydropower. One type is the institutional investor, either with a background from the power sector or a pure investor looking for long-term return on his investment. The other type consists of contractors and manufacturers who have their strongest interest in the construction phase. The first type of investor will be interested in the lowest possible construction cost in order to receive as high a return as possible on his investment, based on the operation of the project. The second type will be more interested in an initial high mark-up on the construction contracts rather than the profit for the Special Purpose Company (SPC) during the period of concession. It seems clear that the interests of the pure investor will be more in line with the interests of the country, since a lowest possible construction cost will give the highest revenue to the country through taxes on the



Legend	
	Existing HP
	Planned HP
	NBCA

Existing and planned Hydropower Projects (HP) in Lao PDR

NORPLAN AS, Norway
November 2004

WGS 1984 - UTM Zone 48S
Source: MAF/HPO

SPC's profits and as dividends on a possible government equity participation in the SPC.

The policy of Lao Government has been to participate in the SPCs with a share of the ownership. This policy has been criticised for blurring the principle of separating the ownership interest and the regulatory functions of Government. As general principle, however, state ownership in power production, is commonly practised both in developed and developing countries. From an environment and social perspective governmental ownership might have both positive and negative impacts. It is likely that a governmental unit will have more understanding and care better for the people and nations environmental quality than a foreign investor. On the other hand, the economic interest of the governmental body might create a force on the regulating units to be lax in their control and enforcement duties. How this will turn out in the end will be determined primarily by the "political power structures", not by the regulations and guidelines.

Least Cost Development and Private Investors

Even with the strong support from the international financing institutions in applying a least-cost strategy for hydropower development in Lao PDR, the implementation of the plans and proposed development sequence has been unsatisfactory. This has resulted in ad hoc development, which has led to less than optimal development seen from a national socio-economic point of view.

The main reason for this is the strong involvement of the IPPs. They have picked up project ideas and signed MOUs on an ad hoc basis often without any upfront timetable or any realistic financing plan. This means that the ranking and selection of projects for development by least cost criteria is not effective, unlike what would have been feasible under a regime of public financing.

It is, however, possible to use this principle in combination with private participation. This requires that a least-cost expansion plan be simulated by the responsible public entity, resulting in candidate schemes ranked in a time sequence. Private investors can then be invited to bid for specific. Such a system is similar to what is used by the Nepal Electricity Authority (NEA).

Another important challenge in handling private sector involvement in hydropower development is to safeguard state of the art environmental and social quality of the projects and to adopt the principle of transparency throughout all the phases of development. Some private developers might be less conscious or concerned about the environmental and social aspects of the development, which is imbedded in the least cost sequence. Unless these requirements are made clear upfront, it might be neglected in the Developers detailed planning.

Award of MOUs for BOOT Developers

The present model for development is based on signing of MOUs between prospective private developers and GOL represented by the Committee for Investment and Management of Foreign Economic Cooperation (CIFEC/FIMEC) under the Prime Ministers Office, is non-transparent and non-competitive, and as far as is known, the content and format of the MOU document is not standardised. Therefore, environmental and social requirements seem not to be incorporated.

The MOU gives the Developer a sole mandate over the project site for proceeding with engineering, environmental and social studies, but unless strict requirements in line with the present EA regulations are included in the MOU, there is nothing that obliges the Developer to adapt technical designs to EIA findings and otherwise minimise environmental and social impacts. GOL has announced a policy that requires Developers to chose project sites that entails the least possible envi-

ronmental and social impacts and to submit EIAs on schedule. However, past experiences with BOOT projects have shown that this policy has been inconsistently applied and not secured timely submission of EIAs and mitigation and action plans.

Award of Licences

As is the case for MOUs the awarding of concession licences appears not to be a standardised process. Ideally, and according to the presently professed hydropower development implementation model, award of a concession licence is supposed to be subsequent to, and contingent on, the signing of a MOU and approval of EIA studies and plans. However, as far as can be ascertained there exists no mechanism that ensures incorporation measures identified in the EIA studies into the concession licence.

4.10 Preparation and Implementation of Plans

4.10.1 *Least Cost Planning*

In the least cost planning process the construction cost of each project will be estimated on a common unit cost basis. Environmental “cost” will be included and financial parameters calculated. The ranking of the projects are based on the final cost per unit (US¢/kWh), where the energy produced in kWh is adjusted by assuming a value of secondary energy reduced compared to the value of primary energy.

The latest ranking studies (HDSS, PSSS, PSDP) are very comprehensive and ambitious as they try to bridge specific environmental and financial issues. These studies have probably reached a higher level of accuracy compared to earlier studies, but there are uncertainties in the methodology, which should not be disregarded. These are:

- The input data is based on projects at *different planning stages*. A project on a reconnaissance level has not been optimised and detailed to the same level as a project that has reached the feasibility stage.
- *Environmental costs are difficult to calculate*. Some valuation of environmental goods and services are possible based on market prices, willingness to pay studies, etc. But in many cases the figures obtained only reflects part of the “real value” as some features of nature are basically impossible to quantify in monetary terms (spiritual values, biodiversity, scenic beauty, etc). Setting price is particularly difficult in regions where the population are not integrated in a market economy. However, the efforts so far indicate that the environmental cost will normally not significantly change the ranking based on financial criteria only. Environmental costs in most cases are much lower than the project cost (5-20%).
- Energy production figures have been based on “stand alone” production presented in the project specific studies and to a lesser degree on *basin-wide energy benefits*. A hydropower project with a large reservoir would normally be very beneficial for all downstream hydropower plants, e.g. the ranking might have changed if the energy gained further downstream had been included and the design of the downstream projects taken upstream reservoirs into account. This limitation can only be mitigated by carrying out a full River Basin Study simulating the operation of different combinations of hydropower projects in the basin. The Vietnam Hydropower Master Plans can serve as an example of such an effort.

4.11 The Power Market and Regional Coordination

At present four main power markets exist in the Greater Mekong Region. These markets are Yunnan, Thailand/Lao PDR, Vietnam and Cambodia. The dominating market is Thailand with close to 60% of the total demand. Its share is expected to decline due to demand growth in the other countries, in particular Yunnan, Vietnam and Cambodia. Consumption in Myanmar and Lao PDR are at present constrained by the lack of generation capacity, or by constraints in the transmission and distribution systems.

Several studies¹ have concluded that there is a large potential for savings in investment and generation cost for the GMS region as a whole, by implementing a least-cost generation and transmission expansion plan covering the whole region. The potential savings from taking a wider perspective can be ascribed to: (i) the avoidance of parallel investments in transmission systems; (ii) reduced needs for total installed capacity (sharing of reserve capacity, peak demand occurring at different hours, etc.); (iii) saving in or postponement of investments in new generation facilities; and (iv) reduced system operating costs.

A general consequence of basin-wide least-cost planning and implementation would, according to the World Bank study (1999), be a more rapid development of the hydropower potential in the basin and a lower growth in thermal production capacity, compared to national power development plans based on minimum criteria for self-sufficiency.

Until a regional system is in place power trading will be based on bilateral agreements between neighbouring countries, as is the case today.

In all countries it is expected that a regional grid will have to be complemented with smaller isolated grid systems. Small hydropower plants and diesel plants will be needed for such isolated systems.

¹ See for instance Power Trade Strategy for the Greater Mekong Sub-Region. World Bank, March 1999. Regional Indicative Master Plan on Power Interconnections in GMS, (Norconsult 2002)

5 BASELINE SITUATION

5.1 National and Regional Key Issues

5.1.1 *Introduction*

In the national perspective there are certain natural and social aspects or characteristics of particular relevance for hydropower development in Lao PDR. Several of these are issues that might mobilise one of the World Bank safeguard directives and consequently have to be carefully addressed in project preparation if World Bank support is sought.

Lao PDR is a landlocked country with an area of 236,800 km². The population was in 2000 estimated to 5,218,000, which gives a population density averaging 21 people per km². This is the third lowest of the ASEAN countries. The most intensely cultivated and the most densely populated areas are found on the floodplains along Mekong and the major tributaries. Most of the land area is mountainous and about 47 % of the land is covered with forest.

5.1.2 *Water Resources*

Lao PDR is rich in water resources. The average annual rainfall is high, 1650 mm/year. On the Boloven plateau in the south east of the country an average rainfall of 3700 mm/year is registered. The Lao PDR part of the Mekong catchment contributes in average 8500 m³/sec of the Mekong flow, which is about 35 % of the total Mekong flow measured at the Delta. A network of rivers criss-crosses the county but there are no natural lakes of significant size.

Being landlocked, all rivers originating in Lao PDR can be classified as international rivers. Most of the land area drains towards Mekong, with Cambodia, Vietnam and to some extent Thailand as downstream countries. Some catchments in the North East drain directly into Vietnam. All hydropower development in Lao PDR therefore have a potential of transboundary impacts. As a signatory party to the Mekong Agreement, Lao PDR is required to notify the other member parties on any development plans with potential downstream impacts.

The Mekong and the major tributaries experience regular flooding. The traditional land-use and the ecological conditions are adapted to, and benefits from, the normal seasonal flooding. The flooding is, in particular, important for wet season rice production and for the very important floodplain and backwater fish breeding.

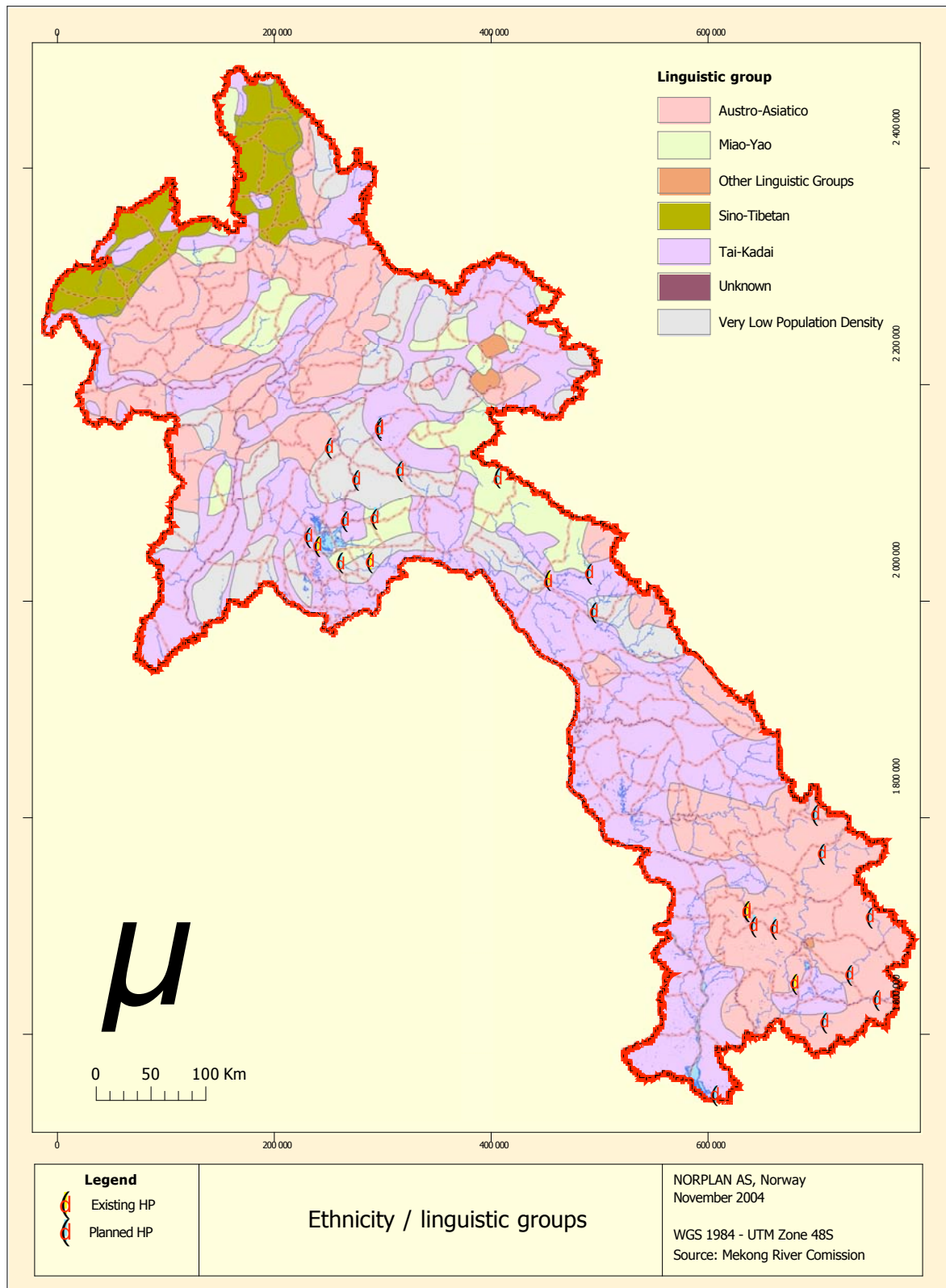
Map 2: Land Use and Forest Cover in the Nam Ngum and Sekong River Basins



Map 3: Land Use and Forest Cover in the Nam Theun / Nam Kading River Basin



Map 4: Distribution of Ethnic Groups in Lao PDR



5.1.3 Terrestrial Biodiversity

The hilly areas of Lao PDR and Vietnam are unusually rich in biodiversity. The high and isolated mountains have created wide variations in climate, soils, and ecological niches, leading to locally adapted and diverse fauna and flora.

One of the largest relatively unspoiled rain forest areas in the world, and some of the least studied, are found in Lao PDR. The recent discovery of new species of large mammals in the border area between Lao PDR and Vietnam underlines the global significance of the region's rich biodiversity. The most prominent species discovered in the 1990s are the ungulates Saola and the Giant Muntjac. Other new mammals have also been observed but their validity as new species are still to be confirmed.

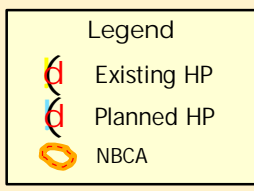
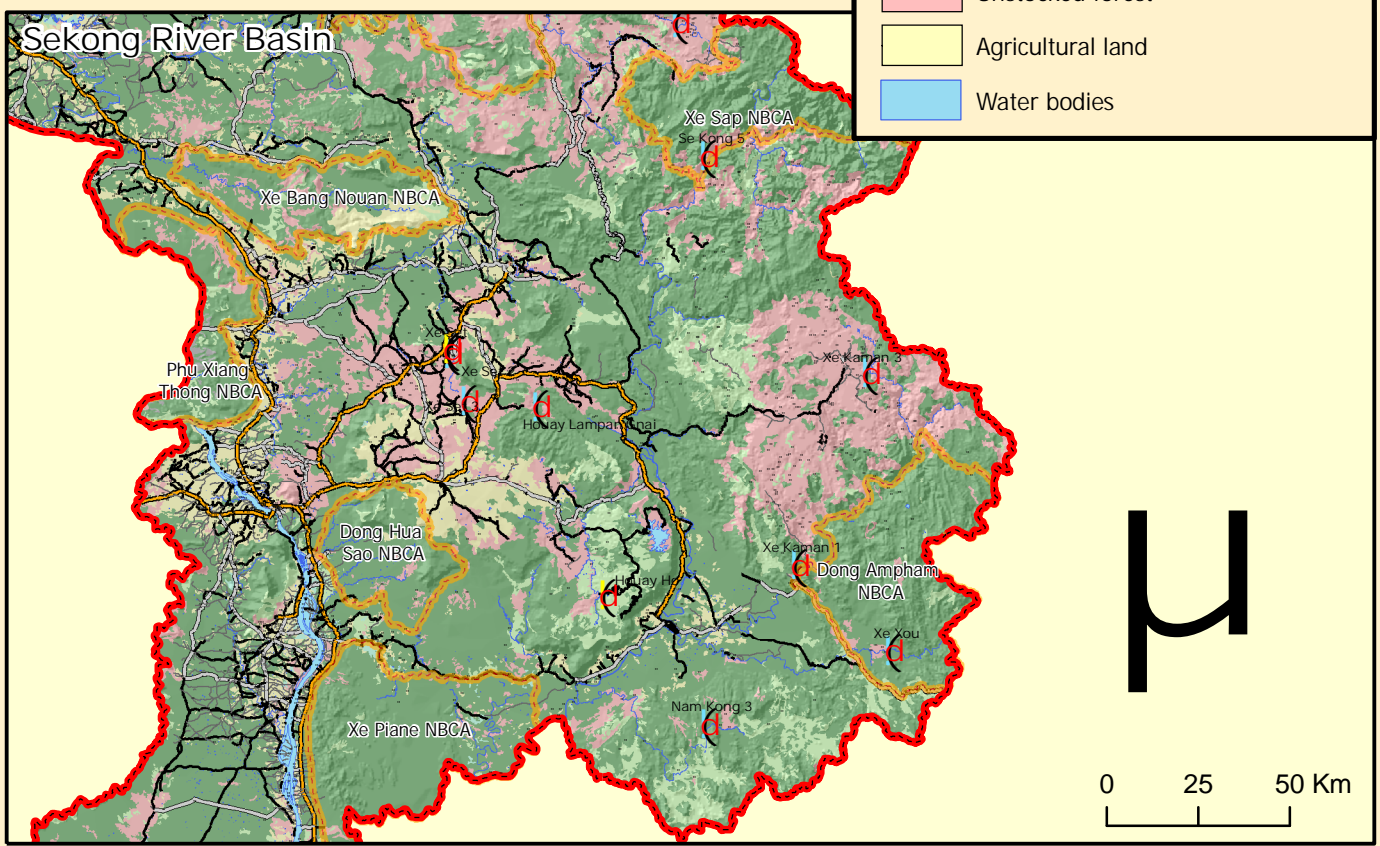
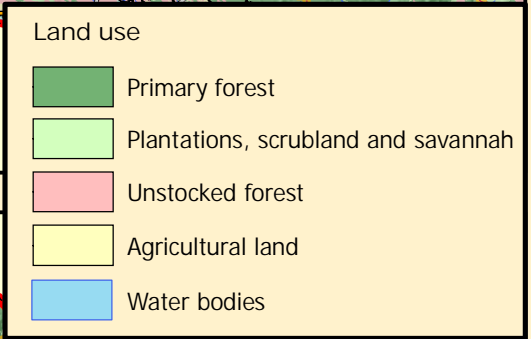
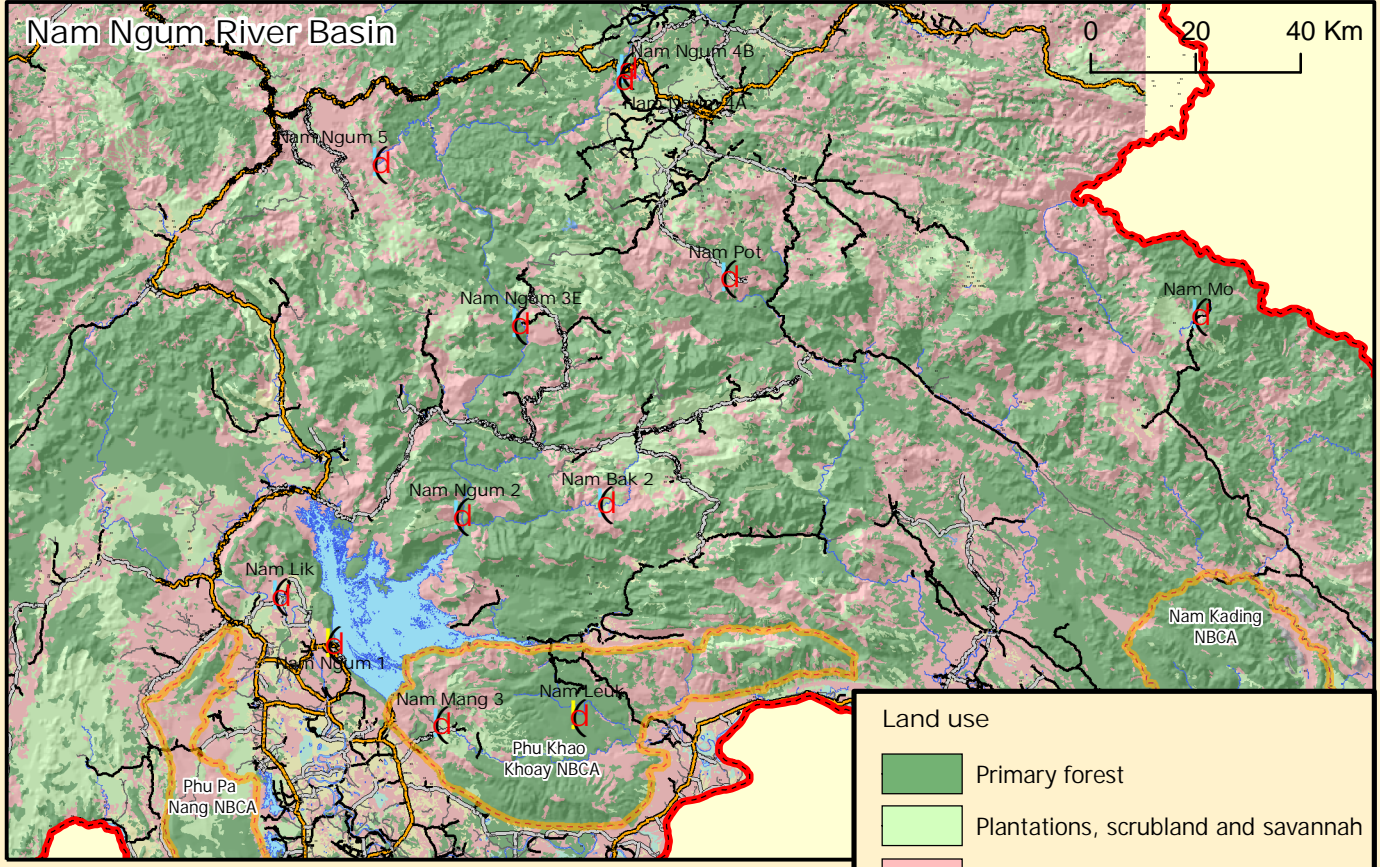
Biodiversity is protected through the establishment of 20 protected areas, called National Biodiversity Conservation Areas (NBCAs) (Table 10). The protected areas comprise 12-14 percent of the country's total land area. The establishment has been based on criteria developed by the IUCN. Twelve of the NBCAs have received international funding support to establish integrated management plans for the protected areas, but in general the capacity and competence for management and control is not sufficient to protect the values in the NBCAs.

The planned Nam Theun 2 development has proactively addressed the biodiversity values in their upstream catchment which, for most part, belongs to Nakai-Nam Theun NBCA. A Social and Environment Management Framework and Operation Plan (SEMFOP – GoL 2003) has been developed and the NT2 Project will provide the Nakai-Nam Theun NBCA with annual funds of US\$ 1 million. This will be an important contribution to protect this globally important NBCA against further encroachment from loggers and poaching.

In addition to the centrally designated protected areas, large areas have been designated as protection or conservation forests at the provincial and district levels, some hopefully to be upgraded to official protected area status in the future. Together, the protected areas and the provincial and district conservation and protection forests cover 8 million ha or 76 percent of forest land.

Table 10: National Biodiversity Conservation Areas in Lao PDR (DoF 2000)

Name of NBCA		Year	Area (ha)	Provinces covered
Dong Amphan	DAP	1993	200,000	Attapeu, Xekong
Dong Hua Sao	DHS	1993	110,000	Champassak
Dong Phou	DPV	1993	197,000	Savannakhet
Hin Namno	HNN	1993	82,000	Kammouan
Nakai Nam Theun	NNT	1993	353,200	Kammouan, Bolikhamsay
Nam Et	NET	1993	170,000	Houaphan
Nam Ha	NHA	1993	222,400	Luang Namtha
Nam Kading	NKD	1993	169,000	Bolikhamsay
Nam Phui	NOI	1993	191,200	Sayaburi
Nam Xam	NXM	1993	70,000	Houaphan
Phou Daen Din	PDD	1993	222,000	Phongsaly



Land use / forest cover

NORPLAN AS, Norway
November 2004

WGS 1984 - UTM Zone 48S
Source: MAF/HPO

Phou Hin Phoun	PHP	1993	150,000	Kammouan
Phou Khao Khouay	PKK	1993	200,000	Vientiane, Bolikhamxay, Xaisombun
Phou Loei	PLI	1993	150,000	Houaphan, Luang Phabang
Phou Phanang	PPN	1993	70,000	Vientiane
Phou Xang He	PXH	1993	109,900	Savannakhet
Phou Xiang Thong	PXT	1993	120,000	Champassak, Salavan
Xe Bang Nouan	XBN	1993	150,000	Salavan, Savannakhet
Xe Pian	XPN	1993	240,000	Attapeu, Champassak
Xe Sap	XSP	1995	133,500	Salavan, Xekong
TOTAL			3,313,596	

Lao PDR has until recently been sheltered from many of the forces acting to reduce biodiversity. However, as the economy of Lao PDR expands this situation might change and threaten the country's biodiversity resources.

Illegal or uncontrolled logging is a serious problem. Destruction of the forests has a dual negative impact. It reduces the biodiversity value of the area and endangers rare or threatened species and at the same time destroys the flood buffering and soil protection capacity of the river catchment.

5.1.4 *Aquatic Biodiversity and Wetlands*

Mekong and its tributaries are extremely rich in fish and other aquatic species. More than 1,300 fish species are found in the Mekong basin. From a biodiversity standpoint the most spectacular species are: the giant catfish, giant Mekong barb, Irrawaddy dolphin and Siamese crocodile. All these are threatened by extinction.

The number of species found in the different Lao Mekong tributaries is not known but it is indicated that 300-500 fish species can be found in some of the larger rivers. The Irrawaddy dolphin is not able to pass the Khone falls and is not found in the Lao part of the Mekong but a small population of dolphins is found in Lao PDR territory in the Se Kong tributary.

It has been established that several of the key species and important parts of the fish production are dependent on specific flood patterns, minimum flows and migration opportunities to maintain life cycles and reproduction. The taxonomic and ecological knowledge of the fish fauna in Mekong River Basin is however, still only rudimentary.

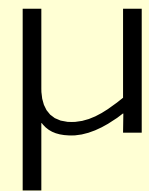
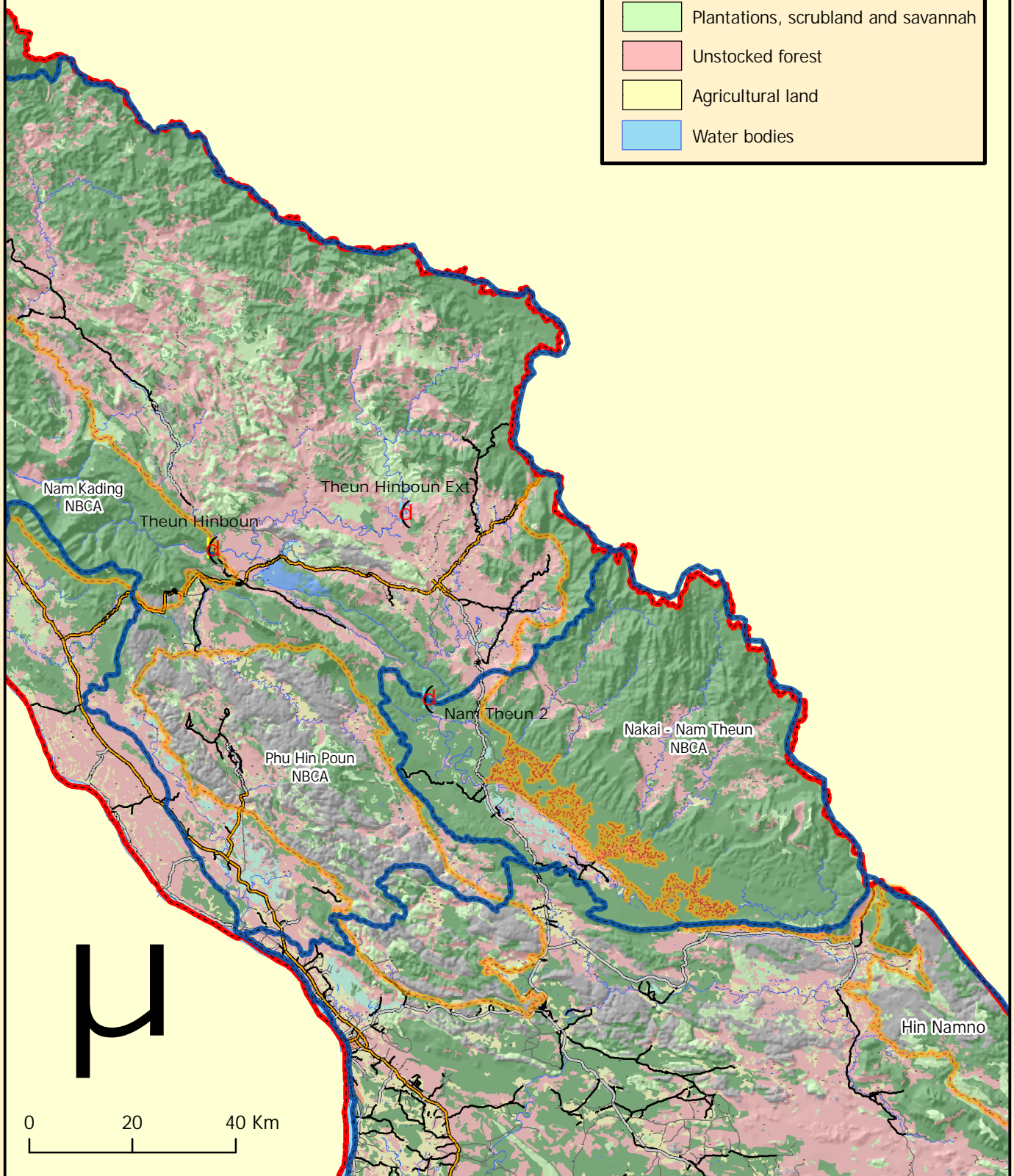
The capture fishery is an important element in rural households in terms of nutrition and income generation in the region. Approximately 71% of rural households (2.7 million people) in Lao PDR rely on fishing to a varying degree as a livelihood strategy. Fish is thus an important part of the staple diet, and the most important source of protein in many parts of Lao PDR. The total freshwater fish catch in Lao PDR was for year 2000 estimated at 133,000 tons. This translates to a consumption of 26 kg/person/year but with much higher average consumption in lowland and floodplain communities than among mountain and forest dwellers.

Wetlands along the Mekong and on some of the major tributaries are of very high biodiversity value. They are inhabited by a large number of rare and threatened species and play a critical role as stopover sites for migratory birds and are key breeding areas for some of the economically important fish species. The regular

Nam Theun / Nam Kading River Basin

Land use

- Primary forest
- Plantations, scrubland and savannah
- Unstocked forest
- Agricultural land
- Water bodies



0 20 40 Km

Legend

- Existing HP
- Planned HP
- NBCA

Land use / forest cover

NORPLAN AS, Norway
November 2004

WGS 1984 - UTM Zone 48S
Source: MAF/HPO

flooding of the wetlands is a key factor for the fish production in the basin. Few of these valuable wetlands are protected and there is no regional wetlands policy or strategy prepared.

The most prominent wetlands in Lao PDR are:

- Attepeu wetlands on the Sekong floodplain. This wetland area has been selected as a Demonstration Site for the Regional GEF project “Mekong River Basin Wetland Biodiversity Conservation and Sustainable Use Program”. A number of globally threatened species of mammals, birds and reptiles are found here. The large array of water birds includes the only known site of the Giant Ibis, which was rediscovered here in 1993.
- Siphandon Wetlands on Mekong. This wetland contains a 14 km wide complex of perennial and seasonal channels and small islands formed by Mekong just upstream of the Khone falls. It serves as a passageway for migrating fish and is a critical habitat for many fish species, waterfowl and other wetland flora and fauna.

None of the NBCAs have been established for wetland protection per se, but several contain river reaches and wetland areas. Parts of the Attepeu wetland are incorporated in existing NBCAs. The Siphandon Wetlands is not formally protected but is suggested as a World Heritage Site because of its conservation value.

In Cambodia downstream of the Khone falls, is found the Stung Treng wetlands, which has been given the status of Ramsar site for its importance as wildfowl habitat and as a key breeding area for many Mekong fish species.

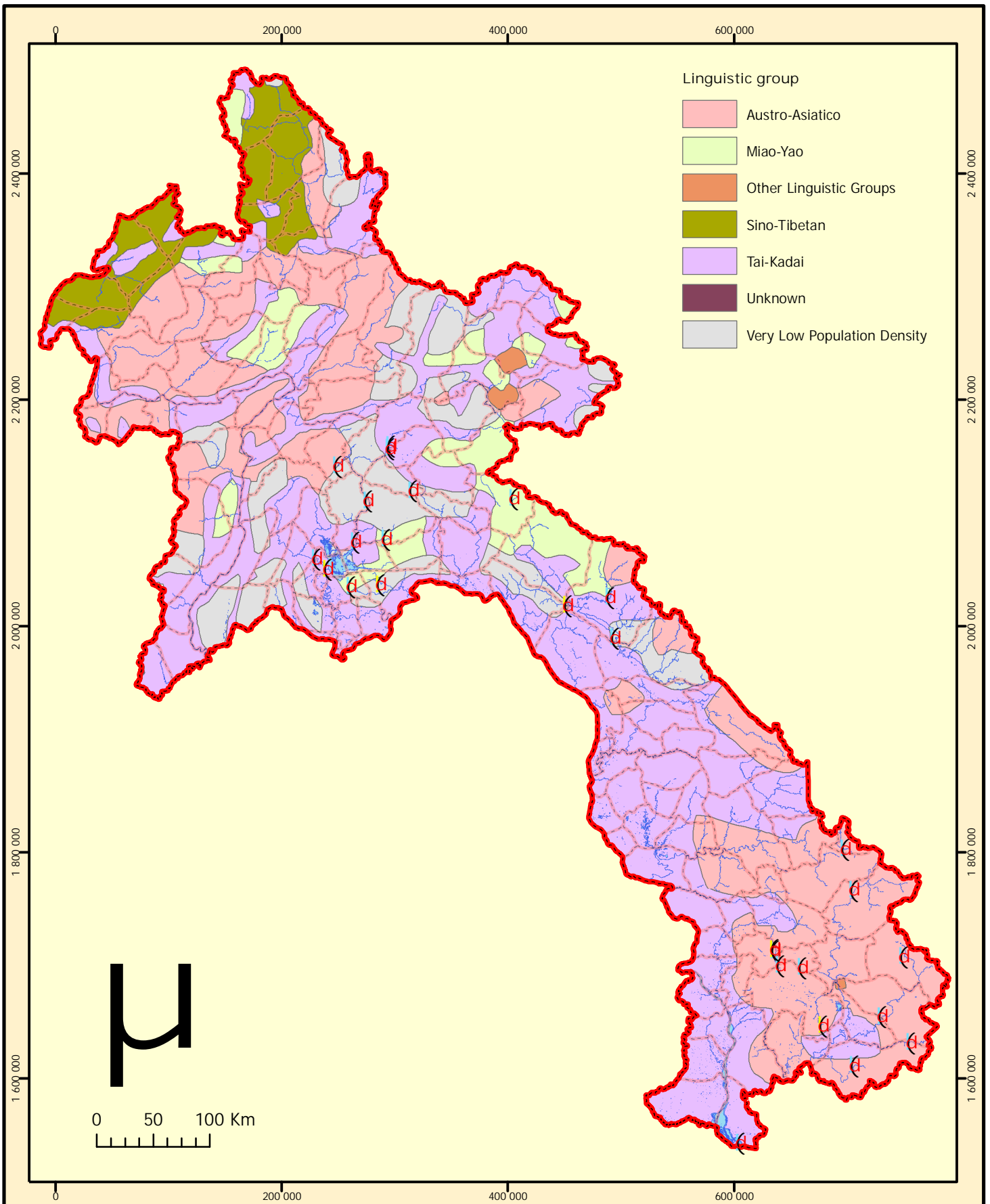
5.1.5 *Population*

Compared to other countries in the South East Asia, Lao PDR is sparsely populated. This is in particular the case for the mountain forest areas along the Vietnam border. In large areas there are no road connections and the few scattered villages survive mostly on subsistent farming (swidden cultivation) and collection of forest products.

The river valley plains and flood plains are the most densely populated areas in the region. Consequently, resettlement and compensation for loss of land and income opportunities are key problems when land is taken for reservoirs. The human production systems, like fisheries, agriculture and aquaculture are also in many cases closely adapted to the river flow volumes, the seasonal changes in river flow and flooding. Hydropower development, which might interfere with natural flow regimes or the inundation of flood plain areas, can therefore affect a large number of people.

5.1.6 *Ethnic Minorities*

There are in Lao PDR officially 49 main ethnic groups and over 100 sub-groups. These comprise 4 ethno-linguistic groups, Tai-Kadai, Mon-Khmer, Sino-Tibetan and Hmong-lumien. The Tai-Kadai ethno-linguistic constitutes about 66% of the population and comprises the largest ethnic group, the lowland Lao. The second largest group is the Mon-Khmer comprising around 23% while the Sino-Tibetan and the Hmong-lumien accounts for the remaining 11%. The smaller Lao-Tai sub-groups, the Mon-Khmer, the Sino-Tibetan and the Hmong lumien are commonly regarded as ethnic minorities.



Legend	
	Existing HP
	Planned HP

Ethnicity / linguistic groups

NORPLAN AS, Norway
November 2004

WGS 1984 - UTM Zone 48S
Source: Mekong River Commission

Residing mostly in the uplands and mountainous parts of the country, where most of the hydropower development projects are planned, ethnic minorities are prone to be more seriously affected than the lowland Lao groups.

In comparison with the majority lowland Lao population ethnic minorities are less integrated into the mainstream economy because of their reliance on the forest for livelihood both in terms of collection of non-timber-forest-products and areas for slash and burn agriculture. Because of this lack of economic integration combined with low rates of numeracy and literacy ethnic minorities are disadvantaged when it comes to utilizing economic opportunities presented by development projects.

5.2 Description of Areas of Major Hydropower Development

The majority of the planned hydropower projects are located within 3 river basins; the Nam Ngum (upstream of the Nam Ngum reservoir); Nam Theun; and Sekong Basins. Below is a brief description of the natural and human environment in these three basins.

5.2.1 *Nam Ngum Basin*

Nam Ngum river basin is located in Xaisomboun Special Zone, and the provinces of Xiangkhouang and Louang Phrabang. The altitude of the basin ranges from about 200 m.a.s.l. at the Nam Ngum reservoir to almost 2500 m.a.s.l. further north. The lower part of the basin is very sparsely populated, and large tracts of forest are still in a fairly undisturbed state (see Map 2). The upper part of the basin has a much larger population, and most of the natural vegetation in this area has been cleared and the land converted into agricultural land, secondary forest and savannah.

According to WWF, the Nam Ngum basin is located within an eco-region named *Luang Prabang montane rain forests* (IM0121). This eco-region is globally outstanding for its diversity of bird species, even though more than 70 percent of the original forest has been lost as a result of shifting cultivation. Despite the loss of habitat, this eco-region still contains large tracts of untouched forest that shelter several large mammals, including endangered species like tigers, Asian elephants, wild dogs, Asiatic black bears, Francois' leaf monkeys, gaurs and others.

There are no NBCAs located within the Nam Ngum river basin, but Phu Khao Khoay NBCA is located near the southern shore of the Nam Ngum reservoir. (Nam Ngum 2 and Nam Bak 2 are located about 25 km north of Phu Khao Khoay). This does not, however, imply that the proposed projects do not have any impacts on the biodiversity. Within the river basin, there are still large areas of high biodiversity value due to low population density and lack of infrastructure, especially in the lower part.

A total of 65 villages are located less than 5 km from the main river or its tributaries (including non-affected tributaries), the majority of these are found in the upper part of the basin (near Nam Ngum 4A and 4B). In relation to population, the area contains a mix of different ethnic groups, representative of the country as a whole. In lowland areas, Lao, Phuan and Tai groups are dominant (Lao-Tai linguistic group), while the hills are inhabited by a number of ethnic minority groups including the Hmong (Hmong-lumien linguistic group), some of whom have been resettled in these regions as part of Government programmes, and Khmu (Mon-Khmer linguist group), the indigenous peoples of the area.

5.2.2 *Nam Theun Basin*

The Nam Theun / Nam Kading river basin is located in the central part of Lao PDR. Most of the river basin is located within the provinces of Khammoune and Bolikhamsay, while the extreme north of the basin belongs to Xiangkhouang Province. The river basin covers an area of almost 18 000 km², and the altitude ranges from about 150 m.a.s.l. at the confluence with Mekong, to almost 2300 m.a.s.l. in the eastern part near the border with Vietnam. There are several major tributaries along Nam Kading / Nam Theun, of which Nam Gnouang, Nam Mouan and Nam Phao are the most important. The hydropower projects Theun Hinboun (existing) and Nam Theun 2 (planned) are both located on the main Nam Kading / Nam Theun river (see Map 2). Except for the Theun Hinboun Extension, there are, at present, no other major hydropower projects planned in this river basin.

The central part of the Nam Theun / Nam Kading river basin is most developed. The Lak Xao area has for a long time been a major hub for the timber industry in this region. The effects of the timber industry is evident on Map 2. Most of the original forests in this area have been cleared, and larger tracts of primary forests are now only found in the north-western part of the basin and along the Lao – Vietnamese border.

According to WWF, the Nam Kading / Nam Theun basin overlaps with two eco-regions: *Northern Annamites rainforest* (IM0136) and *Northern Khorat Plateau moist deciduous forests* (IM0138). The Northern Annamites Rain Forests ecoregion lies largely in Laos, but with a significant area across the crest of the Annamite Range in Vietnam. This area is of international importance when it comes to biodiversity. Almost each new survey turns up new species of mammals, birds, fishes, reptiles, butterflies or plants. Of the 134 mammals now known from the ecoregion, three are near-endemic species and four are endemic. More than half of these are recently described species; therefore, it is very likely that several species could be added to this list as surveys continue. The Northern Khorat Plateau Moist Deciduous Forests are located in the middle Mekong River Valley, along the border of Thailand and Laos. Like many productive habitats that lie along river plains, much of the natural habitat has been cleared for agriculture. Several endangered species (asian elephant, wild dog, sun bear, cluded leopard, etc.) still persist in small numbers, while others (tiger, gaur and banteng) are no longer found in most or all parts of this ecoregion. Both eco-regions are under severe threat due to logging, hydropower development and illegal hunting and trade in wildlife.

There are also several NBCAs located within or near this river basin. Nakai - Nam Theun NBCA near the Lao – Vietnamese border, Phou Hin Pou NBCA (Khammouane Limestone) in the south-western part of the basin and Nam Kading NBCA a little bit further north. In addition, Nam Chat / Nam Phan Provincial Conservation Forest and a corridor connection Nakai – Nam Theun NBCA and Phou Hin Poun NBCA have been gazetted.

Around 550 settlements/villages are found within the river basin. Most of these are located along the main river or it's major tributaries. There are very few settlements in Nam Kading NBCA and the north-eastern part of the basin. Most settlements are found in the vicinity of Lak Xao and along Route 8A.

A number of ethnic minority groups are represented in the Nam Theun Basin. In the upper part of the catchment which is largely corresponds to the Nakai-Nam Theun NBCA, the Brou (So/Makong) predominate along with Vietic groups. The Brou make up a little more than 50% of the population while the Vietic groups represent around 25%. The Brou belongs to the Mon-Khmer ethno-linguistic group practising various types of livelihoods ranging from hunting and gathering com-

bined with swidden cultivation to wet rice farming. The Vietic groups are the oldest known inhabitants in the area and predates all other ethnic groups. They were originally hunter-gatherers but have adopted other livelihoods such as swidden agriculture. Other minor groups in the Nam Theun watershed include the Sek and the Tai Sin and Phu Tai which all belong to the Lao-Tai ethno-linguistic group.

Also on the Nakai Plateau the Boru is the largest ethnic group constituting around 45% of the total population Other ethnic minority groups on the Plateau are the Tai Bo, various other Tai groups and the Vietic population which account for around 12% of the population.

The middle part of the Nam Theun Basin, the part that drains to the reach between the planned NT2 dam at Sop Hia and the Theun-Hinboun dam largely consist of the sub-catchments of the Nam Phao, the Nam Kata, the Nam Nyaung and the Nam Ao. The rural riverside villages in these sub-catchment are mainly inhabited by various Tai and Vietic ethnic groups. There are also a number of Hmong communities that are mostly located on the upper slopes and ridge-tops.

5.2.3 *Sekong Basin*

Sekong river basin is located in the southern part of Lao PDR, where the river crosses the border with Cambodia before joining the Mekong below the Khone falls. Most of the river basin is located within the provinces of Xekong, Attapu and Champasak. The altitude of the basin ranges from about 100 m.a.s.l. in the extreme south to more than 2000 m.a.s.l. near the border with Vietnam. There are several major tributaries of the Sekong, and most of the planned hydropower projects are located on these tributaries (see Map 2).

Due to the large size of this river basin, it covers a wide range of land use categories and ecosystems. As Map 2 shows, there are still large areas of intact forest within this basin, while the forest in other areas (parts of the Bolovens Plateau and the south-eastern part of Xekong Province) have been logged and converted into agricultural land and degraded forest.

According to WWF, the Sekong basin overlaps with three eco-regions: *Southern Annamites montane rainforest* (IM0152), *Central Indochina dry forest* (IM0202) and *Southeastern Indochina dry evergreen forest* (IM0210). The details of the Southern Annamites montane rainforest plants and animals are poorly known, but recent discoveries have shown that the region's biodiversity is globally outstanding. All eco-regions are under severe threat of habitat destruction due to logging.

There are also several NBCAs located within or near this river basin. Xe Sap NBCA and Dong Amphan in the largely mountainous areas along the Lao – Vietnamese border, and Xe Plane in the south along the border with Cambodia. Both the Se Kong 5 project and the Xe Xou project is located within NBCAs, which makes them particularly controversial considering the globally outstanding biodiversity values in these NBCAs. The lower floodplains of Sekong (the Attepeu Wetlands) are of unique biodiversity value. The biodiversity values of these plains are adapted do the natural flood regime that can be altered by the cumulative impacts of upstream hydropower development.

288 villages are located less than 5 km from Sekong river and it's main tributaries. The vast majority of these villages are ethnic minorities belonging to the Mon-Khmer group, consisting of Laven, Gnaheun, Brao (Halang), Sadang (Duan, Kayong), Suey and Oi among others. The majority of these groups retain their own language and traditions that are different from the dominant majority Lao culture.

6 ENVIRONMENTAL AND SOCIAL IMPACTS

6.1 Generic Description of Potential Impacts

6.1.1 *Introduction*

The fact that hydropower projects in addition to their economic and social benefits also might have significant negative impacts is well-established knowledge. This is reflected in most countries' environmental legislation where it is mandatory to have hydropower projects undergo comprehensive impact assessments. The main reasons for the strong awareness and focus on hydropower impacts seems to be the fact that changes in hydrology and ecology might be felt for long distances both upstream and downstream and that the development often takes place in remote and pristine areas where the local people have to bear the negative impacts but might see little of the benefits of increased power production.

The impacts of hydropower projects are diverse but for simplification the most important are related to either:

- Direct or indirect impacts caused by changes in river morphology and hydrology, or
- Direct and indirect changes caused by large-scale construction work.

A brief summary of the character of these impacts is given below.

6.1.2 *Impacts Caused by River Changes*

Dam or intake weir

A reservoir dam or an intake weir will create a blockage for upstream movements of fish and other active swimming animals. This issue is particularly important if fish migration is part of a regular breeding cycle. Fish ladders or similar devices can be effective in mitigating the problem, but such structures have shown to be of limited value for the fish species found in this region.

Reservoir or intake head pond

Upstream the intake a smaller or larger reservoir or intake pond will be established. In most cases this will result in the transformation of a river ecosystem to a lake ecosystem, resulting in changes in aquatic biodiversity and fishing opportunities. The reservoir might experience oxygen deficiency in the deeper water layers and thus in the discharge water from the power plant. The problem is determined by a combination of factors like; amount of organic materials in the inundated area (vegetation), oxygen and nutrient load in inflowing water, residence time in the reservoir, and thermal stratification.

For larger reservoirs the issue about land-take is often important. There might be the loss of valuable natural forests or wetlands or loss of agricultural land and human settlements. The need for resettlement of individuals or whole communities and the loss of agriculture land (the most productive land is often found close to rivers) are normally the most difficult and controversial aspects of hydropower development. On the benefit side, a reservoir might provide new opportunities for development and economic activities. Conditions might be created for more productive fisheries than the original river fisheries. The reservoir might also give more stable conditions for domestic water supply and irrigation and tourist and recreational activities might be attracted to the new lake.

Diversion

Except for plants where the turbines are built in the dam itself (as in Nam Ngum 1), there will be a stretch between the intake and the powerhouse where the river might become more or less dry. Unless any requirements for environmental flow are agreed upon, this reach will lose its aquatic life and remove water use opportunities for the people living nearby. Depending on the operation of the plant and the water release, the river might return to an almost normal status below the discharge channel of the powerhouse.

A particular case emerges when the scheme includes the diversion from one river to another. Modern tunnelling techniques have made it possible to utilise the height potential by diverting water from an intake in one river to a powerhouse in a different basin. In such cases significant changes to the normal hydrology, aquatic ecosystems and downstream water use will be experienced both in the discharging and in the recipient rivers.

Water storage

There are two basic different categories of hydropower plants seen from the water storage perspective; Run-of-River (RoR) projects and seasonal storage project.

The RoR projects have no or very limited reservoir storage capacity, as it is based on producing electricity out of the natural flow in the river on a daily (or a few days) basis. The project might include a high dam, with a substantial amount of water behind, but such reservoirs are not used for storing water over long periods but for creating head for increased power potential.

A seasonal storage project is designed for storing water in the wet season to allow for power production in the dry season. This will in all cases require a reservoir with a large storage volume. Depending on the landscape this might appear as a narrow and deep or a wide and shallow lake. The fluctuations in water level will be a dominant feature of such a reservoir.

Both categories can, depending on the operation, create daily or weekly fluctuation in downstream water flow. It is however, only the seasonal storage plants that have the capacity to change the seasonal pattern of downstream flow, and thus increase the minimum flow in the dry season and reduce the flow in the in the wet season. Such seasonal change in flow pattern might have both positive and negative impacts on river ecosystems function and water related use. There might be negative impacts on fish reproduction and migration but on the other hand damaging flood incidents can be reduced and more water will be available for water supply and irrigation in the dry season.

Operation mode

A number of potential negative impacts and downstream use opportunities are related to the operation of the plant. The most decisive factor is if the plant is operated for base load (constant) production or if it is operated for production of peak load electricity.

Extreme peaking operation will result in a fluctuating flow in the downstream river as the turbines and the discharge are running or shut down, this being a 6+18 hour, 12+12 hour, or other daily sequences. Unless water balancing measures are included in the project the "water pulse" might cause serious ecological and water use problems and sometimes dangerous situations at some distance downstream.

A run of river project operating for base load will not create any significant changes in water regime downstream the tailrace discharge.

6.1.3 *Impacts Caused by Construction*

Land take

In addition to the land occupied by the reservoir the construction of the plant will require land for rig sites, camps, workshops, quarries, spoil tips, etc. In total the impact on the land might be significant and even though some of the land might be deserted and reclaimed after the construction is finished there might be permanent damages and eyesores in the landscape.

Access

As hydropower development often takes place in remote mountainous areas with weak infrastructure, there is often a need to build new or upgrade existing roads. Improved road conditions can be positive for districts lagging behind in social and economic development. On the other hand, in the case of remote mountain forests, the improved access might open the area for unsustainable logging and land use and also be a threat to biodiversity values and ethnic minorities vulnerable to outside pressures.

Workforce influx / social impacts

Hydropower projects typically initiate a construction “boom”. This will to some extent give opportunities for paid work for local people but there will always be an influx of outside workforce and followers (families, traders, etc.). This influx might impose a serious threat to the local communities’ social and cultural fabric, which might be under additional stress from uncertainty related to resettlement and loss of land. Pioneer settlements like this are also associated with increased risk for spread of HIV/AIDS and other STDs.

The increased population in the project area will constitute a pressure on the available natural resources like fuel wood, drinking water, etc. but on the other hand create a market for local products and services which might trigger local development.

Pollution, noise and accidents

All larger construction activities have the potential of causing pollution and other hazards for their neighborhood. Pollution of soil and water, noise problems, blasting accidents and vehicular accidents and nuisance because of heavy truck traffic are commonly felt. An application of “best practice” procedures will minimize the problems.

A particular problem might be downstream silt load in the period of clearance of the dam site and other project areas. This might cause a dramatic setback for aquatic fauna and flora and create problems for downstream water users.

6.2 **Summary of Environmental and Social Impacts of Planned Projects**

6.2.1 *Introduction*

Annex 1 gives a short description of some of the environmental and social issues related to each of the projects included in the 20 year development plans for hydropower in Lao PDR.

The description is to a large extent based on the "Project Catalogue" published as an annex to the Hydropower Development Strategy Study (Worley and Lahmeyer, 2000). The Project Catalog has compiled data from a number of sources of varying detail and focus. In a few instances environmental impact studies have been prepared, in other cases only reconnaissance or map studies are available. Consequently the quality of the information and the issues covered are not on an equal level for all projects.

An additional problem is the constant change in project layout and operational mode prescribed for the project. New project alternatives are generated continuously, which might in some cases fundamentally change the potential environmental and social impacts. The environmental studies do not always keep up with these changes and there are risks that the impacts indicated below might no longer be valid or that new ones should have been added. In particular the figures for resettlement requirements have to be read with caution, as there may have been significant changes in the relevant population since the estimates were made.

One example of changing project and impact characteristics is the Nam Theun 2 Project where steadily progressing studies and planning over a number of years have seen an increase in the number of resettlers from less than 3,500 (630 households) in the earliest surveys in 1995 to more than 6,200 today.

Another example of uncertain project data is the project called Theun Hinboun Extension. The PSDP and this SIA has analyzed an alternative including a large reservoir. The Developer underlines, however, that no final decision has been made and also alternatives without new reservoirs are presently considered.

A summary and analysis of data for the projects included in the Hydropower Development Plans for Lao PDR as described in Chapter 4, is given below. Again it must be acknowledged that the information for these summary predictions is to some extent sketchy and incomplete. There may also be cases where the design of a project has recently been changed and the data given are no longer representative.

Some of the assumed impacts and impact indicators for the studied project are summarised in Table 11.

Table 11: Summary of Project Characteristics and Key Impacts.

Project	Installed capacity (MW)	Type of project	Active storage (Mill m ³)	Inundated land (Km ²)	Resettlement (People)	Distance to nearest road	Number of villages in 5 km radius form damsite	Ethnic Minorities affected	Interference with protected areas
Nam Mang 3	35	S	45	9.5	750			Mostly EMs	
Xeset 2	76	RoR	0	1.5	0	2.5	4	Near EM villages	Close to forest CA
Nam Lik	100	S	826	42.2	0			Near EM villages	
Xepon	75	S	361	29.5	1500	7.6	15	All EMs	Close to NBCA
T. Hinboun Ext.	105	S, IT	2870	126	1220	12.9	4	Majority EMs	In prop. NBCA
Nam Mo	100	S	264	10.8	0	6.0	0	N/A	
Nam Theun 2	1074	S, IT	3510	450	6224	9.5	0	Majority EMs	Close to NBCA
H. Lamphan Gnai	60	S	89	3.5	0	4.8	0	Near EM villages	In prop. NBCA
Xe Kaman 3	250	S	109	5.2	0		7.7	Near EM villages	
Nam Ngum 5	90	S	252	14.6	300-500	7.0	0	Majority EMs	
Thakho	36	RoR	0	0	0	0.5	6	Near EM villages	In important area
Xeset 3	20	RoR	0	1.3	0		1.9	Near EM villages	
Xe Kaman 1	468	S	3340	222	>800	0.1	0	Majority EMs	In NBCA
Nam Ngum 4A	55	S	332	14.5	1470			Majority EMs	
Nam Kong 3	25	S	299	36.9	1550			Majority EMs	
Nam Pot	38	S	71	6.1	0			Near EM villages	
Xe Kong 5	248	S	2210	70	980	18.9	2	All EMs	In NBCA
Nam Bak 2B	116	S, IT	119	4.8	0			Near EM villages	
Nam Ngum 4B	56	RoR	0	0.5	0			Near EM villages	
Xe Xou	59	S	1710	113	500			All EMs	In NBCA
Nam Ngum 3E	580	S	983	26.5	500	0.1	0	Some EMs	
Nam Ngum 2B	183	S	150	7.5	1000			Some EMs	
Total	3,849	-	17,540	1,195.9	>16,700	-	-	-	-

Legend: S = Seasonal Storage, RoR = Run-of-River, IT = Inter basin transfer

6.2.2 *Impacts on Biodiversity*

Baseline information is not available to give a clear assessment of the projects' impact on biodiversity. It is likely, however, that the negative impact on the primary forest and the unique wildlife found in the mountainous areas of Lao PDR will be significant as most of the projects are located in mountain forest areas. 3 of the short-listed projects are located inside NBCAs and 2 others are located in areas that have been proposed as NBCAs (ref. Map 1). Other projects are located close to areas of documented biodiversity value and might thus contribute to increased pressure on these vulnerable areas.

The combined impacts on the water flow regime by a number of hydropower projects located in the Sekong basin (see Chapter 5) might have an impact on the biodiversity and ecosystem function of the Attepeu Wetlands. Of particular concern are the cumulative impacts of seasonal storage of upstream projects, which will change flooding and dry season flow pattern on which the wetland productivity and unique biodiversity are dependent.

Upstream seasonal storage projects might also have an impact on the Siphandon Wetlands upstream Khone falls but the impact of Lao developments will be relatively small compared to the total flow in Mekong. A special case is the Thakho Run of River project at Khone falls, which seems to cause minimal negative impacts except for the potential negative effect on Irrawaddy dolphin habitat.

Using the NT2 project as an example it should be noted that hydropower development creates an opportunity for mobilising funding for better management of NBCAs.

6.2.3 *Downstream Loss of River Ecosystems*

A characteristic feature of most of the planned projects is the long distance of water diversion between the intake at the reservoir and the discharge point back into the river (length of tunnel and penstock). 9 projects have a diversion distance of more than 5 km and 14 more than 1 km. In most cases the distance of dry or minimum flow river reach will be longer than the diversion distance as the tunnels contrary to the rivers, tend to be straight.

Also downstream of the tailrace discharge point loss or reduced value of the aquatic ecosystems might be experienced. It is assumed that most of the hydropower plants will be operated in a peaking mode. Unless this fluctuation, in water release, is mitigated by a buffer-reservoir, significant negative impacts might be experienced.

Both permanently dry and periodically dry river reaches will lose much or all of their value as aquatic ecosystems. River based biodiversity and fisheries will be lost.

The final assessment of such downstream impacts can only be made when conditions for minimum release flow and the operational regime of the power plant have been decided.

6.2.4 *Irrigation, Water Supply, etc.*

The loss of water flow in certain reaches, as described above, will also cause negative impacts for water use for irrigation, water supply, transport, etc. The operation of seasonal storage plants, which constitutes the majority (17) of the projects, will, however, result in downstream increased water availability in the dry season. Additional water in the dry season might help the development of dry

season irrigation and improve the health situation through better water supply. Also the established reservoirs might provide improved and stable conditions for irrigation and water supply for local communities.

Downstream power plants with larger storage reservoir the oxygen content of discharged water might be reduced for a certain distance. This might have a negative impact on river ecology and fisheries and well as the waters suitability for human consumption. Cascades, aeration structure, etc. will mitigate the problem.

6.2.5 *Flood Protection*

By operation of the seasonal storage plants the peaks of downstream floods might be modified, reducing risks of loss of human life and economic damages. The efficiency of the reservoirs as flood protective devices can be significantly enhanced if focus and priority is given to this aspect in the operation of the power plants.

6.2.6 *River Blockage*

In general the planned dams are high. Only Xeset 2 and Thakho have dams or intakes of a height less than 15 m which is the definition of large dams in Bank OP/BP 4.37 "Safety of Dams". 14 projects have dams higher than 50 m and 8 higher than 90 m. The highest one is Nam Ngum 3E which is planned with a dam height of 217 m. This implies that dam safety is an issue for most projects. The dams will also effectively stop all upstream migration of fish. To some extent the passage of fish can be helped by technical measures like weirs, channels and fish ladders. However, such measures have shown limited success in the Mekong basin. Few of the migrating species found in this region are able to negotiate such structures.

6.2.7 *Land Take and Inundation*

According to the information available the total land area that will be inundated in connection with the construction of reservoirs and intake head ponds adds up to about 1200 km². The majority of the projects have reservoirs of small or moderate size, with Nam Theun 2 (450 km²), Xe Kaman 1 (222 km²), Theun Hinboun Extension (126 km²) and Xe Xou (113 km²) as clear exceptions.

6.2.8 *Resettlement*

It is recorded that 12 of 21 projects will include a component of resettlement. The total figure given is about 16,000 people but this is likely to be a minimum figure. In all the 12 projects the number of resettled people will exceed 200 and thus be above the number where the Lao PDR and World Bank requirement of a Resettlement Action Plan will be triggered. The existing data shows that Nam Theun 2 is the project with far the largest resettlement component as more than 6000 will be required to relocate.

6.2.9 *Interference with Ethnic Minorities*

Most of the projects are located in the higher reaches of the river basins where the majority of the local people will belong to ethnic minorities (ref Map 3) and thus, most of the people in need of resettlement will be of this category. Given their dependence on the natural resource base and their general low degree of integration into the mainstream economy, ethnic minority groups tend to be more vulnerable to the effects of hydropower development. For instance, if the projects entail resettlements and loss of traditional livelihoods, ethnic minority groups may face

serious problems in relocation and adapting to a new and different way of life including the adoption of different agricultural technology and loss of possibilities to hunt and gather forest products. Unless special measures (pro-active in nature) are taken it is likely that cultural diversity will be reduced as a result of hydropower project development.

The Xepon project seems to be particularly critical in this respect as the project is planned in the heartland of the 15,000 people belonging to the Pako group.

However, there are innovative measures being considered for a number of projects, including Nam Theun 2 where resettlement is within indigenous spirit territories, rights to land and resources are secured and sustainable livelihood development is taking place *in situ*.

To what extent the hydropower development will force these groups to change lifestyle and contribute to the loss of their cultural identity, is difficult to identify before detailed studies have been carried out. It is likely that the development will accelerate the ongoing process of integration of ethnic minorities into the main Lao culture.

6.2.10 *Tourist Attractions and Scenic Waterfalls*

The loss of waterfalls is mentioned as a feature of 2 of the planned projects, but is likely to be a feature of more projects. To what extent this is to be considered a loss of a potential tourist attraction is not known. Most of the projects are located far from areas presently frequented by tourists.

The experience from the Nam Ngum 1 reservoir shows that, in Lao PDR which is deficient in natural lakes, reservoirs might be of significant value as tourist and recreational sites. The most likely candidates for attracting tourists will be Nam Theun 2 and the Theun-Hinboun Extension (Nam Theun 3). In addition to the attraction of the reservoir itself other interesting natural areas may also be made accessible by the roads constructed in connection with the power project.

6.2.11 *Downstream Mekong Hydrology and Water Use.*

Except for Nam Mo all proposed projects are located on rivers draining to Mekong and thus have a potential of impacting on the Mekong reach shared with Thailand, downstream areas in Cambodia and the Mekong Delta in Vietnam.

The determining parameter for the downstream changes in river flow is the active storage of the planned projects. The combined active storage of the planned projects in the Lao PDR part of the Mekong Basin projects is about 17,300 mill. m³.

If all these projects are implemented the result at the Kratie monitoring station in Cambodia, will be a reduction in average annual maximum discharge of about 4% (reducing the average maximum flow from 35,250 m³/s to 33,860 m³/s). This will have small positive impact of reducing the risk for flood damages. However, high flood levels are positive for the reproduction of fish on floodplains and in The Great Lake (Tonle Sap). The reduced maximum flow will result in an average reduction in Lake level of about 17 cm, compared to an annual variation in maximum level of about 2,5 – 3 m, and thus potentially cause a minor reduction in fish production capacity.

The storage will also result in an increase of the dry season discharge. The dry season discharge at Kratie will be increased by 36% in February, March and April. This increase will have a slight positive impact by supporting irrigation and reduce salt intrusion in Mekong Delta.

6.2.12 *Downstream Impacts in Vietnam*

Nam Mo is one of the tributaries to Song Ca discharging into the Gulf of Tonkin at Vinh. No assessment seems to have been carried out to cover environmental impacts in Vietnam. It is not likely, however, that the Nam Mo project will cause any significant negative transboundary impacts.

7

ALTERNATIVES

7.1 Alternative Energy Resources

7.1.1 Primary Energy Sources

The Hydropower potential in Lao PDR is described in detail in Chapter 4. Below is given a brief overview of the availability and potential of other primary energy sources. The information is summarised from the Hydropower Development Strategy Study (Worley and Lahmeyer, 2000).

Oil and gas

Exploratory drilling, geophysical mapping and investigation have been carried out in central and southern Laos. The results are not available but if positive there might be a potential for power production in the long-term (10-15 year) perspective.

Lignite

A major resource is located at Hongsa in northwest Lao PDR. It contains 810 million tonnes of proven reserves of which 530 million tonnes are found to be economically recoverable. The sulphur content is relatively low (0.7 -1.1%). The reserves are sufficient to cater for power production of about 2,000 MW installed capacity.

A 300 MW base load thermal plant has been planned at the Hongsa site but the development has stalled because of difficulties in obtaining lenders support. The reason being relatively high generation costs as well as environmental concerns.

Coal

Several fields of coal, mostly anthracite, are found throughout Lao PDR and further exploration is going on. To date the proven reserves are about 100 million tonnes. The current annual production is about 130,000 tonnes, used by local enterprises or exported. It is estimated that there is a long-term option for electricity production of about 500 MW installed capacity.

The Viengphouka 50 MW project has been evaluated as part of the Power System Development Strategy (Meritec and Lahmeyer, 2004). The project was not among the priority projects but it is interesting since it has a reasonable good economy and would supply the northern provinces, which have few hydropower alternatives.

Uranium

There are no known reserves of uranium in Lao PDR.

Geothermal

No significant potential is known.

Biomass

There are significant resources and production potential of biomass in Lao PDR. At present this has not been utilised for electricity production but the use of fuel wood counts for about 88% of the total energy consumption in the country.

The infrastructure for large-scale biomass fuelled power plants is not yet available in the country. Organic waste can, however, be used for internal and local supply of heat and power in some industries (wood processing, food processing, etc.).

Solar

The annual solar radiation received in Lao PDR corresponds to the situation in southern Europe. Small-scale photovoltaic units are in common use, in particular in remote areas. At present the cost of power produced from large-scale thermal or photovoltaic power units is much higher than hydropower and fossil fuel alternatives.

Wind

The mean wind speed at Louang Prabang and Vientiane is around 1 m/s and it is assumed that some of the mountainous regions have a somewhat higher average. However, this would still be well below the levels where wind is a competitive alternative for power generation.

7.1.2 *Conclusion*

There are significant resources of lignite and coal available in Lao PDR, which to some extent can provide an alternative to the hydro-based power production. Utilisation of the resources has been discussed both for domestic supply and for export power generation but the generation cost and environmental concerns have so far halted development plans. In any case hydro provides a larger technical and economical potential than the present fossil alternatives.

There is also potential for solar and biomass power generation. This might be of local importance, in particular for locations outside the main grid systems. However, the generation and cost and scale of these sources make them an insignificant alternative to hydropower for delivery to the main grid and for power exports.

7.2 **Alternative Power Development Plans**

7.2.1 *Other Strategies and Alternative Rankings*

As described in Section 4.7 several hydropower development plans and project rankings have been prepared over the last decade in Lao PDR. The basic approach for the development of these rankings is relatively similar. The starting point has been a "long-list" (30-50) of potential projects, which based on technical and cost parameters, has been reduced to a short-list. The short-listed projects have then undergone a more detailed assessment and ranked, based on a number of technical, economic, and environmental criteria. The ranking of projects or "priorities" in a least-cost sequence of development show many similarities. For instance, Nam Theun 2 is ranked at the most "attractive" project in all the recent studies. Slight differences in ranking occur resulting from adjustments in economic assumptions, new design or operational concepts, inclusion of environmental parameters in the ranking process and to what extent the progress of financing arrangement and seriousness of the developer is taken into consideration.

The main difficulty and weakness of the present plans (as also mentioned in Section 4.10) is that the projects are ranked individually. Since many of the planned projects are located in river basins with many project alternatives, the interactions between the different projects are crucial for the project economy and the envi-

ronmental and social impacts. Thus an optimisation of the development and operation of a cascade of project might result in a different priority than when the projects are judged one by one.

As concluded in Section 7.1 there are limited alternatives to hydropower for power production in Lao PDR. The relevant authorities have therefore not seriously considered or presented fundamentally different strategies as alternatives to the hydropower based development strategies. A strategy dominated by coal based power generation would for instance have had different environmental and social impact structure than a hydro-based strategy.

The main uncertainty related to future power development and thus to the potential and extent of social and environmental impacts, is the development of a regional power export market.

7.2.2 *Ad hoc Development*

A possible alternative to the implementation of the least-cost development plans, as described above and analysed in this study, is that the development takes place more or less on an ad hoc basis. Such a “development alternative” would make it almost impossible to give an overview of the combined environmental and social impacts of future projects. The means and ways to secure a development based on least-cost plans are discussed in Chapter 8. Success in that respect is important both for optimising the benefits of power development and to maintain a positive political and public attitude towards hydropower as the preferred power development alternative in Lao PDR.

7.3 **Export Alternatives**

The hydropower developments plans of Lao PDR for the next 20 years are dominated by export to Thailand and Vietnam. The situation for such export is dependent on development on both the demand side and on the generation side in the recipient countries. It is also dependent on the development priorities and generation costs in the countries “competing” with Lao PDR for delivery of power for export, i.e. Cambodia, Myanmar and PR China (Yunnan)

The general situation for the countries in question is indicated below:

In Thailand the future power generation development will largely be based on external resources. The main candidates for production are hydropower import from Lao PDR, Yunnan and Myanmar, combined cycle gas plants based on domestic and imported gas, and thermal plants based on imported coal. The use of coal is controversial due to environmental concerns. With gas as the only thermal alternative, Thai generation would depend heavily on gas for between 75 and 90 % of its installed capacity in 2020.

In Vietnam many alternatives for future generation are available; hydro, coal, oil and gas and geothermal. Vietnam also considers development of nuclear power. The demand is, however, rapidly growing and agreements have been reached with Lao PDR for import. Similar arrangements are being discussed with Cambodia and Yunnan.

The future Cambodian power generation will be based on oil and gas thermal generation in the main cities and hydropower in the west and northeast. Import from Vietnam and Thailand might be considered in some regions. At the same time Cambodia are also considering the development of projects for export to Vietnam. In the southwest there are a few promising hydropower projects. They could po-

tentially form the basis for power exchange cooperation between Thailand and Cambodia.

Yunnan Province, PRC, is rich in energy resources. At present only about 5 % of the estimated 400 TWh hydro resources have been exploited and they have alternatives in considerable coal resources. Power export to Thailand and Vietnam is planned.

Myanmar is rich in coal, oil, gas and hydropower. It is expected that the main source for future generation will be hydropower. In addition, the intention is to build some gas-based generation plants. Myanmar is today exporting gas for power production in Thailand. Export to Thailand from the planned 3600 MW Ta-sang hydropower project, has been considered.

Further development of hydropower in the region will very much be dependent on the definition of external cost for thermal alternatives. Practice so far has been not to take explicitly into account the costs of greenhouse gas and pollutant emissions when comparing hydropower and thermal production in the riparian countries. On the other hand, there is often a "benefit bias" built into evaluations of hydropower projects, since unmitigated environmental and social costs of hydropower do not lend themselves easily to quantification and valuation tends to be given less weight in the overall assessment.

For the near future the power export agreements have been established through Memoranda of Understanding with neighbour countries. An agreement was signed between Lao PDR and Vietnam in 1995 for Lao PDR to supply 1,500 to 2,000 MW by 2010. A similar MoU is signed with Thailand for delivery of 3,000 MW by 2010.

However, from the status described above it is clear there exists a number of alternative future paths for power development and power exchange in the Greater Mekong Sub-region. The demand for and economy in, hydropower export from Lao PDR will be dependent on how the total regional picture in demand and generation cost (including environmental and social considerations and policies) develops in the region. The Thai Government has recently announced that a condition for signing power purchase agreements, with developers in other countries, is that international standard environmental and social assessment has been prepared and environmental management plans developed. Thus, for future export contracts it will be important for Lao PDR to document that their environmental and social safeguard systems are in place and operated efficiently.

Assuming the radical (and unrealistic) alternative that the new export market of hydropower from Lao PDR totally disappears, the Lao PDR 20 year Power Development Plan will have to be reduced from a total of 4366 MW to only 840 MW.

7.4 Demand Side Management

The power demand in Lao PDR is growing at a rapid rate, presently about 11 % per year. Behind such growth lies large, unsatisfied needs for more energy. In developed countries an important element in reducing the demand and thus the need for new generation projects, will be demand side management (DSM). However, the large majority of the population in Lao PDR is still without access to electricity. In such a situation, the primary concern of the Government and EdL will be to provide more energy. Although measures such as DSM are cost-effective means of easing the situation, the contribution they can make in a situation where less than 20% of the population has access to electricity will be limited. In addition, there are barriers to implementing DSM interventions with prospects for any

significant impact on consumption. With few institutional and financial resources, it must be recognised that the main focus of the country will be on capacity expansion. Over time, however, this should change.

8 RECOMMENDATIONS FOR MITIGATION, MANAGEMENT AND TRAINING

8.1 Introduction

This chapter revisits some of the problems and challenges in hydropower development described in earlier chapters and discusses potential measures to improve the situation and reduce the identified problems. The recommendations address several levels of problems with different parties responsible for follow up and implementation. These parties include government institutions involved with environmental management and protection as well as policy makers and political bodies that passes legislation and sets the frame conditions for the environmental and hydropower sector. The presentation is organised in 5 Sections:

- Mitigation and compensation related to the construction and operation of hydropower schemes;
- Supplementary management initiatives
- Systems for improved integrated management;
- Improvement of system for planning and assessment of hydropower projects;
- Institutional strengthening and training.

8.2 Mitigation and Compensation Related to Construction and Operation

A number of measures and actions can be taken to avoid, minimise or compensate for potential negative impacts of planned hydropower schemes. Below is described some of the measures that should be observed for hydropower projects in Lao PDR. The list is a generic description of measures. Some of the measures might be relevant for some projects and other projects might end up with a different set of mitigation measures. The EIA regulations require the preparation of a specific mitigation and environmental management plan for each project. In this Strategic Impact Assessment it is not possible or appropriate to prepare or indicate any “combined mitigation plan” for all the projects included in the 20-year development plan.

8.2.1 *Water Related Mitigation*

General Issues

Water related mitigation measures will focus on the protection of biodiversity and integrity of the ecosystem in the impacted parts of the water system, and mitigate the potential damage to fisheries and other water related use (irrigation, water supply, transport, etc.).

In this region there is a common problem with oxygen depletion in the reservoir water, causing problems downstream of the power plant. The problem can be reduced with clearance of the reservoir vegetation before inundation and by technical measures like discharge structures, aeration cascades, etc. Clearing the vegetation will also help reduce the generation of Greenhouse Gasses (GHG) from the reservoir.

The problems of downstream riverbank and reservoir erosion can be counteracted by appropriate discharge and operational regime of the power plant, and by riverbank protection work in critical reaches.

Control and treatment of domestic and industrial waste water discharge should be considered as compensatory measures in the cases where the development cause reduced flow and thus reduced recipient capacity in the water body.

The protection of some of the ecological features of the reaches with heavily reduced or no water flow (often found between the dam site and the tailrace discharge point) can be achieved through constructing a cascade of low weirs. This might also have a positive impact on surrounding wildlife and water supply and maintain the visual impression of a river reach in an otherwise dry riverbed.

Building fish passage structures can compensate the loss of fisheries. This has proven to be efficient to maintain salmon and trout migration in Europe and North America. In this region however, the construction of fish passage has shown to be of limited value. It seems that most species are not able to negotiate such structures. Fish propagation measures are relevant in the cases where new reservoirs have been constructed and opportunities for new fisheries have been established. It is advised, however, to avoid the introduction of exotic species for this purpose.

Environmental Flow

The most important measure for mitigation of the negative impacts to river ecology caused by changes in the natural river flow regime is the implementation of a minimum flow regime. The definition of environmental flow is the minimum flow required downstream of the project site necessary to maintain specified valued features of the river ecosystem or certain specific water uses such as requirement for irrigation water, migration or breeding of valuable fish species, water for dilution of polluting discharges, etc. Different names have been used: Environmental Flow, In-Stream Flow, Minimum Flow Requirements, Riparian Flow, etc.

The environmental flow requirements can be specified in a number of different ways. It can be a simple continuous water release figure, daily and seasonal varied flow regime or combination of stable flow and short-term flood releases to mimic high flow situations, etc. The internationally most used system and the system easiest to manage, is a stable flow release or one "dry season" release and one "wet season" release.

For countries, like Lao PDR, with weak systems of environmental control and enforcement and sketchy baseline data for ecological parameters, it is advisable to have a realistic and simple, methodological approach in setting Environmental Flow standards or requirements. The preparation of EIA for hydropower projects should include specific assessments of the minimum flow requirements in reaches impacted by the hydropower development. It is crucial that such studies are done at an early stage in Project preparation, so that the findings can be integrated into the design and operational agreements.

There is an urgent need for an initiative from the environmental and licensing authorities to develop general guidelines specifying the principles of setting environmental flow requirements and what studies will be required by the developer for assessment of the such requirements. The final decision on flow requirements should rest on the licensing authorities and the conditions should be specified in the concession documents.

8.2.2 *Land Based Mitigation*

In an erosion or landslide prone environment the project must include measures to reduce or halt such problems. This might include erosion control structures, protective re-vegetation and reforestation, etc. Larger changes in the landscape from quarries, tunnel spoil tips, etc. should be landscaped and replanted, both to reduce erosion problems and to reduce the visual impact of the construction.

The construction activities will always cause some degree of negative impacts and risks (dust, noise, air - and water pollution, traffic, etc.), which might affect local communities and natural qualities. These impacts can be minimised by applying the principle of "best professional practise". It will be necessary, however, to define these principles in detail in the concession and contract documents. Unless the specified requirements are included in legally binding documents, there will inevitably be problems in implementing the "best practise standards".

Thus the requirements have to be spelled out clearly in the concession document between the licensing authority and the developer and in the contract between the developer and the contractor.

8.3 **Compensatory Development and Management Programmes**

Many of the potential impacts of hydropower development cannot be mitigated or directly compensated in cash or kind. To protect the natural values that are under stress from the development and safeguard the livelihood of the local communities it is customary to establish development or management programmes paid by the developer. The content of such programmes will depend on the social and natural environment impacted by the project. Examples of such programmes include:

- Forestation plans
- Catchment protection programmes
- Fisheries development plans
- Nature protection and compensation plans
- Infrastructure development programmes
- Social development plans
- Ethnic minority development plans

In Lao PDR Nam Theun 2 is the hydropower development project that has developed the most detailed and comprehensive Development and Management Programmes. These include programmes and activities contained in the Environmental Management Plan, the Ethnic Minority Development Plan, the Resettlement Action Plan and the Social and Environmental Framework and Operational Plan (SEMFOP).

The planning processes in connection with NT2 have provided "best practice" examples that to a large degree are reflected in today's regulations and guidelines for environmental and social management mitigation plans, including resettlement and compensation. The implementation of the environmental and social programmes will provide important experience and learning for further refinement and development of complementary guidelines and regulations. A close monitoring and follow up by external monitors and responsible government agencies (STEA /SEMD) is therefore necessary. Given the resource situation STEA and SEMD currently faces, it is recommended that funds for monitoring and follow up of the implementation of environmental and social programmes is sought and secured.

The SEMFOP, which is concerned with the preservation and conservation of the Nakai-Nam Theun NBCA including the Nam Theun watershed, is of particular im-

portance as it will create a precedence for establishing a system of having hydropower developers contribute to the conservation and protection of NBCAs and other protected areas in the river basin. The example and momentum created by the SEMFOP should be utilised to put the linking of hydropower development and biodiversity and conservation more firmly on the agenda. It would appear important that this issue is considered when deciding the terms for awarding of concessions for hydropower project that affects protected areas and NBCAs.

8.4 Initiatives for Integrated Water Resources Management

8.4.1 *Catchment Management and Integrated Water Resources Planning*

The advantages of “Integrated Water Resources Management” (IWRM) and “River Basin Management” have been promoted as tools for better planning and control of activities in rivers by the community of water professionals and international organisations, including the World Bank. Many case studies and models have shown that integrated management of the quantitative and qualitative aspects of water in a particular river or river basin, can make water use more effective and reduce water management conflicts. This is particularly valid for hydropower options as such a system allows for a more balanced and upfront assessment of the benefits and costs of a certain development than can be provided for by a regular EIA process.

Without a river basin plan and an authority to enforce it, there is a risk that upstream projects/developers are likely to operate their power plant for maximisation of their own income from power sales without consideration of downstream projects or other water needs. If successfully organised these authorities could be given the task of analysing and preparing a set of reservoir operation rules by which developers must abide. Calculation of compensation from upstream developers to downstream users for lost income would be a part of such a duty.

In this effort the work started in Lao PDR through the establishment of the Water Resources Co-ordination Committee (WRCC) needs support. The key challenge will be to coordinate the development of a river basin water resource planning system, including detailed procedures and roles for WRCCs and river basin committees, and other key participants. The plans are expected to serve as guidelines for provinces, local authorities and other central agencies to conduct detailed project planning in a coordinated manner. The plans will also indicate agency responsibilities, including the responsibility for monitoring plan implementation.

The results from ongoing test projects have to be carefully evaluated and a realistic organisational and methodological approach implemented nationwide, including building a sustainable capacity for IWRM. The issues to be addressed include clarification of issues like: policy and legislation, integrated planning and coordination, data and information management, training, awareness building and consultation.

To undertake this significant task the WRCC requires a strong, dedicated and experienced secretariat. This can only be achieved by sustained support from donors and commitment from the top levels of government.

8.4.2 *Intact River Protection*

From an aquatic biodiversity and reference perspective the protection of certain rivers from major construction work and hydrological changes, would be desirable. Systems of “protected rivers” or “intact rivers” are established in many countries but have so far not been seen as a part of the nature protection system in Lao PDR.

The main regulatory system for nature protection in Lao PDR is the area protection as NBCAs. This system is primarily focussed on protection of the terrestrial values and is not designed for the protection of rivers along their full length in order to safeguard the river as an intact hydrological system. In fact some of the existing and planned hydropower comprise construction work and establishment of reservoirs inside existing or planned NBCAs.

An investigation of the natural qualities in remaining, untouched rivers in Lao PDR should be carried out and recommendations should be given as to which rivers qualify to be protected from major physical changes and construction work. Before any final decision on protection is made, an assessment of both the natural and present status values, as well as the values of potential developments, has to be made.

The legal basis for river protection may need to be established. In an interface before such systems are in place, however, it might be sufficient to enforce the protection as an administrative decision by the relevant central authorities.

8.5 Planning and Assessment of Hydropower Development

8.5.1 *Implementation of Least Cost Strategies*

Even with the strong support from the international financing institutions in applying a least-cost strategy for hydropower development in Lao PDR, the implementation of the plans and proposed development sequence has been unsatisfactory. This has resulted in ad hoc development, which has led to less than optimal development seen from a national socio-economic point of view.

Even with the known problems of implementing the least-cost planning principles, it is possible to maintain the methodology also in combination with private participation. This requires that a least-cost expansion plan is simulated by the responsible public entity, resulting in candidate schemes ranked in a time sequence. Private investors can then be invited to bid for specific projects based on a certain number of project specific criteria. Such a system is similar to what is used by the Nepal Electricity Authority (NEA).

Alternatively, bids may be solicited from private developers before the simulation studies are performed, to help determine the least-cost plan. An approach combining least-cost simulation plans and private participation is relevant for countries that prefer a phased approach to privatisation, or for those that see value in using the models for indicative planning.

8.5.2 *Award of MOUs for Developers*

As described under Section 4.9.2 it appears that MOUs are not standardised to include environmental and social obligations. There are different options for addressing this shortcoming. The most fundamental would be to abandon the system of awarding MOUs based on an unsolicited expression of interest and negotiations, and introduce a system of least cost development planning and competitive bidding as noted under 8.5.1. If the necessary EIA studies, as a part of this system, could be carried out prior to tendering this would contribute to a better integration of the technical planning and environmental and social concerns. Financing of the required EIA studies could for instance come from a fund established with assistance from international development agencies or donors. The successful bidder should then be required to redeem the costs of the EIA studies. This procedure would demonstrate for prospective developers and investors that a particular project would entail certain environmental and social obligations and costs.

The alternative would be to keep the present negotiation system but ensure the incorporation of environmental and social requirements through standardisation of the content of the MOU. A comprehensive document outlining the whole environmental legal framework pertaining to hydropower development and environmental requirements should be compiled in order to alert potential developers and investors to their obligations.

8.5.3 *Award of Licenses*

Since the inclusion of environmental and social obligations into concession terms seem not to be secured under the present system (4.9.2) it is recommended that this is done through standardisation of the content of licenses. The Electricity Law, that provides the legal basis for awarding of licences, only deals with environmental requirements in general terms. For instance, Article 14 requires the Developer to submit social and environmental studies and action plans while Article 15 briefly states that projects should not adversely impact the environment. Thus, it will be necessary to develop more detailed and specific environmental and social terms for award of licences. This can be achieved through additional regulations and guidelines that amend the Electricity Law and the Licensing Decree.

8.5.4 *Identified Needs for Clarification of Regulations*

Although there has not been much experience with the implementation of the new set of laws and regulations for carrying out environmental and social assessment in Lao PDR, it is possible to point to a few areas and shortcomings that need to be addressed.

Emergency Procedures

The Regulation on Implementing “Environmental Assessment for Electricity Projects in Lao PDR” (447/MIH) provides an opening for a dispensation from the requirements for EIA studies. Article 18 states that “if emergency circumstances make it necessary to plan and construct and operate a project without following the requirements of the regulation, the MIH/DOE and STEA shall consult with each other about alternative arrangements”. It is not specified what type of emergency circumstances would allow a deviation from the requirements. It would undoubtedly strengthen the regulation if some criteria for invoking the “Emergency Procedures” could be given. Presently the provisions in the Regulation can easily be overridden by political considerations and pressure from vested interest groups. It is recommended to consider developing criteria for identifying emergency situations that justify application of Emergency Procedures. STEA and DOE should carry out this revision in cooperation.

Enforcement of Regulations

Measures should be taken to secure a uniform application of laws, regulations and decrees pertaining to social and environmental safeguards for hydropower development. At present, it is difficult to gain a full overview of what needs to be done to achieve this goal. One issue relates to the mandate of STEA, given in the Environmental Protection Law. According to article 36 STEA is only given the right and the duty “to cooperate with authorised concerned sectors in giving orders to adjust, suspend, remove or close down any activities that cause adverse impacts to human health, human life, animals, plants and the environment”. It thus seems that STEA is not invested with regulatory powers or the right to enforce the provisions in the environmental legal framework.

It should be noted that a step in the right direction is already being made as the National Assembly has made a decision to elevate STEA to sub-ministerial level. However, to legally assign regulatory powers to the organisation an amendment

to the Environmental Protection Law would probably be needed. If STEA is given a regulatory function, which is highly recommended and now appears to be a possibility, there is a need for the agency to further develop both its environmental and social safeguard capacity and also make the necessary structural adjustments and adaptations. It would be important to focus considerable efforts on this objective in the future.

Resettlement Planning and Implementation

Although the present body of decrees, regulations and guidelines for environmental and social safeguarding, undoubtedly is comprehensive and largely compatible with international standards, previous experiences and a review of existing resettlement regulations indicate a need for developing more detailed guidelines. In particular there is a need to identify clearer criteria for assessment of loss of livelihoods and assets for the project affected population in order to determine compensation entitlements in a more standardised and just way.

The Decree on Resettlement and Compensation designates STEA as the regulatory agency for resettlement and compensation, also giving it the authority to issue requisite additional Implementation Regulations and Resettlement Technical Guidelines in support of the Decree. It is therefore recommended that STEA reviews the present resettlement regulations and issues additional guidelines. A special emphasis should be given to compensation and livelihood issues in order, as soon as possible, to amend the weaknesses pointed to above. This will have a crucial significance for how compensation and livelihood restoration is handled in the many other planned hydropower development projects in Lao PDR.

The Nam Theun 2 project will in this process be able to provide valuable experiences and “best practice” examples in that its resettlement plan is in accordance with international standards (ADB and WB Safeguard Policies). It has already provided a model in connection with the drafting of the National Resettlement Policy and contributed to improving the capacity of various government institutions, such as STEA, in dealing with the challenges of resettlement.

Development Opportunities

As noted under 2.7, hydropower development represents an opportunity to bring development to and create benefits for local communities. In order to achieve more development focus in hydropower planning, it is necessary at an early stage to incorporate government plans and goals into the project context. This requires integrated planning on the one hand, but also a clear division of responsibilities in terms of tasks and funding. Even if this appears to be difficult in the present context of Lao PDR where local and regional governments often lack the resources and experience, it is recommended that the government take a lead role in regional development linkages with hydropower planning in connection with future projects.

NBCA Status

According to the “Decree on Protected Areas” hydropower development may be allowed in NBCAs provided it takes place within a designated “Permit Zone”. If hydropower project is planned within a “Total Protection Zone” it will conflict with the provisions in the Decree and the Forestry Law, which prohibits exploitation of any kind. It is not presently known to what degree a zoning of NBCAs has been carried out. Presumably very few have been subdivided into zones. If so, it would be important to investigate the natural and biodiversity values and status of the parts of the NBCAs in which hydropower development is planned. This investigation could form part of the EIA studies or be carried out in advance as a separate study. The result of the study would then form the basis for deciding if the areas

should be classified as a “Total Protection Zone” or a “Controlled Use Zone” (“Permit Zone”). Classification as a Total Protection Zone would rule out hydropower development in that part of the NBCA.

Zoning of NBCAs should be carried out as soon as possible. Such zoning should be done with the participation of NBCA inhabitants and reflect local communities' use of the natural resources, particularly concerning what could be considered as customary rights. This would clarify the status of different parts of NBCAs and their eligibility for hydropower development. It would also give better protection status to those areas that are most intact and have the highest biodiversity values and where is found indigenous ethnic minorities living mostly isolated from mainstream society. Priority should be given to those NBCAs that are most likely to be impacted by hydropower development plans.

Definitions of Impact Zones

During consultations on this strategic impact assessment the issue of the extent of compensation and mitigation responsibilities on the part of the developer has been raised. This relates in particular to the delineation of Impact Zones, which the present EIA regulations largely leaves undefined. Impact Zones are only indirectly addressed by the guideline “ Environmental Assessment for Electricity Projects in Lao PDR” (447/MIH, 2001). Here it is stated: “*The EIA shall describe the overall environmental study areas for the project. This shall include all areas within which the impacts must be considered and include those areas that the project may have a short term and long term influence on*”. It would represent a strengthening of the EIA regulations if some criteria could be provided for determining Impact Zones more precisely, particularly for downstream impacts. This may prove a challenging task but it is nevertheless considered worthwhile.

8.5.5 *Consultation and Public Involvement*

Regulation Development

The “Regulation on Implementation Environmental Assessment for Electricity Projects in Lao PDR” (447/MIH.DOE) clearly indicates that more elaborate guidelines for conducting consultations and public involvement processes is deemed necessary. A general reference is made to other “approved criteria developed for the implementation of public involvement activities”. Development of such additional criteria is therefore recommended as a way of standardising the consultation and public involvement process.

Past experiences with consultations and public involvement in connection with hydropower development are mixed. The EIA processes described in Chapter 3 predates the present safeguard regulations but showed the importance of carrying out consultations in a timely and comprehensive manner. However, the consultation process in connection with the Nam-Theun 2 Hydropower Project may provide “best practice examples” that should inspire and provide important lessons for future consultation and public involvement processes. Consultations started at an early stage of project planning in 1996 and have continued to date on a local, regional and international level. The process has been very comprehensive and important experiences with methods and approaches and participatory planning have been gained.

This should be utilised in the development of specific guidelines for consultation and public involvement. Part of the basis for developing the guidelines should be a thorough review of the Nam-Theun 2 consultations and other regional and international experiences. The development process should result in guidelines that prescribe a set of requirements for information collection and dissemination method-

ologies as well as for scope, timing and number of consultations that need to be undertaken.

Given the situation and vulnerability of ethnic minorities discussed under 2.6 and 6.2.9 it will be of particular importance to include in the guidelines specific prescriptions for procedures for consultation and involvement of affected ethnic minorities. These prescriptions could for instance include use of certain anthropological approaches as well as provisions to ensure that enough time is spent with the affected communities at an early stage of project planning.

Civil Society

As noted under 2.5.3 civil society can play an important role in promoting transparency and accountability in connection with planning and implementation of hydropower projects. Although Lao PDR have had a cautious approach to allowing independent organisations outside the Government and Party to evolve, there are presently some noticeable positive development trends. A number of community service groups as well as a range of private training centres and professional and vocational associations have emerged over the last years, indicating a larger tolerance and space for private sector organisations. A change in policy towards civil society may be under way as the Government has publicly stated that the preparation of a legal framework for independent organisations is under consideration. The Governments international development partners should support and encourage this development.

8.6 Training and Capacity Building

8.6.1 Funding Mechanisms

In the present situation staff capacity and resource scarcity appears to be the most critical factors when it comes to securing appropriate implementation of environmental and social safeguards in the hydropower sector. Currently the availability of resources for new positions, salaries, training and field travel is a factor that critically constrains the performance of both STEA and the SEMD. Resource scarcity is an inherent constraint within the whole Government system. There are no easy solutions to this fundamental problem but it is important to acknowledge the importance of the social and environmental safeguarding. The hydropower sector holds the potential to substantially improve the economy of Lao PDR and it is crucial that this potential is developed in a sustainable manner and that benefits are distributed in a socially equitable manner. The social and environmental safeguarding is also one of the keys to obtain international financing for hydropower development. It can therefore only be recommended that the GoL and its development partners address the resource shortage within the national safeguard agencies as soon as possible.

One possible approach to improve the funding mechanism for capacity building would be to set up a fund that the Government could draw on in their efforts to put in place an environmental and social safeguard system for the hydropower sector. In the present situation the Government is dependent on funding from various separate projects and development assistance agencies where allocation and release of funds are subject to an array of different approval and reporting requirements. Setting up a sort of "basket fund" would contribute to speeding up the necessary capacity building process and enable the Government to better plan and carry out training without having to request funds and negotiate terms for each separate training event.

8.6.2 *Capacity Building*

STE A / SEMD

The SEMD and STEA staff has a mixed background with many having technical backgrounds of bachelor degree level. This suggests that there is a need for creating more understanding and knowledge about environmental and social issues. Furthermore, as SEMD and the EIA Division of STEA is responsible for ensuring the quality of the EA process, training on review of EIA documents and monitoring of implementation should be considered as a priority. Finally, for monitoring and reporting purposes a good database is a prerequisite and training on database establishment and operation should therefore be another issue for capacity building efforts at central level.

Province and District Level

The most urgent training needs for province and district level relates to implementation of mitigation activities and the monitoring of outcomes. The provincial offices of STEA, which has been established quite recently, will need time to build up the capacities of their staff.

On district level the leaders of the administration, the line ministry offices and the mass organisations have in general lower technical qualifications and less management experience and skills. It is therefore recommended that leaders on district level receive a more comprehensive training package than those at province level.

Language Skills

A generally identified need, valid for all organisations and agencies involved in environmental and social safeguarding is the need for English language training. This arises from the fact that hydropower development in Lao PDR mostly involves international actors like investors, financing institutions and consultants. There is thus a need for most of the staff to read and understand documents and reports written in English as well as being able to correspond and give comments and evaluations of reports in writing. It is recommended that language training is given over the longer term and that the training can be combined with the staff's normal function and work.

Working Approaches

A feature that still seems to be prevalent within government agencies is the tendency to think and operate in a traditional top-down manner in their dealings with grass root communities and people affected by hydropower development. In order to instil more participatory attitudes and practices it is therefore recommended that training on public consultation approaches and participatory planning and implementation is made an important part of the training for all staff on different levels of technical line agencies that are involved in planning and implementation of mitigation activities. The training should especially emphasize gender sensitivity and culturally appropriate approaches for working with ethnic minorities.

8.6.3 *Training Methods*

In general future training should be composed of workshops, on-the-job-training, in-service formal courses, and to a certain degree, awarding of scholarships for university degree and certificate studies.

Workshops are best suited for well-defined and limited topics such as presentation of environmental guidelines and regulations and should be limited in duration (2-3 days) and in the number of participants.

On-the-job training can be utilized in the cases where experienced staff, national and international, can act as coaches and trainers in connection with more process-oriented tasks like for instance appropriate environmental management methods and monitoring procedures.

In-service formal courses have the advantage that they do not remove valuable and much needed staff from the organisation for a long period of time. There are presently an expanding number of regional universities, institutes, schools and international NGOs that can offer courses in relevant technical subject matters on a part time basis that allows the student to stay at home and continue work. These possibilities can be expected to expand in the future, especially in the form of internet-based courses in different technical subjects, including environmental and social assessment. Future capacity building projects should also fully make use of the possibility to tailor courses in cooperation with national and regional learning institutions as well as utilising the possibilities of Internet based training.

Full time degree and certificate studies at national, regional or overseas universities and institutes are an option that will have to be considered for a selected number of well-qualified and motivated staff. This will require the staff member to be absent for one or two years and should only be offered to the staff with the highest potentials.

8.7 Summary of Recommendations

Some of the key recommendations mentioned in this chapter is summarised in Table 12 below.

Table 12: Recommendations

Issues	Recommendations
Construction and Operation	
Oxygen depletion in reservoir water	3) Clearing of vegetation in the reservoir prior to inundation. 4) Construction of aeration structures.
Downstream riverbank and reservoir erosion	3) Riverbank protection structures. 4) Appropriate discharge and operational regime.
Reduced water flow	Construction of weirs in the river.
Loss of fisheries	Fish breeding and propagation of local species for stocking of reservoirs avoiding introduction of exotic species.
Environmental flow	3) Inclusion of specific assessment of minimum flow requirements in the EIA. 4) Development of guidelines by responsible authorities for setting environmental flow requirements.
Erosion and land slides	Construction of erosion structures, re-vegetation and landscaping.
Dust, noise, air and water pollution	Incorporation of "best professional practice" in concession and contract documents.
Management Programmes	

NT2 experiences	<p>4) Close follow up of NT2 Programmes to make use of experiences and “best practice” examples for refining and developing existing regulations and guidelines.</p> <p>5) Ensure provision of funds for monitoring and follow up.</p> <p>6) Utilisation of the SEMFOP to make the case for funding of biodiversity and conservation initiatives by hydropower developers.</p>
Integrated Water Resource Management	
Integrated water resource planning	<p>3) Carefully evaluate experiences with ongoing Nam Ngum test project and development of a realistic and methodological approach to be implemented nationwide.</p> <p>4) Building of capacity for IWRM.</p>
Intact River Protection	<p>4) Carry out an investigation of natural qualities in remaining untouched rivers in Lao PDR resulting in recommendations as to which rivers qualify for protection from major physical changes.</p> <p>5) Assessment of present status values versus potential development values as a basis for reaching final decision on protection.</p> <p>6) Clarification and putting in place of legal requirements for intact river protection with administrative protection as a preliminary measure if necessary.</p>
Assessment of Hydropower Development	
Least-cost implementation system	<p>3) Implementation of a least cost strategy for hydropower development through simulation of a least cost development plan and introduction of competitive bidding.</p> <p>4) Alternatively introduce competitive bidding before simulation studies to generate a least-cost development plan.</p>
Award of MOUs	<p>4) Preferably abandon the MOU awarding system based on negotiations and introduce competitive bidding to secure more transparency and better integration of EIA findings and technical planning.</p> <p>5) Alternatively standardise the content MOUs to include environmental and social requirements.</p> <p>6) As a minimum develop a comprehensive document outlining environmental and social requirements in laws and regulations for up-front presentation to prospective Developers.</p>
Award of Licences	Standardisation of concession licenses to include social and environmental requirements in order to ensure that they are legally binding for the Developer.
Enforcement of regulations	<p>3) Ensure that STEA is fully invested with regulatory powers to enforce environmental and social obligations on the part of the Developer and other responsible parties.</p> <p>4) Develop and ensure the capacity of STEA to take on enforcement responsibilities.</p>
Resettlement planning and implementation	<p>3) Identify and develop clearer criteria for assessment of loss of livelihoods and assets for the project-affected population.</p> <p>4) Incorporate and utilise the experiences provided by the NT2 Resettlement Process and Plans in the work to develop supplementary and more detailed resettlement guidelines and standards.</p>
Development Opportuni-	The Government should take the lead in linking social and eco-

ties	nomical development plans to hydropower planning to create benefits for local communities.
NBCA status	<p>3) Investigate the present state and biodiversity values of the parts of NBCAs planned for hydropower development and decide if the areas are eligible for total protection.</p> <p>4) Carry out a zoning of all NBCAs to identify all areas that should be classified as “Total Protection Zones” where hydropower is ruled out.</p>
Definitions of Impact Zones	Develop clear guidelines for defining impact zones, especially for downstream impacts.
Environmental and social monitoring systems	Establish databases and support systems for data storage and dissemination, both for reporting on the general state of the environment and for special issues, such as hydropower project assessments.
Monitoring of environmental performance	Establish a clear system of indicators and criteria for good environmental and social practice against which implementation results can be measured.
Consultation and public involvement	<p>3) Develop more elaborate and comprehensive guidelines to secure a standardisation of consultation and public involvement processes.</p> <p>4) The guidelines should pay special attention to prescribing consultation procedures for ethnic minorities to ensure real participation</p>
Training and Capacity Building	
Funding mechanisms	<p>3) Ensure sufficient and adequate resources for STEA and SEMD to enable them to carry out their assigned tasks and duties through prioritization and GOL – donor agency cooperation.</p> <p>4) Consider the setting up of a fund for capacity building to facilitate and speed up necessary training and institution strengthening.</p>
Capacity building focus	<p>6) Improve over-all knowledge of environmental subjects and review of EIA documents and plans for STEA and SEMD staff.</p> <p>7) Training on management, monitoring and reporting skills for staff involved with monitoring and implementation of mitigation measures on central and province/district level.</p> <p>8) Improvement of English language skills for all staff involved with review of EA documents and implementation of social and environmental plans.</p> <p>9) Training of planners and implementers on gender sensitive and participatory working approaches.</p> <p>10) Training of planners and implementers on ethnic minority concerns and culturally sensitive approaches.</p>
Training Methods	<p>4) Arrange workshops for well-defined and limited topics.</p> <p>5) Conduct on-the-job-training with local and international experts for more process oriented tasks like development of EIAs and monitoring methods and procedures.</p> <p>6) Arrange in-service courses with utilization of Internet based courses and tailor-made courses in cooperation with national and regional learning institutions.</p>

9 ENVIRONMENTAL AND SOCIAL MONITORING

9.1 Introduction

Environmental and social monitoring in connection with hydropower development might support several functions. The adequate organisation and responsibility for the monitoring will be determined by the function it is supposed to support.

9.2 Monitoring to Establish Baseline

The quality of project specific EIAs in Lao PDR are to a large extent constrained by the limitation of baseline information and data time series. The information about present status and development trends are needed for good predictions of impacts. The problem is in particular true for natural phenomena where there are fluctuations from year to year. Fish biodiversity and fisheries are typical examples of issues where several years of study are needed for a reasonably precise assessment of the impacts. For water quality a few ad hoc samples might produce a totally wrong picture of the situation. Long term monitoring can normally not be catered for in the frame of a specific EIA and thus upfront monitoring would be necessary.

The EIA experiences from Lao PDR have shown that upfront studies and monitoring for the following themes would have been of particular value for better assessment of future hydropower projects:

- Fish biodiversity, fish ecology and the economic and social importance of fisheries are one of the weakest point in impact assessments of hydropower.
- Systematic monitoring of water quality is needed. The most important parameters would be sediment transport, oxygen status, nutrients and in some specific cases heavy metals.
- Regular updating of lands use map in a GIS format, in particular concerning forest cover and status.
- Regularly updated population data combined with socio-economic data.

It is recommended that initiatives are taken to assess the feasibility of setting up an environmental and social monitoring system and establishment of databases as well as support systems for data storage and dissemination. Such systems might be established for collecting data for general State of the Environment reporting but it can also be more thematically focussed to cover issues of special relevance for hydropower project assessment or restricted to river basins or regions where hydropower developments are most likely to take place.

The financing of such monitoring will be the responsibility of governmental bodies. Governmental bodies or institutions on central or provincial level can execute the monitoring. Monitoring can also be contracted to research institutions or private companies, which possess the required competence and capacity. It might also be possible to organise elements of such monitoring as a part of MRC environmental monitoring programmes.

9.3 Monitoring Construction Activities and Compensation Measures

A normal part of a hydropower concession is to organise a comprehensive monitoring programme for overseeing the environmental performance of the contractor for the construction work and the parties responsible for resettlement plans, and

other management plans. This monitoring can be seen as a regular assessment of to what extent the Developer fulfils his obligations according to the concession. A unit independent of the Developer should carry out the monitoring but the Developer will in most cases have to cover the costs.

The character of the potential impacts (as identified in the EIA report) will determine the exact outline of the monitoring programme. Normally included elements are:

- Monitoring of construction performance. I.e. checking that the prescribed safeguard measures are taken to avoid accidents on site and downstream.
- Controlling that good environmental practise and contractual conditions are followed for avoiding pollution of water and air, nuisances of heavy traffic and competition with local peoples for water, fuel wood and other natural resources, etc.
- Monitoring the implementation and efficiency of resettlement plans, livelihood improvement plans, and other development plans prescribed for the project.

As a basis of this monitoring a system of indicators and criteria for good environmental and social practice should be defined and the monitoring should be related to these indicators and fulfilment of these criteria. The indicators will differ from project to project.

9.4 Long Term Environmental and Social Monitoring

Both with and without the existence of an upfront monitoring system as described in section 9.2, it is important to carry out some elements of long-term monitoring in the area impacted by hydropower development. Such monitoring might have at last two functions:

- Monitoring for verification of the impact predictions of the EIA. This is important for improvement of the general knowledge and understanding of the impact mechanisms and the changes in social and ecological situation caused by the implementation of a hydropower project. The use of monitoring data and post implementation assessments would help establishing a better basis for future environmental and social impact assessments. To some extent the financing and organising of such monitoring can be placed on the Developer but it is likely that the main responsibility will have to be carried by relevant governmental bodies and institutions.
- Basis for revision of concessions. The concession system should allow for revision of concession details after a certain period of time. With such an opportunity some of the details can be revised based not only on predictions but on real life experiences. The reason for revision might be that the upfront assessments (EIAs) were inaccurate or that new issues have emerged. The result from the monitoring might for instance result in changes in environmental flow requirements and operational details of the power plant or a revisit of the assessment of compensation for downstream users of land and water.

Again the character of the potential impacts of the specific project will determine the exact outline of the monitoring programme. However, in Lao PDR it will be of particular value to collect information on:

- Long-term impacts on fish biodiversity and production.
- Impacts on downstream agriculture.

- Impacts on forest status and terrestrial biodiversity.
- Impacts on social development and livelihood.
- Impacts on ethnic minorities.

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