

**STRATEGIC ENVIRONMENTAL ASSESSMENT
OF THE HYDROPOWER MASTER PLAN IN THE
CONTEXT OF THE POWER DEVELOPMENT
PLAN VI**

FINAL REPORT



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Preface and Acknowledgments

This report and the associated Appendices and Policy Summary represent the principle documented outputs of a 15 month long process of analysis and consultation. The issue being discussed, the social and environmental consequences of hydropower development, is inherently complex and often controversial, in Viet Nam as elsewhere. The nature of this Study, which was looking at hydropower within the context of a long-term strategic national plan, compounds the level of complexity and uncertainty. The Study has managed to arrive at a consensus position, supported by strong evidence and analysis, that gives clarity to the approach and decisions needed to move toward a more sustainable approach to hydropower as part of the overall planning of the power generation sector. In a country where demand for power will continue to grow at over 10% a year for the foreseeable future, this is of vital strategic importance for the sector and for the country as a whole.

That the Study was able to arrive at such a position reflects the contributions of many people throughout the 15 months duration of the project. This final report and associated documentation was drafted by a core team of John Soussan and Mans Nilsson of SEI (co-team leaders), Bach Tan Sinh (NISTPASS), Goran Lifwenborg (SWECO), Pham Quang Tu (CODE), Trang Quang Lam (Ministry of Health), Nguyen Ngoc Hung (Institute of Energy) and Lothar Linde (ADB GMS EOC). Further contributions to the Study came from other members of the SEI consultancy team (Luu Canh Trung, MARD, Eva Lindskog, SEI, Nguyen Huy Phuong, IWRP, Jeremy Carew-Reid, ICEM, Hoang Minh Hieu and Ngo Sy Hoai), whilst Vu Hoang Khanh Linh gave excellent administrative support to the study throughout its duration.

A governmental Working Group, consisting of members of the Government of Viet Nam agencies most centrally involved with SEA and hydropower planning, supervised the study. It played a vital role by their active involvement in, and detailed insights on, all stages of analysis throughout the Study period. The Working Group members were Tran Viet Hoa and Nguyen Thi Lam Giang (Ministry of Industry and Trade), Pham Anh Dung (Ministry of Natural Resources and Environment), Le Thi Ngoc Quynh (Electricity Viet Nam) and Nguyen Thi Thu Huyen and Pham Thi Minh Hoa (Institute of Energy). Finally, the Study team are extremely grateful for the detailed contributions from and active support of Pavit Ramachandran and Jorgen Eriksson of the Asian Development Bank's Greater Mekong Subregion Core Environment Program, as well as to the views and wisdom of many people in Viet Nam and beyond who participated in workshops, contributed to consultations and commented on documents throughout the Study.

Key Messages

A number of key messages have emerged from the Strategic Environmental Assessment (SEA) of hydropower in Viet Nam. These are:

- SEA provides a powerful tool for the analysis of the social and environmental impacts of hydropower development and can be fully integrated into the overall strategic planning process for the power sector and in particular the preparation of Power Development Plan VII.
- The level of hydropower development envisaged in Power Development Plan VI can be justified when compared to the feasible alternative sources of power generation, which have higher economic, social and environmental costs.
- The present approaches to address social and environmental issues in hydropower development are not adequate and more effective mitigation and compensation measures must be introduced if hydropower development in Viet Nam is to be placed on a more sustainable pathway.
- Most of these necessary social and environmental mitigation measures can be costed and these costs can be internalized into the overall economic analysis of hydropower schemes without compromising their financial or economic viability.
- There are opportunities in areas such as water management, agricultural development, service provision and poverty reduction for positive impacts from hydropower development, but these positive benefits are not yet fully recognized or realized.
- Many mitigation measures need to be introduced pro-actively, before development starts, to reduce the risks of negative impacts. The measures will not be effective if they are introduced too late.
- A number of mitigation measures can be linked to existing government programmes in other sectors, such as Programme 135, the Community Forestry Programme, Protected Areas Development and River Basin Planning. Making such links will reduce the costs and increase the effectiveness of mitigation measures.
- Capacity development is necessary in many parts of the system for planning and implementing hydropower development if the potential of SEA as a strategic planning tool is to be realized.
- Knowledge and data gaps exist and need to be reduced if more effective integration of social and environmental issues into power sector planning is to take place.
- Benefit sharing mechanisms have been piloted and proven to be effective. These mechanisms provide the means through which hydropower can be more effectively linked to the wider development processes in the vicinity where schemes are constructed.

Executive Summary

The Ministry of Industry and Trade (MoIT), supported by the Stockholm Environment Institute (SEI), has undertaken a pilot Strategic Environmental Assessment (SEA) of hydropower in Viet Nam in the context of the Power Development Plan (PDP) VI. The pilot SEA is supported by the ADB's Greater Mekong Subregion Core Environmental Program. The main purpose of the pilot SEA exercise is to build capacities for the integration of SEA into the strategic planning of hydropower in Viet Nam, including the preparation of PDP VII.

SEA is a structured approach to integrate social and environmental considerations into strategic decision making such as the formulation of policies, plans and programmes. The pilot SEA is focused at a national level and on assessing the potential contribution of hydropower to national development through a **strategic planning** approach that balances economic development, social equity and environmental sustainability. This in turn reflects the goals of the 2006 – 2010 SEDP and the Viet Nam 2020 Vision. The **goal** of the SEA is to optimize the contribution of sustainable hydropower to national development over the period up to 2025 in Viet Nam. The execution of the SEA followed six phases: (i) scoping, (ii) baseline, (iii) scenarios and alternatives, (iv) risk and impact assessment, (v) weighting and trade-offs analysis and (vi) reporting, including recommendations.

The execution of the SEA in this study demonstrates the potential of SEA as a key part of the strategic planning framework for the hydropower sector. The SEA has provided a mechanism to assess and understand the full range of potential **risks** associated with hydropower for people and the environment, both within the immediate vicinity of hydropower construction and beyond. It also provides a mechanism for identifying and assessing the most effective **mitigation and compensation actions**, including actions to reduce risks and to fully compensate for negative impacts where they do occur. The SEA provides a framework for the **internalization** of the costs of social and environmental impacts and mitigation measures into the assessment of the economic feasibility of hydropower schemes.

In addition, where conducted in a participatory manner, the SEA provides a framework for establishing a **consensus** amongst stakeholders on the most appropriate forms of social and environmental mitigation measures and the level of hydropower development that is most efficient and sustainable as part of the overall power sector planning system. The approach to SEA set out here is an important part of the consensus-building approach. It provides a means for ensuring objectivity and balance in the decision-making system.

Where an economic analysis is undertaken, the SEA also provides a basis for the internalization of costs and benefits that have traditionally been treated as externalities. This in turn provides a means for comparing the full range of risks and impacts that are very different in character. For example, through the economic analysis one can compare potential impacts on the culture and livelihoods of local communities with risks to biodiversity resources and with impacts on global atmospheric processes including greenhouse gas emissions. This in turn provides a basis for **objective decision-making** on the most desirable and sustainable levels of hydropower development.

When approached in this way, the full potential of SEA as part of **strategic planning** can be realised. This differentiates SEA from more traditional EIA and safeguard approaches to social and environmental issues, approaches that have often proved to be ineffective in catalyzing more sustainable patterns of development. The introduction to SEA above emphasised that an SEA should be decision-oriented, balanced and evidence-based. The SEA presented in this report demonstrated that these three principles can be followed in relation to the hydropower sector.

The **evidence and analysis** presented in the SEA has not required the collection of significant amounts of new data: in almost all cases the analysis is based on readily available data from documentary sources in Viet Nam. This is essential if the SEA is to be replicable within the context of existing institutional capacities. There are a number of areas where the availability of better data would have improved the certainty of the conclusions that have been drawn in the analysis. Future SEAs should seek to enhance the quality of analysis through improving the evidence collection process, but this can be done in a gradual and incremental manner. The analysis in this report shows that effective conclusions can be arrived at within the confines of existing data availability. This significantly enhances the potential for the full institutionalization of SEA within strategic planning systems.

The use of **scenarios** within the SEA has proved to be effective, providing an analytical tool that could compare the implications of different mix of power generation sources for social and environmental sustainability. This is essential: the hydropower sector should not be considered in isolation, as any decision on hydropower development needs to consider alternatives to hydropower. The scenarios approach allows stakeholders to assess the full implications of decisions on the level of hydropower that should be developed.

The effectiveness of the SEA as a mechanism for strategic planning in the hydropower sector in Viet Nam, which is inherently complex and controversial, is demonstrated in this report. This suggests that the SEA approach is **transferable**, both to other sectors in Viet Nam and for analysis and planning for hydropower in other countries in the Mekong region and beyond. As such, as a **pilot**, this SEA has been extremely successful: it shows that the approach works in a challenging context and can be applied elsewhere.

The scoping phase of the SEA identified a number of key strategic issues that have guided the analysis presented in this report. The lessons learnt from the SEA in relation to each of the strategic issues are

The contribution of hydropower to **economic development** was the first strategic issue. The SEA demonstrates that the level of hydropower planned in PDP VI is essentially a desirable one in terms of the least cost means to ensure that Viet Nam's future power needs are met. This is true even where the full range of social and environmental costs are internalized into the economic analysis of hydropower, as the full costs of alternative generation sources are even higher. As such, the significance of hydropower in contributing to overall national development has been demonstrated.

The SEA also suggests that hydropower can contribute to development in another way *if* appropriate measures are taken: it can be a catalyst to the development of the economies of remote locations inhabited by poor and marginalized people. This is far from guaranteed and the planning of hydropower needs to include measures to take advantage of local development opportunities. Where this is the case, hydropower can provide significant benefits to local communities through improved access to external markets, new livelihood opportunities and better access to a range of services.

The **displacement of local communities** is a key and controversial issue for hydropower development. It is an inevitable consequence of hydropower in many localities. Past experiences in mitigating the impact of displacement in Viet Nam have not been adequate when compared to international good practice on resettlement. The SEA has demonstrated that this need not to be the case: it is possible to provide a mitigation and development package that will provide a means to ensure that displaced people have long-term development support and ultimately are better off after they are resettled. This package entails additional costs, but these costs are not at a level that has any impact on the economic viability of any of the planned schemes. The package also requires political will and more

effective coordination with other development efforts, but this is achievable if and when the sector recognises its obligations to demonstrate social responsibility and the need to establish better relations with local government institutions and the communities in the areas where dams are built.

Water Resources are inevitably affected by hydropower development and many stakeholders expressed concerns that these effects are not taken into account in the planning and management of reservoirs. The present management regimes are in general single purpose: to maximise power generation. The analysis presented in the SEA demonstrates that, at a minimum, it is necessary to take into account the need to ensure minimum environmental flows if serious downstream impacts on ecosystems integrity are to be avoided. The analysis also demonstrated the potential benefits in terms of flood protection and improvements to dry season water availability that could be accrued if more effective multipurpose management regimes are adopted.

The impacts of hydropower on **ecosystems integrity** was identified by stakeholders as a key strategic issue. The SEA demonstrated that some levels of impact are inevitable across three areas: for forest resources, for aquatic resources and for biodiversity. The risks of such impacts can, however, be significantly reduced through the adoption of effective anticipatory mitigation measures, with the cost of these measures internalized into the costs of hydropower development. Such measures require much closer links to other agencies responsible for forestry, fisheries, protected areas, etc.

The final strategic issue is the **hydropower planning system**, which was identified as needing change if social and environmental issues are to be more effectively taken into account in hydropower planning. This includes the need for more effective consultation and participation of other stakeholders including local communities. A model for achieving this through the integration of SEA into the power development planning system is outlined in the report. Taking this step, to fully integrate SEA into the sector strategic planning system, would necessitate some level of capacity development in national institutions, but this investment would significantly improve the effectiveness of the PDP process and would provide the means for better informed and more transparent decision making on investments in the power generation sector.

The assessment of **risk and impacts** took place at three scales: for the reservoir area, for a “Zone of Influence” (ZoI) surrounding each dam site and for the wider area beyond this zone. The analysis chapter shows that there are a wide range of potential social and environmental impacts, both positive and negative, from hydropower development. The degree of certainty that these impacts will transpire ranges from extremely high for the reservoir area to low for many potential impacts in the zones of influence and beyond. This means that most potential impacts are best understood as a risk factor, and the risks that can be reduced or removed by effective anticipatory mitigation measures.

The clearest **positive impacts** are for agricultural production (both within the ZoI and further afield) and water resources management. Increased agricultural income could catalyze wider development benefits in remote locations. Similarly, improvements to dry season water availability and reduced flood risks will both generate wider development benefits.

The **impacts on displaced people** will be substantial, with a risk of creating deep and sustained impoverishment. The package of mitigation measures outlined in chapter 6 are an essential part of the planning and cost of hydropower if these risks are to be avoided and the sector is to develop in a socially responsible and sustainable manner.

Wider social impacts are less certain and more differential in their effects. These impacts relate to increased access to natural resources and the effects of opening up remote areas to external influences. There will be a concentration of these impacts in the locality that is the “host” to resettlement and around the construction site for the dam.

The risk of impacts on **natural resources** is significant. In particular, potential losses of forest resources could be high. Aquatic resources will also be affected where river lengths are impacted by dam construction and changes to flow regimes.

The risk of **biodiversity impacts** could be severe in some cases. In particular, the risk of ecosystems fragmentation is significant where a high proportion of sensitive biodiversity areas are located close to the dam site. In many cases, Viet Nam’s biodiversity assets are of global significance and their loss would have consequences far beyond the immediate site.

There are several individual schemes where a number of these different forms of risk of social and environmental impacts are high: these schemes merit particular attention and mitigation actions during planning and implementation. The schemes that have high risks across a number of categories and are potentially the most problematic are Bac Me, Ban Chat, Trung Son and Lai Chau. All of these schemes are located in the north of Viet Nam, in areas where poverty is particularly entrenched and where there is a very high proportion of ethnic minorities in the affected populations. The presence of several schemes on one river basin also presents the possibility of cumulative impacts that will compound the effects of individual schemes. This is particularly an issue in the Vu Gai-Thu Bon basin, where five schemes included in the scenario analysis are found.

The risk and impacts of hydropower development need to be balanced against the risks and impacts of alternative developments, including social and environmental impacts of the increase in thermal power generation based on natural gas or coal. The alternatives have their own risks and impacts. Any SEA of hydropower will not be complete unless an assessment of the alternatives to hydropower is included as an integral part of the analysis.

Overall, the analysis shows that the risks of social and environmental impacts from hydropower development are significant, can in most cases be measured and can, to a great degree be mitigated if effective actions are taken. There are some schemes that are particularly problematic and will require concerted efforts to mitigate negative impacts, whilst some types of impact (such as those on aquatic environments) are harder to mitigate than others. Mitigation is nevertheless possible in most cases. Such actions entail costs, but these costs are (a) not at a level where they compromise the financial viability of any of the hydropower schemes and are (b) good investments in terms of their overall economic returns to Viet Nam’s sustainable development.

The approach to **mitigating the impacts** of hydropower development outlined here seeks to maximize potentials, reduce risks and compensate for negative impacts as an integral part of the planning of these investments. The planning and construction of major infrastructure investments such as dams and associated facilities changes irrevocably, for better or worse, the localities in which they are built. This change should be seen as an opportunity to catalyze the development and transformation of what are often remote localities with high incidences of poverty, poor access to services and limited opportunity to participate in the growth and change that characterizes contemporary Viet Nam. In other words, developing hydropower is not just about generating electricity: it is about generating change, and this change can be steered in the direction of reducing poverty, sustaining the resource base and catalyzing development in addition to the primary purpose of meeting the country’s electricity needs.

The first group of mitigation measures relate to the **technical and planning** aspects of hydropower. Technical measures to avoid, reduce or offset adverse environmental and social impacts of hydropower projects can be taken during the following three phases:

- The **Planning Phase**, including site selection, infrastructure design to minimise impacts on, for example, fish migration or water flows, and the routing of construction roads and power transmission lines.
- The **Construction Phase**, based on social and environmental control and protection plans that specify the obligations of the constructor to minimize, mitigate and compensate for any negative impacts (including those from the construction process itself and the worker's camp).
- The **Operation Phase**, especially the reservoir operational scheme, taking into account water flows and quality, soil erosion and potential pollution incidents.

Increased **stakeholder participation** at all levels should be an integral part of the development and operation of hydropower schemes in each of these three phases. This should be linked to the wider decentralization and democratization processes in Viet Nam, and should take account of the potential of **benefit sharing mechanisms** that can provide the resources to ensure that the local development potentials of hydropower are realized.

Measures to mitigate the impacts of hydropower development on **displaced people** have been identified based on a model of international good practice. The measures include long-term development support designed to provide a long-term opportunity for the displaced communities to move out of poverty and benefit wider development opportunities. The increased costs that result from the introduction of a more comprehensive range of long-term development support are less than a quarter of the original costs; reflecting the fact that many more expensive items such as infrastructure provision are already provided. The mitigation measures should also be extended to the **host population** where people are moved to.

There is a significant risk of unsustainable pressure on the **forest resources** of a number of zones of influence following hydropower development. An effective strategy to reduce the risk of such unsustainable pressures is through community forest management (CFM), whereby specific areas of forest land are handed over to community control for management and exploitation. The costs of such a programme would be a small fraction of the value of the forest resources at risk from over-exploitation.

Mitigating negative impacts on **aquatic resources** is essential during the detailed planning of individual hydropower schemes, with the introduction of measures such as aquaculture development, the introduction of hatcheries to reintroduce productive fish species and the development of alternative livelihood options. The costs of such measures (which will not be particularly expensive) should be internalised in the costs of the different schemes.

The potential impact of hydropower development on **biodiversity resources** is significant in a number of cases. Actions to mitigate these risks must be taken as part of the hydropower planning and development process. A package based on the use and strengthening of existing protected area regulations is advanced, with the need for the proactive preparation of biodiversity action plans in high risk sites identified.

The potential benefits of **multipurpose management** of water resources are identified, with the planned hydropower schemes likely to provide an important capacity for more effective river basin management, particularly in relation to flood control, mitigating dry season water shortages and ensuring minimum flows to protect the integrity of aquatic and wetland ecosystems. Action areas are improved dam and reservoir design, more effective

multipurpose reservoir management and integrated water resources management within river basins affected by hydropower development

The SEA Study has shown that hydropower development inevitably affects the people and environment of the areas in which schemes are constructed and that specific concerns about the environmental and social impacts are quite different for different energy sources. Effective **planning for the future power system**, including sustainable hydropower development needs to integrate a full understanding of these factors in the sector's decision-making process, as well as the positive and negative aspects on water resources from the construction and management of reservoirs for hydropower projects.

The analysis of the potential social and environmental impacts of hydropower in the PDP VI has demonstrated that the inclusion of more wide-ranging mitigation measures for both social and environmental impacts will not compromise the economic feasibility of the different hydropower schemes in the plan: in essence, developing hydropower in a sustainable manner and up to the highest international standards is both achievable and affordable for contemporary Viet Nam.

There are a number of changes to the **PDP planning process** that need to be made to ensure that social and environmental impacts are fully integrated into the planning for the sector and a detailed model of how to achieve this is advanced in the final chapter of the Study. There are also wider changes needed to the policy and regulatory system for hydropower planning to ensure that these issues are fully integrated into the planning and implementation of hydropower in Viet Nam.

The **recommendations** fall into three categories: (i) recommendations that are concerned with the institutionalisation of SEA as part of the strategic planning process for the power sector; (ii) recommendations that define actions that are necessary if Viet Nam is to more adequately accord with international best practice for sustainable hydropower development; and (iii) other recommendations concerning the larger power sector development context. Actions in all three areas are needed. The present practice of planning in the sector has many strengths, but does not adequately take account of social and environmental factors, for instance in decisions on the cost and design of hydropower schemes.

The result is a combination of missed opportunities (for example, for enhanced poverty reduction impacts and more effective water management) and substandard practices with regard to protecting the environment and ensuring that the needs and interests of local communities are adequately protected. The SEA has identified a range of costs that at present are not included in the calculation of the costs and benefits of hydropower schemes. The same is true for the rest of the PDP: for example, in relation to the costs and impacts of air pollution and greenhouse gas emissions from thermal power plants. These costs need to be internalized in the assessment of the economic feasibility of and allocation of budgets for all aspects of power development.

The current SEA has been a pilot to test the effectiveness of SEA where applied to a national-level strategic plan. It has shown that SEA can be an effective and cost-efficient means to enhance the planning such as the PDP by taking account of social and environmental issues in a policy-oriented way. It is recommended that the existing PDP guidelines be reviewed and modified to ensure that they provide for this type of strategic SEA process.

1. Introduction

1.1. Background and Context

This pilot SEA report is the main report from the study “Strategic Environmental Assessment of the Hydropower Master Plan in the context of the PDPVI”, which has performed a pilot SEA of the Vietnamese hydropower plan in the context of PDPVI, with a view to the broader power sector development. The project has carried out analysis, built capacity and awareness, and had broad-based deliberations to ensure that significant sustainability issues arising from the Vietnamese hydropower plan and reasonable alternatives in future planning processes (e.g. PDPVII) will be identified, assessed, subjected to deliberation, and taken into account by decision-makers.

This pilot SEA exercise is taking place in a period of rapid change and reform in Viet Nam. The economy is booming and greater levels of prosperity are spreading through most sections of the population. Viet Nam has emerged from a long period of international isolation and is now fully participating in the international economy and international environment and development platforms, as symbolized by the country’s accession to the World Trade Organization in the autumn of 2006. At the same time, poverty still remains an intractable problem in some pockets of the country, the historical legacy of poor services and low investment has to be overcome and new problems that are a consequence of growth and development are emerging. Not least of these are widening social and economic inequalities and a range of environmental problems that jeopardize the integrity of Viet Nam’s rich ecological heritage, including air pollution, greenhouse gas emissions and degradation of water resources, forests and ecosystems.

The government is actively promoting reform and modernization throughout the administrative system, and is seeking to adopt and adapt international best practices in governance systems and in the management of the economy, society and environment of the country. This reform process takes time and is being undertaken in an evolutionary manner. Vietnamese institutions want new ways of working, but they also want practical and pragmatic approaches that reflect Vietnamese conditions and the structure and capacities of the host organizations.

The approach to the development of the SEA of the hydropower sector described in this report reflects these factors: the necessity to ensure that growth and development are not hampered by power shortages, the speed of change, the emerging social and environmental challenges, the reform process, the search for new knowledge and approaches and the need for recommendations that are practical and suitable for Vietnamese conditions. As will be further discussed below, this boils down to three key principle departure points:

- a) That the SEA is *decision-oriented*, i.e. its primary purpose is to provide strategic decision support to the agencies and officials in charge of planning and decision making for the sector.
- b) That the SEA is *balanced*, i.e. treats environmental, social and economic aspects that are part of the Vietnamese development policy framework as equally valid and important.
- c) That the SEA is *evidence-based*, i.e. devotes significant resources to assembling empirical information to underpin the assessment and judgments made.

1.2. Introduction to SEA and the Main Components of the Study

1.2.1. Introduction

Strategic Environmental Assessment (SEA) is a form of policy analysis that has gained in popularity in the last decade. Grown out of years of experience in EIA and an increasing recognition for the need to apply assessment also at more strategic levels of decision-making, the practice of SEA has spread around the world with remarkable speed, and development of SEA methods and practice is on-going around the world. In the field of development cooperation in particular, the move from project-based support towards a programmatic-strategic approach, has induced a shift towards strategic assessments rather than project-level EIAs or similar sorts of assessments.

However, as of yet the practice of SEA is far from institutionalized: neither in Europe nor in most parts of the developing world. Across the European Union, a directive “on the assessment of certain plans of programmes” has been in place since 2004, but implementation has been piecemeal and slow at the national level. The European directive does not include the policy level. A protocol developed by UN ECE follows the same basic approach. Some countries, including Viet Nam, have adopted a more far-reaching SEA legislation, which also addresses the policy level. In European Union the policy-making level is addressed in a different system, called the “extended impact assessment” procedure, which involves social and economic factors in an integrated approach for the European Commission’s policy proposals. However, also here evaluations on the actual practice and implementation of these procedures have consistently been relatively negative.

One reason for the relatively weak implementation is that methods and tools for SEA have been conspicuously missing in SEA research and applications to date. There are also problems of political will and resistance from sectoral interests in taking on board SEA. Nevertheless, great hopes have been attached to SEA as a procedure that can support governmental policymakers and planners in different sectors to make better-informed decisions about the sector’s development, and to ensure that the national government’s sustainable development policies are addressed in strategic sectoral decision making.

SEA can be defined as:

“A process directed at providing the authority responsible for policy development and the decision-maker with a holistic understanding of the environment, social and economic implications of the policy proposal, expanding the focus well beyond what were the original driving forces for new policy” (Brown and Therivel, 2000)

Essentially, it is a systematic process for integrating sustainability considerations into policies, plans and programmes, often with a focus on analyzing the systemic effects of proposed policies, plans and programmes.

The present study represents a **Pilot SEA** of the National Hydropower Plan (NHP) in the context of Power Development Plan VI (PDP VI) that has been approved by the Government of Viet Nam. The SEA has focused on national strategic issues and the long-term development of the sector. The approach here is to follow international best practice for a full SEA procedure, going through iterative steps of scoping, baseline, alternatives, impact analysis, weighting and trade-offs, and reporting, all in close collaboration with national counterparts. The framework for this study builds on a sequential approach containing six analytical stages. It is consistent with the Vietnamese national legislative framework, OECD DAC guidelines as well as methodological frameworks developed by SEI that accord with

international state of the art in the field. The study has learned lessons from past SEAs within the hydropower sector, including the ADB study in the Vu Gia-Thu Bon River Basin¹ and the World Bank SEA focused on the risks to biodiversity from the PDP VI. It should be noted, however, that the focus in this SEA is somewhat different to these two SEAs, being focused at the national level and on all aspects of the impacts (positive and negative) of hydropower development.

Recent research has often contrasted two approaches to SEA: the impact-oriented approach, which is grounded in the traditional EIA procedure; and the decision-oriented approach, which represents an approach more grounded in policy analysis and strategic planning. The framework adopted for this SEA embraces a decision-oriented approach to SEA, viewing the SEA process as integral to the overall strategic planning of the sector. The assessment should, in this approach, connect and integrate with the decision-making process so as to maximize its impact. It is distinct from the impact-oriented approach, which sees SEA, as something that is “done” to a plan once it is completed: it approaches SEA as separate to, rather than an integral part of, the planning process. The adoption of a decision-oriented approach to the SEA means that it is of particular importance that the SEA includes an analysis of national administrative practice and decision-making processes and rules with the aim of identifying how they can be adapted so that SEA is an integral part of the strategic planning process (see Chapter 6). This approach has gained increasing support among researchers in SEA, and the process discussed is based on insights into past experience and best practice that have identified that effective SEAs should:

- Put governmental sector planners and line ministries in the driving seat as a means for policy integration (Nilsson, 2005)
- Institutionalize SEA upstream –beyond impact analysis of already proposed decisions, into a more strategic support covering discussions around e.g. the setting of goals and alternatives (Dalkmann et al., 2004).
- Broaden the scope from environment to assessments of strategically important sustainability aspects (Partidario, 1999).
- Institutionalize SEA not as a regulatory burden but more as a learning and decision support process: one feature of this approach is that it should make the total planning process simpler, more efficient and more effective (Bina, 2003).

The basis of the SEA framework in this study is the Vietnamese regulatory framework coupled with previous work of the consultants towards developing a generic analytical framework for SEA in the energy sector (Finnveden et al., 2003). However, methodologies used in other contexts cannot be transferred across the board. First, although some of the technical systems have similar features, issues and priorities are very different and pose analytical challenges, in relation to developments of transmission grids and dams for instance, that have not been systematically addressed in the European SEA research. Second, there are also particular institutional, data-related and methodological barriers related to the particular policy and planning context in each country.

SEA frameworks vary, but the general template often includes a number of distinct components. These are not necessarily followed in a step-by-step process, although the general stream of activities is easy to follow. The study adopted this procedure as the overall SEA framework, as represented in six stages:

¹ The ADB TA 4713-VIE: Capacity Building in the Strategic Environmental Assessment of the Hydropower Sector officially commenced on 2nd October, 2006.

- **Scoping** handles what to include in the SEA, the temporal and spatial boundaries, the institutional context and decision scope, and delimitations in terms of issue coverage and stakeholder participation.
- **Baseline Assessment** provides a baseline to determine the sustainability concerns, challenges and opportunities in the areas or sectors that are affected by the proposed intervention. It formulates objectives, criteria and indicators for subsequent components.
- **Scenarios and Alternatives** generate the decision alternatives for analysis in close deliberation with the decision-makers, often through applying a scenario analysis. In some cases, it is possible to introduce ‘sustainability alternatives’ as part of the package.
- **Risk & Impact Analysis** deals with the identification and analysis of environmental and social pressures and impacts of the various alternatives.
- **Weighting & Trade-Offs** makes a transparent and deliberated weighting of impact information through for instance multi-criteria analysis or economic valuation.
- **Recommendations & Reporting** is concerned with drawing out the decision implications from the analysis, including policies, investments, institutional arrangements, and technical mitigation measures, and with the structured presentation of the SEA process and results, in what ways the decision has taken environmental concerns into account, and the motivation for the choices made.

SEA is an objectives-led assessment where potential impacts are gauged in relation to a series of objectives for sustainable development. The objectives provide a yardstick against which to assess the effects of the plan. For this reason, the key elements of the SEA framework include objectives and associated targets (where these exist) as well as indicators representing these objectives and targets. If the Plan objectives (above) already include an exhaustive list of sustainability objectives, these should be identified in this section as a key element of the SEA framework. However, it is more common that the list of such objectives is developed or refined after the completion of the draft baseline data and initial analysis of indicators.

Appendix 1 gives a detailed description of a number of key methodologies used in this and other SEAs, including scenario development approaches, GIS techniques, weighting methodologies and valuation approaches.

1.2.2. Summary of Purpose and Objectives

The overall purpose and objectives of the pilot SEA are defined in the agreement between the GoV and the ADB that are in turn reflected in the terms of reference of the team undertaking the detailed work of the SEA.

The **Purpose** of the pilot SEA is to enhance the development of sustainable hydropower in Viet Nam through improvements to the strategic planning of the energy sector so that it reflects more closely the overall development vision and plans of Viet Nam.

The **Development Objective** of this Pilot SEA is to enable Vietnamese governmental bodies and other stakeholders to undertake and review international state-of-the-art SEA for the energy sector.

The **Immediate Objective** is to perform a **Pilot SEA** of the Vietnamese hydropower plan in the context of PDPVI, with a view to the broader energy sector development. This includes to *inform decision makers and desk officers on significant sustainable development issues arising from hydropower plan and reasonable alternatives* and to *build capacity and awareness for full SEA in next PDP cycle (PDP VII)*.

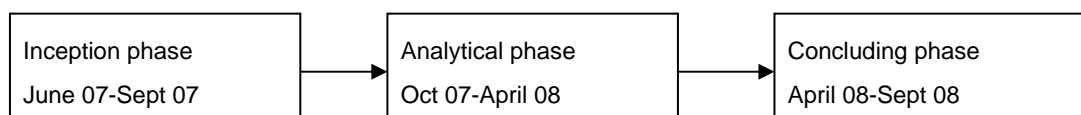
1.2.3. Organization and Implementation of the SEA Process

The study has been funded by the Asian Development Bank's Core Environment Programme (CEP)². Component 1 of the CEP - Environmental Assessment of Economic Corridors and Sectors in the GMS – deals with the potential cumulative and multiplier impacts of projects within the key development sectors of energy (hydropower), transport and tourism. To achieve this, the component promotes and supports the use of a number of tools, including Strategic Environmental Assessments (SEAs).

The Ministry of Industry and Trade (MoIT) is the owner of this pilot SEA study. The Ministry has, in turn, nominated a Core Working Group consisting of key national ministries and agencies concerned with energy-sector decision making or its implications. The Core Working Group has engaged with and contributed to the study on a daily basis and guided the conduct of the SEA. MoIT has provided additional input and suggestions to the study and has been in charge of invitations to workshops and communications within the Vietnamese government. In addition to the Core Working Group, sectoral linkages to water resources and agriculture, fisheries, transport, and planning and investment sectors have been integrated into the SEA through their representation in the four project workshops (see below).

The Stockholm Environment Institute (SEI) has served as the implementing agency (IA) in collaboration with international and national consultants and several national institutions. The implementation of the study has followed a step-wise approach organized into three major phases; an inception phase, an analytical phase and a concluding phase (See Figure 1.1).

Figure 1.1: Steps in the SEA Process



- | | | |
|--|--------------------------------|---------------------------|
| 1. Inception | 4. Scoping of strategic issues | 7. Weighting |
| 2. Development SEA Methodologies | 5. Baseline Assessment | 8. Training Workshop |
| 3. Institutional and Regulation Review | 6. Scenarios & Alternatives | 9. Policy recommendations |
| | 7. Risk & Impact Analysis | 10. Final SEA Report |

Four main SEA workshops have been undertaken during the course of the project:

1. Inception and scoping workshop in Hanoi in June 2007
2. Scenarios and impacts workshop in Tam Dao in January 2008
3. Impact and weighting and Training workshop in Mui Ne in April 2008
4. National workshop on final results in Hanoi in July 2008

² The CEP is executed through a multi-year regional technical assistance approved in December 2005 and financed by grants from the Asian Development Bank (ADB), and the Governments of the Netherlands and Sweden. The implementation of activities within the CEP is administered and coordinated through the Environment Operations Center (EOC) in Bangkok, Thailand.

These workshops involved a wider group of participants (beyond the Core Working Group). The purpose of these workshops were to allow a wider group of stakeholders and organizations in Viet Nam to review progress and provide input, comments and suggestions to the study. All workshops contributed in significant ways to the successful completion of the study. In addition, the project has been implemented with the support from regular and frequent meetings between the consultants and the Core Working Group. Draft material and suggestions from the consultants have been reviewed and discussed with the group, after which the MoIT has approved or requested changes.

1.3. The Legal and Institutional Framework for SEA and Hydropower

Viet Nam is experiencing a period of widespread and sustained change to its legal and policy framework that affects all sectors of the economy and tiers of government. Many of these changes are relatively new and have yet to be embedded into the administrative system; others are still under development and have yet to be fully formed. There are uncertainties over where responsibilities lie for some important aspects of government and, in some cases, concerns that different policies and regulations are to an extent contradictory or over-lapping. The notion of an “implementation gap”, where policies exist on paper but have yet to be turned into robust administrative procedures, is recognized as a concern.

Despite these uncertainties, the general direction of change is clear: Viet Nam is in transition from a centrally-planned and highly centralized country towards a decentralized system where a much wider range of actors are involved in decision-making and in which a more complex set of factors need to be taken into account in making strategic choices. The adoption of market-based approaches in different aspects of development is also a characteristic of current reform processes.

The development of strategic planning of the hydropower sector that takes social and environmental issues as an integral part of the planning process needs to be based on the wider policy and institutional environment of the power development sector. There are a number of key pieces of policy and legislation that affect both the power sector SEA approach and hydropower development more broadly. Other policies and laws indirectly influence the process in that they are part of the overall strategic development structure of Viet Nam.

This section reviews this policy, legal and institutional framework within which an SEA of hydropower must take place. It identifies a number of key characteristics that the SEA will possess to ensure it conforms to legislative requirements and will be policy relevant. It should be noted that to ensure that SEA becomes an integral part of sector strategic planning requires a number of changes in approach and procedures for the existing planning system for the sector. These changes need to be based on a consensus on where they are needed and firmly rooted in the overall national policy and legislative context discussed here.

The following sections outline firstly the wider policy context of the 2006-2010 Socio-Economic Development Plan (SEDP) and other relevant development policies and legislation in Viet Nam. This is followed by a review of the specific policies and regulations that relate to environmental protection in general and SEA in particular. The final sections discuss the policy and regulatory framework of the power sector and consider related sectors and issues such as water, resettlement provisions and policies related to the development of ethnic minorities.

1.3.1. Overall National Development Policies

The **long-term strategic issues** associated with hydropower development reflect the goals of the 2006 – 2010 SEDP and the Viet Nam 2020 Vision, which represent an approach that balances economic development, social equity and environmental sustainability. The Government of Viet Nam (GoV) is concerned to ensure that planning in all sectors is in accordance with the overall approach and the specific goals and targets of these national policies, strategies and plans.

Socio-Economic Development Plan 2006-2010³: The 2006 – 2010 SEDP sets the context within which all government programs and plans should be considered. The SEDP represents a significant new direction for national development and is based on the awareness of senior decision-makers in Viet Nam for the need for systematic change to national development approaches if the country is to continue to modernize and grow. It emphasizes the need for a coherent and integrated approach to sustainable development that builds on and boosts the existing rapid economic growth, but that also takes full account of the need to balance growth with enhanced social equity and environmental sustainability. The SEDP stresses economic diversification and modernization, but also emphasizes social and institutional reform and wider participation in decision-making.

The SEDP anticipates Viet Nam's transition to being a developed country by the year 2020, with a knowledge-based economy and stable and secure livelihoods for all sections of society. The SEDP emphasizes the diversification of the rural economy, the need to target appropriate development solutions for the needs of communities in remote and impoverished parts of the country, the strengthening of private sector engagement in rural development and the continuation of decentralization and local democratization processes. The priorities and development principles set out in the SEDP provide a context within which sectoral and provincial level plans should be established.

The plan contains specific provisions that relate to hydropower development. This includes targets that during the 2006-2010 period investments in hydropower will provide an additional 5,500 MW installed electricity generation capacity. Hydropower development projects are accorded a high priority amongst investment projects. The SEDP identifies three hydropower plans that will be a priority for state investment: Quang Tri, Son La and Cua Dat. In addition, there are 51 hydropower plants listed for state credit and private investment and three hydropower projects calling for foreign direct investment.

The overall approach to the power sector is to expand capacity to meet demands, but also to improve efficiency, balance fuel sources, expand the network to poor and remote areas (using new and renewable energy technologies where needed) and reduce the environmental impacts associated with electricity generation.

The SEDP also states that by 2010, 100% of communes will have electricity connections and 90-95% households in the rural areas have electricity with regulated price. The SEDP states that remote areas where grid connections are not viable will receive power from new sources like micro hydropower stations (page 79).

The SEDP includes measures to ensure reasonable, effective and sustainable use of natural and environmental resources in watershed areas, and mainstream environmental protection into socio-economic development plans. There is a commitment to renew the planning work in regard to environmental protection (page 109). There are provisions to expand forest

³ National Assembly. Decision 56/2006/QH11, June 2006.

coverage and to integrate climate change into strategic planning and natural resource management.

The overall focus on poverty reduction is strong and runs throughout the plan, but one dimension of this is provisions on social equity and specifically on the position of ethnic minorities and remote communities:

“Pay more attention to development in disadvantaged regions, mountainous, border-line and ethnic minority density areas through direct support of the government in order to narrow the gaps of development, income and living standards among regions and ethnic groups” (page d).

The 2006 – 2010 SEDP consequently provides a strong anchor point for the overall direction of strategic planning in Viet Nam, including for the power sector. Both the overall approach, balancing growth, equity and sustainability, and the specific provisions on issues such as hydropower development, rural electrification, environmental protection and ethnic minorities need to be clearly taken into account in the development of SEA as an integral part of strategic planning for hydropower development.

There are other core development policies and approaches that also need to be reflected in the development of the hydropower sector. The key overall direction of government reform policies in the current decade is towards **decentralization** of most aspects of development planning and the implementation of state programmes. The approach to decentralization is based on the principle of subsidiarity, with the devolution of decision-making to the lowest appropriate level and actions to ensure the effective coordination of information and decision-making flows between central, provincial, district and commune levels.

This decentralization policy is reflected in a number of pieces of legislation issued in recent years that have built on **Decree 24/1999/ND-CP**, which regulates the mobilization, management and utilization of people’s contribution to construct rural infrastructure in communes and district towns. Recent legislation also provides support for demand driven approaches and access to credit. This includes **Decree 52/1999/ND-CP**, issued in 1999 and amended in 2003 with **Decree 07/2003/ND-CP** on the management of investment and construction. The objective of Decree 07 is to improve the decentralization of investment management and construction. More recently, Decree **16/2005/ND-CP** empowered PPCs to authorize DPCs to decide on any investment not bigger than 5 billion VND and DPCs can authorize CPCs to decide on investments not bigger than 3 billion VND. This succession of Decrees consequently reflects an increasing level of potential empowerment of lower levels of the administrative system to decide on and manage investments, but the rights are not automatic and are under the discretion of the PPC.

For hydropower, the investment limits are relevant for **small-scale hydro schemes**, an option that could be attractive for decentralized authorities seeking to provide power to remote communities in particular. Decisions on small-scale hydro are primarily taken at the provincial level or below. Although there is provision for a proportion of future additions to generating capacity to come from small hydro in PDP VI, the plan does not specify where or when such investments should be made. This makes the assessment of the likely social and environmental costs and benefits of small-scale hydro difficult to assess beyond some analysis of generic issues associated with small hydro development.

The **Grassroots Democracy** Decree 79/ND-CP, issued in 2003, aimed to increase community participation in local decision-making, especially planning and budgeting. Grassroots Democracy provides a legal instrument for community priorities to be presented to local decision-makers for inclusion in the planning process. Decree 79 increased the responsibility

of commune and township administrations to use democratic principles in decision-making, but the capacity of local officials to effectively implement this varies and is often very limited.

The GoV issued the “**One-Door**” legal reforms in 2003 on simplifying local administrative procedures with the aim of improving transparency and accountability in the provinces. The reforms have not been implemented in all provinces yet, and many of the poor and non-poor are not aware of the legislation or remain unsure of ways to access local authorities. In addition, many procedures, such as land registration, cooperative and business registration and household registration books, remain under the control of the district administration.

The **Revised State Budget Law** came in force in January 2004. This new law simplifies but strengthens the legal arrangements between central and local levels. Under the revised law, the provincial People’s Council approves the provincial budget, and those of its subordinate levels. The law gives more explicit powers to provincial People’s Councils such as the power to develop priorities for local investments, decide and approve allocations to different sectors to implement investment decisions, and transfer funds to local levels.

Other recent legislation has increased the responsibilities of provincial authorities in a number of areas. This includes **Decree 33** and, **Guideline 2215** to provincial Departments of Planning and Investment for “Rolling-out the development of the provincial socio-economic plan taking into account the Comprehensive Poverty Reduction and Growth Strategy” issued by MPI in April 2004. The objective is to apply an integrated approach in preparing the socio-economic development plan to ensure pro-poor policies that promote sustainable economic growth while ensuring social development and equity.

In June 2004, the Prime Minister issued **Decree 8/ND-CP** outlining reforms in state management between central and provincial governments. The objective of the decree is to further clarify the roles, responsibilities and control of central and provincial levels of government and improve coordination between the levels of government. The decree prioritizes reforms in budget management, land and natural resource management, the management of state owned enterprises and public services.

During mid-2004, the GoV issued **Decision 62**, which creates the conditions for households to access credit from the Bank for Social Policy, while corporate bodies and enterprises can borrow Development Assistance Funds in compliance with the Government's regulations on Investment and Development Credit. **Decision 134**, also from 2004, promotes assistance for ethnic minorities in different areas of livelihoods support.

The **Procurement Law** issued by the National Assembly in November 2005 outlines the legal framework for the tendering process for consultant agencies and service provision, the process for procurement and a process where agencies can tender for a package of projects. The main objective of the law is to guarantee a public and open tendering process, and a transparent and competitive tendering system where all tendering agencies have an equal opportunity to participate in all steps of the process.

Viet Nam’s **Agenda 21** redefined the traditional concept of ‘socio-economic’ development into ‘a tight, reasonable and harmonious combination of three elements: economic development, social equity and environmental protection’. This viewpoint on sustainable development has become centralized into the overall approach to the country’s future, influencing the approach to environmental protection outlined in the 2005 Law on Environmental Protection and significantly affecting the development of the SEDP 2006 – 2010. It was also the basis for the intensive work in 2005 that took place at the Ministry of

Planning and Investment to develop a Strategic Environmental Assessment policy and plan that is the basis of the specific provisions on SEA discussed below.

1.3.2. Laws and Regulations related to Strategic Environmental Assessment

There is a wide range of recent legislation that relates to different aspects of environmental protection and management. These new laws and regulations include provisions that relate specifically to SEA, which is now a mandatory requirement for the planning of different sectors in Viet Nam. The legislation also creates a framework to which plans and actions that have consequences for environmental quality or natural resource management must conform.

The most important recent legislation is the 2005 **Law on Environmental Protection (LEP)**, which amended and replaced the 1993 Environment Protection Law. This included a requirement for SEA (LEP 2005)⁴. There are several specific articles of LEP 2005 that address SEA and hydropower development issues.

In articles 14 to 17, LEP 2005 identifies 6 areas where SEA should be applied. Among these, it is required that SEA shall be applied in preparing (i) national development strategy/ plan of a sector, and (ii) inter-region or inter province natural resource exploitation plan. The scope of an SEA shall include social development issues as well as issues related to environmental protection and resource management. Article 16 states that an SEA report should cover five specific issues:

- Briefly outline the plan/project objective/scope that relates to the environment.
- Outline natural, economic, social and environment conditions related to the project or plan.
- Forecast possible negative impacts on the environment.
- Identify data sources and assessment approaches.
- Propose environmental protection measures in project implementation.

This can be taken as a mandatory minimum in the development of any SEA but should not be regarded as defining the limits of any SEA assessment. It is a starting point, not a defining statement that covers all aspects of an SEA process.

Concerning institutional organization, LEP 2005 states that MoNRE shall organize an SEA appraisal committee for strategies that are to be approved by the National Assembly, Government and Prime Minister; that ministries establish SEA appraisal committees for projects that will be approved by them; and Province People's Committees set up SEA appraisal committees for projects approved by the Province People's Council (article 17). The Province People's Committees in a river basin have the right to make comments on the SEA of projects proposed for development in the river basin (article 60).

The 2005 LEP has provisions that state that renewable energy, including hydropower, is encouraged and government will provide incentives such as favourable tax, credit and land rent provisions in order to support renewable energy projects (article 33). Objectives on renewable energy development are clear as they focus on:

- Increasing the ratio of renewable energy in total energy sources.
- Contributing to energy security.
- Reducing Viet Nam's contribution to climate change.
- Integrating with poverty alleviation.

⁴ Law on Environment Protection, National Assembly, Decision 52/2005/QH11, 29 November 2005

The protection of the river water environment is another issue that LEP 2005 addresses (articles 59, 60, 64). The law determines that provinces in a river basin shall coordinate in protecting the river environment and exploiting river water to benefit their communities. It stipulates that the construction and operation of reservoirs shall integrate with environment protection measures.

The national government has expressed its interest in enhancing the implementation of the different LEP 2005 provisions. In 2006, the government issued one decree on LEP 2005 implementation guidelines⁵. It is noted that the Decree has focused more on EIA than on SEA. The policy states that all service institutions and organizations that meet required conditions could apply for EIA report preparation, but the decree does not extend these provisions to SEA. The decree has addressed SEA in relation to two further issues:

- Proposes that MoF will allocate budget for SEA preparation, appraisal and monitoring (article 8).
- Identifies 3 documents needed for SEA appraisal (article 9) as Proposal for SEA Appraisal, SEA Report and Project Document.

In November 2006, the government again confirmed⁶ that an SEA report shall be conducted during development strategy preparation, and SEA report appraisal shall be attached to strategy documents submitted to the government for approval.

Following the issuance of Decree 80, MoNRE has issued Circular 08/2006/TT-BTNMT (8 September 2006) on SEA, EIA and environment protection commitment. The circular gives guidance and proposed in detail the structure of an SEA report. However, the circular has largely addressed SEA within the context of project planning and implementation rather than in relation to strategic planning. This makes the content of an SEA report not notably different to that of an EIA. Discussions with MoNRE have identified the need to establish more effective guidelines and procedures for SEA as part of a strategic planning process.

The ADB funded project on Strengthening SEA Capacity building in hydropower development⁷ piloting in Quang Nam Province has developed new SEA Technical Guidance. The Sida-supported SEMLA project has also worked with MoNRE to prepare draft SEA Guidelines that have been circulated in October 2007 but as yet are not complete or sanctioned by the Government. There is consequently as yet no specific regulations that define the scope or methodology for an SEA process and experience of SEA at the national strategic level is extremely limited.

1.3.3. Institutional Aspects of Strategic Environmental Assessment Processes

The responsibility in SEA report preparation is defined in Decree 140/2006/ND-CP (22 November 2006). This Decree sets out the relative roles of ministries that are responsible for conducting environment protection preparation during drafting, approving and implementing a development strategy or plan. Specific responsibilities are defined as:

MPI, in coordination with relevant ministries and province: (i) ensures that SEA is conducted during drafting strategy (approved by government) and be considered in strategy appraisal;

⁵ Guiding for implementing some contents of LEP2005. Government, Decree 80/2006/ND-CP, 9 August 2006.

⁶ Conducting environment protection preparation during drafting, approving and implementing development strategy, plan. Government, Decree 140/2006/ND-CP, 22 November 2006.

⁷ Strengthening SEA Capacity building in hydropower development, TA 4713 VIE, ADB-MONRE-ICEM, October 2006-October 2007

(ii) monitor following environment protection measures in strategy/plan implementation. Department of Science - Education – Natural Resource and Environment is in charge of environment protection tasks including SEA.

MoNRE is in charge of (i) organizing SEA report appraisal; (ii) preparing annual report on environment protection implementation of strategy/plan to submit to the Prime Minister; (iii) ensuring environment protection consideration in drafting, appraisal and implementing of strategy/plan approved by provinces and ministries; (iv) issuing guidance on environment protection enforcement monitoring, and reporting procedures. The Department of Appraisal and EIA is in charge of the SEA issue, including drafting SEA guideline, proposing SEA appraisal committee, reviewing and having comment on SEA report submitted to MoNRE.

Other ministries and Province People's Committee: (i) follow environment protection requirement in drafting, appraisal and implementing strategy, plan or project approved by them; (ii) monitor and produce an annual report on environment protection enforcement to be send to MoNRE.

1.3.4. Conservation Policies and Institutional Arrangements

A system of protected areas (PA) has been established by GoV for the purpose of maintaining terrestrial and marine biodiversity conservation and the protection of cultural and historical sites. Although of relatively recent origin, the protected area system in Viet Nam has expanded rapidly and there is little doubt that hydropower development will in many cases have consequences for protected areas, including both those around the development site and those downstream. The different types of protected area in the Vietnamese system include:

Special-use forests (SUFs): In total, Viet Nam has established 128 SUFs covering an area of 2.5 million ha (7% of the national land area). SUFs are classified into four management categories: (1) national parks, (2) “nature conservation zones” including nature reserves and species-habitat conservation zones, (3) landscape protection zones (formerly cultural and historical sites) and (4) forests for scientific research or experimentation.

Marine Protected Areas (MPAs): including (i) marine parks, (ii) marine species and habitat conservation areas and (iii) aquatic resource reserves. In addition to the Nha Trang Bay and Cu Lao Cham MPAs which were established in 2001 and 2005, further 13 MPAs are proposed for formal establishment and recognition by 2015.

Wetland Conservation Areas (WLAs): 86 wetlands are recognized to be of national importance and potential PAs. Yet, none have been formally designated as “wetland conservation areas” and more than half have already been listed as either SUFs or MPAs.

Apart from seven national parks and one MPA (Truong Sa), all PAs are managed or proposed for management at a local government level. MARD is responsible for the development of the national system of SUFs, Marine Protected Areas (MPAs) and inland wetland protected areas. MoNRE has responsibility for defining the detailed institutional arrangements for wetland conservation areas under a National Wetlands Programme.

The on-site managers of protected areas, whether SUFs, MPAs or wetlands, are management boards which are identified as the “owners” of protected areas. Yet, more than 40 per cent of PAs do not have management boards because of budget constraints and most of them have not been issued with tenure certificates. Though the development of hydropower may affect all 3 PA types, SUFs are expected to be the most affected one because of dam construction and consequent inundation, change of river flows and watershed forest disturbance.

In the last two decades, attempts have been made by Viet Nam to develop and improve the policy and legal framework needed for nature conservation and effective management of the national PA system. Of great significance are the following regulatory and legal documents:

The National Conservation Strategy (NCS) 1986 and the **Biodiversity Action Plan (BAP) 1995** proposed conservation policy initiatives and identified key actions toward the establishment and management of the PA system.

The **Land Law 2003** has determined that it is necessary to consider environment protection and appropriate natural resource utilization in land use planning. With regard to hydropower, the law states that reservoirs shall not obstruct the natural flow of water and water transport, and must follow the specific regulations on environment protection (article 102).

The **Law on Forest Protection and Development** contains provisions on forest development, forest classification and the role of local authorities in forest management. The law does not mention water and hydropower issues, but it is determined in Article 28 that the PPC is responsible for reclassifying forest (from special use forest to protection forest or to production forest for example).

According to the **Fisheries Law 2003** and draft management regulations for the MPA system, management responsibility for MPAs will be at the provincial level except where more than one province is involved and issues of international and national significance are concerned – similar to the Forest Law and Decision 186.

The **Biodiversity Law**, which was submitted to the National Assembly for approval at the beginning of 2007, intends to legalize the payment for environment services (PES) provided by forests, including water supply for hydropower stations.

In 2001, **Decision 08** defined buffer zones as forest or wetland areas bordering national parks and nature reserves, helping to prevent or alleviate encroachment to special use forests. That provision was repeated in 2004 in the **Forest Protection and Development Law** and in 2006 through **Decision 186**, Article 24.

In 2004 the Government adopted **Decree 109** on the conservation and sustainable use of wetlands. It assigns responsibilities for wetland management to various Ministries and other government agencies. MoNRE is responsible for wetland establishment and defining the policy framework for their management. In April 2005, the MoNRE Minister approved the Action Plan for Wetlands Conservation and Sustainable Development 2004-2010.

1.3.5. Power Sector Laws and Policies

The 2004 **Electricity Law**⁸ has focused more on the electricity market, and not addressed in detail environment protection or hydropower development. But it has confirmed the policy on accelerating renewable energy development and considering environment protection in electricity development (article 4), and on the special privilege policy on investment, tax, electricity price to renewable energy projects (article 13).

Viet Nam's **National Energy Strategy** has a clear statement on the overall approach to the development of energy resources and production capabilities:

*“Exploiting and using reasonably and effectively the domestic energy resources;
Supplying sufficiently the energy requirements with the highly increasing quality and*

⁸ Electricity Law. National Assembly, decision 28/2004/QH11, December 2004

the reasonable price for the socio-economic development course; Ensuring the national energy security; Diversifying the investment and commerce ways in the energy field, gradually establishing and developing the competitive energy market; Strengthening the development of the new and renewable energy sources in order to meet the need of power requirement, especially in the remote areas, border and islands; Developing rapidly, effectively and sustainably the energy sector, developing must be attached to the environment protection”.

There are a number of specific development goals of the energy sector regarding hydropower development and environmental protection:

- Hydropower: by the year of 2010, additional generating 10 billion kWh, and by the year of 2020, the additional generation will be 15 – 20 billion kWh.
- Hydropower generation of about 35 billion kWh by 2010; about 60 – 65 billion kWh by 2020; and up to 70 – 80 billion kWh after 2020.
- Speeding up the rural and mountainous energy development program. Increasing the number of rural household using commercial energy for cooking from about 30% as current up to 50% by 2010 and 80% by 2020. By the year of 2010, 90% of rural households will have access to electricity, and by 2020, most will have access to electricity.
- Working out the long-term environmental objectives and standards in a way consistent with international and regional environmental standards, but also suitable to Viet Nam’s economic conditions. Controlling and abating environmental pollution in energy-relevant activities and all the power projects must meet the environmental standards by 2010.

Power Developments Plans (PDPs) are the main strategic planning tool for the power sector. A PDP includes the following: (i) an Electricity Demand Forecast to predict the capacity (MW) and energy (GWh) demand in the future, and (ii) a Least Cost Expansion Plan to provide the infrastructure needed to meet demand at the lowest possible cost, while maintaining system reliability and quality of supply, (iii) a Transmission Expansion Plan to transmit the generated electricity to the costumers, (iv) a Fuel Supply Assessment to determine the national energy resources (coal, gas, oil) that would be available for energy generation, (v) a Rural Electrification Program for electricity supply to remote areas that cannot be covered by the national grid, and (vi) an Investment Program on financing future energy sector investments.

1.3.6. Other Sector Policies and Legislation

Several other sectors need to be considered during hydropower development, either because they directly influence the viability of hydropower schemes or because these sectors will in many cases be impacted by hydropower development. The legal and regulatory framework of these sectors needs to be reflected in hydropower planning, including specific attention to any restrictions that the legislation for other sectors places upon the management of land or water resources.

The 2003 **Law on Fishery**⁹ has listed activities that may obstruct waterways and consequently interfere with the natural movement of fish and that affect the living environment of fish (article 6). This law mentions only the necessity to have an EIA when there is a project that is likely to affect the living environment of fish. The LEP 2005, which

⁹ Law on Fishery, National Assembly, decision 17/2003/QH11, 26 November 2003.

sets out the planning requirements on SEA, states that any plans shall cover the fishery issue in its SEA report, and MARD representative shall be invited to participate in the SEA appraisal committee.

The 1998 **Law on Water Resource**¹⁰ has focused on water resource management and exploitation for consuming purposes by river basin. Hydropower projects do not consume water like agriculture or industry, but it only transfers/channels water to generate power. There is one article in the law on water for hydropower.

Hydropower construction projects shall follow river basin (water resource management) plans and environmental protection regulations. The law states that water management in hydropower shall follow water operational procedure approved by an authorized institution (Article 29). This means that in special cases, the priority is given to water for other purposes (flood control, water supply to agriculture for example) but not for power generation.

In addition to the Law on Water Resources, directly relevant legislation includes:

- Government Resolution No. 179/1999/ND-CP, dated 30 December 1999, on the implementation of the LWR;
- Decision No. 67/2000/QĐ-TTg, dated 15 June 2000, on the establishment of the National Water Resources Council;
- Decision No. 99/2001/QĐ-TTg of the Prime Minister on the promulgation of regulations on the organization and operation of National Water Resources Council and accompanying regulations on the organization and operation of NWRC;
- Decree on Flood and Storm Control No. 26/2000/PL-UBTVQH10, dated 24 August 2000,
- Decisions No 37, 38 and 39/2001/QĐ/BNN-TCCB, dated 9 April 2001, by the Minister of Agriculture and Rural Development on the establishment of River Basin Planning Management Organisations (RBO) in the Lower Mekong, Dong Nai and Red River basins; and
- Decree on Exploitation and Protection of Hydraulic Works No. 32/2001/PL-UBTVQH10, dated 4 April 2001 and effective 1 July 2001.

More recent documents on the establishment of MoNRE include:

- Prime Minister's Decision No. 91/2002/ND-CP on Functions, Responsibilities, Authority and Organizational Structure of MoNRE, dated 11 November 2002.
- Decision No. 600/2003/QĐ-BTNMT on the Functions, Responsibilities, Authority and Organizational Structure of the Department of Water Resources Management.
- Decree 149/2004/NĐ-CP on regulation on licensing of water resources exploitation, extraction and use and wastewater discharge in water sources.
- Decree 134/2005/NĐ-CP on regulation on sanction of violation in the field of water resources.

The SEDP 2001 – 2010, discussed above, is the fundamental document that reflects official policy on national stability, development and sustainability in relation to water resources. Water resources development plans of various sectors have also been developed for different periods and in different forms of documents. These include:

- MARD – Agriculture and Rural Development Five Year Plan (2001-2005).
- MARD – Forestry Development Strategy for the Period 2001 – 2010.
- MARD - Hydraulic Development Strategy to 2010.

¹⁰ Law on Water Resource. National Assembly, decision 08/1998/QH10, 01 June 1998.

- MARD– National Strategy on Rural Clean Water Supply and Sanitation.
- MARD and Central Committee for Floods and Storms – Second National Strategy on Action Plan for Management and Reduction of Natural Disasters in Viet Nam.

The Strategy also makes statements about water-related issues in specific regions:

Northern Mid-land and Mountainous Areas: where the potential exists, small hydraulic works shall be developed. Reforestation in upstream catchments above reservoirs will be increased and stabilize the lives of ethnic minority people so that they protect forest areas. Construct large scale hydropower projects to meet national demand and develop small scale hydropower plants to provide electricity to remote areas.

Northern Central Area: the construction of hydraulic works with a flood regulation function will be completed. Construction of some flood elimination works will be carried out in line with flood elimination planning in central part. Conduct preparedness measures to deal with flood and drought.

Central Highlands: construct hydraulic works, especially hydropower plants, dams with associated canal systems.

Downstream Mekong River Delta: construct and consolidate the sea dikes system for eastern and western areas of the delta and hydraulic works for salinity prevention and aquaculture production.

The **National Target Program on Poverty Reduction in 2006-2010**¹¹ and **Program 135(II)**¹² have outlined the national poverty reductions goals to 2010 as:

- Reduce poor households from 22% in 2005 to 10-11% in 2010.
- Income of poor households increases 1.45 times against 2005 level.

The programs have proposed to provide support to poor households in commune levels. But they have not explicitly considered how environmental protection or hydropower development will affect the poor. The emerging patterns of poverty clusters in Viet Nam mean that areas of rich biodiversity and high hydropower potential, especially mountainous areas in the north and centre of the country, are also where levels of poverty are the highest and problems of poverty reduction most intractable.

Viet Nam has 54 ethnic groups, of which the Kinh majority constitutes more than 86% of the total population. The remaining 53 ethnic minority groups live spread in more than 3/4 of the total area of the country, mainly in the mountainous and isolated areas that are often the most promising sites for hydropower development.

At the policy level, Viet Nam has a clear policy of equal treating between all ethnic groups in Viet Nam. The **resolution of Politburo of the Central Communist Party** in 1951 had stated that "all the ethnic groups living in Viet Nam have equal benefits and responsibilities, helping each other toward unify the country". The solution also urged the government officers, who are Kinh people when coming to work in the ethnic minority people area as "preventing and boycott the ethnocentric attitude".

Since the 1960s, the Vietnamese government has launch a "fixed cultivation and habitation" policy, which mainly help ethnic minority and mountainous community to settle their life from shifting cultivation, which is looked as causing poverty and deforestation. This

¹¹ Decree 20/2007/QĐ-TTg, 5 February 2007

¹² Decree 164/2006/QĐ-TTg, 11 July 2006. Prime Minister

viewpoint is, of course, contested by many people who see the traditional livelihood systems of many ethnic minorities as both sustainable and appropriate for their circumstances.

From 1998 the government started Program 135 on poverty reduction in the remote, ethnic minority and mountainous areas. In the first phase of Program 135, 2015 communes participated, and it is mainly ethnic minorities that have benefited from the program. From 2006 the program started the second phase by the Decree 07/2006/QD-TTg of the Prime Minister named "Social - economic development program for the extremely difficult, ethnic minority and mountainous communes, phase 2006 - 2010". The overall objective of the program is: by 2010, basically there are no hunger-stricken households in the targeted areas and the number of poor households drops below 30% of the poverty line.

Recently, the Prime Minister has issued Decree 33/2007/QD-TTg, named "policy on assisting to fix cultivation and habitation for ethnic minority people, period 2007 - 2010". The objective of this program is that, by 2010, those ethnic minority communities whose still practicing shifting cultivation will have moved to fixed cultivation patterns. It is also expected that the fixed cultivation and habitation of ethnic minority people will help to protect forest and environment.

1.3.7. Resettlement/Compensation Regulations

The issue of resettlement and compensation is very much related to the land right issue for those communities and households who are resettled, as when people have to resettle, they lose access to both owned and common property land, with the latter being one of the most important livelihoods assets of these communities. These issues have been regulated in several government policies, especially in the Land Law. The Decree 181/2004/ND-CP, which included provisions for implementing Land Law, article 36 and includes provisions that stipulate the procedures and conditions whereby Government can take back land from other stakeholders to serve for national security purposes or national and communal benefits.

Decree 197/2004/ND-CP, from December 2004, on the "compensation, assistance and resettlement when Government taking back the land" regulates compensation for local people when Government taking back their land. According to this Decree, when Government used the land from people for national security and national benefit purposes, the compensation for those who effected including: land (resident, agriculture and non-agriculture...), properties over land (houses, graves, cultural constructions, animals, trees and others), resettlement and other assistance like job recreation and education. The Decree also regulates that the conditions of the resettlement area needs to have enough basic infrastructure and have to be better than the former area.

In cases where projects affect a whole community and multiple aspects of people life such as economic, social, traditional culture, compensation arrangements need to be decided by Central Government or Parliament case by case. Article 47 of the Decree states that in case the Government has implementing the right compensation and resettlement policy but the individual or households still do not follow, these families will have to be subject to compulsory resettlement according to the Law.

The above discussion has draw out that in general the Vietnamese government has good policies regarding to ethnic minority, resettlement and compensation issues. However, there are still many difficulties when applying those policies into practice, especially for hydropower projects.

Almost all of the hydropower projects are located in the poor mountainous areas, which are the traditional habitat of ethnic minority people. However, there is still no coherent or comprehensive set of policies or regulations for resettlement and compensation resulting from the hydropower sector. It is normally done on an individual project basis and is often a contentious issue. In addition, up to now the resettlement and compensation for hydropower projects can only cover the direct impacts to the community like land and properties. The indirect impact such as long-term economic stability, means of livelihoods, traditional cultural and social issues have not been totally realized and compensated. These issues play a very important role in the livelihoods and traditions of ethnic minority people in Viet Nam.

It is consequently clear that there is a wide range of laws, policies and regulations that are of relevance to hydropower development in addition to those that directly concern the sector. There are also many pertinent environmental management provisions other than those directly related to SEA. The overall development policies as encapsulated in the 2006 – 2010 SEDP, the different policies and regulations on water management, the provisions on forests and protected areas and the different policies and laws related to ethnic minorities and to resettlement and compensation are all of importance and need to be reflected in the SEA process where it is an integral part of the overall strategic planning of the sector.

2. General Description of Plan Objectives, Scales and Environmental and Social Characteristics

2.1. The Power Development Plan (PDP)

The overall objective of the present SEA Study is to look at the potential social and environmental consequences of hydropower development in Viet Nam, taking into account the implications of replacing hydropower with alternative sources of generation and based on the consideration of the following documents, described in more detail below, related to the future expansion of the energy sector in Viet Nam:

- The Power Development Plan (PDP) VI
- The National Hydropower Plan (NHP) Study

Power developments plans (called Master Plan in Viet Nam) are continuously undertaken in Viet Nam as a basic planning tool to meet the challenges in the power sector, and consist amongst others of an Electricity Demand Forecast to predict the capacity (MW) and energy (GWh) demand in the future, and a Least Cost Expansion Plan giving the infrastructure needed to meet that demand at all times for the forecast period and at the lowest possible cost, while maintaining system reliability and quality of supply.

Master plans or power development plans were previously established for five-year periods but are now established for 10-year periods with outlook for the next 10 years. A revision will be made after 5 years. The current master plan, PDP VI, covers the period 2006-2015 and with the outlook up to 2025. PDP VI was carried out by Institute of Energy (IOE) and was approved by the Prime Minister in 2007.

More information on PDP VI is given in Section 3.4 in connection with the baseline description of the energy supply and demand.

Viet Nam - Major hydro and thermal power plants

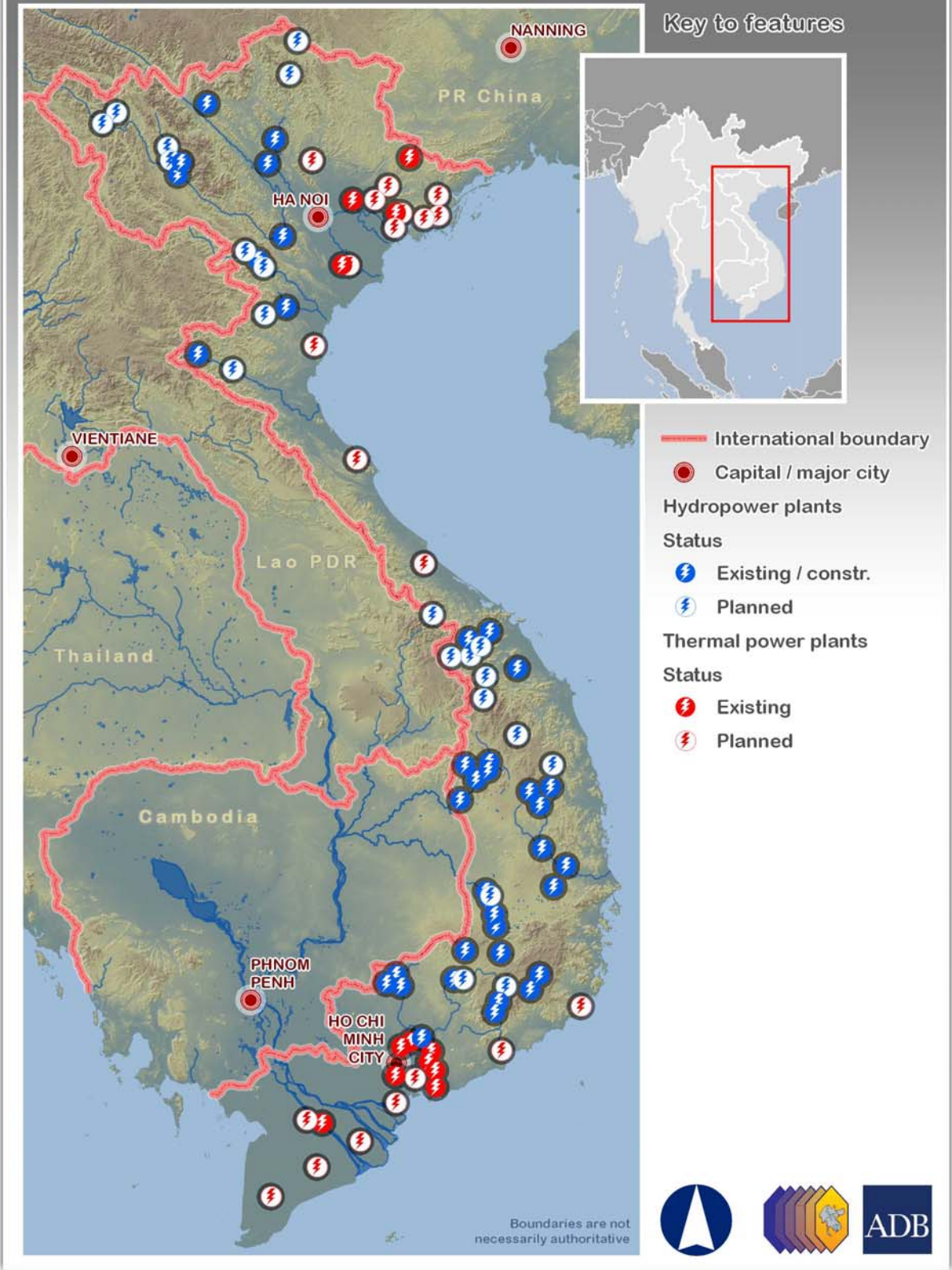


Figure 2-1: Major hydro and thermal power plants – existing and planned (PDP6)

2.1.1. The National Hydropower Plan (NHP) Study

The main objective of the NHP Study was to assess and rank, in a Ranking Study, selected hydropower projects in Viet Nam using an integrated assessment based on the technical and economic viability, including multipurpose aspects, and the environmental and social aspects of the projects. During the pre-study period it was recognized that the completion of a comprehensive National Hydropower Plan for the whole country would not be possible, and it was therefore decided that the NHP Study should be conducted in two stages, Stage 1 and Stage 2, as follows:

- Stage 1 covered the five main river basins in Viet Nam; Da, Lo-Gam-Chay and Ca in the north, Se San in the central and Dong Nai in the south, covering some 70% of the total hydropower potential in the country, see location of river basins in Appendix 2-1.
- Stage 2 covered the four remaining river basins with major hydropower potential in Viet Nam; Ma-Chu in the north, Vu Gia-Thu Bon and Ba in the central, and Srepok in the south, see location of river basins in Appendix 2-1.

A total of 22 hydropower projects were studied in NHP Stage 2 as listed in Appendix 2-2, of which 15 projects were selected (after a coarse screening) from the four river basins in NHP Stage 2, and 7 projects, being neither under construction nor committed by EVN, from the five river basins in NHP Stage 1.

Ranking Study

The objective of the Ranking Study was to assess and rank, by an integrated assessment methodology, the selected hydropower projects given in Appendix 2-2. The integrated assessment took into account the following two significant and basically non-comparable indicators of the projects:

- Technical/Economic Preference Index (TEPI) reflecting the technical and economic viability, including costs for environmental and social mitigation measures, and restrictions to and benefits of other water uses.
- Environmental/Social Preference Index (ESPI) reflecting the environmental and social aspects with due considerations given to possible enhancement and mitigation measures, as well as beneficial outcomes of the projects.

The Ranking Study was structured into the following main parts:

- Technical/Economic Ranking.
- Environmental/Social Ranking.
- Integrated Ranking based on an integrated assessment of TEPI and ESPI.

Technical/Economic Ranking

The Benefit/Cost Ratio (B/C Ratio) was used as the criterion for the Technical/Economic Ranking of the selected hydropower projects. Potential multipurpose benefits, such as flood control and irrigation, were included as additional benefits in the economic evaluation of the projects. Water allocations for other water user categories, such as abstraction of water for irrigation upstream of the projects and reservoir provisions for flood control, were reflected in the operating rules of the reservoirs and thus accounted for as restrictions in hydropower generations. Costs for environmental and social enhancement and mitigation measures were included in the investment costs of the projects.

The project with the highest B/C Ratio was awarded a Technical/Economic Preference Index of 100, while the Technical/Economic Preference Index for the other projects was valued according to the following relative scale:

Technical/Economic Preference Index (TEPI) = $100(BC/BC_{High})$
BC_{High} = Highest B/C Ratio among all the selected hydropower projects
BC = Actual B/C Ratio for the hydropower project under consideration

The Result of the Technical/Economic Ranking of the selected hydropower projects based on the Technical/Economic Preference Indices (TEPI) is given in Appendix 2-3.

Environmental/Social Ranking

The Environmental/Social Ranking were based on the Environmental/Social Preference Index (ESPI) that was based on environmental/social scoring of the selected hydropower projects for both negative and positive aspects. The scores were based on values related to both quantity and quality referring to the respective Magnitude and Importance for each of the parameters given in Appendix 2-4. Magnitude and Importance were described in qualitative terms and were differentiated in a 5-degree Scoring Scale as also shown in Appendix 2-4.

Each parameter was ascribed a score, defined as the product of the scoring of the two categories Magnitude and Importance. The scoring values for all parameters were added into Baseline Environmental/Social Scores for each of the selected hydropower projects, and the Environmental/Social Preference Index was derived according to the following steps:

- Weighted Environmental/Social Score where the 20 detrimental parameters were given different weights based on e.g. expressions by the stakeholders.
- Balanced Environmental/Social Score where the negative and positive scores were combined into one score by a quotient for the positive scores as expressed by the stakeholders.

The project with the least impact, expressed as with the lowest Balanced Environmental/Social Score, was awarded an Environmental/Social Preference Index of 100, while the Environmental/Social Preference Index (ESPI) for the other projects was valued according to the following relative scale:

Environmental/Social Preference Index (ESPI) = $100(BESS_{Low}/BESS)$
BESS_{Low} = Lowest Balanced Environmental/Social Score for all selected hydropower projects
BESS = Balanced Environmental/Social Score for the hydropower project under consideration

The results of the Environmental/Social Ranking of the selected hydropower projects are given in Appendix 2-3.

Integrated Ranking

The final step of the Ranking Study was the integration of the Technical/Economic Preference Index with the Environmental/Social Preference Index into a Total Preference Index (TPI).

As the Total Preference Index (TPI) was based on combining two non-comparative values, Technical/Economic and Environmental/Social preferences, sensitivity analyses were

warranted on the basis of different weights assessed to the preference indices as given in Appendix 2-5 where also the formula for calculating the Total Preference Index is given.

Finally, the selected hydropower projects were ranked according to a Normalized Total Preference Index (NTPI) in a scale from 0 to 100. The project with the highest Total Preference Index was awarded a Normalized Total Preference Index of 100, while the Normalized Total Preference Index for the other projects was valued according to the following relative scale:

Normalized Total Preference Index (NTPI) = $100(TPI/TPI_{High})$ TPI _{High} = Highest Total Preference Index among all the selected hydropower projects TPI = Actual Total Preference Index for the hydropower project under consideration

The results of the Integrated Ranking, i.e. taking account of both Technical/Economic and Environmental/Social issues of the selected hydropower projects are given in Appendix 2-3.

2.1.2. The NHP Study in the Context of PDP VI

As outlined above, the Power Development Plan or Master Plan is the basic planning tool for the Government of Viet Nam to decide on the power projects to be implemented to cover the future increase in electricity demand. As the power development plans are established for the coming 10 years (and with the outlook for the next 10 years), in the case of PDP VI up to 2015, it may be assumed that the suggested power projects, whether hydro or thermal, will also be the projects to be implemented as (i) the lead time for approval of relevant studies, arrangements of financing, tendering and construction will normally require, at least for hydropower projects, a time span of 8-10 years, and (ii) it is the only comprehensive document approved by the Prime Minister looking at the broad picture of energy development in the country.

A revision of the power development plan is made after 5 years, in the case of PDP VI by 2010, mainly to adjust for deviations in the forecast energy demand. One can also assume that additional studies on the candidate projects, or other pertinent issues, will be taken into consideration in the revision. It is also a well know fact that many of the power projects in power development plans lag behind in their implementation compared to the time schedules given in the plan. This may also call for adjustments in the revision, such that some projects are taken ahead of schedule. It should be noted that a power development plan is not a static document but are adjusted in accordance with reality; however, the overall framework with the basket of various power projects remains the same.

The NHP Study, on the other hand, is not a “legal” document, but is intended to serve as guidance, or input, for EVN and their agencies (including IOE) in their planning of the development of the hydropower resources in the country.

The main differences between PDP VI and the NHP Study are that (i) the optimum plan for development of the hydropower resources in PDP VI is solely based on economics while environmental and social impacts, other than resettlement costs, are not evaluated or accounted for as in the NHP Study, and (ii) the NHP Study only deals with hydropower development, and the environmental and social aspects thereof, while PDP VI deals with the optimum expansion plan based on different energy sources, including hydropower. The environmental and social impacts of different energy sources are very different in nature, both in time and in space. The impacts of hydropower projects are normally confined to the vicinity of the project, and some impacts are limited to the construction period and some are

reversible, while impacts from thermal power plants normally affect a larger area and even globally. This SEA Study aims at bridging that gap.

If comparing the hydropower projects selected in the NHP Study and the hydropower projects suggested to be included in PDP VI, that are not under construction, the list of projects are almost identical, while the year of commissioning differs (the year of commissioning of the hydropower projects are generally earlier in PDP VI).

Based on the above it may be concluded that the hydropower projects selected in the NHP Study corresponds to the projects suggested in PDP VI and can therefore be used in the present SEA Study.

2.1.3. Alternative Energy Strategies and Scenarios

Viet Nam is well endorsed with natural energy sources, such as hydropower potential, coal, gas and oil, which constitute a good base for energy generation to cover for the huge increase in demand anticipated in the future.

As seen in Appendix 3-9 the increase in demand in the period 2005-2025 is estimated at 77,466 MW and anticipated to be covered by the following energy sources:

Table 2-1: Increase in Energy Supply 2005-2025

Energy Source	Increase in Capacity 2005-2025 MW	Increase in Energy 2005-2025 TWh	Average Plant Factor	Remarks
Hydro	11,759	49.28	0.48	
Small Hydro	1,400	4.94	0.40	
Pumped Storage	4,200	-2.46	-	Net consumer of energy
Coal	34,775	196.19	0.65	
Gas	12,721	50.18	0.45	
Diesel & Oil	-485	2.24	0.51	Plant Factor based on 500 MW in 2025
Renewable Energy	500	1.01	0.23	
Nuclear	8,000	53.27	0.76	
Import (Hydro)	4,596	24.36	0.61	
Total	77,466	379.01		

The distribution of energy sources given in the table below is based on the least cost expansion plan in PDP VI, i.e. being the optimum mix of projects of different energy sources giving the lowest total Present Value (PV) over the development period, i.e. up to 2025, to cover for the future demand.

As seen from Table 2-1, the backbone of the development of the Vietnamese power generation system up to 2025 consists of coal-fired power plants (34,775 MW), gas-fired power plants (12,721 MW), hydropower (11,759 MW), nuclear (8,000 MW) and import (4,596 MW), however, with regional differences as follows:

- The coal-fired power plants are mainly concentrated to the northern region where the coal reserves are located. Coal may however be imported (e.g. from Australia) that will facilitate coal-fired power plants also in the south.
- The gas-fired power plants are mainly concentrated to the southern region where the offshore gas reserves are located. Gas reserves are however limited and other types of energy sources will be required to cover the future demand in the southern region.
- The hydropower potential is mainly concentrated to the northern and central regions.
- Uranium for nuclear power plants will need to be imported due to limited domestic resources.
- Import will be to the northern (mainly from China) and central (from Laos) regions.

As also seen from Table 2-1, other energy sources are anticipated to be of limited use at least up to 2025 with the following comments:

- Renewable energy (500 MW) and small hydro (1,400 MW) are mainly being used for rural electrification in remote areas that for economic reasons may not be connected to the national grid.
- Pumped storage plants (4,200 MW) are used to produce peak power using surplus base load energy during the pumping mode, and are special projects in that they use more energy than they produce.
- Diesel and oil-fired plant (-485 MW) will be taken out of service as they are the most expensive power plants to operate.

As there are alternative energy sources to hydropower, different energy strategies than the least cost expansion plan given in PDP VI are possible. Such energy strategies would be less viable from a strictly economic perspective, but could have positive implications from environmental and social, and other, perspectives.

One of the objectives of the present SEA Study is to look at alternatives to hydropower development in Viet Nam and what consequences these would have on the environmental and social impacts in the national perspective. Following the discussions above the following alternatives to hydropower may be identified in the Vietnamese context:

- Coal-fired power plants.
- Gas-fired power plants.
- Combined cycle gas turbines (CCGT).
- Nuclear power.
- Import of hydropower.
- Renewable energy, including small hydropower.
- Pumped storage hydropower.

At present the available gas reserves within Viet Nam are limited, but new gas resources may be discovered in the future. Hydropower resources in Laos for import are, at least in theory, abundant but long transmission lines and a political reluctance to be too dependent on energy sources from other countries may limit the potential of import. One may also argue if the development of hydropower potential outside Viet Nam may only transfer the impacts related to hydropower development to somewhere else.

The present Study takes account of PDP VI for the period 2011 to 2025 as projects assumed to be commissioned before 2011 are already under construction or in an advanced stage of planning.

As seen in Appendix 3-9 the total increase in generation capacity for the period 2011-2025 is estimated to be 62,639 MW and anticipated to be covered by the following energy sources:

Table 2-2: Increase in Energy Supply 2011-2025

Energy Source	Total Capacity in 2010 MW	Total Capacity in 2025 MW	Increase in Capacity 2011-2025, MW
Hydro	9,412	20,306	10,894
Coal-fired	6,595	36,290	29,695
Gas-fired	9,072	17,224	8,152
Diesel & Oil-fired	472	2,400	1,928
Nuclear	0	8,000	8,000
Import (Hydro)	658	4,628	3,970
Total	26,209	88,848	62,639

It will not be possible to replace all the 10,894 MW of installed capacity scheduled for hydropower in the period 2011 to 2025, as many of the projects are under construction, and some consists of small hydropower and pumped storage hydropower that in this Study are assumed to remain as scheduled in PDP VI, but some 4,700 MW as seen in the capacity balance of hydropower for the year 2025 in Table 2-3.

Table 2-3: Hydropower Balance 2025

Item of Hydro	Installed Capacity MW
In operation 2010	9,412
Hydro under Construction	2,296
Planned Hydro 2011-2025	4,738
Small Hydro & Pumped Storage 2011-2025	3,860
Total Capacity 2025	20,306

A list and the main data of the planned hydropower projects are given in Appendix 2-6 taken from the National Hydropower Plan (NHP) Study as most of these projects were included in that Study. The total installed capacity of the projects of 4,738 MW according to the NHP Study is higher than the total capacity of the same projects of 4,610 MW given in PDP VI, i.e. with 128 MW. In the following the installed capacities of the planned hydropower projects according to the NHP Study have been used and the import of hydropower have been adjusted with the same amount to maintain the total capacity in the power system of 88,848 MW in 2025.

As mentioned above one of the objectives of the present SEA Study is to look at alternatives to hydropower development in Viet Nam and what consequences these would have on the environmental and social impacts in the national perspective.

In that respect replacement of the planned hydropower projects in Viet Nam are assumed to be replaced by coal-fired thermal plants and CCGT for the following reasons:

- This is in line with PDP VI where the main part of thermal power in the future, apart from nuclear, will come from these sources.
- Diesel and oil-fired thermal plants are not considered to be economically viable compared to other thermal energy sources.
- Nuclear power has not been considered as an alternative in this Study.
- Import of more hydropower from neighbouring countries is not considered as an option for reasons stated above.
- Increase of renewable energy, including small hydropower, is not considered feasible and can anyhow only account for a small amount mainly for supply to non-grid areas, see below.
- Increase of pumped storage capacity is not considered an option as it is a net consumer of energy and needs to be in balance with nuclear power development in Viet Nam.

According to the latest data on availability of renewable energy in Viet Nam, see the table below, the total potential of renewable energy is estimated at 11.73 TWh/year. According to PDP VI, the total generation from small hydro and renewable energy is estimated at 8.39 TWh in 2025, see Appendix 3-9. Hence, about 72% of the total potential renewable energy is estimated to be utilized for power generation by 2025. The balance of 3.34 TWh/year is small in comparison with the anticipated generation from hydropower resources in PDP VI (estimated at more than 64 TWh by 2025). Consequently, this SEA study does not consider non-hydro renewable energy a *major* alternative for hydropower development in the future.

Table 2-4: Summary of Renewable Energy Potential for Power Generation in Viet Nam

Resource	Number of Potential Sites	Capacity MW	Potential Annual Output GWh/year	Cost US\$/KW
Mini-Hydro				
Technically Exploitable	1,035	4,014		
Economically Exploitable	376	1,767	5,904	
Geothermal				1,700
Technically Exploitable	29	340		
Economically Exploitable	12	113	732	
Wind	>14			1,250
Technically Exploitable		1,600		
Economically Exploitable		500	1,778	
Biomass				
Bagasse				1,200
Technically Exploitable		250		
Economically Exploitable		200	1,200	
Rice husk				1,600
Technically Exploitable		150	900	
Economically Exploitable				
Municipal Solid Waste/ Landfill gas				
Technically Exploitable	>15	200	1,200	NA
Economically Exploitable				
PV Solar				
Technically Exploitable	59 communes and >3 mill households			
Economically Exploitable	59 communes		12	
TOTAL			11,726	

As reported in Section 2.1, the NHP Study looked at the hydropower projects in the technical/economic, environmental and social perspectives where the Normalized Total Preference Index (NTPI) was used for the ranking of the planned hydropower projects with the results as tabled in Appendix 2-3.

Some of the hydropower projects according to PDP VI were not included in the NHP Study and the following assumptions have been made in respect of these projects:

- Dong Nai 5 Hydropower Project, with supposedly low environmental and social impacts (no people to be resettled and part of a cascade development of Dong Nai River) and low economic viability, is assumed to have a NTPI between 60 and 65.
- A Luoi Hydropower Project, with supposedly high environmental and social impacts,

is assumed to have a NTPI below 60.

- Vinh Son II Hydropower Project, being an extension of an existing project, is assumed to have a NTPI higher than 75.

A high value of NTPI indicates a “good” project both in terms of the economic viability of the project, and the environmental and social impacts. In this Study, six scenarios have been developed, of which three are based on the NTPI as given in Table 2-5.

Table 2-5: Alternative Energy Scenarios

Scenario	Strategy
Base	According to PDP VI
Alternative 1	Hydropower projects with NTPI < 60 are replaced by thermal power
Alternative 2	Hydropower projects with NTPI < 65 are replaced by thermal power
Alternative 3	Hydropower projects with NTPI < 75 are replaced by thermal power
Alternative 4	All planned hydropower projects are replaced by thermal power
Alternative 5	The planned hydropower projects are not implemented and not replaced by thermal power

The alternative energy scenarios were based on the following criteria:

- Base Scenario according to the Recommended Power Development Plan resulting from the least cost expansion planning in PDP VI (Figure 2-2).
- Alternatives 1-3 based on the Normalized Total Preference Index (NTPI), as defined in Section 2.1, for the planned hydropower projects scheduled for commissioning after 2011 according to PDP VI and presently not under construction.
- Alternative 4 assuming that all planned hydropower projects scheduled for commissioning after 2011 according to PDP VI, and presently not under construction, would be replaced by thermal power (4,738 MW).
- Alternative 5 assuming that the planned hydropower projects scheduled for commissioning after 2011 according to PDP VI, and presently not under construction, would not be implemented and not be replaced by thermal power, i.e. the “do-nothing” alternative.

Viet Nam - Hydropower plants: Base Scenario

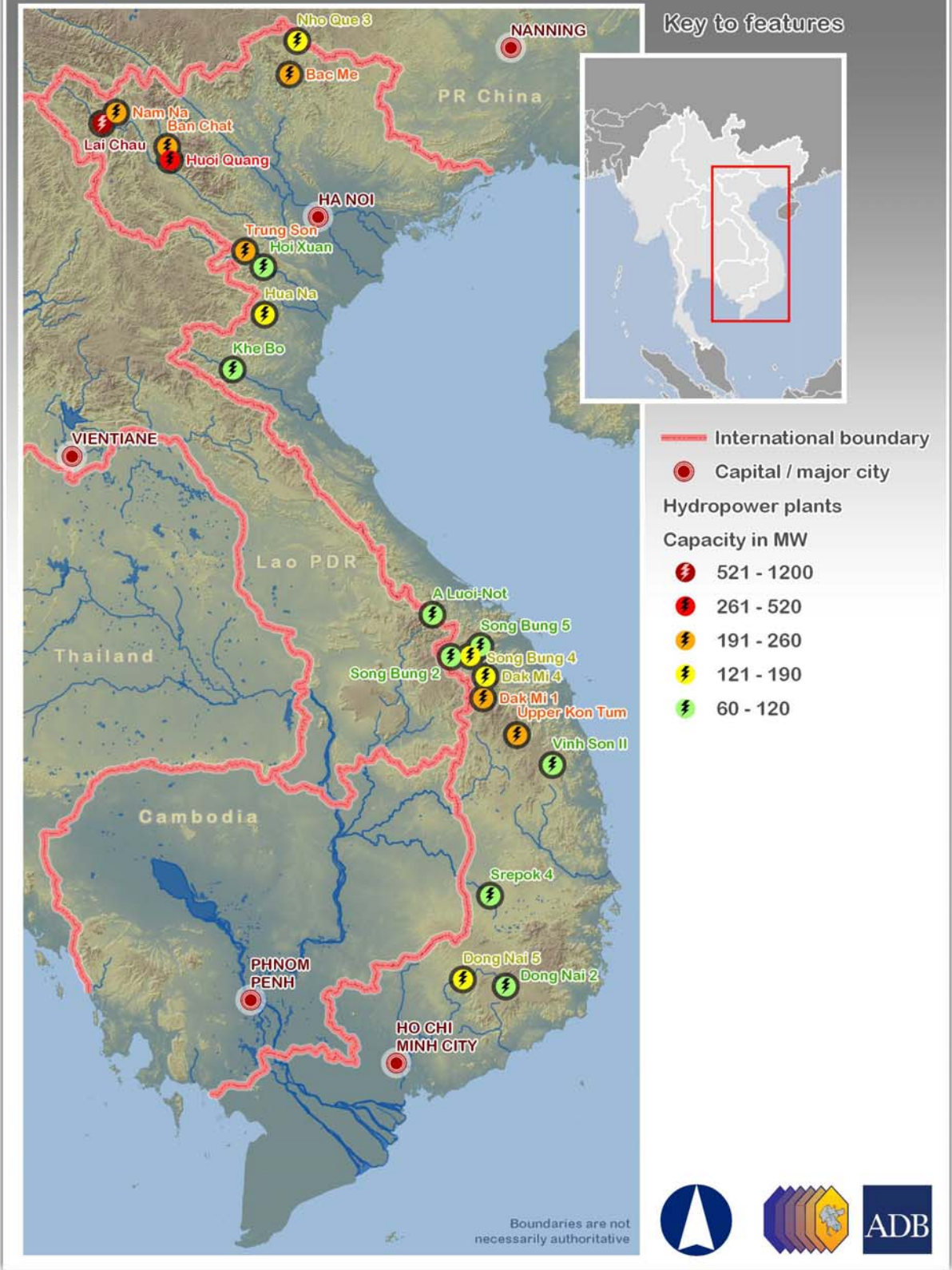


Figure 2-2: Base scenario according to the recommended power development plan. Maps on alternative energy scenarios 1-3: see appendix.

Table 2-6: Distribution of Energy Generation

Load	Time during the Day	Hours/Day	Incremental Hours/Day	Incremental Hours/Day %	Distribution in Energy Generation %
Base	0-24	24	6	25	0
Intermediate	6-22	18	12	50	70 (66.7)
Peak	10-12 and 17-19	6	6	25	30 (33.3)

According to PDP VI, hydropower will mainly be used for intermediate and peak loads, while the distribution in the future is difficult to estimate, however, covering the intermediate load being the dominant. In this Study the assumptions set out in Table 2-6 have been made regarding distribution of the different loads.

Based on Table 2-6, it has been assumed that the energy generation from the planned hydropower projects will be replaced by 70% from coal-fired thermal plants (for intermediate load) and 30% from gas-fired (CCGT) thermal power plants (for peak load), and the same distribution has also assumed in terms of replacement of hydropower capacity. This corresponds well with the distribution of additional thermal capacity for the period 2011-2025 where of the total coal- and gas-fired thermal plants of 53,514 MW, coal-fired accounts for 68% (36,290 MW) and gas-fired for 32% (17,224 MW).

It should however be noted that in order to correctly assess the replacement of the planned hydropower projects, the power system should be re-optimized for each of the scenarios above with the respective hydropower projects being taken out. This is however outside the scope of the present Study, but the assumption of replacement of 70% by coal-fired thermal power plants and 30% by CCGT is judged to be the best estimate without such a re-optimization.

The planned hydropower projects, and their locations, and the capacity balance for the Base Scenario and Alternatives 1-4 are given in Appendix 2-7 to Appendix 2-11, respectively. It should be noted that the installed capacities of the planned hydropower projects according to the NHP Study have been used.

2.2. Overview of the Environmental and Social Characteristics Related to PDP VI

The development of hydropower in any place, any country, has implications for a wide range of social and environmental issues. Of course, not all of these are relevant in all places and some will be far more important than others. This section discusses the range of issues that need to be considered in the assessment of social and environmental risks and impacts as part of a strategic planning process for the hydropower sector. It provides an understanding of the starting point for the **scoping phase** of the SEA process. This scoping, which should be as broad as possible in terms of stakeholders consulted, should start as broadly as possible and should, through consultation and consensus-building, focus down to a number of key strategic issues that there is a consensus over in terms of their importance for the SEA process. These key strategic issues are presented in section 2.3, below. The much longer list of issues that should be considered is discussed in the remainder of this section.

2.2.1. Social Issues

While most hydropower development takes place in the mountainous and upland areas, affected peoples are mostly ethnic minorities; that is these groups are of other ethnic background than the majority Kinh. As shown from numerous experiences in Viet Nam and elsewhere, these social and cultural differences have implications for the short and long term impact of hydropower development.

Generally, the ethnic groups in Viet Nam (including Kinh) represent a great variety in cultural traditions and languages. Historically, their worldview and cultural rituals to uphold it, is inherently linked to the different production systems in the lowlands as well as in the highlands. This relationship is particularly strong in the highland areas where alternative production systems have yet not penetrated in full.

Hydropower development will, intentionally or not, change the current livelihood and cultural patterns of the different ethnic groups and in different ways. Therefore, such development needs to be closely interlinked with the general social, cultural and economic development plans in each area.

Population Growth, Changes in Consumption Patterns and Electricity Demand

According to Power Development Plan VI, among five groups of electricity consumers, management and domestic consumption stays in second place accounting for more than 44%, only after consumption for industry and construction (about 46%). Though the share of electricity consumption for management and domestic will reduce to only 30% in 2025, it still accounts for a considerable share of total demand. The average electricity consumption per capita for household use in 2004 was about 484 kWh/year: a remarkably low level given Viet Nam's rapid development of recent years.

Population growth, urbanization and increased per capita electricity consumption will have a direct and considerable impact on future demand for electricity. Urban residents typically consumes more electricity than people living in rural areas. According to the Institute of Energy (2007), electricity consumption per capita in rural areas was only 122 kWh/person/year in 2004: the figure was 12 times higher for the urban population (1488 kWh). It is forecasted that urban population will increase from 27% in 2006 to 40% in 2025.

Resettlement and Hydropower Development

It is generally considered that resettlement should at least not worsen the situation of the displaced people. In fact, the intention of resettlement and compensation plans is to improve the living standard of the displaced people. Up to now, resettlement in Viet Nam has been aiming at stabilizing people's livelihoods in the short term, with the hope that this would lead to subsequent development. However, experiences show (Hoa Binh, Yali, Song Hinh) that in the long term, displaced people's living standard has not been improved. Rather, in many cases, the living standard has deteriorated, in particular when it comes to access to land of good quality and to the cultural and psychological dimensions of daily life such as opportunities to preserve and develop local traditions and habits and to take part in decision-making related to the displaced people's situation.

Generally, displaced people, of which a great majority are ethnic groups other than Kinh, has had difficulties in adapting to the new situation in the resettlement areas. This is not only due to the fact that the resettled areas are alien to the newcomers, but also that the host people often is of another ethnic group, that in-migration is attractive due to the 'new frontier' atmosphere, that new agricultural plants and techniques are introduced, that the existing forest is not open for exploitation, that the housing style and location is not according to the preferences of the displaced people etc.

Until now, there is no overall policy for resettlement and compensation in Viet Nam. Compensation is regulated in the Land Law (2003). At present, resettlement caused by hydropower is regulated at a project level, but investors, including EVN, must follow the provincial guidelines for resettlement. Unlike the environment sector, where EIAs nowadays are compulsory; there are still no obligations for social impact assessment. Resettlement and compensation caused by hydropower projects tend to only cover the short term impacts like loss of land, plants and houses. The long term impacts such as loss of the basis of livelihoods, and the implications of the new conditions for cultural traditions and for feelings of belongingness and opportunities to influence the new situation, have in the past not been satisfactorily addressed and compensated for.

Hydropower Development; Opportunities for Support to Poverty Reduction

Even if there is limited evidence so far in Viet Nam, in theory, hydropower development could contribute to poverty reduction in the areas where hydropower schemes are built. Whatever form it takes, there is little doubt that major infrastructure investments such as hydropower have a great impact upon the locality where it is constructed: the issue is whether this is beneficial in poverty reduction terms.

Experiences from Hoa Binh, Yali and Song Hinh show that one key issue concerns the affected people's participation in the planning and implementation of the hydropower construction. If information, options, alternatives and local participation in decision-making are at hand, affected people will take their responsibility and the basis for sustainable livelihoods could be established. Another key issue is that if all short and long term costs are taken into account, then hydropower development could also support poverty reduction in affected areas through enhancing positive development opportunities whilst effectively mitigating potentially negative impacts.

Devolution of Responsibilities to Lower Administrative Levels

In Viet Nam, the Grass Roots Democracy Policy is the basis for bringing lower levels in the administration system including villages into the decision-making system. Generally, the current 'socialization' policies also intend to bring responsibilities down to the lowest levels. In practice this often means that lower levels should take greater charge of development costs.

Until now, the role of the mass organizations¹³, led by the Fatherland Front, has been crucial and effective to bring in local people's interests into the focus of the development. Not the least, have the mass organizations assumed the tasks of managing credit schemes bringing them to the most remote areas and to people (often ethnic minorities) who then have been able to raise their living standard; where often women have been playing a key role.

Current trends of devolved decision-making and community participation in Viet Nam open up increased opportunities to involve local stakeholders (authorities, mass organizations and people) in hydropower planning. Until now, local stakeholders have typically not participated in feasibility studies and early stages of hydropower planning. In all cases so far, except the NHP Study, the participation, if any, starts only after the decision on a hydropower complex has already been made. Examples where local participation in resettlement planning and implementation have taken/are taking place are Song Hinh and Son La.

¹³ Farmers Association, Women's Union, Youth Union, Veterans Association

2.2.2. Environmental Issues

The range of adverse environmental and related social impacts that can result from hydropower projects is remarkably diverse. While some impacts occur only during construction, the most important impacts usually are due to the long-term existence and operation of the reservoirs. Other significant impacts can result from complementary civil works such as access roads, power transmission lines, and quarries and borrow pits.

With properly implemented mitigation measures, many of the negative environmental and related social impacts of hydroelectric projects can be reduced to very acceptable levels. As will be discussed later in this report, mitigation measures can effectively prevent, minimize, or compensate for most adverse impacts, but only if they are properly implemented.

There are however, environmental impacts which occur at some hydropower projects that cannot be fully mitigated. These include (i) irreversible biodiversity loss, if critical natural habitats not occurring elsewhere are submerged (or left dry) by the dam; (ii) fish passage facilities frequently cannot restore the pre-dam ecological balance of a river, in terms of species composition or fish migrations; and (iii) some cultural property (including sacred sites) cannot be adequately salvaged prior to reservoir inundation. Thus, because mitigation measures are often not fully implemented, and are sometimes inherently inadequate, the single most important environmental mitigation measure for a new hydropower project is good site selection, to ensure that the proposed dam will be largely benign in the first place. In the following summary of potential adverse environmental impacts and corresponding mitigation options, it is important to keep in mind that the risks associated with all of these types of impacts can be reduced through good project site selection.

Flooding of Natural Habitats

Some reservoirs permanently flood extensive natural habitats, with local and even global extinctions of animal and plant species. Very large hydropower reservoirs in the tropics are especially likely to cause species extinctions (although such losses are only infrequently documented due to the lack of scientific data). Particularly hard-hit are riverine forests and other riparian ecosystems, which naturally occur only along rivers and streams. From a biodiversity conservation standpoint, the terrestrial natural habitats lost to flooding are usually much more valuable than the aquatic habitats created by the reservoir. One occasional exception to this rule is that shallow reservoirs in dry zones can provide a permanent oasis, sometimes important for migratory waterfowl and other terrestrial and aquatic fauna.

Loss of Terrestrial Wildlife

The loss of terrestrial wildlife to drowning during reservoir filling is an inherent consequence of the flooding of terrestrial natural habitats, although often treated as a separate impact. Although they may be useful for public relations purposes, wildlife rescue efforts rarely succeed in restoring wild populations. Instead of drowning, the captured and relocated animals typically starve, are killed by competitors or predators, or fail to reproduce successfully, due to the limited carrying capacity of their new habitats. Wildlife rescue is most likely to be justified on conservation grounds if (a) the species rescued are globally threatened with extinction and (b) the relocation habitat is ecologically suitable and effectively protected. However, the money spent on rescue would usually do much more for wildlife conservation if it were invested in compensatory protected areas. The most effective way to minimize wildlife mortality in hydropower projects is to choose dam sites which minimize the wildlife habitat flooded.

Deterioration of Water Quality

The damming of rivers can cause serious water quality deterioration, due to the reduced oxygenation and dilution of pollutants by relatively stagnant reservoirs (compared to fast-flowing rivers), flooding of biomass (especially forests) and resulting underwater decay, and/or reservoir stratification (where deeper lake waters lack oxygen). Where poor water quality would result from the decay of flooded biomass, selective forest clearing within the impoundment area should be completed before reservoir filling.

Downstream Hydrological Changes

Major downstream hydrological changes can affect riparian ecosystems dependent on periodic natural flooding, exacerbate water pollution during low flow periods and increase saltwater intrusion near river mouths. Reduced sediment and nutrient loads downstream of dams can increase river-edge and coastal erosion and damage the biological and economic productivity of rivers and estuaries. Induced desiccation of rivers below dams (when the water is diverted to another portion of the river or to a different river) kills fish and other fauna and flora dependent on the river; it can also damage agriculture and human water supplies.

These adverse impacts can be minimized through careful management of water releases. Objectives to consider in optimizing water releases from the turbines include adequate downstream water supply for riparian ecosystems, reservoir and downstream fish survival, reservoir and downstream water quality, aquatic weed and disease vector control, irrigation and other human uses of water, downstream flood protection, recreation (such as whitewater boating), and, of course, power generation.

From an ecological standpoint, the ideal water release pattern would closely mimic the natural flooding regime. Dams that generate baseload electricity are typically more capable of replicating near-natural downstream flows than those that produce peaking power (where daily water releases may fluctuate sharply, often to the detriment of aquatic organisms that are adapted to less frequent flow changes). Environmental management plans for hydropower projects should specify environmental water releases, including for dams owned or operated by the private sector.

Water-Related Diseases

Some infectious diseases can spread around hydropower reservoirs, particularly in warm climates and densely populated areas. Some diseases (such as malaria and schistosomiasis) are borne by water-dependent disease vectors (mosquitoes and aquatic snails); others (such as dysentery, cholera, and hepatitis A) are spread by contaminated water, which frequently becomes worse in stagnant reservoirs than it was in fast-flowing rivers. Corresponding public health measures should include preventive measures (such as awareness campaigns and window screens), monitoring of vectors and disease outbreaks, vector control, and clinical treatment of disease cases, as needed. Control of floating aquatic weeds (see below) near populated areas can reduce mosquito-borne disease risks.

Fish and Other Aquatic Life

Hydropower projects often have major effects on fish and other aquatic life. Reservoirs positively affect certain fish species (and fisheries) by increasing the area of available aquatic habitat. However, the net impacts are often negative because (a) the dam blocks upriver fish migrations and affects downstream passage; (b) many river-adapted fish and other aquatic species cannot survive in artificial lakes; (c) changes in downstream flow patterns adversely affect many species, and (d) water quality deterioration in or downstream of reservoirs kills fish and damages aquatic habitats. Freshwater molluscs, crustaceans, and other benthic organisms are even more sensitive to these changes than most fish species, due to their limited

mobility. Management of water releases may be needed for the survival of certain fish species, in and downstream of the reservoir.

Fish passage facilities (fish ladders, elevators, or trap-and-truck operations) are intended to help migratory fish move upstream past a dam but are usually of limited effectiveness. Fish hatcheries can be useful for maintaining populations of native species which can survive but not successfully reproduce within the reservoir. They are also often used for stocking the reservoir with economically desired species, although introducing non-native fish is often devastating to native species and not ecologically desirable. Fishing regulation is often essential to maintain viable populations of commercially valuable species, especially in the waters immediately downstream of a dam where migratory fish species concentrate in high numbers and are unnaturally easy to catch.

Floating Aquatic Vegetation

Floating aquatic vegetation can rapidly proliferate in eutrophic reservoirs, causing problems such as (a) degraded habitat for most species of fish and other aquatic life, (b) improved breeding grounds for mosquitoes and other nuisance species and disease vectors, (c) impeded navigation and swimming, (d) clogging of electro-mechanical equipment at dams, and (e) increased water loss from some reservoirs.

Pollution control and pre-impoundment selective forest clearing will make reservoirs less conducive to aquatic weed growth. Physical removal or containment of floating aquatic weeds is effective but imposes a high and recurrent expense for large reservoirs. Where compatible with other objectives (power generation, fish survival, etc.), occasional drawdown of reservoir water levels may be used to kill aquatic weeds. Chemical poisoning of weeds or related insect pests requires much environmental caution and is usually best avoided.

Reservoir Sedimentation

Over time, live storage and power generation are reduced by reservoir sedimentation, such that much of some projects' hydroelectric energy might not be renewable over the long term. If effectively implemented, watershed management can minimize sedimentation and extend a reservoir's useful physical life, through the control of forestry, road construction, mining, agriculture, and other land use in the upper catchment area. Protected areas are sometimes established in upper catchments to reduce sediment flows into reservoirs, as in the proposed Nam Theun II (Laos) project. Aside from watershed management, other sediment management techniques for hydroelectric reservoirs may at times be physically and economically feasible; they include, among others, upstream check structures, protecting dam outlets, reservoir flushing, mechanical removal, and increasing the dam's height.

Greenhouse Gases

Greenhouse gases (carbon dioxide and methane) are released into the atmosphere from reservoirs that flood forests and other biomass, either slowly (as flooded organic matter decomposes) or rapidly (if the forest is cut and burned before reservoir filling). Many hydropower reservoirs flood relatively little forest or other biomass. Moreover, most hydropower projects generate sufficient electricity to more than offset the greenhouse gases which would otherwise have been produced by burning fossil fuels (natural gas, fuel oil, or coal) in power plants, see Section 5.2.2.

However, some projects which flood extensive forest areas, such as the Balbina Dam in Amazonian Brazil, appear to emit greenhouse gases in greater amounts than would be produced by burning natural gas for many years of comparable electricity generation.

Greenhouse gas releases from reservoirs can be reduced by a thorough salvage of commercial timber and fuelwood, although frequently this does not happen because of (a) high extraction and transportation costs, (b) marketing constraints, or (c) political and economic pressures not to delay reservoir filling. The surest way to minimize greenhouse gas releases from reservoirs is to choose dam sites that minimize the flooding of land in general, and forests in particular.

2.2.3. Impacts of Complementary Civil Works

Access Roads

New access roads to hydropower dams can induce major land use changes, particularly deforestation, with resulting loss of biodiversity, accelerated erosion, and other environmental problems. In some projects environmental impacts of access roads can greatly exceed those of the reservoir. The siting of any new access roads should be in the environmentally and socially least damaging corridors. Forests and other environmentally sensitive areas along the chosen road corridor should receive legal and on-the-ground protection. Road engineering should ensure proper drainage, to protect waterways and minimize erosion. Environmental rules for contractors (including penalties for noncompliance) should cover construction camp siting, gravel extraction, waste disposal, avoiding water pollution, worker behavior (such as no hunting), and other construction practices. See Ledec and Posas (2003) for details.

Power Transmission Lines

Power transmission line rights-of-way often reduce and fragment forests; indirectly, they occasionally facilitate further deforestation by improving physical access. Large birds are sometimes killed in collisions with power lines, or by electrocution. Power lines can also be aesthetically objectionable. Power lines should be sited to minimize these concerns and built using good environmental practices (as with roads). In areas with concentrations of vulnerable bird species, the top (grounding) wire should be made more visible with plastic devices. Electrocution (mainly of large birds of prey) should be avoided through bird-friendly tower design and proper spacing of conducting wires.

Quarries and Borrow Pits

Quarries and borrow pits are used to provide material for construction of the dam and complementary works. They can considerably increase the area of natural habitats or agricultural lands that are lost to a hydropower project. To the greatest extent feasible, quarries and borrow pits should be sited within the future inundation zone. Where this is not feasible, the pits should be rehabilitated after use, ideally for conservation purposes such as wetland habitats.

Associated Development Projects

Hydropower dams often make possible new development projects with major environmental impacts, including irrigation, urban expansion, and industrial facilities (due to new water supplies). New development projects should be planned to minimize adverse environmental and social impacts. Environmental impact assessment studies should be carried out in the early stages of project planning.

2.3. Strategic Issues for Hydropower Development in Viet Nam

Phase 1 of the SEA was a **Scoping Exercise** that addresses what strategic issues should be included in the SEA. This Scoping Exercise is based on **stakeholder consultations** with key individuals and institutions in Viet Nam. The purpose of the scoping process was to build a consensus on the current situation and the key issues that need to be considered in the execution of the SEA. The findings of this scoping process are presented here. All key government agencies, NGOs, donors and other stakeholders were consulted in the process.

The results of the interviews and discussions showed a strong consensus on some issues, divergent opinions on others: hardly a surprising result but nonetheless significant. It is worth noting that responses did not in any way follow institutional interests: the respondents

discussed the issues on their merits and demonstrated an awareness of the wider strategic significance of hydropower in contemporary Viet Nam.

Hydropower was seen as having an important role to play in the **long-term development of Viet Nam**. All respondents recognized the importance of meeting growing energy demand that reflects the rapid economic growth the country is experiencing. The significance of hydropower in ensuring **national energy security**, including reducing dependence on imported fuels such as oil and natural gas, was also seen as a significant issue by some, but not all, respondents. A wide range of **trade-offs** were recognized, including a consensus that the negative impacts of hydropower are not taken into account in hydropower planning. The overall trade-off between developments that can be favourable nationally but have negative local impacts was accepted as a reality that has to be managed with clear and fair rules.

The results of the consultations were presented to a stakeholder meeting in which the key strategic issues for hydropower development in Viet Nam were discussed. The consultation findings were an input to this discussion, but the discussion was wide-ranging and worked towards identifying the priority issues around which there was a consensus. **Five key strategic issues** emerged from the discussion as representing a consensus amongst the consultation respondents and meeting participants. These are:

1. The importance of hydropower for **economic development** in Viet Nam. Energy production including hydropower is fundamental for economic development which in turn is a pre-condition for establishing and maintaining social and cultural well-being. However, in order to obtain sustainable hydropower, there is a need to create a better economic balance between the beneficiaries of the energy production and related positive effects such as irrigation schemes, flood control, improved fisheries etc. and those who are negatively affected at least initially, because these two groups are usually not the same. There was a consensus in the scoping consultations on the need to plan and implement hydropower in a balanced and sustainable manner, but also a consensus that hydropower development is essential when alternative means of electricity generation are considered. The goal of optimizing sustainable hydropower development was agreed as expressing the consensus on this issue, with the recognition that the SEA needs to define precisely what sustainable hydropower means. As part of this, sustainable hydropower can be defined as where hydropower development is covering all costs, including full social and environmental mitigation costs, associated with its development.
2. The effective and sustainable use of **water resources**, which was recognized as a key for future hydropower development. Sustainable hydropower should take into account the fact that there is always competition of the use of water resources among different stakeholders in particular in a densely populated country as Viet Nam. Hydropower construction tends to mean a loss of access to water resources and has multiple impacts on people living in the future reservoir area, close to the hydropower site area and downstream including the estuaries of the rivers. In fact, the main criteria (except forest) for the local people, who are of ethnic minority origin, to choose a habitation area, is its proximity to a river. The river is essential for the daily livelihoods as it brings water for cooking, washing, irrigation and fisheries. This includes concerns over the allocation of water for other users within a river basin, water shortages (potentially made worse by climate change, and including possible impacts on hydropower scheme viability) and the need for integrated water resources planning and management in river basins.
3. Impacts on **project affected people**, and especially ethnic minorities, along with the process through which these impacts are compensated for. Project affected peoples

include several categories of people: (i) people who, because of resettlement, lose all assets such as housing, garden, land, plants, forest land, water resources, places of cultural importance such as holy forests, graves, place of worshipping; (ii) partially affected are people who do not relocate but loose at least one of the assets above; and (iii) a third group are people living upstream, downstream and at river estuaries, where access to and quality of water usually is the main concern. Concerns here were most clearly expressed in relation to the resettlement process, but wider livelihood impacts, concerns over the impact of the loss of land and forests and cultural impacts were also identified as concerns. People affected by hydropower development do not just need compensation to establish a kind of status-quo situation: they need investments in a range of areas to support sustainable livelihoods development such as good quality of land, forests, water, services support in form of agricultural extension and credit. The costs of these investments should be included in the hydropower development plans.

4. The maintenance of **ecosystems integrity**, both around the hydropower development site and downstream and recognizing the cumulative impact of multiple hydropower schemes within a river basin. All aspects of the environmental implications of hydropower development are important but the consensus was that many of these are already taken into account in existing environmental impact assessment procedures. Maintenance of the ecosystems is in the interest of the affected peoples. Given that most of the affected peoples are living from the nature resources in the uplands, they are also the main proponents to protect those resources. Also, nature has a value as a beautiful landscape not only for material but also for spiritual and cultural survival. A loss of ecosystems would also mean loss of opportunities to deliver environmental services (and get paid for it) to people downstream (in particular) and loss of income from visiting tourists. The wider and long-term impact on overall ecosystems integrity was recognized as the key strategic environmental issue for national hydropower development.
5. Different aspects of the **hydropower planning process**: many respondents felt that it is not possible to separate strategic policy issues from the process through which hydropower is planned, as the nature of the positive and/or negative impacts is largely conditioned by the way the planning works. Issues of balancing goals (social, economic and environmental) and of transparency and participation in planning were raised. The need to conform to international good practice was cited as an important issue. In line with the general decentralization process in Viet Nam and devolution of rights to participate and have an influence on decision-making processes, hydropower planning should also be part of this process. If local authorities (from provincial levels and downwards) and local groups at village level are informed and given opportunity to take part in the hydropower planning and the design of alternatives, their ownership and responsibility will increase as well as their readiness to sacrifice. Here the role of the local authorities is extremely important as they will have to be in charge of whatever short and long term impacts the hydropower site may have for the local people's livelihoods. Enabling local participation is contributing to sustainable hydropower development.

In order to develop a true participation of local authorities and peoples, the hydropower planning process needs to be transparent from the start and give alternatives for affected authorities and peoples to decide upon. The argument that hydropower construction is too technical for laymen to understand is not valid. Technical proposals can be re-written and informed in a simple way. For example, it is easy to understand the relationship between the height of a dam and the flooded area. In addition, local authorities and people are more knowledgeable than central planners tend to believe.

3. Natural, Socio-Economic and Environmental Conditions Related to the Power Development Plan

3.1. Overall Development Context and Trajectories

Viet Nam is in a period of rapid and sustained economic growth and transition from being a poor, centrally-planned economy dominated by agriculture to becoming a middle-income, market-based economy where industry and services are major and growing proportions of the national economy. Economic changes are paralleled by a social transformation, with an increasingly mobile population who are more and more living in urban areas and have changing consumption patterns and aspirations. At the same time, there is an increasing awareness of the dangers of uncontrolled growth and widespread concerns over the degradation of many aspects of the natural resource base and environment in Viet Nam. There is also an awareness that the increasing prosperity of the majority does not reach all sections of society, with some rural communities in more remote areas (many of whom are ethnic minorities) not benefiting from the country's economic development to the same degree as the rest of society. Poverty rates amongst ethnic minorities and in remote, mountainous areas are at least three times the national average and the gap is growing¹⁴.

Viet Nam is increasingly integrating into global processes and shows a commitment to meet international standards and obligations with regard to environmental and social development issues. There has been a significant shift in development thinking in the last two years, with a move from a "growth at any cost" approach to a desire to balance economic development, social equity and environmental sustainability in all areas of policy, investment and regulation: this is reflected in the focus of development plans and aspirations in Viet Nam and reflected in the 2006 – 2010 SEDP, discussed above. There is also an increasingly significant process of decentralization taking place that places responsibility for planning, budgeting and implementation of policies with province-level institutions. The government is also committed to policies of "grassroots democracy" and "socialization"¹⁵ that together foster community participation and encourage local level private sector development.

The more balanced approach to development is not seen as being at the expense of growth; indeed, there is a determination to maintain and enhance economic development to ensure that Viet Nam emerges as a developed country within the next twenty years. Rather, the focus is on the sustainability and quality of growth. With regard to electricity generation, the rate of growth of demand is extremely high (see section 3.4 below), and the government is aware of the social and economic costs of not meeting this growing demand. This is reflected in the high level of investment plans included in PDP VI, which sets the context for understanding the assessment of the social and environmental implications of hydropower development. The key issue is consequently not "hydropower or no hydropower", but is rather "if not hydropower, what alternative source of power generation".

¹⁴ See Scervini, F. (2005) *Income level and Distribution in Viet Nam: A Territorial Analysis* ISESIO, Milano, for a fuller discussion of this issue.

¹⁵ The concept 'socialization' is under debate in Viet Nam. Critical voices argue that it covers the intention of the central authorities to delegate costs down to local level; in other words: local people will have to carry the burden of commitments made at higher levels.

3.2. Baseline of the Environmental Situation

3.2.1. Overall Setting

This section provides an overview of the key environmental information related to hydropower development for Viet Nam. The full environmental baseline assessment is provided in Appendix 3-1. Viet Nam shares its borders and natural river, forest and mountain systems with China, Cambodia and Lao PDR. The S-shaped country has a north-to-south distance of 1,650 kilometres and is about 50 kilometres wide at the narrowest point in Quang Binh province while the widest point from the East to West is 600 km. Viet Nam has a coastline of 3,260 kilometres, excluding islands. Viet Nam is a country of tropical lowlands, hills, and densely forested highlands, with level land covering no more than 20% of the national area. The country is divided into the highlands and the Red River Delta in the north; the Gai Truong Son (Central Annamite Mountains) forming a backbone along its western border, the coastal lowlands, and the Mekong River Delta in the south.

Viet Nam has a tropical monsoon climate, with humidity averaging 84% throughout the year. However, because of differences in latitude and the marked variety of topographical relief, the climate vary considerably from place to place. Annual rainfall is substantial in all regions and torrential in some, ranging from 1,200 mm to 3,000 mm. Viet Nam has a mean annual rainfall of 1,940 mm and the total volume of 640 billion cubic metres per year, which ranks it as one of the world's highest rainfall countries. However, rainfall is unevenly distributed in both space and time. Rainfall mostly occur during the 4-5 month rainy season, and accounts for 75-85% of the year's total precipitation. The rest, approximately 15-25%, falls over the 7-8 month dry season.

Viet Nam has 2,372 rivers which are over 10 km long and have a perennial flow. If rivers are classified according to basin area, there are 13 rivers whose basin area is over 10,000 km², of which 9 are major rivers (Red, Thai Binh, Bang Giang-Ky Cung, Ma, Ca, Vu Gia-Thu Bon, Ba, Dong Nai and Cuu Long) and 4 branch rivers (Đa, Lo, Se San, Sre Pok). 10 out of these 13 rivers are international rivers; and the out-of-border basin area is 3.3 times larger than the within-border basin area. The basins of the nine major rivers account for almost 93% of the total basin area of the river network, and the within-border section represents approximately 77% of the total country area. The Mekong River's total runoff accounts for 59% of the total national runoff, followed by the Red River with 14.9%, and the Dong Nai River with 4.3%. The runoff of Ma, Ca, and Thu Bon is approximately 20 km³ each.

Many parts of Viet Nam are increasingly susceptible to floods and/or droughts and severe floods are occurring with higher frequency. Flash floods are a particular hazard in many mountainous areas, especially in the central regions of the country, whilst lowland areas and the two main deltas experience some level of flooding in most years. Droughts are an emerging problem as demand for water grows, and are particularly an issue in the southern and central parts of the country during the dry season when river flow volumes account for only 15 - 25% of the total annual flow. In the dry season, groundwater is the main source to supplement water from rivers, and in this season many rivers in the coastal areas, especially in the southern centre, runs dry.

There is increasing evidence that pollution associated with rapid urbanization and industrial development is a concern in many parts of the country, affecting water courses and urban air quality in particular. These problems are of particular concern in coastal areas and around cities and industrial zones, locations that are distant from most hydropower development sites in mountainous areas. More localized and non-point pollution from village-based industries and agricultural chemicals is also an issue in many places, again reflecting rapid and, at times, poorly controlled development pressures with inadequate systems of environmental

monitoring and protection. Detailed data on water and air quality is lacking and it is difficult to assess just how widespread or serious these problems are.

3.2.2. Agro-ecological zones

Based on topography, soil patterns and climate, Viet Nam can be divided into 7 agro-ecological zones. As these zones are utilized in the macro-level planning process, they provide a convenient framework for ecosystem analysis in strategic environmental assessment and planning.

Zone 1: Mountain Region and Middle-Land of the North: this zone covers hilly and mountainous land in 9 provinces of the NE, N, NW and W of the Red River Delta. Total area is approximately 10.2 million ha. Population, including ethnic minorities, is around 12.4 million people and population density is about 120 people/km². Elevation ranges from 100 – 3,143 m above sea level. The mean annual rainfall varies between 1,600 – 2,500 mm with the rainy season lasting from April to October and the dry season from November to April. The zone is cool during the NE monsoon from December to March and suffers from cold spells with acute frost in higher areas.

Soil erosion is without doubt the principal constraint to agriculture development of this zone. Some 60% of the land area is estimated to suffer from soil erosion and/or land degradation as a result of deforestation and shifting cultivation.

Zone 2: the Red River Delta consists of alluvial plains, tidal flats and back swamps in 7 provinces which make up the Red River Delta. Total area is 1.25 million ha and total population is around 14 million with a population density of about 1,124 people/km². Elevation is generally little more than a few meters above sea level. Some 90% of the RRD is presently cultivated, the remaining 100,000 ha being located along the coast. Approximately 70% of the cultivated area is served by irrigation and flood control. The remaining 30% is drought prone in the dry season and subject to flooding during the rainy season. Rice is the dominant crop, with average paddy yield around 7 t/ha from 2 crops (summer and spring). Maize is grown in spring or winter, while other subsidiary crops include sweet potato, potato, groundnut, and a variety of temperate vegetables.

Zone 3: Northern Part of the Central Coastline: this zone encompasses the six northern coastal provinces of Thanh Hoa, Nghe An, Ha Tinh, Quang Binh, Quang Tri, Thua Thien – Hue, with a total area of about 5.2 million ha. Total population is about 10 million and population density 190 people/km². Some 80% of the total area is covered by hills and mountains with elevations ranging from 100 – 2,711 m above sea level. The remaining 20% is made up of narrow coastal lands, sand dunes and estuarine flats. The weather varies but Hue City is amongst the wettest parts of Viet Nam, with a mean annual rainfall of 2,890 mm. This area is subject to typhoons and floods, which tend to be more severe in recent years. Agricultural yields are often low, being hindered by weather uncertainties, low levels of investment and poor market access. Degradation of natural forests in uplands and establishment of extensive industrial plantation for wood chip production along the lower/coastal areas is taking place in this zone. Watersheds are often small (generally less than 50 km²) and most of the many rivers are short and steep – a factor which is, together with deforestation, explaining the increased incidence of flash floods.

Zone 4: Southern Part of the Central Coastline: this zone covers the eight southern coastal provinces of Quang Nam, Quang Ngai, Binh Dinh, Phu Yen, Khanh Hoa, Ninh Thuan, Binh Thuan and Thuan Hai with a total area of about 4.5 million ha and a population of some 7.5 million people (density 167 people/km²). Some 70% of the total area consists of hills and

mountains with elevations ranging from 100 – 2,287 m above sea level. The remaining 30% is narrow coastal lowlands and plains, sand dunes, and small estuarine flats. This is the driest area of Viet Nam. Mean annual rainfall at Nha Trang is 700 mm and the dry season lasts for 6 – 7 months. Salinity and alkalinity of water and soils and dune sand encroachment are problems in many areas. Watersheds are relatively small and rivers are short and steep. Deforestation and shifting cultivation is a major cause of soil erosion and flash floods are common in hilly and mountain areas. In contrast, in the lower/coastal areas, industrial plantation development is greatly facilitated by good access to a system of wood-processing facilities installed around ports.

Zone 5: the Central Highlands (Western Plateau) cover approximately 5.6 million ha distributed in the provinces of Gia Lai, Kon Tum, Dak Lak, Dak Nong and Lam Dong. This zone is basically a plateau draining to Laos and Cambodia in the west. Elevations range from 100 – 2,598 m above sea level, but much of the plateau is above 1,000 m. The rainy season occurs between April – October, coinciding with the SW monsoon. Mean annual rainfall is around 2,280 mm and temperature varies between 21 - 23° C. Coffee is the most important cash crop followed by rubber, tea, pepper, fruit trees, cocoa, mulberry, and temperate vegetables and flowers. Water shortage, especially with the prolonged dry season, conversion of natural forests into these cash crops and spontaneous migration of people from the North and Mid-Lowlands are amongst the most pressing issues of the area. Extensive hydropower development is planned for many of the central highland provinces.

Zone 6: North-East South: located between Mekong Delta to the South and Central Highlands to the North, this zone has a total area of about 2.4 million ha and a population density of 378 people/km². Topography is predominantly undulating to rolling. Elevations range between 100 – 1,000 m above sea level, but the majority of the zone is below 500 m. Mean annual rainfall is some 2,000 mm and the mean annual temperature is 26° C. The rainy season occurs between April – October, and the dry season extends from November to March. Soil degradation, rather than erosion, is the main constraint to agricultural development. The old alluvium parent material is low in inherent fertility and relatively acid. In addition, the legacy of chemical defoliants is still said to be felt in the West of the zone. The fastest rate of urbanization and industrialization in Viet Nam is taking place in this area. As a result, agriculture becomes less dominant, and the emerged shortage of labour force is expected to escalate in near future.

Zone 7: the Mekong Delta covers 11 provinces and has a total area of some 4 million ha. The population totals at about 16.0 million and the population density is 400/km². The topography is level to gently undulating and slope gradient is slight. Mean annual rainfall is around 2,000 mm and the majority of the rain falls between June and November, but water availability is closely linked with the seasonal flow of the Mekong River. Its flow is strongest during the rainy season and at its peak 70 – 80% of the delta is flooded to depths between 1 – 4 m. In the dry season this situation is reversed, drought stress is common and there are shortages of fresh water, especially in the Plain of Reeds and the Ca Mau Peninsular. Intensive rice production is carried out over 2.5 million ha of fertile alluvial soil adjacent to Mekong River and its main distributaries.

3.2.3. Aquatic Ecosystems

Viet Nam has a very rich and diversified freshwater ecosystem with various kinds of flora and fauna - planktons, algae, plants, wetland weeds, invertebrates and fish. It is estimated that there are 20 types of freshwater seaweed; 1,402 algal species; 782 invertebrate animals; 547 types of fish (60 of which are endemic); and 52 types of crab.

Brackish and sea water ecosystems are highly diversified mixed with high levels of endemism and regional differences. Currently, around 11,000 floating flora species and sea species have been identified, including: 537 floating flora; 667 seaweeds; 657 floating fauna; around 6,000 bottom species; 225 types of shrimp; 2,038 types of fish; and nearly 300 types of coral. Beside these, there are about 50 species of sea snakes and other poisonous algae.

Viet Nam possesses a huge number of freshwater, brackish and sea water swamps. Most of them are in the Red River and Cuu Long River deltas and along the 3,260 km long coastal zone. Although Viet Nam has many wetlands that meet “standards of internationally important wetlands”, there is only one wetland, the Xuan Thuy conservation site, which is listed under the Ramsar Convention.

3.2.4. Coastal Ecosystems

Viet Nam has more than 3,000 km of coastline dotted with numerous estuaries, lagoons, marshes, sand dunes and beaches, over 3,000 islands, and an extensive and shallow continental shelf. The coastal ecosystems include mangrove forests in the North and the South, sandy lands largely covered by casuarina plantations in the central Viet Nam, and, to a certain extent, Melalauca forests in Mekong Delta.

Mangrove communities span the interface between marine and terrestrial environments, growing at the mouths of rivers, inter-tidal swamps and along coastlines where they are regularly inundated by salty or brackish water. The critical role of mangrove forests in maintaining coastal ecology, settlements and infrastructure make them a focus of conservation effort. Over the second half of the 20th century, about 62% of mangrove forest were lost (from 409,000 ha as of 1943 down to 155,000 ha in 1999), initially due to warfare damage, and later through massive expansion of shrimp farming.

3.2.5. Forests

Because of Viet Nam’s shape, topography, climatic conditions, and location along mainland Asia’s south-eastern edge, the country holds a great variety of forest ecosystems within its boundaries. Lowland evergreen forests occur where annual monsoons and local topography generate high rainfall and regular fogs and mists. These forests are the most threatened as their accessibility places them under the greatest pressure from exploitation, cropping and development. Semi-evergreen lowland forests, characterized by a mixture of evergreen and deciduous trees, grow in areas with moderate yet highly seasonal rainfall of 1,200 – 2,000 mm per year. They are often found as riverine or gallery forests lining rivers and streams in areas with long dry seasons from Quang Ninh Province in the north to Tay Ninh Province in the south. Semi-evergreen forests experiencing relatively short dry seasons on the Annamite Mountain’s eastern slopes, where most of the rivers in the central Viet Nam begin, in contrast with drier formations on the western slopes in Laos and Cambodia.

Highland forests are home to most of watersheds and protected areas of Viet Nam. They coincide with most of the existing and proposed hydropower development in Viet Nam. There are many forest formations in the highlands. Of great significance are limestone/karst forests and montane forests. Forests growing over limestone are different in structure and species composition from other forest formations, harbouring a large number of species per unit. Most trees growing on limestone are adapted to the low water supply and nutrient levels and the high concentrations of calcium and magnesium.

Montane forests are found across the uplands of the northern Viet Nam, extending southward along the Truong Son Range and terminating in south-central Viet Nam's Da Lat Plateau. These regions are distinguished from adjacent lower lands by higher rainfall, shorter dry seasons, and cooler temperatures. Montane forests begin at elevations of 700 – 1,200 m, depending on latitude and local conditions. All are evergreen, and the dominant species may be broad-leaved, conifers, or a mixture. Viet Nam's montane forests stand out for their high richness of conifer trees and rare, threatened endemic primate populations.

All forest types have experienced degradation over the last several decades, with these pressures particularly affecting mangroves, lowland tropical moist forests and forest areas close to centres of rapid population growth. There has been some reversal of the trend in terms of overall forest coverage over the last decade, due in no small measure to the government's 5 million hectare programme, but the evidence available suggests that the quality and variety of the reconstituted forest areas is below that of the remaining natural forests. There has also been a rapid growth of plantations of various sorts, again increasing the area covered by trees but adding little to biodiversity.

3.2.6. Agricultural land

Viet Nam is predominantly an agricultural economy, based on paddy rice production. The sector (including crop cultivation, animal husbandry, aqua-culture, agro-processing, agro-forestry) accounts for 34% of the country GDP value and 30% of the national income. The sector employs about 62% of the national labour force, accounted for 16.5% of the state investment and produces 35% of total export. Of the total national area of about 33.3 million ha, about 19.5 million ha is now under "productive" use, of which 35% (7.35 million ha) is for agriculture and the remainder under forests. Viet Nam's land endowment is unequally distributed geographically: in the South, the Mekong Delta accounts for 40% of both Viet Nam's cultivated area and its food production, but only 24% of its rural population. The RRD, with 13% of cultivated area, has 22% of the labour force, and accounts for 18% of food production. In recent years, productivity has increased to the point where Viet Nam can satisfy domestic needs and export 3 – 4 million tons of milled rice annually making it the second ranked rice exporter worldwide.

3.3. Baseline of Social Situation

This section provides an overview of the key social and demographic issues relevant for hydropower development in Viet Nam (see Appendix 3-2 for a more detailed appraisal of these issues). It reflects the dynamic changes happening in Viet Nam in relation to where people live and how they participate in major developments that affect their lives. The major part (over 90%) of Viet Nam's 84 million people live in the lowlands, concentrated to the two large river delta areas of Red River in the north and the Mekong River in the south and along the coastal regions. The rest of the country's area (or about 70%) consist of ranges of mountains and high plateaus partly covered by forest and is by comparison scarcely inhabited.

Although the population growth rate slowed down between 1996 and 2006 (from 1.6 to 1.26%) Viet Nam's population is still growing with about 1 million persons per year: from about 72 million persons in 1995 to more than 84 million persons in 2006 (GSO, 2006). Population growth rates vary considerably between regions. High growth rates are found in the North West, Central Highland and South East with 1.71, 2.33 and 2.27% in 2006 respectively. In contrast, the lowest population growth rates occur in the North Central (0.6%) and the Mekong River Delta (0.92%).

The proportion of urban population increased from 20.7% in 1995 to 27.1% in 2006 (GSO, 2006). The proportion of urban population is highest in the South East (about 55%) – where Ho Chi Minh city and large industrial parks in surrounding provinces such as Dong Nai, Binh Duong and Ba Ria-Vung Tau are situated. Proportions of urban population are lowest in the North West (13.9%) and North Central (13.7%).

Within 12 months prior to April, 2006, there were more than 337 000 persons moving between regions, equaling to about 4‰ of the total population. The figure is about 20% higher compared to the same period of 2005 (3.4‰). Out of 8 regions, only the Central Highlands and the South East receive more migrants with positive net migration rates of 1.4‰ and 10.4‰ respectively. The South East is still the most attractive place for migrants i.e. the net migration rate increased 3.2% compared to 12 months prior to April, 2005. Major cities and industrialized provinces, i.e. Ho Chi Minh city, Hanoi and Binh Duong are most attractive for migrants. Out of the 486 000 migrants, Ho Chi Minh city receives nearly 158 000, followed by Hanoi with more than 49 000 and Binh Duong with 36 000. The three cities/provinces account for half of the total migrants between provinces.

In 1999 ethnic minorities accounted for almost 14% of the population. The ethnic minority population is unevenly distributed between regions and is concentrated to the mountainous and upland areas such as North West (79%), North East (41%) and Central Highland (33%). Provinces having minority population of more than 70% are mainly in the North of the country i.e. Cao Bang, Ha Giang, Tuyen Quang, Lao Cai, Dien Bien, Lai Chau, Son La and Hoa Binh (website www.gso.gov.vn). It is notable that the areas where ethnic minorities are concentrated, in mountainous areas in the north and centre of the country, are precisely the areas where the majority of new hydropower schemes are planned for.

3.3.1. Sources of Income

Localizing sources of income to the different regions in Viet Nam will give a picture what regions are mostly dependant on farming, non-farming and income from wages or daily labour. In general, there are three main sources of income accounting for roughly one third each: income from salary/wage, from agriculture, forestry and fishery and from industry, trade and services. Sources of income sources vary greatly by region. Income from salary/wage accounts for nearly 40% each in the Mekong River Delta, South Central and Red River Delta. Income from agriculture, forestry and fishery makes up for about half of the total income in the North West and the Central Highlands.

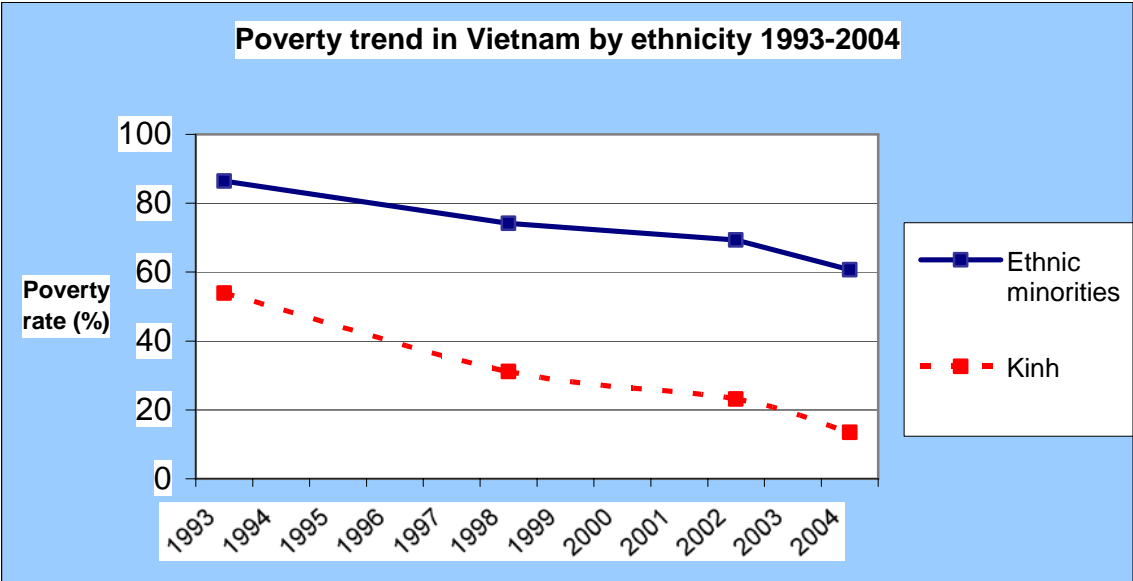
The monthly income per capita doubled from about 230,000 VND in 1996 to 480,000 VND in 2004. Similar patterns are found in all regions. Monthly income varies by region. In 2004, the highest monthly income was 883,000 VND in the South East, almost doubled the second highest region, i.e. Red River Delta with 488,000 VND, and three times higher than the lowest monthly income region, i.e. North West with 265,700 VND. The income gap tends to increase in poorer regions such as the Central Highlands, the North East and the South Central. Income gaps are generally higher in mountainous regions than in major cities.

3.3.2. Poverty Incidence

Poverty reduction work has made great progress in Viet Nam. According to the 2007 Viet Nam Development Report (World Bank, 2007) and GSO (2006), the general poverty rate decreased from 58% in 1993 to 37.4% in 1998 and 19.5% in 2005. During the same period, the poverty rate among ethnic minorities decreased from 86% in 1993 to 61% in 2004.

At the provincial level, a food poverty rate of more than 10% is mostly found in provinces in the North East, North West, North Central and the Central Highland. The figures are especially high, i.e. more than 20%, in provinces such as Cao Bang, Bac Kan and Lao Cai, in the North East, Dien Bien, Lai Chau and Hoa Binh, in the North West and Dak Nong in the Central Highlands. The above evidence is consistent with the findings from the 2007 Viet Nam Development Report (World Bank, 2007) that food poverty is still prevalent among ethnic minorities. Ethnic minorities account for only 14% of the total population but make up 39% of the total poor persons.

Figure 3-1: Difference in Poverty between Kinh and Ethnic Minorities



Source: GSO

3.3.3. Situation of Ethnic Minorities

While most hydropower development takes place in the mountainous and upland areas, affected peoples are mostly so called ethnic minorities; that is these groups are of other ethnic background than the majority Kinh. As shown from numerous experiences in Viet Nam and elsewhere, these social and cultural differences have implications for the short and long term impact of hydropower development.

Viet Nam has 54 ethnic groups, of which the Kinh majority constitutes more than 86%, while the other 53 ethnic minority groups make up for about 14% of the total population. Ethnic minorities groups in Viet Nam vary largely in size. According to the 2006 census, 5 groups had over one million people and at the end of the spectrum 17 groups had less than 10,000 people and some groups less than 1,000 people.

Generally, the ethnic groups in Viet Nam (including Kinh) represent a great variety in cultural traditions and languages. Historically, the worldview and following rituals to uphold it is inherently linked to the different production systems in the lowlands as well as in the highlands. This relationship is particularly strong in the highland areas where alternative production systems have yet not penetrated in full.

The nature conditions in Viet Nam are varied and rich, and specific micro-climates in the mountainous regions offer opportunities to develop produces and skills that cannot be found

elsewhere. Historically, this is precisely what the different ethnic groups in the highlands have been living from, more or less in connection with the majority society in the lowlands. Rich and dense forest has been the basis for shifting cultivation which included a great variety of crops, from daily goods, such as rice, to cash crops such as cinnamon and other produces particular for the highlands. Except for timber, the forest also offered a great variety of what now is called non-timber forest products such as rattan, mushrooms, and plants used for medical purposes. Hunting was an important part of income and for own consumption. The rivers were always the veins in the body of the highlands, offering important sources of protein, such as fish and water for drinking, washing and bathing. Land and forest had no clear individual owner, but was claimed and managed based on needs at village level, often in the name of the Village Head. Education and health facilities in the modern terms hardly existed.

This pattern of livelihood is gradually disappearing due to new needs and demands of the society as a whole and of the ethnic minorities themselves. The challenge has been to develop a social welfare system that is suitable for both the conditions in the lowlands and in the highlands. Given that this is not an easy 'project' and that poverty is defined from the lowlands' perspective, the ethnic minorities in the highlands are founding themselves to be poor in comparison with their fellow countrymen living elsewhere or even with those lowlanders who migrated to the highlands. The poverty factor is also increased by the fact that the ethnic minority groups increasingly are demanding 'welfare' produces such as TV, motorbikes, and other expensive consumables.

Infrastructure in form of roads, electricity, schools and health clinics always arrived later to the mountainous areas and as a result its dwellers always felt more isolated from the mainstream society. Education is a typical example as the Vietnamese language, being a totally different from practically all minority languages, is compulsory in the education system. Thus, children who did not grow up with Vietnamese as their first language will be 'disabled' from the start. As the education system cannot offer all three levels of basic education¹⁶, pupils either go for boarding schools offered in town centers or finish school earlier (also much depending on the social situation of each household). For example, many children, and very often girls, drop out already during primary school due to demands of labour and other reasons.

Thus, if poverty is measured in terms of lack of land certificates, lack of capital, distances to markets, access to education, health and information, ethnic minorities living in the mountainous areas are unavoidably poor.

Generally, and as a consequence of the above, the process of poverty alleviation has been much more rapid for the Kinh population than for the ethnic minorities. In 2004, 61% of ethnic minority people were still living in poverty, while only 14% of the Kinh population. The gap in welfare between the majority and minority groups has grown over the decade, resulting in a situation where ethnic minorities are 39% of all poor people, despite representing only 14% of the total population of Viet Nam. This represents a near-doubling of the proportion of ethnic minorities in the poor population in eleven years. The poverty gap between Kinh and ethnic minority groups is thus widening. If these trends remain unchanged, this graph suggests that poverty in five years' time will be an issue of ethnicity.

As outlined above, there are several factors leading to the relative poverty of ethnic minority people in Viet Nam. Most ethnic groups are living in disaster prone areas where droughts and

¹⁶ Three levels divided into primary school (grade 1-5), lower secondary school (grade 6-9) and upper secondary school (grade 10-12)

floods are common. While the basis of living is agriculture and forestry, the status and quality of nature resources are decisive for sustainable development.

Also, ambitious government programs such as the ‘Fixed cultivation and settlement’ program that started in 1968, has only partly being able to solve the issue of improved livelihoods for ethnic minorities in the mountainous areas. Regarding shifting cultivation as a major contribution factor to deforestation, the government has tried to encourage the shifting cultivators to move ‘down the mountains’ and at the same time bring in wet-rice growing into the valleys and cash cropping in the high plateaus such as in the Central Highlands.

In addition, ethnic minorities are not yet fully used to the conditions of the market economy where price information and negotiation skills are important. Other constraints have been the notion that ethnic minorities can only ‘develop’ if they are receiving resources brought in from outside, neglecting that people in the mountainous areas have knowledge and skills that are suitable for the nature conditions in those areas.

3.3.4. Participation and Decision-Making

‘Public participation, ‘stakeholder participation, ‘citizen participation’, ‘people’s participation’ are internationally among the most commonly used terms to describe an increasing concern of the value of local engagement of those directly affected by various national or local interventions. This is an indication that representative democracy is not a sufficient mechanism to answer to local interests and demands. One example reflecting the current discussion in Europe on the state-citizenship relationship in policy-making is the OECD publication ‘Citizens as Partners’ (Gramberger, 2001) where information, consultation and active participation in decision-making are the core issues.

There are reasons to underline the difference between ‘participation’ and ‘consultation’. While both concepts have their own value, they should not be mixed up. ‘Participation’ usually includes decision-making by concerned parties while ‘consultation’ is hearing different actors’ views without any commitment to transform these views into decisions.

Participation in Viet Nam so far largely takes place in Government and donor supported development projects at local level. An example is the recent document produced by the Ministry of Labour, Invalids and Social Affairs on training material for commune and village staff in poverty reduction where the methodology is entirely built on Participatory Rural Appraisal (PRA) tools. (Bo Lao Dong – Thuong Binh va Xa Hoi, 2007). Lessons learned by donor supported projects are numerous.

Public participation in integrated water resource management is still limited in Viet Nam. (Hiort and Pham, 2004). Earlier experiences from the construction of the Hoa Binh Hydropower Plant reveal that virtually no participation or consultations took place among the affected peoples and their representatives in form of local governments at provincial, district and commune levels. Still many years after the Hoa Binh construction, the problems around resettlement are still not fully addressed as commented by VUSTA (2007) in an assessment of the recently adopted Power Development Plan VI.

Even when a limited participation in the resettlement scheme itself takes place, lack of considerations of the long term impacts of involuntary resettlement leads inevitably to impoverishment. This is because the costs for reconstruction of affected people’s lost livelihoods are not included in the total costs of the hydropower construction. (Lindskog and Vu, 2004).

Recent and ongoing resettlement schemes in Viet Nam such as Pleikrong (Dao, 2006) and Son La (VUSTA, 2006) show that the resettlement and compensation plans are increasingly more participatory and fair. However, the lack of productive land is still the major issue.

A major input in the planning of hydropower in Viet Nam, has been the National Hydropower Plan Study (NHP) supported by Sida and Norad. Starting in 1999, the second phase was finished in 2006 with a Final Report produced in 2007 (EVN, 2007). The NHP study does not specifically deal with resettlement issues as such but rather with participatory approaches to hydropower planning. The way participation is understood in the NHP is creating opportunities for ‘stakeholders’, such as affected peoples and their representatives, and external organizations to be informed and consulted. This was done through regular workshops and meetings in affected areas.

Experiences in Viet Nam and elsewhere reveal that local people’s participation in decision-making increase the opportunities of sharing responsibility between authorities and affected people. Examples from hydropower development in Viet Nam (Song Hinh) show that when the resettled Ede and Bana ethnic people were invited to take part in deciding the location of the resettlement, the new village plans and the type of housing, they took their part of the responsibility for the implementation.

Adequate and understandable information and transparency in decisions and performance are pre-conditions for well performing participation in all types of projects, including hydropower construction. Examples in Viet Nam can be found in Song Hinh (Lindskog & Vu, 2004).

3.4. Baseline of Economic and Energy Supply Situation

3.4.1. The Power Sector in Viet Nam: Issues and Challenges

Viet Nam had sustained a high growth of 14.2% in electricity demand during the period 1990 – 2003 and during the recent years the growth rate has further increased to 15.2% (see Appendix 3.3). Electricity production in 2006 was 59 TWh, being 14% higher than 2005. Demand for electricity is projected to grow at a very high rate (e.g. 15%/year to 2010 and 11 %/year to 2015). Meeting this rapidly growing demand in order to ensure uninterrupted supply for economic production, as well as for satisfying burgeoning domestic demand for electricity, is the most challenging task facing the power sector in Viet Nam. To meet this challenge requires mobilizing adequate capital for investment in generation, transmission and distribution; implementing an appropriate tariff structure so as to stimulate rational consumption patterns; reforming the sector to facilitate competition; creating appropriate regulatory mechanism to manage the sector under a more competitive environment; managing environmental impacts while ensuring financial viability of the utility. Maintaining adequate investments to meet the rapid growth in demand for electricity is also a formidable task.

The development of a competitive power market as envisaged in the Electricity Law (effective July 2005) is to develop a power market on the principles of transparency and competition to achieve economic efficiency, to attract investments from both state and non-state sectors and to ensure the legitimate rights of the consumers and the investors. The Law states that the state monopoly would be limited to power transmission, national load dispatch and strategically important large power plants. This leaves the power distribution and non-strategic power generation to potential private sector investors. The Law specifically encourages investments from foreign private investors, and joint ventures between foreign investors and domestic enterprises. Subsequent to the enactment of the Electricity Law, the Electricity Regulatory Authority (ERA) for the power sector has been established. EVN’s

cooperate restructuring program is planned to be completed by 2008, before the establishment of wholesale competitive power market in 2009.

For a long period of time the cross sector average electricity tariff stood at 5.2 US cent/kWh, significantly below the long-run marginal cost of supply, LRMC, estimated at 7.5 US cent/kWh. EVN has planned to raise the tariff to the level that sustains the investment in system capacity, but the government requires that tariff increase should be gradual to avoid general inflation. In 2006, an 8.8% tariff increase had been approved, bringing the cross sector average tariff to 5.7 US cent/kWh.

The electricity generation sector has seen major investments in recent years and energy security has improved significantly. Despite this, the sector still faces numerous challenges such as:

- General efficiency of the energy sector is still low.
- Effectiveness of production and business is low.
- There is still loss compensation and cross subsidy in energy prices.
- Investment in energy development is still lower than the required level.
- There have been delays in many power projects.

In parallel with expanding the supply system, the Government is pushing ahead the national program on energy/electricity conservation. Since the early 1990s, several projects had been carried out with assistance from bilateral and multilateral cooperation, aiming at reducing peak demand and lessening the pressure on the supply side investment.

Renewable electricity is also given due attention, even though it will take time for renewable electricity to gain a considerable share in the generation mix. The development of renewable electricity is more advantageous in the remote areas, such as mountainous districts and islands. Mini and micro hydropower is being utilized intensively in the northern and central mountains. In the future, the government plans to increase the share of renewable energies in the country's capacity mix.

3.4.2. Power Sector Development Strategy

In order to meet the rapidly growing demand, the power industry has struggled to expand and improve the power system through power resource development, enhancement of high voltage transmission lines connecting the country's three regions (North, Central and South), reduction of transmission and distribution losses (T&D losses), importing electricity from neighboring countries and demand management (DSM) efforts. In summary, the development strategy for the power sector in Viet Nam is as follows:

- Promotion of conventional power resource development typified by hydro and thermal energy.
- Increased power imports from neighboring countries.
- Development of renewable energy.
- Nuclear power development.
- Control of power demand through energy efficiency improvement and DSM.
- Financial resource mobilization, such as the attraction of ODA, equitization process, and IPP development.
- Tariff revision to reflect the long-run marginal cost of supply and the removal of existing cross subsidies.
- Institutional reform of the power sector.

- Rural electrification.

The current rural electrification rate is 90.4% (12.05 million households out of 13.3 million) and is targeted as follows and with the following power sources for non-grid customers:

Table 3-1: Rural electrification rate and power sources for non-grid customers

Year	Rural Electrification Rate %		Power Source for Non-grid Costumers %			
	Total	Non-Grid Costumers	Solar PV	Wind	Mini Hydro	Bio-Gas
2010	95	1.4	33	54.2	13.8	0
2015	98	1.5	44	10	45	1

3.4.3. Key Demand and Supply Drivers in Hydropower Development

In order to meet the rapidly growing energy demand driven by the economy, the energy sector in Viet Nam has developed strongly in recent years. Along with the very high economic development target in the following decades, energy supply must keep growing at a very high rate. It is expected that Viet Nam will become a net energy importer in 2014 when the domestic supply capability would reach the plateau. Hydropower is given priority for development in the future as mentioned in the National Energy Strategy, and the following key drivers for hydropower development should be taken into account:

- High growth in future electricity demand and Viet Nam's strategy to develop its own domestic resources.
- Limited availability of other domestic resources, such as oil, gas and coal.
- Limited availability and knowledge of the potential of renewable energy sources.
- Enhancement of energy security by limiting the dependency on import.
- Competitive in economic terms to thermal alternatives.
- Unstable, and presently high, market prices for fuel for thermal alternatives.
- Considerable more flexible in meeting short-term variation of the demand compared to thermal alternatives.
- Multipurpose benefits (irrigation and flood control) that increase the competitiveness of hydropower compared to thermal alternatives.
- Renewed interest for hydropower from international financing agencies.
- Keen interest from domestic investors to invest in medium-sized hydropower.
- Generally the most feasible alternative for rural electrification in remote and off-grid areas (small hydro).

3.4.4. Power Demand

Historical Demand

The historical electricity demand in Viet Nam, including geographic and sectoral distributions, are accounted for in Appendix 3.3, where it is stated that the power demand in 2006 recorded 51,368 GWh being nearly 4 times larger than the demand in 1996 of 13,400 GWh, and corresponding to an average annual growth of 14.4%. Peak demand has also more than tripled during the same period, increasing from 3,200 MW to 9,700 MW.

Demand Forecast

IOE has used a combination of projection methods in order to prepare the future demand forecast, and based on different scenarios regarding the future GDP growth rate and economic structures, high, base and low scenarios of electricity demand have been estimated. Appendix 3-4 contains the main indicators of the power demand forecast for the whole country for different scenarios as estimated in PDP VI, and summarized below for the Base Scenario for the period 2005 to 2025:

Table 3-2: Power demand forecast for the Base Scenario for the period 2005 to 2025

Item	2005	2010	2015	2020	2025
Electricity Demand, GWh	45,603	97,111	164,961	257,260	381,160
Losses, %	12.0	10.8	9.6	8.5	7.5
Own Use, %	2.7	3.0	3.6	4.0	4.2
Power Generation, GWh	53,462	112,658	190,047	294,012	431,664
Peak Load, MW	9,225	19,117	31,495	47,607	68,440

Appendix 3-5 gives additional background to the demand forecast in PDP VI including geographic and sectoral distributions.

3.4.5. Power Supply

Historical Supply

The historical sources of power supply for the period 1990 to 2006 are listed in Appendix 3-6, showing that the importance of thermal power has reduced in relative terms, even if the total thermal power production has increased, while gas turbines has increased from negligible to a substantial part of the power production. The use of diesel-generated power has diminished over time and is now a marginal source in the power system. It is also evident that hydropower plays an important role in the Vietnamese power system, and that IPP's (Independent Power Producers) have recently entered the Vietnamese power market, a role that will probably increase in the future. The existing (2006) generation system in Viet Nam is described in Appendix 3-7.

Supply Forecast

The options for future development of the power system, without looking at other system constraints and investment requirements, are derived from the following considerations:

- Availability of hydropower resources.
- Availability of domestic fuel supply.
- Availability of domestic renewable energy resources.
- Possibility of importing fuels.
- Power trade (import/export) with neighboring countries.

Viet Nam has considerable domestic energy resources for power generation, including hydropower, coal, natural gas and oil, and some potential of renewable energy sources, as outlined in Appendix 3-8.

The optimization of the system expansion in the Least Cost Expansion Plan in PDP VI resulted in an optimal schedule of new capacities to be added to the system for the whole period 2005-2025. Appendix 3-9 shows the forecasts of power generation and installed capacity for power generation for the recommended Base Scenario in the optimum least cost expansion plan in PDP VI, while Appendix 3-10 gives the corresponding selected projects for different energy sources. From the forecast, power generation from coal-fired plants will drastically increase, from 16.2% to 47.4% in 2025. This growth, and with the introduction of nuclear power, makes the share of oil & gas power generation and hydropower decreasing. The renewable energy share is stable at around 2%. The projection of supply of hydrocarbon fuel in Viet Nam and the corresponding total demand of the country shows that after 2014, Viet Nam will not be able to meet its energy demand using only domestic resource and it will become a net energy importer.

Appendix 3-11 gives an account of the other scenarios included in PDP VI and the geographic and generation source distributions

The estimated investment cost of all infrastructures required to cover for the demand up to 2025 is estimated at some 109 billion USD for the Base Scenario with the breakdown as given in Appendix 3-12.

4. Assessment of Risks and Impacts of Hydropower on People and the Environment

4.1. Introduction and Context

A key stage in the SEA process is the assessment of risks and impacts, both positive and negative, on people, the availability of natural resources and the integrity of ecological processes. Such an assessment should contain two components: (i) the analysis of risks and impacts, where possible based on physical estimates or measurements and if possible including an assessment of economic values; and (ii) the identification of potentials to ameliorate negative risks and enhance positive impacts. This second component in turn provides the basis for the identification of mitigation measures, discussed below in chapter 6 of this report.

The methodology that the SEA adopted for assessing the social and environmental impact of hydropower development is described in detail in Appendix 4-1. It initially focused on an assessment of impacts for each of the planned hydropower schemes conducted individually. These are then integrated into an overall analysis, based on schemes with river basins and the schemes in each of the scenarios. The basis of the impact analysis is a rigorous interrogation of existing data based on the following components:

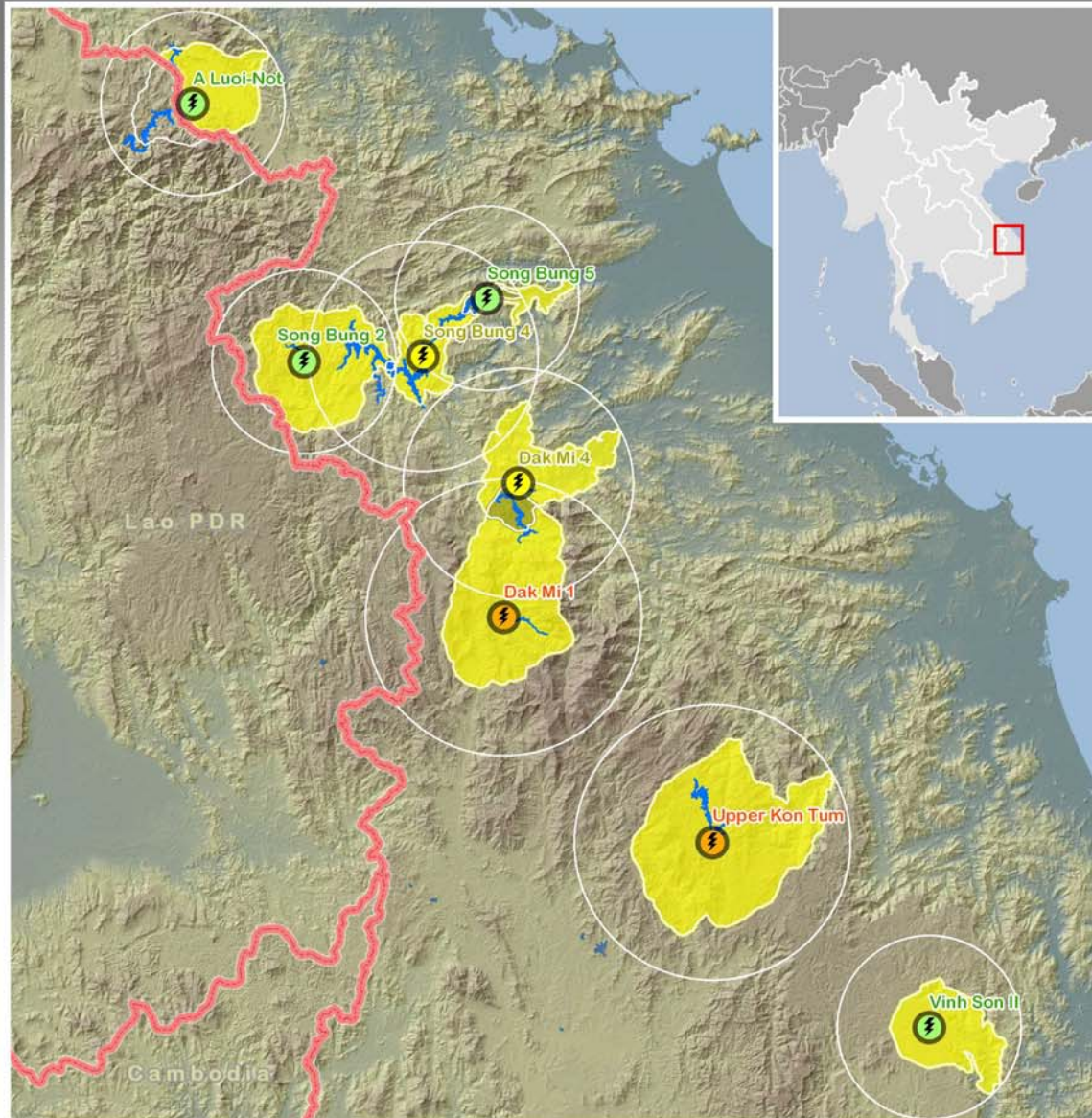
Reservoir Area: this includes the land areas lost in different categories and the assessment of impacts on displaced people. A Social Impact Coefficient for each scheme has been calculated: this uses existing data to give a weighting value for the impact on directly affected people for each scheme. An amended social mitigation cost for each scheme has been calculated, based on the values from the NHP Study but extending them to include other factors not considered therein. As Geographic Information System (GIS) was used to calculate the inundation zones from the coordinates of the dam location and a digital elevation model¹⁷. Subsequently the inundation polygons were used as masks for geostatistical summary of environmental and sociodemographic parameters.

Zone of Influence: this approach has been used for assessing impacts in the vicinity of the hydropower schemes, both with regard to environmental impacts (other than inundation) and impacts on local communities (other than the people who are resettled). The approach uses a Geographic Information System (GIS) to calculate the Zone of Influence (ZoI) for each scheme, based on a ratio of distance and altitude to reflect the 'cost of access' to the resources from the dam point (see maps for , a cluster of ZoIs in the Central Highlands (Figure 4-1), an example of the ZoI of Upper Kon Tum (Figure 4-2), and the land-use pattern in Upper Kon Tum (Figure 4-3)). The land-use and population of each ZoI is calculated based on other spatial datasets on land use (FIPI) and district population densities (GSO). The land use data is used to calculate resource values within the ZoI. Hydropower impacts are then estimated based on judgments of the likely change in the resource values of the different land-use types that are a result of hydropower development. Where possible, these impacts are assigned an economic value. Where this is not possible then the severity of impacts are assessed on a scale ranging from low to severe.

¹⁷ The inundation zone is considered the closed contour line that is defined by the dam base elevation plus the full supply level (FSL)

The social impacts in the ZoI are assessed in relation to the impacts, of changes in access to natural resources and to external markets, on the livelihoods of resident populations. Additional qualitative analysis of the potential social and cultural impacts are also included. The main risks have been assessed as being where increased population and reduced forest resources would result in unsustainable pressure on remaining forests. Balanced against this risk is the likely increase in agricultural incomes, with studies in Viet Nam showing that income per hectare of agricultural land increases by an average of 10% where upland areas are connected to markets through improved transport facilities.

Viet Nam-Planned HPPs: Inundation & Zone of Influence (4)



Key to features

km 0 15 30 60

	International boundary		Hydropower plants
	Capital / major city		Capacity in MW
	Dam inundation zone		521 - 1200
	Dam Zone of Influence (ZOI)		261 - 520
	Overlap of ZOIs		191 - 260
	no		121 - 190
	yes		60 - 120

Boundaries are not necessarily authoritative



ADB

Figure 4-1: Zones of Influence in Central Viet Nam.

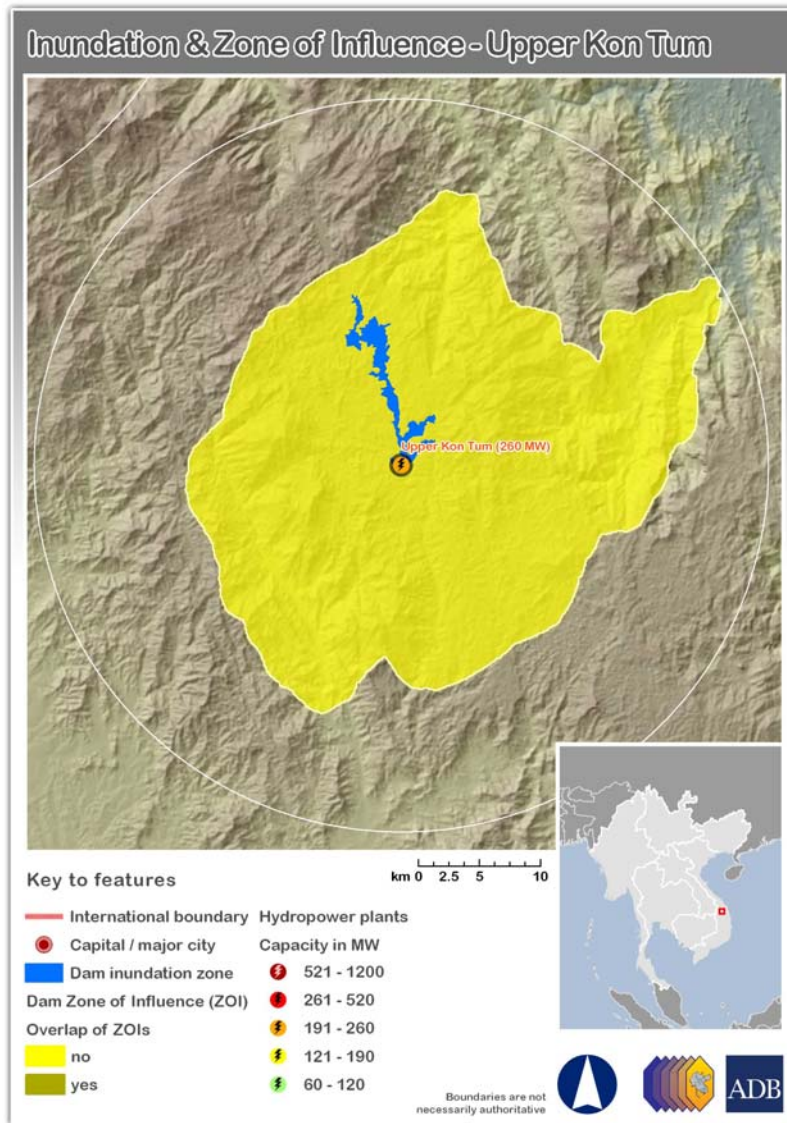


Figure 4-2: Upper Kon Tum Zone of Influence.

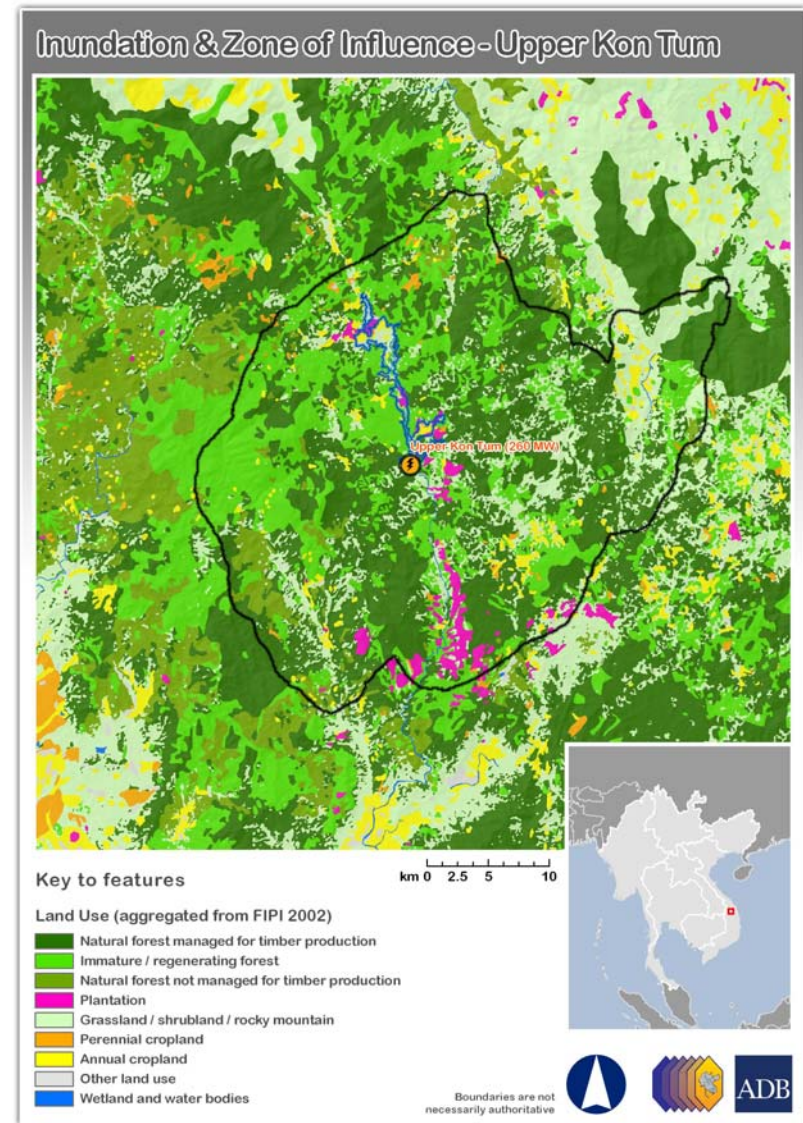


Figure 4-3: Land-Use Pattern in Upper Kon Tum ZoI.

Environmental risks in the ZoI are assessed in relation to three factors: changes to forest area and quality, impacts on river ecosystems and biodiversity impacts. The first two factors are estimated in relation to resource values, using valuation studies and estimates of the roles of forests and rivers in local livelihoods. The biodiversity impacts are assessed in relation to two main variables: the existence of endangered and/or indigenous species in the ZoI and the proportion of Protected Areas and Key Biodiversity Areas that fall within the different ZoI.

Wider Impacts: the impacts beyond the zone of influence include the assessment of air pollution (from reservoirs, but with wider impacts) and changes to hydrology, assessed through the hydrological modeling. The assessment of these data includes assigning economic values where this is possible. In addition to the air pollution costs, this will principally be for the improvements to dry season water availability in each river basin (not for each individual scheme) under each scenario. The value is computed by assuming all the additional water is used for irrigated paddy production (the minimum environmental flow is not problematic in any of the basins on the future water balance calculations). The additional irrigated area (on a smoothed annual average basis) have been calculated and, from that, the increased production and economic value of the production (based on 2007 yields and March 2008 export prices). It is not possible to calculate the economic benefits from enhanced flood control with existing data but a methodology for how this could be done in the future is defined.

Social Impacts and Mitigation Costs: the impact of the construction and operation of hydropower schemes on the communities in and around the sites of the dams and reservoirs is an issue identified as being of central importance for future hydropower planning by all stakeholders consulted in the scoping phase of the SEA. This includes both the positive benefits that hydropower development can bring to these communities and the potential negative impacts on sections of the community. The scoping exercise identified the impacts on **project affected people**, and especially ethnic minorities, along with the compensation of these impacts, as one of the areas where more systematic analysis and effective actions are needed. Concerns here were most clearly expressed in relation to the resettlement process, but wider livelihood impacts, concerns over the impact of the loss of land and forests and cultural impacts were also identified as concerns.

Other studies in Viet Nam have found similar concerns, and this issue cannot be separated from the key fact that in most cases the people affected by hydropower development in Viet Nam are poor, live in remote areas with poor access to services and frequently come from ethnic minority communities. Recent studies¹⁸ have demonstrated that these are the communities who are least able to access the development opportunities that the economic growth and change in contemporary Viet Nam is generating for most sections of the population. A recent ADB paper¹⁹ estimated that it takes people displaced by hydropower development a minimum period of 10 years to stabilize their lives and livelihoods to a level similar to that experienced before displacement (which was below the poverty line for most

¹⁸ See, for example, Swinkles, R. & Turk, C. (2004) **Poverty and remote areas: evidence from new data and questions for the future** World Bank, Hanoi. This issue is explicitly recognised in the Government of Viet Nam's **2006 – 2010 Socio-Economic Development Plan**: see, for example, page 99 on plans and targets for the Northern Mountains Region.

¹⁹ Haas, L. & Dang Vu Tung (December 2007) **Benefit sharing mechanisms for people adversely affected by power generation projects in Viet Nam** Prepared for the Electricity Regulatory Authority of Viet Nam under ADB TS-4689 (VIE).

people). This, of course, is not an issue unique to Viet Nam²⁰ but the current phase, with rapid hydropower development in an era of economic growth and concerns about ensuring social equity in development, means that it is of particular importance.

The analysis of the impact of hydropower on social development presented here builds from the recognition of the need to ensure social equity in hydropower development. It assesses the impacts of hydropower on two groups of people: (a) those communities displaced by the construction of the dams and flooding of land by the reservoir; and (b) people living within the Zone of Influence of the schemes who are not physically displaced but who are nonetheless potentially impacted by hydropower development close to their homes.

The assessment presented here outlines and seeks to quantify the different forms of impact that can occur, although some aspects of the impacts (such as effects on cultural cohesion) are not amenable to quantification. It also proposes a Social Impact Coefficient, for both the displaced people and the indirectly affected communities, as a mean to compare the potential social impact of different schemes and consequently identify where special measures to ensure no adverse effects are likely to be needed during the planning and implementation of different schemes.

Environmental Impacts are assessed through the analysis of two issues: (i) the **resource value** of natural resources, valuing where possible both the inherent value of the resource and the cost of mitigation measures to ameliorate any negative impacts; and (ii) the inherent **biodiversity value** of the ecosystems that are at risk of being affected by hydropower development. The biodiversity assets are not given either quantitative (e.g. number of species affected) or economic values: the data does not exist to make this possible within the scope of the present study. Instead, an assessment is made of the level of potential risk of loss of biodiversity values.

This in turn is related to the proportion of particular ecosystems that fall within the zones of influence and the presence in these ecosystems of animals, plants or habitats of particular biodiversity significance. The proportion of ecosystems in the zones is assessed through the GIS analysis in relation to two (related) areas: Protected Areas (Pas): that is, areas designated under Vietnamese regulations as being subject to particular types of protection such as Special Use Forests and Key Biodiversity Areas (KBAs).

The KBAs have been identified and listed in an authoritative source²¹ which also gives a description of the areas in terms of biodiversity significance. Many, but not all, are also PAs and of course care has been taken not to “double count” these areas in terms of biodiversity impacts. Most are also forest areas and care is taken to distinguish between the resource values and the biodiversity values of these areas.

4.2. Reservoir Areas

The impact of hydropower on the people and resources of the reservoir areas are of course total, as these areas will be submerged, the land resources will disappear and the people will

²⁰ See Ledec, G. & Quintero, J. (2003) **Good dams and bad dams** Latin America and Caribbean Region Sustainable Development Working Paper 16, World Bank, Washington D.C.

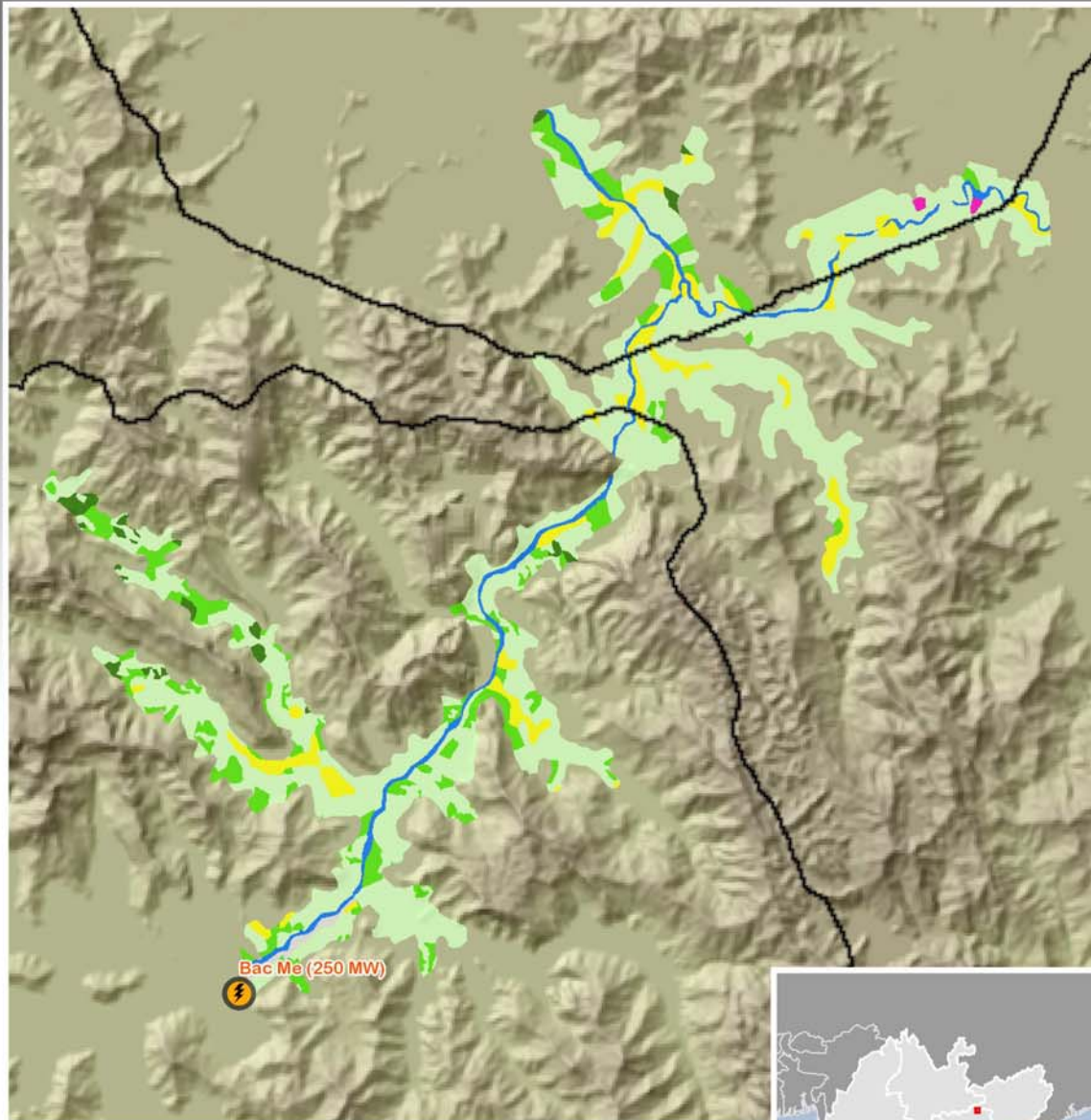
²¹ Bird Life International (2006) *Sourcebook of Existing and Proposed Protected Areas in Viet Nam: second edition*, which provides a comprehensive overview of areas of particular significance in biodiversity terms.

be displaced. These costs have been recognized in the calculations of the cost of the hydropower schemes in PDP VI, but the analysis undertaken here suggests that some aspects of the analysis are not complete. In particular, whilst the value of farmland lost is included (in terms of payments to the families who lose their land), the value of forests submerged is not. Similarly, the calculations used for assessing the costs of mitigating impacts on displaced people are assessed as being incomplete when compared to international good practice on mitigating the impacts of resettlement on displaced communities.

4.2.1. Land Resources in the Reservoir Areas

Detailed data is available from the NHP Study and from GIS analysis of land use of the reservoir area of 18 of the 21 hydropower schemes included in the scenario analysis (Table 4-1 and Figure 4-4). In the NHP Study, the average value of agricultural land was computed as being 45 million VND (around \$2,800) per hectare: a figure based on Ministry of Finance regulations for compensation. The actual value of agricultural land varies greatly within different regions of Viet Nam and has also changed over time, but would on average be at least double the figures used in the NHP Study.

Bac Me - Land Cover in Inundation Zone



Key to features

km 0 1.25 2.5 5

Land Use (aggregated from FIPI 2002)

- Natural forest managed for timber production
- Immature / regenerating forest
- Natural forest not managed for timber production
- Plantation
- Grassland / shrubland / rocky mountain
- Perennial cropland
- Annual cropland
- Other land use
- Wetland and water bodies



Boundaries are not necessarily authoritative

x: Land-Use in Bac Me Inundation Zone

Another means of calculating the value of the agricultural land is to base it on the annual income derived from agricultural production. A study on farm incomes²² in the two northern mountain provinces of Lai Chau and Ha Giang found an average income of around 6.4 million VND (\$400) per hectare, including both subsistence crops and crops sold commercially. Data on farm sizes and incomes from the General Statistical Office for the 13 provinces in which the hydropower schemes are planned showed considerable variation, with average incomes higher in the central and southern parts of the country than in the north, but the average figure of 7.8 million VND/hectare is comparable to that from the Sakata study. This would suggest that the figure of \$2,800 in the NHP Study is significantly below the true value of the farmland lost to reservoirs.

The actual costs can only be calculated for individual schemes at the time of land acquisition, but using the figures in the NHP Study the total value of agricultural land lost to reservoirs would be around \$16,700,000. A more realistic figure that reflects the value of production of farmlands would be \$5,600/ha, which would mean a total value of \$33,400,000 for the farmlands lost due to impoundment of the reservoirs. Taking the average income figures discussed above, the annual income lost from the loss of agricultural lands in reservoirs would be \$2,900,000.

Table 4-1: Land Use Patterns of Reservoir Areas

Hydropower schemes	Area lost in reservoirs (ha)					Total
	Natural forest	Planted forest	Agricultural Land	Residential land	Others ²³	
Ban Chat	900	100	1077	41	3932	6050
Huoi Quang	130	13	570	31	136	870
Song Bung 4	413	0	210	3	964	1590
Dong Nai 2	230	160	840	220	470	1920
Khe Bo	304	0	228	29	389	950
Dak Mi 4	144	0	68	1	827	1040
Srepok 4	23	112	17	0	328	480
Dong Nai 5 ²⁴	-	-	-	-	-	-
Upper Kon Tum	200	0	150	20	70	440
Song Bung 2	158	0	21	0	111	290
A'Loui ⁷	-	-	-	-	-	-
Lai Chau	346		474	33	3110	3963
Hua Na	369	781	431	35	444	2060
Song Bung 5	117	0	11	0	42	170
Dak Mi 1	323	0	75	0	47	445
Trung Son	667	171	194	14	223	1270
Hoi Xuan	226	0	190	0	134	590
Bac Me	0	30	720	190	1080	2020
Nho Que 3	0	0	320	10	170	500
Nam Na	0	0	440	110	380	930
Vinh Son 2 ⁷	-	-	-	-	-	-
Total⁷	4227	1367	5961	737	12810	25133

²² Sakata, S. (2007) *Marketisation in Poverty-Ridden Areas: Analysis of Household Survey in Lai Chau and Ha Giang Provinces*.....

²³ Including: unused land, grass with shrub

²⁴ Dong Nai 5, A'Loui and Vinh Son 2 were not included in the NHP and data on land use in the reservoir area is not available for these schemes

A study on the forest valuation done by the Forestry Science Institute of Viet Nam has separated two kinds of values from forest, those are (1) direct values including timber and NTFP, and (2) indirect values from environmental services that the forests provide, including: soil protection, water regulation and carbon dioxide restoration and absorption. The study of Forestry Science Institute shows the value of forest timber from natural and planted forest as given in Table 4-2.

Table 4-2: Timber Value of Forests in Viet Nam

Placed of study	Types of forest	Natural forest		Planted forest ²⁵	
		Timber (m3/ha)	Timber value (million VND/ha)	Timber (m3/ha)	Timber value (million VND/ha)
Yen Bai and Phu Tho provinces	Rich	168.9	201.463		
	Average	87.3	100.157	91	22.893
	Poor	52.0	33.570		
	Regenerating	37.3	26.230		
Quang Binh – Hue provinces	Rich	273.5	191.724		
	Average	134.9	96.036	82.1	30.688
	Poor	96.0	75.743		
	Regenerating	44.9	31.678		
Gia Lai and Dong Nai provinces	Rich	259.2	288.058		
	Average	145.5	182.986	112.5	30.906
	Poor	97.3	51.534		
	Regenerating	69.6	40.819		

Table 4-3: Estimated Value of Environmental Services from Forests in Viet Nam

Placed of study	Types of forest	Environmental service values (million VND/ha)			
		Soil protection	Water regulation	Carbon dioxide	Total value
Yen Bai and Phu Tho provinces	Rich	6.3	21.9	85.2	113.4
	Average	5.9	16.6	62.3	84.8
	Poor	5.5	13.5	48.9	67.9
	Regenerating	5.4	9.3	38.5	53.2
Quang Binh – Hue provinces	Rich	4.1	16.5	106.0	126.6
	Average	3.8	13.9	75.7	93.4
	Poor	3.5	11.6	62.8	77.9
	Regenerating	3.4	7.8	42.9	54.1
Gia Lai and Dong Nai provinces	Rich	4.4	5.8	104.9	115.1
	Average	4.0	4.3	78.7	87.0
	Poor	3.9	3.8	64.2	71.9
	Regenerating	3.5	2.2	52.3	58.0

²⁵ In the Central of Viet Nam, the timber capacity per hectare of planted forest is low (82.1 m3/ha), but the value is high (30,688,000 VND/hectare) – it is because the planted timber price is higher than other area.

Beside the value of the timber, there is also the non-timber forest products (NTFPs) in the natural forest. According to the study done by Nguyen Quang Tan²⁶, Humboldt University Berlin, has showed that the average value of NTFPs in the Vietnamese natural forests is about 2 million VND per hectare. Forests also provide vital environmental services, and the estimated value of these services is shown in Table 4-3.

Combining these figures, it is possible to calculate the total forest value to be lost in the reservoirs of the 18 different hydropower schemes for which data is available (Table 4-4). The total value of 1,159 billion VND (or around \$72.4 million) is a significant figure, but will not jeopardizes the economic viability of any of the hydropower schemes. As will be further argued in the recommendations, these values should nevertheless be internalized in the cost calculations for hydropower schemes.

Table 4-4: Total of forest value lost in reservoirs for each hydropower scheme (MVND)

Hydropower schemes	Value of timber from natural forest	Value of timber from planted forest	Value of NTFPs	Value of environmental service	Total Value
Ban Chat	90,141.300	2,289.300	1,800.000	84,800.000	179,030.600
Huoi Quang	13,020.410	297.609	260.000	12,126.400	25,704.419
Song Bung 4	75,573.218	0.000	826.000	35,931.000	112,330.218
Dong Nai 2	42,086.780	4,944.960	460.000	33,930.000	81,421.740
Khe Bo	29,194.944	0.000	608.000	28,393.600	58,196.544
Dak Mi 4	26,349.984	0.000	288.000	12,528.000	39,165.984
Srepok 4	4,208.678	3,461.472	46.000	11,745.000	19,461.150
Dong Nai 5	-	-	-	-	-
Upper Kon Tum	36,597.200	0.000	400.000	17,400.000	54,397.200
Song Bung 2	28,911.788	0.000	316.000	13,746.000	42,973.788
A'Luoi	-	-	-	-	-
Lai Chau	34,654.322	0.000	692.000	29,340.800	64,687.122
Hua Na	35,437.284	23,967.328	738.000	107,410.000	167,552.612
Song Bung 5	21,409.362	0.000	234.000	10,179.000	31,822.362
Dak Mi 1	59,104.478	0.000	646.000	28,101.000	87,851.478
Trung Son	64,056.012	5,247.648	1,334.000	78,269.200	148,906.860
Hoi Xuan	21,704.136	0.000	452.000	21,108.400	43,264.536
Bac Me	0.000	686.790	0.000	2,544.000	3,230.790
Nho Que 3	0.000	0.000	0.000	0.000	0.000
Nam Na	0.000	0.000	0.000	0.000	0.000
Vinh Son 2	-	-	-	-	-
Total	582,449.90	40,895.11	9,100.00	527,552.40	1,159,997.40

²⁶ The study done by Tan (2001) released the overall NTFP entitlement is 1.6 million VND/ hectare – which is equivalent to 2 million VND in 2008.

4.2.2. Impacts on Displaced Communities

Table 4-5 shows the estimated number of people who would be displaced by the construction of the different hydropower schemes included in the scenario analysis. A total of 61,571 people would be displaced if all 21 schemes are constructed (based on the present population of these schemes and with a projection for estimated population growth in the period before construction), but the number of people who would be displaced varies significantly from scheme to scheme.

Seven of the 21 schemes would require little or no resettlement as there are no people residing in the reservoir area. A further three have 650 or less people, whilst at the other extreme Bac Me would result in the displacement of 10,700 people and Ban Chat of 14,800 people. The four schemes with more than 7,000 displaced people (Ban Chat, Bac Me, Huoi Quang and Lai Chau) would result in over 41,000 displaced people, or two-thirds of the total for all 21 schemes. These four schemes require special attention with regard to the resettlement issues.

Table 4-5: Numbers of People to be Displaced in Individual Schemes and for Each Scenario

Hydropower schemes	Number of displaced people (Base Scenario)	Alt 1	Alt 2	Alt 3	Alt 4	Ethnic minorities in total displaced people (%)
Ban Chat	14800	14800	14800	-	-	95
Huoi Quang	7050	7050	7050	-	-	100
Song Bung 4	1216	1216	-	-	-	79
Dong Nai 2	2993	-	-	-	-	5
Khe Bo	3482	-	-	-	-	91
Dak Mi 4	150	-	-	-	-	76
Srepok 4	0	0	0	0		-
Dong Nai 5 ²⁷	-	-	-	-	-	-
Upper Kon Tum	650	650	650	650		48
Song Bung 2	0	0	0	-	-	-
A luoi	-	-	-	-	-	-
Lai Chau	8460	8460	8460	8460		96
Hua Na	4865	4865	-	-	-	99
Song Bung 5	0	0	-	-	-	-
Dak Mi 1	0	0	-	-	-	-
Trung Son	2285	2285	2285	-	-	80
Hoi Xuan	1615	1615	-	-	-	93
Bac Me	10700	-	-	-	-	100
Nho Que 3	565	565	565	565	-	100
Nam Na	2325	2325	2325	-	-	89
Vinh Son 2	-	-	-	-	-	-
Total	61571	43831	36135	9675	0	90.5

The total number of displaced people obviously declines for each scenario, with a particularly noticeable fall between Alternatives 2 and 3. Almost all of the displaced people (over 90%) in

²⁷ There are no exact number of displaced people in Dong Nai 5, A Luoi and Vinh Son 2 since they were not included in the original NHP. However, according to update information there is no (or very little) displaced people in these hydropower schemes.

the 21 hydropower projects are ethnic minority people. Except for Dong Nai 2 and Upper Kon Tum projects, percentages of ethnic minority people in total displaced people are higher than 79%. This is of particular significance for two reasons:

- In Viet Nam, many ethnic minority communities have a particular affinity to their lands and homes and are highly dependent upon access to common property resources (especially forests) for their livelihoods. The present resettlement system provides no compensation for any loss of access to these vital livelihood assets. The social structure and cultural identity of ethnic minorities are also important in their lives and livelihoods and are liable to disruption caused by resettlement.
- In many cases, there is a reasonable probability that the “host” population in the locality where displaced people are resettled will be of a different ethnic group. This has the potential to lead to resentment, social tensions and even conflict unless precautionary measures are taken to establish good social relationships and a shared community development agenda.

These issues are exacerbated by the higher levels of poverty amongst ethnic minority communities in general and the people who are likely to be displaced. Government statistics show the extent to which the poverty gap between the Kinh majority (86% of the population) and the 53 other main ethnic groups who constitute the remaining 14% of the population (Figure 3-1, above). With a poverty rate of over 60% and food poverty rate of over 34%, compared to 13.5% and 3.5%, respectively, for Kinh people, poverty is a pressing issue amongst ethnic minorities in Viet Nam and is a characteristic of the majority of people liable to be displaced by hydropower development.

The livelihood patterns, cultural characteristics and poverty levels of the communities likely to be displaced mean that the impact of the disruption to their lives and livelihoods will be far more severe than that experienced by families from the Kinh majority group (people whose livelihoods are less dependent on access to the natural resource base and more prosperous people who will have other assets and savings on which to fall back during the resettlement process and whilst reconstructing their livelihoods in their new homes).

There is a danger, unless proactive actions are taken, that the poverty incidence amongst displaced communities will increase as a result of resettlement. International experience²⁸ shows that this occurs frequently, and the mitigation package outlined in chapter 6 reflects this. It is intended to provide a range of support that will provide the means for displaced people to establish themselves in a new location, gain access to an adequate level of services and have opportunities to reconstruct their livelihoods in ways that reflect the characteristics of their new locations.

Types of Impact Risks

The potential impact of hydropower schemes on displaced people takes many forms and can be categorized in many different ways. One such categorization has been developed in the Impoverishment, Risk and Reconstruction model (IRR)²⁹, which presents an eight-fold

²⁸ Cernea, M. (2000) *Impoverishment, Risk and Reconstruction: A Model for Population Displacement and Resettlement* in Cernea, M. & McDowell, C. (eds 2000) *Risk and Reconstruction: Experiences of Resettlers and Refugees* World Bank, Washington D.C.

²⁹ *ibid*

categorization of risks (table 4-6). The table demonstrates that serious risks of negative impacts on displaced people exist across most indicators in the model. In many cases, such as for landlessness and homelessness, such impacts are inevitable and adequate measures to compensate for these impacts should be an integral part of the hydropower planning system.

The awareness of this wide range of risks is a key issue in sustainable and responsible hydropower planning and the package of mitigation measures that are provided in response to the risks must reflect the scope and severity of potential impacts. This is discussed in further detail in chapter 6, where a proposal for a mitigation package based on the IRR model is outlined. One of the virtues of the IRR model is that it reflects risk factors such as the long-term impacts on the health of displaced communities that have not been adequately accounted for in existing social impact assessment approaches in Viet Nam (and many other countries). The model consequently provides an international good practice reference point for assessing the risks of impacts and the mitigation measures necessary to ensure that displaced people are adequately taken care of in the hydropower development process.

Table 4-6: The Impoverishment, Risk and Reconstruction Model for Displaced People in Viet Nam

Type of Risk	Likelihood and Intensity of Risk in Hydropower Schemes in Viet Nam
Landlessness	High: most displaced households own and farm land in the reservoir area
Joblessness	Medium/Low: wage employment is not a dominant source of livelihood for most households
Homelessness	High: over 61,000 people will lose their existing homes
Marginalization	Medium/High: the high incidence of ethnic minorities and the dangers of social and cultural disruption present significant risks of social marginalization
Increased Morbidity	High: existing morbidity levels are relatively high and the disruption in access to services and health facilities will significantly increase these risks unless remedial actions are taken
Food Insecurity	High: especially in the period immediately after relocation where new agricultural production is not ready and access to forest foods has not been established
Loss of Access to Common Property Resources	Very High: resettlement destroys existing access patterns and current practice does not provide any replacement access in the resettlement area
Social Disarticulation	Medium/High: this varies according to the social characteristics of both the relocated communities and the host community in the resettlement area

Social Impact Coefficient for Directly Affected People

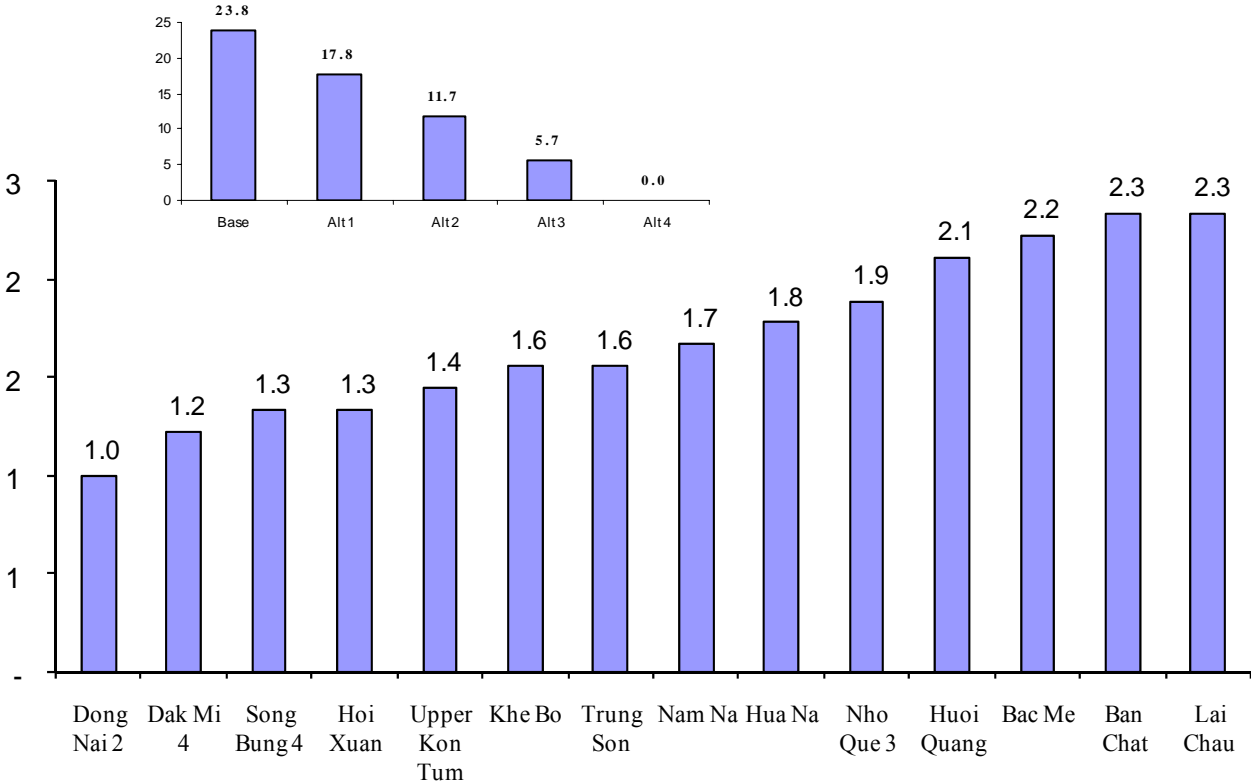
The livelihood and social characteristics of the communities at risk from displacement varies from scheme to scheme, as do the characteristics of the localities in which the schemes are to be constructed. The vulnerability of different communities to disruption and the intensity of resettlement impacts reflect these variations. Hydropower projects with larger reservoir areas, more displaced people, higher proportion of ethnic minorities, poorer community, located in more difficult areas, more agricultural and forest land lost, etc. are likely to have higher negative social costs.

Although it is difficult to measure these variable factors accurately, it is possible to calculate the relative vulnerability of the affected communities and compile this into a social impact coefficient (see Appendix 4-2 for the details of how the coefficient is calculated) for different

hydropower schemes using available secondary data from project reports and other sources. The data used includes information on the numbers of people at risk, the structure of their livelihoods, the risk of impacts on natural resources, the social characteristics of the communities in question and other factors. The coefficient makes it possible to compare the relative risks of social impacts between hydropower schemes; an important factor in ensuring that social impacts are integrated into the power sector planning process. This can help planners to make decisions based trade-offs between economic benefits and social costs that reflect the relative vulnerability of different sites. It also helps to understand where special measures to mitigate the risks of social impacts may be needed.

There are two types of social impact coefficients: one for displaced people and the other for population in ZoIs (discussed in the next section). The social impact coefficient for displaced people is a composite indicator constructed from 6 component parameters, i.e. number of displaced people, percentage of ethnic minorities, poverty indicator, monthly average income, average social mitigation cost and income proportion from agriculture, forest and fishery.

Figure 4-5: Social impact coefficient for directly affected people



The coefficient is constructed for 14 hydropower schemes which have displaced people. It ranges from 1 to 2.3 as shown in Figure 4-5. The lowest possible social impact is found in Dong Nai 2 scheme. Lai Chau and Ban Chat hydropower projects have the highest coefficients meaning highest possible social cost. Generally, projects with larger planned capacity are more likely to have higher negative social impact on displaced people. However, Upper Kon Tum and Trung Son have relatively low coefficients compared to their planned capacity, reflecting the specific characteristics of these sites.

Social impact coefficients for directly affected people is also calculated for each scenario by adding the total coefficient score of the hydropower projects in each scenario. The base

scenario which includes all hydropower projects has the highest total value of 23.8. The total scores are 17.8, 11.7 and 5.7 for Base Scenario, Alternative 1 and Alternative 2, respectively. In Alternative 4, there will be no hydropower project implemented.

4.3. Impacts in the Zone of Influence

The assessment of potential impacts in the Zones of Influence (ZoIs) of the 21 hydropower schemes included in the scenarios analysis is challenging, as it entails (i) an identification and assessment of types of impact, both positive and negative and (ii) an assessment of the level of risk involved, that is the degree of certainty over whether possible impacts will be a reality. This latter factor is highly variable (both within individual ZoI and between different schemes) and difficult to predict, as many factors are involved in determining whether impacts actually happen. The scale of risks is significant and reflects the size of the areas concerned: the 21 ZoIs cover nearly 1.5 million ha and have more than 1.3 million people living within them. In reality, most of this area and most of these people will experience little, if any, noticeable direct impact from the construction of the hydropower schemes, though all will be affected indirectly in some ways by the changes that occur in the areas where they live. The nature and intensity of the risks in the ZoIs are discussed below; firstly looking at people living in these areas and then considering potential impacts on natural resources and biodiversity.

4.3.1. Indirectly Affected People: Communities in the Zones of Influence

Assessing the potential impacts on the wider communities in the ZoIs is a challenging exercise. There are a large number of residents of these zones, with a total population of more than 1,340,000 ranging from just over 8,000 for Khe Bo to more than 330,000 in the ZoI of Lai Chau. The ZoIs of nine schemes have populations of less than 30,000, five in the 30,000-60,000 range, four in the 60,000-90,000 range and three populations of more than 90,000. The majority are from ethnic minority groups, with 16 of the planned schemes having over 75% of the ZoI population from ethnic minorities and only three (Dong Nai 2, Dong Nai 5 and Vinh Son 2) with less than 25% of the ZoI population from ethnic minorities.

The incidence of poverty amongst the ZoI population is significantly above the national average in nearly all of the schemes; reflecting the socio-economic characteristics of these areas as well as the high incidence of ethnic minorities. Most ZoI populations are dependent on agriculture, forestry and fisheries in their livelihoods, but this dependency is perhaps not as high as would have been expected, being in the 30%-60% range for the majority of schemes. This means that, whilst access to land and natural resources is important for their livelihoods, income from other sources is also significant for many communities living in the ZoIs of the hydropower schemes.

The development of hydropower can have a wide range of impacts, both positive and negative, in the areas surrounding the dam sites. Some of these are temporary, especially associated with the construction process when a large number of outside construction workers are brought in. Others are more long-term, as people are resettled (affecting the host population), natural resources are exposed to a new set of pressures caused by improved access to external markets and the social fabric of communities can be affected by greatly increased exposure to the outside world. Table 4-7 outlines the nature and likely severity of these risks within the IRR model framework. It should be emphasized that the model focuses on negative risks only: potentially beneficial impacts are not included but are discussed

elsewhere in this section.

The most significant risks relate to the impact of loss of access to natural resources, especially forests and aquatic resources (discussed in detail below) and the social and cultural disruption that dam construction and associated changes can bring. There are some cases where households lose farmland but are not resettled, with a significant risk of disruption to their livelihoods where this occurs. The mitigation package must provide full compensation for this land and support to ensure that they are able to reestablish a viable livelihood.

Table 4-7: The Impoverishment, Risk and Reconstruction Model for People in the Zones of Influence

Type of Risk	Likelihood and Intensity of Risk in Hydropower Schemes in Viet Nam
landlessness	Low: some households who are not displaced may own and farm land in the reservoir area and must be compensated, but the data available suggests the numbers are low in most schemes
joblessness	Low/Potentially Positive: little evidence to suggest jobs are lost and there is a potential for labour opportunities, especially during construction to service the workforce
homelessness	Zero: no evidence that any households other than those resettled will lose their homes
marginalization	Medium/Low: the high incidence of ethnic minorities and the dangers of social and cultural disruption present risks of social marginalization in some cases, and especially for communities immediately adjacent to the construction site
increased morbidity	Medium/Low: existing morbidity levels are relatively high and any disruption in access to services and health facilities has the potential to increase these risks unless remedial actions are taken
food insecurity	Low/Medium/Potentially Positive: some communities in the ZoI may experience increased food insecurity except caused by reduced access to forest resources. This needs to be balanced against potential increases to agricultural production stimulated by improved access to markets.
loss of access to common property resources	Medium/High: dam construction and related infrastructure such as roads is likely to cause some decline in the quality and area of forests in the ZoI, and there are likely to be severe impacts on aquatic resources
social disarticulation	Medium/high: this varies according to the social characteristics of the resettlement host communities and the communities around the dam construction site.

Social Disarticulation

The issue of social and cultural impacts is complex and controversial. For the population of the ZoI, it is not generally manifested in physical terms (except, for example, where cultural artifacts such as temples or graveyards are affected by the reservoir or dam construction) and is not quantifiable in any meaningful manner. It is a particularly sensitive issue given the ethnic composition of most of the ZoI residents. These communities can be disrupted by the influx of construction workers and new settlers of a different social character in particular. Such impacts are particularly severe around the immediate vicinity of the construction site and during the construction period, when crime, prostitution and antisocial behavior can undermine the social fabric of local communities.

The risks of such impacts are exacerbated by the low level of involvement of local

communities in the planning and decision-making over hydropower development. It is not suggested that these communities should have any sort of veto over construction decisions, for these decisions reflect wider national interests. But there is considerable scope for reducing the risks of social marginalization and disarticulation through more sensitive planning of construction camps, better management of the process through which outsiders move in and the provision of social and cultural support measures as part of the compensation package. Such issues are relevant for all schemes, but are a particular issue for the very large dams, where construction can involve the influx of many thousands of workers for a considerable period of time. Vulnerability to such disruption is reflected in the variables used to calculate the social impact coefficient for the ZoIs discussed below.

Impacts on Relocation Sites

The relocation of large numbers of people displaced by the flooding of the reservoirs will impact upon the sites to which they are relocated. These sites have not yet been identified, so it is not possible to discuss in any detail the nature and scale of such impacts, but it is essential that they are recognized and planned for in hydropower development. There are 14 schemes where people will be relocated, with four of these (Ban Chat, Bac Me, Huoi Quang and Lai Chau) having more than 7,000 people scheduled for resettlement and accounting for two-thirds of the total. In these four cases, resettlement is likely to have severe impacts upon the host communities, with greatly increased pressures on local resources, on services and on livelihood opportunities. Where they are of a different ethnic community, there is also a high likelihood of social tensions and disarticulation. The impact of resettlement in the other 10 schemes, where the numbers are lower, will be less severe but could be locally significant.

Reducing the risks of negative impacts on the host communities involves ensuring that they are involved in the resettlement planning and that they also have access to benefits from resettlement where this is appropriate: this is discussed in detail in chapter 6. At this stage, it is important to note that the risk of such impacts exists for 14 schemes and is particularly significant in four cases.

Agricultural Production and Incomes

One area where hydropower development is likely to have a positive impact in the ZoI is in increasing incomes from agricultural production. A recent detailed empirical study³⁰ of the impact of improved market access on agricultural incomes in the mountainous areas of Viet Nam found that better market access and new varieties of crop adoption led to an increase in agricultural incomes of about 10%. The study noted that two effects were in play: intensification of production through the adoption of new seed varieties, better plant protection and increased fertilizer inputs (which accounted for around 60% of the increase) and specialization effects where new, higher value, crops were adopted, which is responsible for around 40% of the increased income.

According to the study done by Shozo Sakata³¹, the average income from agriculture of the mountainous rural household is about 4.3 million VND/year; a figure that can be taken as a conservative estimate for many parts of the country. Then the improvement (in cash) for rural

³⁰ Nguyen Huu Cuong (2007) *Impact of Market Access on Agriculture Production in Viet Nam*

³¹ Sakata, S. (2007) *Marketisation in Poverty-Ridden Areas: Analysis of Household Survey in Lai Chau and Ha Giang Provinces*

household due to better market accession is 0.43 million VND per household. With the statistic from the GIS on the number of agricultural households in the ZoI, the improvement of the agricultural in the ZoI due to better market accession for all hydropower schemes and each scenario can be calculated (Table 4-8). The cumulative figure for all of the scenarios is close to 64 billion VND, or about \$4 million, a year: not a huge amount but a significant figure for the very poor and isolated households of many of the localities where the hydropower schemes are planned to be built.

These direct benefits in agricultural incomes will also generate further benefits in the local economy through multiplier effects whereby the increased income generates further investments and local demand for goods and services. These benefits are also distributed over a large number (nearly 150,000) of households in all communities in the ZoIs. The benefits have the additional virtue in being in cash income, which increases the local economic impacts. The Sakata study showed that, on average, only 30.2% of agricultural output is sold in Lai Chau and as little as 7.2% is marketed in Ha Giang, meaning that the opening up of marketing opportunities creates development benefits that are disproportionate to the actual income increases involved. As such, the improvements to agricultural incomes that result from the improved market access, that hydropower development typically brings, will play an important role in generating local development that benefits most sections of the community in the ZoIs.

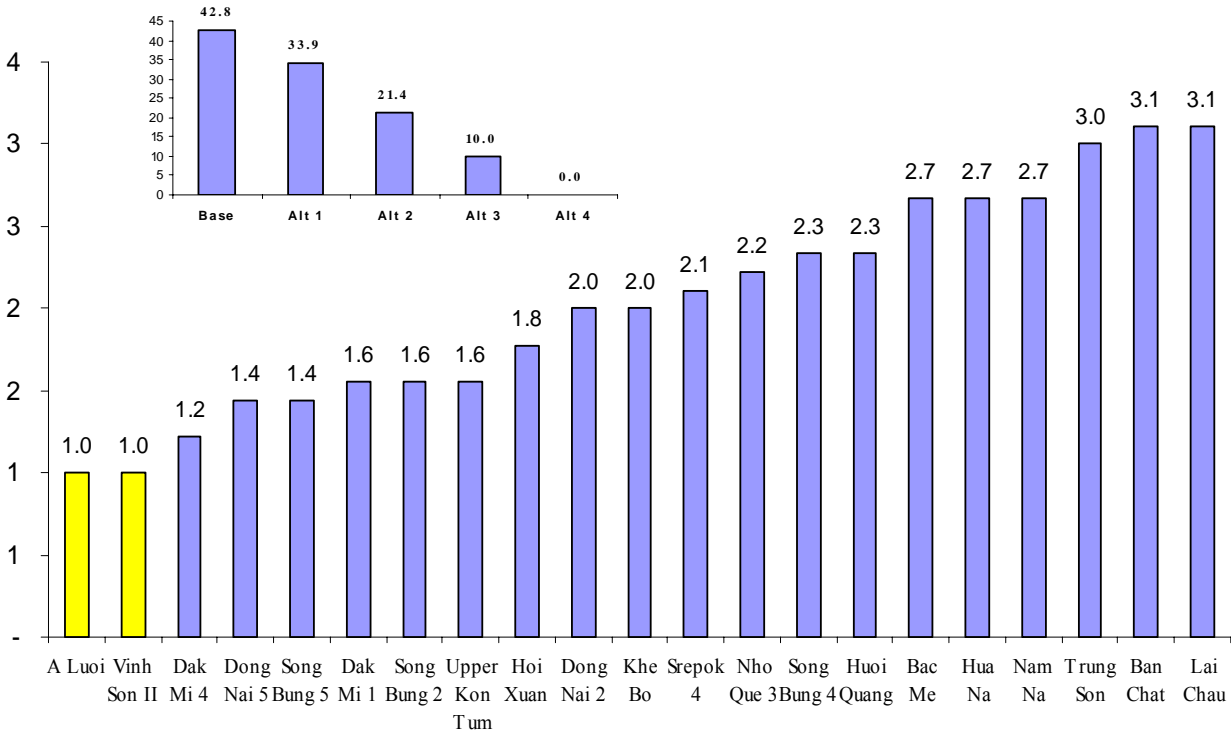
Table 4-8: Increases in Agricultural Incomes from Hydropower Development (million VND/year)

Hydropower Scheme	Number of agricultural household in ZoI	Increased value of agricultural production (Base Scenario)	Alt 1	Alt 2	Alt 3	Alt 4
Ban Chat	3229	1388.58	1388.58	1388.58	-	-
Huoi Quang	7936	3412.46	3412.46	-	-	-
Song Bung 4	1163	500.10	500.10	-	-	-
Dong Nai 2	24582	10570.36	-	-	-	-
Khe Bo	3534	1519.71	-	-	-	-
Dak Mi 4	4063	1746.91	-	-	-	-
Srepok 4	13487	5799.37	5799.37	5799.37	5799.37	-
Dong Nai 5	8502	3655.94	-	-	-	-
Upper Kon Tum	5000	2150.00	2150.00	2150.00	2150.00	-
Song Bung 2	2929	1259.64	1259.64	1259.64	-	-
A Luoi	935	402.25	-	-	-	-
Lai Chau	17626	7579.14	7579.14	7579.14	7579.14	-
Hua Na	1106	475.38	475.38	-	-	-
Song Bung 5	1763	758.29	758.29	-	-	-
Dak Mi 1	8793	3780.81	3780.81	-	-	-
Trung Son	12332	5302.71	5302.71	5302.71	-	-
Hoi Xuan	7173	3084.48	3084.48	-	-	-
Bac Me	5902	2538.06	-	-	-	-
Nho Que 3	7478	3215.61	3215.61	3215.61	3215.61	-
Nam Na	8670	3728.23	3728.23	3728.23	3728.23	-
Vinh Son II	1395	599.93	599.93	599.93	599.93	-
Total	147598	63,467.87	43034.73	31023.21	23072.28	0

ZoI Social Impact Coefficient

The social impact coefficient for the population in the ZoIs has been prepared to provide a means for assessing the relative vulnerability of the different populations to impacts from hydropower. The coefficient is constructed from 10 component parameters including ZoI’s population density, total population of ZoI, proportion of displaced people among the total population of ZoI, percentage of ethnic minorities among population in ZoI (percent), ZoI’s poverty index, reservoir area, percentage of agricultural land lost, percentage of forest land lost, income proportion from agriculture, forest and fishery for population in ZoI, and number of agricultural households (see Appendix 4-2).

Figure 4-6: Social impact coefficient for population in ZoIs



The coefficient is constructed for the 21 hydropower schemes and by scenario. The results are presented in Figure 4-6. A’Luoi and Vinh Son are found to have the lowest possible social impact on ZoI’s population. The impact is about 3 times higher in Trung Son, Ban Chat and Lai Chau. This helps planners and decision-makers to understand which schemes need the greatest attention in relation to the risks of impacts on the communities in surrounding areas. Although some attention is paid to this issue in the present hydropower development system, it is insufficient to reflect the levels of risk and nature of potential impacts involved. The social impact coefficient for the ZoI is indicative only, but it is simple to compute, uses existing and readily available data and provides decision-makers with a means to identify which schemes require special attention with regard to potential social impacts on surrounding populations.

4.3.2. Impacts on Natural Resources and Biodiversity

The impact of hydropower development on the natural resource base and integrity of biodiversity in the ZoIs is one of the key issues for the overall SEA. The assessment of these risks is presented here through the analysis of potential impacts upon forest and aquatic resources and risks associated with the degradation of biodiversity in the Zones of Influence. It is possible to identify options to mitigate most of these risks: these are discussed in chapter 6. This section gives an assessment, based on quantitative data where possible, of the level of risks involved and the significance of these risks for the integrity of the ecosystems of the ZoIs and the livelihoods of communities that depend on these resources.

Impacts on Forest Resources

The Zones of Influence contain substantial areas of forest (Table 4-9), with a total of 681,576 ha that includes 534,995 ha of mature natural forest, 109,197 ha of immature or regenerating forest and 37,384 ha of plantations. Forests represent an important land use category in all of the ZoI in the schemes included in the scenarios analysis. They are the dominant productive land resource category in most schemes, representing over 75% of the ZoI area in 17 of 21 schemes once the category of grasslands, shrublands and rocky mountains are excluded.

Table 4-9: Forest Area by Type in the Zones of Influence

Hydropower schemes	Forest area in Zone of Influence (ha)				
	Natural forest managed for timber	Natural forest not managed for timber	Immature / regenerating forest	Plantations	Total
Ban Chat	2954	106	16932	1800	21792
Huoi Quang	9133	348	10521	476	20478
Song Bung 4	17088	120	774	0	17982
Dong Nai 2	5704	18300	4575	453	29032
Khe Bo	1066	4280	2745	1547	9638
Dak Mi 4	18191	0	919	1155	20265
Srepok 4	4493	39734	2618	12	46857
Dong Nai 5	17713	14910	11917	132	44672
Upper Kon Tum	49365	4017	30426	2737	86545
Song Bung 2	26302	1062	2892	0	30256
A'Luoi	15862	0	1214	1285	18361
Lai Chau	37064	3993	67798	4335	113190
Hua Na	14387	9617	8648	620	33272
Song Bung 5	4540	0	407	329	5276
Dak Mi 1	38988	2403	7078	6226	54695
Trung Son	18890	7505	4146	8542	39083
Hoi Xuan	4008	1426	1600	7932	14966
Bac Me	24709	1645	28071	321	54746
Nho Que 3	3193	37	5755	221	9206
Nam Na	6829	0	18899	2869	28597
Vinh Son 2	14697	0	4305	865	19867
Total³²	321108	213887	109197	37384	681576

³² Totals not equal to sum of individual ZoI areas because some ZoIs overlap

The type of forest varies greatly in different parts of the country, reflecting changes in ecological conditions in different regions as well as some variations due to altitude. The forests in the central and southern regions are mostly mixed tropical broadleaf evergreen and deciduous forests that have high inherent resource and ecological values, whilst the forest areas in the northern river basins are mostly mountain evergreen forests with significant altitude variations that reflect the colder winter temperatures in this region.

These are extremely important and valuable resources, vital for both the livelihoods of local communities and the integrity of local ecological systems. They are a national asset, both in relation to their economic values and their role in ecological and biodiversity protection. These forests provide important ecosystems services, in terms of regulating water flows, maintaining land and soil fertility and absorbing CO₂. The risks of substantial damage to these forest resources are consequently extremely serious in relation to economic and environmental processes at both local and national levels.

The value of the forests in the ZoIs has been estimated using the method presented in section 4.2, above. This valuation, which includes timber, non-timber forest products and environmental services values, is comprehensive. It reflects the local livelihood values as well as wider commercial values and includes an economic valuation of the role of forests in regulating wider environmental processes for land, water and the atmosphere. The results of the valuation are striking (Table 4-10), with the total value of the forests in the 21 ZoI areas computed to be nearly 135,000 billion VND (around \$8.4 billion). This is an extremely high resource value of national significance.

Table 4-10: Value of Forests in the Zones of Influence

Hydropower Schemes	Values of Forest Area in Zone of Influence (million VND)				
	Values of timber from natural forest	Values of timber from regenerating forest	NTFPs values	Environmental values	Total values
Ban Chat	306480.42	444126.36	39984	1695322	2485912.78
Huoi Quang	949588.517	275965.83	40004	1696170	2961728.35
Song Bung 4	3148823.088	31593.906	35964	1564434	4780814.99
Dong Nai 2	4392395.944	186746.93	57158	2486373	7122673.87
Khe Bo	513408.456	86956.11	16182	755699.4	1372245.97
Dak Mi 4	3328698.326	37512.661	38220	1662570	5067000.99
Srepok 4	8092921.822	106864.14	93690	4075515	12368990.96
Dong Nai 5	5969552.278	486440.023	89080	3874980	10452675.3
Upper Kon Tum	9768158.652	1241958.9	167616	7291296	18469029.55
Song Bung 2	5007228.904	118048.55	60512	2632272	7818061.45
Aluoi	1523323.032	38457.092	34152	1594898	3206692.52
Lai Chau	4112145.949	1778341.5	217710	9230904	15339101.45
Hua Na	2305248.144	273951.34	65304	3049697	5694200.48
Song Bung 5	830756.44	16613.333	9894	430389	1287652.77
Dak Mi 1	7573973.526	288916.88	96938	4216803	12176631.41
Trung Son	2534870.22	131336.99	61082	2852529	5579818.21
Hoi Xuan	521859.624	50684.8	14068	656975.6	1243588.02
Bac Me	2639537.578	736302.33	108850	4615240	8099929.91
Nho Que 3	323507.11	150953.65	17970	761928	1254358.76
Nam Na	683972.153	495720.77	51456	2181734	3412882.92
Vinh Son 2	2689345.242	175725.795	83004	1653174	4570946.04
Total	67215795.00	7153217.89	1398838.00	58978903.00	134764936.70

Any substantial risk of degradation of these resources caused by hydropower development represents a threat that would devastate the livelihoods of a large proportion of the 1.3 million people living in the ZoIs. It would have similarly devastating environmental consequences, not just in the immediate vicinity (where they would be catastrophic) but also to the integrity of environmental services over a much wider area downstream and beyond. One of the impacts, should these forests disappear, would be to significantly shorten the lifespan of the hydropower schemes as increases in erosion would result in far more rapid siltation of reservoirs than expected. The risks associated with the degradation of forest resources in the ZoIs are consequently severe.

How likely is it that these risks will be realized: in other words what evidence is there to suggest that hydropower development will have a substantial negative impact on the forest resources of the ZoIs? There is little solid evidence from existing hydropower schemes on this issue: this is something that needs to be studied in more detail, in later stages of more concrete hydropower planning and feasibility studies. It is possible to identify the processes that would lead to the degradation of forest resources in the ZoIs and then make informed estimates of the likelihood of these processes occurring. Three main processes can lead to forest resource degradation (in addition to the forest area lost in the reservoir, discussed above): (i) forests cleared during the construction of roads, power lines and other infrastructure associated with dams; (ii) forest resources degraded because improved market access means that there are increased levels of unsustainable logging and other forms of resource extraction; and (iii) unsustainable pressures that result from increased population densities that are a consequence of in-migration and resettlement.

The specific lengths of **roads and power lines** constructed in each scheme vary, but in most cases these are relatively short in relation to the area of forest in the ZoI. The quantity of forest cleared for their construction will make little direct impact on the availability of forest resources in the ZoI areas: they are far more significant in terms of their impact in terms of increasing the accessibility of forest areas to encroachment and unsustainable exploitation. From the very limited information available, it is assumed that the construction of roads and power lines will entail the clearance of 1% of the total forest areas in the ZoIs. Although only a small proportion of the forest resources and will have no significant implications for the availability of forest resources for local needs, this nevertheless represents a value of over \$80 million in terms of resource values lost.

The issue of **unsustainable exploitation** is one that affects all forests in Viet Nam. These resources have substantially declined in recent decades, though present forest policies focus on reversing these trends and are making an impact on this. These problems are no doubt true of the localities where the ZoIs are found. The categorization of forests includes the designation of areas of natural forest as eligible for timber extraction with what are meant to be sustainable methods. Whether this does in fact take place varies from place to place and relates to the capacities of local officials to control extraction methods.

This is, as has been said, a generic issue and there is nothing inherent in hydropower development that will exacerbate the problem apart from easier access because of road construction. This means that the pressures will be along the lines of the road access and not general throughout the ZoIs. For the analysis presented here, it is assumed that this will result in an increased level of extraction to the equivalent of 2% of the forest resource values, the equivalent of \$160 million.

Increased pressures due to higher **population pressures** are easier to assess, as it is a function of the ratio of people to forest area. These vary greatly between schemes. At present, 10 of the 21 schemes have people-to-forest ratios of less than 2 persons per hectare. This represents a low level of pressure and it is unlikely that any possible influx of people due to hydropower development will result in unsustainable levels of pressure on these resources. A further eight schemes have a ratio between 2.0 and 3.9: a level where there is some risk of future pressures, but these risks are relatively low and will be confined to some parts of the ZoI only. The remaining three schemes, Nam Na, Nho Que 3 and Trung Son, have present people-to-forest ratios above 4.0, with Nho Que 3 and Trung Son having extremely high ratios above 7.0. There is a high likelihood that existing high pressures will be significantly exacerbated by the influx of people associated with hydropower development.

A mitigation strategy for forest resources, based on a community forestry approach, is presented in chapter 6. It is a strategy that, if introduced before development of the project commence, has the potential to anticipate potentially unsustainable pressures on forest resources in most cases. If this mitigation approach is adopted, then the pressures caused by increased population pressures are only likely to be significant in Nho Que 3 and Trung Son, where it is reasonable to assume that 10% of the value of the forest resources will be lost (representing a resource value of \$400,000). If anticipatory mitigation measures are not introduced then it is likely that levels of unsustainable exploitation of forest resources will be higher.

Impacts on Aquatic Resources

Data on the lengths of river both upstream and downstream from the dam site that will be affected by the development of individual schemes is available from the NHP study (Table 4-11). These data show a great deal of variation between schemes, with some dams having little impact downstream in particular. This is either because the river in question joins another, larger, river a short distance downstream or because the scheme is part of a cascade development where the river downstream links with reservoirs of downstream schemes.

These rivers play an important role in the livelihoods of people living alongside them. Many people fish in the rivers, whilst others gather plants or other animals and the rivers provide a means of transport, water for domestic and productive uses and a means of waste disposal. The construction of a dam will affect the exploitation of plants and animals in particular by acting as a barrier for migration routes, altering water flows and disrupting ecosystem dynamics. Other uses are less affected, with the impacts being contingent upon how the dam and reservoir affect water flows. Impacts on aquatic resources are consequently primarily an issue of the impact on the availability of biotic resources. The evidence available from existing dams and the analysis in the NHP Study suggests that these impacts are likely to be severe, with the availability of fish and other valuable biotic resources significantly diminished as a result of dam construction.

The numbers involved can be calculated if one assumes that people using the rivers live within a 1 kilometer distance. Using average population densities (and these figures should be updated and calculated with a better resolution in the project planning stages for each site), this would mean that around 180,000 people are potentially affected by the diminished availability of aquatic resources. Of course not everyone in these communities fish or gather other animals and plants: it is estimated that 30% of the population in living close to the river do make some use of their biotic resources. In terms of the significance in people's livelihoods, fisheries are not a dominant source of income in most mountainous areas. A

recent study³³ estimated that fisheries accounts for 6% of rural incomes in mountainous areas of Viet Nam, including that from both aquaculture and wild catches in rivers and lakes. Based on these figures and assuming an above average dependency amongst families closer to the river, it is assumed that aquatic resources on average account for 10% of the income of households who exploit them.

Table 4-11: Population living within 1 km of rivers – up and down stream

Name	Affected D/S River (km)	Affected U/S River (km)	Population density (persons/km ²)	D/S population (person)	U/S population (person)	Total (person)
Song Bung 2	17	5.6	141	4,794	1,579	6,373
Ban Chat	0	92	52	-	9,568	9,568
Huoi Quang	3	31	60	360	3,720	4,080
Song Bung 4	6.6	29	143	1,888	8,294	10,182
Srepok 4	0	11.2	68	-	1,523	1,523
Upper Kon Tum	26	22	17	884	748	1,632
Hua Na	6	18.9	50	600	1,890	2,490
Dak Mi 4	36.5	30.5	28	2,044	1,708	3,752
Dak Mi 1	17	13.3	20	680	532	1,212
Dong Nai 2	7.2	22.5	102	1,469	4,590	6,059
Lai Chau	0	34	111	-	7,548	7,548
Dong Nai 5	8	7.5	69	1,104	1,035	2,139
Song Bung 5	0	15.8	209	-	6,604	6,604
Khe Bo	0	32.5	31	-	2,015	2,015
Nho Que 3	28	3.4	82	4,592	558	5,150
Trung Son	0	15.6	299	-	9,329	9,329
Hoi Xuan	0	19.5	59	-	2,301	2,301
Bac Me	0	93	49	-	9,114	9,114
Nam Na	0	40	97	-	7,760	7,760
A Luoi	8	17	32	512	1,088	1,600
Vinh Son II	0	0	37	-	-	-
Total				18,926	81,504	100,431

The high risk of a severe impact on the availability of these resources would have a significant impact upon these families. Assuming an average income of 4.3 million VND/year, this would represent a total loss in income of 15.5 billion VND, or a little less than \$1 million per year. This is not a large amount in total terms but represents an important loss for the affected families and the need for mitigation measures is discussed in chapter 6.

Risks to Biodiversity

The potential impact of hydropower development on biodiversity resources is an extremely contentious issue that is difficult to assess. This is in part a reflection of inherent difficulties in measuring biodiversity values, but also reflects the current reality of Viet Nam where there are a wide range of other threats to biodiversity resources. It is difficult, if not impossible, to separate the specific impacts of hydropower development from these wider pressures on these resources. The risks to biodiversity from hydropower relate to two main processes:

³³ ref

- The fragmentation of critical ecosystems that is a consequence of the construction of the dams themselves, of roads and power lines and of the flooding of reservoir areas.
- Increased pressures on the resources associated with land use conversions, increased hunting and gathering and changes to flows of water or nutrients.

Measuring these risks in a comprehensive manner, where all aspects of biodiversity (including, for example, that of agricultural lands) are considered is not a feasible proposition within the context of a national-level SEA. Such an analysis is most appropriate for a detailed assessment of individual sites, such as within an environmental impact assessment made during the planning of an individual hydropower scheme. In contemporary Viet Nam, the information is available to assess major biodiversity risks, based on the categorisation of, firstly, protected areas (PAs) and, secondly, key biodiversity areas³⁴ (KBAs).

Two stages have been undertaken in this analysis:

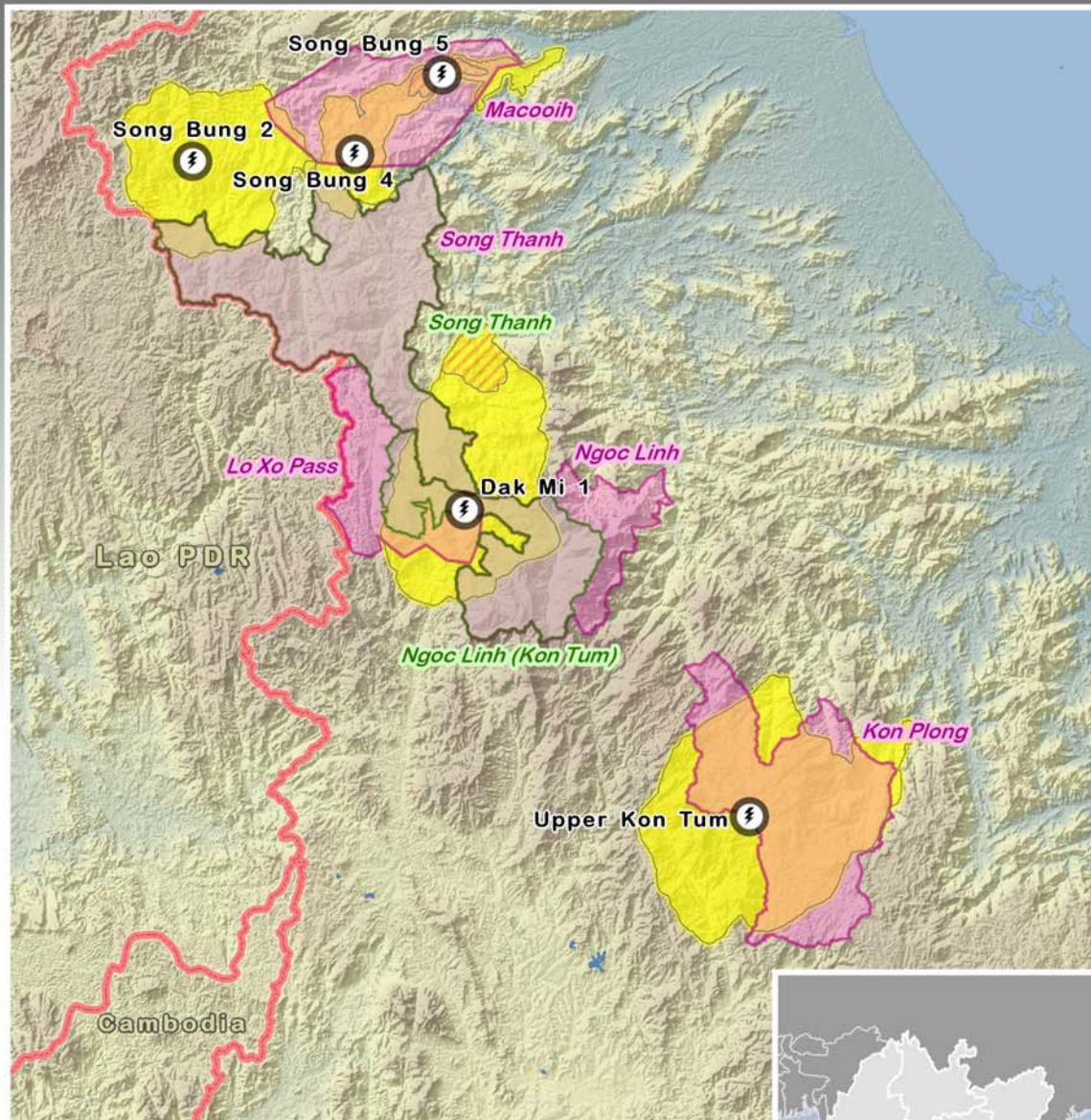
1. The GIS analysis provided data on the percentage of both PAs and KBAs that fell within particular ZoIs (for example, see Figure 4-7). These data were used to assess ecosystems fragmentation risks by calculating where the area and proportion of PAs and KBAs in the ZoIs were at a level where such risks were assessed as being high.
2. The analysis of impact risks to species and habitats that have high biodiversity values has been made based on information of the occurrence of threatened and endemic species within the PAs and KBAs.

The data on the proportion of KBAs and PAs in the different ZoIs is presented in Appendix 4-3. Whilst most ZoIs contain some lands that fall within KBAs and PAs, in most cases, the percentage of these areas is low. A total of 19 KBAs have part of their area within a ZoI, but of these eight have less than 10% in the ZoI and a further six have between 10% and 20% in a ZoI. The risk of fragmentation caused by hydropower development is low in these cases. There are five locations where more than 20% of a KBA falls within the ZoIs of hydropower schemes. The risk of ecosystems fragmentation can be taken as being significant for these areas. These KBAs are: Cat Loc (60% in the ZoI of Dong Nai 5); Kon Plong (75% in the ZoI of Upper Kon Tum); Lo Xo Pass (45% in the ZoI of Dak Mi 1); Macooih (42% in the ZoIs of Song Bung 2, 4 & 5); and Xuan Lien (49% in the ZoI of Hua Na). Of these five KBAs, Cat Loc, Lo Xo Pass, Hua Nam and a small part of Macooih are designated as PAs (sometimes with a different name). Most of Macooih and all of Kon Plong KBAs (over 62,000 ha of which falls within the ZoI) have not been designated as PAs.

In addition to these KBAs, there are several PAs that have a significant proportion of their area in the ZoIs but that are not listed as KBAs, including Bac Me (89% in Bac Me scheme), Muong Nhe (nearly 78,000 ha falling within the ZoI of Lau Chai), and Pu Hu (40% in the ZoIs of Trung Son and Hoi Xuan schemes). When the information on KBAs and PAs is combined, there are a total of 10 sites where there is a significant risk of biodiversity impacts across the 21 hydropower schemes in the scenarios analysis. Table 4-13 presents data on the main characteristics of the eight that are PAs (for which more detailed information is available). Comparable information is not available for Kon Plong and Macooih, but the former contains important mammal, bird, reptile and plant species whilst Macooih is listed as containing important mammal and bird species.

³⁴ Key Biodiversity Areas have been identified through use of the analysis in: Bird Life International (2006) *Sourcebook of Existing and Proposed Protected Areas in Viet Nam: second edition*, which provides a comprehensive overview of areas of particular significance in biodiversity terms.

VietNam-HPPs with High Risk of Significant Biodiv. Impacts (4)



Key to features

- International boundary
- HPP with high risk of significant biodiversity impacts
- HPP Zone of Influence (Overlap of ZOI):
 - yes
 - no
- Protected Area
- Key Biodiversity Area (KBA)

km 0 10 20 40



Boundaries are not necessarily authoritative



Figure 4-7: GIS Analysis to Identify High Risks of Ecosystem Fragmentation

Table 4-12: Hydropower Schemes with a High Risk of Significant Biodiversity Impacts

Hydropower Scheme	At-Risk Protected Area/Key Biodiversity Area
Bac Me	Bac Me (24,238 ha, 89% of total)
Dak Mi 1	Ngoc Linh (23,061 ha, 48% of total)
Dong Nai 5	Cat Tien (19,092 ha, 24% of total)
Hua Na	Xuan Lien (11,163 ha, 49% of total)
Huoi Quang	Nam Don (12,144 ha, 100% of total)
Lai Chau	Muong Nhe (77,968 ha, 23% of total)
Trung Son	Pu Hu (12,533 ha, 40% of total) & Xuan Nha (11,298 ha, 31% of total)
Song Bung 2, 4 & 5	Macooih (21,677 ha, 42% of total)
Upper Kon Tum	Kon Plong (62,446 ha, 75% of total)

Many, but not all, of the PAs identified as having high risk areas contain important and threatened species, including tigers (Muong Nhe), rhinoceros (Cat Tien), primates (including highly endangered and indigenous species) and a wide range of indigenous birds, plants, mammals and other species. Some of these species are of international biodiversity significance. They should be regarded as a national resource of great significance that should be protected through concerted efforts. Actions to mitigate these risks should consequently be seen as a high priority in the development of the hydropower schemes in question.

The list of schemes and the associated PAs and KBAs is shown in Table 4-12, whilst Table 4-13 outlines the main characteristics of the most vulnerable Protected Areas. A total of 11 schemes (Macooih is scattered across Song Bung 2, 4 & 5 schemes, whilst Trung Son contains two protected areas, Pu Hu and Xuan Nha) contain biodiversity resources that are potentially at risk. Not all have the same value and the levels of risk differ, but all of these schemes require special and specific actions in the planning and development of the hydropower project to ensure that these biodiversity risks are mitigated.

Table 4-13: Assessment of Biodiversity Values in High Risk Protected Areas

Name	Province	Category	Total area (ha)	Forest Type	Globally threatened, endemic, keystone species	Objective of Protection	Area in ZOI	Percentage of Area in ZOI	Rank
Bac Me	Ha Giang	Nature Reserve	27,800	-	-	Forest on limestone mountain. Many endemic and precious timber tree species. Capricornis sumatraensis and many primate species	24,238	89	Important
Cat Tien	Dong Nai, Lam Dong, Binh Phuoc	National park	70,548	Lowland evergreen and semi-evergreen forests	Lesser One-horned Rhinoceros, Asian Elephant, Gaur, Orange-necked Partridge, Siamese Crocodile (<i>Crocodylus siamensis</i>)	Forest in lowland; diverse forest type. Many large mammal species such as rhinoceros sundaicus, gaur, elephant, crocodile and many threatened and endemic bird species	19,092	24	Very important
Muong Nhe	Lai Chau	Nature Reserve	182,000	Lowland evergreen forest, lower montane evergreen forest and upper montane evergreen forest	Asian Elephant (<i>Elephas maximus</i>), Tiger (<i>Panthera tigris</i>), Gaur (<i>Bos gaurus</i>)	Evergreen, broad-leaved forest; many large mammal species	77,968	23	Important
Nam Don	Son La	Nature Reserve	-	-	-	-	12,144	100	Not very important
Ngoc Linh	Kon Tum	Nature Reserve	41,424	Lowland evergreen forest, Lower montane evergreen forest, Upper montane evergreen forest, elfin forest	<i>Pinus dalatensis</i> and <i>Panax vietnamensis</i> (endemic species), Golden-winged Laughingthrush (<i>Garrulax ngoclinensis</i>); endemic mammal species, Annamite Muntjac <i>Muntiacus truongsoneis</i>	Evergreen forest on high and medium mountains. Panax Viet Namensis, Pinus dalatensis; tiger, Truong Son deer, giant muntjac; endemic and new bird	23,061	48	Important

Name	Province	Category	Total area (ha)	Forest Type	Globally threatened, endemic, keystone species	Objective of Protection	Area in ZOI	Percentage of Area in ZOI	Rank
						species			
Pu Hu	Thanh Hoa	Nature Reserve	35,089	Lowland evergreen forest, Lower montane evergreen forest	Asian Black Bear (<i>Ursus thibetanus</i>), Sun Bear (<i>U. malayanus</i>), Gaur (<i>Bos gaurus</i>), White-cheeked Crested Gibbon (<i>Hylobates leucogenys</i>), Yellow-billed Nuthatch <i>Sitta solangiae</i>	Evergreen forest on low mountain; Chukrasia tabularis, Burretiodendron tonkinensis, Podocarpus neriifolius	13,850	40	Important
Xuan Lien	Thanh Hoa	Nature Reserve	23,610	Lower montane mixed coniferous and broadleaf evergreen forest, lowland evergreen forest, regenerating forest and mixed bamboo and timber forest	<i>Cinnamomum balansae</i> , <i>Colona poilanei</i> , <i>Croton boniana</i> and <i>Macaranga balansae</i> , Gaur (<i>Bos gaurus</i>), Phayre's Leaf Monkey (<i>Trachypithecus phayrei</i>), White-cheeked Crested Gibbon (<i>Hylobates leucogenys</i>), Roosevelt's Muntjac (<i>Muntiacus rooseveltorum</i>), Short-tailed Scimitar Babbler <i>Jabouilleia danjoui</i>	Evergreen forest on limestone; Fokienia hodginsii; gaur, Roosevelt deer	11,163	49	Important
Xuan Nha	Son La	Nature Reserve	38,069	Evergreen forest	<i>Madhuca pasquieri</i>	Forest on limestone mountains with many threatened primate species	11,298	31	Not very important

4.4. Wider Impacts beyond the Zone of Influence

Whilst the main social and environmental impacts of hydropower development take place in the area around where the schemes are constructed, there are potential impacts beyond these areas that need to be taken into account in the analysis of an SEA. These wider impacts take two main forms: impacts on water resources in the whole river basin and impacts upon the atmosphere. The impacts on water resources are considered in detail in the next section.

The **impacts on the atmosphere** come primarily from the release of greenhouse gases from reservoirs. The quantities of such gases are not great, but should be recognised in the SEA analysis. The estimates used here are discussed in more detail in chapter 5. It is estimated that average releases of CO₂ from reservoirs are 6.65kg/ha/day, whilst those of CH₄ are 0.1kg/ha/day. With a total reservoir area of 25,133 ha for the 21 reservoirs, this would mean a total of 61,000 tonnes of CO₂/year and 917 tonnes of CH₄/year.

Using the valuation figures presented in chapter 5, this would mean a total Present Value (30 years and 10% discount rate) of \$19.47 million for the 21 hydropower schemes. It should also be noted that these figures should be balanced against the loss of greenhouse gas emissions from the lands that are flooded. This would be zero for forests, which are balanced emitters and absorbers when mature, but would be substantial from agricultural lands, and especially paddy rice fields which have very high levels of methane emissions in particular. As such, the overall increment of greenhouse gas emissions from the flooding of the reservoirs will be marginal.

4.4.1 Impact on Water Resources

The impact of hydropower development on Viet Nam's water resources was identified as a key strategic issue in the scoping phase of the SEA. This reflects, firstly, widespread concerns over the future availability and quality of water in Viet Nam and, secondly, the awareness that existing hydropower schemes have had a substantial effect on the hydrological regime. These concerns were compounded by the existing management regime of hydro reservoirs, which are not generally managed with multi-purpose objectives as a specific intent. The extent to which this has an impact on other sectors at the present time is hard to calculate, but as the analysis below shows the potential benefits of multi-purpose management are significant.

Analyses undertaken as part of the on-going, at the time of writing, National Water Sector Review³⁵ has identified a range of water resource availability and management problems that present Viet Nam with severe challenges if it is to meet future water needs in an efficient and sustainable manner. These challenges include existing and increasing **water shortages** in many river basins during the dry season, widespread vulnerability to **floods** (especially in central and southern parts of the country), degrading **water quality** and increasing pollution from a variety of sources (industry, agriculture and human settlements especially), concerns over the widespread degradation of the quality of **aquatic ecosystems** and, not least, major uncertainties over the future impacts of **climate change** on the water resources of Viet Nam. The Water Sector Review, along with an earlier review on rural water supply and sanitation³⁶, also identified the link between access to water resources and **poverty** reduction.

³⁵ Kellogg Brown and Root (2008) **Water Sector Review Status Report**, report prepared for the Asian Development Bank.

³⁶ Soussan, J. *et al* (2005) **Rural Water Supply and Sanitation Review**, SEI, Stockholm.

The Water Sector Review identified a number of specific issues of concern in relation to the impacts of hydropower on the overall water resources base, including: (a) the poor integration of the hydropower sector into the wider water resources management system; (b) the existing limited consideration of other sectors in the design and management of dams and reservoirs; (c) low levels of participation and a limited consideration of social and environmental impacts (something the current SEA is intended to remedy); and (d) the limited knowledge available on the impacts of changes to hydrological systems (including inter-basin transfers) on the overall water resource base.

It is worth noting that these concerns, which are all legitimate, relate as much or more to the process of planning, implementation and management of hydropower schemes than any inherent effects of hydropower. In other words, as the Review acknowledges, most of these concerns could be addressed if and when hydropower is more effectively integrated into the overall water resources management system and, in particular, when the needs and concerns of other sectors (including the environment) are taken into account in the planning and design of schemes and the management of reservoirs. A specific intention of the National Water Resources Strategy is to ensure the integrated planning of water resources within river basins, but this has been hampered in Viet Nam by a lack of specific legislation and institutional uncertainties over where responsibilities for river basin planning lie.

Assessing Impacts on Water Resources

The assessment of the proposed hydropower schemes in PDPVI on water resources focuses on the implications of likely changes to hydrological flows within the different river basins where schemes are planned for development. Impacts on aquatic ecosystems are considered in another section of the report: this section concentrates on water resources. The basis of the assessment presented here is hydrological modelling undertaken by the Institute for Water Resources Planning using the MIKE Basin model (more detailed presentation of the results of the modeling are presented in Appendix 4-4). Supply-demand balances for the years 2015 and 2025 were calculated for the ten river basins in which hydropower schemes are planned in the scenarios analysed in this SEA.

Of these ten river basins, five have only one scheme planned: the Ca RB (Khe Bo scheme), Huong RB (A Luoi scheme), San Se RB (Upper Kon Tum scheme), Srepok RB (Srepok 4 scheme) and Kone RB (Vinh Son II scheme). These are mostly smaller schemes and their overall impacts on the basins in which they are planned for would be small in terms of changes to hydrological flows. Together, these five schemes represent only 5% of the total additions to storage capacity of the 21 schemes that are planned for development after 2010 and considered in the scenarios. The hydrological modelling showed that the hydropower schemes will make only marginal differences to river flows and storage capacities in these basins, including where (such as in the Srepok RB) there are predicted future problems in meeting dry season water demands. Other solutions to these likely deficits will need to be found, including the construction of additional storage capacities where appropriate.

The remaining five basins have at least two planned schemes: the Da RB with four schemes, the Lo Gam RB with two schemes, the Ma-Chu RB with three schemes, the Vu Gia-Thu Bon RB with five schemes and the Dong Nai RB with two schemes. The impacts of the planned hydropower schemes on hydrological flows are more significant in these basins as briefly discussed below.

The four schemes in the Da RB (which feeds into the Red River in northern Viet Nam, see Map 4-1) include Lai Chau (1,215 million m³) and Ban Chat (2,138 million m³) which, between them, represent over 43% of the total changes to storage capacity of the 21 planned schemes. The impact of the schemes on the Da RB will be significant, both reducing wet

season flood peaks (for example, the flood peak at Pa Vinh will be reduced by 10%) and adding some 145 m³/second to dry season flows. Although there are not at present any concerns over drought conditions in this river basin, further ensuring the security of dry season flows is potentially valuable.

Figure 4-8: Planned Hydropower Schemes in the Da River Basin

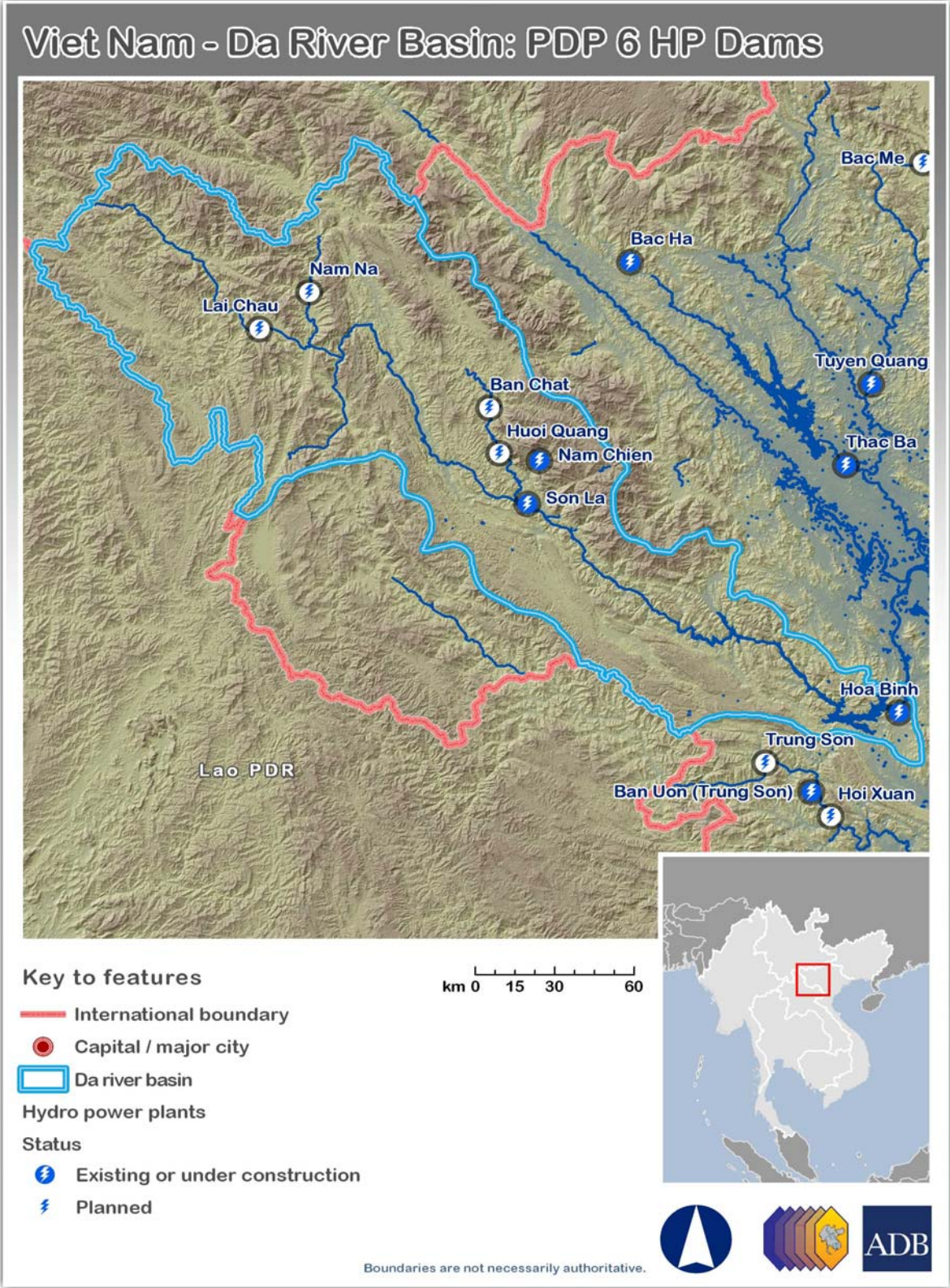
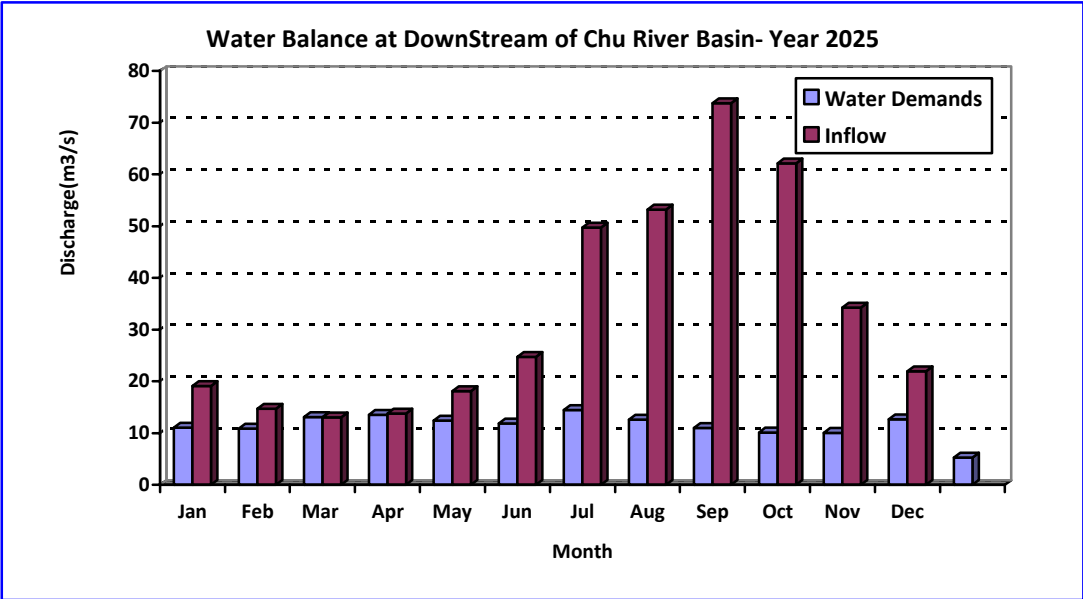


Figure 4-9:



The two planned schemes in the Lo-Gam RBs, Bac Me and Nho Que 3, in the very north of Viet Nam, are in an area where the prospects of structural dry season water deficits are very serious if there are not interventions to increase storage capacity and regulate flows. The hydrological modelling suggest that these deficits will become acute by 2025 without interventions, affecting downstream water users and jeopardising environmental flows to downstream ecosystems. Bac Me Hydropower Project will contribute to, but not be sufficient, addressing this problem.

The three schemes planned for the Ma – Cu basins (Trung Son, Hoi Xuan and Hua Na), on the border between northern and central Viet Nam, will have a total storage capacity of over 900 million m³, which is a significant amount on a river system of this size. There is at present no water shortage in this area but the modelling predicted a deficit in the dry season by 2025 if the additional storage capacity in the hydropower schemes is not constructed. As the figure above shows, these potential shortages would just about be addressed by the construction of the hydropower schemes.

The five schemes (Song Bung 2, Song Bung 4, song Bung 5, Dak Mi 1 and Dak Mi4) planned for the Vu Gia – Thu Bon basin would, if constructed, provide an additional 1,434 million m³ storage capacity in an area that is likely to experience severe dry season water shortages in the near future. The modeling predicted a 90% probability of significant water shortages in the lower reaches of the basin in the five months April – August, at an average total level of 277 million m³ for this period if there is no additional storage capacity built in the basin. The five schemes would have the potential to provide an additional 218 m³ for this period, meeting most but not all of the predicted deficit, *if* the reservoirs are managed to maximize dry season flows. The remaining deficit could be met if existing hydropower schemes (A Vuong and Song Tranh 2) are managed to regulate their release discharges in an appropriate manner. There is consequently little doubt that the hydropower schemes in the Vu Gia – Thu Bon basin will have a significant impact on the hydrology of the area. The precise nature of this impact is contingent upon the management regime implemented in the reservoirs of these five hydropower schemes.

The two schemes planned for the Dong Nai basin, Dong Nai 2 and Dong Nai 5, are to be built in one of the most intensively developed parts of Viet Nam, with the Dong Nai River feeding

into the Ho Chi Minh City region with its dense collection of industry, intensive agriculture and human settlements. This area is not likely to suffer from water shortages in the future, however, with the model predicting inflows to exceed demand by several times in 2025 even during the dry season. The impact of the two hydropower schemes on the hydrology of this river basin will be marginal.

Economic and Development Impacts of Hydropower on Water Resources

The above paragraphs provide an overview of the likely impacts of the 21 hydropower schemes on the hydrology of the nine river basins in which they are planned to be built. The impact will be significant, in terms of overall and seasonal water flows, in a few basins and marginal in the rest. To what extent will these changes in hydrology be reflected in significant impacts on the economies and human development of the different basins? These effects are assessed here, firstly through the consideration of changes in dry season water availability and then through a discussion of potential impacts on the incidence of floods in the different basins.

Table 4-14 summarizes these impacts for each of the five scenarios generated in the SEA. The data on storage capacities, dry season supply changes and flood control capacities were derived from the modeling exercise. The data on irrigated area, crop yields and economic values for crops were derived using average national figures. This is based on the assumption that *all* of the additional dry season water flows are used for irrigated paddy rice production, and that average yields are achieved in the areas irrigated. The figures consequently represent a theoretical maximum, not a likely outcome. But balanced against this is the consideration that using the water for irrigated agriculture represents a low economic value use of water and it is possible that some of the water would be used for higher value forms of production (including activities such as vegetable production and aquaculture in the agricultural sector as well as non-agricultural activities).

Table 4-14: Changes to Storage Capacity, Dry Seasons Flows and Maximum Potential Benefits by Scenario

Scenario	Addition to Storage Capacity (Mm ³)	Dry Season Supply Change (m ³ /s)	Flood Control Capacity (Mm ³)	Additional Irrigated Area (Ha)	Additional Crop Yield (rice ton/year)	Economic Value of Crop Yield (000 US\$)
Base Scenario	7,644.4	495	734	26,990	156,542	92,047
Alt 1	6139.9	365	403	19,290	111,882	65,786
Alt 2	4553.2	231	102	11,090	64,322	37,821
Alt 3	1470.6	95	0	4,490	26,042	15,312
Alt 4	0	0	0	0	0	0

As such, the figures do provide a robust indication of the potential economic impact of changes to dry season water flows *if and when* the reservoir discharge regimes are managed to take these potential non-power benefits into account (though of course the total value cannot be attributed to changed water management alone, as there are other costs of production such construction and operation & maintenance that need to be taken into

account). This, of course, represents a further qualification to the analysis presented here, as at present most hydropower reservoirs are managed for power generation purposes only and the potential non-power benefits are not sufficiently recognised. As the analysis presented here shows, such benefits are far from insignificant. It should however be noted that any changes in the reservoir operation to cater for other water users could imply decreased energy production and thus less power benefits.

The Base Scenario, where all 21 schemes are built, is of course where the highest impacts would be found. The improvements to dry season water flows in this scenario would allow over 25,000 extra hectares to be irrigated, producing a yield of over 150,000 tonnes of rice and generating an income of over \$90 million (using March 2008 prices³⁷) per year. This additional income would benefit many thousands of farming families throughout the country. Given that, at the time of writing, the world is experiencing a rice shortage and rapidly rising prices, and that such problems are predicted to intensify in the future, the economic and food security benefits of improved dry season water availability are likely to be even more significant than the figures presented here.

The scale of these benefits, inevitably, falls for each scenario, with a particularly significant drop for Alternative 2 where additional yields and income almost halve. It was noted, above, that the planned schemes have the potential to play an important role in ameliorating predicted future dry season water deficits in a number of river basins. The data presented here translates these figures into an economic value that can be taken as a minimum. If dry season water deficits impacts beyond irrigated agriculture, into human consumption, industrial production or the maintenance of ecosystems integrity, then the social, economic and environmental impacts would be even higher.

The planned hydropower schemes also have potential flood control benefits in a number of river basins. The data available does not permit a calculation of the economic significance of these potential flood control benefits (data on the economic losses from flooding is almost non-existent in Viet Nam and by their very nature floods are unpredictable so calculating the reduction of risk is itself an inherently risky business). It is possible to provide some indicative analysis on the potential scale of such benefits.

Floods in the wet season are a concern in the Red River system, with at present Hanoi vulnerable to 500 and 1000 year return flood events and many rural areas experiencing inundations on a regular basis. There is an extensive and long-standing system of flood control measures in the lower Red River, but these are not effective against all floods and future uncertainties over the impact of climate change mean that there is a risk that such system failures will increase in the future. Upstream reservoirs, if managed effectively, can significantly improve the prospects of water levels remaining below the water levels of the existing dyke systems. The modeling of water flows in Da and Lo-Gam river basins suggests that the risks of downstream floods would be significantly reduced, with Hanoi no longer at risk from 500 and 1000 year return events and water levels staying below dyke design levels in most years for most of the lower Red River area. Such potential benefits cannot be quantified but are of major significance.

The modeling suggested that there are also potentially significant flood control benefits in the lower Vu Gia-Thu Bon basin. The total flood storage capacity of the reservoirs would be over 1 billion m³, about 20% of the total designed flood volumes at a frequency of 10% at Ai Nghia and Giao Thuy if all the schemes were built in this basin. This translates to a reduction

³⁷ FAO Rice Price Update: www.fao.org/es/esc/en/15/70.

of between 0.7 and 1 metre in maximum inundation depths in the lower basin, which is in itself significant but does not provide anything close to full flood protection as there are still maximum potential inundation depths of between 2 and 3 metres in some places. As such, flood risks will be reduced but will still be significant in this river basin.

Taken together, the impacts of the altered hydrology of the nine river basins in which it is planned to build hydropower schemes are extremely significant if, and this must be stressed, the resultant reservoirs are managed so as to maximize multi-purpose benefits. Potential increases in dry season water flows could generate additional income for thousands of families, improve national food security and total over \$90 million in additional agricultural production a year. When potential flood control benefits are added, there is little doubt that the overall impact of the hydropower planned in PDPVI on water resources is potentially significant and beneficial.

4.5. Conclusions of the Impact Assessment

The analysis presented in this chapter shows that there are a wide range of potential social and environmental impacts, both positive and negative, from hydropower development. The degree of certainty that these impacts will transpire ranges from extremely high for many impacts in the reservoir area to low for many potential impacts in the zones of influence and beyond. This means that most potential impacts are best understood as a risk factor, and in many cases they are risks that can be reduced or removed by effective anticipatory mitigation measures: an issue discussed in detail in chapter 6.

The clearest **positive impacts** are for agricultural production (both within the ZoI and further afield) and water resources management, both of which are likely to be wide ranging in their effects. The increased agricultural income that is a consequence of improved market access could be significant in catalyzing wider development benefits in the economies of poor communities in remote locations. Similarly, improvements to dry season water availability and reduced flood risks will both generate wider development benefits. These potential benefits can be enhanced by measures to support agricultural development and to manage reservoirs for multipurpose benefits.

The **impacts on displaced people** will be substantial, with a risk of creating deep and sustained impoverishment for people who are already extremely vulnerable. The package of mitigation measures outlined in chapter 6 are an essential part of the planning and cost of hydropower if these risks are to be avoided and the sector is to develop in a socially responsible and sustainable manner. These impacts are both material, in terms of loss of livelihood assets, land and homes and access to services, and psychological, in relation to social and cultural identity and cohesion. Neither aspect of the impacts can be mitigated by short term measures alone. Any mitigation package must reflect this full range of risks.

Wider social impacts, in particular for the large numbers of people in the ZoIs, are less certain and will be more differential in their effects, with some people deeply affected whilst others experience far lower levels of impact. These impacts can be identified in relation to changing access to natural resources in particular, but also in terms of the effects of opening up remote areas to external influences. There will be a concentration of these impacts in the locality that is the “host” to resettlement and around the construction site for the dam.

The risk of impacts on **natural resources** is hard to predict but very significant. In particular, potential losses of forest resources could be high in terms of their local livelihood impacts and their inherent resource values. Aquatic resources will also be severely affected in many cases where river lengths are impacted by dam construction and changes to flow regimes. The

extent of the impact on forest resources will vary from scheme to scheme, depending on the intensity of existing pressure on these resources. Mitigation measures can be identified for resource loss risks and are discussed in chapter 6.

The risk of **biodiversity impacts** is hard to quantify or even estimate in more qualitative terms, but could be severe in some cases. In particular, the risk of ecosystems fragmentation is significant where a high proportion of sensitive biodiversity areas are located close to the dam site. In many cases, Viet Nam's biodiversity assets are of global significance and their loss would have consequences far beyond the immediate site. At the same time, it is easy to exaggerate the nature and intensity of the risks that can be directly attributed to hydropower development and this issue can polarise opinions; something that in turn acts as a brake on effective mitigation actions. It is essential that a balanced approach based on an assessment of the nature and intensity of risks is taken to this issue, and that significant efforts to this end are made during the feasibility assessment stages of individual project planning.

There are several individual schemes where a number of these different forms of risk of social and environmental impacts are high: these schemes merit particular attention and mitigation actions during planning and implementation. The schemes that have high risks across a number of categories and are potentially the most problematic are Bac Me, Ban Chat, Trung Son and Lai Chau. All of these schemes are located in the north of Viet Nam, in areas where poverty is particularly entrenched and where there is a very high proportion of ethnic minorities in the affected populations. The presence of several schemes on one river basin also presents the possibility of cumulative impacts that will compound the effects of individual schemes. This is particularly an issue in the Vu Gai-Thu Bon basin, where five schemes included in the scenario analysis are found.

As will be further elaborated in Chapter 5, the risk and impacts of hydropower development discussed here need to be measured and balanced against the risks and impacts of alternative developments, including the non-development of power generation capacity or the increase in thermal power generation based on natural gas or coal. As will be shown, the alternatives have their own risks and impacts, albeit of a very different nature. Any SEA of hydropower will not be complete unless an assessment of the alternatives to hydropower is included as an integral part of the analysis.

Overall, the analysis presented in this chapter shows that the risks of social and environmental impacts from hydropower development are significant, can in most cases be measured, and can to a great degree be mitigated if effective actions are taken. There are some schemes, listed above, that are particularly problematic and will require concerted efforts to mitigate negative impacts, whilst some types of impact (such as those on aquatic environments) are harder to mitigate than others. Mitigation is nevertheless possible in most cases. Such actions entail costs, but these costs are (a) not at a level where they compromise the financial viability of any of the hydropower schemes and are (b) good investments in terms of their overall economic returns to Viet Nam's sustainable development.

5. Valuation and Weighting of Impacts

5.1. Introduction

A key challenge in any SEA, in particular in terms of providing useful knowledge for decision support, is the interpretation and judgment of the impact results for the different scenarios. This can be fruitfully supported by applying a weighting methodology. It should be noted that this analytical step is distinct from the impact analysis, and as such it is not always mandatory in SEA frameworks. Still, it is a critical analytical input to support decision makers in their judgment and interpretation although their final decision will ultimately reflect a wide range of factors and political judgments (and as such may well of course be different from what the results of the weighting would suggest).

The selection of weighting methodology depends on many factors, such as the time available, the type of decision, the nature of the data to support the analysis, the analytical skills of those involved, cultures of decision making and the legislative requirements on the process. In this SEA, two weighting methodologies are applied, one based on a multi-criteria analysis (MCA) (based on multiple-objectives decision theory) and one based on environmental-economic analysis (based on neoclassical economic theory). It should be noted that results from the environmental economic analysis can – and on certain parameters did – feed into the MCA as well as being used independently.

In both approaches, a core question is whose preferences the scores and weights represent. One departure point is that analysis and decision making within governments should represent the “national interest”. However, in all countries different national institutions interpret things like national interest in very different ways and tend to promote their own agendas. The selection of objectives should not promote particular sectoral, economic or environmental agendas but need to encompass the major concerns of the Vietnamese people as a whole: it should reflect a consensus amongst stakeholders. This entails national sustainable development priorities and strategies, but may also include concerns articulated by non-governmental actors, such as scientists, environmentalists, or community organizations. The SEA has already in the scoping stage defined what are the strategic issues and impact categories to be taken into account. This provides the basis for determining the valuation and weighting objectives.

Below the two approaches and overall results in two sections are briefly presented. The first deals with the economic valuation of impacts, and the second a multi-criteria analysis of impacts. Using more than one approach in tandem is particularly useful. If one method of weighting shows a particular result we learn from that, but we can have reservations about approach and methodology and not trust the robustness of results. However, if several methods are used we can learn much more. If they show different overall results (such as the giving a different ranking of alternatives) we are right to be careful and should judiciously consider the assumptions and choices made in the methods. If the different methods point in the same direction, we can be more confident about the results – because they do not vary due to the approach taken (Nilsson et al 2005).

5.2. Economic Valuation

The use of economic valuation as an integral part of a SEA for a sector such as hydropower is particularly attractive for a number of reasons. Firstly, it accords with the main approach to power sector planning, which is based on a least cost analysis whereby the most economical power generation options are prioritised in the planning system. Valuation allows the

internalization of social and environmental costs that have traditionally not been included in economic cost calculations for the sector. Secondly, the use of economic valuation as a common parameter greatly facilitates the comparison of costs and benefits between very diverse factors such as air pollution, resettlement impacts, biodiversity impacts and water resources. Thirdly, the calculation of costs and benefits is extremely effective in attracting the attention of non-specialists and senior policy makers in relation to social and environmental issues that they may not appreciate the significance of. For example, the calculation of the value of the forest resources in the ZoIs of several billion dollars, presented in Chapter 4, greatly increased the appreciation of all stakeholders of the value of these resources.

Of course, set against these advantages is the very important limitation that some key issues, such as risks to inherent biodiversity values or impacts upon local social and cultural cohesion, are difficult or impossible to calculate in economic terms. Whilst this is explicitly spelt out in the text and other means are used to assess their significance, there must be a concern that a valuation process that does not cover all key issues can lead to the lower appreciation of the significance of the issues not valued. Despite this real concern, however, the SEA has found it both possible and extremely valuable to undertake an extensive valuation of potential impacts and mitigation measures. In particular this allows the internalization of costs and benefits that have traditionally been treated as externalities. This section provides this economic analysis, based on the economic valuation of the following factors for the different scenarios outlined in Section 2.2:

- The cost of supply of electricity.
- The economic cost of air pollutants and greenhouse gases, mainly from thermal power plants.
- The social and environmental costs of coal mining.
- Additional social mitigation costs from hydropower.
- Environmental and natural resources costs of hydropower.
- Potential multipurpose benefits from reservoirs.
- The total valuation of the above and the internalization of these costs and benefits into the overall economic profile of each scenario.

5.2.1. Cost of Supply

Methodology

As mentioned in Section 2.2 there are alternatives to hydropower, but with economic consequences for supplying the energy to be replaced as the cost structures are quite different between hydropower and alternatives, such as thermal power. Hydropower has a high initial cost (costs for construction) but the operation costs are marginal, while thermal power normally have a lower initial cost but with higher operation costs (fuel).

When comparing hydropower with thermal power in economic terms (cost of supply), the levelized unit cost of energy (in US cent per kWh) is normally used, with this being the total of the investment costs, operation & maintenance costs and fuel costs levelized over the lifetime of the plant. The investment cost of a thermal power plant is not site specific and standard values can be used, as well as for the operation & maintenance costs. The fuel costs for thermal power plants are dependent on the type of fuel and the future costs for oil, gas and coal, which are difficult to predict (especially during the current market conditions). The levelized unit cost of energy for thermal power plants is furthermore dependent on how many hours per year the plant is operated, the plant factor.

The Institute of Energy has, in PDP VI, calculated the levelized unit cost of energy for different energy sources and different plant factors, and the following are adopted in this Study where the average plant factor according to Table 2-1 has been used:

Table 5-1: Levelized Unit Cost of Energy for Thermal Power

Energy Source	Plant Factor	Levelized Unit Cost of Energy US cent/kWh
Coal-fired	0.65	4.16
CCGT (gas)	0.45	5.53

The levelized unit cost of energy for hydropower is site specific and the values given in Appendix 2-6, collected from the NHP Study, have been adopted in this Study.

If energy is not served to the costumers, due to shortage of capacity or transmission capability in the power system, low fuel supply or extreme dry weather conditions, this will have consequences not only for the power utility but also for the national economy and good-will costs. The economic cost to the society for energy shortage, called “unserved energy”, is normally in the range of 0.25-10 USD/kWh depending on the industrial mix and the development of the country. In PDP VI a value of 0.50 USD/kWh was used and this value has also been adopted in this Study.

Results

The result of the economic valuation related to the Present Value (30 years and a discount rate of 10%) of the cost of supply for the different scenarios (according to Section 2.2 and Appendices 2-7 to 2-11) are summarized in Table 5-2, with a detailed analysis given in Appendix 5-1:

Table 5-2: Present Value of Cost of Supply for Different Scenarios

Scenario	Strategy	Present Value of Cost of Supply (\$ Million)	Difference in Present Value of Cost of Supply (\$ Million)
Base	According to Master Plan VI	5,435.65	0
Alternative 1	Hydropower projects with TPI < 60 are replaced by thermal power	5,445.48	9.83
Alternative 2	Hydropower projects with TPI < 65 are replaced by thermal power	5,729.46	293.81
Alternative 3	Hydropower projects with TPI < 75 are replaced by thermal power	6,268.42	832.77
Alternative 4	The planned hydropower projects are not implemented at all	7,741.38	2,305.73
Alternative 5	The planned hydropower projects are not implemented and not replaced by thermal power	76,937.87	71,502.22

In Alternative 5 the non-supply of 17,952 GWh/year is assumed to cost the society \$8,976 million a year, at a cost of unserved energy of 0.5 USD/kWh, giving a Present Value of \$84,679 million, however, deducted with a non-investment of \$7,741 million for Alternative 4 to produce the figure of \$76,937.87 million shown in Table 5-2.

As seen in the table above, the Base Scenario will give the lowest Present Value of the cost of supply, i.e. to develop the planned hydropower projects according to PDP VI is from a supply cost perspective the least cost option. The “do-nothing” scenario, i.e. Alternative 5, is from a supply cost perspective the worst option with a Present Value cost to the society of some \$77 billion over 30 years, a difference of nearly \$72 billion to the Base Scenario. It is evident that not constructing adequate generation capacity to meet future demands is not an option.

5.2.2. Economic Costs of Air Pollutants and Greenhouse Gases

Methodology

In this second step, social and environmental costs associated with greenhouse gas emissions and local and regional air pollutants are estimated.

Thermal power plants will release pollutions to the air when fossil fuels are burnt to generate electricity, both greenhouse gases (GHG) that are associated with climate change (global warming), CO₂, N₂O and CH₄, and air pollutants, SO₂, NO_x and PM₁₀, that are primarily more local and regional in their impact. The air pollutions from thermal power plants have in this Study been based on the following emissions factors:

Table 5-3: Air Pollution from Thermal Power Plants

Energy Source	Greenhouse Gases			Air Pollutants		
	CO ₂ Emission Tonnes/GWh	N ₂ O Emission Tonnes/GWh	CH ₄ Emission Tonnes/GWh	SO ₂ Emission Tonnes/GWh	NO _x Emission Tonnes/GWh	PM ₁₀ Emission Tonnes/GWh
Coal-fired	1,050	0.072	0.072	1.3	0.71	1.3
CCGT (gas)	460	0	0,037	0	0.22	0
Source	www.CARMA.org	Swedish EPA, 2006	Swedish EPA, 2006	Swedish EPA, 2006	Swedish EPA, 2006	Assumed as SO ₂

There is also a debate whether reservoirs also emit greenhouse gases, i.e. CO₂ and CH₄, with the studies and research on this subject being inconclusive. Reservoir emissions are, however, included in this Study and based on the values according to Appendices 2 and 3 of the 2006 IPCC Guidelines as the average of the values for “warm temperate, moist” and “warm temperate, dry” as follows:

Table 5-4: Greenhouse Gas Emission from Reservoirs

Gas	Emission Kg/ha/day
CO ₂	6.65
CH ₄	0.1

The economic values of air pollutants and greenhouse gases adopted in this Study are given in Table 5-5 based on the SEI/ADB report (Nilsson, 2007) as follows:

- The “Higher Bounds”, as defined in that study, is used for greenhouse gases, i.e. CO₂, N₂O and CH₄, as these are associated with climate change on a global scale (global warming).
- The “Lower Bounds”, as defined in that study, is used for air pollutants, i.e. SO₂, NO_x and PM₁₀, which are primarily more local in their impact and therefore assumed applicable for Viet Nam.

In the SEI/ADB study, for air pollutants, the higher bound value was referring to values of health impacts (mortality and morbidity) and is using European values for these endpoints, whereas the lower-bound value is using values adjusted for GMS-regional average GDP per capita.

It is not possible to put an economic value on all impact pathways associated with the air pollution. The numbers include impacts on human health, crop yields and material corrosion, but not eutrophication and acidification effects on terrestrial and aquatic ecosystems. Dominant among the impact costs (some 90%) are the costs of human health impacts. Estimates have been derived through the methodology of benefits transfer, based on the results from the European ExternE methodology (European Commission, 1999; Bickel and Friedrich, 2005).

Table 5-5: Economic Unit Values of Air Pollution

Greenhouse Gases			Air Pollutants		
CO ₂ Emission USD/Tonnes	N ₂ O Emission USD/Tonnes	CH ₄ Emission USD/Tonnes	SO ₂ Emission USD/Tonnes	NO _x Emission USD/Tonnes	PM ₁₀ Emission USD/Tonnes
25	7,311	568	604	1,083	3,880

Source: Nilsson, M, (2007), Valuation of some environmental costs within the GMS Energy Sector Strategy, SEI report to the Asian Development Bank

Results

The result of the economic valuation related to the Present Value (30 years and a discount rate of 10%) of the economic costs of air pollutants and greenhouse gases for the different scenarios (according to Section 2.2 and Appendices 2-7 to 2-11) are shown in Appendix 5-2, where also the yearly emissions of the air pollutions are shown, and summarized in Table 5-6.

The following observations can be made, (see Appendix 5-2)

- The greenhouse gas CO₂ present the largest cost to the society, some 80% of the total Present Value of air pollutants and greenhouse gases.
- Costs to the society for emissions of greenhouse gases from hydropower reservoirs are negligible compared to emission from thermal power plants.
- Adopting a power generation expansion according to Alternative 4, i.e. all planned hydropower projects are replaced with thermal power, gives an additional Present Value economic costs of air pollutants and greenhouse gases of \$4.54 billion when compared to the Base Scenario, i.e. according to PDP VI.

Since greenhouse gases and air pollution are predominantly associated with the thermal power alternatives, the analysis above reinforces the results from the cost of supply in Section 5.2.1 where the hydropower options become more attractive than the thermal options.

Table 5-6: Present Value of Economic Costs of Air Pollutants and Greenhouse Gases for Different Scenarios

Scenario	Strategy	Present Value (\$ Million)	Difference in Present Value (\$ Million)
Base	According to Master Plan VI	19.47	0
Alternative 1	Hydropower projects with TPI < 60 are replaced by thermal power	679.66	660.19
Alternative 2	Hydropower projects with TPI < 65 are replaced by thermal power	1,709.85	1,690.38
Alternative 3	Hydropower projects with TPI < 75 are replaced by thermal power	2,847.51	2,828.04
Alternative 4	The planned hydropower projects are not implemented at all	4,558.89	4,539.42
Alternative 5	The planned hydropower projects are not implemented and not replaced by thermal power	0	-19.47

5.2.3. Social and Environmental Costs of Coal Mining

Methodology

The estimated costs from the extraction of coal, which is a socially and environmentally disruptive activity, are based on a Vietnamese case study that assessed the total cost of the coal-fired thermal power plants in the North of the country and of the linked coal mining in Quang Ninh Province (Van Song and Van Han, 2001). In Quang Ninh Province, the air in cities and communes is seriously polluted by dust from mining works. Every year, mines discharge 8.86 million m³ of wastewater that carries large amounts of pollutants into rivers and the sea. Other problems caused by the mine industry include solid waste, radioactive gas emissions, noise pollution and forest destruction.

To calculate the costs of these mining-related problems, Van Song and Van Hanh evaluated the economic implications of health problems associated with mining (including injuries, lost productivity costs and mortalities) and looked at how much is spent on air, water and noise treatment to clean up the industry's pollution. The researchers also investigated the impact of the mining industry on tourism and recreation and what effect it had on agriculture, forest production, fisheries and infrastructure. Data was drawn from a variety of studies and commercial and government records.

The researchers calculated that the on-site and off-site costs of coal mining totaled 139, 649 million VND (USD10,344,370 at the exchange rate of USD1 = VND13,500 in 1998 or USD9,435,743 based on the exchange rate of USD1 = VND14,800 as at June 2001). The highest share of this cost was due to pollution abatement in the mines (46%). The total health cost of mining-related illnesses was 29,413 million VND or 21% of the total. Agriculture, forestry and fisheries losses represented about 15% and tourism and recreation losses 10% of the total costs, respectively. Given current estimates for the expansion of the Vietnamese coal mining industry, the researchers found that the marginal environmental cost of coal mining would be 19,029 VND per ton in 2010 or 5.5% of the total production costs at that time, equal to some 1 \$c/kWh that includes both injuries and fatal accidents, and pollution impacts.

Results

The result of the economic valuation related to the Present Value (30 years and a discount rate of 10%) of the social and environmental costs of coal mining for the different scenarios (according to Section 2.2 and Appendices 2-7 to 2-11) are given below based on the coal-fired energy production given in Appendix 5-1 and an impact cost of 1 \$c/kWh:

Table 5-7: Present Value of Social and Environmental Costs of Coal Mining for Different Scenarios

Scenario	Strategy	Coal-fired Energy Production (GWh/year)	Present Value (\$ Million)	Difference in Present Value (\$ Million)
Base	According to Master Plan VI	0	0	0
Alternative 1	Hydropower projects with TPI < 60 are replaced by thermal power	1,832	172.82	172.82
Alternative 2	Hydropower projects with TPI < 65 are replaced by thermal power	4,684	441.92	441.92
Alternative 3	Hydropower projects with TPI < 75 are replaced by thermal power	7,839	739.49	739.49
Alternative 4	The planned hydropower projects are not implemented at all	12,566	1,185.51	1,185.51
Alternative 5	The planned hydropower projects are not implemented and not replaced by thermal power	0	0	0

5.2.4. Additional Social Mitigation Costs from Hydropower

Methodology

Social impacts related to hydropower were discussed in Chapter 4, and in Section 6.3 the need for more effective measures to mitigate the impacts of hydropower development on displaced people is outlined based on analysis of existing mitigation measures as proposed in the NHP Study. Table 6-3 gives the original social mitigation costs according to the NHP Study and the adjusted social mitigation costs proposed in this Study. The original social mitigation costs were included in the cost of supply in Section 5.2.1 and the difference between the original and adjusted social mitigation costs are added as additional social mitigation costs in this section.

Results

The additional social mitigation costs for the different scenarios (according to Section 2.2 and Appendices 2-7 to 2-11) are given in Table 5-8, based on the analysis and data presented on the costs of a full package of mitigation measures that accords with the criteria of the IRR model, as presented in Table 6-3.

Table 5-8: Additional Social Mitigation Costs from Hydropower for Different Scenarios

Scenario	Strategy	Original Social Mitigation Costs (\$ Million)	Adjusted Social Mitigation Costs (\$ Million)	Additional Costs (\$ Million)	Difference in Additional Costs (\$ Million)
Base	According to Master Plan VI	386.74	473.88	87.14	0
Alternative 1	Hydropower projects with TPI < 60 are replaced by thermal power	288.11	346.80	58.70	-28.44
Alternative 2	Hydropower projects with TPI < 65 are replaced by thermal power	196.99	231.05	34.06	-53.08
Alternative 3	Hydropower projects with TPI < 75 are replaced by thermal power	74.24	85.80	11.55	-75.59
Alternative 4	The planned hydropower projects are not implemented at all	0	0	0	-87.14
Alternative 5	The planned hydropower projects are not implemented and not replaced by thermal power	0	0	0	-87.14

5.2.5. Environmental Cost of Hydropower

Methodology

Various environmental impacts due to hydropower development were discussed in Chapter 4 and in this section the following environmental costs have been included as outlined below.

The loss of agricultural land in the reservoir area for each of the hydropower projects were given in Table 4-1 based on the NHP Study. In that study the average value of agricultural land was estimated at \$ 2,800/ha based on regulations by the Ministry of Finance and thus included in the cost of supply in Section 5.2.1. The actual value is, however, higher based on recent studies and a more realistic value, reflecting the value of production, would be \$ 5,600/ha according to Section 4.2.1. The additional cost of \$ 2,800/ha, compared to the estimate in the NHP Study, has been accounted for in this section.

The value of forests lost in the reservoir area for each of the hydropower projects were given in Table 4-4, based on a study by the Forestry Science Institute as outlined in Section 4.2.1, and has been accounted for in this section.

One area where hydropower development is likely to have a positive impact is in increased income from agricultural production, i.e. a negative cost, as discussed in Section 4.3.1. The increases in yearly agricultural income for each of the hydropower projects were estimated in Table 4-8 and the Present Value (30 years and a discount rate of 10%) of these increased income have been accounted for in this section.

Hydropower development will have an impact on the aquatic resources both upstream and downstream of the dam structure. The impacted upstream and downstream river lengths were

estimated in the NHP Study from where the population living within 1 km on both sides of the river was estimated in Table 4-11. In Section 4.3.2 it was assumed that 30% of this population would be affected and that the economic impact of the lost aquatic resources would be 10% of an average income of 4.3 million VND/year. The Present Value (30 years and a discount rate of 10%) of these lost resources have been accounted for in this section.

In Section 6.4.3 community forest management are proposed as an effective strategy to mitigate the impacts on forest resources and Table 6-6 gives the estimated costs for such mitigation and has been accounted for in this section.

It should be noted that the valuation of the environmental costs is partial as it has not been possible to estimate fully an economic value for the risks and losses of biodiversity, either terrestrial or aquatic.

Results

The environmental costs of hydropower, for each cost item and the total, for the different scenarios (according to Section 2.2 and Appendices 2-7 to 2-11) are given in Table 5-9, based on the methodology outlined above.

Table 5-9: Present Value of Environmental Costs of Hydropower for Different Scenarios

Scenario	Strategy	Additional Cost for Lost Agricultural Land (\$ Million)	Value of Forests Lost in Reservoirs (\$ Million)	Increased Present Value of Agricultural Incomes (\$ Million)	Present Value of Impacts on Aquatic Resources (\$ Million)	Community Forestry Costs (\$ Million)	Total Present Value (\$ Million)	Difference in Total Present Value (\$ Million)
Base	According to Master Plan VI	16.90	72.50	-37.42	7.64	57.53	117.14	0
Alternative 1	Hydropower projects with TPI < 60 are replaced by thermal power	11.70	61.12	-25.37	5.92	56.93	110.31	-6.83
Alternative 2	Hydropower projects with TPI < 65 are replaced by thermal power	7.94	35.44	-18.29	3.94	55.97	84.99	-32.15
Alternative 3	Hydropower projects with TPI < 75 are replaced by thermal power	2.69	8.66	-13.60	1.21	26.65	25.61	-91.53
Alternative 4	The planned hydropower projects are not implemented at all	0	0	0	0	0	0	-117.14
Alternative 5	The planned hydropower projects are not implemented and not replaced by thermal power	0	0	0	0	0	0	-117.14

5.2.5. Potential Multipurpose Benefits from Reservoirs

Methodology

Section 4.4.1 assessed the impacts on water resources from the hydropower development in the river basins and Table 4-14 estimated the economic value of additional yearly crop yield due to increased dry season flow (by reservoir regulation) for each of the scenarios, and these potential additional multipurpose benefits have been accounted for in this section.

Results

The Present Value (30 years and a discount rate of 10%) of the potential additional multipurpose benefits from the reservoir regulations for the different scenarios (according to Section 2.2 and Appendices 2-7 to 2-11) are given below based on Table 4-14:

Table 5-10: Present Value of Potential Multipurpose Benefits from Reservoirs for Different Scenarios

Scenario	Strategy	Present Value (\$ Million)	Difference in Present Value (\$ Million)
Base	According to Master Plan VI	-868.40	0
Alternative 1	Hydropower projects with TPI < 60 are replaced by thermal power	-620.66	247.74
Alternative 2	Hydropower projects with TPI < 65 are replaced by thermal power	-356.79	511.61
Alternative 3	Hydropower projects with TPI < 75 are replaced by thermal power	-144.43	723.97
Alternative 4	The planned hydropower projects are not implemented at all	0	868.40
Alternative 5	The planned hydropower projects are not implemented and not replaced by thermal power	0	868.40

It should be noted that the multipurpose benefits given above are potential benefits and would only be realized if e.g. the reservoir operations are taking the needs of the downstream users into account, especially during the dry season. This could imply restrictions on power generation, and thus on the cost of supply, for the hydropower projects.

5.2.6. Total Present Values for the Scenarios and Concluding Comments

Methodology

The Present Values accounted for in this Study and estimated in Sections 5.2.1 to 5.2.5 are added to give the total Present Value for each of the scenarios. This provides an assessment of the consequences of internalizing the wider range of costs and benefits of hydropower development into the calculation of the Present Values of the different scenarios. As has been stated, there are some potential impacts (especially on biodiversity, on aquatic resources and on some aspects of cultural impacts) that has not been possible to value in economic terms. These issues are not included in the calculations shown below; a limitation to the present study that reflects the data and time available. The analysis here is a great improvement on past calculations of social and environmental costs, however, and does demonstrate that the principle of cost internalization is valid.

Results

The total Present Value (30 years and a discount rate of 10%) are given below, based on Table 5-2 and Tables 5-6 to 5-10:

Table 5-11: Total Present Values for Different Scenarios

Scenario	Strategy	Present Value of Cost of Supply (\$ Million)	Present Value of Economic Costs of Air Pollution (\$ Million)	Present Value of Coal Mining (\$ Million)	Additional Social Mitigation Costs (\$ Million)	Present Value of Environmental Costs (\$ Million)	Present Value of Potential Multipurpose Benefits (\$ Million)	Total Present Value (\$ Million)	Difference in Total Present Value (\$ Million)
Base	According to Master Plan VI	5,435.65	19.47	0	87.14	117.14	-868.40	4,791.01	0
Alternative 1	Hydropower projects with TPI < 60 are replaced by thermal power	5,445.48	679.66	172.82	58.70	110.31	-620.66	5,846.30	1,055.29
Alternative 2	Hydropower projects with TPI < 65 are replaced by thermal power	5,729.46	1,709.85	441.92	34.06	84.99	-356.79	7,643.49	2,852.48
Alternative 3	Hydropower projects with TPI < 75 are replaced by thermal power	6,268.42	2,847.51	739.49	11.55	25.61	-144.43	9,748.14	4,957.13
Alternative 4	The planned hydropower projects are not implemented at all	7,741.38	4,558.89	1,185.51	0	0	0	13,485.78	8,694.77
Alternative 5	The planned hydropower projects are not implemented and not replaced by thermal power	76,937.87	0	0	0	0	0	76,937.87	72,146.86

As mentioned in Section 5.2.5 the multipurpose benefits from the reservoirs are potential benefits only and if not realized the total Present Value (30 years and a discount rate of 10%) would instead be as given below based on Table 5-2 and Tables 5-6 to 5-9:

Table 5-12: Total Present Value for Different Scenarios Excluding Potential Multipurpose Benefits from Reservoirs

Scenario	Strategy	Total Present Value (\$ Million)	Difference in Total Present Value (\$ Million)
Base	According to Master Plan VI	5,659.41	0
Alternative 1	Hydropower projects with TPI < 60 are replaced by thermal power	6,466.96	807.55
Alternative 2	Hydropower projects with TPI < 65 are replaced by thermal power	8,000.28	2,340.87
Alternative 3	Hydropower projects with TPI < 75 are replaced by thermal power	9,892.57	4,233.16
Alternative 4	The planned hydropower projects are not implemented at all	13,485.78	8,694.77
Alternative 5	The planned hydropower projects are not implemented and not replaced by thermal power	76,937.87	72,146.86

Based on Tables 5-11 and 5-12 above the following observations can be made:

- The Base Scenario according to PDP VI is clearly the best option not only from a cost of supply perspective but being reinforced when the other factors are taken into account and even if the potential multipurpose benefits are excluded.
- Even a moderate thermal power expansion according to Alternative 1 gives an additional total Present Value cost to the society of some \$0.8-1.1 billion (depending on including or excluding the potential multipurpose benefits) when compared to the Base Scenario, i.e. according to PDP VI.
- The high social and environmental costs to the society associated with coal-fired thermal generation (air pollution and mining) is clearly demonstrated in Table 5-11 with a combined Present Value of some \$5.7 billion for Alternative 4, i.e. all planned hydropower projects are replaced with thermal power, being even higher than the **total** Present Value of the Base Scenario according to PDP VI.
- Adopting a power generation expansion according to Alternative 4, i.e. all planned hydropower projects are replaced with thermal power, gives an additional total Present Value cost to the society of some \$8.7 billion when compared to the Base Scenario, i.e. according to PDP VI. This additional total Present Value cost is some 180% - 150% of the total Present Value for the Base Scenario (depending on including or excluding the potential multipurpose benefits).
- The Present Value of the potential multipurpose benefits is substantial for all alternatives involving hydropower development and outweighs all other factors (apart from cost of supply) for the Base Scenario according to PDP VI.
- As mentioned in Section 5.2.1 the “do-nothing” scenario, i.e. Alternative 5, is from all perspectives the worst option and not constructing adequate generation capacity to meet future demand is not an option.

It has in this Study not been possible to include all factors associated with hydro and thermal power development and in subsequent studies it is recommended that an effort is made to include other factors, such as:

- The potential multipurpose benefits should be further elaborated to determine a better estimate of the potential based on actual conditions (size of suitable areas for irrigation, demand, cost of irrigation, etc.) and the consequences on the power generation. The potential benefits of flood control, and the corresponding consequences on the power generation, should also be elaborated.
- The social and environmental costs for thermal power have included air pollution and mining, however, other social and environmental impacts could also be associated with thermal power projects, such as relocation of people, discharge of cooling water, etc.
- As mentioned in Section 5.2.5 not all environmental costs associated with hydropower development are included, such as for biodiversity.

5.3. Indicative Weighting through Multi-Criteria Analysis

During the impact and weighting workshop, held in April 2008, the core working group and other staff from the associated organizations (MoIT, MONRE, IoE, EVN, plus the national expert consultants) undertook a multi-criteria analysis exercise. The full methodology for this is described in Appendix 5-3. A summary account of this process and some of the overall findings are presented here. The main stages of the approach were the following:

1. Decide the criteria to be included in the exercise.
2. Collect and discuss impact information in relation to these criteria.
3. Set scores based on the performance of each alternative on each criteria (0 -100).
4. Establish the relative importance of each criteria in relation to the other criteria.
5. Estimate the set of weights that is most consistent with the relativities expressed in the matrix (0-1).
6. Multiply scores and weights and add up the weighted scores for each scenario.

Criteria selection

The first stage of the exercise determined what issues and criteria should be considered. Following the logical sequence of the SEA, the four strategic impact issues from the scoping stage were the overall concerns: Power availability for economic development, Effective and sustainable use of water resources, Impacts on project affected people, Maintenance of ecosystems integrity.

Under each of these, impact categories and various subchapters discussed in Chapter 4 were identified as criteria (see Table 5-13). The Base Scenario along with the Alternative 1, Alternative 2, and Alternative 3 were evaluated.

Table 5-13: Weighting Criteria

STRATEGIC ISSUES	Criteria
Power availability for economic development	Direct economic cost of supply
Effective and sustainable use of water resources	Changes to hydrological flows
	Multipurpose benefits
Impacts on project affected people	Impact on displaced people
	Impact on indirectly affected people
	Social and cultural mitigation cost
	Local development impacts / poverty reduction
Maintenance of ecosystems integrity	Terrestrial ecosystems /biodiversity
	Air pollution and greenhouse gases
	Aquatic ecosystems
	Forest resources

Scoring and weighting

With support by impact data on each of these issue, the working group after discussions assigned a score to each criterion for each alternative scenario, on a scale from 0 (=worst hypothetical performance) to 100 (best hypothetical performance). This score represents the collective judgment of the group regarding how well the scenario responds to the national policy objective.

After this, the group performed the weighting between the four strategic issues, through the method of pair-wise comparison. Each strategic issue was compared to each other issue, and given a weight from 1 to 9, according to the following approach: “When it comes to national power development planning, how important is issue 1 compared to issue 2?”

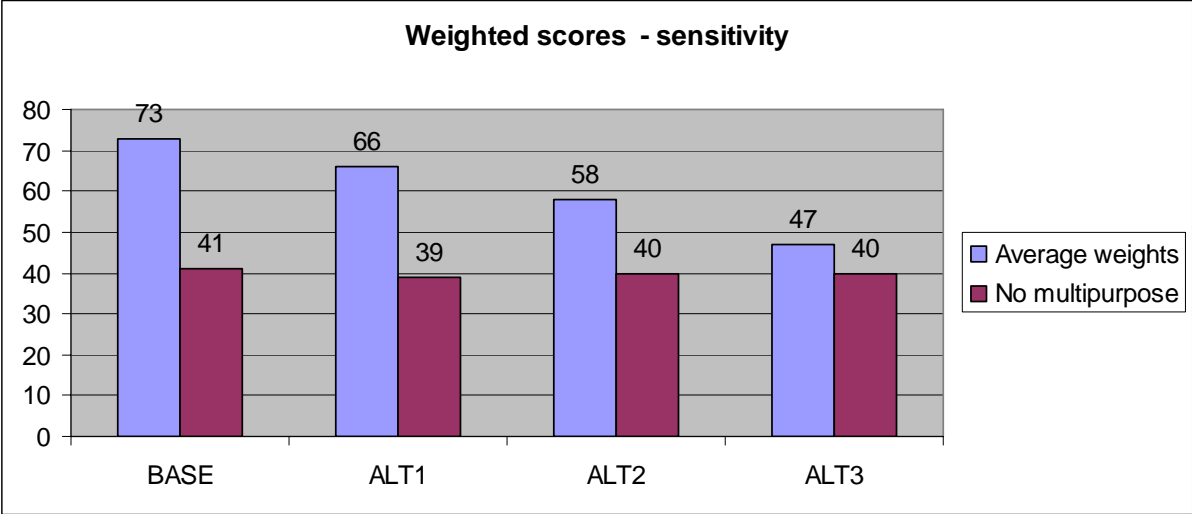
- *Equally important – Index 1*
- *Moderately more important – Index 3*
- *Strongly more important – Index 5*
- *Very strongly more important – Index 7*
- *Overwhelmingly important – Index 9*

Results from the multi-criteria exercise and sensitivity analysis

The result of the weighting, however indicative, was consistent with the weighting performed under the NHP Study (70% economic/resource efficiency and 30% social/environmental). This was confirmed in two separate weighting exercises.

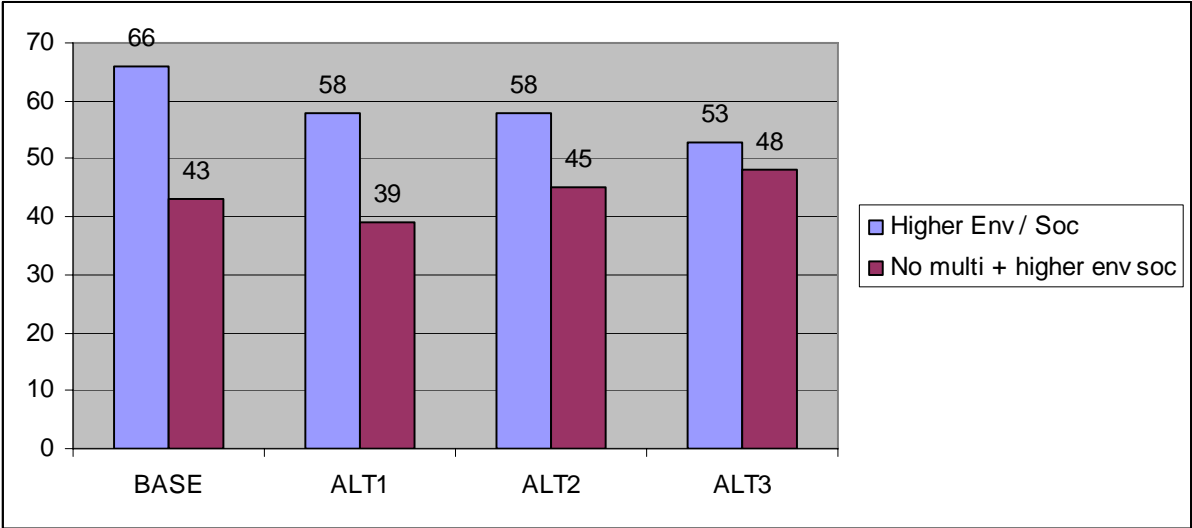
The consultants then combined the scores and the weights and calculated the weighted score, which led to the indicative result showed in Figure 5-1. Figure 5-2 shows the sensitivity analysis performed where considerations were taken to no multipurpose benefits arising from the scenarios, due to the reservoir management. This was considered important since in the current NHP Study, dams are not designed for multiple purposes.

Figure 5-1: Weighted Scores Sensitivity



They also suggest that although the BASE scenario is the most attractive under these weighting conditions, unless multipurpose designs are introduced, the alternative scenarios are just as attractive. In other words, the potential for multipurpose benefits is the major factor that speaks in favour of the BASE scenario. Would one *in addition* consider stronger weights on the environmental and social side, the results would tilt in favour of Alternative 3 (see Figure 5-2).

Figure 5-2: Weighted Scores Sensitivity with Higher Social & Environmental Scores



Concluding comments about multi-criteria weighting

The weighting exercise was performed by the core working group with national consultants and a few other participants, and should be seen as a demonstration exercise only. In an ideal context, one would amplify the exercise both in terms of the impact information made available, the time required to perform the analysis, and the carefully selected participation of very senior-level policy makers. One would then be able to use the results with some

confidence. Ultimately however, the quality of the exercise lies in the quality of the discussion and the in-data. When surprises show up it is often tempting to ignore them or to demean the analysis and find another basis for the decision. But if there are major discrepancies between the intuition of participants and the analytical results, these are important to explore and explain. In this analysis and digestion of results lies much of the strength of MCA, as opposed to MCA “making the decision”.

6. Options to Mitigate Negative Risks and Enhance Positive Potentials

6.1. Introduction

The issue of mitigating the impacts that hydropower development can produce is inevitably wide ranging and complex. The planning and construction of major infrastructure investments such as dams and associated facilities changes irrevocably, for better or worse, many characteristics of the localities in which they are built. Ensuring that negative impacts are minimised and positive potentials are realised is an integral part of the planning of these investments. This chapter discusses the specific measures needed to deal with the potential impacts on the people and environment of the areas in which hydropower schemes are developed, as well as some more overarching policy recommendations, following from the analysis. It is by no means just about reducing risks of harmful impacts: there are many positive potentials that hydropower can help to realise if appropriate measures are taken.

Overall, the approach outlined here seeks to maximise these potentials whilst at the same time reducing risks and compensating for negative impacts where they do take place. A key feature of this approach is that the construction of a hydropower scheme inevitably brings change. This change should be seen as an opportunity to catalyze the development and transformation of what are often remote localities with high incidences of poverty, poor access to services and limited opportunity to participate in the growth and change that characterises contemporary Viet Nam. In other words, developing hydropower is not just about generating electricity: it is about generating change, and this change can be steered in the direction of reducing poverty, sustaining the resource base and catalyzing development in addition to the primary purpose of meeting the country's electricity needs.

6.2. Technical Measures in Hydropower Projects

Technical measures to avoid, reduce or offset adverse environmental and social impacts of hydropower projects can be taken during the following three phases.

6.2.1. Planning Phase

The most important phase to avoid or reduce adverse environmental and social impacts is during the planning phase when the project is defined in detail, and any technical corrections to mitigate impacts at a later stage would be very costly or even impossible. It is therefore essential that the environmental and social impacts of the project are thoroughly assessed and mitigation measures are identified in parallel with the design of the project.

There are a number of technical issues that have a bearing on the environmental and social impacts of a project that need to be addressed during the planning of the project, such as the following (see also the operation phase below):

- The location of the project can in principle be varied in order to reduce the environmental and social impacts such as locating the project to minimize resettlement, avoid national parks, etc., however, the location (topography, geology, and hydrology) also have a profound effect on the economy of the project.
- While changing part of the river into a reservoir and creating a barrier for fish migration are necessary consequences of constructing a dam, the height of the dam (i.e. the full supply level) is a technical parameter that may be varied and that have the

most profound effect on the environmental and social impacts, as well on the economy of the project. To assess the impacts for varying dam height is therefore one of the most important issues during the planning phase and a major part of the impacts can be reduced, or even avoided, if a sensible dam height is selected.

- The minimum operating level can also be varied, and by reducing the water level variations in the reservoir some of the environmental impacts can be reduced.
- The location of the power station vis-à-vis the location of the dam structure can be varied and dry river stretches can be avoided if placed close to the dam.
- The planned operation of the project is a technical parameter that may be varied and a continuous 24/7 operating will reduce the downstream environmental impacts compared to intermittent operation.
- The routing of the transmission lines and access road may be selected to reduce the environmental and social impacts.

6.2.2. Construction Phase

Prior to construction an Environmental Monitoring Plan (EMP) and a Construction Phase Social Management Plan (CPSMP) should be prepared as part of the environmental and social impact assessments of the project. These documents should be included in the tender documents and the tenderers should be obliged to include in their tenders a Contractor's Environmental Control and Protection Plan and a Contractor's Social Management Plan outlining the methods the tenderers propose to apply to minimize the impact during the construction of the project.

The Contractor's Environmental Control and Protection Plan should address issues such as the following:

- Preservation of flora and fauna, such as destroying trees to any extent greater than approved, take measures to prevent hunting and destroying wildlife, ascertain that the work site is kept clean and tidy, and ascertain that animals are not drowned during impoundment of the reservoir.
- Measures to minimize soil erosion and sediment loads, such as control of surface run-off, provision of temporary treatment of disturbed areas, and progressive stabilisation of completed works.
- Control of soil, water and air pollution, such as construction of temporary pollution control facilities to prevent discharge of polluted water into rivers, disposal of waste oil, measures to prevent leakage from fuel tanks, and sedimentation ponds for treatment of construction waste water.
- Control of hazardous and domestic solid waste.
- Dust and noise emission control from quarrying, crushing and transport activities.

The Contractor's Social Management Plan should address issues such as the following:

- Local labour recruitment policy, and accommodation and facilities for the workers.
- Policy on camp followers.
- Impact on local people adjacent to the construction sites (dust, noise, etc).
- Water supply, sanitation and waste disposal for work camps.

- Health issues for workers.
- Traffic safety.
- Management of STD's and human trafficking.

Environmental and social audits should be undertaken regularly following a programme to ascertain that the agreed plans are followed by the contractors.

For the effective implementation of the plans during construction, the project-owner should establish an environmental and social unit to monitor and supervise the mitigation of environmental and social issues, to implement preventive measures to protect the environment, and to improve environmental and social awareness among workers through information campaigns, etc.

6.2.3. Operation Phase

Apart from the environmental and social impacts normally associated with the implementation of a hydropower project as mentioned below, there are environmental impacts during operation that to a lesser or larger extent can be mitigated by technical measures as given below, where some needs to be incorporated during the design of the project:

Table 6-1: Environmental Impacts during Operation and Technical Mitigation Measures

Environmental Impact	Technical Mitigation Measure
Reduced water flow downstream of the dam and intermittent water releases from the power station	Environmental flow from the dam
Reduced oxygen content in water released from the power station	Variable levels of the power intake Aeration structure at the tailrace outlet Reduction of biomass in the inundated area
Accidental water pollution from the power station, in particular oil from transformers	Oil collection devices and Emergency Plan
Soil erosion and surges downstream of the power station	Intermittent start and stop procedures of the turbines

6.2.4. Stakeholder Engagement in the PDP and Project Planning

PDP VII should set up an inter-agency consultation and coordination system, whereby relevant ministries and expert agencies are regularly consulted on the development of the proposal. SEA can be the key vehicle for this, as it provides a structured process through which the involvement of other stakeholders becomes an integral part of the strategic planning process. An important part of this in contemporary Viet Nam is the engagement of provincial authorities; a reflection of the on-going decentralization processes in the country. The construction of large hydropower schemes will have wide implications for many aspects of development and natural resource management at a provincial level. These impacts are intensified where there are a number of hydropower schemes in a river basin, as their cumulative effect is even greater than the sum of their individual impacts. This affects vital interests at the provincial level and provincial authorities should be active stakeholders in hydropower planning from the earliest possible stage, in particular for those river basins with multiple hydropower schemes in the PDP VI.

All directly and indirectly affected communities have the right to be consulted and to influence the decision as well as the package for compensation and resettlement. This is reflected in the recommendations concerning stakeholder participation in the PDP system. It is recognized that the needs and interests of local communities can not amount to a “veto” where other considerations are not taken into account. These needs and interests are among a range of factors that have to be balanced in the decision-making system, but they are at present not sufficiently recognized in hydropower planning. This is particularly true of the earlier stages of the planning system when critical decisions on exact dam site, the height of the dam and any technical measures to reduce impacts are defined. The priorities and perspectives of local communities should be integrated into the decisions on these issues.

6.3. Mitigating the Impacts of Hydropower Development on Displaced People

The need for more effective measures to mitigate the impacts of hydropower development on displaced people was identified as a key strategic issue in the scoping phase of the SEA. This was supported by the analysis of existing mitigation measures, as proposed in the National Hydropower Plan, which proposes measures based on existing regulations that are intended to compensate for the immediate impacts of resettlement on displaced peoples. The analysis in chapter 4 demonstrated that the likely level of displacement is over 60,000 people spread across 14 of the 21 hydropower schemes included in the scenarios analysis. The vast majority (over 90%) of these people are ethnic minorities.

An essential part of responsible and sustainable hydropower planning is to ensure that all people who have potential negative impacts are provided with adequate resources and support to ensure that they, at worst, do not lose out and, ideally, benefit from hydropower development. Two problems can be identified with the existing compensation package: (i) it is short-term and only covers visible physical costs such as infrastructure, land and housing with no compensation for long-term needs or for social and cultural disruption; and (ii) many of the cost norms do not adequately cover real costs and some essential elements of compensation are missing. In addition, and given that one is dealing with poor and remote communities with profound development needs, it is argued that the mitigation package for displaced people should not just aim to re-create poverty in a new location. Rather it should include elements designed to provide a long-term opportunity for the displaced communities to move out of poverty and benefit from the wider developments that contemporary Viet Nam is experiencing.

Based on the impact analysis, the SEA has identified and made cost estimates for an expanded mitigation package. A detailed description of the proposed changes is set out in Appendix 6-1. These include some important elements that go beyond traditional narrow approaches to compensation. The proposed package is based on the “Impoverishment, Risk and Reconstruction”³⁸ (IRR) model that is recognised as reflecting international best practice in mitigation and compensation. It also reflects the principles and approach recommended by the World Commission on Dams³⁹ with regard to displacement and resettlement.

The IRR model identifies eight main risk areas where displaced people can be impacted and, in consequence, eight elements to an effective compensation package (Table 6-2). The

³⁸ Cernea, M. (2000) *Impoverishment, Risk and Reconstruction: A Model for Population Displacement and Resettlement* in Cernea, M. & McDowell, C. (eds 2000) *Risk and Reconstruction: Experiences of Resettlers and Refugees* World Bank, Washington D.C.

³⁹ World Commission on Dams (2000) *Dams and Development*, Earthscan, London, chapters 8 & 9.

existing, inadequate, mitigation package has been expanded to include several new measures and significant increases in the levels of provision for some existing elements in the package. The specific measures set out in Table 6-2 would provide for both the immediate needs and the long-term development of the displaced communities, ensuring that they are able to re-establish their communities and would have access to long-term development support over a 10-year period. The package includes measures such as the establishment and support of a resettlement support group (paid facilitators from within the community), the formation of a community development fund (based on models piloted elsewhere in Viet Nam, such as the Northern Mountains Development Programme) to provide access to credit and support for livelihood activities, activities to ensure that the risk of increased health problems that affect many displaced communities does not occur and actions to restore and sustain the cultural structures of the communities.

Table 6-2: Risks and Resettlement Mitigation Actions in the IRR Model for Viet Nam

Risk Factor	Type of Mitigation Action	Specific Measures Recommended for the Mitigation Package for Viet Nam
Landlessness	Land-based resettlement	Compensation for land, crops, fishponds
Joblessness	reemployment	Investment for production development Investment for livestock development Investment for irrigation Extension training Community development fund
Homelessness	House reconstruction	Residential house Moving allowance within province
Marginalization	Social inclusion;	Support for resettlement Allowance for the resettlement supporting group Assistance partial and indirect Project Affected People
Increased morbidity	Improved health care	Sanitation construction Health & hygiene training Communal health care centre
Food insecurity	Adequate nutrition	Rice support for 36 months
Loss of access	Restoration of community assets and services	Electricity and water supply Public architectural works Local road infrastructure development Maintaining infrastructure
Social disarticulation	Networks and community rebuilding	Moving graveyards Building cultural infrastructure Supporting for the cultural restoration and rehabilitation activities Compensation/support host population

With the proposed changes to the mitigation package, working from a base provided by the social mitigation costs calculated in the NHP Study (i.e. those costs included in existing calculations of the investment costs of the hydropower schemes in Section 5.2.1), the costs for social mitigation for all hydropower schemes have been re-calculated (Table 6-3). The increased costs that result from the introduction of a more comprehensive range of long-term development support are less than a quarter of the original costs; reflecting the fact that many more expensive items such as infrastructure provision are already provided. Whilst this does represent a significant cost, it is by no means out of proportion to the importance of ensuring

adequate mitigation for displaced communities and does not compromise the financial viability of any of the hydropower schemes.

Table 6-3: The Costs of Social Mitigation Actions for Individual Hydropower Schemes

Name of hydropower schemes	Original total social mitigation (million VND)	Adjusted total social mitigation (million VND)
Trung Son	257,390.00	313,939.28
Hoi Xuan	159,340.00	276,950.05
Hua Na	397,170.00	525,779.93
Lai Chau	976,830.00	1,124,047.15
Huoi Quang	480,025.00	566,662.85
Ban Chat	1,201,064.00	1,415,440.65
Nam Na	632,570.00	719,412.53
Bac Me	739,980.00	996,870.55
Nho Que 3	68,000.00	79,462.76
Khe Bo	311,897.00	406,275.81
Song Bung 2	7,846.00	7,845.50
Song Bung 4	209,929.00	262,088.78
Song Bung 5	17,590.00	20,115.03
Dak Mil 1	58,890.00	67,874.95
Dak Mil 4	90,860.00	102,496.10
Upper Kontum	92,351.00	118,533.35
Srepok 4	50,694.00	50,693.50
Dong Nai 2	435,409.00	527,590.96
Total	6,187,835.00	7,582,079.73

6.4. Mitigating Impacts in the Zone of Influence

The package of mitigation measures for displaced people discussed in section 6.4 provides an effective series of measures, based on international good practice, to ensure that the resettlement and development needs of the 60,000+ people who will have to be resettled are met. These are not the only people who will be affected by hydropower development, however, there are also a number of potential impacts on the much larger number of people living in the ZoIs. These wider impacts are potentially both positive and negative. Actions to encourage the positive impacts and mitigate the risks of negative impacts can be identified. The social mitigation package discussed in section 6.4 does include some provision for both the wider community in the ZoI and the host population of resettlement areas (discussed in more detail below). A major area of potential damage is to **forest resources**, which are a key part of the livelihoods of many mountain communities. A detailed package of measures based on community forestry is discussed in section 6.6 to address this risk. Similarly, actions to mitigate impacts on **water resources** are discussed in section 6.8, below. Further measures to reduce risks and maximize opportunities are discussed in the remainder of this section.

6.4.1. Resettlement Host Populations

The impact of resettlement on the host populations of the new localities to which people move will vary according to the number of people resettled. We saw in chapter 4 that there are 14 schemes where people will be displaced and that, of these schemes, for 3 schemes the number is 650 people or less, 7 have between 1,000 and 5,000, 2 between 5,000 and 10,000 and 2

over 10,000. Most are ethnic minorities, which means that the social impact will be greater if they are relocated to a place where the host population is of a different ethnic group. The mitigation package provides for a total of 20 million VND per resettled household to compensate for the effects of resettlement. These funds, which will amount to a considerable fund where larger numbers of displaced families are involved, should be used to finance local development activities for the host population.

The specific details of these activities will vary according to local needs and the existing characteristics in terms of infrastructure and services of the host locality. They should be planned through consultations with the host population and implemented through commune authorities. In addition, activities provided to resettled populations such as health and hygiene promotion, extension training and support for cultural activities should be extended to the host population where needed. The planning of infrastructure investments such as roads, water supply schemes and irrigation facilities should be jointly undertaken between the host and resettled communities and, where the host population lack facilities such as water supplies, their needs should also be met. In other words, the approach taken for the resettled communities, to extend beyond short-term compensation into longer-term development, should be extended to the host population and both parts of the new community (hosts and displaced families) should be treated as equals and work together to plan the development of the locality. This would ensure that there is not resentment of the displaced families who can be perceived to have access to facilities and opportunities that the host population may lack.

6.4.2. Agricultural Development

Chapter 4 showed that the improvements in access to markets that hydropower development often brings is likely to result in, on average, a 10% increase in incomes from agricultural activities. This will be achieved through a combination of the intensification of production from existing crops, as surpluses are more easily marketed, and the adoption of new crops and agricultural practices. Taking advantage of such opportunities can be a challenge for some communities in more remote localities, however, and there is considerable scope for improved agricultural extension services to make a big difference in these areas. This should be integrated into hydropower planning through the inclusion of provincial Departments of Agriculture and Rural Development during the planning phase of individual schemes.

6.4.3. Mitigating the Impact on Forest Resources

The analysis in chapter 4 identified that there is a significant risk of unsustainable pressure on the forest resources of a number of zones of influence following hydropower development. This is a particularly important for ethnic minorities in mountainous areas, as these communities in Viet Nam have a strong connection with the forest in their immediate vicinity and depend on the forest for a wide range of subsistence goods and services.

An effective strategy to reduce the risk of such unsustainable pressures is through community forest management (CFM), whereby specific areas of forest land are handed over to community control for management and exploitation. This takes place within rules which proscribe unsustainable practices such as clear felling for timber, and international experience in countries such as Nepal, India and Thailand demonstrate the effectiveness of CFM as a strategy whereby the needs of local communities can be met on a sustainable basis from smaller areas of forest without jeopardizing the integrity of these forest ecosystems. The 2003 Land Law and the 2004 Forest Protection and Development Law provide a basis for CFM,

and in particular the assignment of forests to village communities and the rights and obligations of village communities in regard to the assigned forests.

The National Forest Development Strategy (2005-2020) identifies “*Piloting and developing CFM*” as a priority for the forest sector for the period 2006-2020. It indicates that natural production forest, plantation forests, small protected areas and protection forests (which are historically attached to communities) will be available for allocation to village communities. Program 5 of the Strategy also gives indicative targets of 4 million ha under community management by 2020 and 2.5 million ha for the period 2006-2010. During the past decade many donor piloted and tested to explore modalities suitable for CFM in the context of Viet Nam’s rapidly evolving policy landscape. These have included the well known GTZ Song Da Social Forestry Project, Mountainous Rural Development Project (MRDP), Extension and Training Support Project (ETSP)-Helvetas and SNV. Other larger forestry projects have had components of social forestry or community forestry included in a wider agenda. Over time, many of these projects proved that CFM is suitable for sustainable forest management and contribution to livelihoods of mountainous communities, especially for those who are minority ethnic communities and is in line with current policies of Viet Nam.

In the areas with high pressure to the forest resource it is recommended to consider a model of community based forest management in the ZoI in order to help (1) improving livelihoods of local people; (2) Reducing the threat / loss to forest and (3) enhancing the community structure / coherence. According to the study done by the Community Forest Project from Ministry of Agricultural and Rural Development (MARD), each community forest site consist of about 400 hectares overall, in which is 300 hectares of forest for protection and 100 hectares of forest land for forest plantation to generate income. The cost for one community forest unit, based on cost norms for average size communities and forest areas, is calculated as shown in Table 6-4.

Table 6-4: Cost Factors in Community Forestry

Items	Qualities	Price (Million VND)	Total (Million VND)
Land and forest allocation	400 hectares	0.2	80
Developing the communal forest regulation	1 unit	15	15
Assisting to implementing community forest management (in 5 years)			
Forest protection ⁴⁰	200 hectares	0.12	24
Agricultural and forest plantation	100 hectares	6	600
Technical training and monitoring	1 unit	15	15
Total cost			734

According to the data of the forest area and population in ZoI, we propose that those hydropower schemes, which has density (number of people per hectare of forest) higher than average densities will be proposed for community forest management in the ZoI (the analysis comes out with 11 schemes: see table 6-5 and Figure 6-1). However, the community forest management will not be applied for all villages / communities in the ZoI, as the risks of unsustainable pressures will not apply to all forest areas. It is proposed that schemes with densities from 2 persons – 4 persons / hectare (8 schemes: Lai Chau, Ban Chat, Dong Nai 2,

⁴⁰ This is to cover the regeneration of a norm of 200 hectares of poor forest, which could not generate income in the first 5 years, and needs a special protection in this period

Hoi Xuan, Huoi Quang, Song Bung 2, Song Bung 4 and Song Bung 5) 30% of the total villages in the ZoI are applied for community forest. For those schemes, which has density above 4 persons / hectare (3 schemes as: Nam Na, Nho Que 3 and Trung Son) 50% of the total villages in the ZoI are applied for community forest. The cost of the community forest under these assumptions is calculated in Table 6-5.

Table 6-5: Priority Schemes and Costs for Community Forestry

Hydropower schemes	Number of villages in ZoI	Number of community forest units	Cost for each community forest unit (Million VND)	Total cost (Million VND)
Ban Chat	214	64	734	46,976
Huoi Quang	178	53	734	38,902
Song Bung 4	71	21	734	15,414
Dong Nai 2	147	44	734	32,296
Song Bung 2	164	49	734	35,966
Lai Chau	1,279	384	734	281,856
Song Bung 5	37	11	734	8,074
Hoi Xuan	42	13	734	9,542
Trung Son	512	256	734	187,904
Nho Que 3	296	148	734	108,632
Nam Na	421	211	734	154,874
Total	3,361	1,254	734	920,436

The cost for community forests in each scenario is shown in Table 6-6.

Table 6-6: Community Forestry Costs by Scenario (Million VND)

Hydropower schemes	Base Scenario	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Ban Chat	46,976	46,976	46,976	-	-
Huoi Quang	38,902	38,902	38,902	-	-
Song Bung 4	15,414	15,414	-	-	-
Dong Nai 2	32,296	-	-	-	-
Song Bung 2	35,966	35,966	35,966	35,966	-
Lai Chau	281,856	281,856	281,856	281,856	-
Song Bung 5	8,074	8,074	8,074	-	-
Hoi Xuan	9,542	9,542	-	-	-
Trung Son	187,904	187,904	187,904	-	-
Nho Que 3	108,632	108,632	108,632	108,632	-
Nam Na	154,874	154,874	154,874	-	-
Total	920,436	910,894	895,480	426,454	0

Community forestry consequently provides an effective and affordable means to mitigate against the risks of unsustainable pressures on forest resources within the ZoIs as a consequence of hydropower development. The CFM approach has a great advantage in that it anticipates and mitigates risks before impacts happen, thereby ensuring continuity in the integrity of forest ecosystems and the availability of forest resources for local communities.

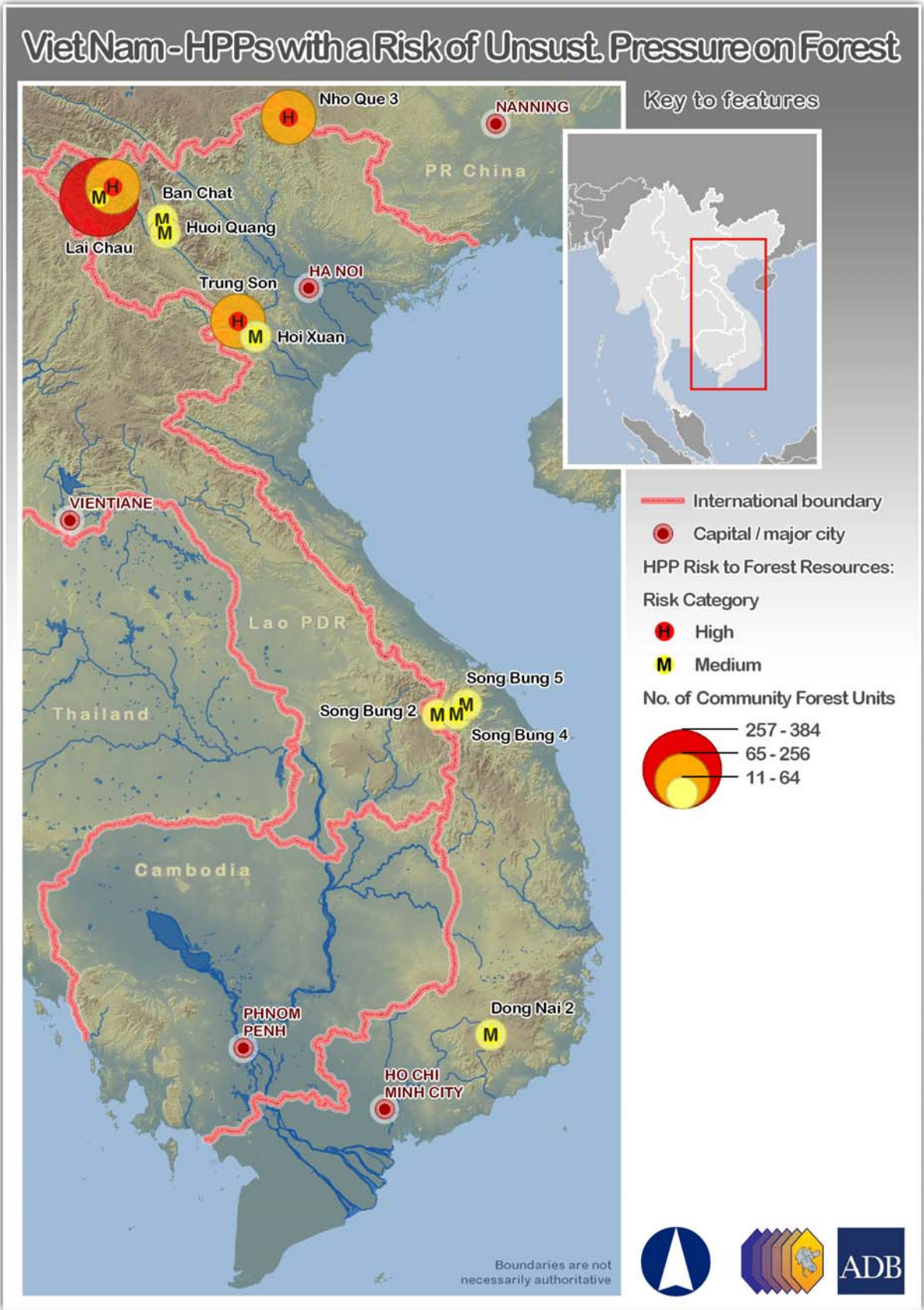


Figure 6-1: Risks to Forest Resources and Numbers of Community Forestry Schemes

6.4.4. Mitigating Biodiversity Impacts

The potential impact of hydropower development on biodiversity resources has been assessed as significant in a number of cases. This assessment of biodiversity risks reflects a combination of factors, including those schemes where a high proportion of a protected area (PA) and/or a key biodiversity area (KBA⁴¹) fall within a ZoI and where there are biodiversity resources of particular value and significance in the ZoI. It was noted that there are five cases where more than 20% of a KBA falls within the ZoIs of the hydropower schemes and the risk of ecosystems fragmentation in these cases can be taken as being significant. These KBAs are: Cat Loc (60% in the ZoI of Dong Nai 5); Kon Plong (75% in the ZoI of Upper Kon Tum); Lo Xo Pass (45% in the ZoI of Dak Mi 1); Macooih (42% in the ZoIs of Song Bung 2, 4 & 5); and Xuan Lien (49% in the ZoI of Hua Na). Of these five KBAs, Cat Loc, Lo Xo Pass, Hua Nam and a small part of Macooih are designated as PAs (sometimes with a different name). The remaining KBAs at risk are not PAs, meaning that a significant part of Macooih and all of Kon Plong (a very large area of over 62,000 ha within the ZoI) do not have any existing protected area status.

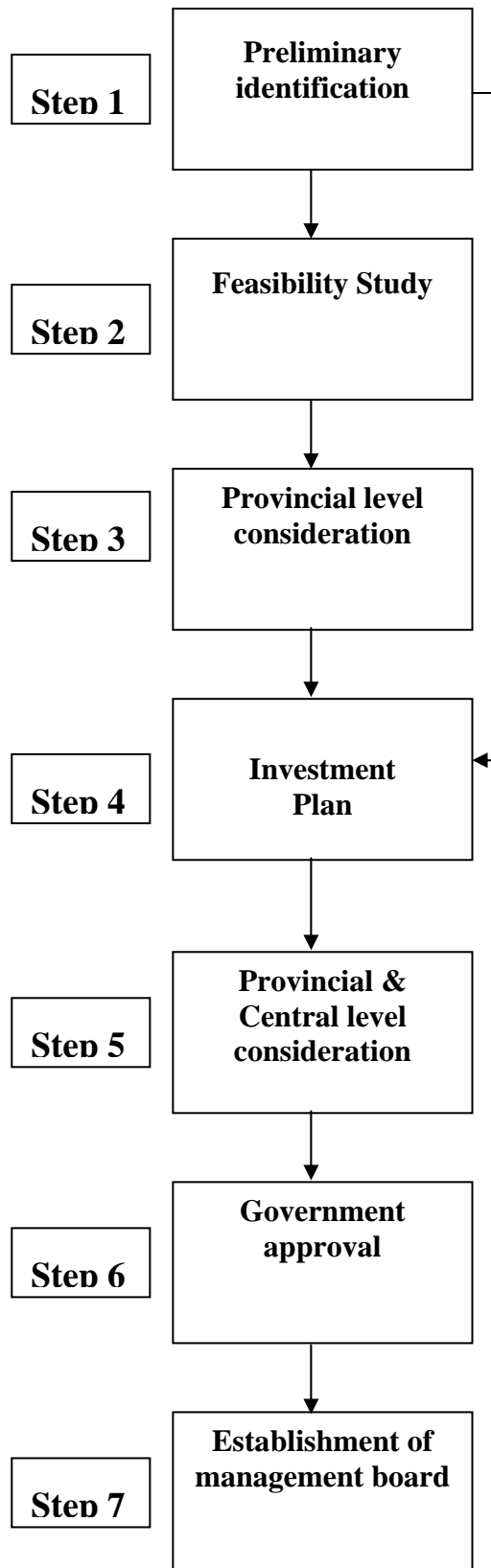
In addition to the identified KBAs, there are a number of PAs that have a significant proportion of their area in the ZoIs but that are not listed as KBAs. Several of these areas are nevertheless of biodiversity significance, including Bac Me (89% in Bac Me scheme), Muong Nhe (a very large area of nearly 78,000 ha falling within the ZoI of Lau Chai), and Pu Hu (40% in the ZoIs of Trung Son and Hoi Xuan schemes). All of these areas have a risk of fragmentation and many contain important and threatened species, including tigers (Muong Nhe), rhinoceros (Cat Tien), primates in almost all locations and a wide range of indigenous birds, plants, mammals and other species. The risks to biodiversity from hydropower development are consequently significant in a number of areas. Actions to mitigate these risks must be taken as part of the hydropower planning and development process.

Viet Nam has effective legislation on the establishment of protected areas (see chapter 2): the problems tend to lie in implementation of the legislation and enforcement of regulations once protected area status is established. Nonetheless, the development of mitigation measures to reduce biodiversity risks from hydropower development should take place within this regulatory system. This is reflected in the measures set out here.

Establishing new protected areas: the first actions are for those KBAs where risks are significant and that are not designated as PAs. These areas, such as Kon Plong, should receive protected area status prior to the planning of the hydropower schemes that will potentially affect them. Introducing effective mitigation measures is far easier where such protected area status exists. MoIT should identify which KBAs (including KBAs affected by hydropower schemes that are under construction or already finished) need PA status and proactively work with other stakeholders to catalyze this process. Figure 6–2 sets out the rather complex procedures involved in this. Primary responsibilities are shared between MARD and provincial authorities. It is consequently essential that MoIT coordinates their efforts with MARD to ensure that steps are taken to designate all KBAs at risk from significant impacts from hydropower development as PAs.

⁴¹ Key Biodiversity Areas have been identified through use of the analysis in: Bird Life International (2006) *Sourcebook of Existing and Proposed Protected Areas in Viet Nam: second edition*, which provides a comprehensive overview of areas of particular significance in biodiversity terms.

Figure 6-2: Steps in the Special-Use Forest Establishment Process



Usually based on existing information, such as forest cover maps, supplemented by scoping information on biodiversity values derived from rapid field and household surveys.

The principal purpose of the feasibility study is to provide an assessment and evaluation of the biodiversity importance of the area for consideration and discussion at the local, provincial and national levels. The Feasibility Study is then submitted to the provincial people's committee (PPC).

The PPC reviews the Feasibility Study and invites concerned stakeholders to discuss proposals for Special-use Forest establishment. On the basis of these discussions, the PPC will decide to approve or reject the Feasibility Study. If approved, the PPC will submit the Feasibility Study to MARD for approval, along with a request for the release of funds from MARD for the preparation of an Investment Plan.

The Investment Plan should provide a greater level of depth on the socio-economic characteristics of the area, and existing uses of forest resources. It should also clearly indicate the proposed boundaries of the Special-use Forest and buffer zone, and costs for staffing and establishing the basic infrastructure of the Special-Use Forest.

The Investment Plan is usually considered at a provincial level workshop, convened by the PPC. A decision is usually taken during or shortly after the workshop. If the PPC approves the Investment Plan, the PPC will send a letter of approval with the Investment Plan to MARD.

Once approved at the provincial level, key decision makers in government will usually consider the Investment Plan at a specially convened workshop. Minor changes may then be incorporated and MARD will then decide to approve or reject the Investment Plan. In the case of a proposed national park, MARD will then send documents to MPI.

This final step formally establishes a management board and government funding. For a nature reserve, the PPC will establish a management board once it receives an approval letter from MARD. For a national park: the PPC will establish a management board once it receives an approval letter from MPI.

Preparing Biodiversity Action Plans: actions are needed to ensure that effective protection measures are taken where the risk of biodiversity impacts in the ZoI is identified as significant. The designation of PA status is a first step, but alone is not enough. Many PAs lack resources and the enforcement of regulations is patchy at best. There is also insufficient collaboration with local communities, whilst international experience shows that the protection of PAs is far more effective where surrounding communities are involved and have a stake in the protection of these areas. The planning of the hydropower schemes should include the preparation of a specific Biodiversity Action Plan that reflects the specific nature of the threat in each case. The development of the scheme should then include the allocation of resources to ensure that the action plan is implemented.

Education and Awareness: a key part of the action plans should be effective awareness-raising campaigns at the local level that provide all stakeholders with better information on the importance and the potential of the threatened biodiversity resources. There is also a need for greater awareness at provincial and national levels. The hydropower sector needs to demonstrate that it is a responsible and proactive partner in the national efforts to protect Viet Nam's unique and special biodiversity heritage. MoIT, EVN and other stakeholders in the sector should combine with the authorities concerned with environmental protection and with environmental NGOs to prepare an information and awareness programme for all stakeholders in hydropower development on the significance of biodiversity protection.

6.5. Mitigation Measures beyond the Zone of Influence

6.5.1. Managing Water Resources

The potential benefits of multipurpose management of water resources were identified in chapter 4, with the planned hydropower schemes likely to provide an important capacity for more effective river basin management, particularly in relation to flood controls, mitigating dry season water shortages and ensuring minimum flows to protect the integrity of aquatic and wetland ecosystems. Three areas of action are needed if these potentials are to be effectively realized:

- **Dam and Reservoir Design** should take into consideration the need for other aspects of water management beyond power generation, reflecting the steps and options identified in section 6.2, above.
- **Reservoir Management**, again reflecting the discussion in section 6.2, should recognize the importance of balancing the optimal regime for power generation with releases that ensure minimum environmental flows are maintained (itself something that needs substantially more investigation in many instances), erosion and other impacts are reduced and the needs of downstream water users are fully taken into account.
- **Integrated Water Resources Management:** one key problem with existing practices is that each hydropower scheme is managed in isolation without taking into account the cumulative impacts of multiple schemes within river basins.

The last point, IWRM, lies at the heart of the more effective management of water resources, which was identified as a key priority issue in the scoping phase of the SEA. Although Viet Nam has to date struggled to establish effective river basin planning, steps are being made to achieve this. At present this takes place with little or no involvement of some of the most influential (in hydrological terms) infrastructure in the river basins. It is incumbent upon river basin managers to understand and include the power sector in their information and management systems. It is equally essential that the power generation sector becomes a full

and active participant in the IWRM process and recognizes the need to balance the maximizing of power generation with the needs of other sectors and of the environment.

6.5.2. External Cost Internalization

This pilot SEA has demonstrated that there are very important externalities involved in the different power technologies considered in the PDPVI. In fact, all power generation technologies, but in particular coal-based thermal power, brings with them serious environmental externalities. Chapters 4 and 5 have detailed the analysis behind some quantitative estimates of these external costs. These costs are not actually externalized outside Viet Nam but have to be paid by the Vietnamese people one way or the other. Current financial incentives in the energy sector are imposing additional costs to society and contributing to the challenge of developing sustainable, secure and competitive power supplies. A more efficient resource allocation in the energy sector would follow if these externalities were to be taken into account in the costing of electricity from different sources. This entails internalization measures in both the planning and modeling for the PDP, in the project design and feasibility studies, and in the pricing of electricity to consumers.

As regards internalization of external costs of power technologies in PDP *planning and modeling*, the differences in externalities between different technologies suggest that the optimization represents optimum only for the electricity-producing sector. For the Vietnamese country as a whole, the optimal generation mix will be different. Integrating external costs into the optimization runs will lead closer to a socially optimal power generation mix.

The internalization of external costs of power technologies in *energy pricing* through policy measures, such as leveling a tax or fee on the production, would moderate the energy demand growth in particular for coal-fired power, and significantly reduce the environmental risk involved in the power sector overall. We recommend appointing a high-level governmental task force to develop recommendations for appropriate policy instruments for the internalization of the external costs at the national level.

6.5.3. Regional Integration Policies

The very ambitious power development schemes implemented in Viet Nam to keep up with economic demand brings with it important social and environmental costs. Viet Nam is a densely populated country and conflicts and issues over land and impacts will always be prominent not least in relation to hydropower exploitation. In general, the potential generation capacity in neighbouring Lao PDR brings with it less environmental and social impact per kWh generated, because fewer people are (on average) affected. Therefore, from a regional social, economic and environmental perspective it would appear beneficial to pursue more international collaboration on energy sector planning.

Further integration between countries in the GMS will eventually enable capacity planning and balancing of a much larger system, which as the GMS Energy Strategy “Building a Sustainable Energy Future” shows, brings with it significant efficiency gains. This gives the opportunity for lower prices and lower environmental impacts since expensive and polluting marginal (thermal) power can be reduced.

Still, regional power sector integration in the GMS remains relatively constrained. Two issues appear as key constraints. The first is the lack of dedicated infrastructure to interconnect between the national grids. The pursuit of *grid interconnections* to Laos needs to be put on par with domestic supply options in the PDP planning process. These are costly and

politically difficult but also potentially viable for beneficial funding schemes. The second is the institutional harmonization to prepare for regional power trade. This involves the pursuit of for instance, technical compatibility between national systems and joint systems planning as well as operational coordination.

Underlying the current constraints to regional power sector integration is the current strong emphasis given to self-sufficiency and national sovereignty in energy policy, not only in Viet Nam but in many parts of the world (including the EU). This calls for a more subtle change of the mind-sets of policy makers and bureaucrats, through engaging in fact-finding, policy deliberations, and awareness raising towards regional cooperation and exchange. This is already an on-going process but also one that takes a long time.

6.5.4. Clean Development Mechanism to Replace Coal with Renewable Energy

Viet Nam has over the past years developed a comprehensive national framework for pursuing the Clean Development Mechanism (CDM) under the Kyoto Protocol of the UNFCCC. However, this has so far not been integral to the PDP discussions. However, the CDM mechanism is now fully operational internationally but with the majority of supported projects in China who has pursued with vigour this type of funding. Integrating CDM-related funding opportunities will provide an opportunity to replace the fossil power sources, potentially providing great environmental benefits at very little cost to Viet Nam. The future of CDM is currently a question mark along with rest of the international climate regime, but one that should be straightened out during 2009. Given the investments made to date, and current political discussions, it appears more than likely that CDM will survive into the post-2012 climate regime.

The government of Viet Nam would be wise to approach CDM in a coordinated and concerted manner, and – to the extent possible – integrating different CDM scenarios into PDP planning and modeling as this will alter the economic viability of the different renewable alternatives. Pushing more renewable energy sources into the national energy mix at low financial cost for Viet Nam will provide an opportunity for a less aggressive development of coal and gas-fired marginal power. In particular it appears that biomass-fired thermal plants could merit further consideration. The use of the CDM mechanism in power sector planning requires enhanced coordination and exchange of information between MONRE's international cooperation department, which is in charge of CDM in Viet Nam, and the power sector actors involved in the PDP process.

It should however be noted that, under current regulations, for projects to be applicable under CDM the projects should not be financially viable without the carbon credits, but become viable with the CDM revenues, reflecting the “additionality” conditions associated with CDM mechanisms.

7. Conclusions and Recommendations

This final chapter of the Strategic Environmental Assessment of hydropower in the context of the power development planning system in Viet Nam builds on the analysis in the first six chapters of this report to draw out conclusions on the effectiveness of SEA as a tool for strategic planning. The chapter also revisits the key strategic issues identified in the initial stages of the SEA to assess the extent to which the concerns expressed during the consultation process can be adequately addressed during the planning and implementation of hydropower.

The chapter also provides an overview of recommendations that have emerged from the study. These recommendations include a detailed assessment of the changes needed to the PDP process to be integrated into SEA, the changes to the policy and regulatory framework for hydropower to ensure that social and environmental issues are effectively taken into account and wider policy recommendations related to the power sector.

7.1. Overall Conclusions

7.1.1. Lessons on the Effectiveness of SEA in Strategic Planning for Hydropower Development

The execution of the SEA in this study demonstrates the potential of SEA as a key part of the strategic planning framework for the hydropower sector. The SEA has provided a mechanism to assess and understand the full range of potential **risks** associated with hydropower for people and the environment, both within the immediate vicinity of project construction and beyond. It also provides a mechanism for identifying and assessing the most effective **mitigation and compensation actions**, including actions to reduce risks and to fully compensate for negative impacts where they do occur. The SEA provides a framework for the **internalization** of the costs of social and environmental impacts and mitigation measures into the assessment of economic feasibility of hydropower schemes.

In addition, where conducted in a participatory manner, the SEA provides a framework for establishing a **consensus** amongst stakeholders on the most appropriate forms of social and environmental mitigation measures and the level of hydropower development that is most efficient and sustainable as part of the overall power sector planning system. The approach to SEA set out here, which stresses the compilation and analysis of the best evidence available in a balanced and transparent manner, is an important part of the consensus-building approach. It provides a means for ensuring objectivity and balance in the decision-making system.

Where an economic analysis is undertaken, the SEA also provides a basis for the internalization of costs and benefits that have traditionally been treated as externalities. This in turn provides a means for comparing the full range of risks and impacts that are very different in character. For example, through the economic analysis one can compare potential impacts on the culture and livelihoods of local communities with risks to biodiversity resources and with impacts on global atmospheric processes including greenhouse gas emissions. This in turn provides a basis for **objective decision-making** on the most desirable and sustainable levels of hydropower development.

When approached in this way, the full potential of SEA as part of **strategic planning** can be realised. This differentiates SEA from more traditional EIA and safeguard approaches to social and environmental issues, approaches that have often proved to be ineffective in catalyzing more sustainable patterns of development. The introduction to SEA in chapter 1 emphasised that an SEA should be decision-oriented, balanced and evidence-based. The SEA

presented in this report demonstrated that these three principles can be followed in relation to the hydropower sector.

The **evidence** and analysis presented in this report has not required the collection of significant amounts of new data: in almost all cases the analysis is based on readily available data from documentary sources in Viet Nam. This is essential if the SEA is to be replicable within the context of existing institutional capacities. There are a number of areas where the availability of better data would have improved the certainty of the conclusions that have been drawn in the analysis. Future SEAs should seek to enhance the quality of analysis through improving the evidence collection process, but this can be done in a gradual and incremental manner. The analysis in this report shows that effective conclusions can be arrived at within the confines of existing data availability. This significantly enhances the potential for the full institutionalization of SEA within strategic planning systems.

The use of **scenarios** within the SEA has proved to be effective, providing an analytical tool that could compare the implications of different power generation source mixes for social and environmental sustainability. This is essential: the hydropower sector should not be considered in isolation (unfortunately a tendency found in some past SEAs), as any decision on hydropower development needs to be taken based on the consideration of alternatives to hydropower. The scenarios approach allows stakeholders to assess the full implications of decisions on the level of hydropower that should be developed.

The effectiveness of the SEA as a mechanism for strategic planning in the hydropower sector in Viet Nam, which is inherently complex and controversial, is demonstrated in this report. This suggests that the SEA approach is **transferable**, both to other sectors in Viet Nam and for analysis and planning for hydropower in other countries in the region. As such, as a **pilot**, this SEA has been extremely successful: it shows that the approach works in a challenging context and can be applied elsewhere. Indeed, the MoIT has already stated their intention to apply the SEA approach to the planning of the power sector as a whole and to other sectors within the responsibility of their ministry. Other sectors in Viet Nam, including both water supply and sanitation and fisheries under MARD, have expressed their interest in learning from the experience of this SEA.

7.1.2. Key Strategic Issues

The scoping phase of the SEA identified a number of key strategic issues that have guided the analysis presented in this report. This section provides brief conclusions on the lessons learnt from the SEA in relation to each of the strategic issues.

The contribution of hydropower to **economic development** was the first strategic issue. The SEA demonstrates that the level of hydropower planned in PDP VI is essentially a desirable one in terms of the least cost means to ensure that Viet Nam's future power needs are met. This is true even where the full range of social and environmental costs are internalized into the economic analysis of hydropower, as the full costs of alternative generation sources are even higher. As such, the significance of hydropower in contributing to overall national development has been demonstrated.

The SEA also suggests that hydropower can contribute to development in another way *if* appropriate measures are taken: it can be a catalyst to the development of the economies of remote locations inhabited by poor and marginalized people. This is far from guaranteed and the planning of hydropower needs to include measures to take advantage of local development opportunities. Where this is the case, hydropower can provide significant

benefits to local communities through improved access to external markets, new livelihood opportunities and better access to a range of services.

The **displacement of local communities** is a key and controversial issue for hydropower development. It is an inevitable consequence of hydropower in many localities. Past experiences in mitigating the impact of displacement have not been adequate when compared to international good practice on resettlement. The SEA has demonstrated that this need not be the case: it is possible to provide a mitigation and development package that will provide a means to ensure that displaced people have long-term development support and ultimately are better off after they are resettled. This package entails additional costs, but these costs are not at a level that had any impact on the economic viability of any of the planned schemes. The package also requires political will and more effective coordination with other development efforts, but this is achievable if and when the sector recognises its obligations to demonstrate social responsibility and the need to establish better relations with local government institutions and the communities in the areas where dams are built.

Water Resources are inevitably affected by hydropower development and many stakeholders expressed concerns that these effects are not taken into account in the planning and management of reservoirs. The present management regimes are in general single purpose: to maximise power generation. The analysis presented in the SEA demonstrates that, at a minimum, it is necessary to take into account the need to ensure minimum environmental flows if serious downstream impacts on ecosystems integrity are to be avoided. The analysis also demonstrated the potential benefits in terms of flood protection and improvements to dry season water availability that could be accrued if more effective multipurpose management regimes are adopted.

The impacts of hydropower on **ecosystems integrity** was identified by stakeholders as a key strategic issue. The SEA demonstrated that some levels of impact are inevitable across three areas: for forest resources, for aquatic resources and for biodiversity. The risks of such impacts can, however, be significantly reduced through the adoption of effective anticipatory mitigation measures, with the cost of these measures internalized in the costs of hydropower development. Such measures require much closer links to other agencies responsible for forestry, fisheries, protected areas, etc.

The final strategic issue is the **hydropower planning system**, which was identified as needing change if social and environmental issues are to be more effectively taken into account in hydropower planning. This includes the need for more effective consultation and participation of other stakeholders including local communities. A model for achieving this through the integration of SEA into the power development planning system is outlined in the next section.

7.2. Summary of Overall Recommendations for PDP VII

7.2.1. Introduction

The SEA Study has shown that hydropower development inevitably affects the people and environment of the areas in which schemes are constructed and that specific concerns about the environmental and social impacts are quite different for different energy sources. Effective planning for the future power system, including sustainable hydropower development needs to integrate a full understanding of these factors in the sector's decision-making process, as well as the positive and negative aspects on water resources from the construction and management of reservoirs for hydropower projects.

The analysis of the potential social and environmental impacts of hydropower in the PDP VI has demonstrated that the inclusion of more wide-ranging mitigation measures for both social and environmental impacts will not compromise the economic feasibility of the different hydropower schemes in the plan: in essence, developing hydropower in a sustainable manner and up to the highest international standards is both achievable and affordable for contemporary Viet Nam.

There are a number of changes to the PDP planning process that need to be made to ensure that social and environmental impacts are fully integrated into the planning for the sector. There are also wider changes needed to the policy and regulatory system for hydropower planning to ensure that these issues are fully integrated into the planning and implementation of hydropower in Viet Nam. These changes are specified in this section as a series of recommendations that should be considered and worked through in detail by the Ministry of Industry and Trade and other relevant agencies in Viet Nam.

The recommendations fall into three main categories: (i) recommendations that are concerned with the institutionalisation of SEA as part of the strategic planning process for the power sector; (ii) recommendations that define actions that are necessary if Viet Nam is to more adequately accord with international best practice for sustainable hydropower development; and (iii) other recommendations concerning the larger power sector development context. Actions in all three areas are needed. The present practice of planning in the sector has many strengths, but does not adequately take account of social and environmental factors, for instance in decisions on the cost and design of hydropower schemes.

The result is a combination of missed opportunities (for example, for enhanced poverty reduction impacts and more effective water management) and substandard practices with regard to protecting the environment and ensuring that the needs and interests of local communities are adequately protected. The SEA has identified a range of costs that are at present not included in the calculation of the costs and benefits of hydropower schemes (the costs are “externalized”). The same is true for the rest of the PDP: for example, in relation to the costs and impacts of air pollution and greenhouse gas emissions from thermal power plants. These costs need to be included (“internalized”) in the assessment of the economic feasibility of and allocation of budgets for all aspects of power development.

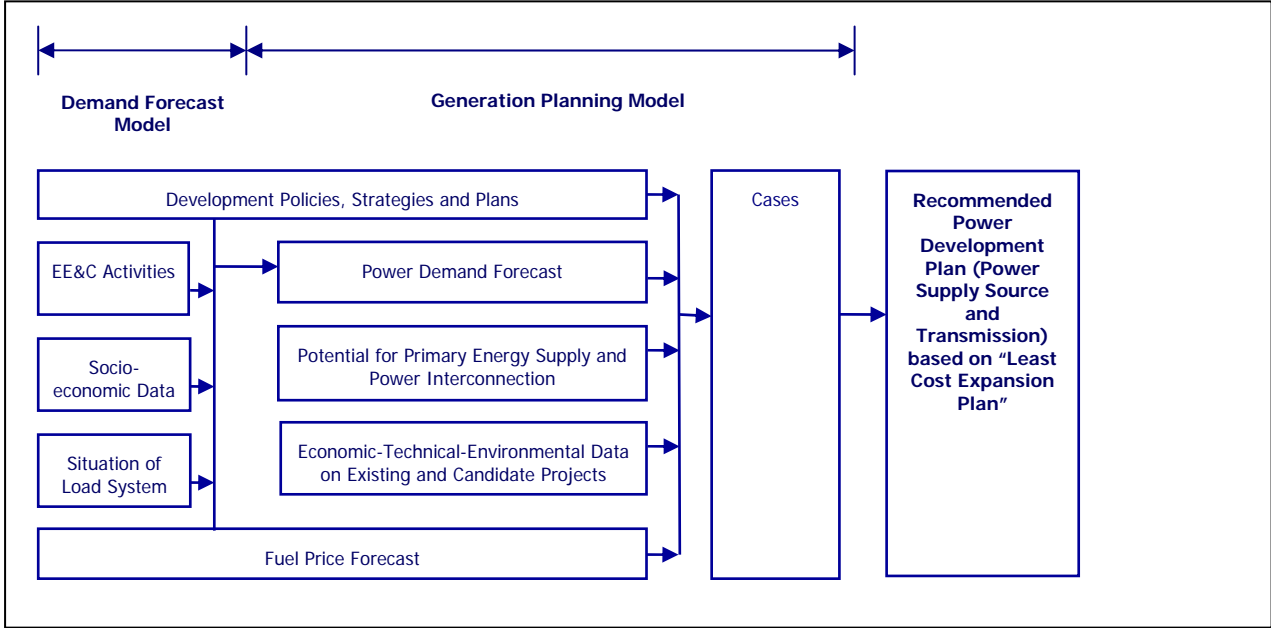
7.2.2. Recommendations on the Power Development Planning System

Power Development Planning: the PDP process should be adjusted so as to ensure that a SEA is an integral part of the planning system and the MoIT should adjust relevant Decisions and Guidelines so as to ensure that this is a requirement for the agency assigned with the task of detailed plan preparation. The resources allocated to plan preparation should be adjusted to take account of the tasks that integrating a SEA into the planning process entails. The SEA process should be extended to include the whole power sector and not just hydropower. This should include an assessment of clean production technologies for thermal power investment. These recommended changes build on the existing PDP system, but reflect the findings of this study and are in accordance with the key principles and guidelines identified by the World Commission on Dams⁴², which include the assessment of all development options, ensuring public acceptance, sustaining rivers and livelihoods and the strategic assessment of environmental, social, health and cultural issues.

⁴² World Commission on Dams (2000) *Dams and Development*, Earthscan, London, chapters 8 & 9.

Figures 7-1 – 7-3, below, sets out the sequence through which SEA can be fully integrated into the PDP process. **Figure 7-1** shows the present procedures in the PDP from collection of data at national and project levels to the recommended power development plan. **Figure 7-2** shows the process undertaken in the present study to include SEA into the PDP VI analysis, reflecting the fact that the SEA analysis took place within the limitations of an existing and complete structure. **Figure 7-3** has been prepared based on the experience of undertaking the current study and represents recommendations for the changes to the PDP planning process. The relevant steps undertaken in each option are outlined after each figure.

Figure 7-1: Current PDP Process

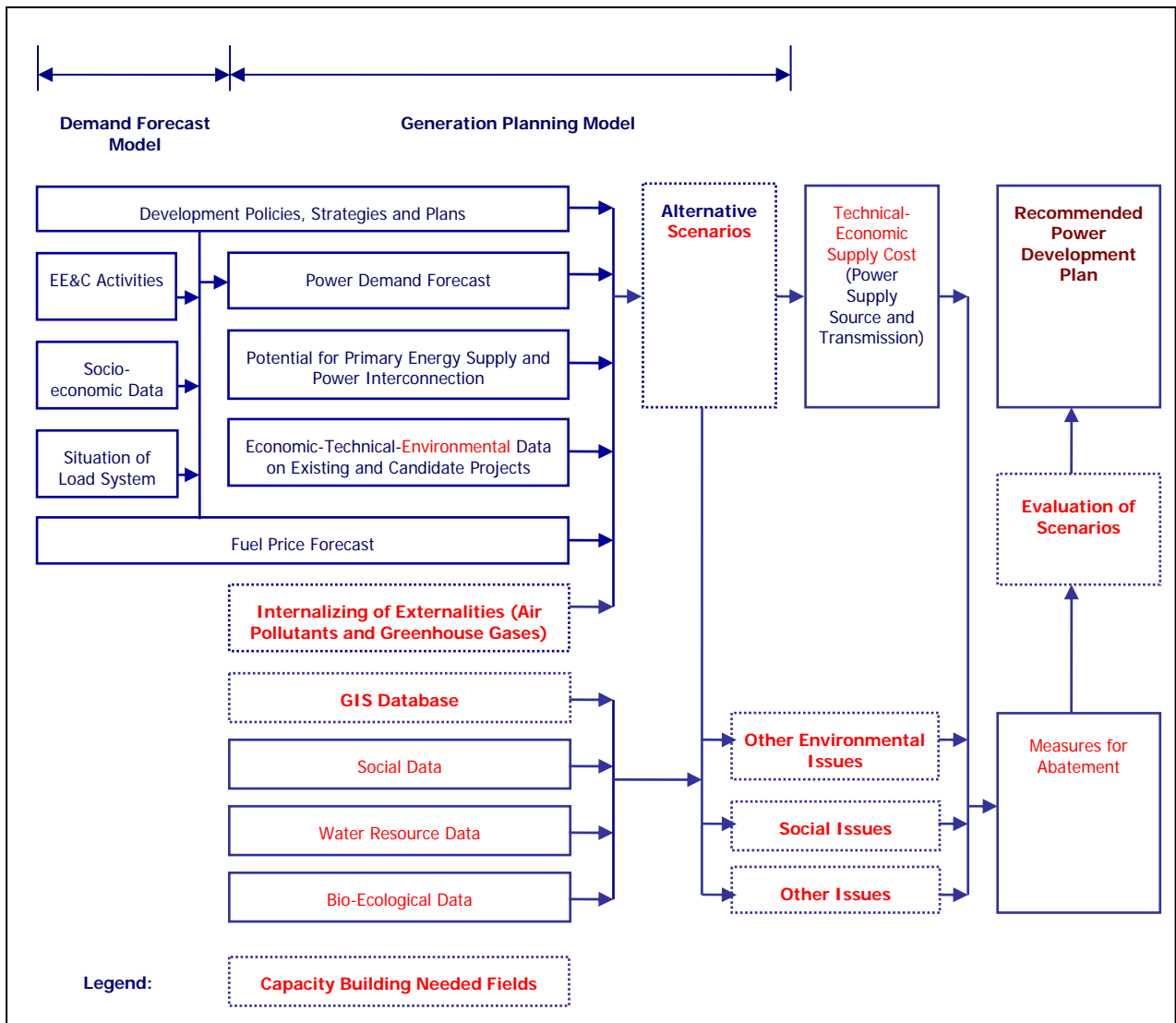


Main blocks: (1) Demand Forecast, (2) Generation Planning and (3) Transmission Planning (500kV and 220kV)

Alternative Cases: fuel price, 500kV interconnection, limitation on gas and coal supply

Power Demand: high, base and low

Figure 7-3: Suggested Integration of SEA into PDP VII



Main steps:

- (1) Assessing environmental damage costs for air pollutants and greenhouse gases
- (2) Internalizing these external costs into generation planning model
- (3) Developing different alternative scenarios on power supply source (not only hydropower but also other sources such as coal, gas, nuclear, renewable, etc)
- (4) Obtaining least-cost plans (total cost and generation mix) for each scenario taking into account both supply and environmental costs
- (5) Valuing other environmental, social and other issues
- (6) Recommending measures for mitigating impacts
- (7) Evaluation of scenarios
- (8) Recommending a power development plan

There are a number of barriers for the implementation of the full integration of SEA into PDP, such as:

- (1) Is assessing environmental damage costs possible for Viet Nam? (using international data adapted for Vietnam circumstance)
- (2) How can the modeler include external cost in generation technologies? (some generation planning models do not allow the modeler to apply environmental tax. The simplest way is including external costs in variable cost of both fossil fuel and renewable technologies)
- (3) GIS database and spatial analysis skills are required for valuation of all aspects. (GIS technology transfer)
- (4) Valuation of impacts of transmission network. (A pilot study or capacity building needed)

Capacity building is needed in the following fields:

- (1) Assessment of environmental damage cost
- (2) Development of scenarios
- (3) Methods for valuation of environmental, social, water resource and other issues
- (4) GIS database and spatial analysis
- (5) Evaluation of scenarios

For the above suggested integration of the SEA into the planning process of the PDP the Ministry of Industry's Decision No. 42/2005/QĐ-BCN needs to be changed to introduce the concept of SEA and give detailed regulations on the methodology and criteria to be adopted in respect of the following:

- Methodology to be used for defining alternative energy scenarios.
- Methodology and criteria to be used for defining and valuing environmental issues.
- Methodology and criteria to be used for defining and valuing social issues.
- Methodology and criteria to be used for defining and valuing other issues.
- Methodology and criteria to be used for defining and valuing the economic costs of air pollutants and greenhouse gases.
- Methodology and criteria for weighing all aspects above in the Evaluation of the Alternative Energy Scenarios.
- Criteria for selection of "least cost" scenario.

Not only legal changes are required as mentioned above, but also institutional changes are necessary for the successful integration of the SEA into the present planning process of the PDP, such as the following:

- Changes in the organizational structure of the organization performing the PDP (the Institute of Energy) including the recruitment of additional expertise, such as for environmental and social issues, GIS, etc.
- Establishment of inter-agency working groups that provide expertise and technical input to the SEA as well as oversee its overall implementation.
- Capacity building in the fields of SEA in general, scenario development and analysis, methods for valuation of environmental and social aspects including air pollutants and greenhouse gases from thermal power plants, definition of zone of influence for power projects, inclusion of water resources aspects, etc. The capacity building specifically needs to include the MoIT's Department of Science and Technology and Environment,

who are responsible for formulating PDP ToRs, for reviewing the PDP and for reviewing SEAs and EIAs prepared during investment design.

Further development of policy-oriented SEA in power sector development: the current SEA has been a pilot to test the effectiveness of SEA where applied to a national-level strategic plan. It has shown that SEA can be an effective and cost-efficient mean to enhance the planning, such as the PDP, by taking account of social and environmental issues in a policy-oriented way. It has also shown that such policy-oriented SEAs are very different in character to a number of SEAs that have been undertaken in Viet Nam to date.

In particular, the approach of preparing scenarios and undertaking a risk and mitigation assessment, based where possible on economic valuation, have proved to be valuable, as well as the significance given to empirical evidence to support the assessment. It has also been valuable to maintain a relatively broad sustainability focus as opposed to only looking at environmental impacts. It is recommended that a full consideration of the adaptation of existing SEA guidelines be undertaken to ensure that they provide for this type of policy-oriented SEA process.

Stakeholder consultation: the PDP process should also be adjusted to require wider stakeholder consultation as an integral part of the system. This should in particular ensure that the full understanding of potential impacts is taken into account in the planning and that the needs and interests of potentially affected people are included in the delineation of mitigation measures. It is also essential that the process of PDP development is more effectively integrated with wider administrative reforms such as decentralisation and the full participation of affected stakeholders at the grass-root level.

Provincial authorities are at present not involved in the PDP process in anything other than a marginal manner. It is essential that their more effective participation is included in the future. This is especially true for provinces that are in river basins where several hydropower schemes are planned, as these schemes will have much wider effects on the future sustainability and development of these areas, including their influence on water resources, agriculture and large numbers of local communities in and around the dam sites.

SEA capacity development: including a SEA as an integral part of the PDP planning process will significantly enhance the quality of sector planning, but this will require capacity development in the agencies involved if it is to be fully effective. This is particularly true with relation to both professional capabilities in areas such as social and environmental analysis and in investments to collect and process the wider range of data and data management tools (for example, GIS) needed to undertake an effective SEA.

Internalization of external costs of power technologies in PDP optimization modeling: the differences in externalities between different technologies suggest that the optimization represents an optimum only for the electricity-producing sector. For Viet Nam as a whole, the optimal generation mix will be different. Integrating external costs into the optimization runs will produce results that are closer to a social optimum,

7.2.3. Recommendations on Policy and Regulatory Changes

It was noted, above, that a number of changes are needed to the policies and regulations that affect hydropower development if it is to be brought in line with international best practice and if it is to be both sustainable and beneficial to the areas in which construction takes place as well as the country as a whole. As noted above, these changes will entail the introduction of new guidelines and regulations that will involve some direct costs, but these are an integral

and indivisible part of the full cost of hydropower development that need to be integrated into the overall assessment of economic feasibility. When compared to both the benefits they will generate and the overall scale of hydropower investments, these costs are minor and generate high and important returns in terms of local economic development and socially responsible infrastructure investments. The principle areas where changes are needed are:

Water resources management: the SEA has demonstrated the potential benefits of the adoption of multipurpose water resources management within the power sector. This includes both the design stage, where hydropower schemes should consider their impacts on the whole river basin and assess the costs and benefits of design modification to include purposes beyond power generation. It also includes the key issue of reservoir management (including of existing schemes) to take account of the full potentials of multipurpose management. The criteria for this should reflect national water management policies and priorities and should specifically include the assessment of water release regimes necessary to guarantee minimum environmental flows in order to ensure the maintenance of the integrity of downstream ecosystems.

Although general regulations on the need for this exist, they are not specific enough to provide clear guidance for reservoir managers on the most appropriate regimes. The basis for achieving this is the full participation of the hydropower sector in the emerging river basin management systems of Viet Nam. It is recommended that a more detailed and thorough assessment of the costs and benefits of multipurpose management should be undertaken (including distributive effects) and that new reservoir management regulations should be issued for both existing and future reservoirs to reflect the benefits of multi-purpose management within an integrated water resources management context and based on cumulative river basin effects where multiple reservoirs exist.

Mitigating social impacts: the SEA demonstrates that hydropower development has a wide range of potential impacts on local communities, both in relation to displaced persons and with regard to the impacts on communities in the zones of influence. There are several components to the recommendations on the mitigation of social impacts:

- A mitigation package for displaced persons
- Mitigation support for “host” communities in localities where resettlement takes place
- Support to agricultural development
- Mitigating risks of reduced access to forest resources
- Mitigating risks or reduced access to resources from aquatic ecosystems

Taken together, these different dimensions of the social mitigation measures identified in the SEA go significantly beyond traditional “safeguard” approaches, which are limited to identifying and compensating for measuring direct impacts only. The different components of the package provide a comprehensive approach to ensuring that hydropower can be a positive force for development and poverty reduction in the localities where schemes are constructed.

Displaced persons: a detailed social mitigation package for communities that are displaced by hydropower development has been identified in this SEA report, based on the “Impoverishment, Risk and Reconstruction” model⁴³, which represents an established model of international best practice for resettlement of project affected communities. This package

⁴³Cernea, M. (2000) *Impoverishment, Risk and Reconstruction: A Model for Population Displacement and Resettlement* in Cernea, M. & McDowell, C. (eds 2000) *Risk and Reconstruction: Experiences of Resettlers and Refugees* World Bank, Washington D.C.

includes measures to ensure long-term support to livelihoods development and poverty reduction amongst affected communities. The costs of the mitigation package should be fully internalised into the calculation of the economic costs of each hydropower scheme. The costs of the expanded package do not affect the economic feasibility of any of the schemes and are estimated to be only 23% above the cost of existing compensation measures as calculated in the NHP Study. They should be accepted as part of the costs of sustainable and socially responsible hydropower development. The MoIT should issue regulations that specify the compensation package as a mandatory requirement for all future hydropower development, including hydropower schemes that are planned and developed at provincial levels and by private sector investors.

Resettlement “host” populations: the risk of negative impacts on the host populations where resettlement takes place are significant but are impossible to predict until the specific resettlement sites are identified. Nonetheless, mitigation measures can be identified. The approach recommended is to ensure that the host populations are provided with the same development possibilities as the resettled households, with in particular investments provided to ensure that they have equal access to basic services and livelihood development opportunities. The planning of resettlement and development activities should be jointly undertaken by the resettled and host communities, providing a means to build mutual understanding and shared development objectives and ensuring that the potential resentment of host populations to the resettled communities is reduced.

Mitigating negative forest resource impacts: the SEA has identified the risk of negative impacts on forest resources in the areas affected by the planned schemes. The valuation of these resources estimated their total value as being over \$7 billion, so even a relatively minor negative impact can have a high value. These risks reflect increased pressures on forest resources due to a combination of increased population and the possible reduction of forest area and quality. These impacts may be significant in some places, but can be mitigated by proactive measures to ensure the future availability of the resources in question.

For forest resources, this can be achieved through the introduction of a community forestry programme in areas where there is a risk of increased stress on forest resources; that is, in zones of influence where there is a high dependency on forests as part of local livelihood patterns and where the density of population is such that potential declines in forest area and/or quality could result in unsustainable pressures. The costs of the community forestry, which should follow the guidelines and costs of the national community forestry programme, should be internalised in the calculations of the hydropower development costs. Community forestry is organised at a village level, with standardised unit costs per village of approximately \$45,000 per village group. It is estimated that the likely total cost of the introduction of community forestry would be minor compared to the resource value of forest areas under risk from hydropower development and that economic rates of return in the order of 10:1 or more could be expected.

Mitigating negative impacts on aquatic resources: the National Hydropower Plan (NHP) Study identifies the lengths of upstream and downstream rivers that are likely to be severely affected by the individual hydropower schemes. The impact on the availability of aquatic resources is likely to be severe in most cases. It is estimated that over 100,000 people live within one kilometre of these lengths of affected rivers and rely on these resources to a greater or lesser extent. These can be mitigated by the introduction of measures such as aquaculture development, the introduction of hatcheries to reintroduce productive fish species and the development of alternative livelihood options. The provision of these investments should be an integral part of the planning of each scheme and the costs of such measures (which in most

cases will not be particularly expensive) internalised in the cost calculations of the different schemes.

Identifying and mitigating biodiversity impacts: the assessment of potential biodiversity impacts of the hydropower schemes assessed in detail in the SEA found that there are a number of schemes where potential risks to biodiversity are of particular concern. This is a combination of fragmentation risks, where a high proportion of key biodiversity areas lie within a zone of influence, and inherent biodiversity value as represented by the presence of endangered or indigenous species. These concerns are compounded where there are several schemes within a river basin. Where risks to biodiversity are high it is recommended that the planning process for the hydropower scheme include the detailed assessment of likely impacts and a biodiversity action plan, including necessary funding, to ensure that adequate protection measures are introduced and implemented.

A key part of this will be the establishment of protected areas in localities where threatened key habitats do not have a protected status. The mitigation measures should also include exploring the costs and technical feasibility of transferring key endangered species to new habitats. It is also recommended that an education and awareness programme on the importance and value of biodiversity resources is developed for implementation both in the sites where schemes are constructed and for wider stakeholders involved in the sector. As with other areas of mitigation, the costs of biodiversity protection measures should be internalised to the calculation of the economic costs of individual hydropower schemes.

Benefit sharing mechanisms: the contribution of hydropower development to the long-term development of communities in the vicinity of dam development is a key means for ensuring that hydropower has positive impacts for local communities. The financing of such development actions (such as infrastructure development, community forestry, improved agriculture and enterprise development activities) should come from a benefit sharing mechanism whereby a percentage of revenues from electricity generation is provided for local development activities. A successful piloting of such a mechanism under an ADB-funded project⁴⁴ in relation to the A'Vuong hydropower scheme in Central Viet Nam demonstrates the viability of such an approach and it is recommended that this mechanism be adopted for all future hydropower development.

7.2.4. Policy Recommendations Concerning General Power Development

Internalization of external costs of power technologies in energy pricing: all power generation technologies, but in particular coal-based thermal power, brings with them serious environmental externalities. These external costs are paid by the society and need to be taken into account in the pricing of electricity from different sources, for instance by leveling a tax or fee on the production or consumption of electricity. We recommend appointing an investigation to develop recommendations for internalization of the external costs at the national level.

Grid interconnections: the very ambitious power development schemes implemented in Viet Nam to keep up with economic demand brings with it important social and environmental costs. Viet Nam is a densely populated country and conflicts and issues over land and impacts will always be prominent. In general, the potential generation capacity in Laos brings with it less environmental and social impact per kWh, because fewer people are (on average)

⁴⁴ Haas, L., Dang Vu Tung and the Institute for Energy Studies (2007) *Benefit Sharing Mechanisms for People Adversely Affected by Power Generation Projects in Viet Nam* Electricity Regulatory Authority of Viet Nam.

affected. Therefore, it makes economic, social and environmental sense to pursue with vigour grid interconnections with Laos.

Institutional harmonization to prepare for regional power trade: further integration between countries in the GMS, will eventually enable capacity planning and balancing of a much larger system, which, as the recently published GMS energy strategy states, brings with it significant efficiency gains. This gives the opportunity for lower prices and lower environmental impacts since expensive and dirty marginal thermal power can be reduced.

Pursue CDM funding for replacement of thermal with biomass and wind power: the Clean Development Mechanism has so far not been integral to the PDP discussions. Integrating these types of funding opportunities will provide an opportunity to replace the fossil power sources and provide large environmental benefits for very little cost to Viet Nam.