

BIODIVERSITY AND DEVELOPMENT OF THE HYDROPOWER SECTOR: LESSONS FROM THE VIETNAMESE EXPERIENCE

Biodiversity and Hydropower in Vietnam

Introduction

This policy brief provides an overview of relevant biodiversity issues for those carrying out assessments or studies relating to hydropower development in Vietnam. The Brief is volume 3 in the 5-volume information kit - *Biodiversity and Development of the Hydropower Sector: Lessons from the Vietnamese Experience*. It targets civil society, Government and donors and aims to be an accessible, practical summary of Volume I – which reviews current knowledge on the relationship between hydropower and its effects on biodiversity as distilled from a number of Strategic Environmental Assessments conducted in Vietnam.

The Government of Vietnam has embarked on a major expansion of the hydropower sector, which is transforming the aquatic systems of the country. All main river systems are or will be dammed by one or more hydropower projects – each with road access and transmission lines and linked development shaping the terrestrial, aquatic and social environment.

The overall effects on biodiversity of Vietnam’s comprehensive hydropower development will be significant – involving a total transformation of the nation’s aquatic systems and a reshaping of large segments of its terrestrial systems.

The mechanisms for addressing social and environmental effects and the full economic consequences of hydropower developments are not adequate. The pace and scale of hydropower development is well beyond existing mechanisms and capacities for addressing social and environmental effects and the full economic consequences. Hydropower development is proceeding on a rapid and comprehensive scale for maximising power and profits but with only rudimentary or even misleading information and analysis on its sustainability and implications for other sectors and social and natural systems.

Hydropower Development in Vietnam

Vietnam’s 6th Power Development Plan (PDPVI) prepared by Electricity of Vietnam (EVN) and approved by the Prime Minister in 2007. PDPVI states that to 2025 hydropower will make up 23% of total installed capacity by 2025 (Table 1). PDPVI refers to 73 existing and proposed hydropower projects. However, most of the numerous small and medium dams proposed in each basin are not included in the national plan (e.g. some 60 in Quang Nam’s Vu Gia – Thu Bong basin in addition to the 8 large projects listed in the PDPVI, and 92 in the Se San Basin in addition to the 7 listed in PDPVI).

Table 1: Generation Types in PDP VI

Generation Type	2010 Installed Capacity (MW)	Proportion of Total Installed Capacity	2025 Installed Capacity (MW)	Proportion of Total Installed Capacity
Hydropower	9412	36%	20,306	23%

Coal fired	6595	25%	36,290	41%
Gas fired	9072	35%	17,224	19%
Diesel / oil fired	472	2%	2,400	3%
Nuclear	0	-	8,000	9%
Imported hydropower	658	2%	4,628	5%
TOTAL	26,209	100%	88,848	100%

Biodiversity in Vietnam

Vietnam has biodiversity values of international importance - while covering less than one percent of the land area, it contains around ten percent of the world's species. Vietnam is one of the most biologically diverse countries on Earth. Vietnam is a hotspot for endemic primates, reptiles, amphibians and flora. Vietnam's remaining forest is of global biodiversity importance. Vietnam's freshwater biodiversity is equally significant.

Vietnam's natural ecosystems support many species found nowhere else in the world. For many species Vietnam represents the only opportunity for their conservation. 10% of floras in the country are endemic species.

Vietnam's biodiversity provides goods and services to poor, rural communities and underpins national economic development through:

1. Support to community development through regulating services and provision of ecosystem products (provision of clean water, medicine, food, fuel, natural disaster management, etc.)
2. Management of water resources (flood control, waste treatment storm protection and soil erosion control)
3. Support to energy development (particularly hydropower)
4. Support to agriculture development (conservation of wild relatives of crops)
5. Support to fisheries development (protection of spawning and stocking areas) and the aquaculture industry
6. Support to tourism development (provision of opportunities to develop nature-based tourism)
7. Support to industrial development (e.g. provision of raw materials, navigation and carbon sequestration)
8. Conservation of biodiversity (e.g. protection of wild gene stocks and medicinal plants)

Close to 65% of Vietnam's important biodiversity lies outside protected areas and are not subject to legal protection. However, Vietnam supports an extensive protected area network that came into being in 1962 with the establishment, by Presidential decree, of Cuc Phuong National Park. Protected areas in Vietnam can be grouped into three categories: special use forests (SUFs), marine protected areas (MPAs) and wetlands. To date, Vietnam has 164 SUFs (including 30 national parks), 15 proposed MPAs of which 6 are officially gazetted and 68 Wetland sites.

There are substantial and persistent threats to biodiversity in Vietnam. The biodiversity in Vietnam continues to diminish with losses to habitat, species and genetic resources. The most significant threats are encroachment and forest and wetland clearing in areas of biodiversity value, increasing infrastructure development, and the wildlife trade (Table 2).

Table 2: Key threats to biodiversity and their relative importance

Rank / Threat	Drivers
(1) Hunting / illegal wildlife trade	Population pressure; economic development / trade liberalisation; high urban demand; low awareness; low management capacity and weak enforcement / disincentives
(1) Infrastructure development	Low coordination between agencies; lack of strategic planning and impact assessment across provinces and sectors; low awareness (lack of baseline data and monitoring)
(2) Deforestation/ illegal timber trade	Agricultural expansion / population pressure; rural poverty / fuelwood; economic development / trade liberalisation; high urban (especially international) demand; low management capacity and weak enforcement

The Relationship between Hydropower and Biodiversity

Hydropower development has the potential to significantly affect biodiversity (Table 3). Damming a river has the potential to impact on the biodiversity of the source and upper reaches of a river, the flow regime, the functions of the tributaries, the mainstream aquatic habitats, wetland and floodplains vegetation, delta mangroves and coastal habitats, as well as the marine ecosystems in the vicinity of the river's discharge. The type and intensity of impact varies with construction, operation and location of a dam. Cumulative effects of multiple hydropower developments require special consideration.

Hydropower development can lead to extinctions of both aquatic and terrestrial species and ecosystems. The SEA of hydropower on the Vu Gia-Thu Bon River Basin found a rich diversity of fish includes six endangered species. The SEA concluded that "Imposing 8 major and 34 minor hydropower developments on a single river system appears certain to devastate the fish fauna. It will prevent crucial migrations, directly degrade or alter aquatic habitats, disrupt metapopulation dynamics of habitat specialists, fragment populations of widespread species, and alter nutrient flows and dynamics." The Mekong River Commission SEA of hydropower on the mainstream also found that the Sambor and Stung Treng projects proposed in Cambodia would lead to species extinctions including the Mekong River Dolphin. The Three Gorges Dam (PRC) scheme in China reduced the endangered baiji or Yangtze River dolphin's habitat and facilitated an increase in ship traffic, finally driving the species to functional extinction – the first extinction of cetacean species in 20 million years and one directly attributable to human actions.

Climate change can intensify hydropower effects on biodiversity. Biodiversity that is already stressed by non-climatic, anthropogenic pressure, including hydropower development, will generally have an increased vulnerability and lower capacity to adapt to negative effects of climate change. Species with narrow climatic tolerance envelopes, restricted ranges, or where impediments to migration exist (i.e. anthropogenic barriers or habitat fragmentation) will be most affected. Headwaters of river systems are likely to act as climate refuges for certain species and the maintenance of riverine corridors are important in species adaptation to climate changes through migration. It is those ecosystems that are amongst the most affected by hydropower development

Table 3: Impacts of hydropower on biodiversity

Direct Impact	Indirect Impact
<ul style="list-style-type: none"> ▪ Habitat loss ▪ Habitat fragmentation ▪ Direct loss of species ▪ Impediments to species migration ▪ Genetic isolation of populations ▪ Invasive species propagation 	<ul style="list-style-type: none"> ▪ Water quality deterioration ▪ Hydrological flow regime changes ▪ Changes to sediment patterns ▪ Changes to flooding regimes ▪ Changes to natural shorelines in riparian ecosystems ▪ Increased pressure on natural resources ▪ Induced development

Hydropower Development and Biodiversity in Vietnam

Information presented in this section has been sourced from two Strategic Environmental Assessments¹² (SEA) which investigated the effects of hydropower as outlined in the PDPVI, on biodiversity. SEAs assess socio-economic and environmental risks and opportunities associated with policies and plans, including multiple dams, at the basin and national level. The two SEAs applied a Zones of Influence (ZOI) methodology to estimate biodiversity effects for each river basin in Vietnam. ZOI takes into account the construction of ancillary infrastructure, changes in resource use by local communities, area inundated by reservoirs and the associated upstream and downstream effects of dam operation.

The direct effects of hydropower development on biodiversity are significant. The overall effects on biodiversity of Vietnam's comprehensive hydropower development effort will involve a total transformation of the nation's aquatic and terrestrial systems. Taxonomic diversity and ecosystem integrity, at the basin level and nationally, are in constant state of degradation resulting from the impacts of multiple dams – an issue not fully understood or appreciated among stakeholders. It is possible to identify options to mitigate some of these risks. Other risks would have irreversible consequences.

The river basins where biodiversity is at highest relative risk from hydropower development are the Ba, Da, Dong Nai and Se San. The Ca, Lo-Cam Chay, Ma-Chu, Srepok, Tra Khuc-Huong and Vu Gia-Thu Bon river basins are subject to slightly lesser risk but include specific zones or hot spots where potential cumulative and project specific impacts on terrestrial and aquatic biodiversity may be significant.

The total impact of hydropower on biodiversity will be significantly greater than the estimated in the pilot SEAs. The 21 studied HP projects of the SEAs represent only a small part of the total planned hydropower development throughout the country – i.e. less than half the proposed hydropower development contained in the PDPVI, and an unknown number of additional medium and small hydropower projects proposed in provincial power development plans each with its access roads and transmission infrastructure.

There are significant gaps in biodiversity baseline information in Vietnam that limit the accuracy and robustness of impact predictions. In addition, little research has been undertaken on tropical ecosystem responses to hydropower development.

The pace, scope and scale of the hydropower development in Vietnam post publication of the two SEA implies that these pilots, and the information they present, has not been fully assimilated by those responsible for the planning and approval of hydropower dams at the national level.

Mitigation potential

Hydropower development proposed in the 6th Power Development Plan needs to move forward at a pace and scale which is more cautious and which includes more rigorous safeguards policies, arrangements and practices to mitigate biodiversity impacts. A more cautious approach will lead to

¹ ICEM, 2008, *Strategic Environmental Assessment of the Quang Nam Province Hydropower Plan for the Vu Gia-Thu Bon River Basin*, Prepared for the ADB, MONRE, MOITT & EVN, Hanoi, Viet Nam

² ICEM, 2007, *Pilot Strategic Environmental Assessment in the Hydropower Sub-sector, Vietnam. Final Report: Biodiversity Impacts of the hydropower components of the 6th Power Development Plan*. Prepared with BirdLife International for The World Bank, MONRE, MOI & EVN, Hanoi, Vietnam.

better overall development outcomes with fewer opportunity costs and negative effects on biodiversity, which undermine sustainability in the sector.

Sustainable hydropower principles for Vietnam: Seven principles, which if followed, would enhance the sustainability and equity of the hydropower sector in Vietnam:

1. **Net provincial economic gain:** Provincial economies should not be left worse off by national and provincial hydropower development plans
2. **User pays:** HP developers should contribute substantially to meeting all direct and indirect environmental and socio-economic costs of the plan implementation
3. **Multiple use:** HP projects with reservoirs should be designed and managed for multiple uses of water resources
4. **Safe operations:** Implement operational regimes and institutional arrangements to reduce droughts and floods and prepare for disasters
5. **Net biodiversity gain:** Avoid and minimize harm to biodiversity and introduce conservation offsets to extend and enhance biodiversity conservation.
6. **Net gain in minority well being:** Reduce poverty and increase food security and the quality of life in affected minorities
7. **The precautionary principle:** Take care to avoid permanent loss of provincial assets

At the sectoral and regional or river basin level the following design and location measures to mitigate the cumulative impact of hydropower projects should be employed:

- **Defer hydropower projects inside areas of known biodiversity importance:** a deferral would allow time to research and understand the knowledge and information gap. This would allow decision makers to understand the full consequences of the hydropower dams on particular river ecosystems.
- **Introduce an Intact Rivers Policy:** at least one continuous river waterway in all basins would be kept free of barriers to migration from its headwaters to the ocean, and environmentally destructive practices strictly controlled within and adjacent to the intact rivers to maximize habitat quality
- **Offset biodiversity losses:** Offset in the form of replacing lost area of significant forests or aquatic biodiversity with new forests or protection of areas with similar characteristics, should take the form of establishing forest corridors to re-connect isolated forests or rehabilitating degraded forests to improve biological values of the landscape as a whole.
- **Test fish passage technologies:** fish ladders, fish elevators or similar devices that are usable by key local species should be installed where possible to overcome the cumulative impacts of series of barriers.
- **Commit to Environmental Flows Plans:** Multi-purpose and coordinated management of water releases could minimize excessive flooding and improve minimum flows to help maintain critical habitats and help to alleviate adverse impacts of altered flows in areas downstream of the dams
- **Review alternatives to full river dams:** Placing dams across a river is an old technology. There are in stream and out of stream alternatives which need to be considered before full dam options are selected.
- **Review alternative locations:** look at alternative locations for projects which allow concentration of projects on some rivers less important for biodiversity and leave others free flowing;
- **Reduce habitat loss or fragmentation:** realign the ecological footprint of related infrastructure and resettlement to avoid or minimise habitat loss or fragmentation;
- **Monitor and report on impacts:** over the project lifespan as the key to better implementation of mitigation/control measures, adaptive management and learning from experience regarding suitability and effectiveness.

- **Enhance enforcement:** Strict controls on activities likely to exacerbate the impacts of hydropower development are needed to support other mitigation measures
- **Clarify responsibilities for mitigation and carry environmental management plan conditions into contracts**

Conclusions

At the national level, the cumulative impact on biodiversity of the more than 73 large dams proposed in PDP VI, together with existing large dams will be significant. Moreover, these major dam projects are being developed within a context of hundreds of smaller dams, both existing and proposed, that are approved at the local level and go largely unnoticed at the national level. This is a serious failing in development planning within the sector and of the associated strategic and project specific assessments – the effects on the nation's biodiversity is not being captured – and therefore not influencing decisions. Major future losses in Vietnam's biodiversity estate are likely in the decades to come due to hydropower without registering at national level – and with inadequate attention to avoidance and mitigation.

Hydropower is playing a very important role in the country's power development strategy. However, as has been repeatedly shown in EIAs and SEAs the cost of too many dams and dams in environmentally sensitive locations may well prove to have great long-term costs, which are not being adequately considered in development decisions. Vietnam depends on intact natural systems. Environmental services from terrestrial and aquatic biodiversity are crucial to the lives of many poor, rural communities and the population as a whole relies on river water for industry, water supply, sanitation, irrigation, alluvial sediments and for fisheries, inland and marine. Future planning of hydropower development must take these issues into account – resulting in a strategically planned and assessed energy mix for Vietnam that is sustainable in the long term.

The challenge facing Vietnam is settling on the right scale and pace of hydropower development so that natural resources and their uses by other sectors are maintained along with biodiversity and social and cultural assets. Potential losses in development, social and environmental values of biodiversity need to be weighed against the economic and social benefits of hydropower. It is in this context that Strategic Environmental Assessment, or SEA, is valuable as a development planning tool.

This brief is part of a set of good practice materials on "*Biodiversity and Development of the Hydropower Sector: Lessons from the Vietnamese Experience*" that have been designed to widen understanding of the relationship between hydropower and biodiversity, and to provide guidance on the use of SEA as a planning tool. These resource materials are intended to support hydropower as a central part of Vietnam's power generation sector for decades to come, without contributing to destruction of the nation's rich biodiversity.

This volume focuses on SEA and the ways it needs to be used to better address biodiversity concerns. It is based on ICEM **Volume II – Hydropower and Biodiversity: The Use of Strategic Environmental Assessment as an Assessment Tool**.

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