ENVIRONMENTAL IMPACT ASSESSMENT OF LAM TA KHONG PUMPED STORAGE PROJECT

PURPOSE

This case study critically evaluates the comprehensiveness and credibility of an environmental impact assessment (EIA) completed for the Lam Ta Khong Dam project in central Thailand. Aspects of the EIA considered in detail are the initial environmental examination (IEE), project scoping and terms of reference, and monitoring and impact assessment. Particular attention is given to identifying gaps and deficiencies in the initial EIA process followed and assessing the effectiveness of mitigation measures implemented and the usefulness of follow-up audits completed for the project.

ETP1 COURSE TOPIC COVERAGE:

- ENVIRONMENTAL IMPACT ASSESSMENT (EIA) PROCEDURES
- ENVIRONMENTAL SCIENCE IN THE MRB
- ENVIRONMENTAL MONITORING
- FULL-SCALE EIA
- CHALLENGES IN APPLYING EIA IN THE MRB
- ENVIRONMENTAL ECONOMICS
- SOCIO-ECONOMIC IMPACT ASSESSMENT (SIA)
- SUSTAINABLE DEVELOPMENT AND ENVIRONMENTAL AWARENESS

ISSUES

Specific issues highlighted in this case study are:

1. *Post hoc* review of previously completed project EIA's can reveal useful insights which will help improve currently-accepted EIA practices
2. EIA, if done properly, is an important environmental management tool in minimizing impacts of proposed development projects
3. Good science is critical to the credibility of the EIA findings and the usefulness of the EIA in informing the project decision-making process and in implementing measures to minimize environmental impacts
4. EIA's should be comprehensive in assessing all potential project impacts – including cultural and socio-economic issues as well as impacts to physical, ecological systems

LEARNING OBJECTIVES

On completion of this case study, participants will be able to do:

- Explain the purpose of project screening and provide examples of screening criteria applied in Thailand
- Assess the comprehensiveness of the baseline monitoring program completed as part of the Lam Ta Khong EIA
- Describe the intent and conclusions of the IEE completed for the project

- List and critique the valued environmental components (VEC) identified during the IEE
- Discuss how significant environmental issues (SEI) were determined in completing the project EIA
- Assess the adequacy of the EIA's spatial and temporal boundaries
- Detail the methodology used in predicting potential impacts of the Lam Ta Khong project
- Discuss the socio-economic issues considered in the EIA and the extent of public participation in project assessment and decision making
- Critique the mitigation measures proposed for the project
- Identify weaknesses in the construction and operational phase monitoring programs
- Suggest improvements in the EIA completed for the Lam Ta Khong project

PROJECT SUMMARY

Introduction and Background

The Electricity Generation Authority of Thailand's (EGAT) Lam Ta Khong Pumped Storage Project (hereafter referred to as the Lam Ta Khong project) is located in the Si Khiu and Pak Chong districts of Nakhon Ratchasima province, 200 km northeast of the capital city of Bangkok. The site is 82 and 70 km from Saraburi and Nakhon Ratchasima, respectively. The project is located on the Lam Ta Khong River, a tributary of the Mun River, which is part of the Mekong River watershed.

The Lam Ta Khong project was initially proposed in 1975 to satisfy the projected domestic demand for electricity in Thailand's northeast. With domestic consumption increasing every year in this region of Thailand – the projected demand was 1,600 MW of electricity compared the existing power plant's capacity of only 954 MW – additional power generating capacity was urgently needed. A Japan International Cooperation Agency (JICA) funded feasibility study of the Lam Ta Khong project was subsequently undertaken from 1989 to 1991 for EGAT. In 1991, EGAT appointed Khon Kaen University to conduct an environmental impact assessment (EIA) of the project. The Lam TA Khong project was finally approved for construction in February 1994.

When fully completed, the Lam Ta Khong project was to have a total capacity of 1,000 MW. Planned implementation of the project was in two phases, with 500 MW installed immediately and an additional 500 MW to be installed in 1997 or later. Phase I of the project was initiated in December 1995 with expected completion by 2001. Phase II has now been deferred due to the post-1997 economic crisis in Thailand.

Project Description

The concept for the Lam Ta Khong project is straightforward. During off-peak hours in domestic electricity use, from midnight until early morning, consumption is very low comparing to the daytime demand. The Lam Ta Khong project was proposed to take advantage of this electricity usage pattern by using excess energy during off-peak hours to pump water from the existing lower storage reservoir to a new reservoir built at a higher elevation. Water stored in the second reservoir can then be discharged to a power plant during the daytime peak usage period to satisfy the additional electricity demand.

The Lam Ta Khong project has five major components: (i) a new upper reservoir on Khao Yai Tiang hill; (ii) an underground power plant; (iii) a water tunnel from the upper reservoir to the power plant; (iv) a transmission system; and (v) the existing lower Lam Ta Khong reservoir. Design features of these components are detailed below.

Upper Reservoir

The upper reservoir is located approximately 6.5 km upstream from the Lam Ta Khong dam. The 2,210 m long reservoir covering approximately 36.6 hectares was created by construction of a 60 m high rock-filled concrete dam. Total storage and effective storage capacity of the reservoir is 10.3 and 9.9 million m^3, respectively. The reservoir is situated within a Class 1B watershed area containing protected forest.

Power House

The power house is constructed 300 m underground in a large cavern (22 m wide, 117 m long, 45.7 m high). At full capacity, the powerhouse will be equipped with four 250 MW power generators. The transformer room is located in a second cavern (20 m wide, 108 m long, 25.5 m high) approximately 70 m away from the generator room. The total excavated area of the powerhouse complex is approximately 168,000 m^3. Overlying the powerhouse is Class 1A watershed.

Waterway

The waterway transects a Class 1A watershed area and was installed underground to minimize environmental impacts. The waterway comprises two large volume steel pipes (inner diameter varies from 2.6 to 5.8 m), each being approximately 2.8 km in length.

Transmission Lines

The Lam Ta Khong power plant is connected with EGAT's power system via a series of four 230 kV transmission lines – two extending to the Thalan 3 substation and the other two extending to the Saraburi 2 and Nakhon Ratchasima 2 substations, respectively. The total length of newly-constructed transmission corridor is 110 km.

Lower Reservoir

The existing lower reservoir was created in 1969 through construction of the 40.3 m high earth-filled concrete Lam Ta Khong dam. This dam belongs to the Irrigation Department. Normal high water level in the reservoir is 277 m above sea level. The 527 m long reservoir has a total storage and effective storage capacity of 310 and 290 million m^3, respectively.

Potential environmental impacts of these components of the Lam Ta Khong project as identified in the project EIA corresponding to both the construction and operational phases are characterized in the following sections.

Construction Phase – Environmental Impacts of Concern

Land Use Changes

Potential environmental impacts to the protected watershed areas were a major concern identified in the project EIA. Because the Lam Ta Khong project is located in Class 1A and 1B watershed containing protected forest and which is the headwater source for drinking water, by law it must remain in permanent forest cover. Major project activities affecting existing the watershed area and mitigative measures taken to minimize environmental impacts can be summarized as follows:

Flooding of the Upper Reservoir – The upper reservoir was constructed by excavating and partially embanking a shallowly sloped plateau. In order to comply with environmental regulations relating to classified watershed, the site selected for the reservoir was in a Class 1B area where restrictions are less strict compared to Class 1A.

Excavation of the Waterway Tunnel – The route of the waterway was selected to minimize the distance of Class 1A watershed affected during installation of the waterway underground.

Excavation of the Powerhouse – The power station was constructed underground and the size of entrance to the access tunnel of the powerhouse was minimized to avoid disturbing Class 1A watershed.

Disposal of Excavated Materials – Disposal of excavated material (e.g., waste rock) was largely confined to the eastern side of the upper reservoir and along the lower reservoir near the water tunnel outlet. The profile of the upper disposal area was designed such that the area would blend in with the natural surroundings once all dumping was completed. Similarly, the lower disposal area was contoured with the Highway 2 and is slated for future development as a park.

Improvement of the Access Road – Upgrading of the existing, badly degraded road into the project area was necessary. Concerns relating to disturbances to the natural ecosystem as a result of increased traffic volumes were identified.

Installation of Transmission Lines – Routing of transmissions lines connecting the project with the three substations was almost entirely along existing highways to minimize additional loss of land.

Resulting impacts of these construction activities to terrestrial ecology and wildlife in the vicinity of the project were expected to be slight based on the results of a survey completed as part of the EIA. Anticipated impacts were characterized as follows:

1. No significant impacts to the terrestrial ecology were predicted. Soil fertility in the area is low to very low as a result of severe soil erosion. Dominant ground cover consists of grasses bamboo and some remnant trees. The forest is of secondary type containing few big trees or economically-valuable trees. Mitigation measures were proposed to minimize additional soil erosion in Class 1A watershed areas affected by construction activities.

2. Wildlife were not expected to be significantly affected by the project construction activities. No big game mammals or rare and endangered species were observed in the project area. Birds are frequently observed but were found to be common if many other areas. The EIA concluded that while wildlife could be impacted by construction activities (e.g., increased traffic, noise an air pollution), only a limited number of wildlife species would be affected and that impacts would be short term.

Impacts to Water Quality

Concerns about potential degradation of water in the Lam Ta Khong River and the existing lower reservoir were identified in relation to several construction activities as follows:

Earth Works – Construction of the project involved extensive clearance of ground cover, excavation, hauling, embanking, and disposing of soil, dirt, and muck. These activities raised concerns about the potential for soil erosion and for run-off of particulate laden water to receiving water bodies, particularly during rainfall events.

Underwater Works – Construction of the waterway outlet required underwater work in the existing reservoir involving excavation and reconfiguration of a section of the reservoir. A coffer dam was built with an embankment of earth and steel sheet piles for this purpose.

Resulting impacts of these construction activities to the aquatic ecology of Lam Ta Khong reservoir were expected to be short term and confined to the immediate construction areas (i.e., the disposal area and the waterway outlet area). Anticipated impacts were characterized as follows:

1. Deterioration of water quality including higher suspended solids and turbidity resulting from erosion and run-off during rainfall events and suspension of bottom sediments during underwater construction work (e.g., building the coffer dam, pumping out water)

2. Disturbances to aquatic life due to water quality deterioration and destruction of benthic habitat and fisheries habitat. These two factors were expected to lower overall biological activity in the reservoir (i.e., phytoplankton, zooplankton) and affect fish populations.

No further impacts from project construction were expected to occur in the reservoir or in the Lam Ta Khong River downstream.

Operational Phase – Environmental Impacts of Concern

In contrast to the construction phase, only limited environmental impacts were predicted to occur during the operational phase.

Transitional Impacts

Traffic volumes on local roads were expected to increase slightly from pre-construction levels as a result of the improve ease-of-access to the project area. Environmental concerns raised relating to increased traffic volumes were degradation of air quality, noise pollution and disturbances to the natural ecosystem.

Concerns about the potential for serious additional soil erosion in the project area as a result of construction were expected to gradually decrease as the appropriate reforestation and soil erosion prevention schemes were applied.

Although slight impacts to terrestrial ecosystems and wildlife were predicted for the construction phase, the affected ecosystems were expected to rebound and stabilize during the operational phase as they adapt to the project-induced changes.

Impacts to Aquatic Ecosystems and Other Water Related Issues

The potential for the Lam Ta Khong project to negatively impact aquatic ecosystems was examined in the project EIA. Productivity of the reservoir itself could be impacted by daily pumping, storage and discharge operations (i.e., averaging 9.9 million m^3 of water transfers each day). In addition, seasonal fluctuations of water levels in the reservoir could result in lower releases of water from the existing dam which would affect the Lam Ta Khong River and irrigation system.

Daily water movements in the reservoir were expected to negatively affect fish and other aquatic organisms (e.g., phytoplankton) and lead to lower fish yields in both the reservoir and in the Lam Ta Khong River. Direct mortality to fish from pumping operations can be mitigated by partitioning of fish from entering the intake tunnel. Of more concern is direct impacts to fish as a result of the anticipated reduction in the phytoplankton biomass. Modelling results indicated that reservoir productivity would be marginally reduced in all years and that significant decreases in phytoplankton could occur in dry years. Fish species which utilize phytoplankton as a major part of their diet would be at risk in this situation. It was determined that

if steps were taken to adjust pumping operations based on reservoir water levels, fish yields would only decrease by 10% in a normal year and 17% in a dry year. If corrective steps were not taken, significant reductions in fish yields were predicted.

Restriction on water releases from the Lam Ta Khong reservoir to meet existing uses (i.e., irrigation, water supply, pollution control) are only expected to occur when the reservoir water levels are extremely low. To address this concern, it was recommended that normal water levels in the reservoir be raised to ensure that sufficient water is available to meet both project operational requirements and to maintain dam discharges at existing levels.

Socio-Economic Assessment

Results of the socio-economic assessment completed for the Lam Ta Khong project suggested that the project would have both negative and positive consequences for local communities. Local villages which will be affected by the project are Ban Knao Yai Tiang and Ban Khon Yai Tiang. Forty five households with a total population of about 205 people live in the Lam Ta Khong project area.

Predicted Negative Aspects of the Project

The major negative impact of the project is on farming activity resulting from the loss of approximately 223 hectares of agricultural land. As a result of poor farming conditions (i.e., due to drought, low soil fertility and poor product prices) in the area, 63% of the agricultural land remains unoccupied with many other areas not fully utilized. Many villagers have abandoned farming to seek other occupations. As a result of the project, the remaining subsistence farmers stand to lose their land and an average annual cash income of 22,232 baht per farmer.

In addition to loss of agricultural land, other negative impacts identified in the socio-economic assessment were: (i) increased noise and air pollution from high volumes of truck traffic during the construction phase; (ii) potential for high accident rates among local unskilled labourers working on the project site; and (iii) restricted fishing access to the reservoir during the construction phase.

Mitigation measures proposed in response to negative impacts included:

- Implement a public relations campaign to properly inform local communities about the project and to promote a positive attitude towards the project
- Compensate people whose farm land is to be inundated by the upper reservoir
- Implement measures to minimize soil erosion, transport, and sedimentation during construction
- Implement measures to minimize dust, noise and vibration from construction trucks
- Implement traffic control measures to prevent accidents
- Implement a project site health and safety program

- Rehabilitate all lands impacted during the construction phase
- Implement fisheries conservation and protection measures in the existing Lam Ta Khong reservoir
- Develop a water allocation and management plan for the Lam Ta Khong reservoir to ensure maintenance of existing water uses.

Predicted Positive Aspects of the Project

The major benefit of the Lam Ta Khong project for local people is the opportunity to work either directly on the project or to obtain income by running small businesses and services for the site workers and project personnel.

Local communities and the entire region (e.g., the people in Pak Chong district, Si Khiu district and Muang district, Nakhon Ratchasima) were also expected to benefit significantly from improved overall economic conditions as a result of project-related spending during the construction and operational phases. More tourists are also expected to be drawn to the region by the improved road and scenic and aesthetic aspects of the reservoirs once the project is complete and the planting and reforestation of impacted areas has been completed.

Benefit-cost calculations completed for the project indicated that benefits and costs would be 17,680 and 12,037 million baht, respectively, resulting in present value cost-benefit ratio 1.16. These calculations assumed that all project costs for the two construction phases are included based on 1991 price levels.

SITE VISIT METHODOLOGY

Course participants will have the opportunity to visit the Lam Ta Khong project site to view the completed project and collect additional information through observation, interviews and review of supplementary documents to complete their assessment of the EIA which was prepared for the project. The site inspection will be guided by knowledgeable persons who should be able to answer most questions. The expected duration of the site visit is two days.

The overall objective of the site visit will be for the class to critique the project EIA and to evaluate whether existing mitigative measures have effectively addressed all environmental concerns related to the project. To this end, participants will be organized into small groups for the site visit with each group being assigned a specific task as summarized in the following table.

SUBJECT	FOCUS
Water Resources	Water resources impacted by project Adequacy of fisheries knowledge Receptors at risk Stressors Significance of impacts Effectiveness of mitigation measures
Forest and Wildlife	Terrestrial ecosystems impacted by project Existing knowledge of terrestrial habitat Receptors at risk Stressors Significance of impacts Effectiveness of mitigation measures
Land Use	Relevance of protected area status Soil and erosion before and after the project Alternative means of undertaking the project Effectiveness of mitigation measures
Socio-Economic	Economic benefits to community Negative impacts to community Fairness of compensation measures Equitable distribution of benefits in community Hiring policies of project Effectiveness of mitigation measures Unintended effects of project on community Community support for project

On completion of the site visit, the small groups will be asked to present their findings to the class with an emphasis on the practical lessons learned by participants which reinforce EIA theory taught in the course.

TAKE HOME MESSAGES

Anticipated lessons learned by course participants in completing the case study and site visit might include:

1. Recognition of the challenges faced by EIA practitioners in undertaking comprehensive assessments which address all majors issues of concern to interested parties. Participants will have an opportunity to re-examine the environmental aspects and impacts of the project and decide for themselves whether the EIA completed for the Lam Ta Khong project was adequate. In critiquing the EIA in this way, participants will gain insights into how to improve EIA's undertaken for future projects.
2. Better understanding of the purpose and appropriateness of mitigative measures. Participants will also be asked to consider whether mitigative measures recommended in the Lam Ta Khong project EIA adequately addressed significant potential environment impacts of the project. In examining available choices of mitigative measures and their expected and actual effectiveness, participants will recognize the importance of accurately predicting the magnitude of potential impacts and the need for confidence in prescribing mitigative measures.

3. Finally, participants will learn that EIA's are not static – ongoing review of completed projects is required to confirm that mitigative measures implemented are proving effective and to ensure that unexpected impacts are not occurring as a result of a project. In this respect, the importance of well-designed monitoring programs is highlighted as a means of informing project operators and government regulators in continuing to oversee projects during their operational phase.

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