

what was observed in the river system. This is probably what will be observed in the Nam Ngiep reservoir, as the result of the reduction of habitat diversity and of the stop of migration from downstream. However, the reduction in species does not mean also a reduction in production. The impact of blocking the move of migratory species may have also effects on the Mekong population. However, there are several other rivers, as the Nam Xan, which confluence with the Mekong is only few kilometers downstream that of the Nam Ngiep, which can provide the fish the same habitats required for spawning or feeding.

5.7.6.3. POTENTIAL FOR CAPTURE FISHERIES

After stabilization, which is expected within 2-6 years after impounding, depending on the Project alternative, fish will develop rapidly in a nutrient rich reservoir. Empirical models for potential fish yields in reservoirs have been developed by several specialists. Bernacek is one of them and has developed several regression equation from the comparison of Asian reservoirs (Bernacek, 1997). Some results are provided in the table below.

Table5.18 Fish Yields Prevision

Author	Model based on	Unit	FSL360	FSL320
Henderson and Welcome	Total Dissolved Solids	kg/ha/yr	11.26	19.91
Bernacek (1997)	Mean depth	kg/ha/yr	11.33	13.60
		tons/year	160	96

These figures have to be considered carefully, but they look on the conservative side as sustainable fish yields from deep tropical lakes are generally considered to range from 10-30 kg/ha/year (Costa Pierce, B., 1997).

5.7.6.4. POTENTIAL FOR FISH CULTURE

With Thaviang area as a junction for National Roads 1 and 5, the first North South from the Chinese border to Cambodia, and the second East West from Thailand to Vietnam, the Upper Reservoir Area will be a focal zone for development of resources to take advantage of the enormous market potential of these surrounding countries. The same can be true for the Lower Reservoir communities which will have road access for the first time southward to National Road 13.

The keynote paper on Involuntary Resettlement at the recent Workshop on Large Dams in Gland, Switzerland points out that critics of large dams have tended to underestimate the importance of reservoir fisheries for project affected people. To benefit, however, training and technical assistance are required, as is protection of the entry of project affected people during the early years of a new fishery. Otherwise, more competitive fishers from existing reservoirs and natural water bodies can be expected to dominate the new fishery. While for capture fisheries, which are the most common use of reservoir resources, a major policy deficiency has been failure to anticipate the decline in productivity that characterizes the formation of new water bodies, techniques exist to at least partially compensate for such a decline by expanding the fishery to capture a wider range of species and to use a wider range of

techniques.

One technique that the paper did not explore is that of developing floating net cage fish culture on reservoirs. The World Bank funded Saguling-Cirata Reservoir Project was the first to demonstrate the potential of a planned, "ecosystems" approach to resettlement fisheries. These environmentally oriented resettlement efforts fully utilized the new water surface for fish culture and capture fisheries and developed supporting production, economic, and marketing infrastructure. More new jobs were created in the support industries for reservoir fisheries than in the fisheries themselves (Costa-Pierce B.A., 1997).

The Indonesian experience with floating net cage reservoir fisheries as a resettlement livelihood package can be an important model for the NNPP to take advantage of its strategic location with respect to these markets. It will be essential to plan for this possible development of the reservoir well in advance of the actual creation of the reservoir, so that fisheries experts and reservoir management engineers may fully coordinate their efforts.

It will also be important to fully explore the development of fish net cage fish culture as part of a multilateral regional development program to take advantage of the strategic location of the reservoir. The funding from the hydro project and from electricity generation should be, if possible, part of a larger funding supported by the World Bank, ADB or another major funding agency. The initial steps required will be to develop a feasibility study of this area development program that will meet the standards of such agencies.

The strategic importance of Highway 4 in the Upper Reservoir meant that it is a site of extensive UXO contamination. The strong likelihood that defoliants such as Agent Orange were used in the area will require a reconnaissance survey to determine the extent, if any, of contamination by such chemical substances. This will have a bearing on the potential for fisheries in the newly created reservoir.

Besides the Indonesian experience, there are a number of reservoirs in Thailand where similar fish culture experience may be reviewed, for instance the Ubol Ratana in Northeast Thailand, Srinagarind, and Khao Laem.

The consultants Resource Management & Resource (RMR) have already reviewed some of this experience for the Nam Leuk Hydropower Project's "Intensification of Fish Production Systems" planning to mitigate any possible impacts on downstream fisheries on the Nam Leuk River.

Of even more relevance will be a review and assessment of recent experience in the Lao PDR itself on among others the Nam Ngum 1 Reservoir, the Ang Nam Hum, the Ang Nam Souang, the Ang Houay Xe Mouin, the Ang Houay Latkhoay, and the Ang Nam Thon Reservoir. Again, RMR have made a preliminary review of this experience, which can be built upon.

Table 5.19 Most Important Net Cage Species in Lao Reservoirs (Values 1999)

Scientific Name	Lao Name	Cost in Lao PDR from Private Farms	
		Per kg (Larger)	Very Small Fish
<i>Oreochromis (Tilapia) nilotica</i>	Pa nin	\$1.42/kg	\$0.86 per 100 fish
<i>Channa micropeltes</i>	Pa do	\$2.80/kg	\$1.70 per 100 fish
<i>Cyprinus carpio</i>	Pa Nai	\$1.42/kg	0.86 per 100 fish
<i>Cyprinus sp.</i>	Pa kin ya	\$1.29/kg	\$0.80 per 100 fish
<i>Cyprinus sp.</i>	Pa Indiya	\$1.42/kg	\$0.86 per 100 fish

Most cages are constructed of a supporting frame of bamboo lashed to floats (chiefly 250 liter plastic barrels). The 'cage' is composed of a cube of heavy net of 1.5cm mesh size. The average cage has a water volume of 20m³, being 4 x 3 by x 1.65m deep. Cages cost US\$25-30 to make, provided the floats can be acquired for US\$ 4 each. Fish are bought or caught to stock the cages in March to May (*Pa nin*) or September (*Pa do*), with the objective of producing fish for sale the following year at a time of high fish prices. Each cage is stocked with 2,000kg in March/April of the following year. Net cage fish are fed on chopped leaves, cassava, rice bran, small dead fish and fish feed pellets. As with fishponds, the proportion of fish feed pellets fed to caged fish has to be carefully controlled to ensure commercial viability.

There has been a rapid expansion of floating net cages in the last five years. It is claimed that a unit of 6 cages (the desirable commercial number) can produce 4-6,000kg of fish annually, with a net profit of US\$1,200-1,800.

5.7.7. AQUATIC WEEDS DEVELOPMENT

The magnitude of the annual draw down, the non dendritic shape of the reservoir are two main criteria which lead to the conclusion that the risk to get the reservoir invaded by aquatic vegetation is low. Nearby experience of Nam Ngum, offering a significant draw down too confirms this point, without significant aquatic vegetation after 25 years of operation. Nevertheless, a monitoring of aquatic vegetation is generally attached to the post impoundment monitoring of water quality and is recommended for Nam Ngiep.

5.7.8. IMPACT ON WATER RELATED DISEASES

The major water related diseases about which concern may be raised are malaria, opistorchiasis and schistosomiasis.

Malaria is already considered as endemic in most Lao PDR, including the Project area. In Nam Ngum, the prevalence of malaria observed before and during the construction of the dam declined after the filling, and only few cases are diagnosed each year around the reservoir. This is mainly the result of the elimination of the breeding places of the two main vectors, *Anopheles minimus* and *A. maculatus*, as the reservoir reaches his FSL. There is no reason at present to anticipate a significant development of these vectors around the future Nam Ngiep reservoir. However, a follow up by the Department of Health of the reported malaria cases in the communities around the reservoir is recommended.

Opistorchiasis (river fluck) is only transmitted through eating raw fish. Some communities around the reservoir may do so and thus be exposed to infection. The development of the parasite may easily be controlled by an appropriate information to the communities. It is not considered as a potential problem.

Schistosomiasis is only observed along the Mekong south of Khong Island, where *Schistosoma mekongii* is the parasite form. *Schistosoma chinensis* is observed only in Northern Laos, at the border with China. Schistosomiasis is not reported anywhere else in Laos, and not from the Project area. It never developed in Nam Ngum lake. It is considered highly unlikely that the parasite would be able to establish by itself in the future reservoir, as the disease at Khong Island has been under considerable control program pressure since 1989, with a present prevalence in the population of less than one percent.

5.7.9. IMPACTS ON GLOBAL WARMING ISSUES

5.7.9.1. PARTICIPATION OF PROJECT TO GLOBAL WARMING (GW)

There are two aspects relating to the contribution of greenhouse gases to the atmosphere by the Nam Ngiep project. The first one relates to the amount of greenhouse gas loading of the atmosphere which will result from the conversion of the forested and vegetated area into a lake, as the decay of vegetation in water or its pre-impoundment burning will release carbon dioxide and methane into the atmosphere.

The second aspect is related to the loss of the forested area as a sink for carbon dioxide. The forest area before the project absorbs CO₂ from the atmosphere and store the carbon. After the project implementation, this beneficial aspect will disappear.

The following table details the gas flux observed for Petit Saut reservoir and already applied to Nam Theun 2. We use these percentages for a tentative estimate of Nam Ngiep gas releases.

Table 5.20 Distribution of Carbon flux

Flux of Carbon in % of total over a 20 years period	C-CH ₄	C-CO ₂	C total
Released through the lake surface	3	54	57
Released downstream and then to the atmosphere	9	34	43
Total	12	88	100

Following this distribution, the flux of Carbon for Nam Ngiep is presented in the next Table 5.21.

As anticipated, clearing reduces significantly the carbon release from the reservoir. However, its contribution to GW must also be considered as presented in the following section.

Table 5.21 Carbon Flux for Nam Ngiep

Flux of Carbon (for 20 years)	in '000 tons	No clearing option			With clearing		
		C-CH ₄	C-CO ₂	C total	C-CH ₄	C-CO ₂	C total
Through lake Surface	FSL360	43	780	823	21	378	399
	FSL320	22	390	412	11	189	200
Released D/S and then to the atmosphere	FSL360	130	491	621	63	238	301
	FSL320	65	246	311	32	119	151
Total	FSL360	173	1,271	1,444	84	616	700
	FSL320	87	636	723	42	308	350

5.7.9.2. JUSTIFICATION FOR CLEARING

Clearing operation reduces effectively the Global Warming Potential (GWP) of the reservoir area and does not only transfer to the atmosphere during burning an equivalent amount of what will be transferred later if no clearing occurs. This is due to the GWP of the various gas concerned in the process.

Each greenhouse gas produces a different degree of warming effect for a given amount, and the life times of the different gas molecules are highly variable. Indeed, a molecule of methane gas is much more effective in forcing warming than carbon dioxide, but the average life-time of carbon dioxide molecule in the ongoing atmospheric processes is much longer. In the human-induced warming of the world's climate, carbon dioxide contributes for about 65% and methane 16%. However, in terms of a unit of mass of produced gas, methane is much more effective in the warming process. To account for these differences, methane is converted to its equivalent mass of carbon dioxide, and results are generally reported as tons of carbon dioxide. Thus, carbon dioxide has a GWP of 1, which compares with 27 for methane.

So, it appears better for the GW process to release one molecule of carbon dioxide rather than one of methane. This is the justification for clearing. In the absence of pre-impoundment clearing, the totality of the above ground biomass will decay in water, a molecule of carbon generating one molecule of methane gas. With clearing, a part of the hard biomass is exported through logging and removal of floating debris, and the soft biomass which is burnt is transformed into carbon dioxide, which molecule has a GWP 27 times lower than that of methane.

Table 5.22 Effect of clearing on Global Warming

Items	Unit	FSL360	FSL320
Initial Carbon in biomass	1,000 tons C	2,166	1,084
Removed Carbon by clearing	1,000 tons C	1,116	558
Carbon removed with logs (30%)	1,000 tons C	335	167
Carbon left as charcoal (30%)	1,000 tons C	335	167
Carbon released as CO ₂ in the atmosphere	1,000 tons C	446	224
CO ₂ released in the atmosphere	1,000 tons	1,633	818

The clearing operation (together with commercial logging and removal of floating debris) can reduce the flooded carbon load by 50% of the initial load. Only 1.6 million and 0.8 million tons of carbon dioxide respectively for FSL360 and FSL320 options, are released in the atmosphere. In case of no clearing, a significant part of this carbon will be released to the atmosphere as methane, with a GWP 27 times higher. Difference with and without clearing for 20 years period is presented in the following table.

Table 5.23 Importance of clearing for the Global Warming process

Emission in million tons of CO ₂ equivalent	CO ₂		CH ₄ (CO ₂ equivalent)		Total CO ₂ equivalent	
	FSL360	FSL320	FSL360	FSL320	FSL360	FSL320
NNG1 No clearing	4.7	2.3	6.2	3.1	10.9	5.4
NNG1 with clearing	3.9 ⁽¹⁾	1.9 ⁽²⁾	3.0	1.5	6.9	3.4

Notes: (1) includes 1.6 million tons CO₂ resulting from clearing-burning operation
(2) includes 0.8 million tons CO₂ resulting from clearing-burning operation

Abatement of greenhouse effect gas due to clearing is about 10 millions tons for FSL360 and 5 millions tons for FSL320, which may represent, if valued at 10 US\$/t (as observed in the international community or recommended by the funding agencies), an economic benefit of US\$54 and US\$26 millions respectively for alternative FSL360 and FSL320.

5.7.9.3. COMPARISON WITH THERMAL ALTERNATIVES

It is possible to compare the production of greenhouse gas by Nam Ngiep 1 with thermal alternatives of similar installed capacity and operating with fuel oil, coal or natural gas. Results of calculation is presented in the following table, for 50 years period (the life duration of the Project).

Table 5.24 Comparison of GWP from Nam Ngiep with thermal plants

Emission of gas in million tons for a 50-year period	CO ₂		CH ₄ (CO ₂ eq)		N ₂ O (CO ₂ eq)		Total CO ₂ eq.	
	FSL360	FSL320	FSL360	FSL320	FSL360	FSL320	FSL360	FSL320
NNG1 No clearing	4.7	2.3	6.2	3.1	ns	ns	10.9	5.4
NNG1 + clearing	3.9	1.9	3.0	1.5	ns	ns	6.9	3.4
Fuel Oil	102.5	75.0	5.7	4.0	9.7	7.0	118.0	86.0
Coal	125.0	90.0	1.0	0.7	57.5	40.0	183.5	130.7
Natural gas	63.7	40.0	58.5	42.0	0.5	0.4	116.5	82.5

From this table, it appears that Nam Ngiep Hydropower Project has by far much lower effects on global warming than equivalent thermal facilities.

5.7.9.4. LOSS OF CARBON CREDITS FOR LAO PDR

As already mentioned, forested areas act as a sequestration system for atmospherical carbon which is used through the photosynthesis to built up wood. The creation of the reservoir will cancel this capacity to store carbon and thus will limit the beneficial effect on greenhouse gas. From the Laotian point of view, the loss of this carbon storage capacity may even be converted in a financial loss: Indeed, since the Rio and Tokyo Environmental Conferences, industrialized countries have the target to reduce by 5% their production of greenhouse gas by 2010. A possibility for some countries is to purchase "carbon credits" from non industrialized countries with still large forest areas. In 1996, Norway purchased from Costa Rica 200,000t of carbon credits at 10 US\$/t. With the Nam Ngiep project, Laos will lost the potential sale of carbon credits that might have occurred without the project. This will result in a financial loss for Laos, unless the value of the loss is built into the price of electricity.

The value of this lost potential sequestering carbon may be estimated on the basis of the lost annual growth of trees in the reservoir area: Based on a wood growth of 2 to 3m³/ha generally observed in the tropical forest, a content of 225kg of carbon per m³ of wood, if valued at 10 US\$/t carbon, this may represent an annual loss of:

- 24,000 to 36,000 US\$/year for alternative FSL320
- 50,000 to 75,000 US\$/year for alternative FSL360

These values should be considered when Laos will negotiate electricity tariffs with Thailand.

5.7.10. IMPACTS ON CONSERVATION AND WILDLIFE

No significant impact different from the ones described for the filling phase are anticipated. The only threat for wildlife in the long term is the development of the population along the lakesides, with increased gathering and hunting pressure on the surrounding ecosystem. The only way to mitigate this impact is to provide this population with an appropriate production system which will discourage in terms of benefits pressure on wildlife. This is a part of a watershed management program.

5.8. THE OPERATION PHASE IN THE DOWNSTREAM

5.8.1. ALTERATION OF DOWNSTREAM RIVER FLOWS

5.8.1.1. UNSTABLE DAILY FLOWS

5.8.1.1.1. SITUATION WITHOUT MITIGATION

Based on the generating scheme considered to day, the Project will operate turbines 16 hours per day, except on Sunday and public holidays. It means that in terms of daily water release downstream, the river will receive a maximum discharge of about 300m³/s for 16 hours and no discharge for 8 hours. The change of discharge will be almost instantaneous. Considering the erosive potential of such management on the riverbed, the absolute impact on the aquatic ecosystem and the public safety aspect with more than 6,000 population downstream, such option without mitigation was not realistic. For that reason, the construction of a re-regulation structure below the tailrace channel is considered in the project design.

5.8.1.1.2. MITIGATION BY RE-REGULATION RESERVOIR

The re-regulation reservoir, with an area of 240ha at FSL will provide a daily regulation of the flow, with a storing capacity of about 6 millions m³. From the 300m³/s incoming flow for 16 hours/day, the structure will deliver downstream a regular 200m³/s flow over a 24 hours period. This discharge should be reduced during Sundays and holidays to 28.6m³/s, the raising discharge to 200m³/s being established on a 8 hours period.

5.8.1.1.3. RECOMMENDATIONS

Optimization of the system should be done during next stage of the study, taking into consideration possible mitigation for the remaining risk for public safety during the period of 8 hours the water flow will raise to 200m³/s.

5.8.1.2. MORE STABLE SEASONAL FLOW

The monthly flow will drastically change in the downstream area. In general it may be observed that the future flow will be much higher in the dry season and lower in the wet season when compared to natural conditions. In a mean year situation at Muangai; the discharge expected for the driest month (April) will be more than 3 times higher than the present situation, and the discharge for the wettest month (August) will be less than half of the original situation.

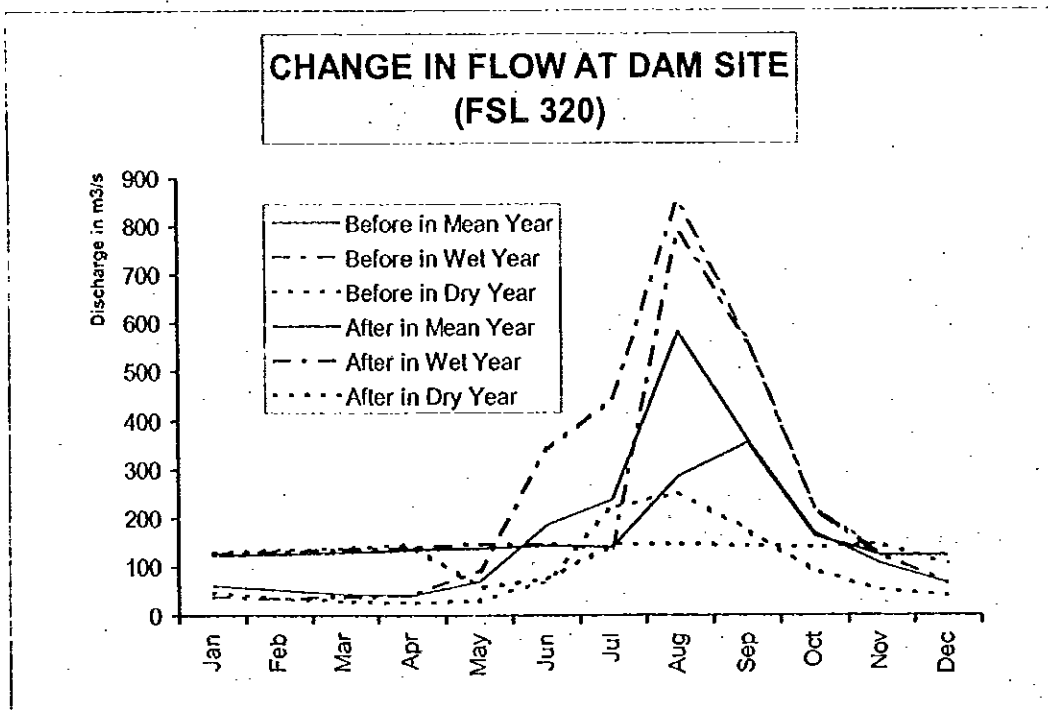
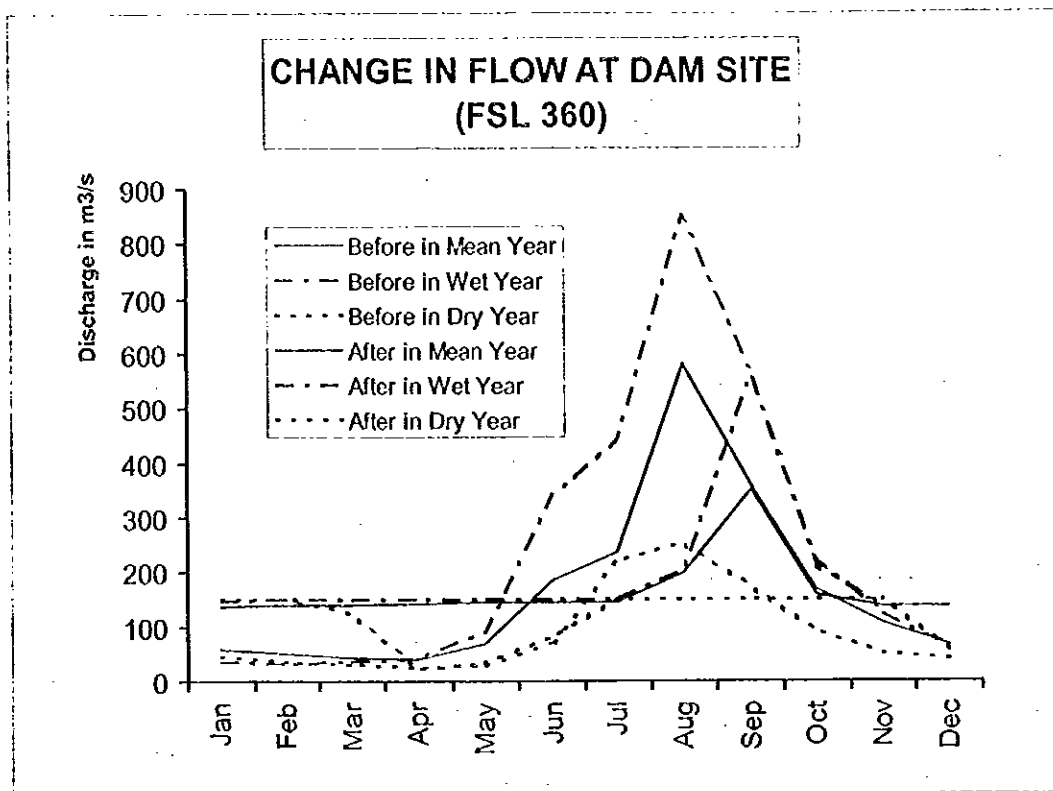
Comparison between present and future situation is presented in Figures 5.17 to 5.22, at dam site, at Muangmai and at Mekong confluence, for mean, wet and dry year conditions.

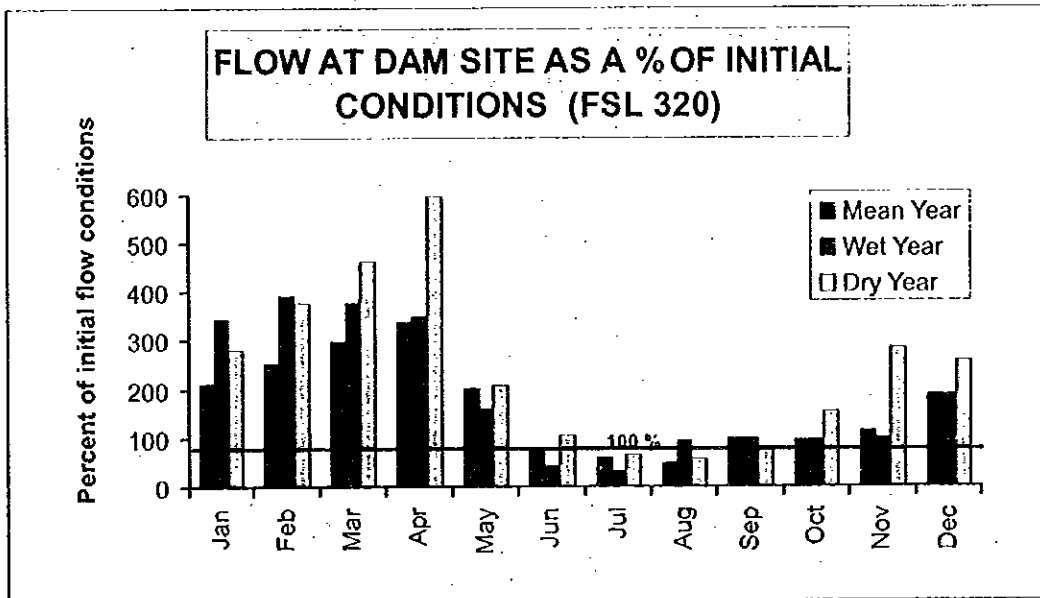
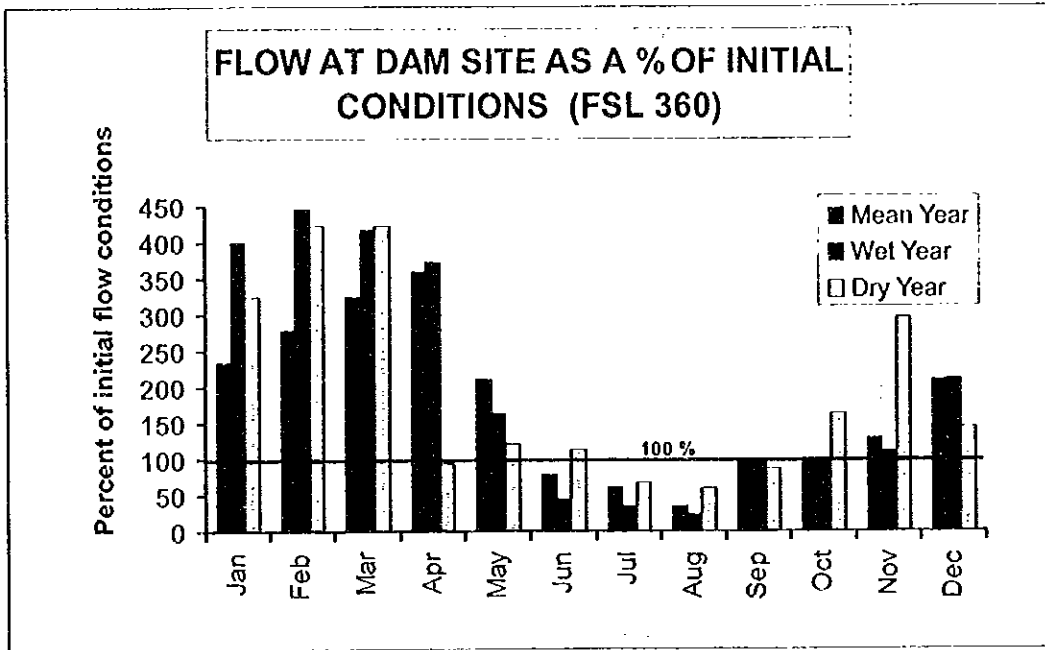
5.8.1.3. FLOOD

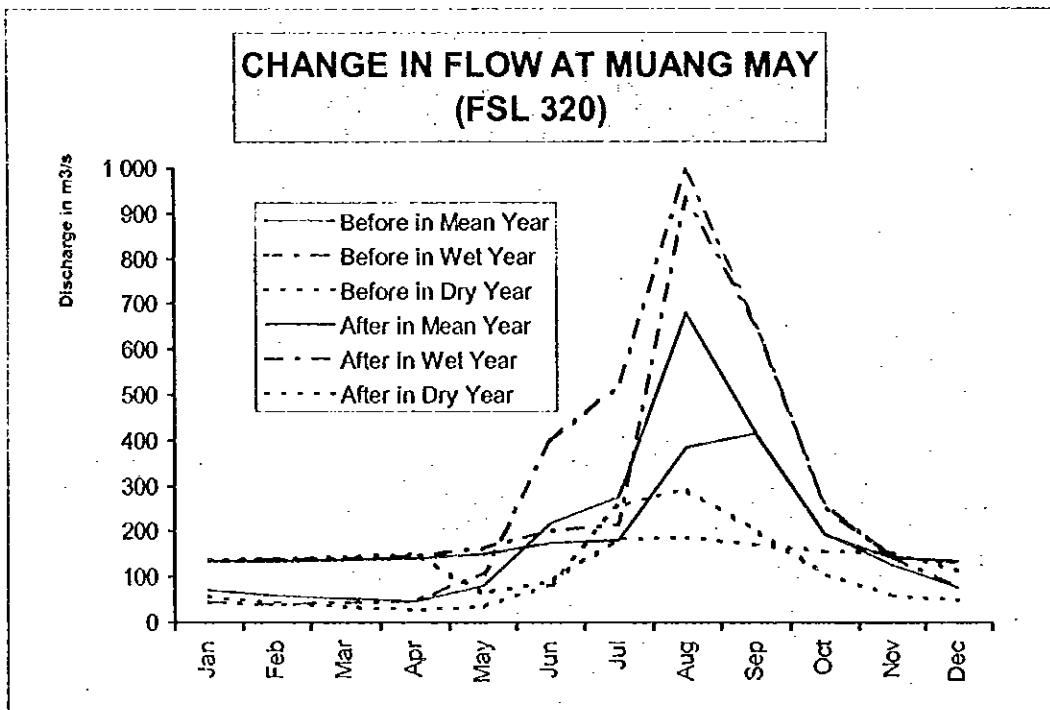
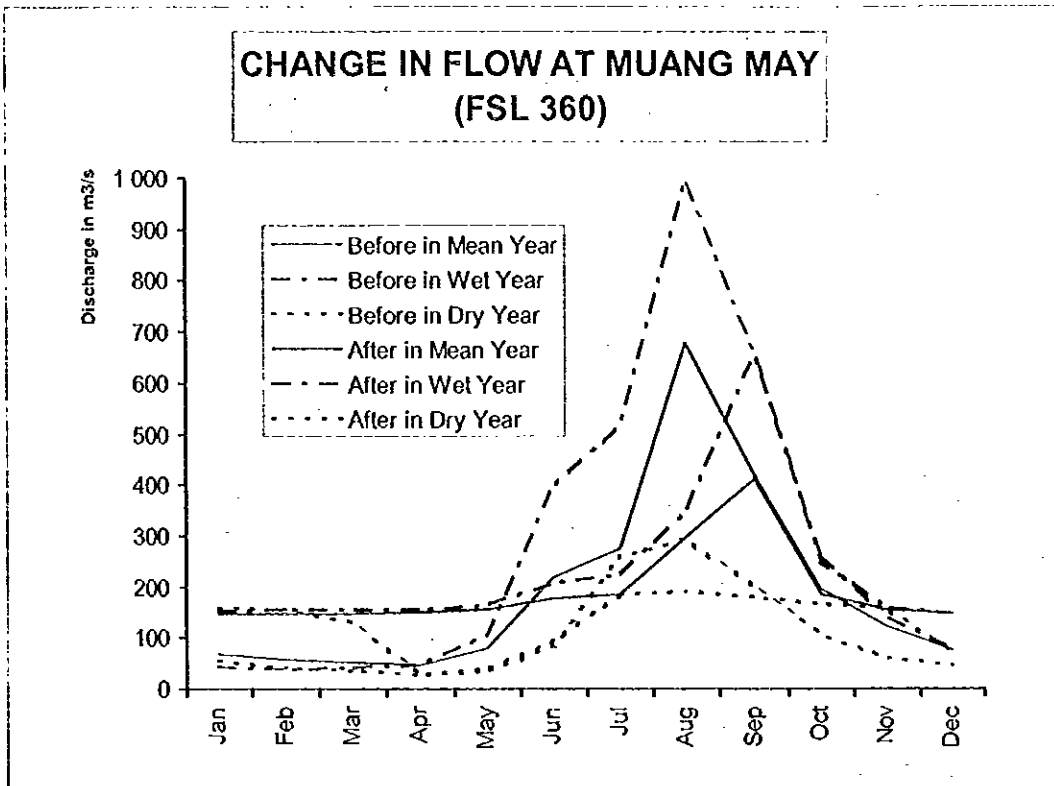
The question of predictability of flood discharge downstream of water regulation structures such as dams needs to be considered very seriously. As for any similar project, the hydrological studies for the Nam Ngiep indicate a reduction of peak flood flows below the dam, but once the dam is filled, spills will arise which may require future attention in terms of their risk profiles to people, livestock, wildlife and property downstream. As recent studies in the Nile valley (but probably the same observation is valid anywhere) have shown, once a river system is domesticated, there is a strong tendency for people to move their dwellings and properties closer to the channel. Unexpected floods, although perhaps smaller than previous peak flood episodes, may cause far more damage than expected.

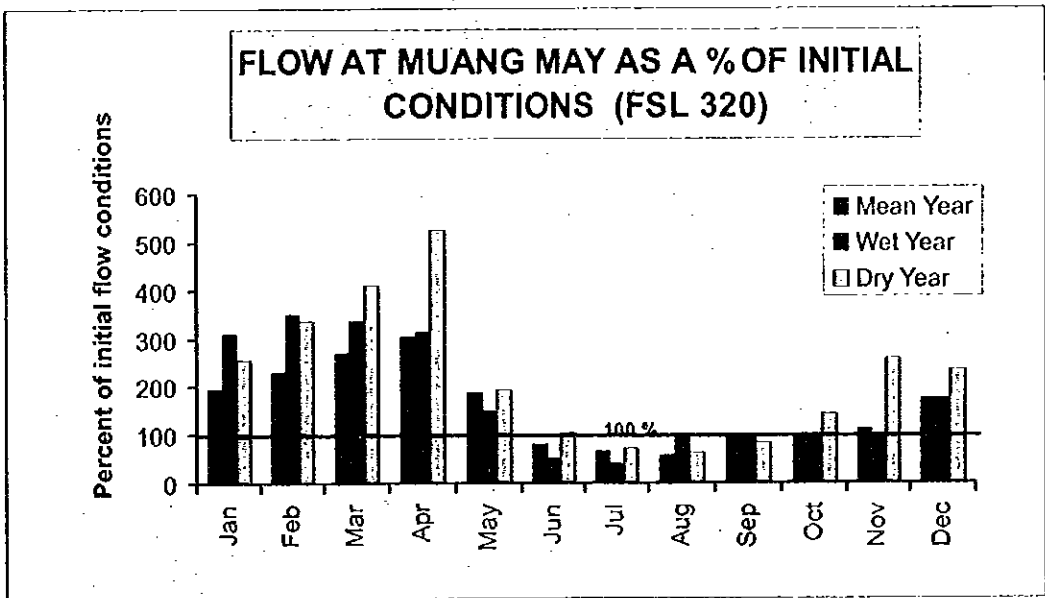
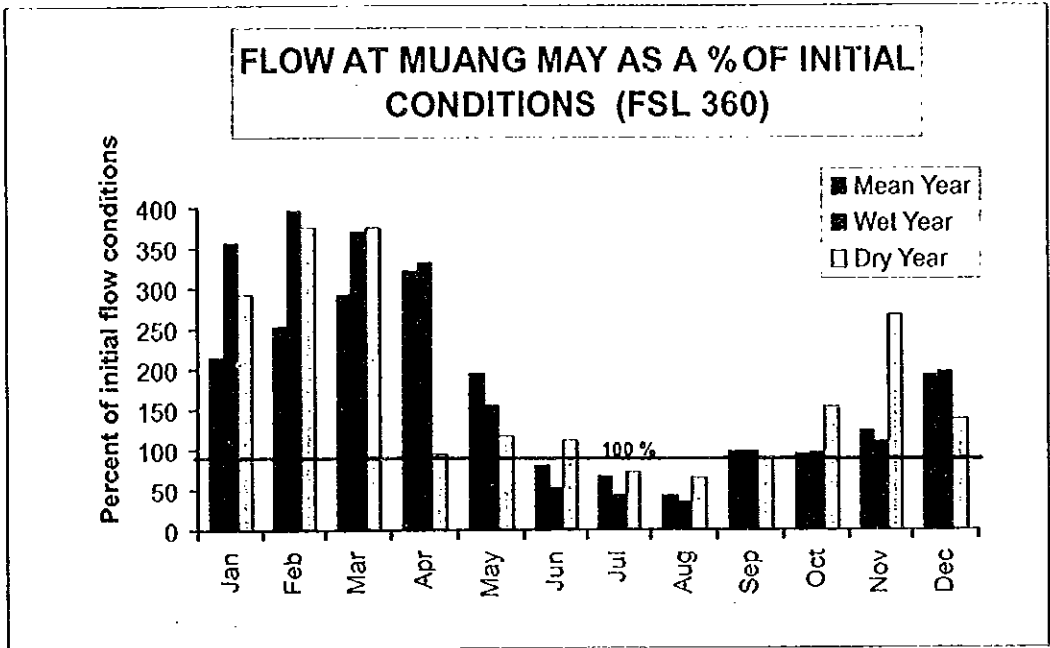
In any river system, and especially in floodplain regions, predictability is a key feature in flood survival planning. Any development, which decreases the predictability of events inevitably, increases the risk of loss of life and damage to properties and resources.

During the next stage of the feasibility, a detailed study of flood predictability should be conducted within the context of the hydrological investigations and studies.

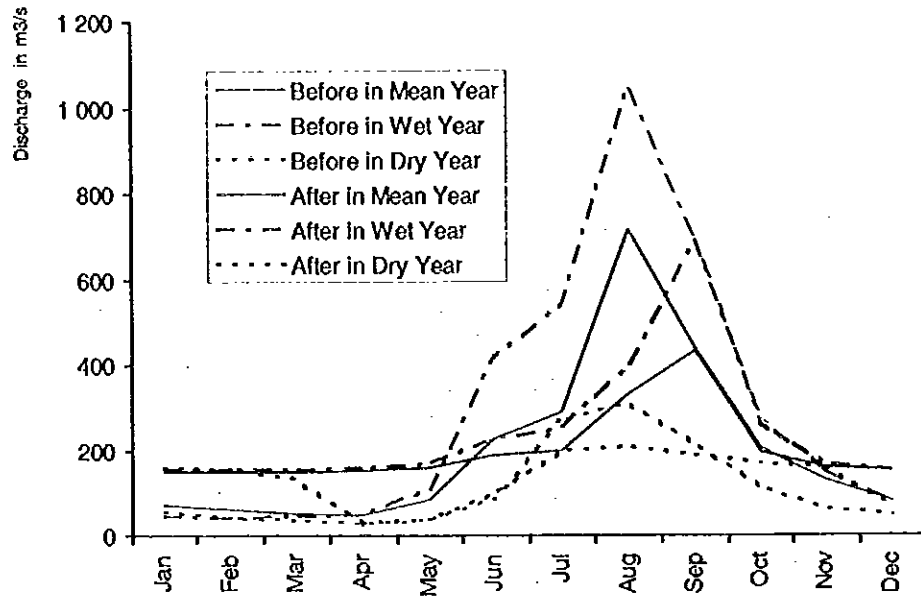




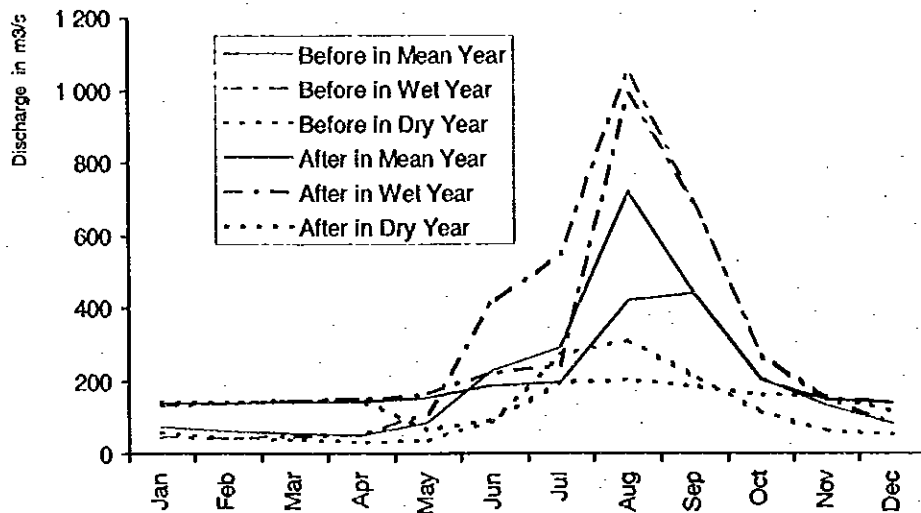


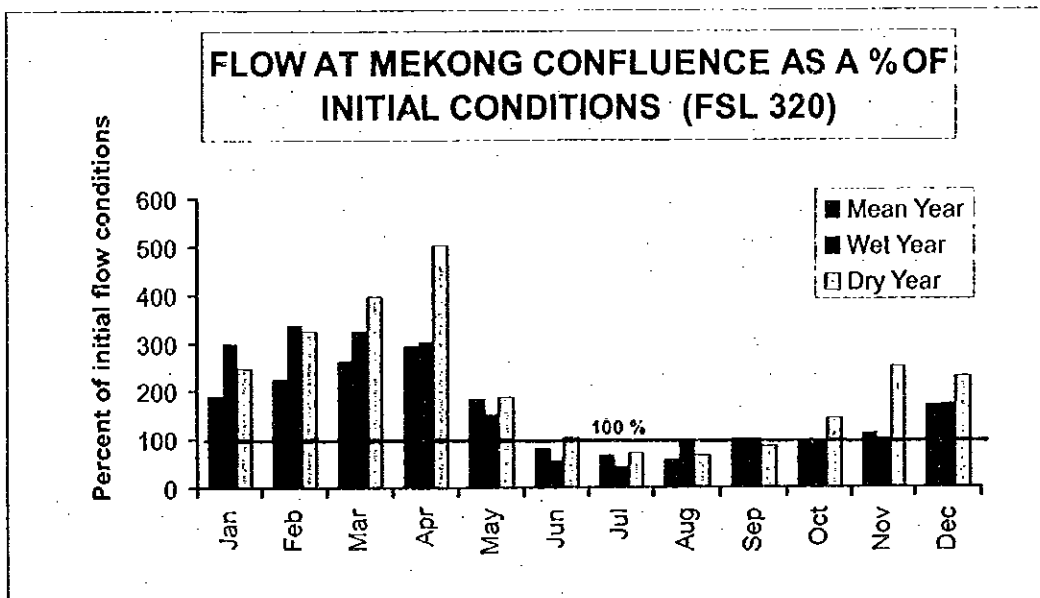
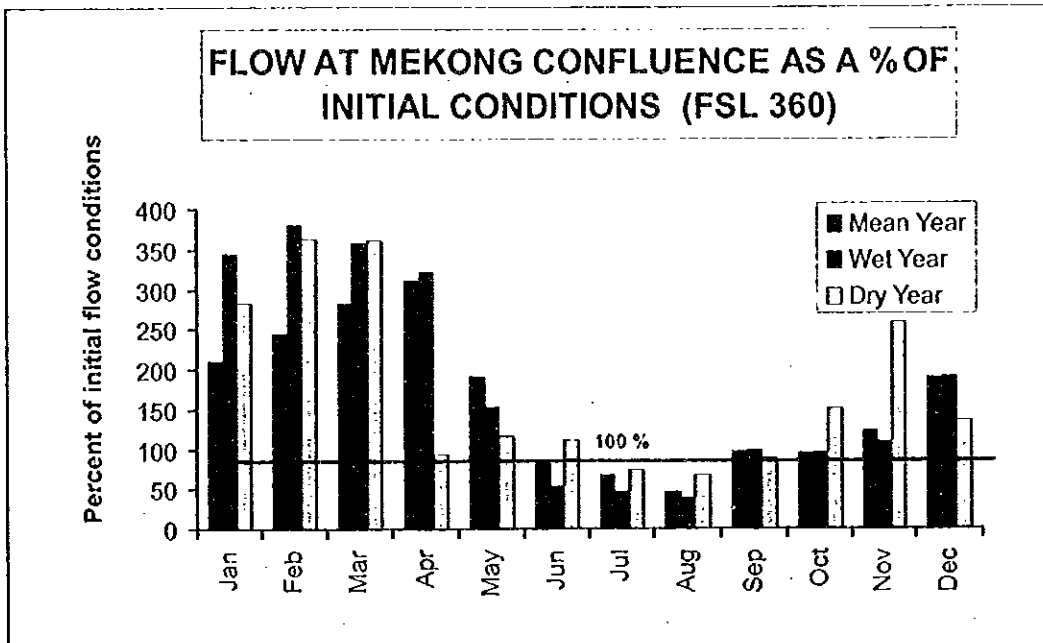


CHANGE IN FLOW AT MEKONG CONFLUENCE (FSL 360)



CHANGE IN FLOW AT MEKONG CONFLUENCE (FSL 320)





5.8.1.4. IMPACTS ON MEKONG RIVER

When compared to the Mekong discharge, the changes in the Nam Ngiep discharge distribution are unlikely to have any significant impact on this major river. The mean annual discharge of Mekong at Vientiane and Pakse is respectively 4,550 and 10,100m³/s. The mean annual flow at the confluence with the Tonle Sap in Cambodia is about 12,000m³/s. There is no trans-basin water transfer, so no significant change in water inflow contribution to the Mekong is anticipated.

More important is to consider the cumulative effect of all the hydropower schemes which are under investigation in the Mekong basin. Each of them will increase slightly the Mekong dry season flow because of the regulation each project impose to its own controlled catchment. The development in the Mekong basin does not concern exclusively hydropower, but also irrigation, for which abstraction from the river system will be mainly during the dry season, and which may balance hydropower effects.

However, any augmentation of damagingly low dry season flows in the Lower Basin will only be gained at the expense of the wet season flows in the tributaries and in the main river itself. Catastrophic declines in floodplain fish stocks have been recorded in other major rivers as a direct result of relatively small but incremental changes in the timing of the onset of the wet season flood. For example, this occurred in the Lake Manchar fishery in the lower Indus valley of Pakistan, a river that bears a close similarity to the Lower Mekong/Tonle Sap/Great Lake system.

So, it seems reasonable to expect that multiple interventions for hydropower and irrigation in the Mekong basin, will affect flood timings to an extent yet unknown. It is an evidence that all projects involving damming result in a strong delaying effect on the initial rise of flood waters in the main tributaries, which may have at a large basin level far wider implications than what is regarded as a purely local risk.

The issue of sedimentation is similar. Sedimentation occurs in reservoirs and silt depletion at estuary level may have major effects on the bimodal sedimentation pattern (silt from land and from the sea). Increased erosion in the countries may balance a potential deficit created by the damming process. At present no-one knows how multiple intervention upstream will affect sediment transport to the Mekong estuary, but a very important marine fishery resource could be at risk if future developments significantly reduce silt transport to the Mekong delta and its nearshore marine waters.

5.8.2. RELEASE OF LOW SEDIMENT LOAD WATER

5.8.2.1. IMPACTS

The bed of a river is a dynamic system which stability results from a subtle balance between the erosion by the water flow and deposit of transported sediments. The construction of a reservoir will definitely brake this balance, by reducing drastically the

amount of transported sediment in the water release downstream.

It may be reasonably expected an erosion of the river bed after implementation of the Project, but at present, any forecast on the magnitude of the phenomena is impossible. A personal observation of a Kenyan reservoir in operation for about 10 years, and operated for peak to medium load without any re-regulation structure, show a deepening of the river bed of more than 3m for a distance of several km resulting in a draw down of the alluvial aquifer with death of trees in the riparian forest.

In the case of Nam Ngiep, the re-regulation structure will strongly reduce the erosive capacity of the flow, but the absence of sedimentation will probably have an effect. The presence of tributaries may mitigate the impact, but slightly only considering the limited discharge of the downstream catchment. A study is required as a part of the technical investigations of the next stage of the Feasibility study.

5.8.3. RELEASE OF ANOXIC WATER DOWNSTREAM THE DAM

This point has already been discussed in the previous section on reservoir quality and thermocline evolution.

According to the level of the water intake, the following situation will be observed:

For FSL360, the risk to release anoxic water downstream covers the period of

- March to December (10 months) for a mean year,
- August to November (4 months) for a wet year, and
- No release of anoxic water for a dry year.

For FSL320, the risk covers the period:

- August to April (9 months) for a mean year,
- July to March (9 months) for a wet year, and
- No release of anoxic water for a dry year.

As presented earlier, the main possible mitigation measures concern the installation of a multi level water intake, the installation of re-aeration facilities on the tailrace channel or compensation for the downstream population. A study on these mitigation alternatives is recommended during the next stage of the EIA.

5.8.4. IMPACT ON DOWNSTREAM FISHERIES

The presence of the dam will definitely stop fish migration from the Mekong to the upstream Nam Ngiep. Some fish may migrate in the Nam Xao tributary, but the size of the catchment is too small to be considered as a replacement. The initial rise of flood early in the wet season is like a signal for many fish to start migration. The dam will delay or even erase this stimulus and it is most probable that migrating fish will not be

anymore attracted in the Nam Ngiep mouth. Anyway, the release of low oxygen water will also have a repulsive role for most of the fish. It is most probable that if the quality of the water released downstream is not improved, the fisheries in the downstream Nam Ngiep will probably be eradicated.

As already suggested, the implementation of a fishery intensification project, to promote more intensive fish production, commercially oriented and independently from the river system may efficiently mitigate the loss supported by the local population, and furthermore increase significantly their animal protein diet and their revenue. It is recommended to carry out a study on this fishery intensification program during the next stage of the EIA.

5.8.5. IMPACTS ON DOWNSTREAM WATER USE

5.8.5.1. DOMESTIC WATER

This point has been already discussed in the section related to the filling period.

5.8.5.2. IRRIGATION

Irrigation in the area is presently mainly developed along the Mekong and the Nam Xan River. Only 3 pumps are observed close to the mouth of the Nam Ngiep. Increasing by about 3 times the discharge during the dry season will offer a significant potential for dry season cropping and irrigation. A higher water level will also reduce the pumping head and thus the pumping cost.

5.8.5.3. RIVER TRANSPORT

A stable flow of about 200m³/s will authorize the use of the river for transportation of persons and goods all year round. This is not the case at present. The Project will have a beneficial impact on this aspect.

5.8.6. IMPACTS ON RIVERSIDE TERRACE GARDENS

During the dry season, it is a common practice for villagers to grow vegetables in small gardens along the lower loamy banks of the river. With the project, the level of the water in the dry season may be raised by about 1 to 1.5m. This will reduce the area traditionally used. Investigation for losses and property for further compensation will be required during the early stage of turbine operation.

CHAPTER - 6

SUMMARY OF ENVIRONMENTAL MANAGEMENT & MONITORING PLAN

6. SUMMARY OF ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN

6.1. OBJECTIVES AND CONTENT OF PLAN

The objectives of the Environmental Management and Monitoring Plan (EMP) is to provide the framework for undertaking all the Environmental Protection Measures (EPMs) recommended and related to direct impacts of the Project, and to establish a monitoring of these measures throughout the life of the project, but with a special focus during the construction and filling phases. The Plan also provides a basis for evaluating the performances of the Project in carrying out the EPMS.

These EPMS include the mitigation measures, monitoring activities and studies for physical and biological impacts of the Project. However, some compensation measures in the downstream area for access road and Power Transmission Line land acquisition have been at this stage of the study included.

The EMMP provides also a possible institutional organization framework for its implementation, defining briefly the roles and responsibilities of each party.

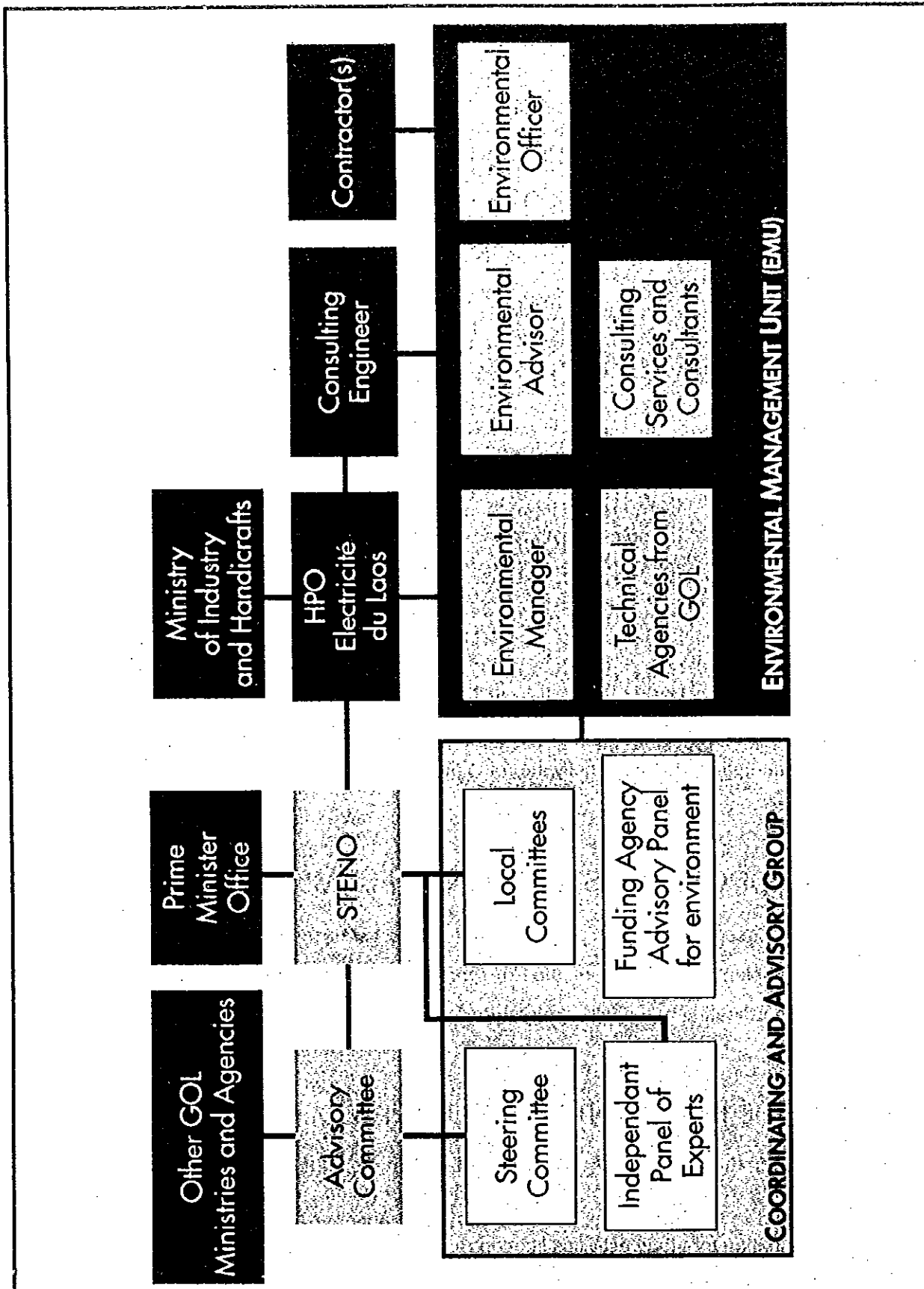
6.2. PROPOSED INSTITUTIONAL FRAMEWORK FOR EMP

The proposed organization presented in Figure 6.1 is based on a 2 level structure:

- An implementing structure, the Environmental Management Unit,
- A coordinating and advisory structure.

6.2.1. THE IMPLEMENTING STRUCTURE

It is recommended that an **Environmental Management Unit (EMU)** be established under the responsibility of the Executing Agency, to implement all the measures proposed in the EMP. The EMU will provide manpower for monitoring activities, and co-ordination for study activities subcontracted to GOL Agencies or private consultants.

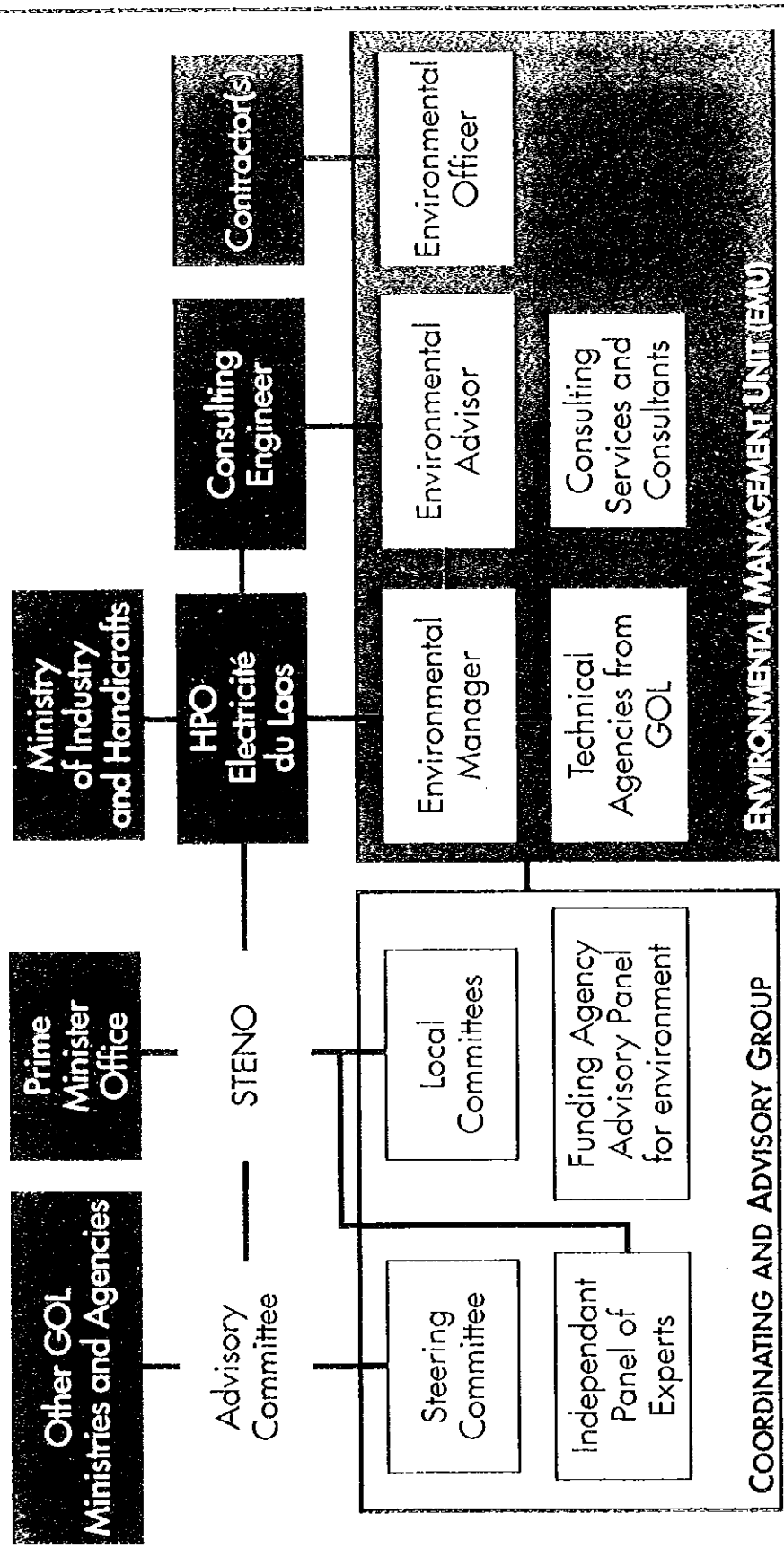


FEASIBILITY STUDY
 ON THE NAM NGIEP-1 HYDROELECTRIC POWER PROJECT
 IN THE LAO PEOPLE'S DEMOCRATIC REPUBLIC
 JAPAN INTERNATIONAL COOPERATION AGENCY

FIRST ENVIRONMENTAL IMPACT ASSESSMENT

Figure 6.1

SUGGESTED ORGANIZATION FOR EMU



The EMU will be composed of the following members:

1. The Environmental Manager (EM), to be appointed by the Executing Agency. The EM will be appointed on a full time basis, for a minimum period of 7 years (5 years of construction and first 2 years of operation). The EM will report directly to the Project Manager. The EM will act on behalf of the Project Manager in dealing with Government Agencies or other parties concerned. He will represent the Executing Agency in the Consultative Committee and will be responsible for maintaining good relations and communication with the local communities and authorities.
2. The Environmental Advisor (EA), to be appointed for the duration of the construction. He will be an environmental engineer appointed by the consulting engineer responsible for the supervision of construction works. He will work on a full time basis in close relation with the EM, assisting him in the monitoring activities and providing technical assistance for selection and follow up of agencies or consultants in charge of technical studies.
3. Representative Engineers from GOL Agencies which have been appointed to carry out field investigations and studies. They will be appointed on an ad hoc basis.
4. Consultants, in charge of studies requiring an expertise field and level not available in GOL Agencies.
5. The Environmental Officer (EO) from the Contractor side, who is in charge to implement efficiently all protection and mitigation measures which are under the responsibility of the Contractor.

6.2.2. THE COORDINATING AND ADVISORY STRUCTURE

This structure is composed of 4 advisory bodies:

1. The Steering Committee, composed of representatives from all concerned GOL Agencies at central and Provincial/District level. It will follow up the progress of the implementation, provide advice and coordination between technical departments of Government Agencies.
2. The Local Committees, composed of representatives from Sub District Level GOL Agencies, and of the villages head and representatives of local groups as the Lao Women Union, the Elders association, the Youth Association, farmers association. At least 3 local committees should be required, for Upper reservoir, Lower reservoir and Downstream villages.
3. The Independent Panel of Experts, appointed by STENO and composed of at least 2 members, one Natural Environmental Expert and one Social development Specialist. This panel, following progress of activities every 4-6 months, will provide recommendation to EMU and make sure that measures are implemented in accordance with the EMP.
4. In case the Project is funded by an International Agency as the World Bank or the ADB, the funding Agency will also probably monitor the progress of the work by regular visits of its specialized staff on the field.

6.2.3. AUTHORITY

For upper level decision making, the creation of an Advisory Committee is also proposed. This Committee, composed of high level members from concerned GOL Ministries and Agencies will provide advice and recommendations in order to reflect in the implementation of the mitigation measures proposed the Government Policy and Strategy. Some measures requiring policy orientation may concern for example watershed management, creation of conservation areas, participation of the Project to Environmental Trust fund. These will require consultation at higher level before implementation

The Committee will also provide advice during the course of the construction phase in case of disagreement or conflicts between parties, particularly for measures involving financial compensation.

It is recommended that this Committee be chaired by STENO, as the Agency is responsible for the enforcement of the Environmental Law and for the enforcement of EIA procedures. Other members should be representatives from each concerned Ministry, together with Provincial and District representatives.

Any decision or requirement of this Committee will be transferred to the executive level through the Steering Committee.

The EMU will be under the Authority of the Executing Agency, either HPO or EDL, depending on the type of Project (Government or private funding). The Environmental manager will report to the Executing Agency. The Environmental Advisor will report to the Resident Engineer and the Environmental Officer to the Contractor site Manager.

Technical staff appointed by the EMU will report to the Environmental Manager.

6.3. ENVIRONMENTAL MEASURES AND ESTIMATED COST

The Environmental Measures proposed in the First EIA study are presented in Tables 6.1 and 6.2 together with related cost estimates.

6.4. SCHEDULE

Implementation schedule of the proposed Environmental Measures is presented in the following Table 6.3.

Table 6.1 Environmental Mitigation Studies and Measures (1/2)

No	Environmental Measures	Responsible Organism	Executing Organism	Duration of Activity (years)	Unit Cost Estimate (US\$)	Total Cost of Period (US\$) FSL360	Total Cost of Period (US\$) FSL320
A	Completion of EIA Study to International Standards	JICA/GOL	HPO/ Consultant	2			
A1	Monitoring of fisheries	JICA/HPO	Dept. Fishery	2	15,000	30,000	30,000
A2	Aquatic Ecology surveys	JICA/HPO	Consulting	2	60,000	60,000	60,000
A3	Study on intensification of fisheries in reservoir area and in downstream villages	JICA/HPO	Consulting	1	60,000	60,000	60,000
A4	Water quality monitoring	JICA/HPO	Consulting	2	25,000	50,000	50,000
A5	Water quality forecast study (reservoir modeling)	JICA/HPO	Consulting	1	60,000	60,000	60,000
A6	Study of sedimentation and backwater effects	JICA/HPO	Consulting	1	100,000	50,000	100,000
A7	Study and design of water re-aeration structures	JICA/HPO	Consulting	1	50,000	50,000	50,000
A8	Study for optimization of riparian release	JICA/HPO	Consulting	1	20,000	20,000	20,000
A9	Study for Downstream villages water supply	JICA/HPO	Consulting	1	50,000	50,000	50,000
A10	Land use study based on new aerial photos for reservoir, access road and TL	JICA/HPO	Consulting	1	60,000	60,000	50,000
A11	Land use study of village gardens along river banks in downstream area	JICA/HPO	Consulting	1	20,000	20,000	20,000
A12	Study on wildlife and biodiversity with preparation of a rescue plan	JICA/HPO	Consulting	1	80,000	80,000	80,000
A13	Survey of reservoir timber and vegetation biomass	JICA/HPO	NOFIP, Consulting	2	150,000	150,000	110,000
A14	Preparation of a logging and clearing plan	JICA/HPO	Consulting	1	50,000	50,000	46,000
A15	Strategic study for biodiversity compensation and support (participation to trust fund?)	JICA/HPO	CPAWM, Consulting	1	20,000	20,000	20,000
A16	Preliminary watershed management plan	JICA/HPO	Consulting	1	10,000	10,000	10,000
A17	EIA for resettlement sites (Provisional budget)	JICA/HPO	JICA/HPO	1	100,000	100,000	70,000
A18	Preparation of detailed Environmental Management and Monitoring Plan	JICA/HPO	Consulting	-	60,000	60,000	60,000
A19	Coordination, reporting, presentation	JICA/HPO	Consulting	-	60,000	60,000	60,000
SUB TOTAL A						1,040,000	1,006,000
B	Organization of the Environmental Management Unit (EMU) and Committee	GOL/DEV	STENO				
B1	Constitution of EMU	GOL/DEV	STENO/ HPO/EOL	0.5	80,000	80,000	80,000
B2	Capacity building of EMU (1 year Technical Assistance) and Creation of Committee	STENO/DEV	EMU/ Consulting	1	300,000	300,000	300,000
B3	Preparation of detailed working program for EMU	GOL/DEV	STENO / Consulting	0.5	Included in previous	-	-
B4	Appointment of Independent Panel of Experts (2)	GOL/DEV	STENO	-	-	-	-
B5	Preparation of detailed envir. spec. for Contractors	JICA/HPO	Consulting	-	30,000	30,000	30,000
SUB TOTAL B						410,000	410,000
C	Measures during Construction Phase	GOL/DEV	EMU	5			
C1	Provide operating budget for EMU	GOL/DEV	STENO	5	180,000	900,000	900,000
C2	Appointment of Independent Panel of Experts (2)	GOL/DEV	EMU	-	60,000/yr	300,000	300,000
C3	Monitoring of contractor's construction sites and camps	GOL/DEV	EMU	5	EMU operation	-	-
C4	Provision for compensation for accidental spill or downstream pollution	STENO	EMU	When justified	(reimb. by contractor)	100,000	100,000
C5	Provision for independent investigation audit and arbitration of impact event if required	EMU	Consulting	When justified	(reimb. by contractor)	20,000	20,000
C6	Monitoring of fisheries in reservoir & D/S villages	EMU	Fishery Dept.	5	15,000	75,000	75,000
C7	Construction of water supply facilities for downstream villages last 1-2 years of Construction	EMU	Contractor	1-2	250,000	250,000	250,000
C8	Water quality monitoring (incl. tech. assistance)	EMU	Vientiane Laboratory	5	25,000	125,000	125,000
C9	Study for detailed rehabilitation of quarries, borrow and spoil banks	EMU	Consulting	1	30,000	30,000	30,000
C10	Preparation of specifications for logging and clearing tender documents, evaluation of tenders	STENO Forest Dept.	EMU Consulting	0.5	20,000	20,000	20,000
C11	Technical Assistance to EMU for supervision and monitoring of logging and clearing	EMU	Consulting D. Forestry	2	200,000	200,000	150,000
C12	Clearing of reservoir	EMU	Contractor	2	5800,000	5,800,000	3,000,000
C13	Preparation of a detailed watershed development and management plan	STENO CPAWM	Consulting	1	100,000	100,000	100,000
C14	Study for creation of wildlife reserve	STENO	EMU, Consulting	1	50,000	50,000	50,000
C15	Budget for land acqui & compens. along A/road & TL	STENO/DEV	EMU	1	110,000	110,000	110,000
SUB TOTAL C						8,080,000	5,230,000

Table 6.2 Environmental Mitigation Studies and Measures (2/2)

No	Environmental Measures	Responsible organism	Executing organism	Duration of activity (years)	Unit cost estimate (US\$)	Total cost of period (US\$) FSL360	Total cost of period (US\$) FSL320
D	Measures during filling phase	STENO	EMU	1			
D1	Provide operation budget for EMU			1	180,000	180,000	180,000
D2	Water quality monitoring	EMU	Vientiane Laboratory	1	12,000	12,000	12,000
D3	Specific monitoring of released water quality	STENO	EMU, Consulting	1	12,000	12,000	12,000
D4	Monitoring of downstream fisheries	EMU	Fishery Dept.	1	15,000	15,000	15,000
D5	Implementation of the animal rescue plan and management of the filling event (2 years)	EMU	Consulting, Contractor	1 st year	180,000	180,000	130,000
D6	Removal of floating trunks and branches and release on ground landings	EMU	Contractor	1	200,000	200,000	150,000
D7	Implementation of the fisheries intensification program in downstream villages	MOAF	Fish. Dept. Contractor	-	Not project	-	-
SUB TOTAL D						599,000	499,000
E	Measures during operation phase (year 1-5)	STENO	EMU	1-5 Years			
E1	Provide operation budget for EMU	GOL/DEV		1	180,000	180,000	180,000
E2	Water quality monitoring	EMU	Vientiane Laboratory	5	18,000	90,000	90,000
E3	Specific monitoring of released water quality	STENO	EMU Consulting	2	12,000	24,000	24,000
E4	Management of the filling event (2 years)	EMU	Consulting Contractor	2 nd year	70,000	70,000	40,000
E5	Evaluation of Compensation for loss of river bank gardens and existing irrigation facilities	STENO	EMU	1	EMU budget	-	-
E6	Provision for Compensation for loss of river bank gardens and existing irrigation facilities	STENO	EMU	1	50,000 (provision)	50,000	50,000
E7	Monitoring of downstream fisheries	EMU	Fish. Dept.	5	15,000	75,000	75,000
E8	Development of irrigation in the downstream area	MOAF	Irrig. Dept. Contractor	-	Not project	-	-
E9	Compensate for lost biodiversity by annual contribution to environmental trust fund ?	GOL	EDL or DEV	5	?	?	?
E10	Implementation of watershed management plan (for aspects related to Project)	GOL	EDL or DEV	5	?	?	?
SUB TOTAL E						489,000	459,000
F	Measures during operation phase (year 6-50)	STENO	EMU	Years 6-50			
F1	Water quality monitoring	EMU	Vientiane Laboratory	5	12,000	60,000	60,000
F2	Compensate for lost biodiversity by annual contribution to environmental trust fund ?	GOL	EDL or DEV	45?	?	?	?
F3	Implementation of watershed management plan	GOL	MOAF	20	?	?	?
F4	Implementation of commercial fisheries program in the reservoir	GOL/DEV	MOAF	5	Not project	-	-
F5	Implementation of fish culture in the reservoir	GOL/DEV	MOAF, Private Sect.	5	Not project	-	-
SUB TOTAL F						60,000	60,000
GRAND TOTAL (A to F)						10,678,000	7,664,000

Note: DEV= Developer, EMU= Environmental management Unit, GOL= Government of Laos

Table 6.3 Preliminary Implementation Schedule for Environmental Management & Monitoring Plan

No.	TASKS Period (Years)	Feasibility + Final EIA		DD-Funding 2 to 3 years	Construction					Filling		Operation	
		1	2		1	2	3	4	5	Years 1-5	Years 6-50		
A	Completion of EIA to Internat. Stand.	1	2										
A1	Monitoring of fisheries												
A2	Aquatic Ecology surveys												
A3	Study on intensification of fisheries												
A4	Water quality monitoring												
A5	Water quality study (reservoir modeling)												
A6	Study of sedimentation / backwater effects												
A7	Study/ design of water re-aeration struct.												
A8	Study for optimization of riparian release												
A9	Study Downstream villages water supply												
A10	Land use study reservoir, access road, TL												
A11	Land use study of village gardens												
A12	Study on wildlife / rescue plan												
A13	Survey reservoir timber and veg. biomass												
A14	Preparation of a logging and clearing plan												
A15	Strategic study for biodiversity support												
A16	Preliminary watershed management plan												
A17	EIA resettlement sites (Provisional budget)												
A18	Preparation of detailed EMP												
A19	Environmental specific. for Contractors												
A20	Coordination, reporting, presentation												
B	Organization of EMU (Year -1)												
B1	Constitution of EMU												
B2	Capacity building of EMU												
B3	Preparation of working program												
B4	Selection Panel of Experts												
B5	Environmental Specification for Contractors												
C	During construction Phase												
C1	Provide operating budget for EMU												
C2	Appointment of Panel of Experts (2)												
C3	Monitoring contractor's sites and camps												
C4	Provision for compensation of spill												
C5	Provision for audit and arbitration of impact												
C6	Monitoring of fisheries												
C7	Construction of water supply facilities												
C8	Water quality monitoring												
C9	Study rehabilitation quarries, borrow areas												
C10	Logging / clearing tender documents												
C11	TA for supervision of logging and clearing												
C12	Clearing of reservoir												
C13	Watershed management plan												
C14	Study for creation of wildlife reserve												
C15	Land acquisition road & TL (Budget)												
D	During Filling Phase												
D1	Provide operation budget for EMU												
D2	Water quality monitoring												
D3	Monitoring of released water quality												
D4	Monitoring of downstream fisheries												
D5	Filling event management, year 1												
D6	Removal of floating wood												
D7	Implement fisheries intensification D/S												
E	During Operation Phase (years 1-5)												
E1	Operation budget for EMU												
E2	Water quality monitoring												
E3	Monitoring of released water quality												
E4	Management of the filling event, year 2												
E5	Evaluation of compensation for bank garden												
E6	Provision of compensation for bank garden												
E7	Downstream fisheries monitoring												
E8	Development of irrigation downstream												
E9	Annual contribution to envir. trust fund ?												
E10	Implement watershed management plan												
F	During Operation Phase (years 6-?)												
F1	Water quality monitoring												
F2	Annual contribution to envir. trust fund ?												
F3	Implement watershed management plan												
F4	Implement reservoir fisheries program												
F5	Implement fish culture in the reservoir												

CHAPTER - 7

SUMMARY OF PRELIMINARY RESETTLEMENT
ACTION PLAN

7. SUMMARY OF PRELIMINARY RESETTLEMENT PLAN (PRP)

7.1. RESERVOIR AREA

The entire NNHP Reservoir Area will be within the Khetpiset (Special Zone) Xaysomboon. Formerly part of Vientiane and Xieng Khouang Provinces, Xaysomboon was set up on July 23, 1994 to give the area special preference for community development. Lao Soung represent the majority of the population in the area (45%) followed by Lao Theung (35%) and Lao Loum (20%).

The *Upper Reservoir Area* of the proposed NNHP is within Thathom District, in Taviang Sub-District. With a population of approximately 7,500 people living in 33 villages, Thathom District has the second lowest population in Xaysomboon. The present National Route 4 to be upgraded to National Road 1 passes through the proposed Upper Reservoir Area. The Government plans to extend the national network with a center spine National Road 1. This road is strategically important for the social economic development of the country and will run from the northern-most point of Lao's border with China to Cambodia in the south, adding another 1,000 km to the network.

The Upper Reservoir Area will also benefit from the transmission line route for the ADB-financed Power Transmission and Distribution Project, since the line is along National Route 4. The district will have an even more strategic location when National Road 5 is completed, linking Thailand through Vientiane to Vietnam. The junction of NR 5 and NR 1 will be in the Taviang Sub-District of Thathom, the Upper Reservoir Area of the NNHP.

It is possible that with better transportation facilities in the Upper Reservoir Area, and with the high population density relative to cultivable land area in China and Vietnam, there could be an excellent potential in *niche* market items grown at high tropical elevations, in addition to more common products such as horticulture, dairy and beef cattle or reservoir fisheries.

The *Lower Reservoir Area* of the proposed NNPP is within Hom District, Xaysomboon. The District's population is approximately 6,600 people living in 31 villages, making it the least populated district in Xaysomboon. Hom District is 90 percent *Lao Soung* with some *Lao Theung* and *Lao Loum* making up balance.¹

¹ In addition to the formal questionnaire survey, the JICA Study Team reviewed the existing sociocultural studies that have been conducted by ethnographers on behalf of other hydro projects in the Lao PDR and the ethnographic literature in general as a basis for planning. In line with accepted international practice for identifying vulnerable 'indigenous peoples' and describing aspects of life not readily captured in questionnaire surveys, a similar study is planned for the second phase of the feasibility study. However, whether or not or how this will take place will be according to the security situation in the Reservoir Area.

7.2. RESETTLEMENT IMPACTS OF RESERVOIR INUNDATION

A reconnaissance field visit August 25-28, 1998 for the IEE found the population within the planned Reservoir Area to be more built up than anticipated. Instead of around an expected 2,000 people, it found the overall reservoir area population to be more than double this figure, at somewhat less than 5,500 persons. The reconnaissance team also found considerable government-supported irrigation development in the proposed Reservoir Area.

The extent of this was confirmed by a socioeconomic survey carried out December 1998-January 1999. This survey found about 650ha of irrigated rice paddy, with 150ha more planned by GOL; instead of, as was originally assumed, only dry evergreen tropical forest, temporary or permanent agricultural areas, degraded forest, old re-growth and fallow resulting from shifting cultivation in the proposed Reservoir Area. In addition, the Upper Reservoir Area is a national Focal Area for Rural Development (FARD), making it a resettlement receiving area for highland populations; and the Lower Reservoir Area has been under a UNDP development project for a couple of decades. At EL.360m, the proposed reservoir will flood 17 villages consisting of some 853 households, with a population of 5,204. More than 800ha of irrigated paddy land built through GOL or UNDP aid schemes would be inundated.

The following table illustrates which villages will be affected at EL.360m and EL.320m level. While not all villages would be submerged even by FSL.360m alternative, their rice lands are all situated along the Nam Ngiep River and its territories at low levels. So we can assume that virtually all the villages would require resettlement if FSL.360m dam is chosen for implementation. Generally speaking, mitigation includes minimizing resettlement to the extent possible, carrying out an international standard of resettlement planning and implementation if unavoidable, and fair compensation for the displaced population.

The recommended design mitigation at this time is to consider the lower dam alternative. The initial thinking was that lowering the FSL to EL.320m would reduce the number of affected villages down to 5 villages. There is not enough information at this time, however, to determine what the amount of *backwater effect* would be, *i.e.*, how much higher the water at the back of the reservoir will be than at the front end. We would assume about two meters, including a safety margin. Therefore, consideration of the backwater effect indicates that EL.318m might be necessary to protect the majority of irrigated paddy land belonging to the Upper Reservoir villages, nearly 300 ha of the total reservoir paddy land. This FSL.318m dam would more surely reduce the affected population down to 260 households and about 1,600 people.

Besides the backwater effect, *population increase* will also need to be taken into account. Since the Upper Reservoir Area is a FARD, located within a river valley and along a national highway, ten years from now the current population will have grown by natural increase (nationally at 2.6% and in Xaysomboon at 3%) and by in-migration. Although this Preliminary Resettlement Plan (PRP) will use the above population figures, for planning sake all quantities and financial evaluations will be increased by 30% to account for natural population increase and for in-migration over a ten year period ending in 2010.

Table 7.1 Numbers Of Households And Population in Reservoir Area

Upper Reservoir:	Households	Population	Elev.(m)
B. Phonehom	67	375	368
B. Namlong	17	107	364
B. Xiangkhong	39	247	362
B. Nakang	25	132	355
B. Nahong	75	446	342
B. Viengthong	46	273	339
B. Naxay	22	125	332
B. Naxong	81	522	330
B. Phonyeng	63	349	328
B. Dong	82	509	327
B. Hatsamkhone	27	174	326
B. Phiangta	49	322	323
B. Pou	66	416	319
Upper Reservoir Sub Total:	659	3,997	
Lower Reservoir:	Households	Population	Elev.(m)
B. Houaypamon	18	127	275
B. Namyouk	86	540	271
B. Soppouh	23	132	261
B. Sopyouk	67	408	245
Lower Reservoir Sub Total:	194	1,207	
TOTAL:	853	5,204	

According to the socioeconomic survey, some 53% of households in the Reservoir Area have been there for less than five years. For the Upper Reservoir this figure is nearly 60% and for the Lower Reservoir almost 40%. Similarly, some 42% of households reported that they had been 'officially resettled' in the Reservoir Area, 43% in the Upper Reservoir and 41% in the Lower Reservoir. The Reservoir Area households surveyed have come from 23 different districts in the 7 Northern Provinces of Xieng Khouang, Xaysomboon, Houaphanh, Bolikhamsay, Vientiane, Luang Namtha, and Luang Prahbhangh.

Most village households in the Upper Reservoir surveyed came from Kham District, Xieng Khouang Province. Thathom District itself, which is the district where the Upper Reservoir is located, accounts for the second largest number of households after Kham District. In contrast to the Upper Reservoir, most of the Lower Reservoir households surveyed, virtually all *Lao Soung*, came from Hom District of Xaysomboon, the district in which they now live.

7.3. DEVELOPMENT OF DRAFT RAP AND FINAL RAP

This document, the Preliminary Resettlement Plan (PRP) is prepared without the final design of the NNHP having been decided. Once the dam height is arrived at, a full Environmental Impact Assessment (EIA) and Social Impact Assessment (SIA) will be required by internationally accepted guidelines, as well as preparation of a full Resettlement Action Plan (RAP) and a Social Action Plan (SAP) for mitigating other social impacts. During preparation of a draft RAP, the following studies will take place:

- Socio-Cultural Assessment of Resettlement and Host Communities (Part of SIA)
- Preparation of a Public Consultation Framework
- Capacity Assessment of Resettlement Sites

- Backwater and Sedimentation Modeling
- Archeological Review and Field Survey
- Technical Resources explored and detailed TOR for development of Livelihood Packages prepared

Upon completion of the draft RAP, the feasibility studies should also come to an end, and Project Preparation, including Detailed Project Engineering Design and a final RAP, should coincide with the process of securing finance and international guarantees for the Project.

During the Project's Detailed Engineering Design Phase, following the feasibility studies, a number of studies and program design activities should be carried out to finalize the RAP. These will include, but not necessarily be limited to:

- Detailed Design of Livelihood Packages
- Detailed Census of Population and Inundation Loss of Assets and Natural Resources, including detailed Land Tenure Survey
- New Village Design, including access roads, electricity, water, infrastructure, housing and community layout of resettlers' choice, and other features determined through community consultation
- Unexploded Ordinance (UXO) Reconnaissance and, as Necessary, Clearance of Resettlement Sites
- Livestock Transport And Health Program Design
- Pre Resettlement Health Program Design, with focus on maternal and child health, elderly, handicapped and otherwise vulnerable persons
- AIDS/HIV Awareness And Prevention Program, with focus on construction sites and surrounding areas
- Estimate of land and population affected by Transmission Line(s) and Access Roads and formulation of compensation plan for affected persons.
- Environmental Impact Assessment (EIA) of RAP

Other studies and program design activities, with TORs and costs will be determined during preparation of a Social Action Plan (SAP) and Watershed Management *cum* Regional Development Plan.

7.4. THE NNHP RESETTLEMENT ACTION PLAN (RAP)

7.4.1. RESETTLEMENT OBJECTIVES AND PRINCIPLES

The resettlement objectives of the NNHP RAP, as it is developed, will be in accordance with the *Draft National Resettlement Policy for Major Projects in the Lao PDR*, as

developed through preparation of the Nam Theun 2 (NT2) resettlement policy. This policy has been reviewed by the World Bank and found in accordance with international best practice.

Accordingly, the main objectives of the NNHP RAP will ensure that (a) the population to be resettled materially improves its standard of living after resettlement and that (b) those compensated under the policy are compensated adequately.

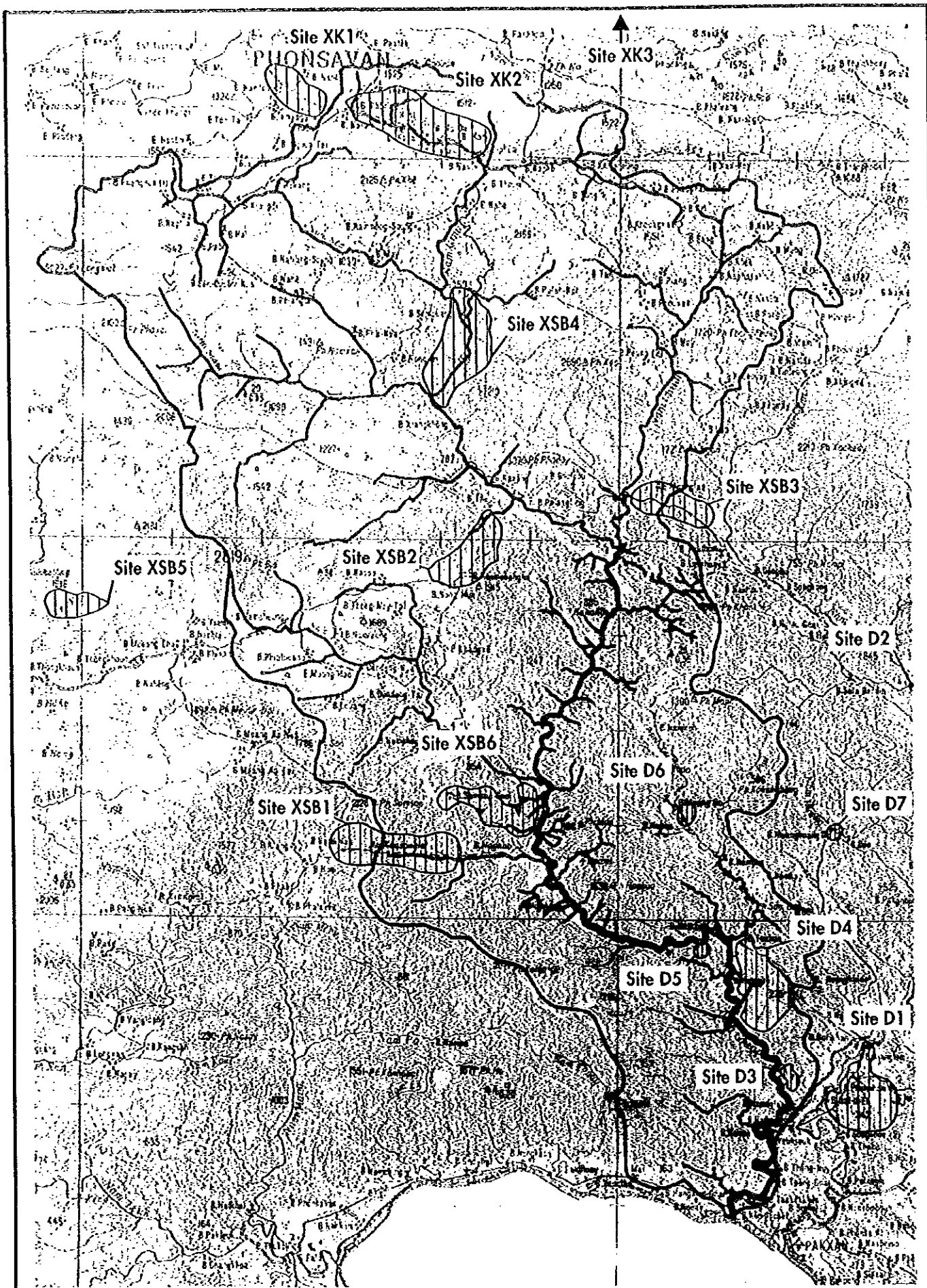
7.4.2. IDENTIFICATION OF POTENTIAL RESETTLEMENT SITES

The Study Team carried out a preliminary inventory of 16 potential Resettlement Sites from mid July to mid August 1999. Most of the sites were recommended through interviews with officials of Xieng Khouang and Bolikhamsay Provinces, of Borikhan District within Bolikhamsay Province, and of the Xaysomboon Special Zone. An assessment of the sites was also made through use of aerial photos (1:30,000 taken in 1998) for identifying land use at each site. The photo interpretation was backed up with topographic maps at a 1:100,000, 1:50,000 and 1:25,000 scale, depending on availability, to study the topographic conditions.

A prioritizing of resettlement areas was carried out, based on the cultural preference of rural Laotians for rice cultivation. Resettled households are assumed to need 1 ha of paddy field and 0.5 ha for housing, gardens and other facilities. This is about 15% higher for land holding than that currently prevailing in the Reservoir Area, at 0.83ha/hh for irrigated and rainfed paddy (0.18ha/hh for wet season irrigated paddy alone). The Study Team generally assumed that about 50% of relatively flat land classified as 'unstocked' forest would be suitable for paddy development. On October 2, 1999, a helicopter reconnaissance was also carried out for the proposed resettlement sites to the South of the proposed Reservoir.

The preliminary inventory of potential Resettlement Sites for the NNHP has indicated that out of 16 sites proposed by Government officials, resettlement might be possible in 14 sites as shown in Figure 7.1. Three (3) of the sites were judged to be most attractive (Sites D1 and D2 in the Bolikhan District, Bolikhamsay Province and XK3 in Kham District, Xieng Khouang Province). Because, they, have greater potential for paddy development, are located close to the administration center and near populated areas that could provide other earning opportunities; are within the FARD of either the concerned District or Province; and have been suggested by local authorities. Although all of the sites will be studied, these three (3) sites alone, it is thought, could accommodate 3,250 households.

The Resettlement Site Inventory is a desk study, and its conclusions are preliminary and indicative. The scope of study for future investigations will include, *inter alia*, technical investigation of soil suitability and water availability for agricultural development, particularly of irrigation development; the prevailing socioeconomic, tenure and cultural conditions of the proposed sites; and other feasibility of additional livelihood packages at the sites.



FEASIBILITY STUDY
 ON THE NAM NGIEP-1 HYDROELECTRIC POWER PROJECT
 IN THE LAO PEOPLE'S DEMOCRATIC REPUBLIC
 JAPAN INTERNATIONAL COOPERATION AGENCY

PRELIMINARY RESETTLEMENT PLAN

Figure 7.1

POTENTIAL RESETTLEMENT SITES

7.4.3. INCOME RESTORATION

Reassembling lost production systems is a complex and difficult task that requires specialists from a diverse set of backgrounds and, in order to work, will require the full participation of the resettlers themselves, not only in implementing the schemes but in planning them as well.

The NNPP will explore a range of livelihood options, each described in more detail in the main text of the PRP. The option of irrigated rice paddy appears to be one that most resettlers from the Reservoir Area are familiar with, given the amount, thanks to Government development programs, of irrigated land that already exists in the affected communities. Forestry management seems to be a concept that is also familiar, at least to those communities in the Lower Reservoir, though more needs to be known about this. Other livelihood options are floating net aquaculture, dairy and/or livestock cattle using grass on some 45km² of the reservoir draw-down area, fruit orchards, eco-tourism, and technical skills training.

7.4.4. REHABILITATION OF INDIGENOUS AND VULNERABLE PEOPLE

The Project will follow WB and ADB policies on indigenous peoples, which require in the cases of impacted vulnerable minorities, preparation of an Indigenous Peoples Development Plan (IPDP).² During the Reservoir Area census carried out as part of the final RAP preparation, identification of other vulnerable groups (elderly, poor, handicapped, etc.) will be made and plans put together accordingly to assist them in making a successful transition to the new Resettlement Sites.

7.4.5. INSTITUTIONAL ORGANIZATION

In response to the NT2, the largest and most complex development project involving significant resettlement with which GOL has had to deal, GOL has established a comprehensive resettlement organizational structure that may be expected to function as well for the NNHP.

This comprises a Resettlement Committee (RC), a Resettlement Management Unit (RMU), District Resettlement Working Groups (DRWG), and Village Resettlement Committees (VRC). Collectively, these organizations will be given the responsibility for implementing the NNHP's RAP. Other Implementing Organizations will include the Provincial Authorities, the Lao Women's Union (LWU), Village Organizations, the

² Asian Development Bank. 1995 "Policy on Involuntary Resettlement," First Annual Report to the Board of Directors. Manila, Philippines. November. World Bank. 1991. OD 4.20: *Indigenous Peoples*. Washington, DC. September 17. In the case of the NT2, a 'culturally sensitive' RAP was judged acceptable, without the necessity to prepare a separate IPDP.

Ownership Company, and Consultants, Contractors and NGOs.

During the resettlement implementation, the RMU and district working groups will play important roles. In order to strengthen their institutional capacity, a training program will be needed for their resettlement staff to have a clear understanding of resettlement policy objectives, the detailed resettlement program, and resettlement entitlements. In addition, workshops and on-the-job training will introduce a wide range of new skills for implementing livelihood and community development programs.

7.4.6. PARTICIPATION AND CONSULTATION

To obtain World Bank or other international donor funding requires that high social, environmental and economic standards be met in Project design and implementation. One such requirement is that the Project development process should involve the stakeholders – those people and institutions who have an interest in the Project, who will be directly or indirectly affected by it – and that their involvement should be integrated into the decision-making for the Project.³

At the RAP preparation phase, the Study Team has carried out environmental and social studies prior to a decision on the project design, so that these factors are incorporated at the earliest possible stage into the project design itself. As part of the feasibility process for the Project, public consultations in the Project Area will be conducted separately during the Scoping, carrying out of EIA and SIA Studies, and Finalization of the EIA and SIA Reports. The Study Team will engage an NGO or subcontract to a local consultant to design and facilitate the implementation of the Public Consultation Process.

To ensure the basic rights and interests of resettlers are protected, concerns are adequately addressed and entitlements delivered, a Grievance and Appeals Procedure will be designed for the Project during preparation of the RAP. At present, an established procedure has been developed by the NT2 and will be the starting point for the NNPP, as described in detail in the main text of the PRP.

Monitoring will be carried out to ensure that the resettlement implementation is successful and that the villagers materially improve their livelihood after resettlement. Monitoring will be both internal and external. Internal monitoring will focus on the physical progress of resettlement implementation against the schedule in the approved RAP. Independent external monitoring will be on the change of livelihood and standard of living among the relocated people.

7.4.7. BUDGET AND INUNDATION COSTS

Actual costs will be determined in the RAP preparation phase, based on a more

³ Franklin, Barbara A.K. 1997. *A Review of Local Public Consultations for the Nam Theun 2 Hydroelectric Project*. Vientiane, Lao PDR. September 30. pp. 2-3.

comprehensive inventory of inundated assets. The current estimate is for FSL.318-320m dam RAP to cost just over US\$5 million and FSL.360m dam RAP to cost in the vicinity of US\$ 18 million. This compares well with international standards for resettlement budgeting, at about \$3,600 per person,⁴ or about ten times the per capita GDP of about US\$350.⁵ Including 30% added for population growth over ten years, these estimated total RAP figures will be around US\$7 and US\$23 million respectively.

7.4.8. ENVIRONMENTAL IMPACTS AND RESTORATION

In addition to a Population Carrying Capacity Survey of the identified Resettlement Sites, the Project will carry out EIA studies of the sites. The EIA will identify the beneficial and adverse impacts arising from the Project's resettlement activities, in terms of both the natural and human environment, and will propose mitigative measures to minimize adverse impacts while maximizing the beneficial impacts. An important aspect of the EIA in northern Laos will also be a reconnaissance survey of UXO and defoliants contamination at the Resettlement Sites.

⁴ This is comparable with the approximately \$3,352 per capita quoted for NT2. The NT2 RAP has not added 30% to the RAP budget to account for natural population growth and in-migration, and the NT2 reservoir area is not a FARD and has not received the in-migration that the NNHP Reservoir Area has already received.

⁵ The World Bank's 1994 review of resettlement worldwide noted that there is a close correlation between investment levels and project capabilities for dealing successfully with resettlement. None of the projects with a ratio of per capita resettlement costs to per capita national GDP of 3.5 or higher has reported major resettlement difficulties. In contrast, virtually all of the projects with a ratio lower than 2.0 are experiencing serious implementation difficulties. "Throwing money at resettlement will not solve all resettlement problems, but starving resettlement of resources is clearly the first step towards resettlement failure." World Bank 1994. *Resettlement and Development: The Bankwide Review of Projects Involving Involuntary Resettlement, 1980-1993*. Washington, DC. April 8. p. 5/19 – 5/20.

CHAPTER - 8

PUBLIC CONSULTATION AND PARTICIPATION

8. PUBLIC CONSULTATION AND PARTICIPATION

8.1. GENERAL

This section is a short introduction of EIA process requirements in terms of public consultation and participation. It summarizes also the activities which were carried out during the present feasibility Study. Detailed presentation of National and Village Workshops organized in 1998 and 1999 is available in Chapter 11 of the Main Report.

8.2. REQUIREMENTS

To obtain World Bank or other international donor funding requires that high social, environmental and economic standards be met in Project design and implementation. One such requirement is that the Project development process should involve the stakeholders – those people and institutions who have an interest in the Project, who will be directly or indirectly affected by it – and that their involvement should be integrated into the decision-making for the Project.¹

While all levels are important, that of the local stakeholders is paramount, since resettlement planning implies critical decisions regarding the future of the displaced groups. It is therefore incumbent upon the agencies involved in this planning to seek the participation of the resettlers. World Bank guidelines recommend specifically that:²

Affected populations [must] be consulted – directly or through their formal and informal leaders, representatives or non-governmental organizations – with respect to the social and economic aspects of the various alternatives being considered for resettlement. This will improve the understanding of their needs, resources and preferences, prevent costly mistakes, help reduce the understandable reluctance to move and the stress associated with the dislocation, and accelerate the subsequent transition to an integration within the new settlements.

For purposes of the RAP, Public Involvement (PI) will be defined as “a process through which the views of all interested parties (stakeholders) are integrated into project decision-making.”³ The NT2 and the UNDP’s PI manual have identified four levels of

¹ Franklin, Barbara A.K. 1997. *A Review of Local Public Consultations for the Nam Theun 2 Hydroelectric Project*. Vientiane, Lao PDR. September 30. pp. 2-3.

² Cernea, Michael M. 1988. *Involuntary Resettlement in Development Projects: Policy Guidelines in World Bank-Financed Projects*. World Bank: Washington, DC. Pp. 14-15.

³ UNDP/ESCAP. 1997, p. 1.

public participation:⁴

- *Information Gathering:* Information on stakeholders needs to be gathered in order to identify broad areas of concern to stakeholders and assure that the initial project design includes them in a broad sense. During this phase of formative research, the flow of information is predominantly from stakeholders to the project developers.
- *Information Dissemination:* The information dissemination phase focuses on giving out information on the project and the terms of reference for the various studies being done. Although members of the public are expected to ask questions at this stage, the communication flow is predominantly from project developers to stakeholders.
- *Consultation:* In this phase, opportunities are organized for groups and individuals to give their opinions and contribute comments, concerns and suggestions about the project in a dialogue with the project developers. This phase of public involvement is important for environmental and social assessment studies, and the results should be reflected in these reports.
- *Participation.* In this final phase, stakeholders take part in joint planning, decision-making, implementation and evaluation of the project, for those aspects that concern them most directly. Participation is most often associated with the later phases of project development and implementation.

8.3. ACHIEVEMENTS

At this stage of the RAP preparation phase, the NNHP's JICA Study Team has carried out environmental and social studies *prior to* deciding on the project design, so that these factors are incorporated at the earliest possible stage in the project design itself. Public Involvement has been a part of the process from the very beginning, starting with a First General Workshop held in Vientiane November 26 and 27, 1998. All major stakeholders, some 89 persons from Government, NGOs and international associations, including from the project area itself, attended this workshop which presented the Inception and Initial Environmental Examination (IEE) Reports.

This was followed by Site Workshops in the Upper and Lower Reservoir Areas March 16 and 17, 1999. The first Site Workshop was in B. Dong attended by local government officials and some 48 villagers from 12 affected villages. The second Site Workshop was in B. Sopyouk attended by local officials and some 23 villagers from the affected communities. Concerns registered in the Upper Reservoir included that inhabitants preferred not to move and wished for the lower dam alternative (318-320 meters). The primary message disseminated by the study team was that the Project is in its early study phase (the results were presented) and could possibly not be built, or if built not until about a decade of preparatory work took place. The Lower Reservoir residents want the conditions of resettlement to be summarized in contract documents with official signatures.

⁴ Franklin 1997, p. 3.

A second General Workshop was held closer to the Project Area in Pakxan town on June 9-11 and in the downstream villages at B. Maung Mai on June 23-24, 1999 at which draft EIA and the socioeconomic survey findings were presented as well as the initial preparations for the RAP. A third General Workshop is planned to begin on December 8th and further local consultation workshops in the Upper and Lower Reservoir and in the Downstream villages during the same month.

In carrying out these public consultation workshops, the Project has assured that PI is integrated with the project decision-making at the earliest possible stages. The PI has also been integrated with the very beginning stages of the Environmental and Social Assessments. In practical terms, all four aspects of PI, information gathering, information dissemination, consultation, and participation have been aspects of the workshop experience.

The workshop objectives have been to have:⁵

- Better informed stakeholders about the Project study and possible future intentions;
- A better informed study team about the needs and concerns of the affected communities;
- Changes to the objectives and design of the Project;
- Outline of plans and agreements for how affected communities will participate in the RAP (and if) a decision is made to go ahead with the Project itself.

A credible Public Consultation Process will be crucial to the successful development of the Project, including the preparation of an acceptable EMP, SAP, RAP and IPDP, if required. As part of the feasibility process for the Project, public consultations in the project area will be conducted separately during Step 1 (Scoping), Step 2 (Study), and Step 3 (Finalization of EIA/SIA Report). The JICA Study Team may engage an NGO or subcontract to a local consultant as part of the Consultant team to design and facilitate the implementation of the Consultation Process. The Consultant/NGO should continuously re-assess the *Public Consultation Process Strategy* as feedback is received from information dissemination and consultation. The Consultant/NGO will:

- *Identify The Stakeholders* - directly affected people, representative Community Based Organizations (CBOs) and NGOs, local media correspondents, traditional leaders, provincial and divisional government agencies, etc., and assemble them in a body that represents the stakeholders. The group should meet periodically during the process of the EIA/SIA study to discuss the emerging findings of the assessments;
- Assist the Stakeholder Group in preparing and disseminating *Public Information* in the appropriate local language (for instance, Hmong romanized script in the Lower Reservoir), including the types of impacts that may be anticipated, and the scope of the draft TOR for the EIASIA and Resettlement Assessment, and the summary of the draft EIA/SIA Report and proposed mitigation measures. Use may be made of non-technical brochures, leaflets, posters, briefings and presentations, public meetings (including visual aids), involvement of the media and provision of public access to the reports;

⁵ Based on UNDP/ESCAP. 1997, p. 35.

- Assist the Stakeholder Group in establishing mechanisms and conduits for *Consulting* communities and representative NGOs when undertaking the steps and tasks described in the EIA/SIA TOR, and TORs for the RAP and IPDP (if required). These will include inputs into the scoping of the EIA/SIA TOR, conducting socioeconomic and community opinion surveys, evaluating alternatives, formulating entitlement packages and drafting the EMP and SAP, as well as of the RAP and IPDP (if required) for the final EIASIA Report. An appropriate number of women staff will be necessary to assure that gender issues are adequately included and that affected women are also appropriately informed about the RAP, especially in the Hmong communities;
- *Keep A Record Of Information And Consultation Activities* - type of activity and mechanisms used, date and location, names of groups and individuals invited, types of attendees, issues raised, responses given and the impact upon subsequent decisions; and
- *Track the Progress of Implementing EMP, SAP, RAP and IPDP (if required)* during facility development and operation, through community monitoring activities.

In addition to copies of the EIA/SIA Report being made available in public locations within the Lao PDR, in accordance with accepted international procedures, the EIA/SIA Report will also, when formally received for HPO and JICA review, be placed in Project Public Information Centers (PICs) in Vientiane and in the Project Area, as well as made public through an internet website.

To ensure the Project Affected Persons (PAPs), their representatives and the local authorities in the affected areas fully understand the details of the RAP, they will be informed about the compensation and rehabilitation assistance being planned during early stages of RAP implementation and throughout.

The public consultation process begun during the Project and RAP preparation stage will continue during the RAP implementation through a PI Program that will be designed as an integral part of the RAP. Village-level consultations organized by the RMU and RO in collaboration with District and Village level Resettlement Working Groups will inform the PAPs about the RAP schedule and the *due process* afforded them in its implementation. These meetings will be held before and during RAP implementation according to a pre-determined schedule and will obtain feedback about the local officials and people's concerns and ideas about the RAP. This input will be integrated into policy and into adjustments of the RAP as required.

LIST OF MAIN REFERENCES

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- Baird, I.G., V.Inthaphaisy, P.Kisouvannalath, B.Phylavanh and B.Mounsouphom, 1999. The Fishes of Southern Lao, Lao Community Fisheries and Dolphin Protection Project, Ministry of Agriculture and Forestry, Lao PDR.
- BCEOM, 1999. Nam Ngum Watershed Project; Revised Fisheries study. CPAWM
- Bernacsek, Garry A. 1997. Large dam fisheries of the lower Mekong countries, Review and assessment, Main Report. Mekong River Commission.
- Bouarapha Consultants Co.Ltd. 1992. The Report on Socio-Economic Survey of Fisheries Communities in Nam Ngum Reservoir (in Lao version). Prepared for Nam Ngum Fisheries Communities Development Project; 63 pages.
- Burapha Development Consultants Co., Ltd. 1992. The Mekong Secretariat Nam Ngum Socio-Economic Survey Final Report. Vientiane. May.
- EdL. 1997. NLHP Social Action Plan, Annex 5, "Anthropological Presentation Of Hmong Communities In The Project Area," From Report by Mr. Jan OVESEN, 1996.
- Galy-Lacaux, Delmas, Dumestre, 1997. Evolution over time of gaseous emissions and dissolved gas profiles. Hydroecologie appliquee, Tome 9, Volume 1-2, 1997.
- Galy-Lacaux, Delmas, Dumestre, 1997. Estimation of the carbon budget in Petit-Saut reservoir, two years after filling. Hydroecologie appliquee, Tome 9, Volume 1-2, 1997.
- Interim Mekong Committee. 1992. Fisheries in the Lower Mekong Basin
- IUCN. 1997. Environmental & Social Action Plan for Naka-Nam Theun Catchment & Corridor Areas. 1st Draft. Volume 1: Management Strategy. June. pp. Part 2 - 20-47.
- Kottelat, M. 1997. Aquatic Biodiversity study of the Nam Mang and Nam San basins . Nam Leuk Hydropower Project
- Kottelat, M. 1996. Potential impacts of Nam Theun 2 hydropower project on the fish and aquatic fauna of the Nam Theun and Xe Bangfai basins, Lao P.D.R. Annex : Fishes of the Nam Theun and Xe Bangfai basins. Report for NTEC, Vientiane.
- Lao PDR. 1998. Basic Statistics About the Socio-Economic Development in the Lao PDR. Vientiane: State Planning Committee, National Statistical Centre.
- Louis Berger International, Inc. 1997. Economic Impact Study of Nam Theun 2 Dam Project. Vol. 1. For Government of the Lao PDR. July 28.
- Lahmeyer International and Hidrotechnica Portuguesa. 1997. *Annex 6.6: Estimated Socio-Economic Impacts and Associated Resettlement/Compensation Costs of Projects*. Hydropower Development Plan for the Lao PDR. Interim Report-Hydropower Inventory. Main Report. Appendices A-C. February. (For Commission of the European Communities and Government of Lao PDR, Ministry of Industry and Handicraft).
- Mekong River Commission Secretariat. 1998. Assessment of Mekong Fisheries - Fish Migrations and Spawning and Impact of Water Management. Inception Report
- Nam Theun 2 Electricity Consortium (NTEC). Environmental and Social Action Plan for Nakai-Nam Theun Catchment and Corridor Areas. *Summary of the Draft Social Action Plan*. Vol. 2.

- NTEC. 1997. (Draft) Nam Theun 2 Hydroelectric Project Resettlement Action Plan. May.
- Nippon Koei Co., Ltd. 1998. Feasibility Study of the Nam Ngiep-I Hydroelectric Power Project in the Lao PDR. Execution Plan of Environmental Assessment Survey. (for JICA and MIH), August.
- Rahman, Ataur. 1990. Fisheries Sector of Lao PDR. International Development Research Center of Canada.
- Rainboth, W.J. 1996. Fishes of the Cambodian Mekong. Food and Agriculture Organization of the United Nations, Rome, 1996
- Resource Management & Research Environmental Impact Specialists (RMR). 1999a. *Intensification of Fish Production Systems: Part 1, Survey of Existing Fish Intensification Methods on the Vientiane Plain*. EdL, Nam Leuk Hydropower Production Systems. January.
- Resource Management & Research Environmental Impact Specialists (RMR). 1999b. *Intensification of Fish Production Systems: Part 2, Existing Fish Intensification Methods Worldwide*. EdL, Nam Leuk Hydropower Production Systems. January.
- Roberts, T.R. & G. Baird. 1995. Traditional fisheries and fish ecology on the Mekong river at Khone Waterfalls in southern Laos. *Natural History Bulletin of the Siam Society*, 43 : 219 –262
- Singkham, P. 1995. Policy Framework for Fishery Sub-sector, Department of Livestock and Fisheries, Ministry of Agriculture and Forestry. 11 pages.
- SOGREAH 1996. Nam Leuk Hydropower Development Project: Environmental Impact Assessment Final Report.
- SOGREAH 1996. Nam Leuk Hydropower Development Project: Environmental Management Plan Final Report.
- SOGREAH 1997. Investigations of the Ban Kengsan Terrace; Report 400195 R35.
- SOGREAH 1997. Investigations of the Downstream Fisheries activities on the Nam Leuk and Nam Mang in the Late Dry Season (March). Report 400195 R38
- SOGREAH, 1997. Survey of the Vegetation Biomass in the Nam Leuk Reservoir Area. Report 400195 R37
- STS Consultants. 1999. Interim Report on Socio-Economic Survey. Prepared for Nippon Koei Co., Ltd. Vientiane: Lao PDR, Nam Ngiep Hydroelectric Project. March.
- Taki, Y. 1974. Fishes of the Laos Mekong basin, USAID Mission to Laos, Agriculture Division, Vientiane, 232

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