LAO PEOPLE'S DEMOCRATIC REPUBLIC
Peace Independence Democracy Unity Prosperity

Ministry of Agriculture and Forestry
National Agriculture and Forestry Research Institute

Study on the loss of biodiversity and its causes in freshwater habitats in Nam Pa in Phonxai District

Final Report

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iii. Abbreviations

DAFO	District Agriculture and Forestry Office
FCA	Fish Conservation Area
FIPD	Forestry Inventory and Planning Division
IPM	Integrated Plant Management
LARReC	Living Aquatic Research Centre of NAFRI
LSUAFRP	Lao-Swedish Upland Agriculture and Forestry Research Programme
MRC	Mekong River Commission
NAFReC	Northern Agriculture and Forestry Research Centre
NAFRI	National Agriculture and Forestry Research Centre
NTFPs	Non Timber Forest Products
WCS	Wildlife Conservation Society

1. BACKGROUND

All over the rural communities of Laos there are some basic food elements like rice, non-timber forest products (NTFPs) and fish.

The observation of the river's fish population seems to have big importance because of its role in its ecosystem. These creatures are one of the most visible bonds between nature and human society, with the loss of the species there will be a reduction in biodiversity and in the human food sources as well.

As volunteers (from Szent István University, Gödöllő, Hungary, Department of Agricultural and Environmental Sciences) we spent our practice in Laos to undertake a fish survey in the valley of Nam Pa. Beside the identification of freshwater fish species we intended to examine the events in its complexity. We tried to find the relations between the life of rural settlements, infrastructure, agriculture development and environment.

„*Wild capture fisheries:*

(…)

- *Poverty alleviation and food security*
- *Wildlife and forest conservation through their provision as a food source*
- *Gender equity through the importance of the role of both women and men in collection*
- *Sustained livelihoods through important contributions to family income*
- *Community health as a vital source of dietary animal protein…"*

*(**Mark Dubois, Khamsai Inthavong, Rachel Barden:** Integrating Local Knowledge in Aquatic Resource Management-Terraqua TEK)*

2. OBJECTIVES

Objective was to gather information on fish species and prepare a simplified environmental impact assessment of Nam Pa and to determine all possible effects inlfuencing the fish stock's in the river.

Effort was made to create a list of native species that are found in the target river section.

3. MAIN TASKS

During our multipurpose fieldwork in Phonxai District we tried to focus on the following tasks:

Identification of fish species in Nam Pa

The observation and the exact identification of the local fish species are the most important tasks of all at the beginning of the fishery survey and biodiversity research. Without these useful data it is hard to undertake various research methods.

Determine the abundance of the species in recent past/present and the description of fish population changes

The goal was to determine the abundance of the various fish populations with subjective, participatory methods, in which the people of the target area had to be involved.

Description of the potential environmental impacts on the river

Including the potential social, infrastructure, economical and ecological impacts on the river and its surrounding environment.

Recommendations for sustainable water management

Some thoughts and ideas to solve problems and conserve the indigenous fish species in the river. Potential follow-up study topics to accomplish the future sustainable management of the valley.

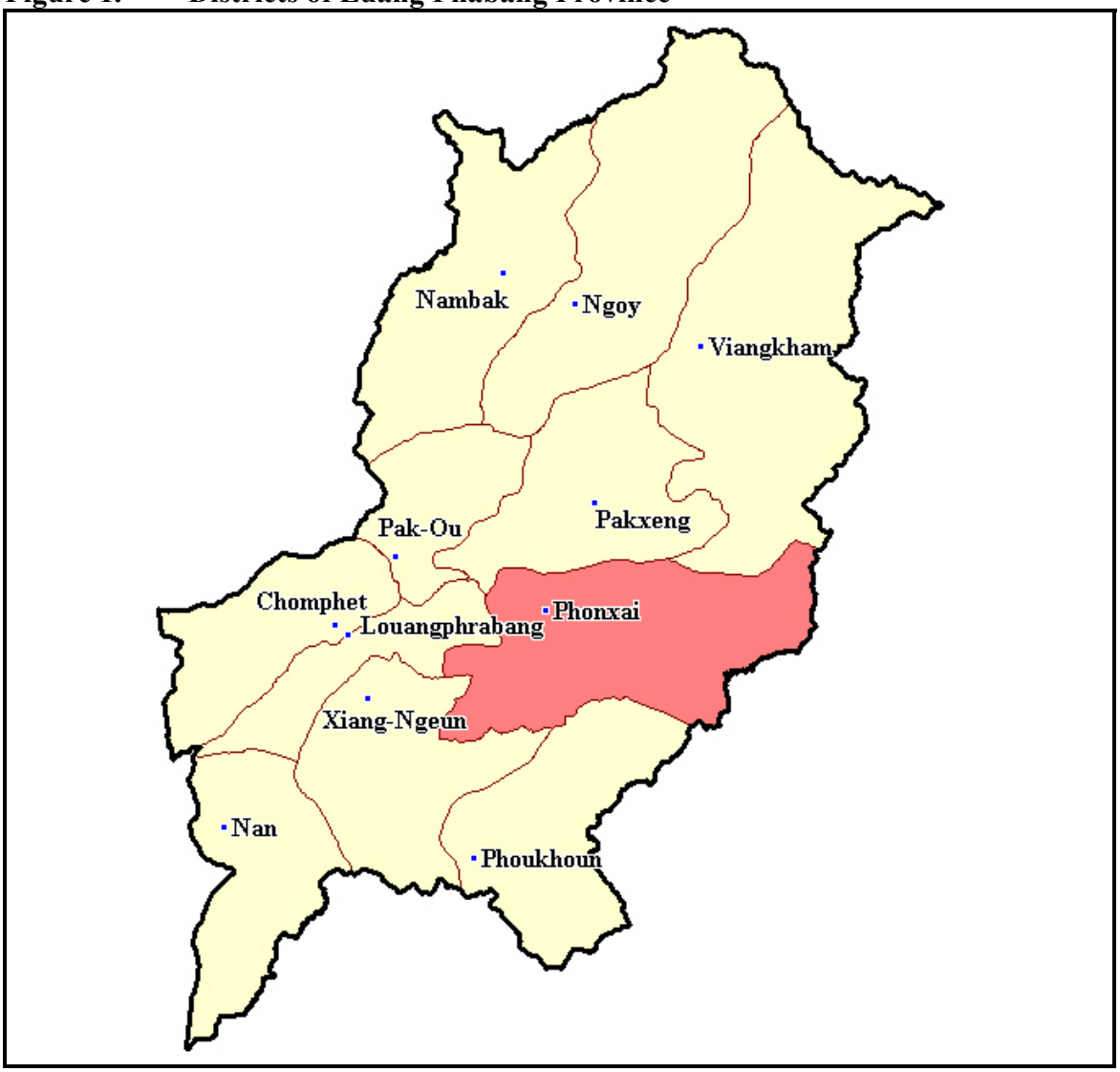
4. SCOPE

The study area is located on the Northeast of Luang Phabang about 46-50 km-s away.

The researches were carried out in Luang Phabang Province, Phonxai District, in the valley of Nam Pa including the river section of four villages: Ban Huayman, Ban Nambo, Ban Thapothai, Ban Thaponue.

The examined river, Nam Pa is a tributary of Nam Xuang and confluences with it shortly before that arrives to the Mekong (Nam Khong).

Figure 1. Districts of Luang Phabang Province



5. METHODOLOGY

The following participatory methods were used to fulfil the tasks mentioned above:

1. Collecting specimens from Nam Pa.
2. Individual interviews with fishermen and -women within four villages about fishes and social questions. Person for the interviews were choosen random at each villages at any time of the day.
3. Individual interviews with local inhabitants (including men participated at the construction of the district's road) about infrastructure, agriculture and population concentration of the valley.
4. Interviews with group of villagers about fishes.
5. Survey of fish supply at local markets.

5.1. Collecting specimens from Nam Pa

Village people were asked to bring their daily catching to the field office, where they were offered to sell the fish. Fishermen were asked to fish with different kind of techniques, at different parts of the day. With this (random sampling) method we tried to get as many species as possible from all kind of underwater habitats of the river. This has resulted that not only the most common fishes were brought to the field office, but various species.

After these usually morning procedures we spent our time identifying the fishes. In some special cases, when the precise identification of the samples were beyond our knowledge descriptions were made and the most important information were recorded (e.g. species of the *Schistura* genera).

Materials: Field guides, pens, baskets, trays, notebooks, pen

5.2. Individual interviews with fishermen and -women about fish and social questions

- 15 individual interviews all together in four villages: Ban Huayman, Ban Nambo, Ban Thapothai, Ban Tahponue
- both men and women involved
- from all ethnic groups: Lao Lhoum, Khamou, Hmong

These interviews were meant to find out as much as possible about:

- traditional fishing techniques and gears
- fishing habits
- consumption habits of the valley's population
- how people think about the conservation zones (these were marked by the villagers)
- environmental, social and infrastructure changes

Pictures of the events (**„APPENDIX V."**) and, questionnaire form (**„APPENDIX VI."**) are attached to this report.

Materials: Questionnaires (printed before), pens

5.3. Individual interviews with inhabitants of the valley

Farmers, men from the former road construction, fishermen, chiefs of villages, women at markets were random asked about infrastructure, agriculture and population concentration of the valley. There were no questionnaires prepared before and questions drafted. With the help of an interpreter we tried to find out the thoughts, problems of the „every-day" people inhabiting the valley. There was always a well defined focus point about the topic which the interviewer was interested in, in these „more friendly, than scientific" conversations.

5.4. Interviews with group of villagers

This method was used to find out how the fish populations changed within one or two decades. The method is a bit subjective, because it compares the past and present

situation by the villagers' memory. However it is good to get information about a river's earlier fish population which was never observed before. Having any data from the past we found useful data collected through the memories and experience of the village's regularly fishing inhabitants from the former conditions.

The chief of the villages was kindly asked to organise a group of men and women. The groups were „mixed", in terms of age and ethnical affiliation. We carried out two interviews with the same target group in each village, one from the present conditions and a second one to describe the past.

Big cards with drawings for the abundance (most abundant, abundant, less abundant, non-available) and little ones with the names of fish species (in Lao and Latin) were prepared. The group could discuss of each species when putting the name card on the abundance card.

After we recorded the results, we mixed all name cards, changed the row of the abundant cards and asked the people to describe the conditions of the past by placing the name cards on the adequate abundant card. While recording the results most of the people were complaining about the changes and were telling stories on big catches.

Observing the exercise from outside it seemed that most of the participants enjoyed this way of *„communicating information"*.

Pictures, images of the interviews at **„APPENDIX V."**.

Materials: Cards showing the abundance (with drawings), name cards for all species, pens, sheets to record the information

5.5. Survey of fish supply in the local markets

There was no fish on sale at the Nambo Ten Day Market, so it was not possible to collect species. This also means that fishing in the valley is not a type of marketing activity, people fish for self-consumption and to entertain themselves. Because of the important role of the fish in the families diet its shortage must be complemented with other kinds of products, especially rice and vegetables which are grown in river bed gardens or on hillside. Although the missing quantity (but not quality) can be replaced by different

types of plants, these are not suitable to complement animal protein. In this case the consumption of NTFPs is a possibility.

6. DATA COLLECTION AND PROCESSING

6.1. Fish taxonomy

The survey was carried out in Phonxai District, Luang Phabang Province. All specimens were collected from fishermen along Nam Pa between the end of April and the middle of May. Two relevant field guides (Rainboth[1996], Kottelat[2001]) were at our disposal to help in identifications. Although first we tried to compare the Lao names with lists from other studies carried out earlier on the Mekong in the southern part of the country. This comparison failed because of the probable differences in dialects between the South and the North.

The table below contains the observed fish species in alphabetical order according to Lao names:

Table 1. Species list

	LAO NAME	***SCIENTIFIC NAME***	***Comments***
1.	PA BE	*Hypsobarbus lagleri* **or** *Acheilognathus deignani*	
2.	PA BHOUK	*Cirhhinus cirrhosus*	*
3.	PA BOU	*Rhinogobius spp.*	*Identification was only possible at genera level*
4.	PA CHAT	*Poropontius(angustus?) spp.*	
5.	PA CHAT NU KHAO	*Tor spp.*	*
6.	PA DUK	*Clarias batrachus*	
7.	PA DUK NONG	*Amblyceps serratum*	
8.	PA HIAN	*Tor (tambroides?)spp.*	
9.	PA IAN	*Monopterus albus*	** , but can not be confused*
10.	PA IANG	*Pseudomystus siamensis*	*
11.	PA KANG	*Channa gachua*	**
12.	PA KHAN HAO		*Just Lao name, no other information*
13.	PA KHAN LAI	*Opsarius pulcherus*	
14.	PA KHAO	*Channa micropeltes*	*
15.	PA KHE	*Glyptothorax (macromaculatus?)spp.*	
16.	PA KHE NOI		*The juveniles of Pa Khe*
17.	PA KHO	*Channa striata*	*
18.	PA KHOM	*Hampala macrolepidota*	
19.	PA KING	*Onychostoma gerlachi*	

20.	PA KOT	*Hemiobargus nemurus*	
21.	PA KUAN	*Channa spp.*	*
22.	PA LAT	*Mastacembulus armatus*	*The biggest examined fish was 220mm long*
23.	PA MAN	*Mekongina erithrospila* **or** *Garra fascicauda*	*Different name depending on size*
24.	PA TYAI		
25.	PA MOM	*Scaphiodonichthys acanthopterus*	
26.	PA MON	*Hemibarbus labeo*	
27.	PA NAM	*Mystacoleucus spp.*	*More different species under the same name*
28.	PA PHE	*Homaloptera yunnanensis* **or** *Vanmanenia spp.*	*Unfortunately there were no photo taken*
29.	PA PHAN	*Schistura spp.*	***
30.	PA PHAO	*Bangana lippus*	
31.	PA VA		*Just Lao name, no other information*
32.	PA PHUNG		
33.	PA SUBLEM	*Xenotodon canciloides*	

** It was not possible to observe the species during the field activities, only fishermen mentioned the Lao name, and showed the possible fish species on pictures*

*** We couldn't give an exact identification of the specimen collected, because there was always one single difference according to the books „Fishes of Laos" and „Fishes of the Cambodian Mekong".*

The anal fin of the fishes had a whitish-yellowish marginal line, not red as mentioned in the books. All the examined fish specimen (size between 82mm and 240mm, n=8) had the red marginal line on all fins, except the anal.

**** see description below*

Fish taxonomy experts[1] checked and evaluated our identification afterwards.

Because of the overlap between the Lao and Latin (scientific) names it is hard to determine the exact number of the observed species. 33 Lao names were mentioned during fieldwork. About one third of the fishes were identified on species level and about

[1] Mr. Kongpheng Bouakhamvongsa (MRC,Assessment of Mekong Fisheries Component, National Officer)
Mr. Maurice Kottelat (Author of fieldguide *Fishes of Laos, 2001*)

quarter of them on genera level. The remaining names include species which are very difficult to identify or simply we have never seen any specimen.

•33 Lao names ≠ 33 different species
•1 Lao name can cover more species with very similar appearance
pa phan = 4 species from the **Schistura** genera
pa bhou = different species from the **Rhinogobius** genera
more than one Lao name for the same species with a different size or sex
pa tyai = **Garra fasciacauda juv.**
pa man= **Garra fasciacauda add.**

The description of the specimen groups evaluated from the *Schistura* genera:

Four, potentially different species from the Schistura genera as follows:

1. *Schistura bucculenta? Unfortunately there was no photo taken because of the very bad condition of that single specimen we have seen during field activities*
2. *PaPhan_a: (n=30) (Schistura porthos* **or** *procera?)*
    - *Big, well patterned head, with eyes on the top*
    - *Body slender properly patterned with parallel, well-contrasted bars*
    - *Bars on body are wider than interspaces, 12-15 bars*
    - *Pectoral fin: yellowish, pointed, with red margin (9-10 rays)*
    - *Ventral fin: yellow , pointed (6 rays)*
    - *Anal fin: homogenous yellow with red margin*
    - *Caudal fin: homogenous red, last black bar at the base connects the ventral part with the caudal (full)*
    - *Dorsal fin: red margin, well-defined red spot at the base of the first (and second) ray (9 rays)*

3. *PaPhan_b: (n=28)*

- *Head not patterned, well-defined line connects the upper lips with the eyes*
- *Body slender, patterned with unparalleled, not contrasted bars*
- *Interspaces wider than bars*
- *Pectoral fin: whitish-yellowish with no margins, pointed*
- *Ventral fin: whitish-yellowish with no margins*
- *Anal fin: whitish-yellowish with no margins*
- *Caudal fin: homogenous red, last black bar at the base connects the ventral part with the caudal (full), but the colours are more definite*
- *Dorsal fin: black spot at the base, followed by a red one*

4. *PaPhan_c: (n=25)*
    - *More slender head with thin line connecting upper lips with the eyes*
    - *Body with well-defined black bars, 6-8 bars on body*
    - *The wideness of the bars decrease in caudal direction*
    - *Pectoral fin: homogenous yellowish*
    - *Ventral fin: homogeous yellowish*
    - *Anal fin: homogenous yellowish*
    - *Caudal fin: wide red margin on upper and lower part, strong, wide black line on the base and in the middle of the fin*
    - *Dorsal fin: yellowish fin with black line on base and middle*

These data might help experts in the later identification, if needed. The images of specimen are included under **„APPENDIX I."**.

The most complicated species were gathered and preserved with the prescribed methods given in scientific bibliography. These were studied by ichthyologist in Vientiane at the Mekong River Commission at LARReC and some specimen still remains there.

The photographs attached to this report were also evaluated by ichthyologist Mr. Maurice Kottelat in Switzerland.

6.2. Individual interviews – focus on social questions

The followings were included on the questionnaire (see "**APPENDIX VI.**" for the complete form):

In this chart we gathered all-important information from the questionnaires. These data show the fishing and consumption habits of a narrow cross-section of the valley's inhabitants.

Table 2. Fish consumption changes in Nam Pa valley

Nr.	Village	Ethnic group	Present	
			Duration	Nr. of meals
1.	Huay Man	Khamou	30 min.	1-2
2.	Huay Man	Khamou	1-2 h	1-2
3.	Huay Man	Khamou	3-4 h	2
4.	Nambo	Khamou	2 h	1-2
5.	Nambo	Hmong	4 h	5
6.	Tapo Nue	Khamou	2-3 h	1-3
7.	Tapo Nue	Lao Lhoum	1-2 h	1-2
8.	Tapo Nue	Lao Lhoum	3 h	1
9.	Tapo Nue	Khamou	2-3 h	1
10.	Tapo Nue	Lao Lhoum	2-3 h	1
11.	Tapo Thai	Lao Lhoum	2-4 h	3
12.	Tapo Thai	Lao Lhoum	1-3 h	1-2
13.	Tapo Thai	Lao Lhoum	1 h	1
14.	Tapo Thai	Khamou	2-3 h	-
15.	Tapo Thai	Lao Lhoum	2-3 h	2

Nr. of meals = meals covered by the fish caught within one day

Duration = the time spent for fishing within one day

The answer for the questions *„Are there any protected areas nearby?”* and *„Do you know about the fishing prohibition in those areas?”* were always the same. 100 percent answered *„Yes”*. The people were always complaining about the reduction in the size and amount of the fish, it is evident why, if we have a closer look on the answers of the following two questions: *„Is there a change in the amount of fish since the Revolution (1975)?”* and *„Is there a change in the size of the fish since the Revolution (1975)?”*. There were 15 *„Yes”*-s from 15 different aged, sexed people. Although not all the of the questioned ones had a long past in fishing experience at Nam Pa. The following chart contains the answers of the question *„For how many years have you been fishing here?”*.

Table 3. Age and sex distribution of the interviewed person at Nam Pa valley

Nr.	Sex of the interviewed person	Period of fishing activity in the region in years
1.	Male	33
2.	Male	2
3.	Female	20
4.	Male	22
5.	Male	7
6.	Male	20
7.	Male	25
8.	Male	1
9.	Male	10
10.	Female	15
11.	Female	11
12.	Male	30
13.	Female	30
14.	Male	5
15.	Female	12

It was very interesting that not only the elder ones had a bad experience about the loss of fish stocks. The young fishermen and –women told us the most about the negative changes and its potential causes. In all cases the road construction was mentioned as a well-defined point of reference in the past.

During our fieldtrip we found that people use different types of fishing gear depending on several different causes. There are differences between women, men and children, other

kinds of techniques are in use at night, noon or morning. We can also generate two groups of the gears depending on its tradition. For images see „**APPENDIX III.**".

Table 4. Use of different fishing gears

				NETS			BASKET TRAPS				
	S	Ch	E	CN	LN	TN	FaT	FuT	Lan Ko	R&H	H
Women		-	-		X	X	X	X	X		
Men	X	-	-	X	X		X	X		X	X
Children		-	-			X	X	X		X	
Traditional				X	X	X	X	X	X	X	
Untraditional	X	X	X								X
Day	X			X	X	X	X	X	X	X	X
Night				X	X	X	X	X			X

Table 5. Relation between caught fishes and used fishing gears/techniques

LAO NAME	S	Ch	E	CN	LN	TN	FaT	FuT	Lan Ko	R&H	H
PA BE	X			X		X					X
PA BHOUK					X					X	
PA BOU						X			X		
PA CHAT	X			X	X	X				X	X
PA CHAT NU KHAO	X			X	X					X	X
PA DUK	X			X	X	X		X		X	X
PA DUK NONG	X			X		X				X	X
PA HIAN	X			X	X	X				X	X
PA IAN										X	
PA IANG	X			X	X	X		X		X	X
PA KANG	X			X		X				X	X
PA KHAN HAO **?**											
PA KHAN LAI						X				X	
PA KHAO	X			X		X				X	X
PA KHE	X			X	X	X				X	X
PA KHE NOI	X			X	X	X				X	X
PA KHO	X			X		X				X	X
PA KHOM	X			X	X	X					X
PA KING	X			X	X	X		X		X	X

PA KOT	**X**			**X**	**X**	**X**		**X**		**X**	**X**
PA KUAN	**X**			**X**		**X**	**X**			**X**	**X**
PA LAT	**X**			**X**	**X**	**X**				**X**	**X**
PA MAN	**X**			**X**	**X**	**X**		**X**		**X**	**X**
PA TYAI	**X**			**X**	**X**	**X**		**X**		**X**	**X**
PA MOM	**X**			**X**	**X**	**X**					**X**
PA MON	**X**			**X**	**X**	**X**					**X**
PA NAM											
PA PHE						**X**					
PA PHAN						**X**					
PA PHAO	**X**			**X**	**X**						**X**
PA PHUNG	**X**			**X**	**X**						**X**
PA SUBLEM	**X**			**X**	**X**						**X**
PA VA **?**											

Abbreviations: S-snorkel; Ch-chemicals; E-explosives; CN-circle net; LN-long net; TN-triangle net; FaT-„Falling door" traps; FuT-funnel traps; R&H-rod and hook; H-harpoon

a) Snorkel and harpoon: these untraditional equipment helps the fishermen, and it is usually used by the younger boys only, to observe the river bed before throwing the circle net in the water or it is used directly at diving with home-made harpoons, it increases the efficiency of fishing in the turbid, muddy river

b) Chemicals and explosives: artificial products and tools brought to the valley during the construction of the road

c) Circle net: called ***he*** in Lao, it is a piece of net with weights applied on the margins, the most popular fishing gear among the people usually used by men only

d) Long net: a piece of linear net used to catch a bigger amount of fish by encircling a section of the river

e) Triangle net: called ***sa ving*** in Lao, it is a piece of net applied on a triangle wooden frame, usually used by women an children to scrape the river bottom; both suitable to catch fish and other aquatic animals

f) Basket traps: two types funnel (called ***lop***) and „falling door" traps made of bamboo and parts of trees, these are applied either on the bottom of the river or on bamboo rods and are left for the night with different baits in it
g) Rod and hook: usually a bamboo rod with a steel hook applied on a piece of string used with different types of baits used both at strong currents and calmly pools of the river
h) Lan Ko: a special and unique way of fishing. Usually women from the same village gather at the riverbank and apply a long and thick roller out of fresh pieces of wood. Later this will fill the role of a dam which makes the water run faster than it would do normally. They all stand in the river next to each other forming a well-regulated line. Their back faces upstream and by holding the roller at their ankle they provide turbulence and a fast run-over. The triangle nets are held before the roller so the fishes are washed in the triangle nets by the strong current.

Little woven baskets are the containers for little sized fishes caught during fishing. This basket is suitable to hold fishes alive. People in the river let the basket sink underwater time by time, this supplies fresh water for fishes in the container. Fishermen who fish a longer section of the river can bring this basket with them by fastening it on their waist. These fishing equipment are made at home or it can be bought at Phonxai at some vendors for about 5.000 Kips (app. 0,5 USD).

During the time period between 1995 and 2002, when the new road was under construction along the river valley, people were using explosive (dynamite) to fish. Besides the poisons this is the most dangerous way of fishing. Poisons (artificial chemicals brought outside of the valley) destroy all kinds of living organism in and usually along the river while it is washed downstream. The explosive might destroy the river bed it-self and changes the habitats. During our study at Phonxai fortunately we have not seen such things only heard about it.

Worms, caterpillars, eggs of ant species, little fish, frogs, leafs of relevant trees and barbecued or fried corn are used on hook as bait, or put in the basket traps for the night. People use lamps at night-time fishing to allure fish to the surface.

The usage of snorkel both with *he* net or harpoon is a very evident example how modern, untraditional techniques spread among the people. Fishermen are very keen on having a snorkel because the underwater observation of the fish increases the efficiency of the catching. Those who can't afford having one are „thrown to the back" in the race for food.

Through the centuries, rural societies developed all kinds of fishing gears to be able to catch the different species inhabiting the various underwater habitats of the rivers. The acceptance of this fact should have priority in fish conservation plans afterwards.

6.3. About the Fish Conservation Areas (FCA)

Each village has allocated a few hundred meters section of the river and proclaimed as a FCA. These sections usually starts upstream, at the top of the village and lasts few meters down streams by the end of the settlement. These FCA are usually marked by old trees or by specific morphological elements in the river bed. There is no man-made sign which would mark these sections for foreigners. These areas are left to nature, there aren't any kind of artificial treatments as far as we discovered. No one is allowed to fish there, although we regularly found people pulling their nets few meters in the area. The chief of the village's has the right to decide about an occasionally fishing if the community receives guest from other villages.

Unfortunately the caught species can be determined as „data deficient" or „not evaluated" species, so there is a shortage of information on the migration and reproduction habits. But in some cases the migration is proved in the breeding period or it is related with the seasonal changes in the region (e.g. the start or the end of the rainy season indicates movements from rivers to smaller creeks, or from/to paddy fields).

Few hundred meters long FCA-s along the villages most probably cannot fulfil the role of a real conservation zone because of the migration habits. To ensure the proper allocation of FCAs further fish biological researches are required in cases of many species.

6.4. Studying the effect of rural development on fish populations

6.4.1. Effect of simple hydropower dams

Each village had decided to build simple wood structure dams on the river to generate hydroelectric power. There seem to be a significant relation between the number of dams and the number of households. The little villages usually have 2-4, while upstream and downstream at the District Centre the number of dams reaches 25. These are little household generators applied on wood structures to supply some houses with electricity after sunset. In the centre of the district these generators are in use all day long to serve some television besides the lights. The generators are imported from China and are on sale in bigger cities (e.g. Luang Phabang) or in district centres like Phonxai, where salesmen ask about 750.000 Kips (app. 75 USD) for each.

Dams create an inaccessible barrier, preventing fish (especially juveniles) from moving or migrating freely along the river. The structures are erected 70 to 150 centimetres above the water level, according to the conditions of the dry seasons. Presumably not all these structures survive the heavy flood during the rainy seasons. Further study is needed assess and compare the different situation in the two seasons. In the case of those surviving the floods in the rainy seasons a „fish-friendly" forming fish-steps would be a good solution.

At „**APPENDIX IV.**" the original image and translation of the generator's parameters is attached to the report.

6.4.2. Effect of road construction

The road construction provided easy access to the river valley and fosters the expansion of the settlements along the riverside.

According[2] to some researches of the LSUAFRP some villages have doubled themselves in short time and many families moved from the hillsides to the valley bottom and to other districts. The growth of the human population has an unknown effect on the surroundings in terms of the river ecosystem. Overfishing, the increase of pollution level, the growth of plantation connected with inconsiderate usage of chemicals (herbicides), more intensive land use in shifting cultivation might all be a source of danger for natural environment.

Following table contains the number of households, and the village population of the target area. Data are cited from *„Report on the diagnostic survey in Phonsay District (draft), 2003"* (Ministry of Agriculture and Forestry, NAFRI, LSUAFRP Socioeconomics Component) and show the conditions from 2003.

Table 6. Data on villages' population

Village	Ethnic groups	Households	Estimated village population
Ban Huayman	Hmong, Khamou	51	365
Ban Nambo	Hmong, Khamou, Lao Lhoum	55	393
Ban Thaponue	Lao Lhoum	118	844
Ban Thapothai			

6.4.3. Effect of fishponds

Most of the villages own a little pound, where villagers are breeding introduced fish species and not natives. Native species should have priority in fish breeding plans to avoid harmful effects on the local fish populations and river's fauna and flora. For example in Ban Nambo the connection between the pound and river is just a little underground filtration at a depression of the soil. Fortunately it is impossible for juveniles to get in the river, although some fishermen reported about *pa nin* and *pa nai,* which are said not to be native species.

6.4.4. Study on the effect of herbicides

According to an interviewed Hmong farmer in Ban Nambo on the 5th of May 2004:

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2 Field report on Land Use Planning and Land Management Activities in Phonsay District, Land Management Component (19-31 May 2003), NAFRI, LSUAFRP

The farmer cultivates Job's tear near his village downstream the river. In lack of human labour he uses herbicides to fight against an aggressive weed.

The chemical is on sale at Luang Phabang and imported from Thailand where it is produced by Monsanto. There is no users' instruction attached to the product. Only the salesman can give advice about the usage of the chemical. One bottle costs 60.000 Kips (little less than 6 USD)

They mix 1 litre of the herbicides with 60 to 80 litres of water. The number of bottles utilised in one vegetation period depends of the farmer's opinion. The man mentioned above used 4 bottles on his plantation, which is 0,7 ha-s big. This chemical pronounced „Round Up" is the most popular (also known and utilised in Europe and USA), there are others used by village people but they couldn't remember the name. April is the month of spraying. Usually heavy rainfalls arrives shortly after the spraying season that washes the herbicides into the river and effecting the aquatic fauna.
We have been told that men using this chemical are aware of its danger and they don't wash the empty bottles in the river but burning them. The handling of this chemical requires protecting gear for its user. Spraying people did not wear anything besides a paper mask.
People use buffalo and goat dung in vegetable plantation, but these dung contain the seeds of the weed.

The most popular herbicide contains the following materials (see **„APPENDIX II.**"):

- N-(phosphonomethyl), glycine, isopropylamine, salt 48% , beside these data everything was written in Thai

6.5. Data processing from group interview to determine trends of past decades

We are able to estimate the changes of the fish populations by comparing and processing the results of the group interviews. Although the statistical analyses has not been done,

the results indicate the decrease of fish resources. More data and an additional direct sampling study are required to justify a significant decrease. The outcome of interviews is listed below with additional graphics. From the graphics it is possible to read the trends.
The gray columns show the change in fish species caught in the present. According to the researches undertaken in the villages it seems that the quantity of the most abundant and abundant species decreased, while the number of non-available ones increased comparing with the past (first two columns). The differences are 5 (Ban Thapothai), 2 (Ban Nambo), 3 (Ban Thaponue), 2 (Ban Huayman).
The most visible change appears in form of 14 species at the results of the interview in Ban Thapothai, where there are huge differences between the most abundant species now and in the past (present: 4 species mentioned, past: 18 species mentioned).

6.5.1. Ban Thapothai

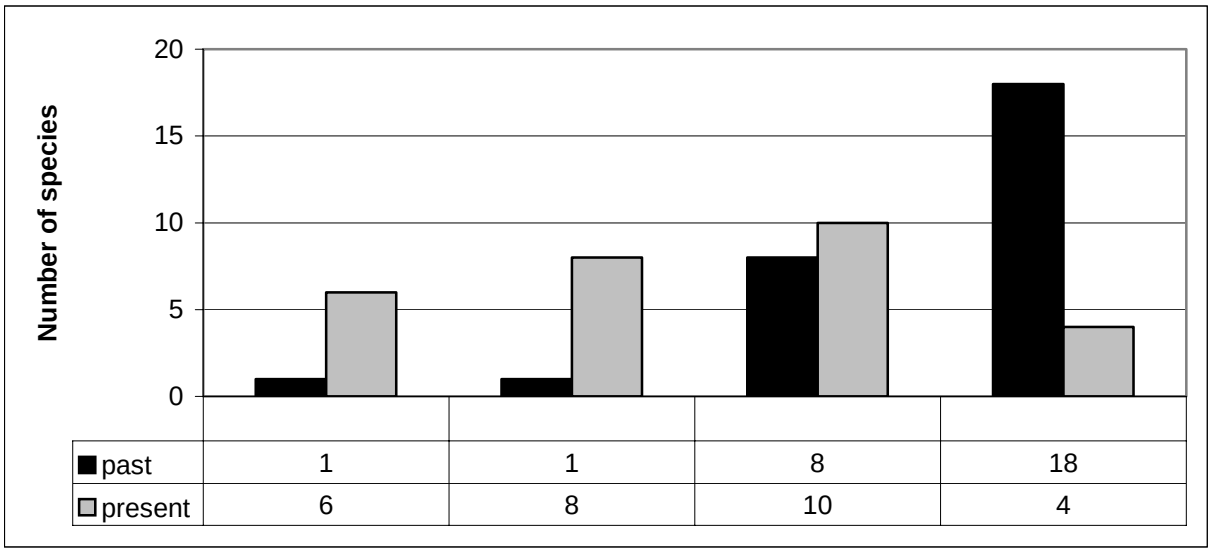
The group interview has been carried out in Ban Thapothai on 22nd of April 2004.

Table 7. Results from Ban Thapothai

PRESENT			
NON-AVAILABLE	**LESS ABUNDANT**	**ABUNDANT**	**MOST ABUNDANT**
Pa khan hao	*Pa khe noi*	*Pa nam*	*Pa tyai*
Pa bhouk	*Pa kho*	*Pa mom*	*Pa phan*
Pa phung	*Pa sublem*	*Pa kang*	*Pa bou*
Pa khao	*Pa ian*	*Pa lat*	*Pa chat*
Pa khe	*Pa chat nu khao*	*Pa king*	
Pa kuan	*Pa kot*	*Pa khan lai*	
	Pa phao	*Pa be*	
	Pa khom	*Pa duk*	
		Pa man	
		Pa hian	
PAST			
NON-AVAILABLE	**LESS ABUNDANT**	**ABUNDANT**	**MOST ABUNDANT**
Pa khao	*Pa chat nu khao*	*Pa khe*	*Pa khan hao*
		Pa duk	*Pa nam*
		Pa phung	*Pa khe noi*
		Pa kot	*Pa man*
		Pa bhouk	*Pa hian*
		Pa ian	*Pa kang*
		Pa sublem	*Pa khan lai*
		Pa kho	*Pa bou*

			Pa phan
			Pa phao
			Pa be
			Pa tyai
			Pa kuan
			Pa lat
			Pa king
			Pa khom
			Pa mom
			Pa chat

Figure 2. Diagram of the group interview from Ban Thapothai



6.5.2. Ban Nambo

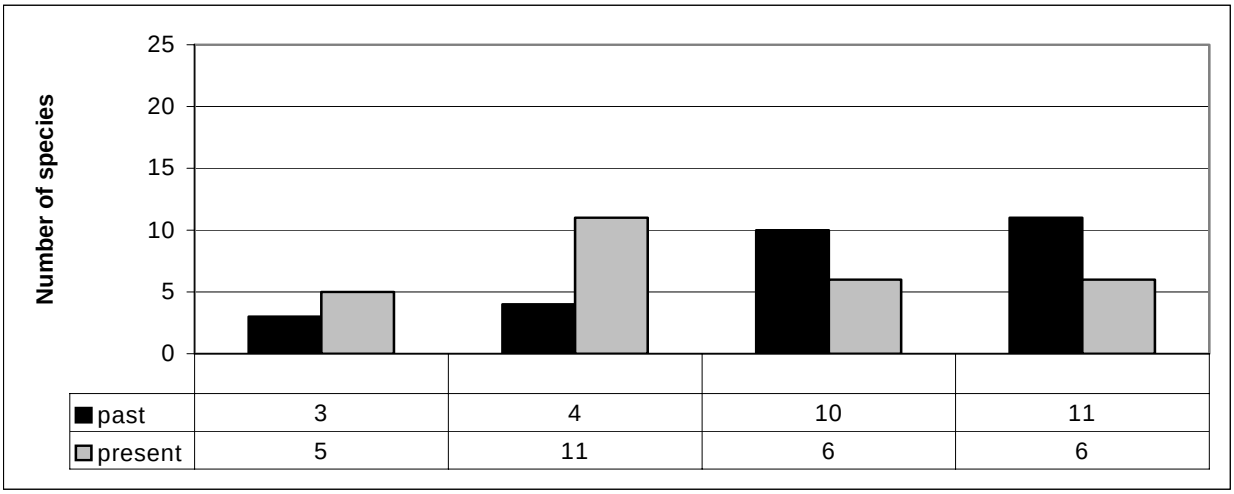
The group interview has been carried out in Ban Nambo on 28th of April 2004.

Table 8. Results from Ban Nambo

PRESENT			
NON-AVAILABLE	**LESS ABUNDANT**	**ABUNDANT**	**MOST ABUNDANT**
Pa khao	*Pa khom*	*Pa nam*	*Pa bou*
Pa phung	*Pa sublem*	*Pa mom*	*Pa phan*
Pa bhouk	*Pa ian*	*Pa man*	*Pa kang*
Pa khan hao	*Pa kot*	*Pa tyai*	*Pa chat nu khao*
Pa khe	*Pa kho*	*Pa khan lai*	*Pa king*
	Pa lat	*Pa hian*	*Pa chat*
	Pa kuan		
	Pa khe noi		
	Pa be		
	Pa duk		
	Pa phao		
PAST			
NON-AVAILABLE	**LESS ABUNDANT**	**ABUNDANT**	**MOST ABUNDANT**
Pa bhouk	*Pa phao*	*Pa khe noi*	*Pa king*
Pa khao	*Pa kot*	*Pa sublem*	*Pa mom*
Pa phung	*Pa kuan*	*Pa khan lai*	*Pa man*
	Pa khe	*Pa lat*	*Pa be*
		Pa duk	*Pa bou*
		Pa ian	*Pa phan*
		Pa hian	*Pa nam*
		Pa khan hao	*Pa kang*

		Pa kho	*Pa chat nu khao*
		Pa khom	*Pa tyai*
			Pa chat

Figure 3. Diagram of the group interview from Ban Nambo



6.5.3. Ban Thaponue

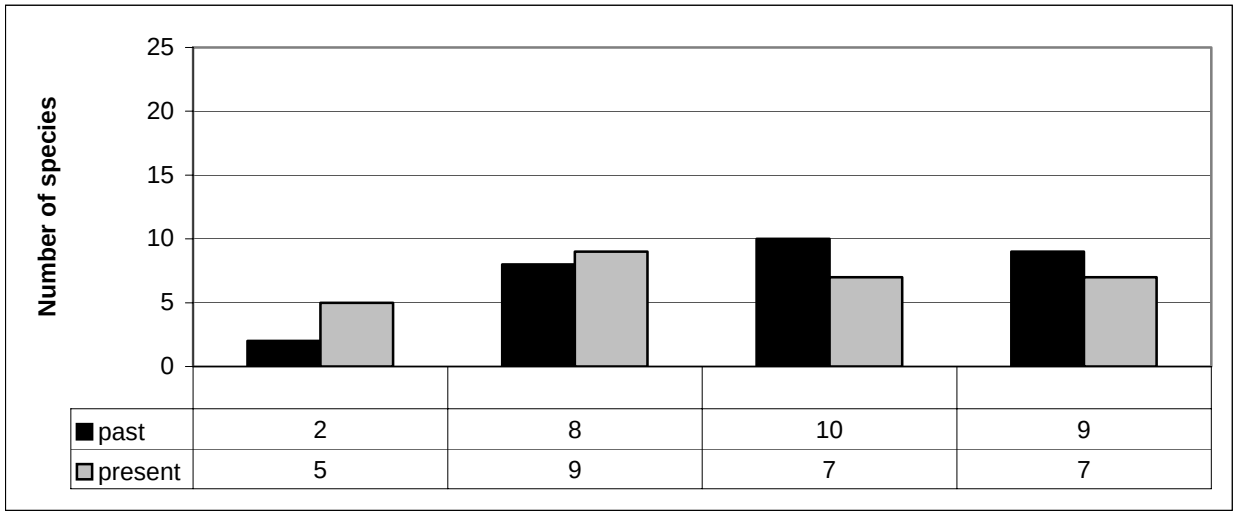
The group interview has been carried out in Ban Thaponue on 29th of April 2004.

Table 9. Results from Ban Thaponue

PRESENT			
NON-AVAILABLE	**LESS ABUNDANT**	**ABUNDANT**	**MOST ABUNDANT**
Pa khe	*Pa khe noi*	*Pa nam*	*Pa khan lai*
Pa phung	*Pa phao*	*Pa mom*	*Pa man*
Pa bhouk	*Pa kho*	*Pa hian*	*Pa lat*
Pa khao	*Pa kuan*	*Pa bou*	*Pa kang*
Pa chat nu khao	*Pa kot*	*Pa ian*	*Pa tyai*
	Pa khom	*Pa be*	*Pa phan*
	Pa sublem	*Pa duk nong*	*Pa chat*
	Pa king	*Pa duk*	
	Pa khan hao		
PAST			
NON-AVAILABLE	**LESS ABUNDANT**	**ABUNDANT**	**MOST ABUNDANT**
Pa khao	*Pa khan hao*	*Pa duk nong*	*Pa khan lai*
Pa chat nu khao	*Pa kua*	*Pa bou*	*Pa hian*
	Pa kot	*Pa khe noi*	*Pa tyai*
	Pa bhouk	*Pa nam*	*Pa be*
	Pa kho	*Pa kang*	*Pa phao*
	Pa sublem	*Pa lat*	*Pa phan*
	Pa khe	*Pa king*	*Pa man*

	Pa phung	*Pa khom*	*Pa chat*
		Pa mom	*Pa ian*
		Pa duk	

Figure 4. Diagram of the group interview from Ban Thaponue



6.5.4. Ban Huayman

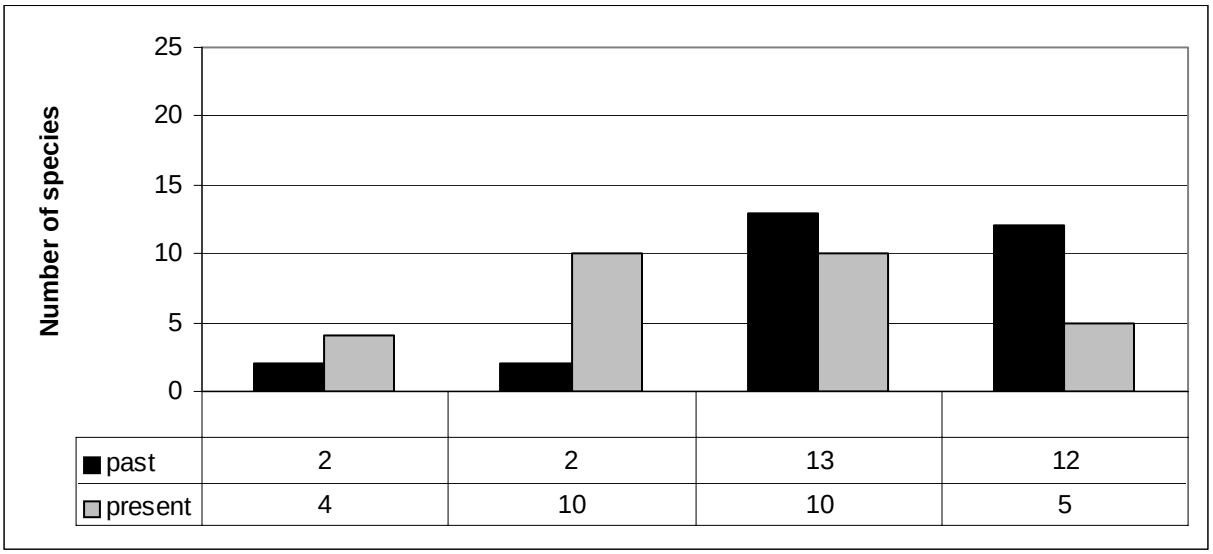
The group interview has been carried out in Ban Huayman on 30th of April 2004.

Table 10. Results from Ban Huayman

PRESENT			
NON-AVAILABLE	**LESS ABUNDANT**	**ABUNDANT**	**MOST ABUNDANT**
Pa chat nu khao	*Pa bhouk*	*Pa nam*	*Pa be*
Pa khan hao	*Pa bou*	*Pa sublem*	*Pa tyai*
Pa khao	*Pa duk nong*	*Pa khom*	*Pa kang*
Pa khe	*Pa khe noi*	*Pa khan lai*	*Pa phan*
	Pa phung	*Pa mom*	*Pa chat*
	Pa phao	*Pa hian*	
	Pa kuan	*Pa king*	
	Pa ian	*Pa lat*	
	Pa kot	*Pa duk*	
	Pa kho	*Pa man*	
PAST			
NON-AVAILABLE	**LESS ABUNDANT**	**ABUNDANT**	**MOST ABUNDANT**
Pa khao	*Pa khe*	*Pa bou*	*Pa nam*
Pa chat nu khao	*Pa kho*	*Pa be*	*Pa tyai*
		Pa bhouk	*Pa phan*
		Pa duk nong	*Pa khan lai*
		Pa lat	*Pa kot*
		Pa sublem	*Pa mom*

		Pa khan hao	*Pa kang*
		Pa phung	*Pa king*
		Pa khe noi	*Pa phao*
		Pa khom	*Pa hian*
		Pa kuan	*Pa nam*
		Pa duk	*Pa chat*
		Pa ian	

Figure 5. Diagram of the group interview from Ban Huayman



7. Analysis of results and evaluation of work

7.1. Identification of fish species in Nam Pa

We could identify the most important species according to the diet of the rural communities and according to their importance in this isolated natural environment. During our fieldwork we were studying about 30 species in the dry season. The identification work was based on two relevant books: *„Fishes of Laos"* (Kottelat, 2001) and *„Fishes of the Cambodian Mekong"* (Rainboth, 1996). After the fieldtrip, ichthyologist helped us to be able to properly identify the fish species.

Specimens were collected from all kinds of underwater habitats. The methods used by collecting the fishes are not suitable for further statistical analysis, the goal was to produce a list of species inhabiting the river at the time of research.

In the future statistically sound methods should be designed and used for fish sampling. The sampling should be carried out in the dry as well as in the rainy season. The comparison of the two datasets would show more realistic situation.

These are the first baseline data. On the basis of this it would be possible to work further on this issue.

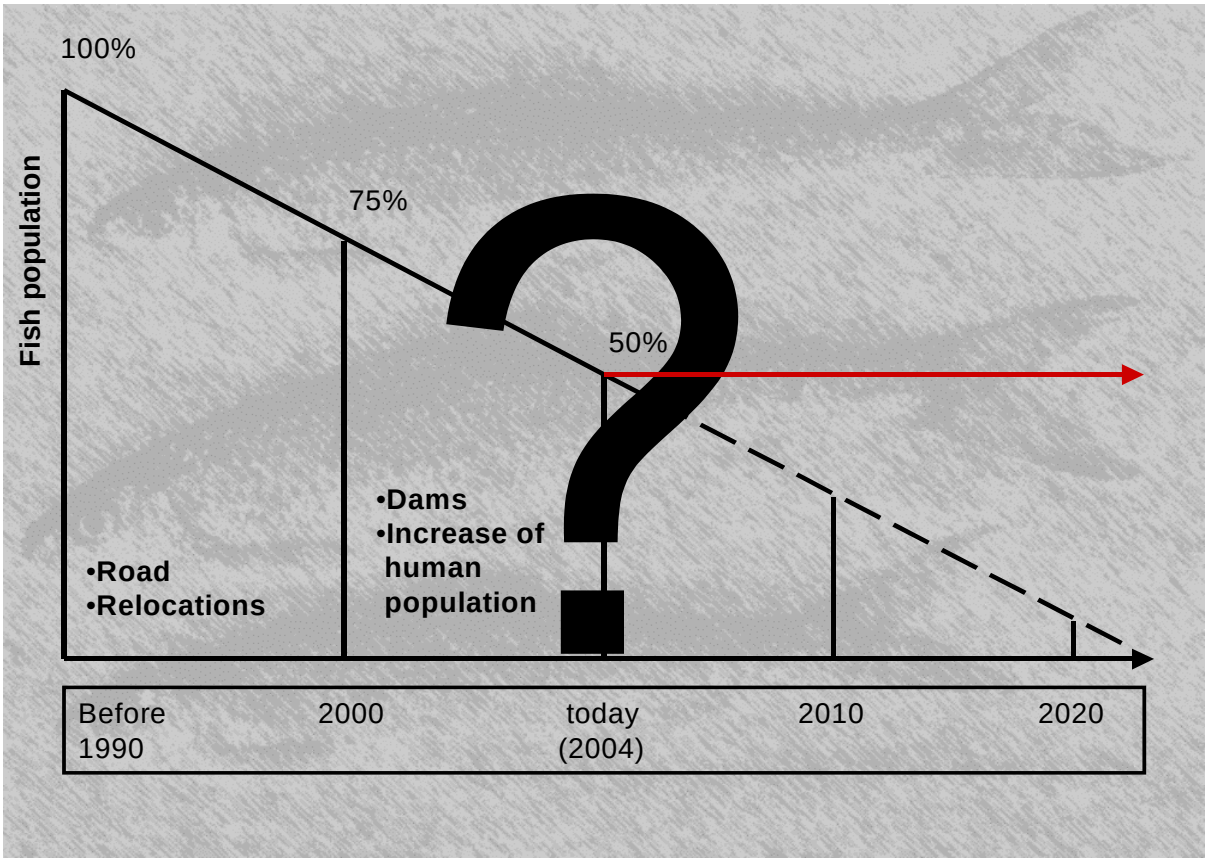
7.2. Abundance of the species in recent past/present and changes of fish population

We had to relay on the memory of local people concerning to the abundance of the fish species in the past due to lack of earlier baseline survey on Nam Pa. Through their knowledge and their routine we are able to describe the probable changes in fish populations. This might reflect on the question of biodiversity loss, which is very important on the other hand. Fishes are basic food source for rural people and indicators on environmental changes as well.

With the participatory methods used in our survey –especially the so called „group interviews"- people could transfer their knowledge and information. The results show some kind of changes, which are evident without any kind of statistical evaluation.

From the group interviews it is clear that the number of the most abundant fishes have decreased in the last two decades. These can be seen from the diagrams attached to the result sheet. There have been already too many changes so the restoration of the former conditions seem to be impossible and has no sense. But to stop these tendencies there are lots of things to do if there is an intention to conserve the present conditions.

Figure 6. Past, present and potential future trends of fish populations



It would be necessary to undertake these kinds of interviews in every village along the river. This would show the distribution and the abundance of the species and their changes at the whole river section. A potential comparison of these data with statistically sound sampling method and a careful habitat and human population survey could give a good view on the trend of the rivers entire fish stock condition.

7.3. Description of the potential environmental impacts on the river

Both kind of interviews and lot of personal discussions are the information sources of the following thoughts which are likely to cover the truth:

In general the rapid increase of the human population is the most important factor, which has a lot of unknown (and known effect as well[3]) on its environment. The changes that

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we estimate are all linked to that basic factor. But this process is supported by other well-defined factors like infrastructure development (e.g. road construction), social migrations, etc.

Hmong people can not swim! There are several things, which might effect decrease of the fish population, but one of them is absolutely clear. The overfishing was mentioned from all villagers we could talk to. And this is a visible aftermath of the increase of inhabitants. The Hmong people resettled from the mountains could not swim at the time of moving into the valley. The unusual activity –fishing- was fun for them, so they all tried to fish and learned swimming for logical safety reasons. This is one more additional reasons to back up the importance of overfishing. On the other hand they had to substitute the loss in their diet, this also made them learn how to catch fishes.

Fish versus electricity! Dams are built to produce hydroelectric power without fish-steps. Although most species are data deficient, we already know that some fishes migrate or move with changes of water temperature, quality and quantity. These wooden structures have a barrier effect on fish migration. We suppose that without the effectiveness of a normal migrating habit, which is linked to the efficiency of reproduction, the river's fish stock decreases.

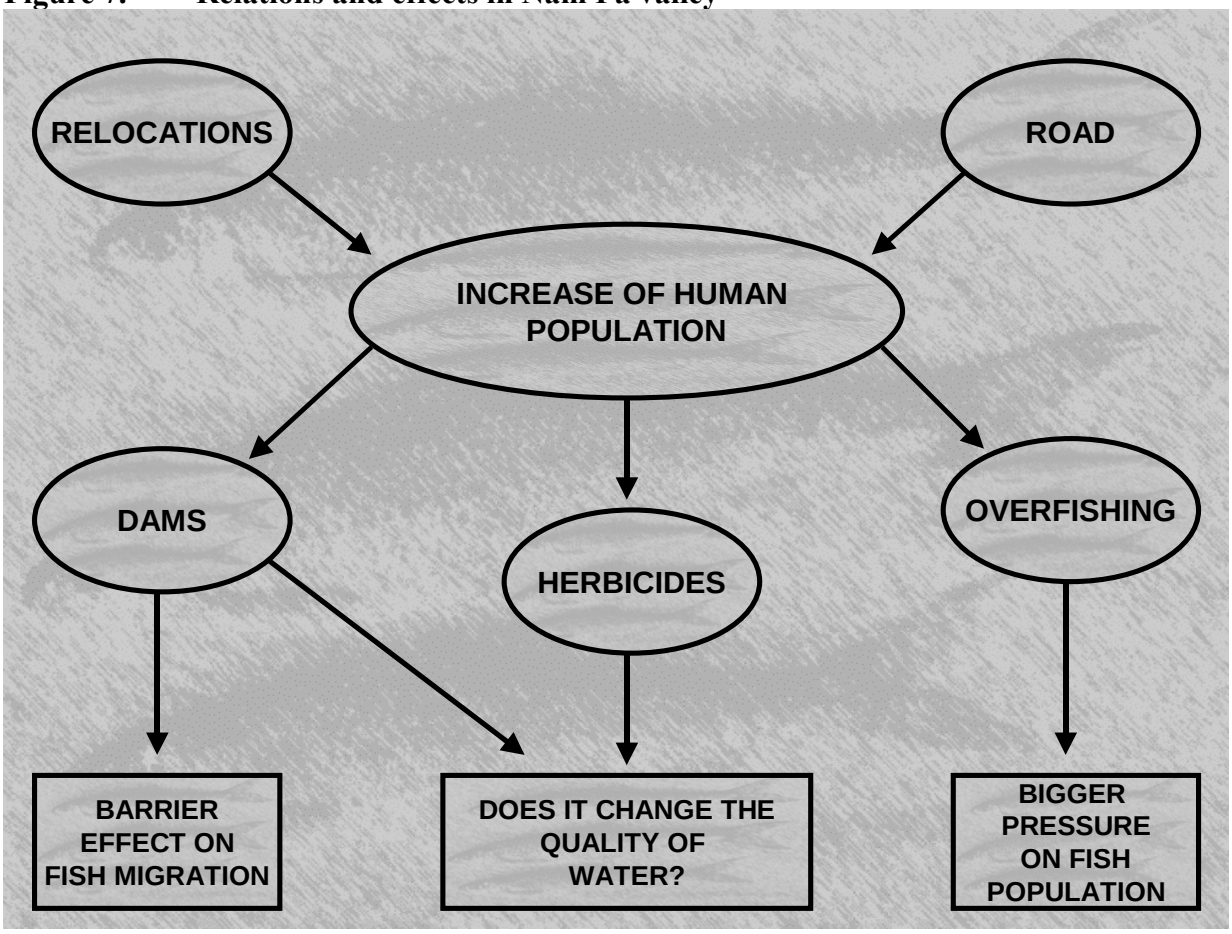
There has to be a solution, so people mustn't give up any of their demand. For example the hydroelectric power generators could be replaced by solar cells. This much more environment friendly way of electric supply opens up more possibilities in further development. And beside the „no influence" on fish migration the villages are not relied on those very unsteady structures. Another option can be a so called „fish-step". This leaves the possibility of hydroelectric power and leaves free access for fish species in their migration during the whole breeding period. For pictures see **„APPENDIX IV.**".

New wave in planting! People substitute fish food for vegetable. This means that they try to take advantage of all kinds of option given by the surroundings. All the little flat lands on the riverbank are initiated to grow vegetable. People are indirectly pressed to harvest

more and more vegetable to feed their family. This little „intensification" of planting manifests in the usage of chemicals, which are imported from the neighbouring Thailand. Before the rainy season arrives people spray these pesticides out in an exaggerated way, as far as we know now. The arriving heavy rainfalls might wash the accumulated chemicals from the soil exactly in the river. We suppose that with the increase of the herbicide's usage the river's water is polluted with the „not-useful" chemical derivatives. This might also have an unknown effect on the fishes it self or on their food sources. One solution can be IPM, Integrated Plant Management to substitute the chemicals with environment friendly technologies for a sustainable agriculture and to protect the river from chemicals as well.
A further water quality study is required to support this thesis and to prove the effects of the chemicals washed into the river.

The cave of the feared creature! The sacred place called Wang Nam Xai downstream from Ban Huayman is a little basin between the mountain and the river where a hot watered spring reaches the surface and confluence with Nam Pa. People believe that this is where the long mythical creature (Naga?) lives, so it is prohibited to fish near this place or in the spring's little basin. We made a little excursion to found out more about this place. The basin of the spring is not bigger than 10-meter diameter circle with absolutely clear water full of fishes living in perfect harmony. This little place is absolutely intact from fishing. It would be a great place to observe all kinds of species and/or to catch (and release afterwards; not to hurt the demon of the place) and identify them. Observation with underwater camera could be the most environment friendly way to identify fishes without hurting them or this little isolated ecosystem.

Figure 7. Relations and effects in Nam Pa valley

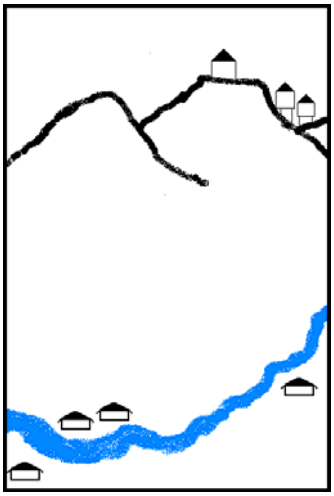


7.3.1. Estimated changes in the valley of Nam Pa

Following figures show the estimated social movements in the valley:

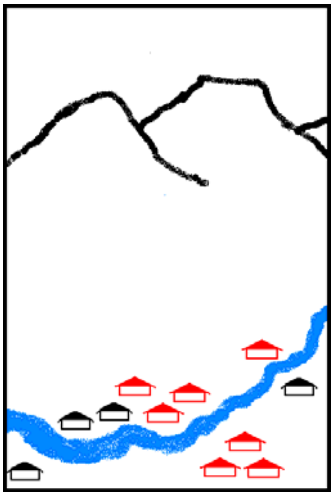
The illustrations below show those possible changes in chronological order, which played a big role in effecting present conditions:

Figure 8.-13. Changes of households and development in Nam Pa valley



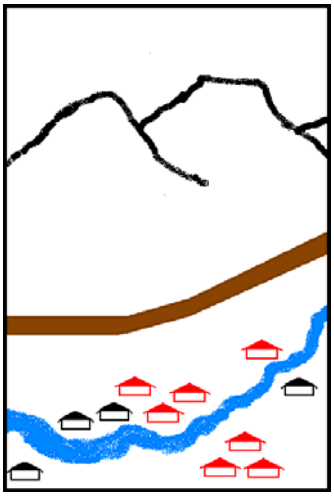
Former environmental and social conditions:

- Valley bottom and hilltop villages
- Traditional distribution of human population
- Traditional fishing gears and habits among the different ethnic groups inhabiting this region



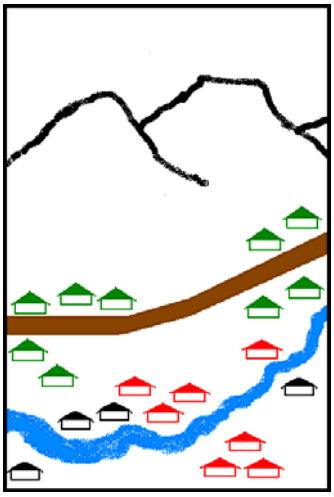
The appearance of new households:

- The permanent migrations of the hill tribes to the valley bottom
- Beginning of overfishing and more intensive land use



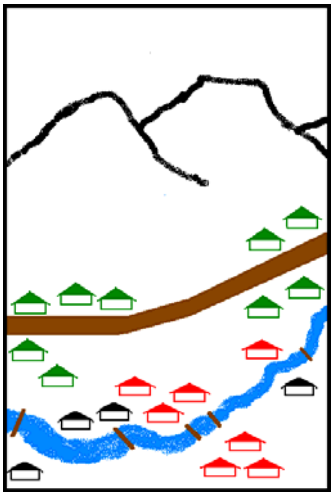
Road construction (1995-2002)

- The new road connects Highway 13 with Phonxai
- Easy access to the district centre
- Possible development of trade and marketing between Luang Phabang and the district
- Regular use of explosive for fishing in this time period



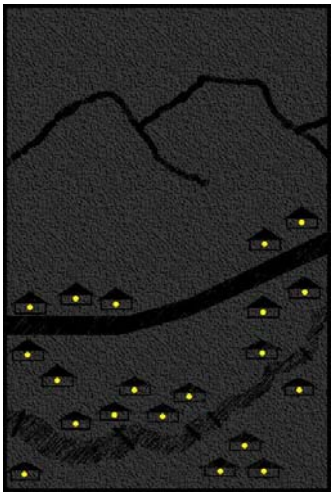
Further increase of human population:

- Linked to infrastructure development
- The overexploitation of the fish resource became more and more evident
- Herbicides: another factor with unspecified effects on this ecosystem



Dam constructions for hydroelectric power:

- Inaccessible wood structures for some fish species
- Development, higher life standard: television, etc.



Present conditions:

- Big and ethnically mixed villages
- Road for easier access and trade
- Simple wood structures, expensive Chinese generators for some bulbs and television
- Overfishing of the river
- Insufficient Fish Conservation Areas

8. Recommendations

We accounted many the potential effects, which might be real or not, however there might be still many left. To stop the negative trends these effects have to be reduced.

During the fieldwork we found that in one hand people know a lot about their fishes, but on the other they are facing problems in identification and fish management. These might seem to be contradictory, but it is not. For examples:

1) The fact that they have more local names for the same species is nice from the language point of view, but it brings up confusions at fish stock management.

2) They harvest everything what gets in to their nets, there is no selection between breeding and not breeding species at the time.

The situation can be improved by simple methods like a fishing calendar, fish size limitation or periodical gear-type prohibition.

A fishing calendar would include the exact breeding period of each species inhabiting the river. During the breeding period people could be asked not to fish for the breeding ones but to throw them back in case of occasional catch.

Since we are lack of the necessary information therefore we just provide an example of fish calendar in table 11.

Table 11. Fishing calendar

	MONTHS											
	J	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Species A				**X**	**X**	**X**						
Species B		**X**	**X**	**X**								
Species C						**X**	**X**	**X**				
…												
Species G					**X**	**X**	**X**					
…												

„X" means fishing prohibition in the whole month, or in a part of that period.

The fish size limitation for catch and the gear-type prohibition is nearly the same. These would mean that in case of all species there is a size limit. Under that limit the caught fish has to be thrown back to the river. This can be connected with the limitation of stitch size of the nets or some kind of special gears like harpoon, etc.

Summary:

a) **Solar energy:** environmental friendly method to generate electricity for the villagers

b) **Integrated Plant Management:** a complex of methods to avoid the negative effects of herbicides

c) **Fishing calendar:** According to the annual breeding periods of different fish species
   It means fishing prohibition for the actually spawning species

d) **Size limitation:** According to fish size at spawning
   It means the fishermen are asked to return the juveniles in the river

e) **Fish-steps combined with the dams:** This combination would mean a compromise
   The fish-steps would ensure the free access of the migrating fish species, while the dams still generate hydroelectric power

9. Acknowledgements

We would like to express our thanks to all those who helped us with their expertise and support during our work in Laos:

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Mr. Thongphath LEVANGKHAMMA	Director of FIPD
Mr. Michael HEDEMARK	Head of WCS-Laos
Mr. Bounchan LATTANAVONGKOTT	Head DAFO
Mr. Houmchitsavath SODARAK	Deputy Director NAFReC
Mr. Peter JONES	Rural Development Specialist
Mr. Sommano PHOUNSAVATH	Mekong River Commission
Mr. Kongpheng BOUAKHAMVONGSA	MRC National Component Officer
Mr: Maurice KOTTELAT	Ichthyologist
Mr. József FIDLÓCZKY	Forest Land Use Classification Adviser, FIPD

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b) **Kottelat, M.**

Fishes of Laos

WHT Publications Ltd. Colombo 5, Sri Lanka, 2001

c) **Ministry of Agriculture and Forestry, NAFRI, LSUAFRP**

Land Management Research Component

Field report on Land Use and Land Management Activities in Phonsay District, 2003

d) **Mark Dubois, Khamsai Inthavong, Rachel Barden**

Integrating Local Knowledge in Aquatic Resource Management-Terraqua TEK

e) **Ministry of Agriculture and Forestry, NAFRI, LSUAFRP**

Land Management Research Component

Report on Soil & Land Suitability of NamBo Village, PhonXai District, Luang Pra Bang Province, 2002

f) **Ministry of Agriculture and Forestry, NAFRI, LSUAFRP**
Socioeconomics Component
Report on the diagnostic survey in Phonsay District (draft), 2003

g) **Ministry of Agriculture and Forestry, NAFRI, LSUAFRP**
Socioeconomics Component
Field Report on Indigenous Soil Taxonomy, Household Level Diagnostic Survey and Market Research in Phonsay District, 2003

11. Itinerary

26th of February – 19th of March

Pre-project activities includes:

- Studying technical bibliography at libraries of NAFRI, LARReC, WCS
- Searching for suitable methods
- Planing of field work activities
- Meetings at:
    a) LARReC
    b) NAFRI
    c) WCS
- Preparing materials for field work

22nd of March – 26th of March

Fieldwork at Phonxai District includes:

- Fish species identification
- Interviews with local fishermen

19th of April – 21st of April

Preparing for second field work in Vientiane:

- Collecting work materials
- Photo processing

22nd of April – 6th of May

Second part of fieldwork in Phonxai District includes:

Two group interviews in each target village:

a) 22nd of April at Ban Thapothai
b) 28th of April at Ban Nambo
c) 29th of April at Ban Thaponue
d) 30th of April at Ban Huayman

- Further fish species identification and specimen collection from villagers
- Interview with river bed garden farmer, visiting vegetable plantations
- Observing fishing gears and habits
- Data collection on fishing techniques

10th of May – 20th of May

Post-project activities in Vientiane includes:

- Data and photo processing and comparison
- Preparing for presentation

Workshop attendance:

a) 12th of May at NAFRI in Vientiane
b) 20th of May: Presentation on preliminary findings of the undertaken researches

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