

# PROVINCIAL AQUACULTURE DEVELOPMENT PROJECT



## LAO PDR

SUPPORT FOR TECHNICAL SERVICES

### **Broodstock and Hatchery Management**

Based on the work of

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**The Provincial Aquaculture Development Project (LAO/97/007) is a nationally executed, UNDP funded project working in five provinces in Lao PDR. Through its activities LAO/97/007 aims to:**

- 1. Improve fish fry production from government hatcheries through structural improvements and training*
- 2. Support fish fry production by farmers and entrepreneurs through the extension of simple appropriate technology.*
- 3. Develop the capacity of Department of Livestock and Fisheries staff to plan and conduct extension of fish culture techniques to farmers.*
- 4. Form farmers groups and extend improved fish culture techniques as part of the Department of Livestock and Fisheries extension process.*
- 5. Assist farmers and small-scale hatchery entrepreneurs to undertake aquaculture activities through provision of fish fry, broodstock and facilitate access to credit.*

**LAO/97/007 is working with the Provincial Livestock and Fisheries Section and farmers groups in: Oudomxay, Sayaboury, Xieng Khouang, Savannakhet and Sekong Provinces. Additional technical assistance and training is also provided to Livestock and Fisheries staff and farmers in other provinces. This publication is part of a commitment by LAO/97/007 to improve the management and production capabilities of the Provincial Fish Hatcheries in Lao PDR.**

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# **1. BACKGROUND**

This consultancy was carried out within the scope of the “Provincial Aquaculture Development Project” LAO/97/007 to assess the current problems and constraints regarding the situation of broodstock in both private and state hatcheries and propose recommendations for future action (Terms of Reference are in Annex 1 and itinerary & timetable in Annex 2).

The consultancy included three 2-day training courses conducted in 3 regions for private and state hatchery managers. The training courses covered aspects of broodstock and hatchery management appropriate to Lao PDR fish seed stations and small-scale hatcheries.

The consultancy also included the writing of a simple manual on broodstock management to be used later by fish seed farm staff and extension officers.

This report is the result of the mission made by the consultant from 5/01/99 to 6/02/99, the manual being prepared separately.

## **2. STATUS OF GOVERNMENT HATCHERIES**

### **2.1 LOCATION AND DESIGN**

Fish seed station location was apparently often chosen for reasons not directly linked to the technical requirements of fish reproduction, such as communication or vicinity of a city. Over the years these reasons have lost their value and additional problems have appeared (such as the station being intersected by a road, surrounded by houses and facilities polluting the water source, located in or dependent upon a service which has limited interest in hatchery activities).

The design of the stations themselves is often unsuitable, relying on hatchery systems not particularly well adapted to the conditions and scale of operations in Lao PDR. Current production methods now by-pass or modify these systems. The Provincial Aquaculture Development Project (LAO/97/007) has now started to assist the stations in this respect by proposing and financing several low-cost but efficient modifications.

### **2.2 INFRASTRUCTURE AND EQUIPMENT**

All stations are rather old (some were constructed in the early 1960's) and maintenance seems to be restricted to a minimum for the components that are now in use. Many ponds have leakage problems, coming partially from a poor design and probably poor construction, or suffer from dike erosion, resulting in accumulation of mud and decrease of pond depth. Further stocking with common carp or rohu will increase problems of turbidity and prevent the development of plankton. It is clear that regular maintenance could have avoided many of the present problems.

The hatchery components are also often in rather a poor condition. They present an accumulation of systems that have been progressively modified on the basis of a mass production system that cannot be implemented properly due to constraints of nursery pond area and water supply. The training and basic modifications or renovations implemented upon advice of the current project (LAO/97/007) are already starting to prove their usefulness, and hatchery production has increased with their implementation.

Generally speaking, various infrastructures (ponds, embankments, canals, hatchery) and the equipment are rather poorly maintained. Equipment (such as nets) and tools happen to be left in water and mud instead of being properly cleaned, dried and kept in a suitable place after use. Improving simple management practices would increase the efficiency of the operations and the lifetime of equipment. Money spared at this level could be use for other purposes.

## 2.3 WATER SUPPLY AND QUALITY

Due to poor siting of hatcheries, and occasionally due to increasing urban developments in the vicinity of the hatcheries, water supply is often a key problem limiting the real capacity of production. Some stations suffer from a poor quality of water (for the hatchery), others from a lack of water (for nursery ponds essentially), and some from both. Where high pressure filtration systems have previously been installed, lack of spare parts and investment in maintenance has resulted in deterioration and the systems are now not in operation. Such high cost systems are not appropriate for these hatcheries which have limited working budgets.

All hatcheries are running without any equipment for measuring water quality. Where equipment is present, it is out of order or is not used because hatchery staff does not know how to use it or do not see the advantage.

In the frame of the LAO/97/007, several low-cost modifications have been implemented or are under way. Although they will not completely solve production problems, they should be sufficient to increase the fry production provided that hatchery managers also improve working methods at the different stages of production. Since the principal constraint to improved production lies with hatchery management, further investments in hatchery modifications are not advised until the managers can demonstrate the ability to implement simple good management practices.

During the consultancy, the use of alum for clearing water of suspended solids was demonstrated at the training sessions. Alum is available on the markets at an affordable price (2,000 to 4,000 Kip/kg) and is very easy to use. It can be useful if the volumes of water to be treated are small, which is the case for the hatchery operations. It could be particularly useful in the stations of Champassak, Luang Pabang, Savannakhet, Khammouan and Nongteng.

In Champassak for instance, the existing reservoir (40 m<sup>3</sup>) could be repaired and divided into 2 compartments that would be filled up with water and cleared with alum alternately, the clarification process taking one day.

It is also suggested that in lowland areas, the digging of wells may be another alternative. A simple manual technique is used by specialized farmers in Thailand for digging wells down to 15 – 20 m for a very low price (3,000 to 4,000 Baht, PVC pipes not included). The digging takes 1 to 3 days depending on the depth. The system has one drawback in the sense that water pumped from such wells may be loaded with sand during the first minutes of pumping. It requires a simple settlement canal. It was not possible during the mission to find out if such a technique was available locally.

## 2.4 BROODSTOCK SITUATION

As a general rule all stations are keeping a large number of fish species. Most of them keep a minimum of 8 species, e.g. tilapia, common carp, silver barb, three Chinese carps (grass, silver and bighead) and two Indian carp (rohu and mrigal). Many stations keep some additional species such as Catla, other species of Puntius and various indigenous species.

Such a high number of species does not efficiently utilize the production potential of the stations in terms of infrastructure (number and size of ponds), water supply, and operational and management capacity.

The number of broodstock and nursery ponds are already limited and not intended to contain so many species. In addition, as explained before, this suitability of the ponds is further reduced in most stations, permanently or temporarily, because of the lack of water, pond leakage, problems of theft, etc.

The result is that stations manage to maintain these species by using practices that will affect broodstock quality and fry production such as:

- Excessive stocking densities for keeping a good number of fish
- Inadequate numbers of each species
- Mixing all species without any consideration of stocking ratio and the appropriateness of keeping the species together
- No separation of sexes for most species for most part of the year

- Mixing of spent broodfish and maturing ones
- The broodstock of big species (Chinese and Indian carps) are small and young resulting in poor egg quality and yield.

These strategies create various problems.

The absence of sex separation requires feeding all fish in the same way, when it would be more effective to feed females and males in a different manner in order to maximize productivity and minimize feeding cost. Early conditioning of common carp denies feed for conditioning other species later in the year. Mixing of sexes can also lead to cases of wild spawning (silver barb) resulting in loss of fry production.

High stocking density is counter-productive if not used in excellent conditions. High stocking density implies that fish are stocked in deep ponds having water of good quality that can be renewed or flushed every few weeks. These conditions are usually not fulfilled in the stations. Feeds of suitable quality must also be available and distributed daily according to the physiological needs. Either because feeds are not available on the local market or because the station cannot afford them due to budgetary problems, high stocking density results in insufficient and unsuitable feeding that affects the overall fecundity of the broodstock. It was advised during the training to limit the stocking rate at 1,000 kg per ha.

In some cases the number of broodstock of one species is kept so low that the success of the reproduction is hazardous as there is little choice concerning the broodfish and no error is allowed in the procedure as, often, spawning can only be attempted once a year.

Chinese and Indian carps have the disadvantage that a second year of growth is normally necessary for getting broodstock with an acceptable level of fecundity. At the stations the broodfish used are often too young/small and give rather poor results, especially for the Chinese carps.

These practices have the effect that the broodstock are not kept in favorable conditions that would let them release all their potential, favor a good development of the gonads and an abundant production of viable eggs. The production of fry is therefore limited, and the cost of fry produced is rather high when put in relation to the amount of broodstock that is maintained.

There is no systematic recording of the movements of species from abroad into the Lao hatcheries, or between the different hatcheries. Some very recent movements have been noted in annual reports, but most information collected comes from hearsay. Information obtained is as follows:

- Silver barb species held at the hatcheries is of Lao origin, caught in the Mekong or its tributaries, usually on an active basis, sometimes by accident (fish pumped from Mekong in Pak Bo station – Savannakhet). Renewal by capture seems however to be rare (last capture mentioned by Pakse hatchery is dated 1992).
- It is claimed by some that a silver barb species from Champassak province is better performing (larger and fast growth) than the silver barb from other provinces. Not a single study, even simple, has been conducted for assessing the performance of that species and comparing it with the performance of silver barb of other provinces.
- Common carp come from different sources: Originally imported by a Japanese project in the '60's (unknown origin), import from Hungary (several times, last time in 1998), and possibly from Vietnam. Indigenous populations are reported in some Northern Provinces.
- Some tilapia were first imported by the Japanese project in the '60's (unknown origin), more was imported later from Thailand. Private imports of tilapia from Thailand are widespread.
- Indian and Chinese carps were first imported, probably from India, by the first FAO project at the end of the '70's and distributed nationwide. Grass carp has also been imported several times from Vietnam. Private imports of fry to farmers are the principal source of this species
- In general, most movements between hatcheries were from the central fish seed station at Nongteng (Vientiane province) to the nearby provinces, and from there to farthest hatcheries.

- LAO/97/007 has distributed silver barb broodstock to several provinces for spawning and restocking of fish seed stations. Some other species have also been moved (principally rohu and common carp).

From this information it appears that the stocks of silver barb and common carp as a whole have benefited from relatively active renewal and that there are local stocks from which further renewal should be possible without requiring imports.

Original stocks of other species are rather limited and have not been renewed with the exception of grass carp. There is the question of the necessity of renewing some species since the local demand for them is not great and they can be difficult to mass produce.

## 2.5 AVAILABILITY OF INPUTS

The main inputs that are of interest for Fish Seed Farms are the following:

- ◆ Lime
- ◆ Manure and chemical fertilizers (urea)
- ◆ Complete feeds for fish, or for livestock
- ◆ Agricultural products or by-products: rice bran, broken rice, corn, soya, etc
- ◆ Hormones for reproduction (Suprefact and Motilium)

Market availability of lime and manure for state hatcheries is not a real problem for the vast majority of them. These inputs are for pond preparation and they are particularly important for nursery ponds as fry rely greatly on the natural food for their growth. They seem to be available for every hatchery. Cost of manure is often surprisingly low when compared to other costs and the price of fingerlings. Lime and manure are certainly underused in all stations.

Fish feed and livestock feed are not so common and are rather expensive, especially away from the Thai border. In Vientiane, Luang Phabang, Savannakhet and Pakse, catfish pellet feed and sometimes herbivorous fish pellet feed are available. Pig feed is available in Vientiane, Savannakhet and Pakse. Chicken feed is available but expensive in most provinces.

Agricultural by-products are not abundant in Lao. Any feeding of fish will be primarily be based on rice bran. Broken rice and corn are the other common products. A kind of artisanal soya cake is the only protein-rich product available, and is usually limited to peri-urban areas. The availability of proteins for the fish is thus limited and must come essentially from natural food in the pond or some additional fish or livestock compounded feed.

Hormone availability is a key factor for running the hatcheries and is not currently distributed routinely in Lao PDR. This last year, Suprefact and Motilium were purchased by LAO/97/007 and distributed to the provincial hatcheries following a small-scale hatchery training course. The procedure is to be repeated this year, but the question of Suprefact availability in the future remains an issue.

The annual purchase of hormone represents only a small amount of money. The best solution for ensuring the continuity of the supply would be that the purchasing and distribution is made an annual activity to the Livestock and Fisheries Department at the central level, according to the request presented by the hatcheries in their annual operations plan. The dilution of the Suprefact would be implemented at Vientiane since individual hatcheries would not require a whole bottle. The hormone would be distributed to each hatchery at cost price, as part of their budget.

## 2.6 FINANCIAL ISSUES

### Budget

The provincial fish seed stations receive only a very limited budget from their province and from the Department of Livestock and Fisheries in Vientiane. It has been difficult to assess how exactly stations are financed and it appears that they do not all function exactly in the same way as they depend essentially from the province and not from the Center (except Nongteng). Permanent staff may be paid by the budget of the hatchery or directly by the state. Profit can be reused totally or partially (shared with the province) according to the province. Some stations provide their staff with some incentives (bonus) but without clear rules, other stations have no such system.

### Market

There is a chronic deficit of table fish and fingerlings in every region. Stations have little problem in selling any kind or size of table fish they have. This is also true for fingerlings, provided they are available at the right time. The peak demand for fish fingerlings is between June to August when farmers want to stock the seasonal ponds (the majority of Lao ponds) and rice fields. A much smaller demand occurs in some regions between January-February for stocking into irrigated rice fields.

Any indigenous species that may be domesticated in the future should be able to spawn in order for the fry to be available between June and August.

All examples worked out with hatchery managers during the training courses have shown that the production of fry is an extremely profitable activity if correctly managed.

## 2.7 PERSONNEL QUALIFICATIONS

Although qualified staff are not evenly distributed amongst stations (Luang Phabang staff for instance are more qualified than the Pakse staff that has only locally educated technicians – Annex 6 refers), the number of personnel is sufficient in every station for performing the tasks required in hatchery and fish farm operations. It seems however that technicians are reluctant to engage in “dirty” work and that they are underutilized. It should thus be easy for them to undertake additional management practices that are currently missing in the stations (see next section about management).

Laborers are in sufficient number for the maintenance of the stations and the basic daily operations. They also seem to be underused (see next section). They are supported in each station by casual labor force when necessary.

Staffing in both quantity and educational qualifications can thus be considered as sufficient for operating the stations for fry production. It would not be sufficient to undertake an effective research type program without additional help.

## 2.8 MANAGEMENT

Examples of poor management in the fish seed stations are numerous. Here are the most important ones encountered during the visits and discussions:

- Most stations have no records for pond stocking, feeding or breeding operations.
- In some cases, stocking numbers are recorded but not the weight; biomass data are uncertain and so is the feeding rate.
- There is no stock record for feeds, fertilizers, etc.
- Underfeeding is a common practice, for both broodstock and fry. Feed quality is often inadequate.
- Water management is poor with water inlets and outlets poorly maintained, many leakages even through the outlets (monks), concrete canals full of mud and vegetation, etc.
- Permanent labor may be necessary for the breeding season or some specific operation, but is clearly under- or poorly utilized in other periods according to the poor conditions of the stations and the level of activity the consultant could see.

- Basic maintenance of infrastructure, easily made by manual labor, is poorly performed.
- There is no clear management plan of any sort, which results in shortage of inputs, inefficiency of labor force, wrong timing of fry production, spilling of resources.
- There has been little reinvestment in recent years (it should be noted that the fish seed stations have had a period under private ownership, further contributing to deterioration).

Weak management is an evident key factor in the current situation of Government hatcheries. It explains many of the problems encountered. But that weakness itself has its reasons, the most important being that managers:

- Do not have education or training in management techniques in general and especially fish farming operations
- Have a poor understanding of the relationship between the management and the productivity of the station
- Have a low motivation due amongst other things to the low salary and the absence of incentives
- Receive insufficient attention and monitoring by the Provincial level and the Ministry

The activities of the LAO/97/007 during the last year (technical advice, low-cost modifications) and the consultancy on mini-hatchery last May have started to show some positive effects. Some remarkable increases in fry production have been noted in several stations (Khammouan 200,000 increased to 400,000, Pakse 400,000 to 700,000, Luang Pabang 700,000 to 1.7 million) and consequently some money is now available for improving operations and commencing small-scale renovation. In 1998 Khammouan Station has dug 2 more ponds and Luang Pabang station has renovated a broodstock pond with the profit of the previous year.

The training given during this consultancy may also contribute to alleviate the first 2 constraints in the future, but much more will have to be done. An additional training specific for the state hatchery managers would be useful. It should review the establishment of an annual budget and its annual working plan broken down in tri-monthly activities plan, and focus on the establishment of recording systems in the hatchery.

The Department of Livestock and Fisheries and the Provincial Department of Agriculture and Forestry Offices also have a responsibility in the improvement of management practices.

With the changes now under way in the Lao society, incentivisation is becoming more acceptable and is even practiced at low/informal level in some stations. This is understandable in view of the very low level of salaries (typically \$11 - \$19 per month). The move should be developed and linked in one or another way to productivity (fry production) or the general results of the station. It can be for instance a premium of 1 or 2 Kip per fry produced and sold on the condition that the station is operating at a profit.

Managers and their staff need to be more than financially motivated. They should feel that they are given some responsibility as well as the means for assuming them. The Department of Livestock and Fisheries, together with the Provincial government, should give more precise guidelines for the management of the fisheries stations and demonstrate that it is awaiting results by closer monitoring of activities.

### **3. STATUS OF PRIVATE HATCHERIES**

### **3.1 INFRASTRUCTURE**

Pond depth is one of the most common problems in Lao hatcheries and is especially important for broodstock ponds. These ponds are supposed to be deep enough so that they have a water volume sufficient for maintaining stable favorable conditions for the development of the gonads. This is far to be the case in the farms visited and it was pointed out during the workshop that current entrepreneurs should progressively reinvest part of their benefit in the improvement of their broodstock and nursery ponds.

### **3.2 WATER SUPPLY AND QUALITY**

Water supply is often a common problem that is aggravated by the shallowness of ponds. The quality of water is also sometimes a problem for the hatchery component (turbidity).

### **3.3 BROODSTOCK**

Private hatcheries obtain most of their broodstock from the State hatcheries. They renew them very rarely. The number of species is fewer than in state hatcheries. Stocking conditions are generally poor, linked to the shallowness of ponds and the insufficient water supply. Feeding is also often insufficient and not well balanced. There are however some interesting exceptions to this. Broodstock ponds are often "large" ponds where all species are mixed together, and with the table fish.

Common carp is the most common species reproduced by farmers because a semi-natural technique can be used that does not require the use of hormones. Silver barb is the second species in importance and has progressed substantially during the last year with the availability of hormones and the activities of projects such as the RDC (Regional Development Committee) and LAO/97/007. Many farmers also keep a pond with mixed sexes of tilapia for natural low level fry production. Another species that is occasionally spawned on the farm is the Rohu.

### **3.4 AVAILABILITY OF INPUTS**

Private hatcheries face the same situation as state hatcheries regarding feeds and fertilizers. Those located in remote areas face more serious problems. Hatcheries in lower areas near the Mekong and the Thai border have an easy access to compounded feeds and some by-products.

Private hatcheries reproducing species other than common carp depend also on state hatcheries for obtaining the hormones, although some entrepreneurs can obtain their supply directly from Thailand.

### **3.5 FINANCIAL VIEW POINT**

Hatchery activity is usually profitable, even if the technical conditions of operations are not excellent.

There is a lack of capital for development in most cases. Farmers are reluctant to borrow from the Agricultural Promotion Bank (APB) which itself is reluctant to lend money for aquaculture activities that are considered too risky. The APB is also reluctant to lend for medium or long-term. This situation seems to vary between provinces.

There is room for significant increase of profitability if :

- improved techniques are used
- managers apply techniques carefully
- more capital is made available for long-term (2-4 years)

LAO/97/007 has calculated the economics for the establishment and operations of several types of small-scale hatchery, and they show that this activity is profitable. There are risks, but these are mainly related to the management ability of the farmer.

An adapted version of this analysis should be sent to and discussed with the provincial branches of the APB. The problem at the bank level is to establish a successful demonstration, by convincing a provincial manager to take the risk, but with training and technical assistance to the borrowing farmer for making the venture successful.

### **3.6 MANAGEMENT**

Small entrepreneurs are often more aware of the limits of their farm than state hatchery managers. They limit the number of species to be reproduced but often still keep too much broodstock for the carrying capacity of their ponds. This is a means of spreading risk by keeping the option of sales of table fish together with fingerling production.

Fertilization and feeding are often insufficient in quality and quantity, because of ignorance of the fish requirements and fear of spending too much money.

Management is often empirical and not very efficient because basic broodstock and even fish farm management rules are not respected. A very common practice for instance is to send spent broodfish back to their original pond that is later seined again and again for further spawning. Recording and planning do not appear to be implemented.

### **3.7 MARKET**

The market for fingerlings during the rainy season is excellent, as there is a general shortage in most provinces. Some hatcheries may however face problems of distribution if they are too isolated. Market is much smaller in the dry season (second rice crop in irrigated area) but is compensated by a high demand for table-sized fish that hatcheries can produce in their nursery ponds if their water supply is sufficient.

## **4. SPECIES TO BE MAINTAINED**

Looking at what has been said concerning the current status and management of the provincial hatcheries and the requirements for small-scale aquaculture, it is clear that keeping so many species in every station is not a sustainable policy. Continuing in the same direction would hamper the overall development of the Lao aquaculture. The number of species must therefore be reduced.

Silver barb and common carp are already essential components of Lao aquaculture and their relative weight in the stations should be increased. Silver barb should be given a higher priority as small-scale private hatcheries can more easily produce common carp (without hormones).

Tilapia, because of its popularity and its natural reproduction, should also be kept. There should be a more active management of the broodstock and of fry fingerlings.

It is proposed that a maximum of 2 other species be kept in stations. Rohu could be a primary choice. Its reproduction is generally easy and successful, stocks are relatively high in the stations, its growth rate is slightly superior to the one of mrigal and it is already more widespread on the markets.

Grass carp could be a secondary choice particularly in the north where it seems to perform better than in other regions.

Both rohu and grass carp reproduce more or less at the same period (rohu slightly earlier) and have complementary diets. They could be stocked in the same pond. They could, if necessary, also be associated with the tilapia while common carp and Puntius would be stocked in other ponds.

## **5. BROODSTOCK SUPPLY/RENEWAL**

The choice of species should be made for a minimum of 5 years awaiting the results of this policy to produce their effects at both hatchery and farmer levels.

In the meantime, imports of new broodstock should not be undertaken. Common carp and grass carp have been imported in previous years from Hungary and Vietnam. Tilapia was also imported very recently from Thailand (Agriculture Development and Service Center Project in Nam Houm).

Silver barb and other *Puntius* species can be collected from the wild, especially in the regions of Pakse and Luang Phabang, as it has been done in the past. The possibility of collecting common carp in the Xiang Khouang region should also be examined. This collection of fish in collaboration with local fishermen should require very limited financial means. A reasonable cycle could be every 3 years.

A regular program of exchange could be organized between the stations. It could be organized as follows:

- A northern ring – or rather a star – centered around Luang Phabang station; it would include all the northern provinces (Sayaboury excluded).
- A southern ring centered around Pakse, including all southern provinces (Bolikhamsay excluded).
- A central region with Nongteng acting as hatchery reference and supplying the Vientiane prefecture, Sayaboury, Xaisomboun, Bolikhamsay).

Nongteng would also be the normal international entrance for further imports.

Collection from the wild and exchange between the three main stations could be made with a 3 year cycle : collection from the wild or exchange on year 1, growth on year 2 and multiplication and distribution to all stations in the region in year 3 (see following table).

The exchange between reference stations would be made by air. The distribution to other stations would be made by road. The cost of this transportation would be very low as the Provincial offices of Livestock and Fisheries have their own vehicles.

Northern provinces in high areas should observe if their ecological conditions do not have a selection effect that may lead to limited exchange with the stations in lower areas. New fish sent from Luang Phabang should be stocked separately for a year and their growth and maturity observed and compared with local stocks.

**Proposed calendar of broodstock renewal and exchange.**

	Year									
Station	1	2	3	4	5	6	7	8	9	10
<b>Luang Phabang</b>	Capture from the wild Exchange with Nongteng	Growth	Multiplication Distribution to all stations in region	Capture from the wild Exchange with Nongteng	Growth	Multiplication Distribution to all stations in region	Capture from the wild Exchange with Nongteng	Growth	Multiplication Distribution to all stations in region	
<b>Northern stations</b>			Get fish from Luang Phabang			Get fish from Luang Phabang			Get fish from Luang Phabang	
<b>Nongteng</b>	Capture from the wild Exchange with Luang Phabang & Pakse	Growth	Multiplication Distribution to all stations in region	Capture from the wild Exchange with Luang Phabang & Pakse	Growth <b>[Import (?)]</b>	Multiplication Distribution to all stations in region	Capture from the wild Exchange with Luang Phabang & Pakse	Growth	Multiplication Distribution to all stations in region	
<b>Central stations</b>			Get fish from Nongteng			Get fish from Nongteng			Get fish from Nongteng	
<b>Pakse</b>	Capture from the wild Exchange with Nongteng	Growth	Multiplication Distribution to all stations in region	Capture from the wild Exchange with Nongteng	Growth	Multiplication Distribution all stations in region	Capture from the wild Exchange with Nongteng	Growth	Multiplication Distribution all stations in region	
<b>Southern stations</b>			Get fish from Pakse			Get fish from Pakse			Get fish from Pakse	

## **6. INDIGENOUS SPECIES**

The Mekong Basin is very rich in fish species and there are growing environmental concerns about the future of this diversity. In Lao PDR, the main concern comes firstly from the negative effects of the established and projected dams. There are also concerns about the use of exotic species in aquaculture and their potential negative effects on the indigenous species.

Currently only two species used in Lao aquaculture can be considered as indigenous. There is no question about the suitability of the silver barb species (*Puntius gonionotus*) but there are some about the common carp (*Cyprinus carpio*). Some consider it was introduced very recently, but many others consider it indigenous as it has been used in indigenous aquaculture for several hundred years in highland areas. It is certainly a recent arrival in lowland areas and could be considered as exotic in these areas.

All other commonly cultured species were introduced in the last 40 years: tilapia (*Oreochromis niloticus*), the Indian carps (Catla, mrigal, rohu) and the Chinese carps (bighead, silver and grass carp).

There is currently no policy for the study of indigenous species and stations keep 5 to 10 riverine species without any plan of research. Species are chosen because they fetch a high price on the market, not because of their potential for aquaculture. They are usually big species requiring 2 or 3 years of rearing. None of the species kept in Nah Luang (Luang Pabang) station for instance has a chance to become an aquaculture species of significance in Lao PDR. Most of these species have already been studied intensively by the Department of Fisheries in Thailand without any significant breakthrough for aquaculture.

Common qualities required for aquaculture species are that species is easy to breed, breeding at small size, fast growing, with good performance and tolerant in ponds and of course acceptable by the market.

It should be added that, in the perspective of aquaculture development in Lao, new species should be adapted to the main requirements of the majority of farmers. Currently, and the situation is not expected to change much in the next 10 years, most farmers run small shallow seasonal ponds or various extensive systems of paddy-cum-fish. These require that :

- species be fast growing in their early life
- fish can be consumed or marketed when less than 5-6 months old
- fry be available early enough in the rainy season for stocking when water availability is sufficient
- fish can grow with a minimum of inputs external to the farm, feed being essentially natural one.

Silver barb and common carp fulfill these all of these conditions and it should be noted that they occupy two different trophic levels in the pond (i.e. at the surface and on the bottom) and are complementary of each other. Their association has been promoted with success for several years in Thailand. But the association would not be complete without a plankton feeder such as tilapia that has been also widely used in Thailand in association with the 2 other species.

It seems thus logical that research about new indigenous species for aquaculture should primarily concentrate on species that should be able to play the role of tilapia in the pond as plankton omnivorous feeder and thus replace it. Otherwise it will be difficult to restrain the use of tilapia.

The local silver barb species, said to be superior to their Thai counterpart (because of supposed inbreeding of the Thai strain), should also receive some attention in order to better know its biological characteristics useful for aquaculture (fecundity, growth, etc). In particular it would be interesting to see if there are real differences between the strain (or possible species) of Champassak region (that some believe to be faster growing and reaching a larger size) and the strains of the other regions. The research could be extended further to other *Puntius* species.

Looking at what has been said concerning the current status and management of the Provincial hatcheries, it is clear that these 2 or 3 limited programs of research would be already big challenges for Lao hatcheries. Besides pond problems, there is also an acute problem of equipment, financial means and experienced scientists. If any, research should have a precise and limited scope.

## **7. TRAINING ON BROODSTOCK MANAGEMENT**

Three 2-days training courses were held during the mission in 3 regions (central, north and south). They were the core part of the mission. The first one was conducted in Nongteng Fish Seed Station on 13-14<sup>th</sup> January. The second was conducted in Luang Phabang Nah Luang Station on 20-21<sup>st</sup> January, and the last one was conducted in Pakse's Km 8 hatchery on 31<sup>st</sup> January and 1<sup>st</sup> February.

The three training courses were organized according to the same schedule but with some modifications in the contents. The schedule of the Nongteng training course is in annex 3.

Participants were from government hatchery and private farms. The 3 UN Volunteers of LAO/97/007 also attended. A total number of 67 participants attended the 3 training courses.

The workshop was made up of four components. A first part concerned basics about broodstock management. Besides some theoretical features, this part included extensive practical information to be used for daily management as well as for yearly planning.

The second session was a practical example of Fish Seed Farm organization based on typical values used in Lao PDR. The example started by discussion of the physical and technical requirements and then moved to consider the economics.

In the third session, participants were split into 3 groups. Three participants from the private sector, owning a hatchery, were nominated head of their group and each group was requested to discuss the organization of the hatchery according to the model discussed the day before. Each group had to present the results of their discussion.

In the last session participants were presented some simple methods for solving or improving management problems in their farm. It included the use of Alum for clearing water, the construction of a simple insulating box for transporting fish (broodstock as well as fingerlings), the use of ice for fish transportation, the use of orlon hatching cage with a frame made of perforated PVC pipe for providing upwelling flow water.

In Nah Luang, it was decided, together with the Project ADA, to modify the content of the second and third session. The practical example proposed in Nongteng was presented and discussed with emphasis on technical constraints. The main components of an annual operation plan were then presented to the participants and they were requested to work out the operational plan for their own station/ farm according to the model presented. Seven groups (from 17 participants) were created. Each plan was presented and discussed. Xieng Khouang example was used for performing the building of a budget (expenses and expected income) according to the operational plan.

Groups were then requested to prepare and present the budget as well as a basic tentative reinvestment plan.

Practical information on fertilization and feeding and other matters was especially welcomed. Participants were also commenting that the practical example and the group exercises had helped them to better understand how their farm could be run.

It appeared that few participants had a good knowledge of the requirements for the proper management of broodstock and in a more general way for effective farm operation and economic management.

## **8. CONCLUSIONS**

Currently Lao hatcheries face several kinds of constraints. Some are structural (poor location, poor design), some are operational (water shortage, inputs shortage, old equipment) and others are directly linked to poor organization and daily management capacity as well as fear or unwillingness to break with previous uses or techniques.

Although structural and operational constraints may be important in some cases, managerial constraints are by far more limiting for the successful development of the hatcheries, especially the Government hatcheries. There is also a lack of clear policy guidelines or instructions coming from the Department of Livestock and Fisheries concerning the objectives of aquaculture development, the way the stations should participate, and how they should be organized for fulfilling their role.

## **9. RECOMMENDATIONS**

### **STATE HATCHERIES**

- ◆ *The number of species should be limited in every station for the next 5 years. This limitation should be part of a development policy of the Department of Livestock and Fisheries focusing on a wide distribution of a minimum of species. The fish species promoted may slightly vary from region to region.*
- ◆ *The Livestock and Fisheries Department of the Ministry of Agriculture and Forestry should create, hold and update at the central level a Registry recording the imports of broodstock from abroad as well as the movements of broodstock between all government hatcheries. The Registry should contain an attempted assessment of the past movements.*
- ◆ *Each hatchery should create, hold and update a hatchery Registry recording the movements of broodstock into and out of the hatchery. They include the capture from wild stock, import from and shipping to other Government hatcheries as well as private hatcheries.*
- ◆ *Further renewal of common carp and silver barb should be made by exchange between hatcheries and by capture from wild stocks, without imports.*
- ◆ *Hatcheries should implement more intensive pond preparation including lime and manure and a subsequent higher rate of organic fertilization for maintaining a high level of natural food. Other feed would be supplemental. This would improve and increase the broodstock feeding at the lowest cost.*
- ◆ *The Department of Livestock and Fisheries should consider the supply of hormones (Suprefact and Motilium) as a national priority and organize its annual import, preparation (dilution) and distribution nationwide, based on the requests made by the State hatcheries for themselves and the private hatcheries in their province.*
- ◆ *The Department of Livestock and Fisheries, with the support of the UNDP/FAO Project LAO/97/007 should organize more participatory training on fish farm management for all hatchery managers. The training should focus on the establishment of appropriate recording systems and internal organization of all fish farm operations.*
- ◆ *The Department of Livestock and Fisheries, together with the Provincial Agriculture and Forestry Offices, should allow and promote the incentivization of the hatchery personnel, based on the results of the hatchery. The system may however differ according to the provinces.*
- ◆ *The Department of Livestock and Fisheries should set up a set of basic management rules to be used by all State hatcheries. These rules should include the writing of an annual budget and its working plan, the establishment of a permanent logbook for each hatchery, of standardized recording sheets for all operations (breeding, hatching, stocking, feeding, harvesting, sale, etc).*

### **PRIVATE HATCHERIES**

- ◆ *The UNDP/FAO Project LAO/97/007 will be organizing a participatory training on fry production techniques for private small-scale hatcheries. Specific assistance to larger hatcheries might also include improved record keeping and operational and financial planning techniques.*

### **SPECIES TO BE MAINTAINED**

- ◆ *The number of species to be kept and reproduced in state hatcheries should be reduced. Silver barb and common carp should be the bulk of any station. Tilapia should be kept as plankton – omnivorous feeder. Another maximum 2 species should be kept, with a preference for rohu in general and grass carp in places where it seems more successful.*
- ◆ *The Department of Livestock and Fisheries, together with the Provincial Agriculture and Forestry Offices and the fish seed stations, should determine the species other than silver barb, common carp and tilapia that should be kept in each station. There should be a maximum of uniformity inside regions (North, Centre, South) in order to allow exchanges of broodstock between stations.*

#### **BROODSTOCK SUPPLY AND EXCHANGE SYSTEM**

- ◆ *The Ministry of Agriculture and Forestry should establish a system of broodstock supply made of wild stock capture and exchange between provincial stations, exclusive of any imports for the medium-term (5 years). Nongteng, Luang Phabang and Pakse stations would be the 3 pivot stations.*

#### **INDIGENOUS SPECIES**

- ◆ *The Ministry of Agriculture and Forestry should determine the direction of the research (Possibly through the Lao Aquatic Resources Research Institute, ACIAR/IDRC Indigenous Fisheries Project, and forthcoming MRC Indigenous fish project) concerning indigenous species for aquaculture and give appropriate guidelines to the fisheries stations. Specific funds should be made available and biologists posted in the stations where research should be conducted. Additional training would be necessary.*
- ◆ *It is proposed that research should focus on a species able to play the same role than tilapia (*Oreochromis niloticus*) in the pond. Study of different strains of Silver barb and of other *Puntius* species should constitute a second and third level of research.*
- ◆ *Research should be conducted only in a few stations (2 or 3) that may have enough pond surfaces for the purpose without endangering the production of fry that should remain their main objective for the next 5 years.*

## **10. ANNEXES**

## **ANNEX 1: TERMS OF REFERENCE**

- Conduct three-day workshop for government and private sector in Nongteng Hatchery, Vientiane dealing in management, budgeting and planning for broodstock maintenance and effective hatchery production. This training will involve a theory session, worked examples with question and answers (day 1 -2) and a practical session (day 2 –3)
- Visit provincial fish seed farm in Luang Prabang to assess the requirement for broodstock (suitable species, numbers of fish, size, source and timing). A 2-day short training session based on the training given in Nongteng will be given to government staff and local farmers.
- Review the potential for aquaculture production of appropriate indigenous species (*i.e.* breed at small size, fast growing, easy to breed, good performance in ponds)
- Develop systems for broodstock supply (evaluate potential for local broodstock production, movement between provinces)
- Assist the Fishery Development Division in locating good quality brood stock of the desired species.
- Prepare a short, simple, manual in English for broodstock management (including: maintenance, selection, prevention of inbreeding, nutrition and transportation) .for Common carp, *Puntius* species and other carp species. The manual will subsequently be translated for use of fish seed centre staff and extension personnel.
- Submit a report to the Department of Livestock and Fisheries detailing the result of the consultancy with recommendations for future action. The report should include an economic analysis of the recommended broodstock production, management and distribution methods

## ANNEX 2: ITINERARY AND TIMETABLE

5/01/99	◆ Travel home to Bangkok for briefing
6/01/99	◆ Travel Bangkok-Vientiane ◆ Meeting and briefing at FAO Vientiane ◆ Meeting at project with NPD
7/01/99	◆ Visit of Tah Ngone farm and a small-scale hatchery (Mr. Khouné) ◆ Visit of Nongteng fisheries station
8/01/99	◆ Visit Huay Sone / Huay Sua Agriculture Development and Service Center Project (Thai project) ◆ Visit small-scale fish farm in Vientiane Prefecture ◆ Visit market
9/01/99	◆ Preparation of training course
10/01/99	◆ Preparation of training course
11/01/99	◆ Visit Project – Discussion with Dr. Simon Funge-Smith, ADA of LAO/97/007
12/01/99	◆ Visit Nongteng Fisheries Station - Preparation of training. ◆ Meeting with Mr. Bounkouang Souvannaphanh, Deputy Director General of Department of Livestock and Fisheries, Ministry of Agriculture and Forestry
13/01/99	◆ Training in Nongteng
14/01/99	◆ Training in Nongteng
15/01/99	◆ Discussion with Dr Simon Funge-Smith, Aquaculture Development Advisor, LAO/97/007 ◆ Preparation of travel to Luang Phabang
16/01/99	◆ Travel Vientiane – Luang Phabang
17/01/99	◆ Writing Report and Manual
18/01/99	◆ Visit to Nambak district (small-scale hatcheries and fish farm)
19/01/99	◆ Visit Nah Luang Fisheries Station ◆ Preparation of training ◆ Meeting with the Director of Provincial Department of Agriculture And Forestry
20/01/99	◆ Training in Na Luang
21/01/99	◆ Training in Na Luang
22/01/99	◆ Travel from Luang Phabang to Vientiane
23/01/99	◆ Writing Report and Manual in Vientiane
24/01/99	◆ Travel to Savannakhet
25/01/99	◆ Visit to Livestock and Fisheries Section, Savannakhet Province ◆ Visit Pak Bo Fisheries Station ◆ Visit small-scale hatcheries around Savannakhet
26/01/99	◆ Travel Savannakhet - Pakse

27/01/99	<ul style="list-style-type: none"> <li>◆ Meeting with Mr. Prachit Noraseng, Chief of Livestock and Fisheries Section, Champassak Province</li> <li>◆ Visit of Km8 hatchery</li> </ul>
28/01/99	◆ Visit of private fish farm – hatchery in Pakse District
29/01/99	◆ Writing Report and Manual
30/01/99	◆ Writing Report and Manual
31/01/99	◆ Training on broodstock management in Pakse
1/02/99	◆ Training on broodstock management in Pakse
2/02/99	◆ Travel by road from Pakse to Vientiane
3/02/99	◆ Finalizing report and manual on broodstock management
4/02/99	◆ Travel Vientiane - Bangkok
5/02/99	◆ Debriefing FAO - RAPA
6/02/99	◆ Travel Bangkok - Home

## ANNEX 3: TIMETABLE OF TRAINING COURSE

### Workshop in Nongteng Fish Seed Station 13/01/99 –14/01/99

<b>DAY 1</b> 8.30 –10.15	Theory – Some basics about broodstock management <ul style="list-style-type: none"> <li>◆ Some biological characteristics</li> <li>◆ Broodstock ponds</li> <li>◆ Stocking broodstock</li> </ul>
10.15-10.30	<ul style="list-style-type: none"> <li>◆ Coffee break</li> </ul>
10.30-12.00	<ul style="list-style-type: none"> <li>◆ Maintaining broodstock</li> <li>◆ Care during reproduction phase</li> <li>◆ Rearing future broodstock</li> <li>◆ Transportation</li> </ul>
12.00-13.00	<ul style="list-style-type: none"> <li>◆ Lunch</li> </ul>
13.00-14.15	<ul style="list-style-type: none"> <li>◆ Exercise of yearly planning and organisation of a typical hatchery</li> </ul>
14.15-14.30	<ul style="list-style-type: none"> <li>◆ Coffee break</li> </ul>
14.30-16.00	<ul style="list-style-type: none"> <li>◆ Exercise of yearly planning and organisation of a typical hatchery (Cont.)</li> </ul>
<b>DAY 2</b> 8.30-10.15	<ul style="list-style-type: none"> <li>◆ Drawing up lessons from the exercise</li> <li>◆ Variations on the typical hatchery with reference to participants' requests</li> </ul>
10.15-10.30	<ul style="list-style-type: none"> <li>◆ Coffee break</li> </ul>
10.30-12.00	<ul style="list-style-type: none"> <li>◆ Drawing up lessons from the exercise (Cont.)</li> <li>◆ Variations on the typical hatchery with reference to participants' requests</li> </ul>
12.00-13.00	<ul style="list-style-type: none"> <li>◆ Lunch</li> </ul>
13.00-14.15	<ul style="list-style-type: none"> <li>◆ Practical activities at the pond: selection / handling / transportation</li> </ul>
14.15-14.30	<ul style="list-style-type: none"> <li>◆ Coffee break</li> </ul>
14.30-16.00	<ul style="list-style-type: none"> <li>◆ Practical activities at the pond: selection / handling / transportation</li> </ul>

## **ANNEX 4: LIST OF PERSONS MET**

- ◆ Mr. Peer Hijmans, FAO Representative in Lao PDR
- ◆ Mr .Bounthong Saphakdy, National Project Director of LAO/97/007
- ◆ Mr. Chanthaboun Sirimanotham, Chief of Fisheries Division
- ◆ Mr. Ounkham, Chief of the Nongteng Fisheries Station
- ◆ Mr. Phounthasy, manager of Tah Ngone farm
- ◆ Mr. Khoune, owner of small-scale hatchery
- ◆ Mr. Bane Lom Siakkhasone, Deputy Director of Huay Sone / Huay Sua Agriculture Development and Service Center Project
- ◆ Dr. Simon Funge-Smith, FAO Aquaculture Development Advisor, Provincial Aquaculture Development project (LAO/97/007)
- ◆ Mr. Bounkouang Souvannaphanh, Deputy Director General of the Department of Livestock and Fisheries, Ministry of Agriculture and Forestry
- ◆ Mr. Chanphone Keoboualapheth, Chief of Livestock and Fisheries Section, Luang Phabang Province
- ◆ Mr. Bunjangmi Keosawath, Director of provincial Agriculture and Forestry Department, Luang Phabang Province
- ◆ Mr. Olideth Souksawan, Chief of Nah Luang Fisheries Station
- ◆ Mr. Bounthak, Chief of Savannakhet Fisheries Station
- ◆ Mr. Prachit Noraseng, Chief of Livestock and Fisheries Section, Champassak Province
- ◆ Mr. Phounsay, Chief of Pakse Fisheries Station

## **ANNEX 5: LIST OF PARTICIPANTS TO THE TRAINING ON BROODSTOCK MANAGEMENT**

### **Broodstock Training at Nongteng13-14/1/99**

1. Dr. Bounkhouang SOUVANNAPHANH, DDG, DLF
2. Mr. Chanthaboune SiRIMANOTHAM, Chief of Fisheries Division
3. Mr. Bounthong SAPHAKDY ,NPD of LAO/97/007
4. Mr. Soukhin KEOMANIVANE, DNP, LAO/97/007
5. Dr. Simon Funge-Smith, ADA, LAO/97/007
6. Mr. Khampiang Onesy, Chief of Nonghai Fish Farm(VTE)
7. Mr. Khamsing VTE
8. Mr. Khoune VTE
9. Mr. Ounkham ,Chief of Nongteng Fish Seed Station
10. Mr. Phonethong THAMMAVONG, Nongteng Fish Seed Station
11. Mr. Vilaykhoun, Nongteng Fish Seed Station
12. Mr. Khamla, Nongteng Fish Seed Station
13. Mr. Sipheth, Nongteng Fish Seed Station
14. Mr. Chitaphong SISONKHAM, Nongteng Fish Seed Station
15. Mr. Aloune PHONVIXAY, LARI
16. Mr. Thavone PHOMMAVONG, LARRI
17. Mr. Phathanong LASY ,Youth Organisation
18. Mr. Khamson, VTE
19. Mr. Bounpany, Fisheries Division
20. Ms. Bounthay, VTE Province (Fisheries Section)
21. Mr. SengSong, Saysomboune Special Zone
22. Mr. Hom, Army( Min. of Defence)
23. Mr. La, Army (Min.of Defence)
24. Mr. Bounseng, Borikhamxay Province
25. Mr. Khantheo KEODARA, VTE
26. Mr. Soulath ONECHANTHIVONG, LAO/97/007
27. Mr. Phounthasy, Tha ngone Fish Farm.

### **Broodstock Training at Luang Phabang 20-21/1/99**

1. Mr. Soukhin KEOMANIVANE, DNP, LAO/97/007
2. Dr. Simon Funge-Smith, ADA, LAO/97/007
3. Mr. Phayvane, Chief of Oudomxay Fish Farm(VTE)
4. Mr. Aveune ,Oudomxay Fisheries staff
5. Mr. Juanich, UNV/LAO/97/007
6. Mrs. Daphone ,Private Fish Farm
7. Mrs. Bouathong , Luangnamtha Fisheries staff
8. Mr. Chanphone ,Luangprabang DLF
9. Mr. Pheng, LPDLF
10. Mr. Onideth, Chief Naluang Fish Seed Station
11. Mr. Kenchanh ,Naluang Fish Seed Station
12. Mr. Bounpanh Naluang Fish Seed Station
13. Mr. Pany Naluang Fish Seed Station
14. Mr. Somthong, Houaphanh Fish Seed Station
15. Mr. Vandy, XK .Proj. Counterpart
16. Mr. Sithon , XK. Chief Fish Seed Station
17. Mr. Feng, 30 Ha Fish seed Station
18. Mr. Pane, Saya. Private Fish Farm
19. Mr. Blake. Sayaboury. UNV/LAO/97/007
20. Mr. Khammouane, XK. Private Fish Farm
21. Mrs. Khamy ,Bokeo Fisheries staff

**Broodstock Training at Champasack 31/1/99-1/2/99**

1. Dr. Bounkhouang SOUVANNAPHANH, DDG, DLF
2. Mr. Chanthaboune SiRIMANOTHAM, Chief of Fisheries Division
3. Mr. Bounthong SAPHAKDY ,NPD of LAO/97/007
4. Dr. Simon Funge-Smith , ADA, LAO/97/007
5. Mr. Phounsay , Chief of KM 8 Fish Farm
7. Mr. Khounbolom ,KM 8 Fish Farm
8. Mr. Phounsavath, Fisheries Technician Prov. Fisheries Section
9. Mr. Bounned , Chief of Khammouane Fish Seed Station
10. Mr. Lamngeune, PakBo Fish Seed Station
11. Mr. Khamsay ,Saravane Fish Seed Station
12. Mr. Bolivane, Saravane Fish Seed Station
13. Mr. Sysouk, Agriculture School
14. Mr. Bounsiang, Agriculture School
15. Mr. Bounnun, Champasak District Fisheries Technician
16. Mrs. Sompong, Attapeu DLF
17. Mr. Seumasy, Sekong DLF
18. Mr. Sounthone, Sekong DLF
19. Mr. Fujino Matsatoji UNV/LAO/97/007 (Sekong)
20. Ms. Bounhuang, Agriculture School
21. Mr. Khamphou, Agriculture School
22. Mr. Sengna ,Agriculture School
23. Mr. Louang, Private Fish Farm
24. Mr. Sa, Fish Community (Solonoi Village)
25. Mr. Simon Bush ,ACIAR
26. Mr. Ken, Outhouphon District
27. Mr. Daovane, Phin District

## **ANNEX 6: TITLES AND EDUCATIONAL BACKGROUND OF PERSONNEL OF VISITED STATIONS**

<b>Nongteng</b>	
Mr. Ounkham	Diploma - Animal Husbandry - Bulgaria (Station head)
Mr. Khamla	Certificate - Tha Ngone Fisheries Project - Vientiane (head of broodstock and market fish production)
Mr. Veelaykhoun	Certificate - Tha Ngone Fisheries Project - Vientiane (head of nursery)
Mr. Bounphanee	Certificate - Animal Husbandry - Czechoslovakia (head administration)
Mr. Phontong	Diploma - Municipal Agriculture School - Vientiane (technician)
4 Labourers	Secondary Education
<b>Luang Phabang</b>	
Mr. Onideth	BSc/MSc - Animal Husbandry - Russia (Station head)
Mr. Inphan	BSc/MSc - Fisheries - Russia (Deputy Station head)
Mr. Kenchan	Diploma Animal Husbandry and Aquaculture - Na Bong agriculture college, Vientiane, Lao (technician)
Ms. Manivorn	Diploma - Fisheries - Russia (administration/technician)
Mr. Phanee	Diploma - Fisheries - Russia (technician)
3 Labourers	Secondary education
<b>Savannakhet</b>	
Mr. Bounthak	Diploma Animal Husbandry and Aquaculture - Na Bong Agriculture college, Vientiane, Lao (Station Head)
Mr. Lamngern	Diploma Animal Husbandry and Aquaculture - Na Bong Agriculture college, Vientiane, Lao (Deputy Station Head)
Mr. Inthong	Diploma Animal Husbandry and Aquaculture - Pakse Agricultural college, Pakse, Lao (technician)
3 Labourers	Secondary education
<b>Pakse</b>	
Mr. Bounsai	Diploma Animal Husbandry and Aquaculture - Na Bong Agriculture College, Vientiane, Lao (Station head)
Mr. Khounboulom	Diploma Animal Husbandry and Aquaculture - Pakse Agriculture College, Pakse, Lao (Deputy station head)
Mr. Bhudsavat	Diploma Animal Husbandry and Aquaculture - Na Bong Agriculture College, Vientiane, Lao (technician)
3 Labourers	Secondary education

## **ANNEX 7: DOCUMENTS PRODUCED BY LAO/97/007.**

### **STS Field Documents:**

- No. 1 Mini-Hatchery Development
- No. 2 Socio-economics and Gender in Aquaculture (English version)
- No. 2L Socio-economics and Gender in Aquaculture (Lao version)
- No. 3 Small-Scale Fish Hatcheries for Lao PDR (English version)
- No. 3L Small-Scale Fish Hatcheries for Lao PDR (Lao version)
- No. 4 Broodstock and Hatchery Management
- No. 5 Guidelines for broodstock management (English version)
- No. 5L Guidelines for broodstock management (Lao version)

### **Project Field Documents and outputs:**

- No. 1 Government Fish Fry Production Facilities in Lao P.D.R. (December 1997)
- No. 2 Current Production Constraints and Suggested Improvements at Nongteng Fish Seed Station, Vientiane, Lao P.D.R.
- No. 3 Timetable of Project Activities 1998
- No. 4 Proposed Strategy for Extension of Aquaculture to Farmers Groups
- No. 5 Comments on Proposed Fish Hatchery/Seed Station at Hooay Keeow, Lamam District, Sekong Province
- No. 6 Introduction to the Provincial Aquaculture Development Project - Potential for Collaboration and Co-ordination
- No. 7 Training Notes for Workshop on Fish Culture Extension (Oudomxay and Savannakhet, March 1998) (English version)
- No. 7L Training Notes for Workshop on Fish Culture Extension (Oudomxay and Savannakhet, March 1998) (Lao version)
- No. 8L Fish Culture in small ponds, Extension Handout (Lao version)
- No. 9L Nursing fish in cages, Extension Handout (Lao version)
- No. 10L Rice-fish culture, Extension Handout (Lao version)