7. TRANSPORTATION

7.1 A FEW BASICS

- Fish to be transported must be in excellent condition, free of diseases or wounds. Weak fish will die more quickly than healthy one.
- For the same weight, small fish require more space and oxygen in the bag than big fish.
- It is of course advised to transport young small broodstock instead of old big ones.
- Fish can be transported for longer time when temperature is lower and fish are quiet and not stressed. This will reduce their activity and their oxygen consumption.

7.2 ON LONG DISTANCES

It is often advised to transport broodfish in large containers. However this kind of carrier is not available in Lao PDR and the use of plastic bags is the only practical method.

7.2.1 CONDITIONING

As well as fry or fingerlings, broodfish must be conditioned before being packed for transport. The main conditioning feature implies that fish should, before packing, rid themselves of all food existing at different stages of digestion in the body. Fish should also be acclimated to a much smaller volume of water.

The duration of conditioning is minimum 1 day and better if 2 days.

If no tank is available fish should be kept in a shaded corner of the pond in a hapa net, near an open water inlet. You should choose a poorly fertilised pond so that the fish little natural food.

If tanks are available, place the fish in the tank and reduce the volume of water available for the fish to move (as low as 0.5 m^3 per fish). Use a shallow water level to prevent the fish from jumping out. Don't distribute any feed and have a vigorous splashing of water for oxygenation and flushing away all excreta.

7.2.2 ANAESTHETIZING

As anaesthetics are not available in Lao PDR this technique will not be considered here. More information is presented in annex 4.

7.2.3 TRANSPORTATION

Plastic bags (20 - 30 litres) for fingerlings are used for broodstock transportation.

Two bags are used. An inner bag is inserted in the outer one. Inner bag is filled with 5 to 10 l for a 30 l bag.

Put clean water at the same temperature than the temperature of water where you keep the fish.

One worker keeps the bag open whilst another introduce the fish in the bag. Oxygen is added and the bag is tightly closed as in the case of fry.

The bags are put in some transport case for protecting against any damage and for insulation. The case can be made of or lined with styrofoam (about 2 cm thick) for thermal insulation. Wooden boxes are useful because they are durable and help to insulate. Metal should be avoided.

If temperature is high and the planned trip a long one, ice can be placed under the bag, on the bottom of the case (not in the bag itself). There should even be some separation layer (a jute sack, rice husks or saw dust for instance) between the ice and the bag. This is because the temperature drop should not be faster than 5° C per hour. The amount of ice is about 10-20 % of the transport water. The reference rate is that half a kg of ice can reduce the temperature of the 10 l of water by 1°C. A better insulation is done by pouring more rice husks or saw dust in the case all around and above the bags. A sheet of styrofoam is added on the top below the cover of the box.

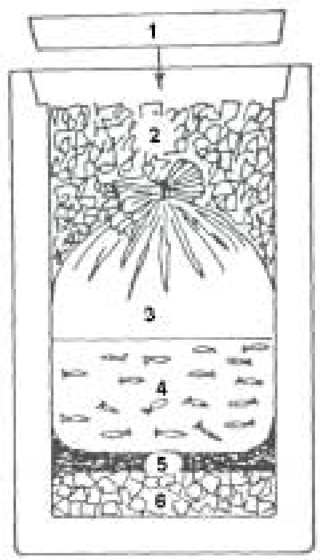
Starting temperature	**Required temperature**	**Difference in temperature**	**Ice to be added in the box if volume of water in bag is:**	
			10 l	**20 l**
32°C	22°C	-10°C	1.25 kg	2.5 kg
30°C	22°C	- 8°C	1.0 kg	2.0 kg
28°C	22°C	- 6°C	0.75 kg	1.5 kg
26°C	22°C	- 4°C	0.5 kg	1.0 kg

Table 4: amount of ice for decreasing temperature.

There can be more than one bag per case if the case is big enough. If adding ice, calculate the weight of ice according to the total volume of water of all bags.

The cases are put on the vehicle that should be covered for protection against the sun. If no roofing is available, or if temperature is high any way, it is possible to reduce water temperature by covering non-insulated cases with wet clothing, which will evaporate through the wind action when driving, and cool the bag. Water has to be added often to the clothing.

Broodfish should be transported in individual bags except if their weight is less than 1 kg. Total weight of several fish in one bag should not exceed 1 to 1.5 kg.



Legend:

1) Insulated lid (polystyrene foam, wood or cardboard)
2) Insulation material (sawdust, rice husks, cloth, straw)
3) Oxygen in fry transport bag
4) Water in bag (30% of total volume of bag)
5) Insulating material to separate bag from ice (sawdust, rice husks, cloth, straw)
6) Broken ice (amount used taken from table 4)

Figure 10: Use of insulated box for transporting plastic fry bags.

7.2.4 RELEASE AT DESTINATION

This moment is a critical stage of the transport process. Fish are under stress and are then exposed suddenly to new water conditions. Water for stocking should be of excellent quality, rich in oxygen.

It is better to stock fish into tanks where water of good quality and rich in oxygen can be provided (*i.e.* in the hatchery) and where they can be observed during the next hours.

Similarly with stocking of fingerlings, it is essential to acclimatise the broodfish by:

- Equalising the temperatures
- Equalising the water characteristics, e.g. the pH if pH is different
- During acclimatisation, fish can be provided aeration if it is available.

7.2.5 BEST PERIOD FOR TRANSPORTATION

- Broodstock should be transported after the breeding season (September – February)
- The best period is during the cool season (November to January). At this time, Chinese and Indian carp have stopped reproducing, and other species are at the lowest activity level.
- In this way, broodfish can be transported in the best conditions, in cool weather, and be stocked for several months in their new pond for recuperation before new spawning season.

7.3 TRANSPORT AROUND THE FARM

- Broodstock should always be transported in water to reduce stress.
- Devices like hammocks made of plastic sheeting can be used.
- Plastic basins of the commerce can also be used. They should be covered by a net or a cover for avoiding injury to the fish jumping out.

8. PLANNING YEARLY AND MEDIUM-TERM ORGANIZATION

At the end of the fry production season (September-October), the hatchery manager needs to plan the operations for the following year and should also draw a development plan for the medium term, let's say 3 or 5 years.

The purpose of the medium-term plan is to determine how the hatchery should be properly maintained at the current level, and if possible how it can be renovated if important works are necessary, and even further how it can be developed by extension or new facilities and equipment. The plan should also include any training requirements. This plan is indicative and must leave space for flexibility.

The purpose of the annual plan is to fix objectives of production, to determine the means to reach these objectives, to draw up the corresponding budget with expected expenses and income, and to establish a calendar of operations that will serve as guideline throughout the year.

Production targets are often fixed according to known production capacity concerning a model or to experience. The problem in Lao PDR, is that hatcheries do not follow any particular model/plan and are in addition affected by various local constraints. It is also widely recognised that the current production levels could be significantly improved.

Rather than fixing in advance an objective of production, it should preferable to reorganise the operations plan according firstly, to the physical constraints of the farm and then to the technical, managerial, personnel and financial means / constraints.

The production plan must follow the demand for fish:

- ***What is the species?***
- ***When are they required?***
- ***How many are required?***

It is important to identify as precisely as possible what constraints are most influencing the production so that they can be addressed first. In many cases constraints are not obvious, only that there is a real problem with production without knowing its origin. Solving these kinds of problems would need:

- Observe and record precisely what is happening each time the problem occurs (before, during and after the occurrence)
- Compare records and see what is similar and what is different
- Modify the technique and compare its record with the former ones

Many constraints, when well understood, can be removed by simple methods without requiring significant financial investment.

8.1 MARKET REQUIREMENTS

Requirements of the market concern:

- The peak months of fry demand
- The preferred species for farmers ponds
- The size of fry (*i.e.* small size for nursing or large size for direct stocking to ponds)
- The quantity

Every hatchery has a limited area of ponds and cannot accommodate all species. Choices must be made, according to the capacity of the hatchery and the demand or, better still, the acceptability by the farmers.

The responsibility of the provincial hatcheries is to assist the development of aquaculture within the provinces. As such, they should concentrate on species that are the best adapted and that perform well in the conditions of most farms: they must be tolerant, feed on natural food or local by-products in green water ponds. They must grow quickly in small, shallow ponds or paddy-cum-fish systems and be consumable or marketable in 5 or 6 months maximum. The fry must be available in large numbers to the farmers as soon as ponds contain enough water.

In Lao PDR, only 2 species meet all these requirements: the common carp and the silver barb. They are already highly appreciated by farmers and should attract the maximum of attention, efforts and means from the hatchery staff. The whole organization of the hatchery should be made in order to put these 2 species in the best condition for breeding and mass production.

Additional species should be accommodated according to what is left over. But the total number of species kept in each hatchery should not exceed 3-4. Tilapia breeding by itself may be considered apart.

The hatcheries can promote farmers to nurse very young fry in their farm so that the demand for nursing ponds is reduced. This will require some extension activity by the hatchery to demonstrate to farmers the feasibility and ease of this method.

8.2 CONSTRAINTS

8.2.1 WATER AVAILABILITY

The number and total area of ponds that can be reasonably kept full of water at the most critical period (usually from March to May) is determined by the water supply. Farm planning requires a decision as to:

- What is the pond area to be devoted to each category of pond: nursing, grow-out, broodstock and market fish
- What is the maximum biomass of broodstock that can be kept under good conditions
- What is the number of species, and which ones, that can be kept

If there is limitation on water availability during March-May, the manager may have to choose whether:

- Is it preferable to decrease the surface of broodstock pond and start early reproduction that can be nursed in nursery ponds?
- Or does he prefer to use most of the water surface with broodstock and start reproduction when the farm has already got water from the new rainy season?

Common ways used by managers for solving this typical problem in Lao PDR are:

- Mixing many species if not all present in the farm
- Mixing the sexes of silver barb and common carp
- Mixing spent broodfish and maturing ones
- Overstocking ponds without consideration of feeding and water requirements

These methods lead to a poor conditioning of the broodstock during their maturation period and a rather low fecundity: low number of eggs per kg of female, low fertilisation success and poor hatching.

8.2.2 POND AREA

The pond area devoted to each category of fish must be balanced in order that the production of eggs by the broodstock corresponds to the carrying capacity of the nursing ponds. Should broodstock be in excess (the most common case), it will not be possible to reproduce some part of it and money for its maintenance will have been wasted. Should it be missing, the hatchery will produce below capacity although several fixed costs still have to be paid (labour force, electricity, etc).

8.2.3 HATCHERY CAPACITY

The hatchery capacity itself is normally not a problem because tanks are used for a very short time. In fact hatchery equipment is always under-utilised.

8.2.4 TECHNICAL

In Lao PDR, water quality is not usually a problem for ponds if they are drained, dried, limed and fertilised according to basic standards for each crop.

Since pond preparation is usually performed badly,
this is a frequent problem with production, especially in nursery ponds.

There may be some problem in the hatchery, and according to the situation, it may be improved by modified operational techniques and/or by specific investment.

8.2.5 MANAGERIAL / PERSONNEL

Serious problems occurring in a hatchery usually result from an accumulation of small errors or lack of care.

Many technical problems and low production can be prevented by a regular and strict application of the basic management rules of a hatchery.

8.2.6 FINANCIAL MEANS FOR OPERATION

Funding by the Province and the Ministry are generally limited and may not always be provided in time. As inputs are not available on the market on a permanent basis, it is important to reserve a significant amount of the previous years profits for the forthcoming years operational costs.

8.3 CASE STUDY

Let's have a look at what could be a typical small-scale Lao hatchery, how to avoid some constraints and draw up a very basic organization plan.

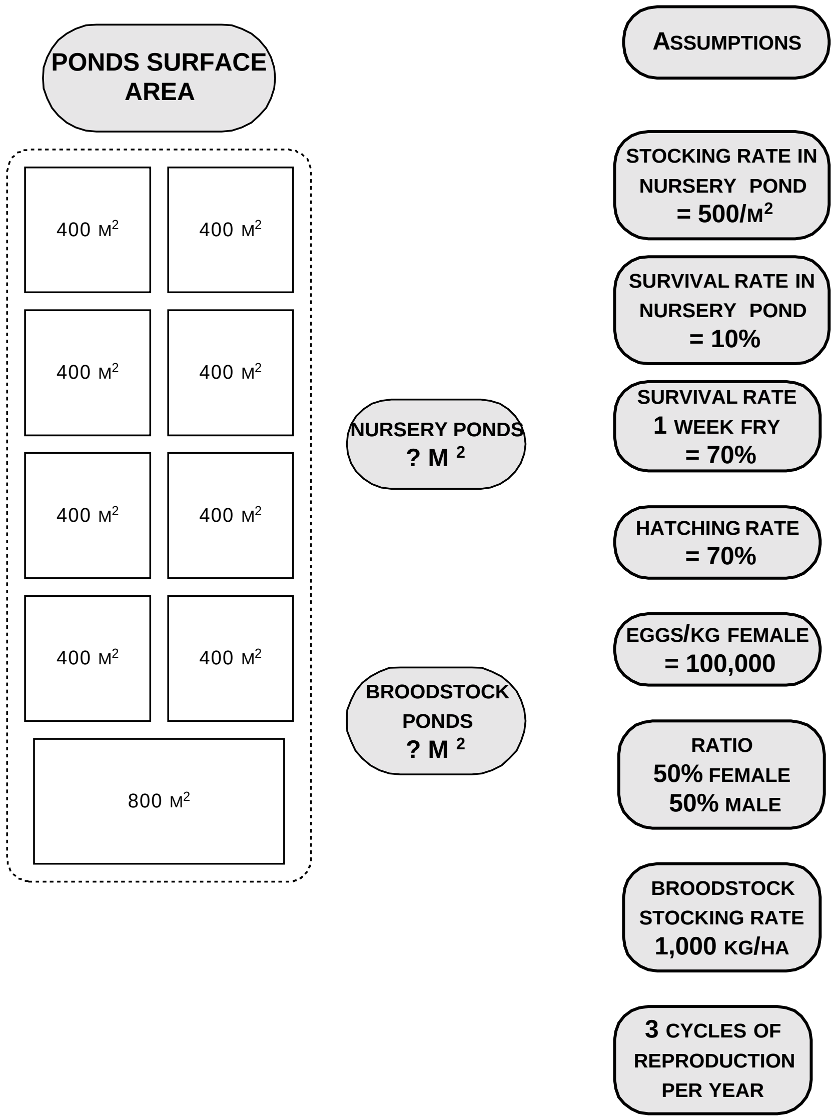


Chart 1: situation of a typical Lao hatchery.

Chart 1 represents a "typical" hatchery in Lao PDR that would be stocked with 2 species like common carp and silver barb. It has 8 ponds of 400 m^2 and 1 pond of 800 m^2. These ponds need to be organised for keeping broodstock and nursing fry. It is supposed that the hatchery itself is big enough and with the appropriate equipment for dealing with all broodstock and its fry production. The chart includes assumptions on technical ratios to be used and probable results occurring at different stages of operation. Figures of results are conservative to reflect the difficulties of Lao conditions.

<u>Tentative organization</u>

Starting from the 9 ponds available, a possible way to plan the organization of that hatchery and calculate its possible production is described in Chart 2.

It is assumed that all small ponds of 400 m^2 are used for nursery and the pond of 800 m^2 is used for broodstock.

The easiest way to see if that plan is working and what it can bring is to start from a single nursery pond:

- The pond is to be stocked with 500 fry/m^2, i.e. 200,000 fry and the survival rate after 1 month is estimated at 10%.
- A cycle produces thus 20,000 fingerlings.
- If there are 8 ponds and 3 cycles are made per year, the total production of fingerlings is 480,000 in one year.

The question is to know the weight of broodstock necessary to produce all these fingerlings.
Chart 2 gives the answer.

For producing 200,000 one-week fry (to be nursed), 4.1 kg of females are necessary assuming that:

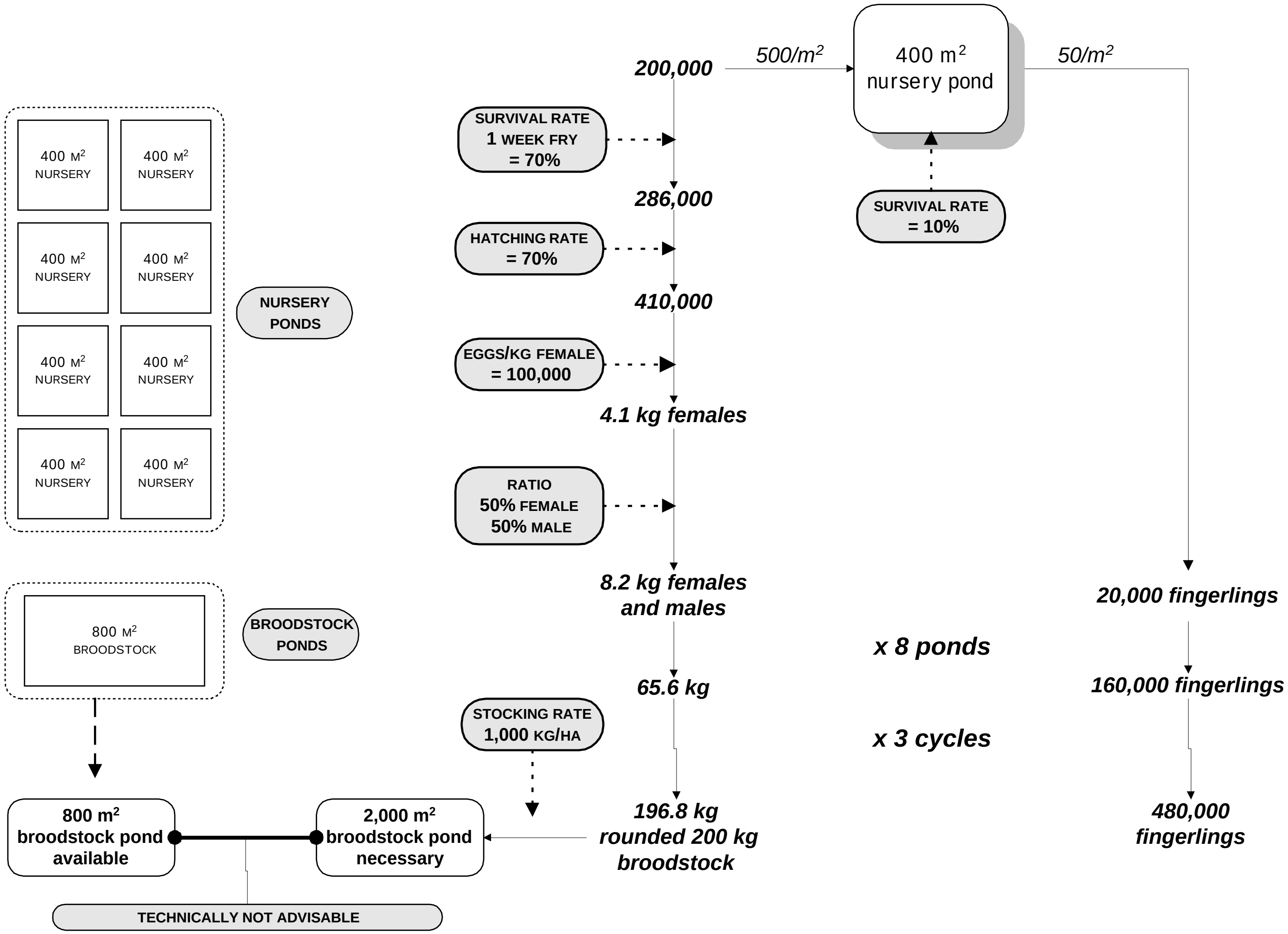
- 1 kg of female produce 100,000 eggs
- The eggs have a hatching rate of 70%
- Hatched fry have a 70% survival at 1 week.

If the ratio of males and females in the pond is 1:1 then
8.2 kg of broodstock are necessary for producing 200,000 one-week fry for one nursery pond.

As there are 8 nursery ponds and 3 cycles in the year, this hatchery must keep about 200 kg of broodstock for which 2,000 m^2 of pond are necessary.

But there is only one 800 m^2 pond available for broodstock, which would mean a stocking rate of 2,500kg/ha instead of the recommended level of less than1,000 kg/ha. This stocking density is too high for the production of good quality broodstock, therefore a change I the management plan is required.

Chart 2: Tentative organization of ponds used by broodstock and nursery in the hatchery.



Reorganisation (chart 3)

The manager needs to increase the pond surface available for the broodstock.

Three ponds totalling 1,600 m^2 are attributed to broodstock and six 400 m^2 ponds are for nursing.

Let's proceed to the calculation in chart 3.

Starting from a single nursery pond. All rates used are the same.

- As there are only 6 nursery ponds, the production of fingerlings is reduced at 360,000 (20,000 x 6 ponds x 3 cycles).
- Because there are now only 6 nursery ponds and still 3 cycles, the required amount of broodstock is now reduced to 150 kg from 200 kg.
- The 150 kg of broodstock requires a pond area of 1,500 m^2 and 1,600 m^2 are available. The solution is thus acceptable.

Improvements (Chart 4)

Chart 4 illustrates the possible effects of better care or improved techniques applied in the hatchery.

In case 1, on the left part of the chart:

- Improved management (better feeding, less stress, etc) allows females to give 125,000 eggs instead of 100,000.
- The number of broodfish necessary to get the same amount of fry is reduced by 25%.
- Now only 120 kg of broodstock are necessary instead of 150 kg.
- The broodstock pond area necessary is reduced by 400 m^2.
- The higher fecundity of the females simplifies the management and decreases the fixed as well as the variable costs of operations.

In case 2, on the right part of the chart:

- More careful and intensive preparation and feeding of the fry in the nursery pond allows to increase the survival rate from 10 to 15%.
- Although 15% may still seem a low survival rate, it gives an increase of the fry survival by 50% (from 360,000 to 540,000)
- This increases the income by 50%.

These 2 small examples show that the manager and the staff of the hatchery can often increase significantly the performance at many stages by working carefully and respecting basic technical guidelines.

Identifying problems

This example also allows us to see how it can be useful to record data during the different phases of operation. Recording data for each operation will allow to see when an operation is failing or less successful and maybe to identify the factor(s) causing the failure.

It gives comparison between ponds, between periods of the year or between 2 years. It will also allow measurement of the progress made after staff training or after tools or facilities are modified or added.

Chart 3: Re-organization of ponds that are used for broodstock and hatchery culture in a hatchery

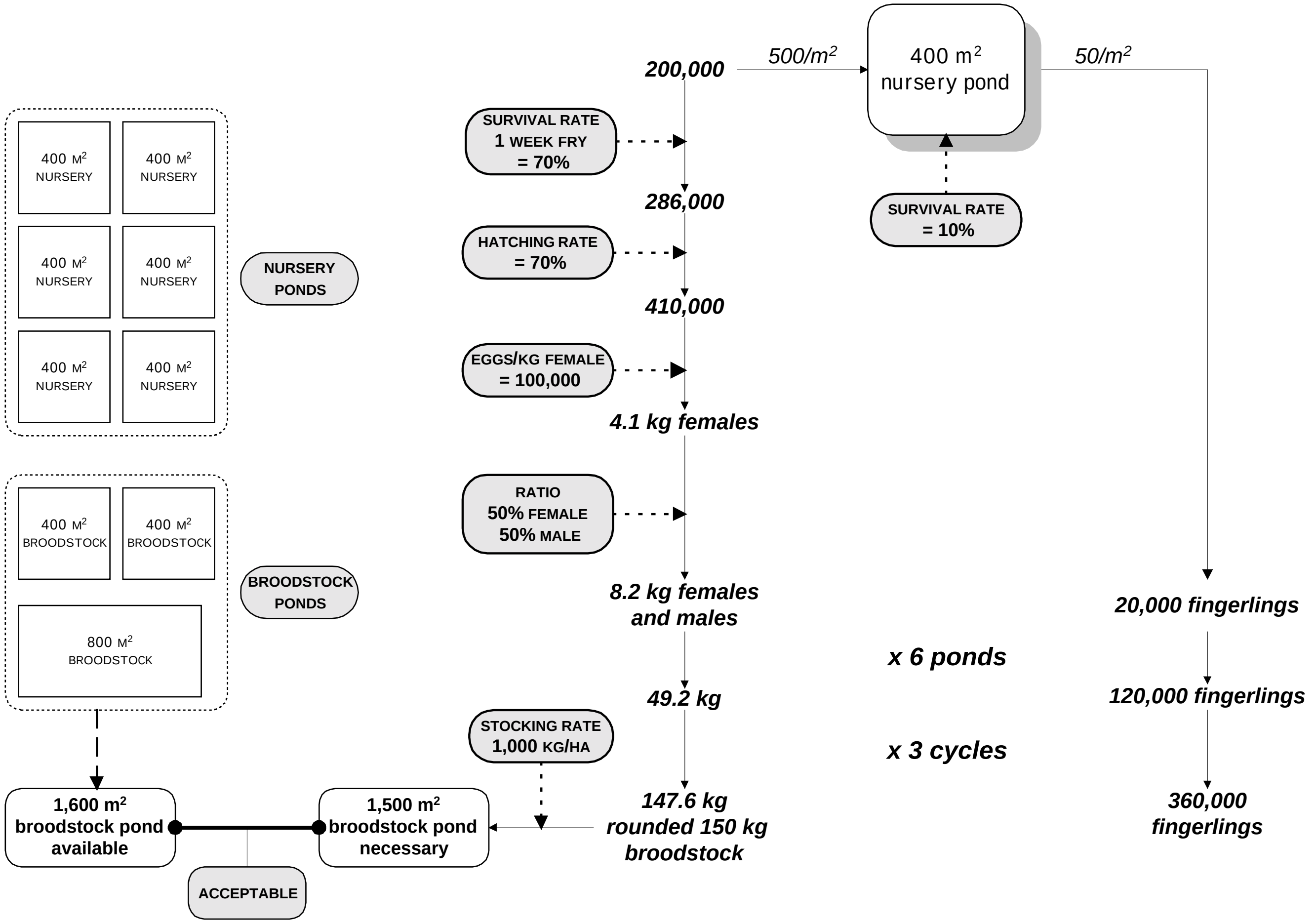
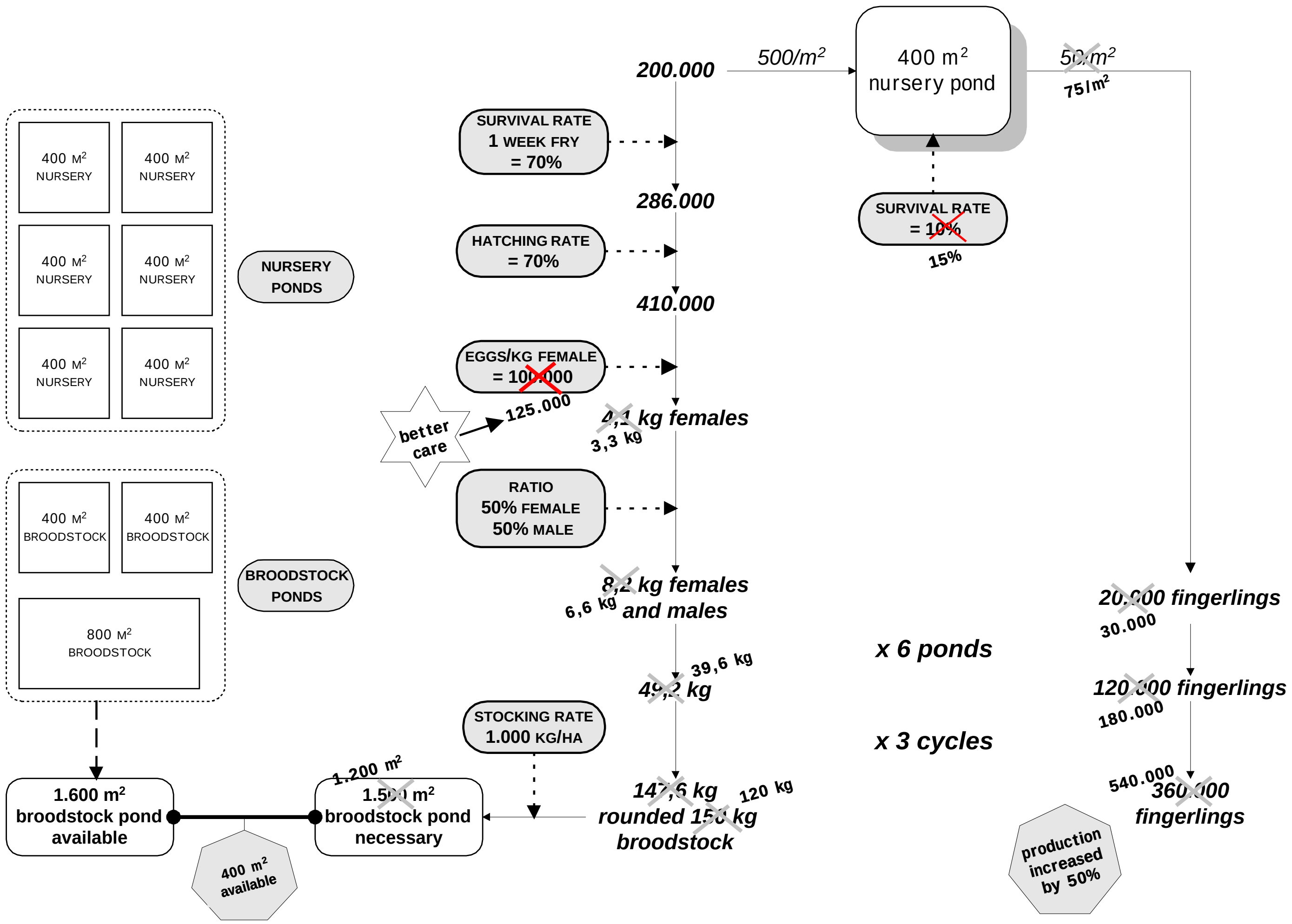


Chart 4: The effects of better care of broodstock and increased survival rate through good nursery pond management



8.4 OPERATIONAL PLAN FOR THE YEAR

Prior to establishing the yearly plan of operations, the manager must carefully estimate the farmers demand for fry for the different kinds of fish culture operations (in seasonal ponds, perennial ponds and paddy-cum-fish systems). As far as possible the number of fry should be quantified per month. The information is visualised on the top of the operations timetable (see Chart 5).

The plan itself should describe the various activities to be implemented; the techniques used, the necessary inputs with the amounts, the cost per unit and the total cost, the personnel involved, the expected productions. All activities should be presented on a timetable like the one in Chart 5.

8.4.1 ACTIVITIES

Activities may be presented in different ways. An easy one is to group them according to the categories of fish: broodstock, fry-fingerlings and market fish. Operations of general interest should be put below.

For each activity the basic factors must be estimated with a reasonable safety margin (let's say 5% in average). Let's review the different activities.

Broodstock and broodstock ponds

POND DRAINAGE AND PREPARATION

This operation should be conducted twice a year, when selecting broodstock and when releasing them after spawning.

The mud in the bottom of the pond is removed every 2 or 3 years after a 1 to 2 week drying. In the meantime, the mud near the water outlet (monk or pipe) should be removed or flushed out of the pond each time it is drained. This operation lasts a few hours for 2 workers.

The pond is cleared from vegetation. It is limed at 4 kg/100 m^2 and manured at 25 kg (chicken manure) /100 m^2 (see Table 2). It is filled up with water after inspection and proper installation of all pond devices (water inlet, protection, oxygenation, and water outlet)

The inputs for each pond are calculated as follows:

Lime: Pond surface (in m^2) x 4 kg) /100

Manure: Pond surface (in m^2) x 25 kg /100

Labour requirement: 2 man-days per 800 m^2 pond

The total requirement may be calculated as follows:

Lime: Total surface ponds used for broodstock x 4 kg x 2 times / 100

Manure: Total surface of ponds used for broodstock x 25 kg / 100

Labour force: Total surface of ponds used for broodstock x 2 man-days / 800 m2

MAINTENANCE FEEDING

Maintenance feeding is performed for 8-9 months per year. The usual feeding rate is 2% of the fish weight. This calculation requires that broodstock are weighed before stocking.

As the broodstock fish grow the feeding rate according to the initial weight should be adapted, increasing 0.1% - 0.2% per month. At the end of the 9 month period, feeding rate would be 2.8% - 3.6%. The average rate to be used for planning and budget calculation should be 2.4% or 2.8%.

Grass carp and silver barb must also be fed grasses.

The feeding is supplemented by a regular (weekly if possible) input of manure.

The needs are calculated as follows:

Feed: Total weight of broodstock (all species) in station (in kg) x % of fish weight x 270 days

Grass: Weight of grass carp + silver barb (in kg) x 20% x 270 days

Manure: Total surface of broodstock pond (ha) x 300 kg chicken manure x 39 weeks / 10.000

BROODSTOCK CONDITIONING WITH HIGH PROTEIN FEEDS

Maturing broodstock require a higher quality feed for development of eggs. Since all species do not mature at the same time, they should be stocked in different ponds so that if feed is scarce, females will have priority. Silver barb and grass carp diets are supplemented with grasses (about 20%)

The needs are calculated as follows:

Feed: Total weight of broodstock (all species) in station (in kg) x % of fish weight x 90 days

Grass: Weight of grass carp + silver barb (in kg) x 20% x 90 days

Manure: Total surface of broodstock pond (ha) x 300 kg chicken manure x 13 weeks / 10.000

SELECTION OF BROODFISH

This operation may require the pumping of pond water if there is no gravity drainage. Only permanent staff of the station should be used. This operation suspends most of the other operations in the station (except feeding and water control). The selection is directly followed by the sale of unsuitable broodfish within the following 2 days.

SEPARATION OF SEXES

This operation is only required for common carp and silver barb. Sex separation is conducted at the same time as the selection of broodfish. It only requires labour from the permanent staff.

REPRODUCTION OF COMMON CARP

This requires the participation of many permanent staff (specialised and non-specialised) for the different operations between the capture of the broodfish in one pond and their release in another pond (that must have been prepared: see Pond preparation above).
No hormone is required. Spawning substrate is cheap but requires time for preparation. Typically plastic string bunches are used and this lasts for a few years.

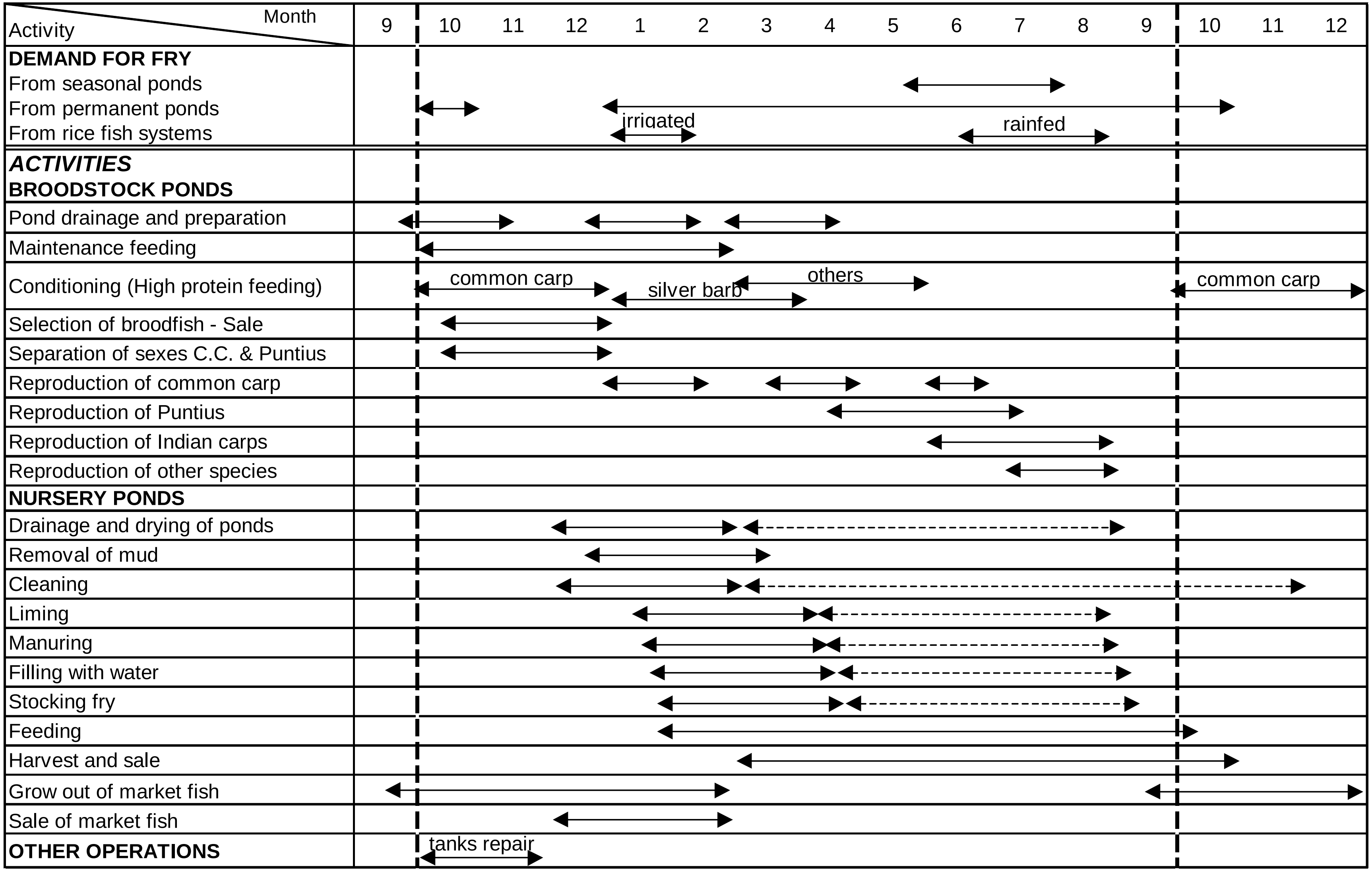
REPRODUCTION OF SILVER BARB

As for the common carp, this requires only the permanent staff. It also requires the use of hormone to be calculated as follows:

Suprefact: Number of kg of females silver barb to be injected x 15 µg

Motilium: Number of kg of females silver barb to be injected x 1 tablet (10 mg)

Chart 5: calendar of activities for farm with hatchery.



REPRODUCTION OF INDIAN CARP

This requires the permanent staff and also requires the use of hormone to be calculated as follows:

Suprefact: Number of kg of females Indian carp to be injected x 20 µg

Motilium: Number of kg of females Indian carp to be injected x 1 pill (10 mg)

REPRODUCTION OF OTHER SPECIES

This requires the permanent staff and also requires the use of hormone to be calculated as follows:

Suprefact: Number of kg of females Chinese carp/other spp. to be injected x 20 - 30 µg

Motilium: Number of kg of females Chinese carp/other spp to be injected x 1 pill (10 mg)

Fry and nursery ponds

Every operation described below is performed several times in the year as each pond is used for nursing several batches of fry, usually 3 or 4 with a possible additional batch being grown out until table size or for broodstock for the following year.

All amounts listed below must thus be multiplied by the number of cycles in one year.

DRAINAGE OF PONDS

This is performed at the beginning of the dry season when the first ponds are prepared for the common carp. Ponds contain big fingerlings or table sized fish coming from the last batches of reproduction. Fish are removed for sale or ongrowing to broodstock size.

If water is scarce, water may be by pumped to other ponds instead of being discharged from the farm.

REMOVAL OF MUD

This operation is performed every 2 or 3 years for each pond after a 1 to 2 week drying. An average of 20 man-days is used for a 400 m^2 pond. In the meantime, the mud near the water outlet (monk or pipe) must be removed or flushed out of the pond each time it is drained. This operation lasts a few hours for 2 workers.

CLEANING

Vegetation in the pond must be uprooted and removed. Grass and weeds on the slope must be cut.

Dikes must be inspected for leakage or excessive erosion and possibly repaired. One or two man-days are enough for a 400 m^2 pond if normal maintenance is performed during the cycle (when the pond is full of water).

If complete drying is not achieved, predatory fish can be killed by application of derris root in the remaining water (see mode of application in annex). This operation requires a minimum of 10 days.

LIMING

The rate should be 7.5 kg of slaked lime/100 m^2 for new ponds This rate is cut by 50% for old well stabilised ponds (4 kg/100 m^2). The operation requires less than one man-hour for a 400 m^2 pond.

The lime required for each pond is as follows:

Pond surface (in m^2) x 4 kg) /100

If each pond is used the same number of times, the lime required for the whole farm :

Total surface of nursery ponds x 4 kg / 100 x number of crops

MANURING

Manuring is performed after liming. The rate should be 25 kg of chicken manure/100 m^2. The rate is to be increased if manure is from another animal (see Table 2). The operation requires one man-hour for a 400 m^2 pond.

The manure required for each pond is as follows:

Pond surface (in m2) x 25 kg /100

If each pond is used the same number of times, the manure required for the whole farm:

Total surface of nursery ponds x 25 kg / 100

FILLING WITH WATER

All pond devices must be properly installed before filling with water. It should require about 2 man-hours maximum.

The filling may be by gravity or by pumping from another pond. If pumping is used then the cost of fuel must be included in budgeting.

STOCKING FRY

Silver barb fry are stocked immediately after filling; other species are stocked 4-7 days after filling when the plankton bloom is established. Fry stocking rate is between 200 and 500 / m^2.
The main labour input is the permanent staff.

FEEDING

After hatching, first feeding in the hatchery is egg yolk during 6-7 days. The rate is 1 egg yolk per 200.000 fry per day.

The eggs required for fry production is thus:

Total weight females x average number of eggs/kg female x hatching rate x 6 days / 200,000

An estimate of numbers of fry must be done when stocking the fry into the pond so that the correct feeding for the pond is calculated. The estimates must be made for each species stocked. The average estimate of survival of each species made during one year should be used for the calculation of the following year.

In pond, feeding is according to the number of fry stocked. If feed used is rice bran + chicken starter feed at 50% each, a way of calculation is as follows:

0 – 7 days	=	Number of fry x 1kg feed x 7 days / 400.000
7 – 17 days	=	Number of fry x 2kg feed x 10 days / 400.000
17 – 42 days	=	Number of fry x 1kg feed x 25 days / 100.000

If the station does complete nursing for 42 days, feeds of the 3 periods are summed. Each station may decide, for local reasons, to have a different duration of nursing. In that case only some part of the calculation above will be used.

HARVEST AND SALE

Fry harvesting operations requires a high level of labour because they are likely to be performed several times a week during the season.

It may be useful for a station to advertise fry harvesting in advance to ensure quick sale. This reduces the load of work and allows a better conditioning of the fry.

GROW OUT OF MARKET FISH

Unsold fry at the end of the breeding season can be grown out in nursery ponds for further sale on the market as table fish. Ponds must thus be fertilised and / or fed according to the pond surface and fish stocked during the growing period (usually 4 or 5 months).

If fish growth is assessed by regular sampling, feeding should be made according to a rate of 2% of the weight estimated at the control for the first 2 months and then 1% of the estimated weight for the following months.

The total requirement can be estimated by applying the Food Conversion Ratio of the feed to the estimated final production. Apparent FCR of rice bran in fertilised pond may be 5 to 6. So for a production of 500 kg of fish, rice bran required is approximately: 5 x 500 kg = 2.5 tons.

Concerning other operations

Fry packaging includes the use of plastic bags and oxygen bottles. Renewal of broodstock includes the capture from the wild. This is especially useful for indigenous species.

There are also general costs for running the station that may be calculated as lump sums: administration, water and electricity, vehicle operation, etc.

8.4.2 OPERATIONAL COSTS

These should be drawn from the timetable of activities drawn up during annual planning (going on line by line). An example of how to make the calculations is presented in Table 5 and Table 6.

For each activity labelled in the first column, the second column describes how to calculate the amount of inputs necessary for that activity. The amount of each input has to be multiplied by its cost/unit located in the third column (an average cost is given). The total cost of the input is in the fourth column.

There are some particular cases. Examples of the cost per unit for inputs are given below.

(1) Feeding may be made of several components instead of just one. The cost of the feed will depend on the percentage of each component in 1 kg of feed.

Example

Suppose a feed made of** 60% **of fish pellet costing** 2.000 **Kip/kg and** 40**% of rice bran costing** 250 **Kip/kg:

The cost of 1 kg feed is:** (0.6 x 2.000) + (0.4 x 250) **= 1,300 Kip

(2) Calculation of hormone need is also particular as one bottle contains 10.000 µg enough for 300 to 1.000 kg of females depending on the species. Instead of calculating a cost for each species as in the Table 5, it may be easier to sum the total amount of Suprefact and Motilium that is necessary and then multiply by the cost.

Not all stations have such a weight of females to inject. One station could share hormone with another, or with private hatcheries; since the 10,000 µg bottle (10 ml) is the smallest volume available.

Although no figured example is given here, a survey of most state hatcheries in Lao PDR has shown that labour is currently the biggest part of operational expenses, often well over 50%.

Cost of pond preparation and feeding for both broodstock and fry are often extremely low. So is the cost of hormones.

These components essential to a good fry production and managers should be aware that sparing on these inputs is in fact counter-productive.

8.4.3 EXPECTED PRODUCTION AND INCOME

The fry production can be planned by using the method described in Chart 2. However the assumptions utilised in that chart are very general. They may be used as provisional values when starting a new hatchery.

When a hatchery is running, it must establish its own rates according to the observations and recordings of operational results.

A good management plan should allow making a breakdown of the fry production per species and per month, according to the calendar of activities. The manager must thus plan how many kg of females (of the different species) he is going to breed every month, and when consequently the fry will be available for farmers.

It will result in a simple table like the one shown in Table 7. The same table can also contain the income expected from the fry production.

8.4.4 PROFIT AND REINVESTMENT

Profit is not available in the same way for all stations.

In a private hatchery, wages are used for family members and often not counted in the operational costs. Casual labour must be accounted if used. As credit from banking system is difficult to obtain, it is very wise that some part of the profit be kept:

- For rolling over when no product is sold but expenses must be made (feeding outside the breeding season for instance)

- For reinvesting in the farm, for renovation or new development (new ponds or tanks, etc.)

State hatcheries are subject to different rules according to the province but all have the possibility to include some reinvestment in the budget as far as the budget remains in excess. **They should absolutely use this opportunity**.

Some guidelines are given in the next section for using the available funds in the most efficient way.

Table 5: how to calculate the expenses according to the planning of activities.

ACTIVITIES	Amount **to be multiplied by**	Cost/Unit *(Kip)	= Total cost(Kip)
BROODSTOCK PONDS			
Pond drainage and preparation	Lime: Total surface ponds used for broodstock x 4 kg x 2 times / 100 Manure: Total surface of ponds used for broodstock x 25 kg / 100 Labour force: Total surface of ponds used for broodstock x 2 man-days / 800 m^2 **SUBTOTAL**	x 350 x 30	
Maintenance feeding	Feed: Total weight of broodstock (all species) in station (in kg) x % of fish weight x 270 days Grass: Weight of grass carp + silver barb (in kg) x 20% x 270 days Manure: Total surface of broodstock pond (ha) x 300 kg chicken manure x 39 weeks / 10.000 **SUBTOTAL**	x 300 [cut by staff] x 30	
Broodstock conditioning (High protein feeding)	Feed: Total weight of broodstock (all species) in station (in kg) x % of fish weight x 90 days Grass: Weight of grass carp + silver barb (in kg) x 20% x 90 days Manure:Total surface of broodstock pond (ha) x 300 kg chicken manure x 13 weeks / 10.000 **SUBTOTAL**	x 900 [cut by staff] x 30	
Selection of broodfish - Sale	Use of permanent labour force		
Sex separation of common carp & *Barbodes*	Use of permanent labour force		
Reproduction of common carp	Use of permanent labour force Spawning substrate: construction cost		
Reproduction of *Barbodes*	Suprefact: Number of kg of females silver barb to be injected x 15 µg / 10.000 Motilium: Number of kg of females silver barb to be injected x 1 pill (10 mg)	x 250.000 x 130	
Reproduction of Indian carp	Suprefact: Number of kg of females Indian carp to be injected x 20 µg Motilium: Number of kg of females Indian carp to be injected x 1 pill (10 mg)	x 250.000 x 130	
Reproduction of other species	Suprefact: Number of kg of females other species to be injected x 20 µg Motilium: Number of kg of females other species to be injected x 1 pill (10 mg)	x 250.000 x 130	

- Costs per unit are only indicative and may vary greatly according to the variability of input (different feeds) and the location.
- 1 US $ = 4,300 Kip (February 1999)

Table 6: how to calculate the expenses according to the planning of activities (cont.).

ACTIVITIES	Amount **to be multiplied by**	Cost/Unit (Kip)	= Total cost(Kip)
NURSERY PONDS			
Drainage of ponds	[If Pumping: water (m^3) x pump consumption (litre/hour) / pump capacity (m^3/hour) x # cycles]	x 1.100	
Removal of mud	Permanent staff for quick cleaning (20 man-days x Total pond surface / (3 years x 400 m^2)	x 3.000	
Cleaning	Permanent staff for quick cleaning		
Liming	# cycles x Total surface of nursery ponds x 4 kg / 100	X 350	
Manuring	# cycles x Total surface of nursery ponds x 25 kg / 100	X 30	
Filling with water	[If Pumping: # cycles x water (m^3) x pump consumption (litre/hour) / pump capacity (m^3/hour)]	1.100	
Stocking fry	Permanent staff		
Feeding	Permanent staff Egg yolk: Total weight females spawned x average number of eggs/kg female x hatching rate x 6 days / 200.000 Total Number of 1-week fry x 1kg feed x 7 days / 400.000 = 0 –7 days Total Number of 1-week fry x 2kg feed x 10 days / 400.000 = 8 – 17 days Total Number of 1-week fry x 1kg feed x 25 days / 100.000 = 18 – 42 days **SUBTOTAL**	x 250 x 1.200 x 1.200 x 1.200	
Harvest and sale	Permanent staff		
Grow out of market fish	Estimated production (in kg) x 5 (FCR of rice bran)	x 200	
Sale of market fish	Permanent staff		
OTHER OPERATIONS			
Repair of tanks	Made by company		
Small equipment items	Syringes, net cages, catching nets, etc purchased or repaired		
OTHERS			
Fry packaging	Number of oxygen bottles Number of Plastic bags	x x	
Broodstock capture from wild	Or purchased from other farmers		Lump sum
Administration			Lump sum
Water and electricity			Lump sum
Vehicle operation			Lump sum
Miscellaneous			Lump sum
GRAND TOTAL			

Table 7: example of form for the planning of fry production.

PLANNING OF FRY PRODUCTION

FISH SEED STATION: ______________________ **PROVINCE:** ______________________ **YEAR:** ____________________

		Month / Target number of fry to be produced												TOTAL	PRICE / UNIT	INCOME
		10	11	12	1	2	3	4	5	6	7	8	9			
1	Common carp															
2	Silver barb															
3	Tilapia															
4	Rohu															
5	Mrigal															
6	Grass carp															
7																
8																
9																
	Total															

8.4 MEDIUM-TERM PLAN

The medium-term development plan should have 3 components:

Improving the methods of working

As the stations have limited access to capital for investment, the manager must try to produce a first surplus of production with the available means. An essential input in the hatchery operation is the personnel, its knowledge and its skills.

There is always room for improving current techniques used at different stages of production and therefore the final production of marketable fry. Important gains can be expected from the application of basic rules such as:

- Number of species produced should be adapted to the capacity of the station
- Use a lower stocking rate of bigger broodstock
- Stocking of broodstock species according to sex and maturation status
- Broodstock feeding increased and improved and adapted to sex
- Use of dry fertilisation method
- Use of upwelling hatching methods
- Thorough preparation of ponds (nursery and broodstock)
- Progressive set-up of observations and recording systems for the different operations: breeding, stocking, fertilising, feeding, duration of cycles, etc.

The plan should include the progressive adoption of these improved ways of working so that the station itself increases its production and make more money available for reinvestment. In that perspective, additional training may be useful but the requirements should be clearly identified.

Maintaining the infrastructures and tools in good working condition so that current productivity can be maintained at the same level; maintenance can be implemented yearly (or even more often) or every 2-3 years. If maintenance is once a year or more often, it should be part of the annual operations plan. If maintenance is less frequent, it should be part of the medium-term plan. Such operations include for instance:

- Cleaning of pond bottom (every 2-3 years depending on the accumulation of mud)
- Repair of dikes
- Cleaning of concrete canals, water inlets and outlets (daily or weekly)
- Repair of concrete canals, water inlets and outlets
- Repair of tanks
- Cleaning of nets, hatching nets, pumps, etc (after each important operation, or if left unused for more than a week)
- Others

Improving some parts or investing in new facilities or equipment

The manager must identify and prioritize the constraints and problems according to the:

- Impact on fry production: a big constraint must be a higher priority
- Amount of money necessary to solve the problem: problems with possible low-cost solutions should be solved first
- Management capability to solve the problem: constraints the current management can solve are coming first

Identification of the cause of the problem is often difficult task for the manager because little information is available. Proper observation and recording is a primary key for solving the problem.

A problem may also have several solutions. The manager should go through the solutions and pick up the one that is coming first on the following list of criteria:

- modifying the way of working (no cost)
- making a low-cost investment (modification – renovation)
- increasing or modifying the use of inputs at low-cost
- making a high-cost investment (modification – new)

Improvement should be done progressively, starting by the pieces that require little capital and few labour and give a boost to the production and the financial result.

Example

Suppose 2 ponds of the farm are too shallow and hold too little water in dry season for keeping broodstock.

One pond is 400 m^2 and the other is 1,200 m^2.

Priority should usually be given to the improvement of the smaller pond. It will be easier to assemble labour force and money for the small pond than for the large one.

Once the small pond is back in operation, it will increase the production capacity of the farm and presumably its income, This will then make the improvement of the bigger pond possible.

Funding the plan

Funds may come from 4 sources: profit from the annual operations, from central level, from provincial level, from other sources.

Although probably the smallest, the fund coming from profit is normally the most secure because the manager can estimate it. According to the province, profit may have to be shared with the province or may be entirely used for reinvestment. This money should be used in priority for the maintenance (2 year cleaning of ponds for instance or larger-scale maintenance).

Money from the Ministry or the Province should fund big specific renovation works or new small facilities or equipment.

If important new facilities must be built or new equipment bought, they are likely to be funded by external sources.

Any request of budget for renovation or purchase should be supported by strong evidence stating:

- The current problem or constraint and its effect on productivity or research results due to the poor status or the absence of this feature

- The reasons why this solution is proposed instead of any other one

- The expected increase of production or improvement of quality that is expected after implementation of the proposal.

9 ANNEXES

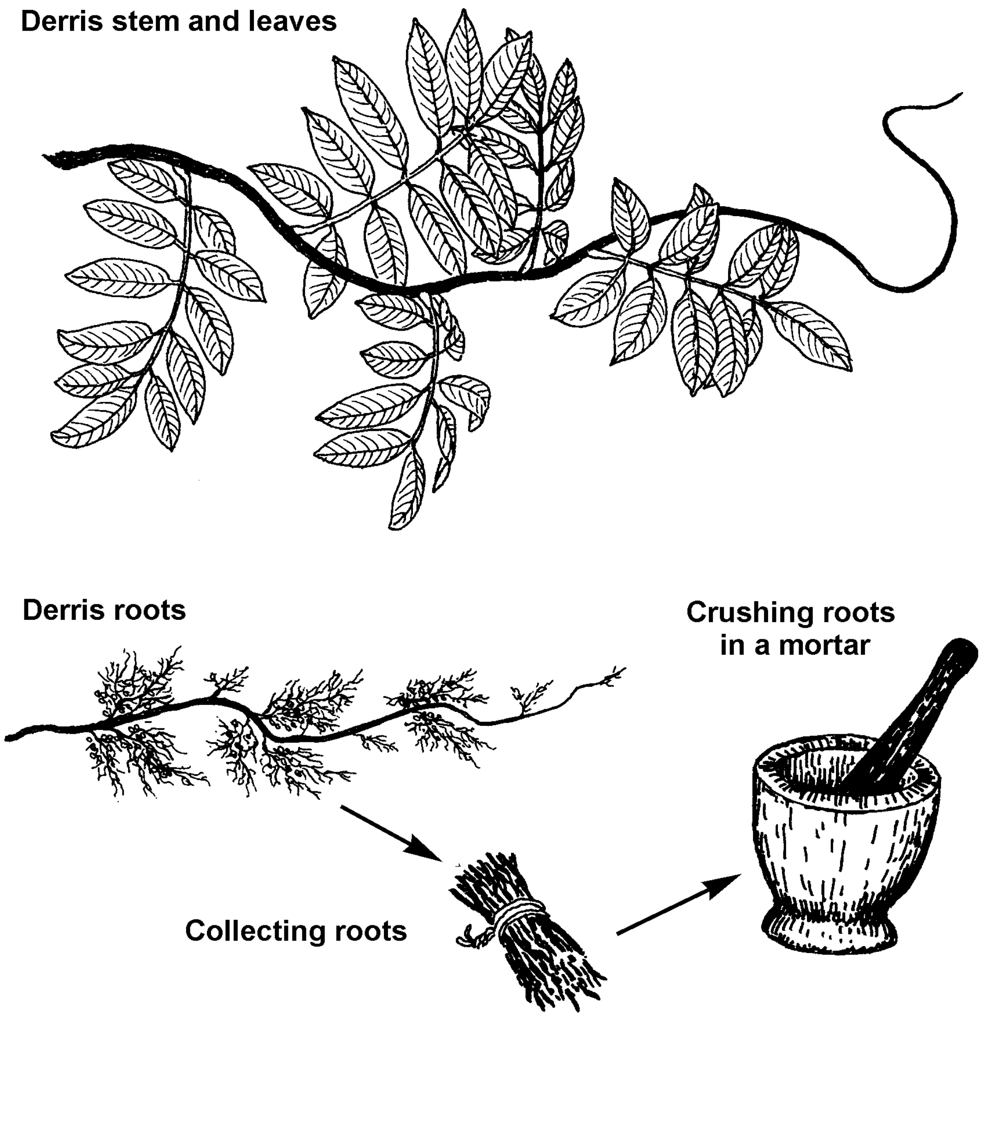
<u>9.1</u> <u>USE OF DERRIS ROOT FOR KILLING UNWANTED FISH IN POND</u>

Derris root contains the chemical rotenone that will make the fish suffocate as it prevents oxygen exchange at the gills.

- The root should be soaked in water overnight and pounded the next morning.
- The sap in the wood should be squeezed out into a bucket and diluted in water.
- It is broadcast over the parts of the pond that still have water. Fish that die in this way can still be eaten.

> ***The poison in derris breaks down slowly after one week - Wait at least a week before stocking fish.***

<u>Application Rate</u>: 4 kg of root per rai if only puddles of water are left in the pond; 20-40 g root per m^3 of water if pond contains significant amounts of water.



9.2 USE OF ALUM FOR CLEARING WATER

Alum is not particularly toxic to fish but does cause low pH. It is thus advised to add slaked lime just before applying alum. The rate is 0.4 kg of lime per 1 kg of alum.

- The typical amount of alum is 20 g per m^3 of water (from 10 to 30 g/m^3).
- Alum must first be thoroughly pounded to a fine powder and then dissolved in a small amount of water in a container.
- Alum must be applied over the entire surface by mixing as rapidly and thoroughly with water as possible.
- The water should then be left absolutely still.
- Suspended particles will flocculate and sediment on the bottom clearing the water (usually 12-24 hours is enough)
- Very fine suspended solids will take between 1 to 3 days to sediment and make the water clear.

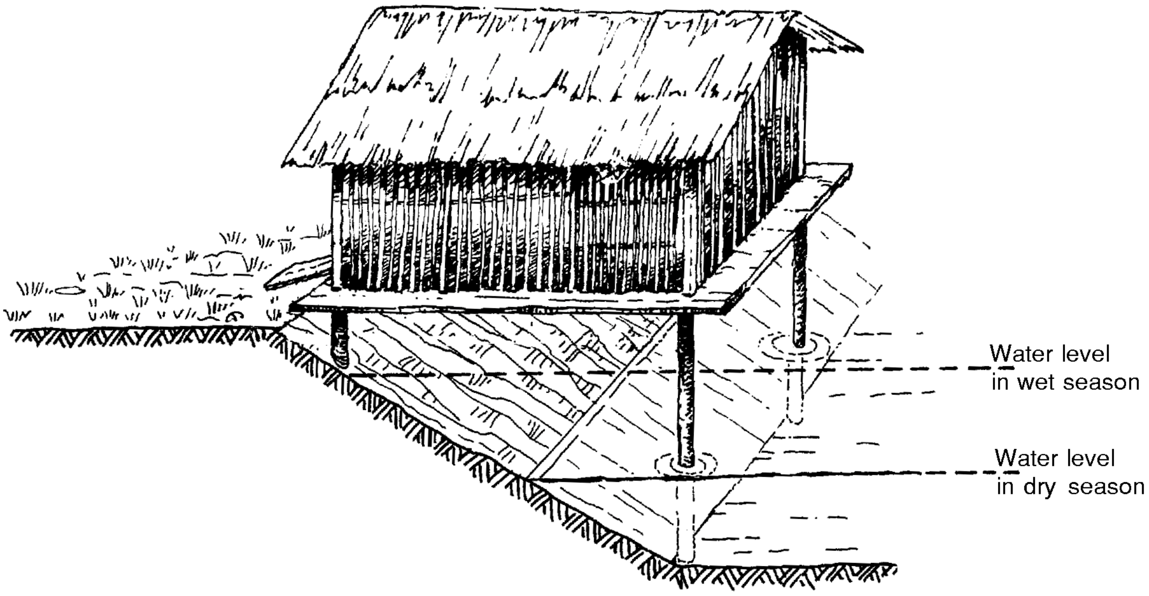
<u>9.3</u> <u>ASSOCIATION WITH LIVESTOCK FOR POND FERTILIZATION</u>

Conservative values for integration of livestock with broodstock ponds are as follows:

Kind of animal	Number of animals
Ducks	125
Chickens	175
Egg Layers	100
Pigs	8
Quail	200

Table 8: number of animals for fertilising a pond of 1 rai (1,600 m^2).

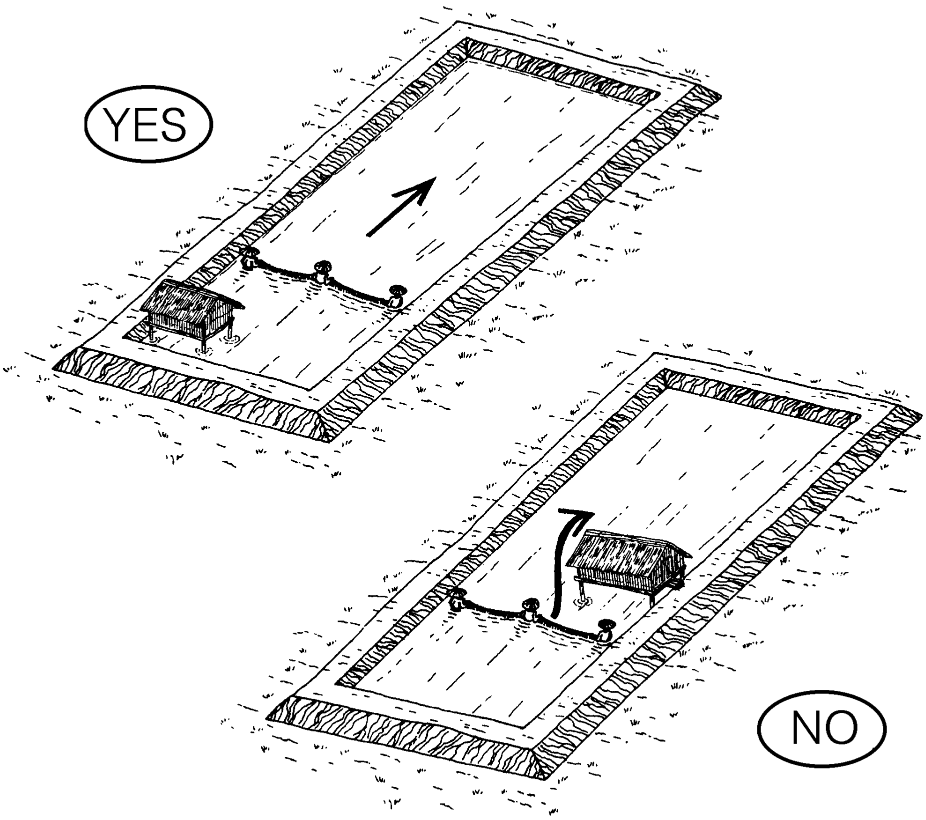
Housing should be built either entirely on dike or better so that a part of it will be on the dike slope and the other part directly over the pond (see figure below). In this way, it does not usually require labour for putting the manure in the pond, and when water is receding during the dry season, only some part of manure will fall directly into the pond. The rest will fall on the dried slope where it can be gathered for other purposes or be put back into the pond if the water is not sufficiently green. This decreases the risk of over-fertilisation.

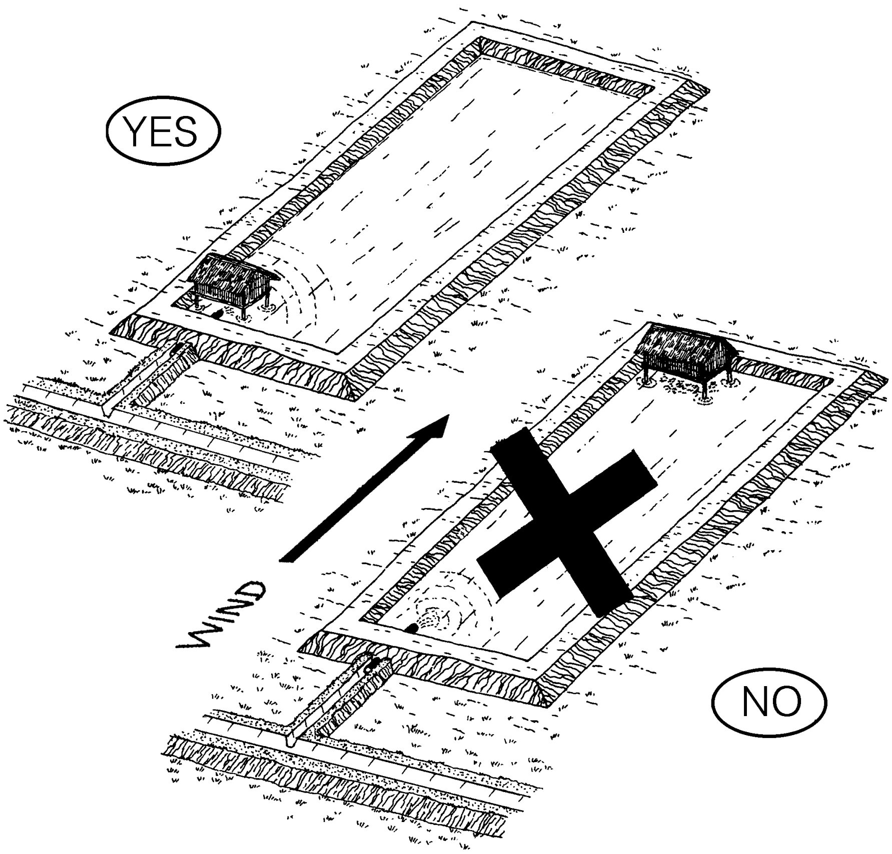


The location of housing must minimise the difficulties of partial harvesting in the pond. The housing should preferably be located at one end of a rectangular pond. Allocation in the middle of the length would make seining operation difficult and not so efficient.

The location should also helps to disseminate the manure and the fertilised water throughout the pond. The housing should be built at the pond's end, that is windward, and near the water inlet (if any), if it is possible to combine.

Wind and water inflow will help to distribute the manure. These features are illustrated in the next figures.


YES
NO


YES
WIND
NO

9.4 ANAESTHETIZING BROODFISH FOR TRANSPORT

Broodfish may be sedated before transportation for the following reasons:

- It reduces stress on the fish
- It reduces the oxygen consumption and the excretion of carbon dioxide and other toxic wastes
- It reduces the chances of physical injury by reducing the level of activity of the fish
- It reduces the time for handling them.

Most commonly used tranquilliser is MS 222. It is advised to prepare a first bath with 5 g per 100 litres of water (50 mg/litre) for tranquillising the fish first during 15-20 minutes and to dilute the solution in the transportation bag as shown in the next table.

SPECIES	**Ratio of MS 222**	**For Total water volume of 20 litres in the bag**	
		Take from the solution	Add fresh water
Tilapia, *Barbodes*, Common carp and grass carp	20 mg/litre	8 l	12 l
Silver carp	10 mg/litre	4 l	16 l
Bighead carp	35 mg/litre	14 l	6 l

Table 9: how to prepare anaesthetic solution for transport.

9.5 EXAMPLES OF OXYGENATION DEVICES

These simple systems can be installed at the water inlet for increasing the oxygen content in the water.