

4. MAINTAINING BROODSTOCK

4.1 KNOWING WATER CHARACTERISTICS

Knowing water characteristics and improving them improves the development of natural food and stabilisation of water characteristics that do not stress the fish and this favours good gonad development.

Basic factors of water quality to be measured with regards to effective broodstock maintenance are oxygen, temperature, pH, and alkalinity. By knowing pH and alkalinity it is possible to know the necessity and importance of liming.

Fish will be more or less stressed and will not develop their potential if:

- pH is low (less than 6.0) or varies greatly
- Oxygen content is low or varies greatly
- Temperature varies often or is above 30°C, due to shallow ponds.

4.2 PREPARING THE POND

Old ponds must have been completely drained to remove any fish. If full drainage and drying of the pond is not possible, the most appropriate way in Lao PDR is probably to treat the pond with derris root to kill all fish. How to use derris root is described in annex 1.

4.2.1 LIMING

Liming is necessary if pH is less than 6.5 or if the alkalinity is less than 75 mg of calcium carbonate. About 100 mg of calcium carbonate per litre of water is a good level to maintain in the pond. It will limit the variations of the pH.

The next table explains the various positive effects of liming on pond and fish.

If the ponds are newly dug and have never been limed, slaked lime is applied at the following rate:

- Sandy soils: Minimum 120 kg/rai (about 12 buckets) up to 240 kg/rai (24 buckets)
- Clay soils: Minimum 120 kg/rai (about 12 buckets) up to 480 kg/rai (48 buckets)

Lime must be spread evenly on the pond bottom and dike slopes.

For old ponds already stabilised, the reference value is 60 kg (6 buckets) per rai (3.75 kg/100 m²).

POSITIVE EFFECTS OF POND LIMING	
ON POND BOTTOM	ON POND WATER
Soil structure is improved	pH increases and is more stable
Organic matter decays more quickly	Alkalinity increases and more carbon dioxide is available for plants
Soil pH increases	More calcium is available for greenwater
	Some substances toxic for fish are neutralised
Nutrients are released more quickly into the pond water	Excess organic matter is settled to the pond bottom
	
	Fish are less stressed, gets more oxygen and natural feed and grows better and quicker

Table 1: effects of liming on pond bottom and pond water.

4.2.2 MANURING

Manuring should be done at least a few days after liming. The amounts to be used are presented in Table 2.

Manuring is necessary and sufficient to provide the various kinds of carp, silver barb and tilapia with natural food. Use of chemical fertilisers is not so favourable, because common carp, mrigal and rohu feed mainly on pond bottom. Manure on the pond bottom will serve directly or indirectly in their feeding. Inorganic fertilisers can however reinforce the effect of manuring.

Any kind of manure can be used but not all manures have the same value. Also, manure, especially if not protected from sun and rain, quickly loses its fertilising elements (nitrogen, phosphorus). The table below gives the rates for manuring a newly dug pond of 1 rai surface. During further pond preparation, rates should be cut by 50 %.

Compost prepared on the ground can also be used. It must be spread on the pond bottom and mixed with the soil. The rate is 800 kg/rai or 50 kg/100 m².

4.2.3 USING CHEMICAL FERTILIZERS

If no manure is available, green water can be obtained by applying 20 kg of urea per rai (1.25 kg/100 m²). Urea must be first dissolved in a few litres of water (see Figure 3) and is then spread as evenly as possible in the pond.

Unlike manure, urea must be applied after the pond has been filled with water.

Origin of manure	Fresh manure	Old dry manure	Remarks
Chicken	400 kg, equivalent to 114 buckets of 3.5 kg (25 kg/100 m ² , equivalent to 7 buckets)	600 kg (38 kg/100 m ²)	If chicken droppings are mixed with rice husks, increase the amount by 20%. If it is wet from drinking water, increase by another 20%. Chicken manure containing rice husks is useful for sealing the pond bottom
Duck	400 kg (25 kg/100 m ²)	600 kg (38 kg/100 m ²)	
Pig	800 kg (50 kg/100 m ²)	1,200 kg (75 kg/100 m ²)	
Cow or buffalo	1,200 kg (75 kg/100 m ² or 12 buckets of 6.5 kg)	1,800 kg (112 kg/100 m ²)	Cow or buffalo manure with litter is convenient for sealing the pond bottom
Compost	800 kg (50 kg/100 m ²)		To be spread on pond bottom and mixed with the top layer of the soil

Table 2: Amount of manure or compost/rai for first pond preparation according to the kind of manure.



Figure 3: Mixing urea with water before applying to the pond.

4.2.4 FILLING WITH WATER

Water should better be added in two steps:

- A first stage where water is 20-30 cm deep for favouring the growth of natural food
- After a week, completely fill up of the pond.

For broodstock as for other fish, efforts must be made, when filling the pond, to:

- Screen water for unwanted fish
- Oxygenate inlet water through various devices (see appendix 5)
- Use clean water, not coming from commercial fish ponds (that can bring diseases)

4.3 FERTILIZING AND FEEDING

4.3.1 NUTRITIONAL REQUIREMENTS

Immature fish intended for use as broodstock should get a protein-rich well balanced diet, because it is the period of laying down the germinal tissue which contains the future egg stock. If possible they should be selected early and stocked with broodstock females that receive the best feeding.

After spawning, broodstock are stressed and tired and have lost weight. The females especially need abundant feeding in order to recover. They then start again to produce ova. Some species will stop the development of ova during the cool season; others will continue the development until spawning.

During the resting period, fish need feed with 50 % of natural organisms (rich in proteins) and 50 % of artificial feeds (rich in energy, like rice bran, broken rice, corn, etc).

When broodfish are in the last phase of ova development, they need to have feeds rich in proteins (30-40 %). This will avoid accumulation of fat in the ovaries.

Year-round broodstock and one-time broodstock do not have the same feeding diet and diets should vary throughout the year.

This also shows that broodstock should better not come from or be mixed with the commercial stock, which receives a poorer and more uniform feeding. It either costs too much for producing table-sized fish or does not prepare the broodstock properly to their function.

Grass carp, which is often grown together with other species, and *Barbodes* also should be given aquatic weeds, vegetables or other soft terrestrial grasses chopped into small pieces.

4.3.2 FERTILIZATION

Fertilisation may be used after first pond preparation for maintaining a continuous production of natural feed in the pond.

Fertilisation should be applied carefully since excess may create unstable water quality conditions in the pond and stress the fish. Tilapia and common carp are more tolerant of poor water quality than *Barbodes* and the Chinese and Indian carp. Any kind of fertiliser should be applied as often as possible in smaller quantities.

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Table 3 gives the maximum safe amount of fresh manure that can be applied per day to the pond in Lao conditions (with water depth of 1 m or less). In case of deep ponds (1 to 2.5 m), the maximum rate can however be increased by 50%. It may not be necessary to apply the rates recommended in Table 3 if the quality of water entering the pond is already good or if the pond is an old one.

Beware

If nothing is applied during a week, it is allowed to give only the daily amount as indicated when resuming fertilisation on the eighth day. The amount that could have been distributed during the past week cannot be given. This would create an algal bloom and low oxygen that may kill the fish.

Animal	Fresh solid manure Maximum amount (kg) to be applied / day	
	Per 100 m ²	Per rai (1,600 m ²)
Buffalo	4.2	67
Cattle	4.0 (2/3 of a bucket)	64
Pig	4.0	64
Duck	1.8	30
Chicken	1.8 (half a bucket)	30
Quail	1.6	26

Table 3: maximum amount of fresh solid manure to be distributed per day.

A broodstock pond could also be integrated with livestock located partially or totally above the pond or on the dike. Data are available only for grow-out ponds not for broodstock ponds and some information on numbers of animals per pond is presented in annex 3.

Compost made on the ground can be used instead of manure. It should be applied every week at a rate of 400 kg/rai or 25 kg/100 m².

Making compost in the pond as shown in Figure 4. is easier. The system is made of a bamboo enclosure inside which the farmer pours vegetal residues like rice straw, cut gasses, rotten fruits or vegetables, kitchen wastes, etc. They should preferably be chopped into small pieces to speed up the decomposition. If available, manure should be added (20 to 50%).

Compost surface should represent about 10% of the pond surface. If the pond is larger than 300-400 m², there should be a second or even third enclosure (the total compost surface still at 10% of pond surface). Compost should be located in the shallows.

For better efficiency, compost should be compacted and later turned over every 1 or 2 weeks.

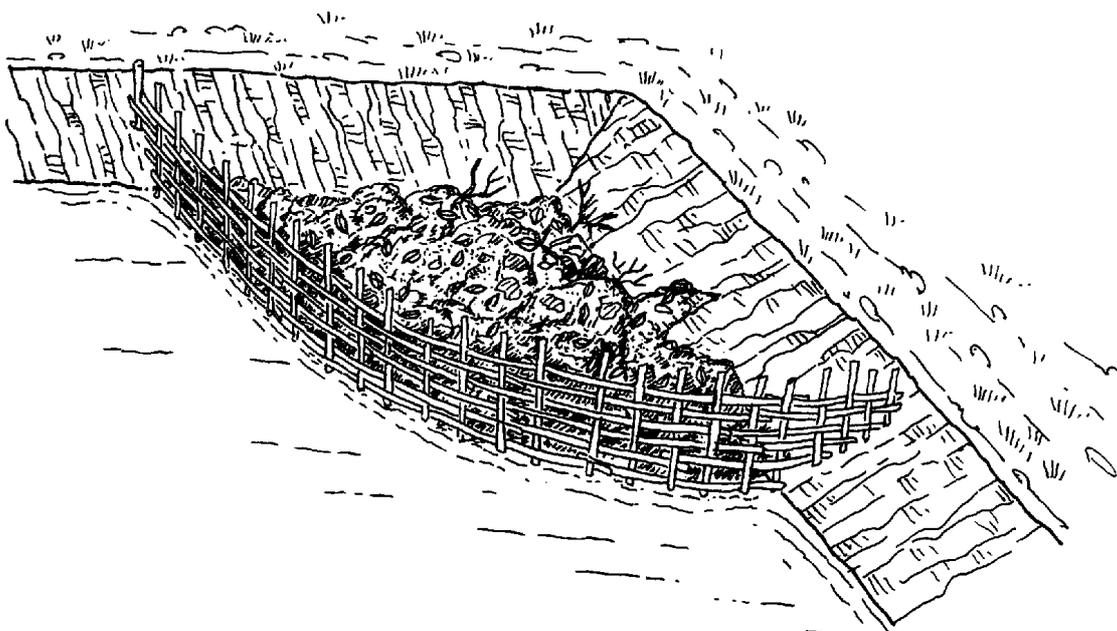


Figure 4: Making compost inside the pond.

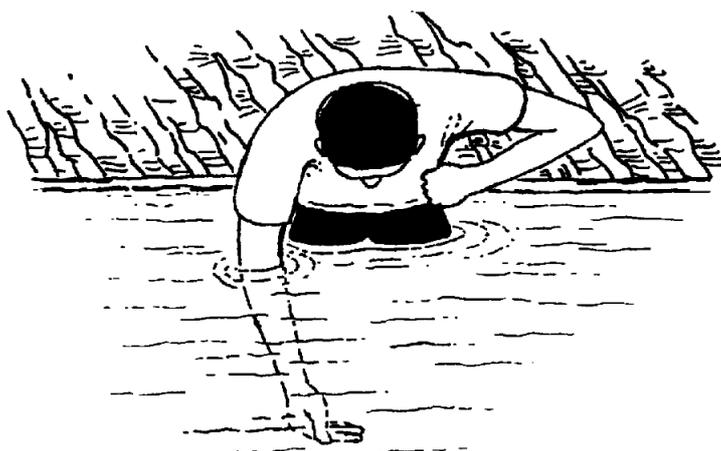
Inorganic fertilisers can also be used but they are usually considered too expensive. The rate is 10 kg urea per rai per week (0.6 kg/100 m² /week).

Warning

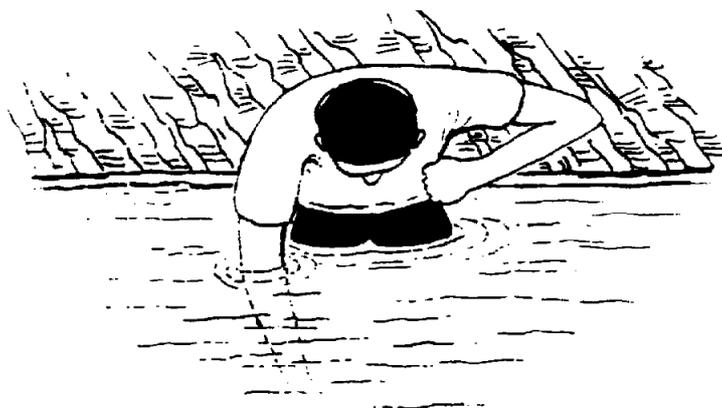
All values for fertilisation listed above are only indicative. The characteristics of the soil and water of the pond are different from farm to farm and sometimes amongst ponds of a single farm. The water quality and fish behaviour must be closely watched and amounts adapted to the local situation.

Fertiliser and manure applications should be decreased or even stopped when pond temperatures are dropping (in the cold season) or when water depth is decreasing in these cases, measuring daily water temperature is useful. As these situations are quite common in Lao PDR, it is advised not to build livestock housing completely above the ponds, for controlling manure input more easily.

An easy way to check if fertilisation is sufficient or excessive is to put the arm until elbow in the water as shown in Figure 5. If one can see his hands more fertilisers should be added. If one cannot see his hand, no more fertilisers should be added until the transparency increases again,



1. Clear water - not enough fertilizer



2. Green water - enough fertilizer

Figure 5: Testing the fertility of the water.

4.3.3 FEEDING

Resting fish after spawning should get a carbohydrate-rich feed. A pellet feed at 16.5 % of proteins given daily at a rate of 2% of fish is excellent. A mixture (50 % each) of this feed with rice bran or even pure rice bran can be used, especially if the fertilisation is good.

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The feeding rate is considered constant throughout the period.

The amount of feed should be in fact increased as the weight of broodstock increases with the time.

In practice it is easier to slightly increase the feeding rate based on the initial stocked weight.

0.1% - 0.2% of increase per month may be an acceptable compromise.

Monthly feeding rates would then be:

<i>Month 1</i>	<i>2.0 % of initial broodstock weight</i>
<i>Month 2</i>	<i>2.1 % of initial broodstock weight</i>
<i>Month 3</i>	<i>2.2 % of initial broodstock weight</i>
<i>Month 4</i>	<i>2.3 % of initial broodstock weight</i>
<i>Month 5</i>	<i>2.4 % of initial broodstock weight</i>
<i>Month 6</i>	<i>2.5 % of initial broodstock weight</i>
<i>Month 7</i>	<i>2.6 % of initial broodstock weight</i>
<i>Month 8</i>	<i>2.7 % of initial broodstock weight</i>
<i>Month 9</i>	<i>2.8 % of initial broodstock weight</i>

Similar to fertilisation, feeding may have to be reduced or stopped during the cool season, particularly in upland areas. Checking water temperature and fish behaviour are important routine tasks.

During the 3 months preceding the estimated start of the breeding season, fish, especially females, should get a feed richer in protein for favouring the optimum development of the gonads. Catfish feed is primary choice. Chicken starter alone or mixed with soya cake or rice bran is an alternative.

Daily feeding rate should be 2%. Males can continue to receive a lower-protein feed. Fertilisation should be well maintained throughout the period, as natural food is rich in protein.

If fish are to be used for a second spawning in the year, they should be stocked apart and given a rich-protein feed at a minimum rate of 5% (up to 10%).

Plant eaters should receive special attention. Grass carp should be given macrovegetation every day at a rate of 20-50% of their bodyweight. In addition to dry feeds *Barbodes* should be given aquatic plants once a week or other soft terrestrial plants 2 or 3 times a week. Plants should be chopped in small pieces.

4.4 MAKING FEEDING EFFICIENT

In order to feed enough but with minimum wastage, some simple methods can be used.

The weight of broodfish stocked should be known with sufficient precision (more or less 10%). A sampling of fish weight should be done after breeding, before stocking. In case of sex or species separation later in the year in view of the next spawning season, not only should the fish be counted but also samples should be made for calculating the biomass stocked in the pond.

Feed the fish 2 times a day, in the morning and evening. In case of cool temperature, you may delay or cancel the morning feeding session because the fish may not be active.

Feeding time should be the same everyday as fish get accustomed to that. See Figure 6.

At the start of the period, choose some places of the pond and keep feeding there.

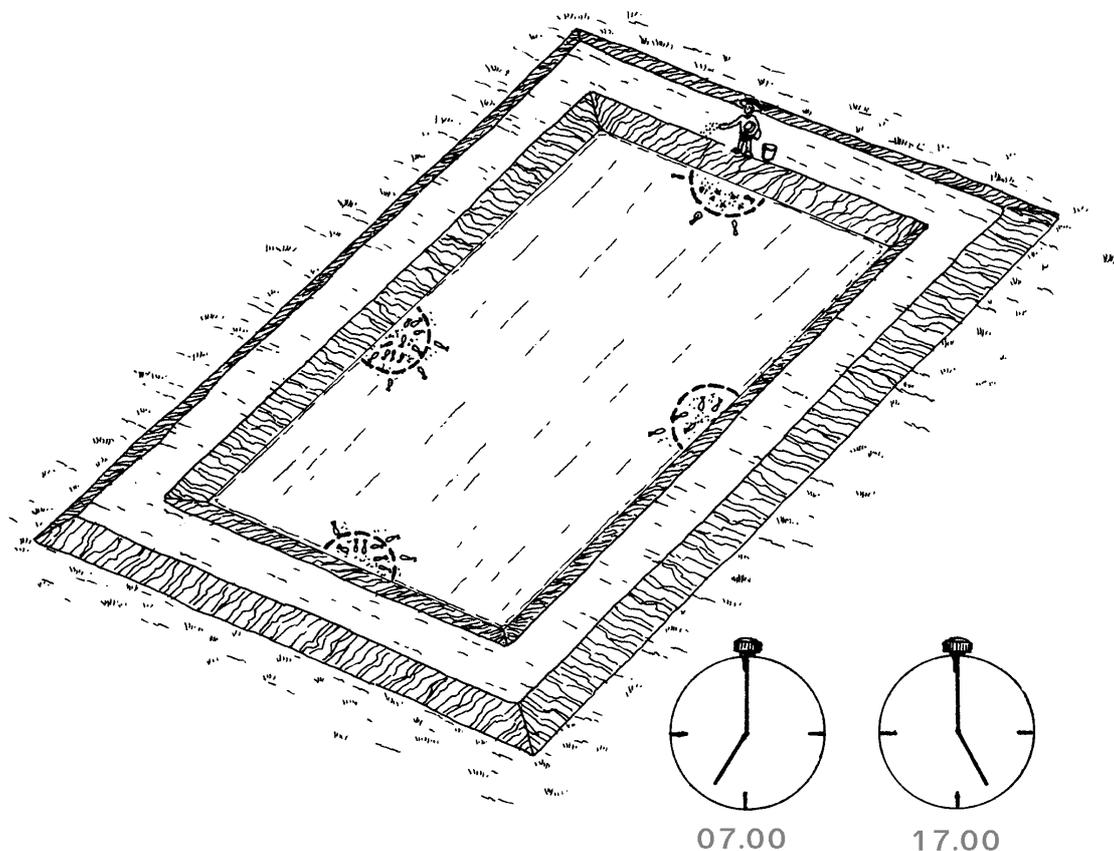


Figure 6: feed always at the same times and places.

If feed floats for only a very short time, feed slowly so that fish have a better chance to eat before it sinks to the bottom.

Floating pellets and grasses can be applied in a feeding frame such as the one in Figure 7. The frame is simply made of 4 pieces of bamboo and kept in place by two poles driven in the pond bottom. Feed applied in the frame will not drift all over the pond and will be more easily consumed.

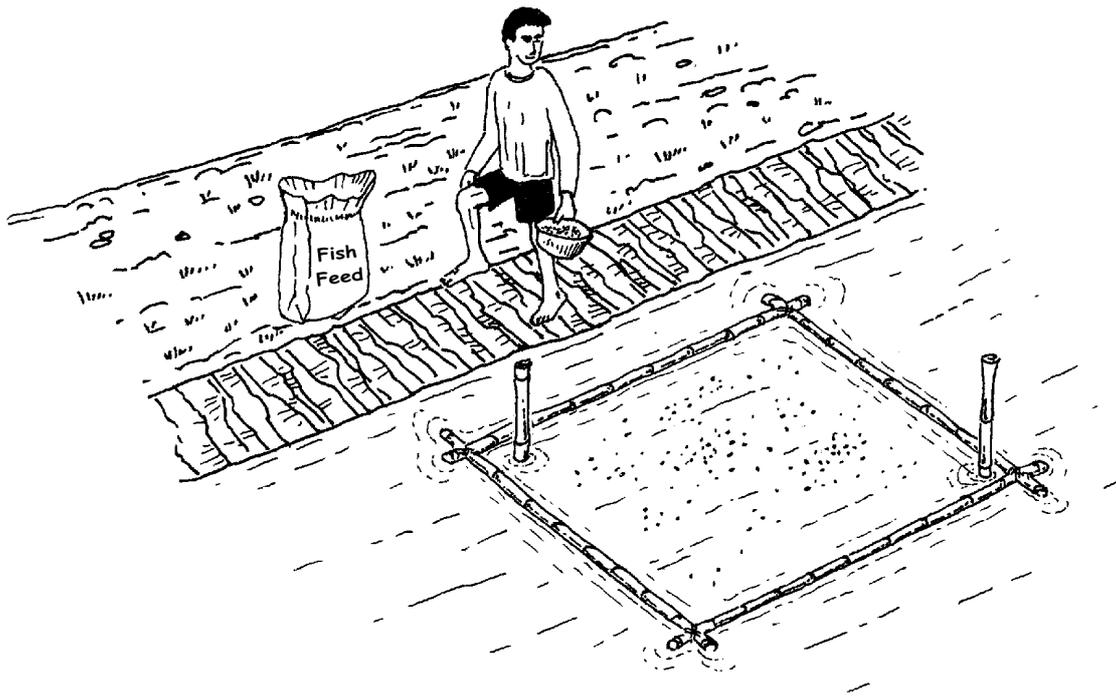


Figure 7: a simple feeding frame made of bamboo.

A feeding tray as the one in Figure 8 is useful for checking feed consumption. Feed is distributed all around the tray, that is to be placed at mid-depth or on the pond bottom. Consumption is checked by lifting the tray 3 or 4 hours after feeding.

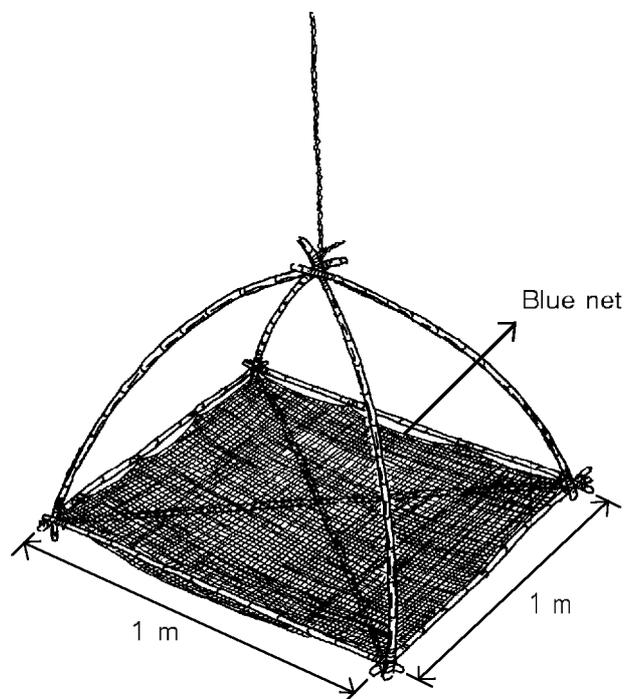


Figure 8: a feeding tray for observing the consumption of feed.

4.5 TAKING CARE OF THE FISH

Broodfish should be left to rest after their spawning session and during the phase of maturation. They should thus not be mixed with commercial stocks or with other broodstock that must be captured later.

Checking fish behaviour must be a daily duty. This may be especially important in the early morning if ponds are heavily fertilised (depletion of oxygen) and in afternoon in case of prolonged hot weather when water depth is rather low (less than 1 meter). Measuring the temperature may be helpful.

In case of abnormal behaviour, such as gasping at the surface, the pond must be flushed with fresh well-oxygenated water. If no such water is available, water of the pond should be re-circulated and oxygenated by pumping as shown in the next figure.

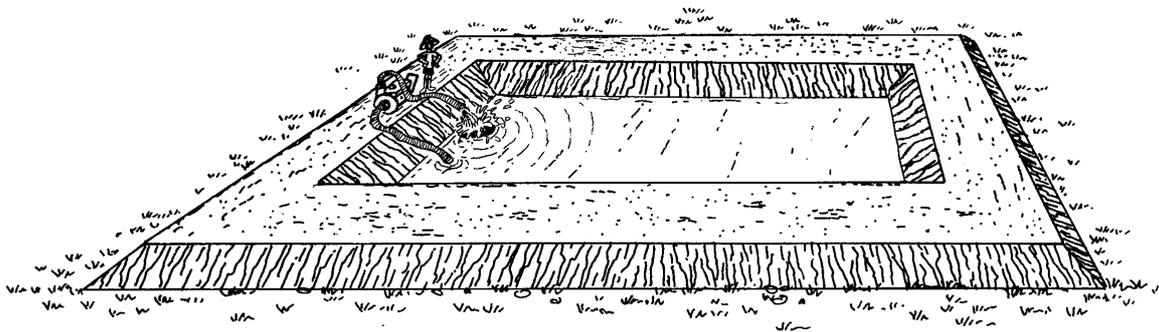


Figure 9: oxygenating water by pumping it out and back into the pond.

During the conditioning period (typically January – April) it is useful to flush the pond with a large amount of fresh water every 3 or 4 weeks. Each flush should last a few hours. It will stimulate the development of the gonads. Water should also be added for compensating for other water losses such as leaking water gates, seepage and evaporation.

4.6 TAKING CARE OF THE PONDS

Dikes must be controlled regularly but more attention must be given in rainy season when erosion or flooding are more likely. Small problems should be repaired rapidly before they become serious and affect production.

Water inlets and outlets, overflow and screening devices must be checked and cleaned if necessary every day. More attention must be given when filling pond with water and in case of heavy rain.

Water level must be monitored and adjusted every few days, more often if necessary. If ponds are across a valley, the spillway or the diversion canal must be kept cleaned of every obstacle.

5. CARE DURING THE SPAWNING PHASE

5.1 BEFORE SPAWNING

Fish are concentrated in a corner of the pond by seining. Breeders are selected one by one. Fish ready to spawn are sent to the hatchery. The ones not yet ready are released in the pond and any wounded or sick fish can be removed and sold.

During the sorting, fish left in the pond may suffer from a lack of oxygen. Technicians should be ready to add in fresh water for increasing oxygen content.

Since fish full of food can look sometimes the same as those full of eggs, females may be kept overnight in nets or tanks allowing for defecation.

Fish awaiting spawning must be kept in tanks with a permanent flow of clean well-aerated water. Tanks should be covered by nets for preventing fish from jumping out of the tank.

5.2 SPAWNING

Females to be injected should be held on a piece of soft foam or on a wet cloth during operation. Small fish can be injected whilst holding in a shallow basin half filled with water. One person should catch, weigh, hold and release the fish while a second person should inject. For dry stripping the fish should be held in a damp cloth to minimise damage.

5.3 CARE AFTER SPAWNING

After the spawning session, spent fish should be transferred to a “rest and recuperation” pond aimed at resting the broodstock for the next 2 or 3 months. This pond should not contain any broodfish that must be spawned in the following months so that no seining has to be performed.

Restocking spent broodstock with nearly mature ones would result in heavy stress and injuries and likely loss of fish due to repeat seining.

By putting spent fish together (and if possible sex-separated), it is also possible to feed them an energy rich diet (e.g rice, cassava, potatoes, Lao lao waste) for getting back the weight lost during reproduction.

6. PREPARING FUTURE BROODSTOCK

Future broodstock selected at the farm should be selected early from the fingerlings available rather than from the commercial stock. Such fish can be stocked together with mature female broodstock that are fed the best diet in the farm. This will allow an optimum development of the gonads.

Fish grown for commercial purpose are more poorly and unequally fed and their gonad development may be poorer resulting in a lower fecundity for a similar weight.

If common carp must be selected, they must be selected amongst the first batch of the season (fry produced in February-March) if the objective is to breed them the next year. This may be difficult, as the manager must usually keep the fry a minimum of time in early rainy season because this is the peak season for reproduction.

It is easier to nurse the last batch of fry produced in June or July since nursery ponds are available for the cold season. There is however the risk that late maturing fish are selected and that it may become with the time more difficult to have early maturing broodstock.