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PROVINCIAL AQUACULTURE DEVELOPMENT PROJECT

LAO PDR

SUPPORT FOR TECHNICAL SERVICES

Guidelines for Broodstock and Hatchery Management

Based on the work of

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GUIDELINES FOR BROODSTOCK AND HATCHERY MANAGEMENT

by

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CREDITS

Figure 10 is from FAO technical paper ”The transport of live fish – A review” by R. Berka. EIFAC Technical Paper N° 48. FAO, Rome. 1986.

Drawing of Annex 4 is from FAO Manual “Simple methods for aquaculture –Management for freshwater fish culture – Ponds and water practices”, by A. Coche, J.F. Muir & T. Laughlin. FAO Training series 21/1, Rome. 1996.

All other drawings are adapted from “Fish culture in Integrated Fish Farming – Part 1, General aspects, Part 2, Rearing Herbivorous fish, Part 5, Managing fish component in the farm”, by Integrated Fish Farming Project. Bank for Agriculture and Agricultural Co-operatives – Belgian Administration for Development Co-operation. Mukdahan, Thailand. 1998.

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INTRODUCTION

The demand for fish fry in Lao PDR is currently estimated at 60 million per year and is constantly increasing. Most fish fry produced in the country originate from the Provincial government hatcheries, which have an estimated annual production of less than 11 million. This shortfall in supply is met in some part by the production activities of private farmers and more importantly through imported fish fry from Vietnam, Thailand and China.

Imported fish fry is usually of poor quality and has suffered extreme transport stress by the time it is stocked into the farmer's ponds. The lack of choice of species and occasional cheating by middlemen also makes the purchase of this foreign fish fry less desirable. There is a high premium for fish fry produced in LAO PDR due mainly to farmer's awareness that foreign imported fry is of poor quality.

There are few private hatcheries providing fish fry to the provinces and thus the dependence upon production from the Provincial fish hatcheries remains. The low production from these hatcheries is due to a wide range of factors, but significant increase in production could be achieved merely by improvement of basic management techniques.

As part of an initiative to improve the production from Provincial fish hatcheries, LAO/97/007 is providing assistance in the form of structural improvements and management training.

Little attention has been paid to the issues of broodstock management in the past, since this has not been considered as being a critical issue. The result has been that the fish used for breeding in the hatcheries are usually not in an appropriate condition for production of good quality fry. The principle reasons for this are: poor nutrition, under sized animals, inadequate spawning techniques and possibly inbreeding problems.

This manual is intended as a guide to hatchery managers and those involved in fish culture activities in Lao PDR. The emphasis of this manual is placed on appropriate techniques that are sensitive to the economic and management realities of Lao PDR. The final chapters of the manual are intended as a guide the effective planning of fish breeding and fry production in hatcheries, together with some examples of how to assess basic economic parameters essential for the sustainable operation of a small fish hatchery.

1. SOME CHARACTERISTICS OF MAIN SPECIES

For the purpose of management, the main species used in Lao aquaculture can be classified according to the following criteria:

- The size at maturity
- The method of reproduction (natural, semi-natural, artificial)
- The location in the pond and the feeding behaviour
- The tolerance of adverse conditions

1.1 SIZE AT MATURITY

Indian and Chinese carp are species that mature at a large size (about 2 kg) and need to be kept for at least 2 years in the pond before becoming productive. It has already been noted during a previous consultancy that the young age of grass carp broodstock was probably the main reason of the poor success of that species in government hatcheries. This large species should preferably be stocked in large and especially deep ponds – which are not usually present in most hatcheries in Lao PDR.

Barbodes, tilapia and common carp are smaller species that reach maturity in the first year and they can be accommodated in smaller ponds without any problem.

Reaching maturity does not mean that fish produce already many eggs. *E.g.* A fully-matured silver barb can produce 300,000 eggs per kg of body weight. This is the case of a 2 or 3 year old fish weighing 1 kg or more.

By comparison, four fish weighing 250 g each and thus totalling 1kg will produce 100,000 or 150,000 eggs only because their ovaries are still small (see Figure 1).
This situation is not unique to silver barb but it is true for every species; the weight and age for full maturity being different for every species. A fish is likely to reach its maturity faster if it is grown in good conditions (good feeding, no stress, etc)

When looking at the potential production of the broodstock the manager must take the age (size) and not only the total weight of broodstock into consideration.

1.2 METHOD OF REPRODUCTION

Indian and Chinese carp cannot spawn naturally in culture ponds and their spawning season is restricted to the rainy season (June-August).

Since they are large fish producing many eggs, these carp have some potential in the Lao situation, which requires large quantities of fingerlings for a short period at the beginning of the rainy season. Spawning of these species is not always successful under Lao conditions.
Large *Barbodes* broodstock are similar in having large numbers of eggs and can spawn between May-September.

Tilapia and common carp have the capacity to spawn almost throughout the year. Tilapia can spawn naturally, several times in the year, but only a few fingerlings are produced at a time.

Common carp may usually spawn well without hormones if any kind of artificial substrate (plastic grass, floating water plants etc) is provided. Spawning can even occur without a substrate. The period

of reproduction typically lasts about 9 to 10 months in the year (January – October). This requires that broodstock of common carp should be sexed early in the season or even kept separated throughout the year (November-December).

Silver barb (*Barbodes*) is a case quite similar to the one of common carp. However natural spawning is much less likely to occur and the injection of hormones to females is usually required for spawning. They should also to be separated early in the season (December-January) to prevent natural spawning in the broodstock ponds.

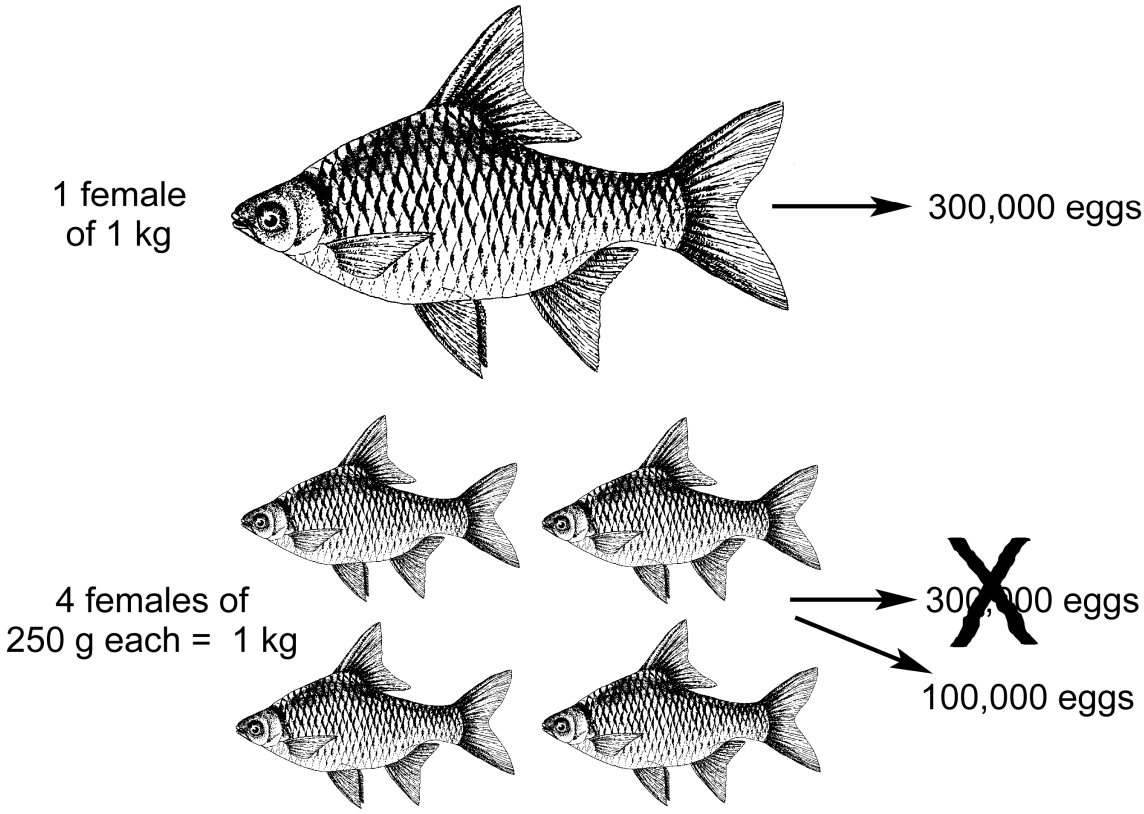

Figure 1: 1 kg of young females gives fewer eggs than 1 kg of mature ones.

1.3 HABITAT AND FEEDING BEHAVIOUR

Not all species live in the same place in the pond and where they live is linked to what they like to eat.

Grass carp and silver barb live near the surface where they can usually find the macrovegetation that they like. Silver barb can also feed to some extent on the plankton.

Silver carp feed on plankton, particularly phytoplankton that it can find in the medium-top level. Bighead carp and Catla live at the same level but filter zooplankton more than phytoplankton.

Rohu and mrigal live closer to the pond bottom. They feed on rotting plants and decaying organic matter on the bottom of the pond. Plankton is also used to some extent.

Common carp lives at the bottom and at the perimeter of the pond where it forages the soil for finding insects, small animals and decaying vegetation. It is less selective than mrigal and rohu for its feeding. Tilapia explores all levels of water, filtering plankton but also feeding on insects, small animals, soft plants, etc.

It should be noted that since fish ponds in Lao PDR are almost all less than 1 metre deep, the different feeding levels probably do not exist.

From all these characteristics, it appears that :

- Fertilisation of the pond, especially organic fertilisation, is important to all species by increasing the amount of natural food present in the pond. Grass carp is the species the least likely to benefit from fertilisation.
- Some species have the same feeding habits and therefore should not be stocked together as they will compete for the food. If stocked together the total stocking density should be decreased.
  Good examples of this are tilapia and silver carp (feeding on phytoplankton), grass carp and silver barb (feeding on plants), mrigal-rohu and common carp (feeding on the bottom).

1.4 TOLERANCE OF ADVERSE CONDITIONS

In normal conditions all species are generally resistant to diseases and no real problem of disease concerning broodstock have been reported so far in Lao PDR. Most species are less resistant when water quality decreases and especially in cases of low level of oxygen or important variations of it.

Common carp and tilapia are the most tolerant species for low levels of oxygen and more generally poor water quality.

Poor water conditions will however affect the fecundity of every species and it should be remembered that over-fertilisation should be avoided to prevent stress to the fish.

COMPARING CHARACTERISTICS OF THE MAIN SPECIES

Species	Main natural feed	Feeding habit	Eat mixed feed or by-products	Eat manure or plankton	Eat plants from farm	Resistance to lack of oxygen	Resistance to water pollution	Disease resistant	Maturity (Years)
Tilapia	Plankton / Insects / small animals	All levels	Good	Very good	Good	High	Very good	Good	Y 1
Common carp	Insects / animals on- & in-ground	Bottom / perimeter of the pond	Good	Very good	Very good	High	Good	Good	Y 1
Silver barb	Plant material / plankton	Water surface	Very good	Very good	Very good	Medium	Medium	Good	Y 1
Rohu	Rotting plants + plankton	Pond bottom	Good	Good	Good	Medium	Medium	Good	Y 2
Mrigal	Decaying organic matter and plankton	Pond bottom	Good	Good	Good	Medium	Medium	Good	Y 2
Catla	Zooplankton	Medium	Good	Good	Medium	Medium	Medium	Good	Y 2
Big head carp	Zooplankton	Medium	Good	Good	Medium	Medium	Medium	Good	Y 2
Silver carp	Phytoplankton	Medium level	Good	Good	Medium	Medium	Medium	Good	Y 2
Grass carp	Grass / Plants	Water surface	Good	Medium	Very good	Medium	Medium	Good	Y 2

2. BROODSTOCK PONDS

2.1 MAIN CHARACTERISTICS

Ponds should be of rectangular shape, width not exceeding 20 m for easy netting operations. They must be drainable in order to assist collection of all fish and correct pond preparation (application of lime and manure). Draining by gravity is recommended.

There should be water inlet and outlet systems for water control.

Water inlets should have a protection/screening device against unwanted fish.

Water depth should not be less than 1 m and should be preferably between 1 to 2.5 m. The main reason for this is that water conditions should be as stable as possible during the months before spawning. This is possible if water volume is large. In case of shallow pond the water temperature will vary greatly according to the air temperature. Weather in Lao PDR varies greatly during the year, particularly during the pre-spawning period, when there is a succession of cold and warm periods before the hot season in April. Very warm water (more than 30° C) is also above the optimum temperature of all species.

Shallow ponds are also not recommended when fish living on pond bottom (especially common carp) are stocked, because they stir up the bottom mud, making it difficult to develop plankton blooms.
It is often suggested that broodstock ponds should be large. But in practice it is better to consider first the depth of the pond and then the number of ponds in relation with the number and type of species to be kept for reproduction. Small well-built ponds can be used for most species and allows better management e.g. sex separation, feeding and capture.

Grass carp and some Indian carp are however considered to require more space and should be kept in ponds not less than 0.2 or 0.5 ha.

2.2 LAYOUT OF PONDS

On a sloping site, nursery ponds must be located in the highest areas, grow-out ponds one step lower and broodstock ponds in the lowest area. The primary reason for this is that nursery ponds must be provided with the best possible water, without any possible contamination (transfer of disease) from broodstock ponds to nursery ponds.

This layout may also allow to draining of the nursery ponds (that are well fertilised) into the grow-out or broodstock ponds, reducing the amount of water and fertilisers needed.
Broodstock ponds should be carefully watched to avoid poaching.

3. STOCKING BROODSTOCK

3.1 RATE

A common stocking rate is 1,000 kg of broodfish per hectare, which means 10 kg/100 m^2. Such a rate supposes however that fish are stocked and maintained in good conditions:

- Water depth is as advised previously (1 to 2.5 m) and should be kept constant throughout the year
- Fresh water should be readily available in case of problem
- Water needs to be of good quality, and properly fertilised so that it is rich in natural food
- Fish are given supplementary feed as described in next section

If any of these conditions cannot be achieved for whatever reason, the stocking rate of broodstock must be decreased.

Rates higher than 1,000 kg/m^2 , used in some other countries should be avoided as Lao conditions concerning pond depth, stocking and feeding are often unsuitable.

3.2 SEPARATION OF SEXES

Fish that do not reproduce naturally in pond can be stocked with mixed sexes. These include the Chinese and Indian carp. However, it may be advisable to stock the sexes separately in order to take better care of the females. Females require better quality feed for developing the gonads. Separation of females will reduce the cost of broodstock feeds, since males can be fed on inferior diet.

Tilapia, silver barb and common carp can breed in the pond and sexes should therefore be stocked in different ponds for maintenance period.

Ideally there should be two ponds for maturing fish of both sexes and two ponds for spent fish. By doing this there can be a more efficient use of feed, females being given protein-richer feed.

As ponds numbers are often limited, females and males could be mixed after spawning, but always in a pond that will not be seined in the next months (see Figure 2).

It may be advised to stock a few (200 / ha) small purely carnivorous fish for controlling unwanted fish that may consume broodstock feed. Catfish is not advised, as it is too omnivorous. Snakehead fish or *Notopterus* are a better choice.

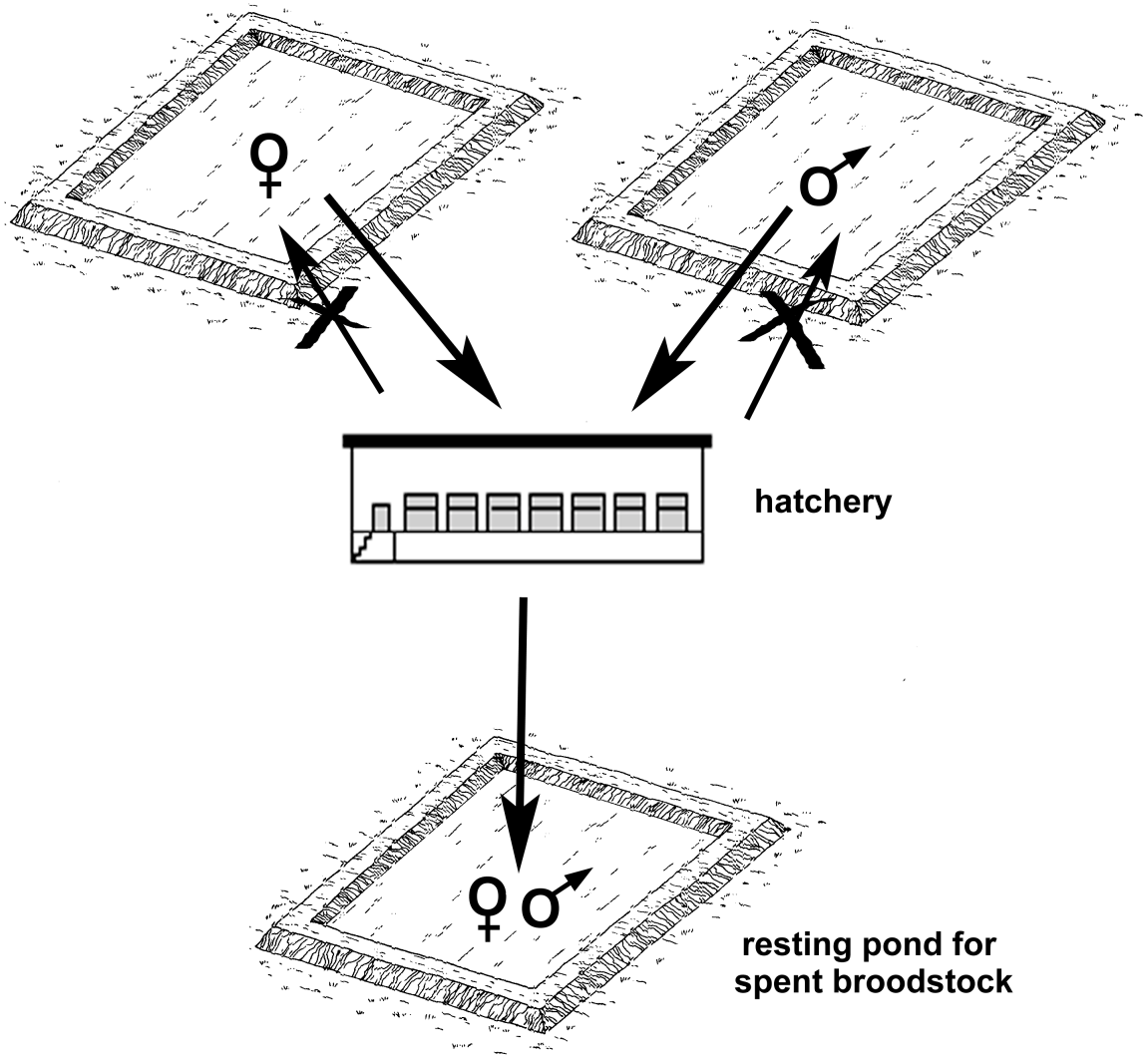

Figure 2: spent broodstock must be sent to a resting pond after reproduction.

3.3 SEPARATION OF SPECIES

Naturally breeding species should be separated. In case of shortage of space, it would be better to keep the same sexes of two species in one pond than the two sexes of a single species. Such a system still avoids wild spawning, but allows feeding females of both species with a suitable diet. Species with different feeding behaviour (silver barb and common carp for instance) will also consume different natural food in the pond.

The problem when mixing different species is that it disturbs the pond frequently as not all species will be ready for breeding at the same period. Fish that are seined often will be stressed and be subject to injuries and loss of scales that will favour the development of diseases. Fish that usually spawn during the same period should be stocked together, especially if they have different feeding habits.

The problem of disturbance is aggravated in some stations where spawned broodfish are returned to their original stocking pond. In the following weeks, that pond will be seined again for getting more broodfish for reproduction and spawned fish, already weakened by their spawning session, are then re-caught and cannot recuperate. The rule should be that after spawning fish should be stocked into another pond for reconditioning, where no seining will occur until the next season.

3.4 NUMBER OF SPECIES

All the former considerations should lead to limit the number of species present in a hatchery according to the number of ponds, their size and their water capacity.

No fixed rules can be given here. A reasonable number of species to be spawned should not exceed 3 or 4 in the current conditions of Lao PDR. In some stations with limited ponds areas or problems with water supply, 2 species should be a maximum. Tilapia can be added as it reproduces naturally.