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Better management practices for tilapia broodstock conditioning and mass spawning in hapas in ponds

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Author

Rose Komugisha Basiita

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Contact

WorldFish Communications and Marketing Department, Jalan Batu Maung, Batu Maung, 11960 Bayan Lepas, Penang, Malaysia. Email: fish@cgiar.org

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1. Introduction

The hapa-in-pond system hatchery technique has been widely adopted and used in hatcheries throughout Asia. It has also been used in Africa, but the practice is still limited in many countries, including the Democratic Republic of Congo, where there is hardly any existing systematic production of quality fry and fingerlings for tilapia. In cooperation with the International Institute of Tropical Agriculture (IITA) in Bukavu and Kinshasa, WorldFish has worked to build the capacities of technicians and hatchery operators from the hatchery sites in the country. The partnership has helped increase access to high-quality aquaculture inputs—specifically seed and feed.

These guidelines were initially developed to optimize the conditioning and spawning of fish for improved fry production used in research but also in fry and fingerling production for the two regions where the hatcheries are situated. In broodstock conditioning, it is important that fish intended for spawning are allowed to rest for a short period to give gametes (sperm for males and eggs for females) time to mature. During this period, fish must be nurtured well and fed a diet that shortens the maturation period. In addition, it is necessary to separate male tilapia from the females to allow for synchronous spawning.

Hapas suspended in a pond at RATALBI, in the DRC.

2. Selecting and separating broodfish

While tilapia broodfish are being conditioned, separate the stock by sex (males and females) to allow for synchronous spawning soon after the conditioning period. For both males and females, select active and healthy mature broodfish—no deformities, fungal infections, lesions, bruises, etc. Mature males and females of Nile tilapia are easily differentiated by their genitalia and the color of their fins and chin (Plates 1A&B and Plate 2). Size is another indicator as males of the same age are usually bigger than the females). The most reliable distinguishing feature is the openings on the body around the anal region of the fish.

2.1. Males

Mature males have two openings around the anal region: one is at the distal end of the papilla, which is elongated relative to what is found in females, and the other is the conspicuous oval anal opening. A mature male will release milt when slight pressure is applied to the abdomen. Generally, males can be distinguished by their red fins (Plate 1B). However, some females can also have colored fins, so it is important to confirm the sex using the genital openings to minimize errors during sexing of broodfish (Plate 2).

Plate 1a. Male Nile tilapia.

Plate 1b. Brightly colored male Nile tilapia.

Plate 2. Female Nile tilapia.

2.2. Females

Female Nile tilapia have three body openings: the anal opening, the urethra and an additional slit midway on the papilla (oviduct) through which eggs are released. When females are ready to spawn, the belly becomes round and soft, and the papilla and openings usually become reddish. The fish will release a small amount of eggs when slight pressure is applied on the abdomen. If a female has spawned before, her chin will appear yellowish.

3. Pond preparation and hapa setting for conditioning and spawning

Ponds used for holding, conditioning and spawning fish should be deep and large enough to suspend the hapas and allow for adequate water circulation. In order to eliminate fish from previous production cycles, drain, dry and lime the ponds. Prior to refilling them, install a screen over the inlet and outlet pipes to prevent unwanted fish from getting into the pond. Once the pond is filled, set the conditioning hapas to make them ready to receive fish for conditioning.

4. Fish stocking in hapas

While stocking fish for conditioning, gently place males and females in separate hapas. As mentioned in section 1, this facilitates synchronous spawning when the fish are finally ready for spawning. For conditioning, stock fish in aerated ponds at densities of 5 fish/m^2 for males and 10 fish/m^2 for females. Lower stocking rates should be considered if additional aeration is not provided.

Plate 3. Conditioning hapas in a pond.

5. Feeds and feeding fish

A number of companies now produce broodstock feeds in Africa. The feed requirements for broodstock are unique, so they are different from both fingerling production and general grow-out feeds, even in tilapia farming. It is best to use broodstock feed, which most commercial feed companies have already developed. For example, Novatek, AllerAqua and Skretting have broodstock feed made specifically for tilapia. The fish should be fed twice daily (09:00 and 15:00) at 2 percent of its weight.

It is further recommended to enrich the broodstock feed with oil, because this improves female gonadal growth and subsequent fry production. Squid oil is preferable, but any other fish oil will work as well. Spray the oil over the feed using a spray bottle (Plate 5) at a rate of 3%. This will ensure that all the pellets are exposed to the oil. Less oil may be required for a well-formulated broodstock diet. However, if the feed is produced locally with low levels of oil added, then it is even more important to add oil to the feed.

At the end of the conditioning period, fish in good condition will normally have a soft round belly, especially females (Plate 6). When slight pressure is applied to mature fish, females will expel eggs while males will expel milt. Place fish with these characteristics in newly set hapas for spawning. Any fish with sunken bellies should be put back for further conditioning. Eliminate any deformed, lesioned, bruised or sick fish from the broodstock intended for spawning.

Plate 5. Spraying fish oil on broodstock feed.

Plate 4. Commercial tilapia broodstock feed.

Plate 6. A mature female Nile tilapia with a soft round belly ready for spawning.

6. Spawning

After four weeks, females and males are selected further on the basis of the characteristics of mature broodfish that are ready for spawning. Stock the fish at a density of one male per 0.8–1 m^2 because males require space to build a nest in natural conditions but still remain territorial in a hapa. In the present context, it is best to use a group mating design where several females are put together with males to spawn at a ratio of one male to three females.

A: spawning hapas suspended in a concrete pond. B: mature male (L) and female (R) broodstock.

7. Egg and larval collection

With hatcheries in the two regions, eggs and larval should be extracted from females and then incubated and reared in the indoor hatchery at Kalambo in Bukavu and at RATALBI in Kinshasa. This is done by briefly herding broodfish to one side of the hapa for easy capture and handling, and then extracting the eggs and larvae from the mouths of the females. This should be done every 5 days. Pool the collected eggs and larvae in containers, depending on the stage of development (Plate 7), and then place the eggs into the incubation jars and the larvae into rearing trays. Collect swim-up from the rearing trays and transfer them to treatment hapas and tanks for onward sex reversal.

Plate 7. Collecting eggs from females and placing them in white egg/larval collection containers.

8. Fry collection

In the absence of an indoor hatchery incubation facility (Plate 8), fry can be collected directly from the spawning hapas every 2–5 days and stocked in nursing hapas. This is best done early in the morning before sunrise and can continue up to 3 weeks, after which broodfish are removed and taken back for reconditioning. For successful sex reversal, collect fry from the spawning hapas (only fry of first feeding stage) and then give them hormone-treated feed to produce all males. Then, nurse them up to a suitable fingerling size for stocking in grow-out ponds and cages or for sale to grow-out farmers (Plates 9 and 10).

Plate 8. Indoor hatchery with egg incubation jars and rearing trays installed at RATALBI, in Kinshasa.

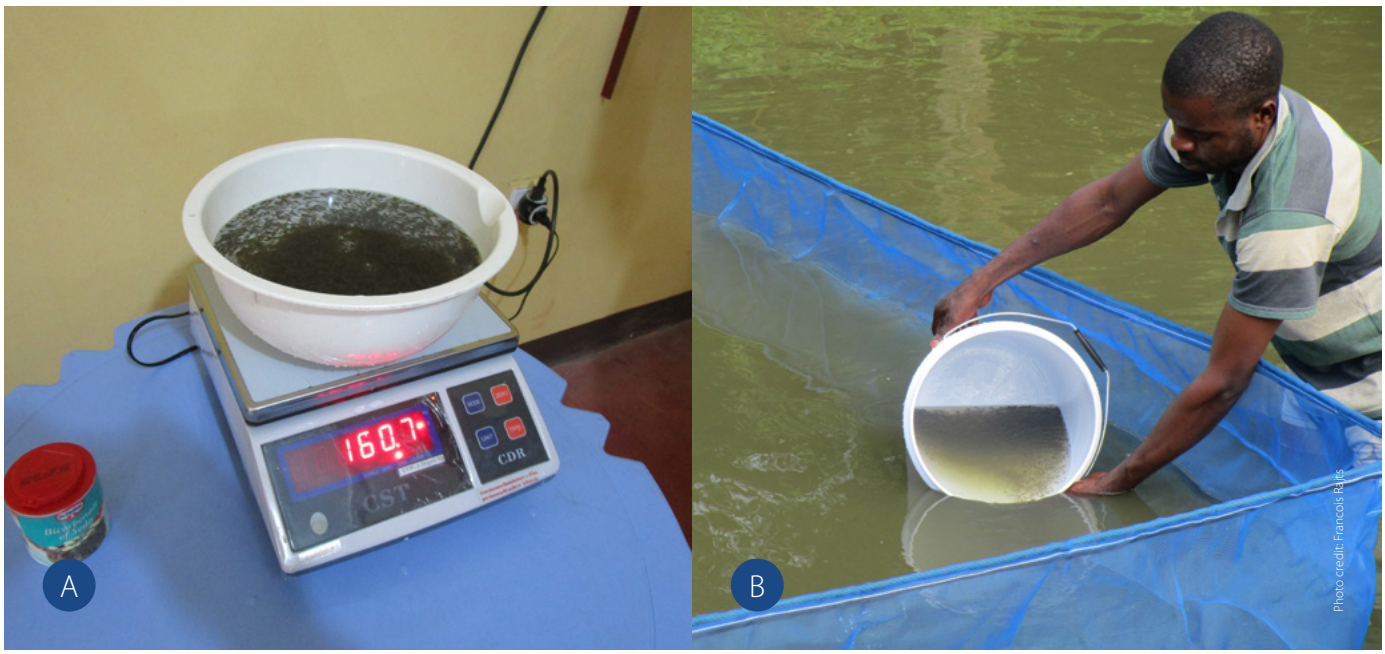

Plate 9. A: weighing the fry before stocking to estimate the number. B: stocking swim-up fry from the hatchery in Kinshasa into hapas.

9. All male production and sex reversal

For sex reversal to be successful, stock young fry of uniform size into hapas and exclusively administer hormone-treated feed, as directed, to produce all males. Given that sex in tilapia is labile, it is important to have young fish of uniform size. Administering adequate hormone feed to fry of suitable size for 21–28 days will result in over 99 percent males. The dose rate and treatment durations vary depending on the environment and the experience of the producer.

Exercise caution while handling hormones for sex reversal. This includes but is not limited to having a dedicated space for preparing the hormone feed and a secure and lockable storage place for the hormone and the hormone-treated feed. Use protective gear (minimum of a mask and gloves) when preparing hormone feed. For smaller hatcheries where these requirements are unattainable, purchasing pre-hormone mixed feed is a suitable alternative to ensure that the right quantities are mixed.

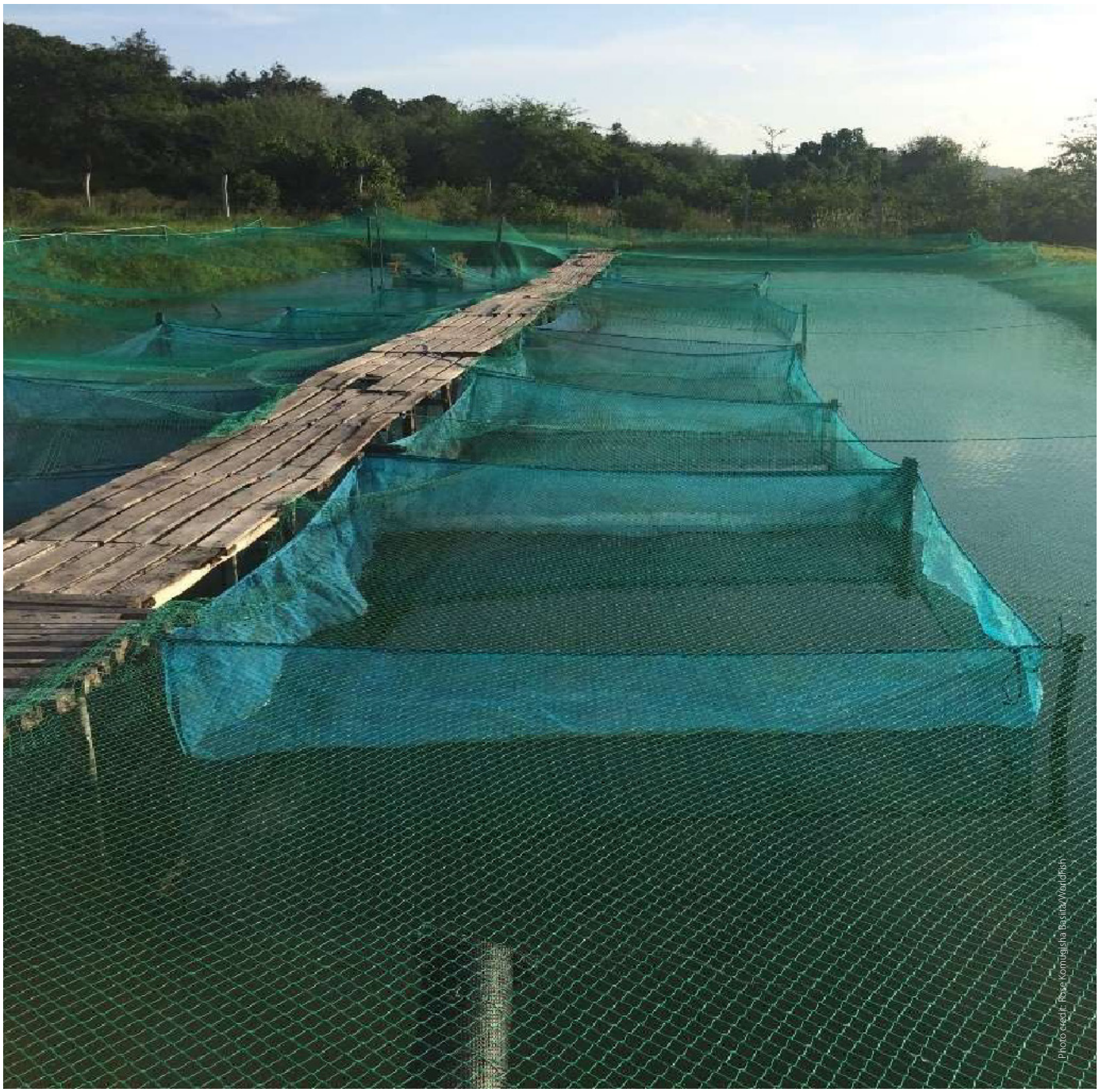

Plate 10. Hapas for nursing fry and covered by a net for biosecurity.

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About FISH

The CGIAR Research Program on Fish Agri-Food Systems (FISH) is a multidisciplinary research program. Designed in collaboration with research partners, beneficiaries and stakeholders, FISH develops and implements research innovations that optimize the individual and joint contributions of aquaculture and small-scale fisheries to reducing poverty, improving food and nutrition security and sustaining the underlying natural resources and ecosystems services upon which both depend. The program is led by WorldFish, a member of the CGIAR Consortium. CGIAR is a global research partnership for a food secure future.

For more information, please visit fish.cgiar.org