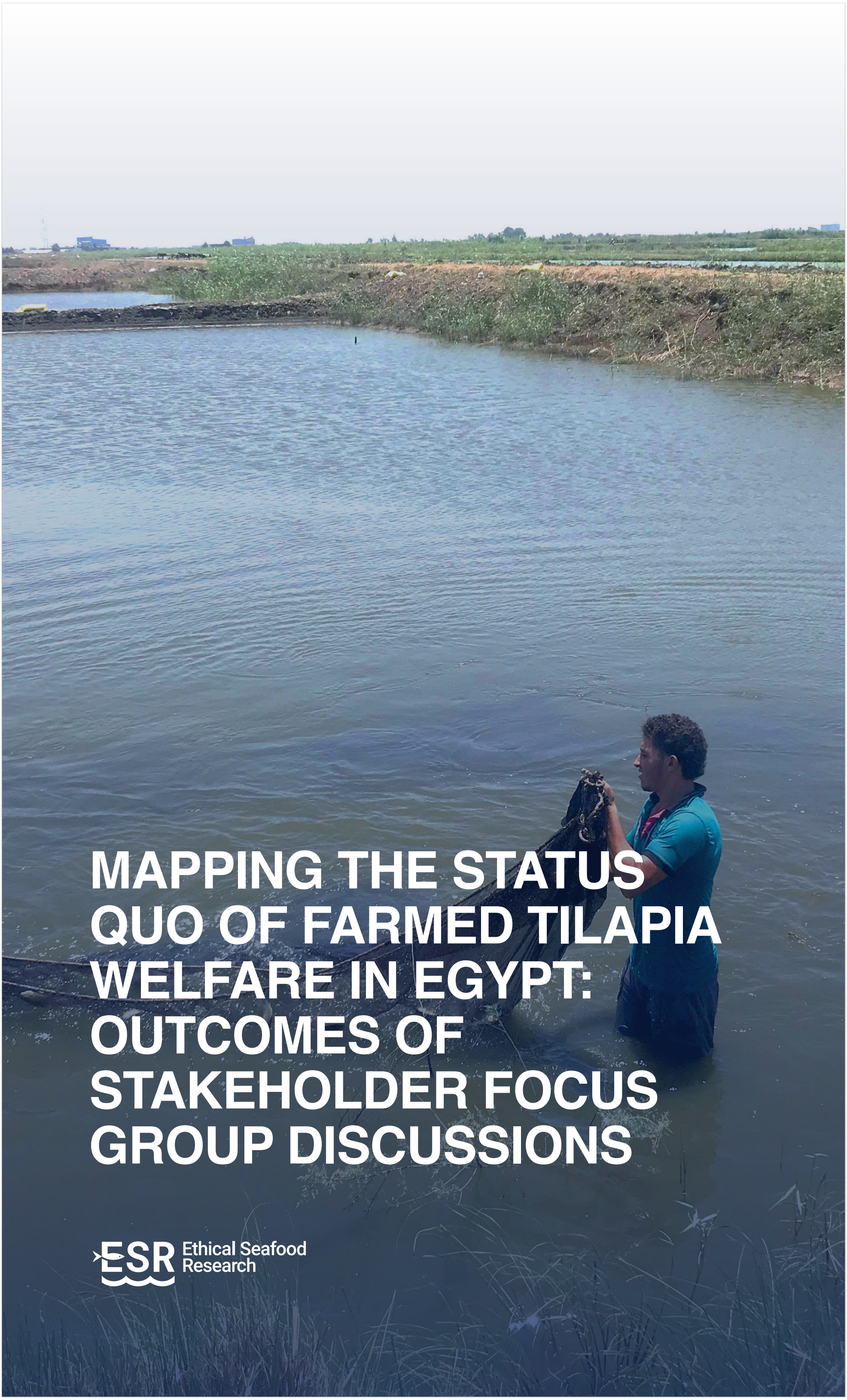

# MAPPING THE STATUS QUO OF FARMED TILAPIA WELFARE IN EGYPT: OUTCOMES OF STAKEHOLDER FOCUS GROUP DISCUSSIONS

ESR Ethical Seafood Research

# ACKNOWLEDGMENTS

This report was prepared by Wasseem Emam (Ethical Seafood Research), Mahmoud Eltholth (Royal Holloway University of London), Ahmad Hamza (Aquavet Egypt), Radi Ali (Kafrelsheikh University, Egypt) and Mohamed Bakr (Ethical Seafood Research). This project was generously funded by Open Philanthropy.

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Ethical Seafood Research
Glasgow, United Kingdom
info@ethicalseafoodresearch.com
ethicalseafoodresearch.com

# INTRODUCTION

Experience on the ground suggests that animal welfare is a topic that is hardly discussed within the animal production sectors in Egypt and the wider region of the Middle East and North Africa. This is even more the case for aquatic animals for whom most people in the region are likely unaware of their sentience. Given the scale of Egypt's aquaculture production (top five finfish producers in the world) and in particular, production of Nile tilapia (*Oreochromis niloticus*), efforts to improve animal welfare in aquaculture could potentially improve the lives of a large number of animals. As such, there is a considerable incentive to find suitable high welfare interventions that can work in the local context.

In order to identify points of particularly low welfare in the tilapia production chain and understand where there is scope for culturally appropriate interventions to be introduced, we first need to understand the current status of tilapia farming in the country. This report describes the findings of the first activity of the tilapia welfare mapping exercise — focus group discussions that were held with key stakeholders in the Egyptian Nile tilapia production chain.

# METHODS

Four participatory workshops were held in three of the major tilapia farming governorates situated in the Egyptian Nile Delta (Kafr El Sheikh, Beheira, and Port Said) between the 23rd of August and the 7th of September 2023. Almost all tilapia farming in Egypt is carried out in earthen ponds without any liner and officially, no cages are allowed for the use of fish production.

Invitations were sent to key stakeholders from across the sector and attendance was both sizeable and representative of the various points of the production chain. In total, 155 people participated in the four workshops made up of predominantly tilapia farmers (62%), tilapia hatchery operators (11%), feed mill operators (8%), aquaculture experts (7%), sales representatives of fish pharmaceutical companies (7%) and veterinarians (5%). Expertise amongst participants covered the entire tilapia farming process including hatcheries, nurseries, grow out, harvest and post-harvest operations. The diversity of experiences allowed for engaging discussions across the distinct groups of stakeholders.

At each workshop, participants were allocated to groups of 5 to 10 stakeholders with a facilitator and a notetaker at each table. Facilitators were trained on how to stimulate the conversation and manage the discussion, making sure that everyone around the table was given a chance to be heard. All activities were facilitated in Arabic and then translated into English by members of the research team.


Each workshop started with an introductory presentation clarifying the objectives of the workshop, assigning individual roles within each roundtable discussion, and providing definitions of key concepts around animal welfare in aquaculture including what good and poor animal welfare might look like.

# RESULTS

## Overview of the standard tilapia farming process in Egypt

The first outcome of the discussions was to identify the different phases of the tilapia farming process and establish standard practices across the sector. The principal stages of production identified were as follows:

*A. Hatchery and broodstock management;*

*B. Nursery ponds;*

*C. Grow-out ponds; and*

*D. Harvest and post-harvest operations.*

Participants pointed out that more than 90% of tilapia hatcheries are privately operated with only a minority run by the relevant government agency (the Lake and Fisheries Resources Protection and Development Authority [LFRPDA], formerly known as the General Authority for Fish Resources Development or GAFRD). Although not commonly used, where nursery ponds are found is, either within the hatchery facilities themselves or in the grow-out ponds. According to workshop participants, there are two primary stocking methods in use. The first, which is used by about 70% of farmers, is to stock the grow-out ponds with so-called ‘fresh’ fry (almost 21 days old and weighing less than 5 g) that are purchased directly from hatcheries. The second method used by the remaining 30% is to stock the ponds with fingerlings that have been ‘overwintered’ during the colder season (October – March)

and weigh about 50 g. Farms that use fresh fry usually stock them in a smaller pond within their grow-out farm (i.e., an on-farm nursery) for about one month before distributing them ('thinning') amongst the other ponds in their farm.

The production cycle typically starts around March/April when the weather starts to warm up and lasts for around five to six months. There is a high variation in pond stocking density for Nile tilapia in these semi-intensive systems ranging between 8,000 fry or fingerlings per feddan which is roughly 2 fish/$m^2$ to 40,000 fry or fingerlings per feddan which is just under 10 fish/$m^2$. Participants mentioned that farmers usually start with a very high stocking density to compensate the potential high mortality rate of up to 30% they typically experience, particularly in the summer. This high mortality rate is typically related to the increased water temperature ('summer mortality syndrome'). Almost all tilapia farmers reported cultivating other species alongside the Nile tilapia, in particular the flathead grey mullet (*Mugil cephalus*, L.) and the thin-lipped mullet (*Chelon ramada*, Risso, 1827); however, these are stocked at much lower densities of between 500 to 1000 fish per feddan (0.12 to 0.24 fish/$m^2$) and 1000 to 2000 fish per feddan (0.24 to 0.48 fish/$m^2$) respectively.

The following sections outline the summary and main concluding points of discussion for each stage of tilapia production.

## Farming practices per stage of production

### *A. Hatchery and broodstock management*

The discussion which mainly centred around the handling and management of tilapia at the hatcheries and how fry are transported between the hatcheries and the nurseries or grow out ponds revealed the following:

1) The selection of broodstock is based on scientific methods that ensure that females are suitable for breeding in terms of weight and being free of any signs of disease. Hatchery owners attempt to obtain broodstock from different sources in the country so as to diversify the gene pool and limit chances of inbreeding. One breeder mentioned that he brings broodstock from Aswan which is in the very south of the country.

2) The preparation of females for spawning usually starts in the middle of January in the parts of the hatchery that are covered with a greenhouse to maintain temperature. Hatching and subsequent egg collection then starts in late February. Participants shared that females that are not 'well-prepared' typically produce low volumes of weak fry that grow slowly and are more vulnerable to diseases. When asked what 'well-prepared' means, participants shared that broodstock needed to be provided with adequate space and feed and be given enough time to naturally acclimate to the artificial temperature in the greenhouse.

3) For the production of all-male monosex tilapia (which is the norm, both in Egypt and in many tilapia-producing countries, given that they grow faster), the hormone *7-alpha methyltestosterone* is added at a rate of 100 milligrams per kg of feed for 21 days. However, this period is insufficient to produce 100% monosex fry so there are always some females in the fry that are sold to fish farms. In fact, some hatcheries add the hormones for an even shorter period of as little as 8 days which leads to the presence of even more females in the grow-out ponds thereby resulting in breeding between males and females, brooding behaviour amongst females, territoriality between males, and a high variation in fish size at harvest. Participants described concerns around the reliability of the hormone obtained given that the two types in circulation (Filipino and Chinese) are not particularly reputable. One hatchery operator mentioned that he noticed poorer performance amongst broodstock (lower spawning rates) when they were only provided hormones (sometimes used to increase spawning) and not provided with additives such as anti-toxins and immune boosters.

4) Participants tended to agree that size grading at the hatchery should ideally be carried out on day 10 after hatching and before selling fry to farmers, since improper grading or no grading at all which happens in some hatcheries usually results in non-uniform fry and significant economic losses to the farmer at harvest.

5) Tilapia hatchery operators believe that the first generation of broodstock is the best of all, as its productivity is highest in terms of survival rates and fry growth rates. It is not clear how quickly productivity tails off with successive generations but this likely merits further investigation.

6) Fry are transported from hatcheries to nurseries or grow-out ponds in two ways:

    a. In plastic bags that are one-third (20 L) filled with water and

that transport 700 to 1000 fry of around 21 days old and with supplementary oxygen. For long travel distances, the bags with fry are transported in refrigerated trucks. Participants mentioned that bags are better for long distances, although there was agreement that transport distances should generally be minimised when using bags. Some participants mentioned that for inter-regional travel, bags of fry need to be placed in a box because vehicles transporting fry are impounded on the road and fined 20,000 EGP for moving 'seed' between governorates. There was consensus that transporting fry in bags is better because it is less stressful to the animals and leads to higher survival rates and better fish health.

b. In tanks or drums supplied with oxygen through aerators. Tanks/barrels are primarily used for transporting fry long distances; however, this is expensive. Most farmers do not seem to disinfect the containers used to transport fry although a few of them reported using disinfectant or humic acid. Some participants mentioned that transporting fry in barrels can be faster and more economical for transporting over short distances.

7) Transporting fry requires skilled workers, access to materials for soft covering, and appropriate weather. In addition, it is recommended to use disinfectants such as hydroxy peroxide/iodine when transporting the fry after incubation. However, the dose of disinfectant must be carefully calculated.

8) Acclimatisation of fry: All participants agreed that the sudden change in temperature and chemical composition of the water is a major cause of mortality in the first larval stages. However, it can be reduced by properly acclimatising the larvae before placing them in ponds during each stage of fish farming. In some hatcheries, the water is acclimatised to the farm to which the fry will be transferred before being transported


to the nursery ponds. However, this is not the norm, only for hatcheries that are in close proximity to the grow-out ponds. One participant shared that direct transfer of fry without acclimatisation results in at least 15% mortality of fry. Acclimatisation is a low-cost and simple (and therefore, cost-effective) intervention that could benefit both the farmer in terms of reducing loss and the animals in terms of reducing thermal stress.

9) Other management problems at the hatchery level that were mentioned by participants included limited quantities of feed provided to both the fry and broodstock, and the conditions that hatchery workers have to withstand. In addition, some voiced concerns about the quality of the breeds being selected and fry being incubated for less than the minimum recommended 21 days (usually 5-10 days). Fluctuations in the market prices of fry were also mentioned.

### *B. Nursery ponds*

1) All participants agreed that fry should ideally be kept in nursery ponds for a period of 30 to 45 days in order to improve the fingerling survival rate. Some farmers even mentioned that they incubate their fry for up to 60 days. Despite agreeing with its importance, not all farmers in attendance incubate their fry, with around 20% stating that they introduce them directly into the grow-out ponds or that they only keep them in the smaller 'incubation ponds' for 10 days. The majority (60%) of farmers in attendance that use nurseries did not mention the use of any pond water treatment.

2) The distribution of fry/fingerlings between the nursery ponds is carried out with great care and caution in order to avoid causing injury or stress to the fish. The process is done by first lowering the water level in the pond and introducing them directly into the drainage canal. Fry are


collected using hand nets and stored in special containers such as buckets. Aeration is provided if needed.

3) Farmers pulverise the pelleted feed and feed it to the fry for 15 days. The typical check here is to ensure that the powdered feed is consumed within the first five minutes.

4) Participants stated that the mortality rate is high in the nurseries due to the high stocking densities (no one gave fixed numbers). There are apparently no specific guidelines for stocking densities in nurseries. One farmer mentioned that genetically improved strains of tilapia experience higher mortality rates; however, almost all strains in use have been selectively bred so the relevance of this comment was not immediately clear.

5) Moving or transporting of overwintered fingerlings between nursery and grow-out ponds: different methods were mentioned depending on the distance and time. Where the nursery is adjacent to the grow-out operation, farmers just flatten a part of the pond wall and spread the fingerlings. Where nursery ponds are not adjacent to the grow-out ponds but where distances are very short (i.e., within the same farm), fingerlings are transferred from one pond to another in plastic boxes (the ones used for selling fish). This method is suitable for transport times of less than 30 minutes. For longer distances (i.e., transport to other farms), it is recommended to use water-filled barrels or tanks and supply with oxygen. These containers are then transported on wagons. This method is suitable for transport times of up to 3 hours.

6) The majority (95%) of farmers that use nursery ponds mentioned that they count the number of fingerlings before transferring them to grow-out ponds. The rest just expand the nursery pond into the grow-out without counting.


### *C. Grow-out ponds*

1) Participants confirmed that most grow-out farmers stock monosex (all-male) tilapia.

2) Most farmers agreed that typical pond depth was around 70 cm.

3) Very few of the grow-out farmers present mentioned the use of aeration in their ponds. All farmers depend on pumping water from external sources or recycling water within the farm in order to increase dissolved oxygen concentrations. Pumping is usually carried out in the evening hours when pond oxygen levels drop (i.e., between 6 pm to 8 am).

4) The production cycle starts with pond preparation where the ponds are left to dry after the previous cycle. Some farmers then add disinfectant to the ponds before filling them with water at least one day before stocking.

5) As mentioned above, most farmers (>80%) release either fresh fry or fingerlings directly to the grow-out ponds without temperature acclimatisation. One farmer who stocks 70,000 fry per pond (likely to be 1 feddan each which is roughly equivalent to 1 acre, i.e., ~17 fish/$m^2$) without acclimatisation was under the impression that such a practice would only be necessary for marine fish species where there are changes in salinity.

6) One farmer shared that he typically obtains a final fish weight of about 300 grams from fry weighing 5 grams during a rearing period ranging from 4 to 5 months, stocked at a density of 20,000 fry per acre (~5 fish/$m^2$).

7) The same farmer experimented with farming Nile tilapia and flathead grey mullet in polyculture at a stocking density of 10,000 and 15,000 fry per feddan respectively. After one year of rearing, the final body weight

for the farmed mullet was around 1 kg.

8) All participants agreed on the fact that getting stocking densities right is vitally important in order to avoid water quality deterioration and mortalities. There was a general consensus (~70% of attendees) that it should never exceed the 'magic number' of 30-35 thousand fry per feddan or acre (~7-8 fish/$m^2$).

9) Stocking densities are based on the targeted yield. For example, if the target is to produce 5 metric tons per acre or feddan, farmers will stock 15,000-25,000 fry per acre (~4-6 fish/$m^2$). One participant shared that around a decade ago, the stocking density was typically around 10,000 tilapia fry per feddan (~2 fish/$m^2$) and currently the stocking density is typically around 20,000 tilapia fry per feddan (~5 fish/$m^2$) with 2,000 fry of flathead grey mullet per feddan (<0.5 fish/$m^2$) and 1,000 fry of thin-lipped mullet per feddan (<0.25 fish/$m^2$). This is more or less consistent with what other participants shared.

10) Most farmers in attendance reported not using any sorts of feed or water additives such as probiotics and vitamins. The majority (80%) use manufactured feed from established feed mills such as Al Quds, Aller Aqua, Skretting, etc., and the remaining formulate their own feed by compressing purchased ingredients. The one farmer that claimed to use feed additives mentioned that the result was typically instantaneous, with any observed improvement occurring when the additive is provided and the problem returning immediately after the additive is stopped. He suggested that the solution would be for the additives to be added at the feed mill itself.

11) The fish feed most commonly used by farmers typically contains around 25% crude protein. The feed conversion ratio (FCR) frequently cited in roundtable discussions for feed with 25% crude protein was 7.5 tons of fish feed to produce 5 tons of tilapia (FCR = 1.5). If instead, the farmers use feed with a 30% crude protein content, the feed conversion ratio falls to 1.3 (i.e., 6.5 tons of feed to produce 5 tons of tilapia).

12) The farmers that prefer using their own formulated feed ('compressed' feed) reported needing 9-10 tons of fish feed to produce 5 tons of tilapia which is an FCR of 1.8-2. Despite being less 'efficient', this form of fish feed is less expensive for the farmer to obtain so final profitability would need to be compared between the two feed types.

13) Only a handful (three) of participants reported using any medications during the production cycle. There are issues with the supply and availability of medicines due to the high prices and difficulties in importation. Very few farmers (two) mentioned the use of products to improve water quality. However, a few more mentioned using disinfectants when necessary (i.e., in the case of experiencing significant fish mortalities).

14) In terms of pond water quality, surprisingly only five farmers in attendance mentioned measuring water quality parameters. The main


one they all measured was dissolved oxygen. However, two mentioned monitoring ammonia concentrations and one even reported he monitored salinity levels and pH. None of them mentioned regular measurements (all of them seemed sporadic). Only one farmer claimed to have devices for monitoring water quality; the others relied on measurements taken by the technicians affiliated with the feed manufacturers whenever they passed by their farms. The lack of monitoring seems to be related to a combination of not valuing water quality as a relevant parameter during production and the affordability of the measuring instruments. However, those who do not measure seemed open to doing so.

15) In terms of polyculture (where one main fish species is farmed alongside others), most farms reported stocking between 10,000-15,000 tilapia fry per feddan (2-4 fish/$m^2$) alongside 2000 fry of flathead grey mullet (<0.5 fish/$m^2$) and 1000 fry of thin-lipped mullet (<0.25 fish/$m^2$).

16) Participants cited different feed conversion rates for different stocking densities:

- 1.25 for 15,000 fry per feddan (~4 fish/$m^2$)
- 1.4 for 20,000 fry per feddan (~5 fish/$m^2$); and
- 1.6 for 25,000-30,000 fry per feddan (6-7 fish/$m^2$).

17) Most farm owners in attendance reported aiming to feed their fish three times per day. These times were given as 9 am, 1 pm and 4 pm. However, anecdotally, we know that it is likely that farm workers combine two feeds into one, especially in larger farms where there are many ponds. This means they feed double the quantity at the same time.

18) A small number of farms (8%) reported carrying out any form of pond

preparation before the start of the production cycle. The type of preparation carried out by all of those farms was the same (so-called 'pond fertilisation' where poultry manure and yeast are applied to the dry soil before filling the pond with water). Pond fertilisation is used in the farming of herbivorous species such as the Nile tilapia to stimulate primary productivity and provide a supplementary natural alternative source of feed in addition to the formulated feed.

19) Where 'fresh' fry are stocked, a small number of farmers (20%) reported not adding supplementary feed for the first few days and relying solely on natural sources of feed in the pond such as phytoplankton. However, the majority reported using powdered feed containing 30% crude protein right at the start of the cycle. These farmers then switch to granulated feed containing 25% crude protein after roughly 40 days. During that time, the farmers gradually increase the quantity of feed they provide to their fish. However, all farmers claimed to do this by eye and not use calculations. Most farmers in attendance reported using floating feed as opposed to sinking feed as they believe it helps to produce a uniform size of fish and they are able to observe the fish as they consume the feed. No comments were made regarding differences in aggressive behaviour with sinking versus floating feed.

20) Farmers in attendance mostly agreed that when the average weight of stocked fish reaches around 80 g, they should start to take regular samples of their fish to monitor growth. They mentioned that this should ideally be done every two weeks. This is typically carried out by seining a section of the pond after adding feed and taking a small number of fish, weighing them in a tared bucket and counting them before returning them to the pond (or keeping them for the farmer's own consumption depending on which stage of the cycle they are sampled in). This information is then used to adjust the quantity of feed provided. However, most farmers admitted that they sample far less frequently than twice a month. Moreover, most do not keep records.

21) The majority (80%) of farms use open ponds that are connected to each other in at least one section. Open ponds are preferred as farmers believe it provides more space for the two species of mullet that are farmed alongside the tilapia.

22) All farmers voiced their frustration with the high degree of fish mortalities they experience. Most do not believe that medicine will solve their problems, and few are interested in using immune boosters due to the high cost. They believe the source of mortalities is the poor water quality which is exacerbated as the weather warms up.

23) One of the key challenges commonly cited by participants is the quality of 'seed' (fish fry). There is apparently a lack of reliable sources for obtaining high quality fry and as a result, many farmers end up mixing fry from different sources in the same farm or even the same pond. Such a practice can lead to variation in the quality of the final

product.

24) Hardly any participants reported consulting with aquaculture specialists or veterinarians to solve production problems they are experiencing.

### *D. Harvest and post-harvest operations*

- During the final ‘harvest’, live fish are either placed in crates with ice and left to suffocate or in water tanks with oxygen (where fish are destined to live markets or restaurants). Around 70% of the fish harvested are stored on ice with the remaining 30% transported alive. Transporting live fish varies highly from one area to another and from one season to another. There seemed to be a general openness to exploring more humane slaughter methods if cost was not a barrier.

- When harvesting, farmers prefer to quickly drain the pond before netting about 80% of the fish from the pond ditch (a deeper canal in one side of the pond).

- Farmers typically harvest one pond after the other and often harvest the entire farm over several days.

- Before the day of harvesting, farmers stop feeding 1 to 2 days in advance.

- The harvest is carried out by a specialised team that move from one farm to another (this likely represents a risk of disease transmission).

- Once fish are removed from the pond, they are graded by size before being placed in ice alive.

- The fish are placed in a plastic box if they are being transported to the wholesale or local market. If they are being transported for exporting, they are first washed and then placed in iced water.

- Workshop participants agreed that the fish transported in ice tend to be of better quality.

- The marketing of harvested fish is a major issue due to the large fluctuations in the price of tilapia throughout the year. Sometimes the farm owner is forced to harvest even when the prices are not favourable which results in a loss of revenue.

- Workshop participants believe that gentle handling and management of tilapia during harvest is important not only for food safety but also for fillet quality and profitability. Better quality means increased market opportunities for exporting their product. It was not immediately clear where they thought the link was between fish handling and food safety.


# CONCLUSIONS

Not a single workshop participant stated that they had heard of animal welfare in aquaculture. However, every single one displayed an interest and willingness to learn. Many participants expressed an interest in changing tilapia handling and management practices. The biggest problem tilapia farmers face seems to be high fish mortality rates. Participants understood that improving fish handling and management practices can help partially address this problem. Several attendees mentioned a willingness to explore certifying their produce but that there would have to be a market incentive for doing so.

Participants agreed on the importance of the following management practices:

1. Optimal feed preparation and provision of adequate volumes of high-quality feed. Feed composition should be analysed and feed additives should be used to improve the feed utilisation rate. Feed should be distributed evenly throughout the pond and fish should be fed three times a day ideally.

2. Minimal handling of fish and gentle handling where it is absolutely necessary.

3. Improving water quality and monitoring water quality regularly right from the start of the production cycle. Farmers should try to use aerators where possible as it reduces the risk of issues related to poor water quality.

4. Maintaining stocking densities much below the recommended maximum of 30-35 thousand fry per feddan or acre (~7-8 fish/$m^2$). This can help to avoid many health and welfare problems, as well as helping maintain better water quality.

5. Obtaining fry from reliable sources to promote high-viability hatchery operations.

6. Ensuring an acclimatisation period for any fish being transported from one environment to another (e.g., from hatcheries to nurseries or grow-out ponds).

7. Continuous monitoring of operations throughout the production cycle to ensure that issues are detected and remedied right away. Fish growth should be monitored frequently in order to adjust feeding levels and practices.

8. Establishing communication networks between tilapia farmers to exchange best practices and warn about water quality issues given that many share the same water source.

9. All farm owners and workers should attend training sessions to learn new skills in appropriate handling and management of farmed tilapia.

# RECOMMENDATIONS FOR FURTHER RESEARCH OR INTERVENTIONS

1) It could be useful to understand the welfare implications of overwintering fry/fingerlings versus stocking ‘fresh’ fry.

2) The welfare implications of using nurseries versus stocking grow-out ponds directly are also poorly understood. Further research in this regard could be useful.

3) The welfare needs of the flathead grey mullet and thin-lipped mullet are

even less understood than those of the Nile tilapia. It is likely worthwhile to understand the effects of stocking them together with tilapia and how to provide for their needs as well.

4) It is not clear whether the production of all-male fry is better from an animal welfare perspective. Further investigation into this point could be useful given the widespread extent of this practice.

5) Hatcheries are a potentially good starting point for higher welfare interventions given that operators have even more incentive to treat their fish with care since they are selling live fish and survival is directly related to profitability. One possible point of entry could be around appropriate use of breeding females (when to replace with younger ones, how many times per year to stimulate them to breed, etc.). Another point could be related to the practice of grading fry and the importance of that both for welfare and farm performance.

6) Guidelines around best practices for transportation of fry or fingerlings are likely to be well-received. Similarly, farmers are likely to be open to hearing guidance around good pond preparation practices.

7) In order to recommend best feeding practices, it might help to understand the welfare implications of using ready-made feed versus making your own feed. Similarly, it is not clear whether floating feed pellets are better for Nile tilapia from a welfare perspective vis-à-vis sinking pellets (for example, are their differences in aggressive behaviour?).

8) There appears to be scope for an intervention around better harvesting practices. Training sessions aimed at these 'harvest teams' could be relatively low cost and impactful given that these are teams that are specialised in this procedure and are responsible for a large number of farms.

9) The practice of live transporting tilapia to restaurants and markets after harvest also represents an opportunity to recommend higher welfare practices given the inherent incentive for the fish to arrive in better condition.

10) It may be worthwhile to explore the introduction of a certification scheme for Egyptian tilapia farmers.

11) A tailored training programme based around the findings of these workshops is likely to help address some of the issues raised by attendees. Moreover, there is certainly an interest and willingness on the part of fish farmers.