Welfare issues in Nile tilapia

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Introduction

The present summary covers 'ongrowers', i.e. fingerlings (1-30 g) to harvest size which can go from 200 g. to more than 1 kg. For a full overview and detailed information on welfare issues in the commercial production of Nile tilapia (including full references) please see the document **Improving the welfare of farmed Nile tilapia at rearing**.

Physical wellbeing

Welfare Issue	Problem	Solution
Confinement/ overcrowding	Fish kept in overcrowded conditions are more likely to be injured (snout and flank damage, fin erosion, cataracts, eye damage). Under this circumstances water quality can deteriorate quickly and affect their gills. Increased closeness can lead to social stress.	Stocking density should be 3 fish/ m^2 (**1.6 kg/m^3**) in ponds or 50 fish/ m^3 (**26.5 kg/m^3**) in nets or cages to allow for sufficient space to live with minimal risk of injury and stress. Lower stocking density (without triggering territoriality) reduces the physiological load on the water, decreasing the risk of low water quality.
Inappropriate water temperature	Confined fish are unable to behaviourally thermoregulate when water temperature is too low or too high, causing physiological stress. Nile tilapia are known to perform depth migrations to avoid temperatures below 21^{0}C.	Nile tilapia are capable of surviving at a wide range of temperatures, but ideally should be reared at temperatures between 25 and 30^{0}C. Increases in temperature reduces dissolved oxygen in the water, which increases the risk of poor water quality.
Poor water quality	Poor water quality leads to acute and chronic stress, reduced ability to osmoregulate, increased susceptibility to disease, poor body condition, fin erosion, gill damage, reduced growth and increased mortality rate.	Ensure regular water exchange within ponds or aeration, and good water flow through nets, hapas or cages. Water parameters (e.g., turbidity, pH, ammonia) should be regularly monitored across the whole water system.
Low dissolved oxygen	Low levels of dissolved oxygen will force tilapia to air-breathe, which is energetically costly.	Dissolved oxygen should be maintained at 4 mg/l at all depths and in all areas of the water system. Aeration or water exchange can be used to achieve this.
Inappropriate diet	Inappropriate diet can lead to starvation and possibly even death, due to a lack of energy reserves and impaired development.	Feed composition should be suitable for the life stage.
Fasting	Fasting leads to hunger in fish, as wells as physiological stress and fatigue	Fish must not be fasted longer than necessary for welfare benefit. Fasting should be below 24 hours and ideally be a maximum of 13.5 hours to reduce unnecessary stress (including transport and holding time for processing).
Diseases	Stress is a main predisposing factor for infestations. Cases of viral outbreak diseases are increasing. The diversity of tilapia strains makes it difficult to design efficient vaccines.	Fish should be monitored regularly for signs of health problems by trained members of staff. When a disease is identified fish must be either treated without delay or fish already moribund humanely euthanised. Diseases should be prevented by improving rearing practices, including good enclosure design, to reduce stress.
Exposure to air	Exposure to air leads to severe physiological stress, fear and discomfort. It also leads to increased susceptibility to injury.	Live fish should not be taken out of water, if not necessary. When unavoidable, they should not be taken out of water for more than 15 seconds maximum.
Fin erosion	Erosion and wounds in fins increases the risk of secondary bacterial infection and is likely to cause pain and discomfort.	Handling should be as gentle as possible. Provide sufficient space and lower stocking density for fish to be able to escape one another.
Live transport	Fish transported alive are likely to experience overcrowding, handling stress, water movement and changes in temperature, noise and vibrations in water, changes in light and build-up of waste deteriorating the water quality. May all occur simultaneously with the potential to cause severe stress.	For the best welfare, Nile tilapia should not be transported while alive, and should be humanely slaughtered on-farm. If live transport is unavoidable, water quality should be constantly monitored during the journey. Additional oxygen should be available in case of delays. Number of fish should be considered and stocking densities should be calculated in advance to ensure that fish are transported adequately, i.e.: in an adequate number of transports and volume of water. A trained person must be present during the journey and be accountable for the fish welfare during transport. Handling should be kept to an absolute minimum during loading and unloading (e.g. through pumping), and sick/ injured animals should not be transported.
Slaughter without effective stunning	Different methods for stunning and killing tilapia vary in how stressful and humane they are. CO_2 exposure, asphyxia and ice slurries are always stressful and inhumane and should never be used. Although electrical and percussive stunning can be humane, there is a risk for these methods to be applied incorrectly, with the risk of painful injuries and recovery of consciousness before death.	The use of a single method that both stuns (instantly) and kills (i.e. electrocution) is recommended above other methods when it is commercially available. Electrical stunning (5 seconds at an electrical current of 50Hz AC, 1 A_{rms}/dm^2) followed by a separate killing method (see below) is also acceptable, providing fish do not regain consciousness after stunning. Acceptable post-stun killing methods for tilapia are: exsanguination, decapitation, spiking/coring or by gill cutting. The use of carbon dioxide systems, and leaving tilapia to asphyxiate in air, are unacceptable killing methods and must be phased out. Fish should be evaluated for consciousness and if any signs of consciousness are observed (or if in any doubt) the stun should be repeater or use an alternative back-up method.

Mental wellbeing

Welfare Issue	Problem	Solution
Long-term overcrowding (i.e. high stocking density)	Keeping fish under overcrowding conditions for long periods leads to severe and often chronic social stress and decreased water quality.	Provide sufficient space and appropriate stocking density for fish to be able to escape one another, without triggering territoriality. Feed distribution methods should allow all fish access to sufficient feed, and they should be fed to satiety.
Short-term overcrowding (i.e. during husbandry manipulation)	Subjecting the fish to short periods of high density leads to severe and acute social stress, fear and vigorous attempts to escape that can cause injuries and/or exposure to air.	Avoid overcrowding wherever possible. When unavoidable, intensity and duration of crowding should be minimised, and should never last more than 2 hours. Water quality, fish health and behaviour should be monitored throughout the crowding period.
Barren environment	A barren environment causes a chronic lack of cognitive, sensory and physical stimulation.	There is evidence that enrichment in the form of three-dimensional structures, sandy or small-grained substrates and shelter are beneficial for tilapia. Blue light reduces stress.
High light intensity	Rearing conditions that include a high light intensity can increase aggresivity.	Keep light intensity below 280 lux. This can be achieved by regulating the light intensity indoors, or if outdoors keeping a good level of turbidity, or using shades over the enclosure.
Handling	Handling procedures often exposes the fish to the air (see air exposure). Incorrect handling can lead the fish to be impacted by their full weight without the support of water.	Only competent and fully trained staff should be allowed to handle the fish during procedures. Staff should be trained and have good knowledge of welfare issues, such as stress in fish. If they need to be out of the water for longer procedures such as vaccination or inspection they should be sedated.

Natural behaviour

Welfare Issue	Problem	Solution
Feeding practices	Territoriality triggered by resource distribution in the environment.	Feeding practices should focus on adequate spatial distribution to ensure feed access without competition. Self-feeding systems have proved to reduce stress originated from feeding. Provide sufficient space and stocking density.
Restriction of behavioural expression	Under high intensity rearing conditions, freedom of movement to swim is severely restricted, a lack of space to escape from one another, and a lack of adequate depth to adapt to changing temperatures.	Provide appropriate space and shelter for fish to rest and escape one another; enclosures should be a minimum of 2 m of depth.
Territoriality (aggression)	If stocking density is very low, some fish are able to defend territories which triggers an increase in tilapia aggression. Tilapia may mature before harvesting and males will defend their nesting site.	Observe tilapia's behaviour in the system to adapt the minimum stocking density to one that does not trigger aggressive behaviour. Ensure harvesting before males mature (3-4 months old, the size will vary: 50-100 g).