INTERNATIONAL STANDARDS FOR RESPONSIBLE TILAPIA AQUACULTURE
Created by the Tilapia Aquaculture Dialogue

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1. INTRODUCTION

Seafood is one of the most popular sources of protein worldwide. U.S. seafood consumption reached its highest level in 2006 and consumption of seafood globally is expected to continue to rise. By volume, almost half of the seafood we eat is wild caught. But the other half is from aquaculture – the fastest growing food production system in the world – and aquaculture's contribution is expected to continue to rise.

There is growing recognition that the aquaculture industry, not unlike any industry, has both good performers and poor performers. Some producers perform well at addressing certain environmental and social concerns, while others may not address these same concerns adequately, but do perform better in other areas. Understanding which producers are performing better at every aspect of production is relevant to the specific party interested and to the depth the party understands the impacts of production and what the environmental and societal effects are. Moreover, these impacts often are generalized to species, production systems and in some cases geographic region for lack of an appropriate method of analyzing and deciding what is "better" or "worse". Nevertheless, the knowledge base is growing and the recognition of perceived versus realized impacts has fostered the notion that with appropriate management, aquaculture can meet the growing demand for seafood and contribute to food security, poverty reduction and sustainable economic development.

One of the most effective tools for minimizing the environmental and social impacts associated with aquaculture is standards for certifying aquaculture products. Aquaculture industry stakeholders increasingly recognize that certification can reassure buyers, retailers and consumers that the impacts related to aquaculture are minimized. Certification also provides aquaculture industry stakeholders, as well as consumers, with the confidence that compliance with government and inter-governmental requirements has been achieved.

Through the Tilapia Aquaculture Dialogue (TAD), established in 2005, standards have been developed for the tilapia aquaculture industry. The standards are measurable performance levels producers must meet if they want their products to be certified. The standards were created by consensus among a diverse set of stakeholders and are based on the most recent science related to tilapia. The full suite of standards (including principles, criteria and indicators) are described in this document. Compliance issues will be described in the auditing document, which will be created after the standards are finalized.

2. WHAT ARE STANDARDS, ACCREDITATION AND CERTIFICATION?

Certification is the end result of standard setting and accreditation. Certification may also refer to the labeling of companies, practices, operations or products that conform to the standards. Certification schemes encompass the processes, systems, procedures and activities related to three primary functions: 1) *standard setting*, 2) *accreditation* and 3) *certification* (i.e., verification of compliance, also known as "conformity assessment"). Aquaculture certification schemes must be consistent with rigorous procedures for standards setting, accreditation and certification to ensure that certification schemes are credible. Through the development of the TAD standards, the

International Social and Environmental Accreditation and Labelling (ISEAL) Alliance's Code of Good Practice for Setting Social and Environmental Standards was used.

For *standard setting* (i.e., the process of creating the norms for practices and products), it is essential that the process is not dominated by one, or a few, stakeholder groups. It is critical that aquaculture certification schemes adequately incorporate multi-stakeholder involvement in an inclusive, transparent process, with attention to the needs and conditions of small-scale producers and their communities. Additionally, if standards are to be global, they must include a wide range of stakeholders from around the world representing a wide array of management practices.

For *accreditation* (i.e., the process of authorizing entities to verify compliance with the standards), it is important that there is no conflict of interest between the entity that coordinated the standard setting process, the entity that "owns" the standards, the entity that accredits third party certification bodies, or the entity that undertakes the third party certification. Firewalls are required between these various entities to assure that independence and credibility is maintained.

For *certification* (i.e., the process of verifying compliance with the standards), it is critical that there is no conflict of interest between the entity that conducts this function and the entities that undertook standard setting, the entity that "owns" the standard or the entity that accredits the certifiers. For this reason, third party certification is the most robust and credible and process.

3. PURPOSE AND SCOPE OF THE TILAPIA AQUACULTURE STANDARDS

3.1 Purpose of the Standards

The purpose of these standards is to measurably improve the environmental and social performance of tilapia aquaculture development and operations.

3.2 Scope of the Standards

3.2.1 Issue areas of tilapia aquaculture to which the standards apply

The tilapia aquaculture standards establish criteria and measurable performance levels for responsible aquaculture with regard to social and environmental issues.

3.2.2 Operational components of tilapia aquaculture to which the standards apply

Tilapia aquaculture and its value chains generally consist of the following operational components:

- Supply chain inputs (e.g., water, seed, feed, chemicals)
- Production systems [e.g., all kinds (net pen, ponds and raceways), all scales and each component of production]
- Processing
- Chain of custody (e.g., production, processing, export, import, distribution, retail)

These standards address the most significant impacts of tilapia aquaculture, which are mostly from the *production* systems and the immediate inputs to production, such as feed, seed and water.

3.2.3 Range of activities within aquaculture to which the standards apply

Aquaculture involves the *planning*, *development* and *operation* of facilities which in turn affect the inputs, production, processing and chain of custody components.

These standards apply to the *planning*, *development* and *operation* of tilapia aquaculture *production* systems. Planning includes farm siting; water use planning; and assessment of environmental, social and cumulative impacts. Development includes construction, habitat alteration and user access. Operation includes stocking densities, effluent discharge, working conditions, use of antibiotics and other chemicals, and feed composition and use.

3.2.4 Geographic scope to which the standards apply

These standards apply to all locations and scales of tilapia aquaculture production systems in the world.

3.2.5 Unit of certification to which the standards apply

The unit of certification is the system within the production chain sought to be examined. In the case of the TAD standards, the unit of production is the farming operation. The size of the production operation can vary considerably and needs careful consideration when determining the entity that will seek assessment for compliance. As the focus of these standards is on production and the immediate inputs to production, the unit of certification will typically consist of a single farm or other production unit.

The unit of certification may also be a group or cluster of facilities or operations that should, for a number of reasons, be considered collectively as the aquaculture operation under consideration. For example, they may be in close proximity to each other, share resources or infrastructure (e.g., water sources or an effluent discharge system), share a landscape unit (e.g., a watershed), have the same production system, and/or involve the same species and have a common market outlet. Regardless of the specific situation, farms and other users will have cumulative effects. This often will be the main effect on the environment. In determining the unit of certification, an appropriate spatial scale and level of potential cumulative effects should be considered. The certification body will determine the ultimate unit of certification and procedures for auditing.

4. PROCESS FOR SETTING THE STANDARDS

4.1 General Considerations

All aquaculture certification schemes should encompass the following procedural and institutional components: the setting of standards, holding of standards, accreditation of independent certifying bodies and certification of aquaculture operations. These functions must be undertaken by separate entities and there must be sufficient distance and distinction between the entities.

The process of setting the standards is among the most critical task of any certification scheme, as it encapsulates the objectives of a scheme and largely determines the system's credibility, viability, practicality and acceptance. In accordance with ISEAL, the process of setting standards for tilapia was multi-stakeholder and transparent and did not prejudice any class of producers or industry segment. Also, in compliance with ISEAL, the tilapia standards will not be held by any of the TAD participants (the standards setting entity).

4.2 Process for setting these tilapia aquaculture standards

The draft standards for tilapia aquaculture were developed through three years of transparent, multi-stakeholder meetings with participants of the TAD. The TAD included many of the world's top tilapia producers and buyers, NGOs, researchers, governments, multi-lateral organizations, development groups and allied businesses. The meetings were convened by World Wildlife Fund. The process included the following steps::

- WWF notified ISEAL of the intent to apply the Code of Good Practice for Setting Social and Environmental Standards to theTAD, the standards- setting body.
- Key players, including producers, wholesalers/distributors/processors, feed companies, retailers, NGOs, government representatives and scientists, were asked to participate in the TAD.
- TAD participants agreed on impacts associated with tilapia aquaculture.
- Agreed on goals and objectives for the TAD.
- Agreed on the procedure for facilitation and note taking at TAD meetings.
- Agreed on policies that ensured the TAD meetings encouraged candid discussion (e.g., policies related to media coverage of the TAD).
- Agreed on TAD budget for such expenses as meeting room rental, research and the TAD coordinator's time. Agreed on the roles of different types of TAD stakeholders.
- Formed a Steering Committee that had equal representation from the aquaculture industry and NGOs.
- Also, the TAD agreed that the Steering Committee decisions would be made by consensus.
- Agreed on draft principles.
- Identified critical information gaps that needed to be filled in order to develop criteria and standards.
- Reviewed research related to criteria, indicators and standards.
- Agreed on draft criteria, indicators and standards
- Posted draft principles, criteria, indicators and standards for review.

5. INTERNATIONAL STANDARDS FOR TILAPIA AQUACULTURE

Legal framework

Principle 1 reinforces the need for the tilapia aquaculture industry to follow the national and local laws of the region where the aquaculture is taking place. A goal of the TAD is to go beyond the law and produce more rigorous standards than that which the law requires, but the legal structure of the producing country must be respected. Conversely, the TAD standards do not break the laws where tilapia aquaculture is practiced. Thus, the TAD sees this principle as a means to reinforce and complement the legal framework in tilapia producing countries.

***Principle 1*:** **Obey the law and comply with all international, national, and local regulations.**

Criteria

1. All local and national legal requirements and regulations shall be complied with.

Indicators

1. Documentation of compliance with local and national legal requirements and regulations.

Standard[1]

1. Compliance with local and national authorities is available, e.g. permits, evidence of lease, concessions and rights to land and/or water use.
2. Compliance with all taxes.
3. Compliance with all labor laws and regulations

Farm Siting/Site Development

Principle 2 addresses the issues of siting tilapia aquaculture facilities, whether new or existing. Stakeholders identified three key impacts that need to be taken into consideration in new farm siting or expansion: 1) the presence of tilapia species in the water course (culture water body and receiving waters) in which the culture activity takes place, 2) oxygen depletion in receiving waters, and 3) the overall impact on wetland habitats.

The issue of tilapia species presence in the water course in which the culture activity takes place relates to whether tilapia is either: a) not present; b) present naturally; c) not naturally present, but has previously become established in the water body; or d) present only in culturing facilities. Risk assessment is a key approach to determining whether tilapia in existing or proposed facilities is likely to escape and become established; however, risk assessments are controversial and some of the assessments are based on observation rather than in situ measurements of population structures. Thus, the TAD has come to the understanding that escapes or release of tilapia can occur with any system. It is important to note that the escape of tilapias in regions where the species is already established and not native may be seen as inconsequential as the out-competition of already non-native tilapia is a somewhat of a paradox. In Africa, however, where the species is native there is more cause for concern when exotic species or strains of tilapia are moved from region to region. Another concern is the live market trade where species are not native or established. The TAD seeks to not cause the introduction of tilapia in any new country or geographic region or promoting the establishment of the species in such areas where it is not already established. Stakeholders believe that if the species is not previously present and established in a water course, tilapia aquaculture should not be allowed.

When water bodies are used for tilapia aquaculture, or to receive pond water discharge, it is important to understand the effects a particular farming activity is having on the environment as a basis for determining and managing the level of change resulting from the aquaculture operation(s). Nutrient loading from aquaculture into receiving waters[2] (for cages - the body of water that is being used as the culture medium) with multiple source effluent loading must be

[1] Applies to hatcheries, grow-out and processing
[2] Receiving water is defined as the water body that receives waste products generated by fish production.

evaluated with respect to the receiver's ability to tolerate more nutrients. Among the many parameters in aquaculture effluents that may impact water quality (e.g. suspended solids, carbon, nitrogen, and phosphorus), phosphorus is the most important as it is a key limiting nutrient in tropical freshwater aquatic environments. Assessing the phosphorus carrying capacity of a water course, however, is an extremely complex undertaking involving considerable time and expense. As a practical alternative parameter for assessing the carrying capacity of a water body the stakeholders propose an index of diurnal fluctuation in dissolved oxygen. The impact or end result to be avoided here is excessive fluctuations between daytime and nighttime dissolved oxygen which is a result of eutrophication of the receiving waters. The overabundance of algae, which leads to diurnal oxygen fluxes, will be limited through this standard. Indicators of eutrophication, such as total phosphorus, primary productivity, or chlorophyll a are measures to determine the trophic status of a water body; conversely, the TAD has chosen to address the impact of the rate of eutrophication increase. Thus, addressing an impact rather than an indicator dissuades the debates around the ability for systems to assimilate nutrients. Moreover, the capacity of a particular water course for phosphorus assimilation is highly correlated with the degree of daily fluctuations in the dissolved oxygen content of the water. Thus rather than requiring an assessment of the phosphorus carrying capacity of the proposed receiving waters, the TAD is proposing to address the actual level of impact itself – the fluctuations of dissolved oxygen in receiving waters.

Although the TAD seeks to protect mesotrophic and eutrophic systems from exhibiting hypereutrophic effects, this alone will force producers to only produce in pristine or nutrient poor environments (oligotrophic). Thus, the TAD seeks to protect these pristine or oligotrophic environments by limiting the amount of impact. Secchi disk visibility must be kept to a high depth and if a decline in Secchi disk visibility exists, producers will be kept to strict limits of chlorophyll a and total phosphorus. Additionally, Secchi disk can give a false measurement of primary productivity if the waters are turbid with suspended sediment, thus total phosphorus and chlorophyll a measures will be employed if this situation exists.

Stakeholders believe that responsible tilapia aquaculture should not result in the net loss of any wetland habitat. However, any conversion of wetlands would apply only where intake and effluent structures are concerned.

***Principle 2*:** **Site farms or expand existing farms to conserve natural habitat and local biodiversity**

Criteria

1. Presence of natural or established tilapia species.
2. Effects of eutrophication
3. Water quality in oligotrpohic systems
4. Wetland conversion.

Indicators

1. The presence of natural or established tilapia species in the water course associated with the culturing activity: the culture water body, its supply waters, and/or the receiving waters.
2. The diurnal change in dissolved oxygen of receiving waters
3. Secchi disk visibility in oligotrophic environments
    a. Total phosphorus (contingent on Secchi disk visibility)
    b. Chlorophyll a (contingent on Secchi disk visibility)

4. Wetland[3] conversion.

Standards

1. Tilapia are only cultured in a countries and geographic regions where they are defined as established, or native by the United Nations Food and Agriculture Organization (http://www.fao.org/fishery/introsp/search).
   It must be demonstrated that the tilapia species cultured is established and naturally reproducing in the receiving waters of the operation.[4]
2. No site will be located in a water body or at a location where the receiving waters have an average yearly fluctuation in diurnal dissolved oxygen greater than 65% of tabulated saturation.
3. Secchi disk visibility in oligotrophic systems ≥ 5.0 meters (if less than 5.0 meters, contingent standards below will be met).
   a. Total phosphorus ≤ 20 μg/L.
   b. Chlorophyll a ≤ 4.0 μg/L.
4. For new farms there is no loss of wetlands in general. As an exception, intake/outlet structures and canals can be constructed through wetlands provided that there is no net loss of wetlands.

Water Quality

Principle 3 addresses the effects of tilapia aquaculture on water resources. There are challenges to setting standards that can be applied equally to pond, recirculating, cage and flow through systems. The qualitative and quantitative behavior of impacts is different for each type of culture system. There has been an intense debate on these issues within the TAD, and it was important to stakeholders to try to foster the understanding of why the TAD proposed certain methods versus other. Listed below are some of the avenues the TAD tried to pursue to address water quality and effluents and the reasons for excluding them in the standards:

- Carrying capacity – difficult to impossible to determine in systems that are large and complex, particularly estuaries.
- Effluent limitation guidelines – arbitrary as they say nothing about what has happened in the environment.
- No impact – presently, it can be argued that this is an impossible scenario.
- Intake and outfall water percentage change – again, arbitrary as this offers no indication of the effect of effluent on the receiving waters.
- Only recirculating aquaculture systems – trade barrier to small scale farmers and at the present not enough volume to shift global markets.

Regardless of the system involved, it is currently impossible to operate large scale, open, commercial tilapia culture systems without some impact on the waters used, whether diluted or concentrated, immediately detectable, or sequestered in sediments. In all cases filtering or treating

[3] Wetlands are defined as areas where water covers the soil, or is present either at or near the surface of the soil all year or for varying periods of time during the year, including during the growing season. (vegetation that requires periodic inundation with water)

[4] Where FAO states that the species is "presumably established", producers must provide evidence of reproducing populations in the receiving waters.

effluents for zero impact (influent-effluent) would require immense engineering, with unmanageable costs.

Stakeholders believe that the efficient use of nutrients is a common denominator for all open and closed culture systems. Thus, the focus of the TAD water resources standard focuses on efficiency of a key nutrient. Therefore, the amount of phosphorus used (that is, the amount of phosphorus input to the culture system in the form of feed, and or fertilizer, and the amount of unassimilated phosphorus that is released to the aquatic environment as waste) in the culture system should be quantified and limited. In all cases consideration will be given for remedial measures that exist or have been taken to reduce loading on the environment. These would include, but not be limited to, *in situ* physical or biological processes that naturally reduce the nutrient load in the receiving waters, purpose built treatment systems interfacing the culture facility and the natural receiving waters, or the recycling of aquaculture effluents in other biologic systems such as agricultural crop lands adjoining the culture facility.

The use of ground water in tilapia aquaculture could lead to salinization of freshwater aquifers if ground water is depleted or mixed with brackish water. Over-pumping can lower the head in the freshwater aquifer and saline water can enter and mix with freshwater. Stakeholders in the TAD believe that responsible operation of a tilapia aquaculture facility should not lead to the salinization of freshwater aquifers.

***Principle 3*: Conserve water resources**

<u>*Criteria*</u>

1. Nutrient use and release.
2. Ground water.

<u>*Indicators*</u>

1. The amount of phosphorus added and released per metric ton of fish produced, and a total phosphorus load reduction over 3 years.
2. Salinization of groundwater.

<u>*Standards*</u>

1. Phosphorus input or utilization in tilapia aquaculture operations will not exceed (30 kg P / mt fish produced), and loads of phosphorus released into natural receiving waters will not exceed (22 kg P/mt fish produced). Phosphorus loading in effluents is determined as net post-treatment facilities, or recycling to secondary biological system, if such exist. Show a reduction in loads of phosphorus into the culture water body, or receiving waters, over the first three years of production (after three years standards will be updated based on data generated through auditing).
2. No salinization of freshwater aquifers.

<u>**Biodiversity/Genetic Impacts**</u>

The discussion on biodiversity and genetic impacts has brought many to the notion of attempting to address biodiversity on and off-farm; however, the suite of standards developed by the TAD is intended to achieve biodiversity conservation rather. Rather than including vague language about protecting ecosystems, the TAD sought to address the concerns surrounding biodiversity that have been raised as impacts for tilapia culture.

Principle 4 addresses the issue of the biodiversity and genetic impacts of tilapia aquaculture. Escapes of tilapia in regions where the species is established and non-native presents little threat, as any negative effects of the escaped fish will be on the non-native, established species. Additionally, the introduction of tilapia for culture is not allowed where is not native or established. Thus, the TAD sought to reduce the effects of escapes within Principle 2. Nevertheless, haphazard stocking and release of tilapia can be considered a key concern for management, and is addressed via the management protocol of keeping all barriers to escapes in operational capacity (i.e., net mesh for cages and screens for raceways and ponds).

Tilapias are some of the hardiest fish currently being reared through aquaculture. They are fast growing and can live in harsh conditions. Methods to enhance the performance of cultured tilapia through selective breeding have allowed for significant improvement, and it is sufficient to negate the inclusion of genetic alteration of culture species within these standards. Thus, transgenic fish are prohibited from being reared.

The killing of animals which may prey on cultured tilapia was discussed at various levels in the TAD, and it became apparent that the killing of predators was not an effective measure to control predation, thus stakeholders agreed that lethal predator control should not be used.

***Principle 4*:** **Conserve species diversity and wild populations.**

Criteria
1. Escapes from aquaculture facilities.
2. Transgenic fish.
3. Predators.

Indicators
1. Mesh for cages and inlet and outlet screens of ponds, raceways or recirculation systems.
2. Stocking of non-transgenic and all-male tilapia or sterile hybrids.
3. Predator control.

Standard
1. All mesh on screens or cages will be maintained intact and provide no exit pathway for stocked fish.
2. No transgenic fish to be cultured (including the offspring of genetically engineered tilapia), and all-male tilapia or sterile hybrids are grown.
3. No intentional lethal predator control.

Feed

Principle 5 addresses the impacts associated with the use of feeds and feed resources for tilapia culture. It is important that feed for tilapia aquaculture is from sustainable sources. Many stakeholders are concerned about contribution of fisheries for aquaculture feed to the depletion of fisheries stocks. The use of wild fish incorporated into feed and offered to cultured tilapia should not exceed the amount of cultured tilapia, and the origin of fish meal/oil should be indicated. There are also concerns about the use of lesser valued "trash fish" or by-products from unsustainable fisheries.

The dependency on forage fish for aquaculture production is of significant importance to stakeholders in the TAD, thus the use of the Feed Fish Equivalency Ratio (FFER) has been employed as a means to quantify the impact of tilapia production on wild fish stocks used as an ingredient in tilapia feed. The calculation (see appendix) takes into account the efficiency of feed used and the inclusion rates of fish meal and fish oil in feed.

In addition to the FFER, stakeholders proposed the inclusion of a means to understand the mass balance of fish meal and oil used versus how much is produced via the rendering of tilapia processing byproducts. Thus, the Inclusive Feed Fish Equivalency Ratio (IFFER) was developed (see appendix) to account for how much fish meal and oil is used and how much is produced via the production process.

***Principle 5*: Use resources efficiently**

Criteria

1. Use of wild fish for feed-fish meal and oil
2. Fish meal and oil sources.
3. Fish meal produced

Indicators

1. Feed Fish Equivalence Ratio (FFER)[5]
2. Inclusive Feed Fish Equivalence Ratio (IFFER)[6]
3. The source of fish meal/oil.

Standards

1. The FFER is ≤0.8
2. The IFFER is ≤0.5
3. If IFFER > 0, then the origin of fish meal and oil should be from fish stocks that have an average score > 7.5 with no individual indicator below 6.0, according to http://www.fishsource.org/site/fisheries

Health Management/Disease

Principle 6 addresses the potential impact of disease on wild stocks and the need to manage the health of stocks in tilapia aquaculture operations. Disease can lead to the use of antibiotics and chemicals, with subsequent impacts on the environment.

Although mortality is a measure of disease problems, identifying the ultimate cause of a mortality event and quantifying the impacts of disease incidents is difficult even in contained culture systems. Nonetheless, it is critical to monitor and report mortality and disease outbreaks. It is important to keep in mind that monitoring of diseases is difficult for small scale producers because of cost and

[5] See appendix for calculation
[6] See appendix for calculation

access to facilities, and that there are few recorded cases of disease directly attributed to tilapia farming.

Stakeholders believe that disease prevention and mitigation is paramount. Record keeping does is not an indicator of impact reduction, thus the TAD has sought to address health management from a survival, mortality and therapeuatant treatment perspective.

***Principle 6*: Manage disease and pests in an environmentally responsible manner**

Criteria

1. Survival
2. Chemical treatments
3. Mortalities

Indicators

1. Percentage survival after the fish reach 100 grams
2. Approved chemicals and therapeutants
3. Prophylactic use of antibiotics
4. Removal and disposal of mortalities

Standard

1. 55% survival
2. Chemicals and therapeutants for disease and pest control must not be banned in the importing or producing country and be approved for use in the importing country.
3. No prophylactic use of antibiotics
4. Mortalities are removed daily and disposed via sanitary method (i.e., landfill, converted to animal meals not destined for the culture of tilapia)

Social Issues/Social Responsibility

Aquaculture should be undertaken in a socially responsible manner that benefits the farm workers, local communities and the country; contributes effectively to rural development, poverty alleviation, and food security; and delivers net benefit to the local community.

Tilapia aquaculture standards should take into account labor issues and work conditions. Workers should be treated and paid fairly, while labor rights are respected, in compliance with the International Labour Organisation (ILO) Conventions, especially those cited in the ILO Declaration of Fundamental Principles regarding: freedom of association and collective bargaining; no child labor; no forced labor; and no discrimination. Complaint procedures and protection for whistle blowers should be in place. And worker health and welfare assured through safe and hygienic working conditions and relevant training for workers and managers on the same.

Tilapia aquaculture standards should also take into account social issues in the surrounding area. Appropriate consultation must be undertaken within local communities so that conflicts are minimized. The impacts of the aquaculture operation on children and women need to be considered, and opportunities for women, other minorities or other persons who risk discrimination should be identified should be identified, evaluated and addressed.

The TAD has attempted to develop key social indicators for farms. It is obvious that other programs may be more comprehensive. In an attempt for harmonization with other certification programs, the TAD has approved the following programs to be substituted for compliance with the standards under Principle 7. They are as follows:

1. SA8000

***Principle 7*: Be socially responsible**

<u>*Criteria*</u>

1. Freedom of Association and Collective bargaining
2. Child Labor
3. Forced, Bonded, or Compulsory Labor
4. Discrimination
5. Health and Safety
6. Wages
7. Contracts (Labor)
8. Conflict Resolution

<u>*Indicators*</u>

1. Transparency in wage setting
2. Access to Worker Associations
3. Workers age.
4. Prevention of forced, bonded or compulsory labor Anti-Discrimination Policy
5. Occupational Safety and Health training program for all employees Accident reporting and response
6. Emergency response plan
7. Corrective action plan
8. Minimum wage with worker incentive program
9. Benefits package
10. No revolving/consecutive contracts to prevent benefit accumulation. The employer is allowed to re-hire employees that have chosen to leave voluntarily.
11. Conflict resolution policy with complaints resolved/complaints received documented

<u>*Standard*</u>

1. Transparency in wage setting – workers know how their wages are calculated and how periodic/annual increases are determined/set.
2. Access to worker associations is allowed.
3. Workers will be more than or equal to 15 years old unless there is a legal requirement for higher age.
4. Forced, bonded, or compulsory labor - 0 incidents
5. Discrimination - 0 incidents
6. 100% of workers trained within the past year and able to articulate key OSH procedures and/or identify principle risks Accurate and transparent reporting on every accident, including a report

on any remediation for workers injured and the preventive and corrective action plan put in place afterwards Presence of emergency response plan

7. Presence of corrective action plan and Annual (or more frequent) internal monitoring activities and corrective action planning
8. Minimum wage is mandatory and incentives for overtime hours or bonus production is offered (e.g. for piece rate employees)
9. Presence of verifiable benefits package mandatory
10. No revolving/consecutive contracts to prevent benefit accumulation. The employer is allowed to re-hire employees that have chosen to leave voluntarily.
11. Presence of verifiable conflict resolution policy with conflicts/complaints tracked transparently and responded to within three months

APPENDIX

Water Resources Calculations

The use of the diurnal fluctuation of dissolved oxygen is a unique measure developed by the TAD. Diurnal oxygen fluctuation will be determined by measuring the surface dissolved oxygen of the receiving waters or culture water (for cages). The annual average difference between daily minimum and daily maximum dissolved oxygen measurements will not be more than 65% of the tabulated dissolved oxygen at saturation for the specific temperature and salinity (Benson and Krause 1984[i]) where the measurements are taken.

Equation 1.

Diurnal difference in dissolved oxygen (mg/L) = Maximum dissolved oxygen (mg/L) in receiving waters – Minimum dissolved oxygen (mg/L) in receiving waters during each 24 hour period

Equation 2.

$$\textbf{Percent diurnal fluctuation of dissolved oxygen relative to saturation (\%)} = \frac{\text{diurnal difference in dissolved (mg/L)}}{\text{tabulated dissolved oxygen at saturation (mg/L)}} \times 100$$

The percentage fluctuation of diurnal dissolved oxygen relative to saturation will be equal to or less than 65% according to TAD standards.

Phosphorus (P) inputs per metric ton (mt) of fish produced – the amount of phosphorus introduced to the culture environment per mt of fish produced per year. This would include phosphorus added primarily in the form of feed and fertilizer.

Phosphorus inputs per mt of fish produced can be calculated by determining the percent fraction of phosphorus in the input material and multiplying by total amount of input material added to the system per mt fish produced.

Equation 3.

$$\textbf{Feed P input} = \text{percent fraction of P in feed} \times \text{eFCR} \times 1000 = \text{kg P/mt}$$

Equation 4.

$$\textbf{Fertilizer P input} = \frac{\text{(percent of P in fertilizer} \times \text{total fertilizer added/year (kg))}}{\text{fish produced (mt/year)}} = \text{kg P/mt}$$

Equation 5.

Total P input = Feed P input + Fertilizer P input = kg P / mt

The total phosphorus output per metric ton of fish produced is the amount of phosphorus released into the natural environment per mt of fish produced. The main output from tilapia farms would be effluent. However, quantifying the amount of phosphorus in effluents is complicated as a result of various feeding times, different times for drain harvests of ponds, precipitation of phosphorus for particular waters, dissolution of phosphorus for specific waters, specific soil phosphorus absorption conditions and the fact that there is no point-source of effluent from cage operations. Thus, phosphorus not included in fish at harvest would be considered the amount of phosphorus released into the environment. An average P content in tilapia is assumed to be 0.8%. Thus, total phosphorus output can be calculated as follows:

Equation 6.

Phosphorus output from feed = P input from feed – (0.008 x 1000)] = kg P / mt fish production

Equation 7.

Phosphorus output from fertilizer = P input from fertilizer

Equation 8.

Total phosphorus output = P output from feed + P output from fertilizer = kg P / mt fish production

Feed Resource Calculations

Economic Feed Conversion Ratio (eFCR) – the quantity of feed used to produce the quantity of fish cultured.

Equation 9.

$$\text{eFCR} = \frac{\text{Feed, kg or mt}}{\text{Net aquacultural production, kg or mt}}$$

Feed Fish Equivalency Ratio (FFER) – the quantity of wild fish used per quantity of cultured fish produced. This measure can be weighted for fish meal or fish oil, whichever component creates a larger burden of wild fish in feed. In the case of tilapia at current status, the fish meal will be the determining factor for the FFER, thus FFER_m is the equation used in the TAD standards.

Equation 10.

$$\text{FFER}_m = \frac{(\%\ \text{fish meal in feed}) \times (\text{eFCR})}{22.2}$$

$$FFER_o = \frac{(\%\text{ Fish oil in feed}) \times (\text{eFCR})}{5.0}$$

Inclusive Feed Fish Equivalency Ratio (IFFER) – a measure developed by the TAD to quantify the amount of fish meal produced through rendering of byproducts from tilapia processing, as an offset to the quantity of fish meal used for the culture of tilapia . As previously state, the current status of tilapia aquaculture reveals that the determining factor for IFFER will be the use and production of fish meal. Thus, $IFFER_m$ is the equation used for the TAD standards.

Equation 11.

$$IFFER_m = \frac{[(\%\text{ fish meal in feed}) \times (\text{eFCR})] - (\%\text{ fish meal rendered from processing byproducts})}{22.2}$$

$$IFFER_o = \frac{[(\%\text{ fish oil in feed}) \times (\text{eFCR})] - (\%\text{ fish oil rendered from processing byproducts})}{5}$$

[i] Benson, B.B. and D. Krause Jr. 1984. The concentration and isotopic fractionation of oxygen dissolved in freshwater and seawater in equilibrium with the atmosphere. Limnology and Oceanography. Vol. 29, no. 3, pp. 620-632.