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SUSTAINABLE FISH AND SHRIMP FARMING

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INTRODUCTION

The ability to develop sustainable aquaculture operations depends on the establishment of a number of necessary institutional and technical preconditions. Public sector institutions play an important role in each stage of an aquaculture project development. Several issues must be addressed in order to gain the full potential of any aquaculture operation that takes place while minimizing the risks and impacts. The basis for a sustainable aquaculture operation is careful planning, zoning and prioritization of sites among the different potential users. Conflicts with other users and other economic activities (e.g. fisheries, agriculture, forestry, tourism, and subsistence users) can be costly and result in the failure of the investment as well as the irreversible damage to ecologically and economically critical resources.

Another key factor is the clear identification of national policies and procedures. Governments should establish clear policies and procedures before the development of the industry explodes. Such policies and procedures do not have to be exhaustive, but they should address the most common issues and impacts that aquaculture activities involve. This means that the procedure for obtaining permits, licenses, concessions, land titles and approvals for projects should be clear and transparent. This is one way to insure that proponents are in compliance with the appropriate procedures and that government officials have clear guidance about how to proceed with approvals.

To ensure the rights of aquaculture farmers and to protect the interests of the state, a sound legal framework should be implemented. This framework should include minimum requirements for the procedures and institutional set-up mentioned above. Other possible methods for regulating aquaculture activities include bans, restrictions, land-use classification and zoning, environmental impact assessment, mitigation plans, permits, user fees, performance bonds, and monitoring requirements. Specific methods applied widely to regulating aquaculture include environmental impact assessments, effluent discharge permits, limitations on the use of non-native species, restrictions on drug and chemical uses, standards for feed composition, restrictions on feed use, and other management practices.

ENVIRONMENTAL ISSUES

Environmental issues associated with the aquaculture sector primarily include the following:

· Threats to biodiversity

· Contamination of aquatic systems

THREATS TO BIODIVERSITY

Threats to biodiversity are mainly associated with conversion of natural habitats during construction; potential release of alien species into the natural environment during operations; potential loss of genetic resources due to collection of larvae, fry, or juveniles for aquaculture production; potential release of artificially propagated seed into the wild (e.g. there are more farmed than wild Atlantic salmon in existence); sustainability of fish meal and fish oil ingredients for fish and crustacean feeds; and development of antibiotic resistance in pathogenic bacteria that can then spread from farms to wild stock.

CONVERSION OF NATURAL HABITATS

The construction and operational phases of the project cycle of an aquaculture facility may require conversion of the natural environment including, for example, the removal of mangroves for excavation of ponds, or alteration of the natural hydrology of lagoons, bays, rivers, or wetlands.2 Operational phase issues may also include alteration of aquatic habitats and substrates (e.g. under sea cages or shellfish farms).

CONVERSION OF AGRICULTURAL LAND - SALINIZATION

If new land areas are not available for aquaculture, an alternative is to convert former agricultural land. If the selected production is based on brackish water, this may pose a risk of salinization of surrounding agricultural land. The following measures can be taken to avoid salinization of agricultural land:

· Ensure that the embankments around brackish water pond systems are high enough to form a physical division between agriculture and aquaculture;

· Ensure that the saline / brackish water discharges areappropriately treated and disposed of (e.g. through use of discharge canals) for the receiving waters;

· Ensure that appropriate discussions are held at the community level to avoid conflicts of interest when agricultural land is transferred to aquaculture production.

FISH MEAL AND FISH OIL

Fish meal and oil are derived from the capture and processing of wild pelagic fish stocks (e.g. anchovy, pilchard, herring, sardine, sand eel, sprat, and capelin). Although the production of fish meal and oil is not covered by these Guidelines, processed fishmeal and oil are the primary sources of protein and dietary lipids in fish feed for farmed fish in aquaculture operations. The aquaculture sector is an important consumer of fish meal and fish oil, and there are concerns regarding the sustainability of the pelagic fish stocks from which fish meal and fish oil are derived. Aquaculture operations should consider incorporating the use of alternatives to supplies of fish feed produced from fish meal and fish oil. Alternatives for fish feedingredients may include use of plant material substitutes [e.g. soya for bulk protein and single-cell protein (yeast for lysine and other amino acids)] and biotechnology options (e.g. biofermentation products).

SOIL EROSION AND SEDIMENTATION

Earth excavation and moving activities conducted during construction of some types of aquaculture projects may result in soil erosion and the subsequent sedimentation of nearby waterbodies.

Sedimentation of aquatic resources may contribute to eutrophication and overall degradation of water quality. Recommended management strategies include the following:

· Stabilize the embankments to prevent erosion;

· Reduce excavation and disturbance of acid sulfate soils during construction;

· Carry out construction work during the 'dry' season to reduce sediment runoff that may pollute adjacent waters;

WASTEWATER DISCHARGES

The effluent released from aquaculture systems typically contains a high organic and nutrient load, suspended solids, and may also contain chemical residues including feed supplements and antibiotics. The possible impacts include contamination of groundwater and surface water from release of effluents or communication to receiving water from unconfined process and storage tanks (such as ponds and lagoons). Impacts on aquatic systems include creation of eutrophic zones within receiving waters, increased fluctuation of dissolved oxygen levels, creation of visible plumes, and accumulation of nutrients within the receiving waters.

The high nutrient load results from efforts to artificially boost production levels by increasing the food supply for the cultured species. This is done by increasing nutrient availability either directly through supplemental feed or indirectly by fertilizing ponds to increase primary productivity. Pond ecosystems have a limited capacity to recycle organic matter and nutrients, and increasing the stocking rate removes this capacity, resulting in the build-up of organic matter, nitrogenous waste, and phosphorus both in the water mass and on the bottom of the pond or pen / cage.

The chemical residues may include the remains of veterinary drugs (e.g. antibiotics) that may have been applied to the cultivated species, and toxic substances such as formalin and malachite green, a cancer causing agent, that may have been that are used to treat finfish for parasites and their eggs for fungal growth. Malachite green is banned in most countries and must not be used. Formalin should only be used under controlled conditions (e.g. in dipping containers) and with proper care – it should not be introduced directly into production systems. The following management measures can prevent the contamination of effluent:

1. Feed:

· Ensure that pellet feed has a minimum amount of "fines" or feed dust. Fines are not consumed and add to the nutrient load in the water;

· Match the pellet size to the species' life-cycle stage (e.g. smaller pellets should be fed to fry or juvenile animals to reduce the unconsumed fraction);

· Regularly monitor feed uptake to determine whether it is being consumed and adjust feeding rates accordingly. Feed may be wasted due to overfeeding or not feeding atthe right time of day;

2. Suspended solids:

· Avoid discharging waters from ponds while they are being harvested with nets, as this will add to the suspended solids in the effluent drainage

3. Fertilizers:

· Plan the rate and mode of application of fertilizers to maximize utilization and prevent over-application, taking into account predicted consumption rates;

· Avoid the use of fertilizers containing ammonia or ammonium in water with pH of 8 or above

4. Chemicals:

· Do not use antifoulants to treat cages and pens. The chemically active substances used in antifouling agents are very poisonous and highly stable in an aquatic environment. Clean nets manually or in a net washing machine.

The following management measures can be taken in pond based systems to prevent pond effluent from entering surrounding water bodies:

· In some fish systems, avoid automatic drainage of ponds at the end of the production cycle as the same pond water may be used to cultivate several crop rotations of certain species (e.g. catfish)

· Reuse water from harvested ponds by pumping it into adjacent ponds to help complement their primary productivity, provided that the level of BOD is controlled; This process is called "bloom seeding," and requires careful timing of harvests;

- Techniques for treating industrial process wastewater in this sector include grease traps, skimmers or oil water separators for separation of floatable solids; flow and load equalization; sedimentation for suspended solids reduction using clarifiers or settling ponds; biological treatment, typically aerobic treatment, for reduction of soluble organic matter (BOD); biological nutrient removal for reduction in nitrogen and phosphorus; chlorination of effluent when disinfection is required.

NITROGEN REMOVAL TECHNIQUES FOR SUSTAINABLE AQUACULTURE:

1. Periphyton treatment techniques
2. Bio-flocs technology
3. Integrated Multi-Tropics Aquaculture (IMTA)
4. Partition Aquaculture System (PAS)
5. Re-circulated Aquaculture Systems (RAS)

REGULATIONS FOR SUSTAINABLE AQUACULTURE

- Environmental impact assessments,
- Effluent discharge permits,
- Limitations on the use of non-native species,
- Restrictions on drug and chemical uses,
- Standards for feed composition,
- Restrictions on feed use,
- Cluster farming
- Licensing system