BEST MANAGEMENT PRACTICES IN AQUACULTURE

by [Name]

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The benthic impacts of net pen aquaculture are normally harmful to the environment. Best management practices are necessary to make the performance of net pen aquaculture facilities environmentally friendly (World Bank 2007). Setting up a net pen aquaculture facility has several steps and better management practices need to be carried out at all steps. In this section, the best practices in site selection, management of feeds, solid management and disposal, management of escapees, mortality removal and disposal, in addition to facility operation and maintenance will be covered. Net pen systems can be utilized for culture of varied species of marine fish. Sometimes, the effectiveness of the best management practices depend on the species of the fish as well as the design of the net pen facility. A practice might be effective in one facility and fail to work in another facility depending on the marine fish species and how the system has been designed. To attain the core goal of minimizing the benthic effects of net pen to the environment, a combination of practices in unique ways is recommended to achieve the intended objectives. The paper will focus on the management practices necessary at all steps and during all activities to meet sustainable development goals and protection of the environment.

Site Selection

The practices ought to be considered when selecting the site because productivity and safety of workers depend on the site on which the system has been set. Site selection is crucial for lowering the effects to the environment, determining the prime health of fish species and their productivity, control of the costs of production, and ensuring the safety of facility operators. Without proper site selection, the net pen farm operators lack ability to control the effects of the interaction between the fishes and the environment (Belle and Nash 2004). The performance of fish, their physiology, and their general health are highly dependent on the environmental conditions in which they are cultured. A proper selection of the site is fundamental in the reduction of the benthic effects of net pen to the environment as well maximization of fish output. In site selection, evaluation of farm sites is necessary to ensure that it is appropriate for the facility being set up and the fish species to be kept (Boyd and Tucker 2008). Experts recommend selection of a site that is not in depositional environment and must have good water exchange features because it is beneficial on output level of cultured species and environmental protection. Baseline surveys about the site are important to uncover the impacts on the safety of employees, the welfare of fish, and the quality of products. The scrutiny of the site also enables to discover whether there are potential pests and predators that are threats to fish production (Cross 2013). The selection must also ensure that negative impacts of the practice can be easily detected and managed in the right manner.

Feed Management

The food remnants and fish feces are the major sources of wastes generated from net pen farm. The collection and concentration of the wastes is normally a major challenge for the operators of net pen systems because the facilities operate in high-energy environments. Controlling the waste generation channel is important to minimize the impacts of the practice. The management of wastes from feeds starts from selection, utilization, and distribution of fish feeds. Proper management of feeds is based on optimal food conversion fraction and waste reduction (Page, 2013). The best practices under management of feed include proper storage of feed, handling, and the feeding of fish need to ensure that waste is not generated. The feeds should be stored in areas that are safe from rodents, excessive heat, and moisture. To ensure that feeds are not wasted in the facility, the farms need to calculate the amount of food that are consumed every day by the fish population in the system. The proper calculation of food conversion ratio helps the farms to plan well for the foods and minimize wastage of feeds. The farmers need to collaborate with manufacturers to supply them with feeds that have less contents of nutrients and discharges of solids via optimization of food formulas. The feeds should be formulated for maximum conversion of nutrients and minimize concentration of nutrients in water (Hargrave 2005). As a way of avoiding wastage of foods to the waters, farmers need to invent proper feeding equipment and examine them from time to time to ensure that they do not waste foods in water. Farmers should also chose fish species that have well-understood food conversion ratios to ensure that the foods are well utilized for maximum productivity. Farmers are advised to examine the bottom of their net pens every year. The examination of the bottoms of the net pens is aimed at finding out whether there is waste feed and how the benthic environment appears to be integrating the nutrient load (Boyd and McNevin 2015).

Solid Waste Management and Disposal

The feces of fish in addition to the feed wastes account for the largest portion of the wastes that are generated from net pen farms. The nutrients from the waste feeds are normally consumed by the fauna attached to the net. The environments in which net pens are operated make the collection and removal of feeds that have not been consumed very hard. The high energy, waves, and currents in which net pens are set are responsible for the challenges experienced by net pen farmers to make the surrounding of the nets free from the feed wastes. There are several proposals to help in the removal of the wastes, for example, provision of secondary nets and installation of deflectors. However, their implementation trials have encountered economic and operational challenges. The failure of the trials has made the removal of the wastes a major challenge associated with net pen farming. However, there are best practices that aim at reducing the impacts of the solid wastes. Farmers need to carry out a systematic review of their operations and come up with proper plans for waste management. In addition, the waste management plans must also be capable of identifying the entire amount of wastes that come from the net pen operations. After identification of the wastes, the plan also needs to classify the wastes according to the risks associated with their collection practices. The main issues to focus on in management of waste in net pens is to minimize generation of wastes and to identify the challenges associated with marine operations (Tucker 2008). The plan of managing wastes needs to encourage recycling of wastes except in situations where the recycling presents health threats to human or fish health. In situations where recycling is not practical, waste containment and disposal plans need to be clearly outlined. The best method of managing wastes in net pen farming starts with prevention of the wastes. Farmers need to examine their farming techniques and chose the best alternatives that do not allow generation of wastes. One of the things that have to be considered is application of packaging and methods that allow handling of materials with minimal packaging needs (Tsutsumi et al. 2006). Net pen farmers are encouraged to circumvent the discharge of elements that are associated with washing of nets using pressure generating machines (Lutz et al. 2004). There is a need to invent alternatives that minimize washing of nets on the site to avoid bio fouling. There are several mechanisms that are recommended to avoid the onsite washing and rinsing of nets. The use of biological, mechanical, air drying in addition to other alternatives that do not use chemicals in the cleaning process is highly recommended by experts in the field (Tucker and Hargreaves 2009). However, in-place net washing is allowed in some places, for instance, with high flush rates and great depth. In places with high rate of net fouling, the treatment of the fouling with chemicals recommended by the environmental protection agency is advisable. Materials used for packaging of feeds and other materials like worn out ropes must be collected from near the water bodies and be disposed off properly. Such materials contribute to the environmental pollution that is associated with net pen systems (Parker et al. 2002).

Management of Escapees

The escape of the fish species cultured in net pen systems might result in several probable jeopardies to the aquatic ecosystem plus other economic activities taking place near the net pen systems. Some of the potential risks that might be caused by the species escapees include transmission of disease causing microorganisms, affecting the genetic composition of other species as well as increased completion for resources. In net pen farming, there are three major causes of escapees and they need to be addressed. The attacks by predators, failure of the equipment, and operational mistakes are responsible for escapees from net pen farms (Cheshire and Volkman 2004). There are proposed solutions to prevent escapees, for example, installation of a secondary containment nets although they might have negative consequences to the environment. The double netting system affects the flow of water through the net pens. Reduced rate of water flow to the systems affects the performance of the cultured fishes. The reduced flow of water negatively affects the dissolved oxygen within and around net pens and causes the rate of sedimentation, in addition to altering the patterns of water flow on other farm sites. The stress triggered by reduced water flow upsurges feed conversion ratio in fish which causes increased generation of wastes per unit biomass of fish. Also, the stress, as a result of reduced rate of water flow, might cause diseases among the fish population (Srithongouthai et al. 2006). Double netting is also a significant challenge to the entire process because it rises the surface area for bio fouling and causes extra costs because there will be augmented need to clean the nets from time to time and disposal of the fouling wastes. Using a secondary net is also disadvantageous because the floatation and mooring activities increase the consumption of petroleum products. The energy use in the manufacture of the equipment used in net pen farming is also augmented through use secondary nets. Genetic isolation and prevention are the two major strategies used to reduce the effects of escapees to the environment (Tucker 2008). Prevention comprises of all activities that are applied to reduce chance of fishes to escape, for example, examining the system frequently. Genetic isolation is accomplished through culturing highly domesticated strains that are unable to survive in the wild as well as keeping species that cannot interbreed with others in the wild waters (Stickney and McVey 2002). When escape occurs, mitigation methods to reduce the impact to the environment include plans to recover the fish and repairing the nets. In addition to the discussed strategies to manage the net pen systems, there are best management practices that need to be adhered to (Conference on Marine Aquaculture, Fisher, and Pacific States Marine Fisheries Commission 2003).

The cultured fish species ought to be derived from the species that perform well within the region where the net pens are being set. A clear understanding of the site characteristics and their effects on risk of escapes is important before installation of the net pens. Important site features that operators must be well informed about include the type of the bottom, the regularity of extreme meteorological conditions, the presence of predators, and the amount of exposure (Lee and Awaya 2003). A loss control and recovery of escapees plan is necessary for all operational net pen systems. The plans need to accommodate site specific analysis and procedures to be applied to lower the escapes. There are three major causes of escapes and the plans must address them. The principle causes are predator attacks, equipment faults, and operational errors. The plans must also be able to allow escape recovery procedures, least equipment and operational standards, in addition to emergency restoration methods. The escape recovery actions in the recovery procedures dictate what farmers are supposed to do to take the escapees back to the net pens. Activities like fish transfer, grading, stocking, and harvesting should be done during appropriate whether. The nets should be obtained from reputable suppliers that meet the required standards and specifications. To prevent fish from jumping from the primary containment, jump nets should be installed. Measures should also be put in place to prevent predation from birds.

Mortality Disposal

Proper management of fish health is the most essential way of reducing mortality rate in the fish population in net pens. Proper monitoring of fish health lowers the need to handle dead fishes (Hargreaves 2011). Monitoring of fish health ought to be carried out frequently with a specified duration for timely identification of aspects that can cause death in fish. The net pens must be designed in a way that allows collection and disposal of dead fish (McLean et al. 2008). Best management practices are majorly based on fish health supervision practices. The methods applied for removal of dead fish should not affect the remaining fish in ways that jeopardize the safety of workers or compromising net integrity. Dead animals should only be transported in closed containers with tight fitting lids to minimize chances of falling back to the water (Le and Cheong 2010).

Facility Operation and Maintenance

The establishment of net pens and their operations need relevant permits from the environmental management agencies, the US Army Corp of Engineers, and other concerned bodies because the facilities operate in public waters. Compliance with the specific requirements is necessary because non-compliance can lead to revoking of the permits (Montwill 2016). The facilities for proper operation and maintenance depend on the number of pounds of live products produced every year. Net pen farms that produce more than 100,000 pounds of live products every year are required to have National Pollution Discharge Elimination System permits. On the other hand, the net pen farms that do not produce more than the specified pounds must contact periodic water quality monitoring (Flynn 2017). When farmers plan to implement some modifications in the system, they should consider the possible environmental outcomes associated with the new modifications. Identification of the probable impacts helps to put in place proper mitigation measures to contain the effects. Since chemicals cause significant harm to the environment, the therapeutic drugs and chemicals used in the farms should be approved by environmental management bodies and their use must adhere to the manufacturer’s instructions. All activities on the net pen system, for example, seeding, feeding, harvesting, and cleaning, ought to be carried out in a diligent manner to minimize potential effects to the surrounding areas (Bonisławska et al. 2016). The operations on the farm need to consider the safest options in terms of their effects to the environment. The alternatives that cause less harm to the environment must be used in order to achieve proper facility operation and management. Prior to carrying out any modification on the farm, the impacts on the water circulation patterns need to be considered. All modifications must maximize water exchange and circulation patterns to eliminate the associated effects (Woo, Leatherland and Bruno 2006). To evade the occurrence and effects of oil spills in water, the farm support vessels must only be fueled at licensed fueling stations. The most crucial part in the operation of net pen facilities is the development of proper record keeping systems. The records aid in monitoring all activities on the farm and can be referred to in case of occurrences that require examinations of the past activities for instance, when fish mortality increases drastically, the recording of the past activities is necessary as reference point to understand the most appropriate action to take when a problem develops in then system. Implementation of the best practices reduces the benthic effects of net pen farming to the environment (Smith 2003).

Conclusion

The better practices in net pen systems are fundamental in the prevention of the environment and to maximize output. All innovations and strategies aimed at increasing productivity from net pen farms need to assess the effects to the environment first. Only activities and materials that have been approved by the Environmental Protection Agency and other relevant bodies should be used on net pen farms. First priority must always be given to prevention of environmental threats by selecting the safest options. Application of methods that have been proved to have less harm to the environment and the productivity of the cultured fishes are the most recommended. Methods that create room for accumulation of wastes are discouraged because they cause unnecessary costs incurred through removal of wastes. Frequent examination of the system to discover faults is also advised in order to uncover equipment faults that could cause fish escapes, damage to the environment, and accumulation of bio fouling matter on the net.

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