



Review Article

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Environmental Concerns in Trout Breeding



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Abstract

As in other production branches, aquaculture facilities are also linked to the environment. Unlike these, aquaculture systems are more common in aquatic ecosystems because of their presence in wetlands, and the plant-environment relationship is more prominent than other food production branches. In this review, it is aimed to emphasize with the rapidly growing environment consciousness, which is fast developing fish breeding sector, with the intersection points of aquaculture and to reveal what can be done in this field.

Keywords: Fish; Aquaculture; Environment; Waste management

Introduction

Aquaculture has been the world's fastest-growing food production technology during the last three decades, with an annual average growth rate of 6.2% since 2000 [1]. Aquaculture is the most probable and feasible solution to providing the aquatic products for an ever-increasing market demand. It provides a consistent and reliable source of high-quality, fresh sea food that is nutritious, safe to eat and reasonably priced [2]. The world human population is increasing exponentially. Such unrestrained population growth raises issues of food security while simultaneously maintaining a clean environment for future generations. As the human population grows, there is a corresponding increase in the demand for seafood [3]. The evaluation of streams, lakes, ponds and seas in terms of aquaculture is important, as it is significant to monitor and control biological changes that may occur in these ecosystems in terms of sustainable aquaculture and conservation of aquatic ecosystems [4]. The mediums, which livings have vital connections, affect and influence in different ways, are called environment. The environment of a creature; where is sustaining all kinds of biological, social, cultural, and economic activities of it, meeting the basic requirements of life such as nutrition, reproduction, and housing.

There is human at the center of all activities carried out in aquaculture and the main goal is to provide a source of protein to people. Therefore, the positive or negative aspects of these facilities will affect first the human being [5]. When people enter these farms, the first thing that will attract their attention is the

appearance of these places. If the landscaping is nice, the person will be happy, but if there are repulsive views or structures, the aesthetic aspect of the human being will be hurt. Similarly, produced fish should not only have a taste but also have a nice view for appetite. As the health status of organisms grown in aquaculture farms will affect the health of people who will consume them, the necessary care should be taken at every stage of cultivation. The most important issue was evaluated as environmentally friendly aquaculture investments and management in the workshops conducted in 2010 in Latin America on aquaculture planning. It was foreseen that the use of technology in financial aspects such as pools used in aquaculture, stocking rates, feed and other material costs would reduce the impact on the environment [6]. According to FAO, "sustainable development" is the protection and management of natural resources while continuously meeting the needs of current and future generations and successfully adapting technological and institutional changes. Sustainable development, including soil, water, plant and animal resources, is a socially acceptable approach that is harmless to the environment and has an economic life [7].

Negative environmental impacts attributed to aquaculture are often the results of these situations [8]:

- a) Bad planning
- b) Unsuitable location selection
- c) Improper management procedures
- d) Disregard to environment protection

Aquaculture plants are produced in wetlands due to the biology of fish. This situation causes the aquaculture plant and environment relations to be more prominent than other food production branches.

Aquaculture has very specific characteristics for the following reasons:

- I. Intersection with aquatic ecosystem which is the most important element of the ecosystem.
- II. Having very different plant structures (pool, hatchery, cage, processing unit etc.)
- III. Showing differences at physical, chemical and biological parameters of aquaculture water.
- IV. Containing high density living stock.
- V. The main theme of production is the animal organisms but the emergence of the product as human food.
- VI. The wide spectrum of produced livings from plankton to frog.

A misconception about aquaculture is that water taken into the plants is considered as consumed water. However, the difference between the amount of water entering the plant and the amount of water exiting the plant is only the loss of evaporation and leakage loss in the production processes. In well-planned facilities this distinction is too small.

The relationship between the facility and the environment before establishing

The relationship of the aquaculture facilities with the environment starts before production. At this stage, visual concerns should be kept in the foreground and designs should be made to provide visual harmony. For example, in terrestrial aquaculture, structures can be designed in harmony with the environment in which they are located, and their exterior facades can be painted appropriately [9]. In the marine environment, since the cage equipment is standard structures, there are no visual problems. As it is in different structures and properties in aquaculture plants (such as, hatchery, production, processing etc.) it should be considered in more detail. It is important to note that there is an existing ecosystem in a region before the establishment of a facility. In inland aquaculture, it is significant to show the necessary care for the protection of river beds during the construction phase of the facilities, the current flow rate, the physical, chemical and biological characteristics of the water should not leave the original structure should be the basic rule of this stage. The possibility of harboring endemic species in these regions is important for preserving the authenticity of the ecosystem. In the light of this sensitivity, the definition of water pollution term has been shaped as moving away the physical, chemical and biological properties of water from the originality. avoided.

Therapeutic chemicals should be given in the correct dosage and time interval according to the conditions of use. Antibiotics should not be used in discriminately and different antibiotics should be used alternately instead of the same antibiotic [10]. Because of the chemicals used in the treatment of bacterial diseases and other purposes used chemicals in the nearby environment (fish, mussels, shrimp, lobster, aquatic plants) bioaccumulation is concerned [11]. The antibiotics are excreted as the parent compounds or metabolites due to poor gut absorption or incomplete metabolism resulting in frequent detection in aquatic environment due to incomplete removal of antibiotics during wastewater treatment and their continued release into the environment [12]. Antibiotic residues develop resistance to bacteria in humans and there are problems in the treatment of diseases. The chemicals used as disinfectants in aquaculture may have toxic aspects so, the dose and time of use should be determined well. Biocides are used for control of predators, pests and weeds in fish farms usually before the start of aquaculture. In this period, there are no significant discharges from the farm, and there is no case of harmful effects in the environment. In addition, the doses used in the aquaculture periods are not enough to cause toxic effects to the fish in our own pools, so the amount of water to be released into the environment is not worth considering. Due to the high product variety in the chemicals, if there is a negative effect of the used chemical in the environment, it is possible to use another equivalent.

Risk of mixing culture species to wild species

The mixing of cultured aquatic species into the natural environment leads to hybridization between species or the exchange of genes among these species, changing the natural structure. Cultured species that are involved in the natural environment rival the domestic species in terms of nutrients, occupy or change the habitat.

Control of Wastes

All animals produce wastes and compared to terrestrial animals, aquatic animals produce relatively smaller amounts, for several reasons. One is the fact that they are poikilothermic. This means they burn no calories when maintaining an internal body temperature higher than the environmental temperature. Another reason aquatic animal produce fewer waste products is that most secrete ammonia passively, directly from the blood into the water through their gills. They don't have to expend any energy converting ammonia to fewer toxic forms such as urea (cows) or uric acid (chickens). Also, aquatic animals live in, what is for them, a basically weightless environment. Most can control buoyancy, so they expend little or no energy fighting gravity. All these energy savings mean it takes less feed to grow an aquatic animal. For example, it takes 7 to 8 kg of feed to produce a kilogram of weight gain in cows, 3 to 4 kg of feed in swine, and 2 to 3 kg in poultry. However, for fish it takes only about 1.5 kg of feed. Because of this relatively efficient feed conversion, less feed in means less waste out. However, even in fish there is always some waste [2].

In aquaculture, fish stocking capacity varies depending on the flow of source water on land, water circulation and the size of cages in the sea. The higher the amount of stocks in the enterprises, the higher the consumption of feed and the use of chemicals. This may cause environmental pollution. In addition, the metabolic wastes of the fish also cause an increase in the amount of organic matter in the water [13]. The rapid development of aquaculture brings about some problems such as solid and dissolved wastes left to the environment. In order to be sustainable in aquaculture production, the issue that needs to be given importance is environmentally conscious production [14]. In addition to feed losses during intensive feeding in aquaculture enterprises, as a result of digestion and metabolic activities by the fish, a waste is discharged into the environment. These wastes are known to cause harmful effects, depending on the nature of the environment [15]. As the main component of the cost of fishery is the feed, compliance with the rules at this stage will significantly increase the economic efficiency.

The impact of aquaculture on the environment; Firstly, it is caused by the release of dissolved - undissolved, organic and inorganic substances from the not consumed feed and feces. The following factors determine the effects of aquaculture on the environment [12]:

- a) The physico-chemical and hydrographic properties of the region
- b) The type of feed
- c) Feed rations
- d) Feeding technology.

The most important part of the waste is suspended solids. Suspended solids in aquaculture facilities must be limited due to the following reasons [8]:

- I. Suspended solids can reduce light penetration and phytoplankton activity in the water mass in the discharge area.
- II. Turbidity-restricted light penetration can affect aquatic plants, corals and other vulnerable underwater habitats.
- III. Sedimentation in shallow waters can damage local travel, fishing and other activities.
- IV. Organisms in affected marshy areas may experience stress or die as a result of excessive sedimentation.
- V. Excess sediment can create undesirable anaerobic conditions and reach the water, resulting in toxic metabolites (ammonium, methane and hydrogen sulfide etc.) which can damage sensitive aquatic life.
- VI. Modern treatment facilities have been developed according to the type of wastes. Considering the features of the facility, it will be solved without any problems with the appropriate equipment.

Gaining the wastes or by-products to the economy

Waste generated in aquaculture facilities; It should be examined under two headings as waste observed during the cultivation practices and during the sea food processing. Current information should be followed, and solutions should be developed according to the type of waste to ensure that the wastes will be reintroduced into the economy. The feces and feed wastes accumulated in the filters can be dried in the sun and used as agricultural fertilizers. In general, fish leave dry weight of 260 kg per kg of feed as feces. The content of this feces varies according to the feed, rate of ingestion and the fish species. Trout feces contain 30% carbon, 4% nitrogen and 2% phosphorus [16]. The performed studies by our research team have shown that the aquaculture wastes using as a fertilizer for vegetable crops produce gives better results than the other fertilizers [17- 19]. Therefore, aquaculture wastes can be considered as fish manure and can be evaluated in agricultural areas alone or in combination with other fertilizers.

The waste or by-products from sea food processing plants is made reusable by operations that do not require much cost. They can be evaluated as fish food, fish oil or silage. The silage improves the durability of these wastes and turns them into feeding materials of fish and brings them to economy. The use of the head and internal organs of the fish as an additive for animal feeds is an appropriate recommendation for protein content. Some aquaculture plants use these products especially in the nutrition of brood stocks [20]. The knowledge and available technology within this field has however grown substantially in recent years and is still growing. With increased scientific understanding of the properties of proteins and fish oil, the by-raw materials have been transformed to highly valuable products, in some cases even higher in value than the fillets [21].

The advantages of fish by-products or wastes [22]:

- a. With simple interventions, there is a possibility of re-turning into the economy.
- b. Equipment required for processing these by-products is not too detailed.
- c. These by-products are the parts of high-quality fish produced for human consumption but not currently used for food. So, the quality of these wastes is unquestionable.
- d. Skin, carcass, head and similar high-quality internal organs can be obtained directly from the processing line. It also does not require labor or cost of transport etc.
- e. High quality fish proteins and oils are obtained

At this stage, it will reduce the burden of wastes to the environment and add value to the aquaculture farms with the regulations and activities that do not require too much labor.

1. Adding to fish feed of seafood processing wastes

2. In this stage, attention should be paid for hygiene to avoid the diseases of aquaculture.
3. Recycling of scales, snail shells, etc. into cosmetics, textiles, decoration, etc.

The most important problems in the environment are fish faces and feed residues, a significant portion of which accumulates on the floor of the ponds. After harvest or with periodic cleaning, they are collectively removed from the pool floor without having environmental problem.

The wastes of fish and crustaceans are important because of the components of them [23]:

1. Proteins
 - Myofibrillar proteins
 - Sarcoplasmic proteins
 - Stroma proteins
2. Enzymes
 - Digestive enzymes
 - Pepsin
 - Chymosins
 - Lipases
3. Peptides
4. Collagen and gelatin
5. Fish oil
6. Chitin and Chitosan

Considering these substances in the content, it will be seen that these are raw materials that are not waste. It will be possible to use such rich content materials in many areas with new ideas to be produced. If these waste products are used as sources in the production of different living things, the impact on the environment can be reduced. For this purpose, especially in cage farming, nutrients that are fed by using wastes, such as mussels and oysters, are also cultured (polyculture) and nutrient contamination can be prevented in the environment.

Food industry waste is an important source of environmental pollution. As a result of conducted researches on the transformation of these wastes into useful products, it has been seen that they can be used again in the following areas [24]:

- a. Animal feed
- b. Bio diesel / bio gas
- c. Naturel pigment resource
- d. Food Industry / cosmetic

Energy Production

Water movement, which is the main necessity in electricity production, is naturally present in aquaculture facilities. As the

discharge water flow rate is high in the facilities which produce especially large capacity, the power needs of the facility can be provided by the stands, which will be built in front of this water plant. Considering the energy deficit, which is the problem of many countries today, it is a fact that this amount will not underestimate the environmental contribution, but also a significant decrease in the expenses of the plant. With this arrangement which will be made without requiring too much investment, the energy cost which is one of the important inputs in production will decrease the cost of the product and thus the profitability will increase.

Recirculated Aquaculture Systems as a suggestion

Recirculated aquaculture systems (RAS) are one of the intensive fish culture technologies where a significant percentage of water can be reused after the necessary applications. Since water resources are not as limiting as they were in the past, the wastewater treatment systems became more efficient, recirculating systems (RAS) have been widely used in fish farming. These systems are used in the cultivation of aquaculture species with continuous production strategies and economically more important fish species due to high investment and operating costs compared to conventional production systems [9].

RAS has improved faster than expected in recent years [25]. While this model of aquaculture is the system where environmental waste is minimized, the main determinant of planning is the economic part of the production. Since the existing fish farms difficult to transform into this structure, planning at the new plant stage will provide economic and labor advantage.

More intensive stock is done in these systems. The living beings are kept in safer environments with all controlled environmental conditions. Temperature, salinity, pH, alkalinity, chemical composition and oxygen are continuously monitored and kept under control. In addition, they are open to operations and innovations for daily market trends [26]. The amount of water used in closed circuit systems should only be renewed (3-5%) due to evaporation and leakage loss. However, in order to maintain the water quality, the cost of filtration and ventilation limits this application types. RAS allow effective economics on scale, which results in the highest production per unit area and per unit worker of any aquaculture system. RAS's are environmentally sustainable; They use 90 to 99 % less water than conventional aquaculture systems, less than 1% of the land area, and they provide for environmentally safe waste management treatment [2, 27]. Considering organic matter-nutrients (especially inorganic nitrogen and phosphorus), RASs are highly environmental-friendly systems [2].

A different perspective to the relationship between aquaculture and the environment

Aquaculture facilities have a positive aspect which is very important for the environment but does not attract attention. Populations are highly diluted as a result of intensive hunting-

gathering of living species that have benefits for people with different purposes or food. For example, the fact that leeches, whose medical use has become widespread in recent years, are collected from nature intensively, have weakened these species in the ecosystem [28]. The provision of leeches from the nature for using in alternative medicine provides problems in terms of hygiene in patients. In order to meet this demand, only plants that produce leeches can be considered, and in some of the plants producing existing fisheries, this and similar species can be produced [29]. The production of more than one species (integrated fish farming) will reduce the amount of waste generated from the plant and increase the income in aquaculture [30].

Results

Aquaculture not only covers a single production model, but also hundreds of species of fish, crustaceans and aquatic plant cultures. This diversity in the production models and the cultivated species requires considerations of the environment in many different dimensions [31]. Compliance with the rules at every stage of the aquaculture will decrease the negative impacts on the environment as in every sector. Aquaculture has more positive effects besides some negative environmental effects. For example, aquaculture can be used as a means of improving waste water. Water and nutrients can be recycled by aquaculture operation [8]. Increasing aquaculture was initially encouraged for economic reasons, but in recent years many countries have started to implement strict regulatory rules to ensure environmental concerns and sustainability [32]. The negative impact of ecosystem and the loss of biodiversity limits the development of aquaculture. In conclusion, management of fish wastes represents an attracting topic, since this suggests a possible way to solve environmental impacts of fishery discards and, at the same time, it provides a tool to exploit them as a source of feeds for farmed fish, so promoting future aquaculture growth in a sustainable way [33]. Aquaculture activities should be environmentally friendly as well as economical. Sustainable growth in aquaculture can easily be achieved with some measures to be taken. In order to minimize the negative impact of the organic load generated by wastes in the areas where aquaculture systems will be established, the number of enterprises and total capacity should be determined considering the “carrying capacity of the environment” and investments exceeding the carrying capacity should not be allowed. Environment-friendly fishing is not an obstacle to be economical [34].

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