CONSIDERATIONS REGARDING FISH FARMING IN POLYCULTURE SYSTEM

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Keywords: polyculture, fish ponds, common carp, grass carp, aquaculture.

ABSTRACT

Marine aquaculture is becoming more widely recognized as a viable alternative to fishing for supplying high-quality protein to the world's rising population. Capture fisheries output is falling short of global demand, and yearly seafood consumption has increased by more than double in the previous three decades. Under these conditions, raising fish in a polyculture system could be a viable option for increasing production globally, but with low effects on the environment.

INTRODUCTION

Culture of fast-growing suitable species with varied eating habits and ecological niches is being conducted in many regions of the world in order to generate the most fish output from a water body (lake/reservoir/pond). This is also known as mixed farming or composite fish culture. The term "polyculture" can also be used to describe such a culture. In composite fish culture, the cultured fishes make the best use of the pond's available food supply (phytoplankton, zooplankton, periphyton, macrophytes, benthos, and detritus materials). (Jhingran, A.G.1991).

Polyculture is a technique that involves raising at least two compatible aquatic species in a single pond with the goal of enhancing output by combining organisms with varied eating habits or spatial distribution. This diversity of fish species uses in a more efficient way the natural foods available in the pond. (Zimmermann et al., 2009).

This fishery management system, which uses fish farming in a polyculture system, is called mixed agriculture or composite fish farming. One of the main objectives of polyculture is to obtain several products that are economically valuable and may include a

combination of growing some species of animals, aquatic and / or terrestrial plants (Stickney, 2013). Therefore, several compatible species are raised together to successfully exploit all ecological niches of the ecosystem, at high levels of performance. Raising fish in polyculture could have major positive effects, especially in poor regions, where it could strengthen regional food security.

MATERIALS AND METHODS

Aquaculture is considered a viable and effective alternative to fishing, in order to provide a growing human population with high quality protein. However, the rapid growth of the aquaculture industry has led to growing concerns about the impact on the environment and several more conflicts that require the proper use of resources. Nutrient loading caused by fish farming can have a negative impact on the benthic environment due to excessive suffocation, or the organic enrichment and can also lead to changes in sediment chemistry, with severe negative effects on benthic biodiversity (Wang et al. 2012).

Some approaches aimed at reducing the amount of nutrients released into the effluent. They are aimed at improving the digestibility of fish feed or the use of computerized feed management systems. Although these systems improve the quality of the effluent to some extent, they have not yet eliminated the problem of nutrient pollution associated with fish farming (Wang et al. 2012). One solution for reducing the environmental impact of fish farming is to use integrated multi-trophic aquaculture, a concept based on the idea that a species always finds a feeding niche in waste generated by another species. Integrated multi-trophic aquaculture can be used for the potential recycling of these nutrients by cultivating additional relevant organisms.
(Sukhdhane et al., Troel et al., 2009; 2018)

Raising fish in polyculture with a focus on increasing productivity is usually a semi-intensive carp farming. Polyculture is characterized by cheap investment, rapid profitability, high profit and rapid increase in yield and meets the requirements of people to improve living standards. Stock density and species combination are the two key factors influencing the performance of polyculture systems. Monoculture production differs significantly from that in polyculture by feeding, Woynarovich et al., 2010). In a polyculture

system, species selection is extremely important, as all species should benefit from available food without competing with each other.

Hepher and Pruginin (*1981*) described that the use of efficiently available natural food is a very important aspect of polyculture, and due to this aspect increases the ability to improve productivity.

Polyculture main strategic objectives:

- Raising a fish crop that is both healthy for the create ecosystem and profitable.
- Maximum output or production of fish per hectare.
- Commercially useful products are produced.
- Utilization of the pond maximum potential.
- Utilization of many forms of food that are available in all ecological niches.
- Farmers should receive a fair financial return.
- The pond's ecological balance is in good condition.
- Low-cost feed is being used.
- Compatible and pond fertilizing species, such as grass carp, are preferred.

RESULTS AND DISCUSSION

Aquaculture management in polyculture

Polyculture management is focused on the interactions between organisms at various stages of the food chain, with the major synergistic interactions being based on two processes: *improved environmental conditions* and *increased food supplies*. The procedures by which different fish species contribute to the improvement of environmental conditions are depending on the feeding chain's levels.

The elements considered when assessing polyculture systems are:
- Better use of fish farming space and feeding niche.
- Complete use of natural and added feed.
- Preventing the decrease of water quality and avoiding the danger of diseases.
- Diversity of consumer and marketing products.
- Risk diversification and higher economic profitability than growth in monoculture.

The biological production, the supplementary feeding, and the surface of the pond are all elements that are influencing the population rate of the fish. Therefore, to optimize the basin's capacity, four to seven species can be introduced at the same time, however owing to interspecific competition, the introduction timings of each species may differ. (Anton-Pardo et al., 2014);

Nutrition and feeding of fish in polyculture system

In a fish farm, feeding is the most important technological element, because it directly determines the profitability of production (Woynarovich et al., 2010). Fish feed on two types of food: natural and supplements / feed.

Foods whose content in carbohydrates, proteins, trace elements, vitamins and lipids is high are extremely important because the nature of the food absorbed together with the conversion coefficient, ie the transformation of ingested foods into fish meat, can differ quite a lot, depending on the period. year and the stage of fish growth. In addition, in an ecosystem, competition for food, intraspecific or interspecific, can lead to both slowdown and starvation and the elimination of the species from the food chain. Nutrition studies must take into account many things, primarily the ecological and ethological characteristics of the species, with direct reference to the eating habits of the species studied, especially when seeking to transfer knowledge from the natural environment, in captivity.

Natural feeding of fish

Natural feeding includes foods that occur naturally in ponds, such as phytoplankton, zooplankton, macrophytes, detritus, etc. (Carballo, Eer, Schie and Hilbrands, 2008). In general, 100 kg of phytoplankton can produce about 10 kg of zooplankton, which in turn can produce 1 kg of fish meat (Woynarovich et al., 2010).

In the natural environment, in conditions of good quality fish water, the food is very diverse. Diversified food promotes growth, development, reproduction and ensures resistance to specific diseases, being the most appropriate means of preventing them. The most varied food, similar quantitatively and qualitatively to the environment of origin of the cultivated species, ensures a harmonious development and a good functioning of the exotic organism and ichthyofauna, adapted to the aquarium conditions, in

the temperate zone. The food distributed to them can be natural or artificial.

Feed and supplements introduced in the aquaculture basin for feeding fish

It includes food that is provided from the outside to maintain the nutrients in the pool / pond, because most of the time, in the naked pool it produces food in the desired quantities. Feed such as vegetables (leaves, herbs), supplementary herbal supplements (mustard, soy), cereals (rice, wheat, sunflower), or products of animal origin (fishmeal, poultry eggs) and additives (vitamins, minerals) are the additional food needed in the development of fishery products (Agropedia, 2012). The feed must be dosed correctly at the right time in an appropriate amount so that the fish accept it optimally. Once the fish have reached a daily ration of about 3% BW, they are usually fed once or twice a day, usually before mid-morning or late afternoon before dusk. The pace and amount of food must be continuously adjusted and requires an assessment of the number of fish and their total weight, in order to properly adjust the ratio so that they are not overfed or undernourished (Stickney, 2005).

The feed conversion ratio (RCH) must be calculated each month as well as at the end of the production season. The basic rule is that the RCH will be lower in the first half of the production season, while it will increase in the second half. The RCH of the same feed for younger fish will be lower than that of older fish, as young fish consume more foods high in natural protein, therefore, they need additional food to gain the same kg of weight (Woynarovich et al., 2010).

Growth technology in polyculture involves the eradication of aquatic weeds and predatory fish, and fish production can be around 3,000 and 6,000 kg per hectare per year even in more difficult areas (Woynarovich et al., 2010). The development of intensive pond management measures has led to an increase in fish production in a more sustained regime.

The advantages of fish species diversity in polyculture

The increase in fish production through polyculture is considerably higher than in the fish monoculture system. The diversity of species in a pond considerably improves the environment of the pond. Each species in the pond fulfills its role, as follows: Algae flowering is common in most ponds, but silver carp can control

the flowering of these algae. Grass carp controls macrophytes due to its feeding behavior with macrovegetation. This species of fish eliminates excretions that are partially digested, which in turn become food for the common carp that lives at the base of the pond. Mrigal together with the common carp have an essential role in resuspending the nutrients from the bottom of the pond throughout the pond. These species look for food on the bottom of the pond, and through this action the aeration of the sediment on the bottom of the pond takes place.(Saiful I., 2019)

Bentivorous fish populations strongly influence the transfer of nutrients to the aquatic environment. The sediments on the bottom store most of the nutrients in the water column.(Rahman M.M., 2007)

Pond limnology is influenced by the transfer of nutrients from the bottom of the pond back to the water column. Sediment resuspension is affected by important critical factors, such as: feeding behavior, food availability, density and size of fish. (Rahman M.M., 2008).

The common carp specializes in the search for benthic macronevertebrates in the sediments at the base of the pond. By doing so, the carp separates the benthic macronevertebrates by digging and sifting the sediments, and during the digging and sifting of the sediments, it causes the soil to resuspend from the bottom, which increases the availability of oxygen in the soil from the base of the pond. (Ritvo G., 2004)

The impact of aquaculture on the environment

As in any production sector, the growth of the aquaculture sector also has a negative impact on the environment and can affect water quality by increasing nutrient loads, and high turbidity to discharges of chemicals such as drugs and biocides. Increasing nutrient loads can lead to eutrophication of the pond water, and this process can cause the death of crop species, as well as the deterioration of water quality. (Duff A, 1987)

In addition to water eutrophication, the spread of disease outbreaks is a consequence of the expansion of the aquaculture sector. For the well-being of the ecosystem and for a food security, it is necessary to elaborate and implement management plans that will manage in a timely manner the prevention, control and elimination of diseases in aquaculture. (Monique Mancuso, 2015)

Aquaculture has a negative impact on the environment, but increasing the efficient use of resources and actions taken to reduce

the negative impact on the environment will obviously contribute to a more sustainable aquaculture practice. (Dabi M., 2015)

CONCLUSIONS

Aquaculture has the potential to release pressure on fish resources and might bring improvements related to pollution and impacts on wild fish populations The challenges for expanding polyculture practice are in many cases significant although it can offer future important advantages. Pond aquaculture is the major method for increasing world supply and will probably continue to be the dominant source of production.

ACKNOWLEDGEMENT

This work was supported by the Romanian Research and Innovation Ministry, through NUCLEU Programme, Project “PN 19 10 02 03: "RESEARCH ON THE INTENSIVE GROWTH OF FISH IN THE POLYCULTURE SYSTEM AND THE COMPLEX VALORIFICATION OF THE BIORESOURCES (PLANTS) OF AQUATIC”, contract no. 5N / 07.02.2019 and ADER 25.3.1 „RECIRCULATING AQUACULTURE SYSTEMS USED IN THE PRE-MARKING STAGE OF NATURAL WATER REPOPULATION WITH FISHING MATERIAL”, contract no ADER 25.3.1 / 26.09.2019.

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