RESEARCHES ON THE DEVELOPMENT OF AN EXPERIMENTAL MODEL OF FISH POND FOR INTENSIVE FISH FARMING IN POLYCULTURE SYSTEM

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Keywords: fish farming, polyculture regime, experimental model, system.

ABSTRACT

In Romania, the fisheries and aquaculture sectors face several challenges. These mainly involve increasing competitiveness for the production and processing sectors. Polyculture is the breeding of several species of fish in the same space (pond, lakes, etc.). It has advantages: better capitalization of trophic potential, diversified assortment for consumers, increased production with the same human and financial effort and disadvantages: competition between species, the need for additional labour in harvest fishing, additional warehouses for parking fish. Polyculture is recommended in lakes, ponds and some ponds for extensive, semi-intensive and sometimes intensive production.

INTRODUCTION

Aquaculture is a branch of agriculture having the purpose of growing aquatic animals and plants for sale. In other words, aquaculture deals with the controlled growth of fish, crustaceans, shellfish, aquatic plants or other aquatic organisms, [1,2]. As marine resources have declined globally due to intensive fishing, but also due to legislative interventions to stop this phenomenon, aquaculture has become the main source of fish for consumers around the world, [3,4]. To achieve sustainable production and a profitable activity, aquaculture must be carried out using9 scientific and technological developments in this field.

Aquaculture is a useful and easy alternative to classic fishing because it allows the growth in 100% controllable conditions of the whole process, from the juvenile stage to the mature one at the time of harvest, [5].

There are also many production methods used in aquaculture: intensive, extensive, in the natural environment or in pools, in fresh or salt water (mariculture), in continuous flow systems or traditional or modern recirculation, classical or organic, in spaces closed or open spaces, etc.

According to the Register of Aquaculture Units (RAU), 518 units are registered in the aquaculture sector, owning 575 aquaculture farms (ponds, pools, lakes, etc.). The 518 units are divided into:

- 19 nurseries (holding only the nursery license);
- 324 farms (licensed only as a farm);
- 175 farms and nurseries (holding both nursery and farm licenses).

At the moment, aquaculture in Romania is carried out in freshwater and is characterized from a technological point of view in two directions:

- intensive growth (especially for salmonids);
- extensive and semi-intensive growth of cyprinids (common carp, Prussian carp) in polyculture systems, in earth basins (ponds, pools, lakes).

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Polyculture with a mixture of species is the most profitable due to the use of all trophic levels by the fish population. Therefore, in establishing the popular formula, the fish farmer must take into account the natural trophic regime of the fish species he wants to use in polyculture, [8,9]. The more species are used in polyculture that have a more varied trophic spectrum, the better the trophic niches of the populated pond are exploited, causing a high fish production, [10].

MATERIAL AND METHOD

The technological system of intensive fish growing in polyculture system and the complex capitalization of aquatic bioresources (plants), ICP 0, presents in its composition the following main elements:

- Basin ICP 1.
- Feeding system with automated distribution control of pelletized feed.
- Aeration system - oxygenation of the fish basin.
- Experimental model of the automated monitoring and control system for the polyculture system for the intensive growth of some fish species.

The pond or fish pool, ICP 1 (fig.1) is a construction made of reinforced concrete with a thickness of 300 mm, its width is 14.4 m, its length is 57 m, and its depth is 4.6 m. Reinforced concrete has been ensured by applying a binder specific to fish ponds that does not affect the good growth and development of fish species and aquatic plants.

Fig.1. Technological system of intensive fish growing in polyculture system and complex capitalization of aquatic bioresources (plants), ICP 0

The feeding system is composed of 3 feeders provided with auger and pelletized feed disperser with a diameter between 2-10 mm. The feeders are supplied with a voltage of 220 V and are equipped with their own automation system that allows the setting of the operating and stationary time that will ensure an optimal growth of fish species. The feed is released by an auger, driven by an electric (low voltage) motor. A second electric (low voltage) motor is used to drive the dispersing disk and ensures the dispersion of feed over a radius between 2 and 10 m). The feeders integrated in the technological system of intensive fish growing in polyculture system and the complex capitalization of aquatic bioresources (plants), were located as follows:

- **1 automated OSAGA feeder (fig 2)** with LCD control screen and a 5 l pelleted feed storing tank placed in the back part of the pond, its attachment being made using a specially made device, and the sliding above the basin is performed with the help of a steel cable provided with cable tensioner, gripping safety hooks and guide rollers;
- 1 automated FISH FEEDER (fig 2), provided with automated controller for setting the feeding time and a 7-litre storage tank, was placed in the front part of the intensive fish growth pond, having the same attachment manner as the Osaga feeder;
- 1 PROFI 200 kg feed dispenser (fig. 2). The feed is pneumatically picked up by the blower and distributed at a distance of up to 10 m. The feed spreader with blower ensures a continuous administration of the feed, almost without friction (compared to the centrifugal disc system). The feed dispenser is recommended for dispensing feed with granulation between 2-10 mm. The dispensed quantity of feed is set using the programmer. The obturation of the device is excluded. The feed ration can be easily and rapidly set. The lid of the tank is hinged and can be easily opened with one hand, being provided with a shock absorber. On the feeding inlet of the tank is fitted an additional protection grid. The dispenser operates at a voltage of 230 V / 1000 W. The command and control unit allows the adjustment at any time of the feeding hours and of the feed quantity dispersed in the water, being possible to connect it to a computer, through the means of the Aqua Feed software. This feeding unit was adjusted by adding 4 125 mm mobile pivoting wheels that will allow the easy movement of the dispenser around the fish pond.

Fig.*2. OSAGA, FISH FEEDER, PROFI feeding systems*

The **aeration - oxygenation system of the fish pond water** (fig. 3) was achieved by means of 2 ***Osaga ORV*** Aerators. An air diffusion system in the pond water was made by means of a HDPE type pipe for water, PE80, D 63 mm, PN 10 connected to the 2 aerators. This HDPE pipe was attached at a height of 1m from the bottom of the pond by means of collar type devices, the total length being 130 ml, and from 100 mm to 100 mm the diffusion devices were made (2 orifices with a diameter of 1 mm).

Fig.3. Aeration - oxygenation system with Osaga ORV aerators

In order to supplement the oxygen supply in the water of the fish pond, an AERATOR AQUA JET 0.75KW type aerator with submersible motor and directional jet was integrated, fig 4. The aerator is of floating type that moves the water in the form of jet thus achieving a good water circulation and increased oxygenation. The water jet is directed, forming currents and thus achieving optimal oxygenation. AQUA JET is equipped with a 20 m cable, the action area being 3 meters, the circulating water being a maximum of 185 m^3 / h.

Fig.4. AQUA JET 0.75KW Aeration - oxygenation system with submersible motor and directional jet

RESULTS AND DISCUSSIONS

The experimental model of the automated monitoring and control system for the polyculture system for the intensive growing of some fish species, (fig 5) consists of: *water quality monitoring subsystem for the polyculture system pond (basin), fish species nutrition monitoring and control subsystem (system feeding), aeration subsystem*.

All these 3 component subsystems are monitored and controlled via a PLC (programmable logic controller). Pond water quality monitoring with fish farming system in polyculture is made through Sensorex 8000 series specific temperature + pH sensors, compact and stationary monitoring system for oxygen determination and control - Aqua Control one with Dryden probe plus mobile probe multiparameter HANNA - HI9829. All information received from the component subsystems is displayed on an operating terminal or directly on the devices' own terminals.

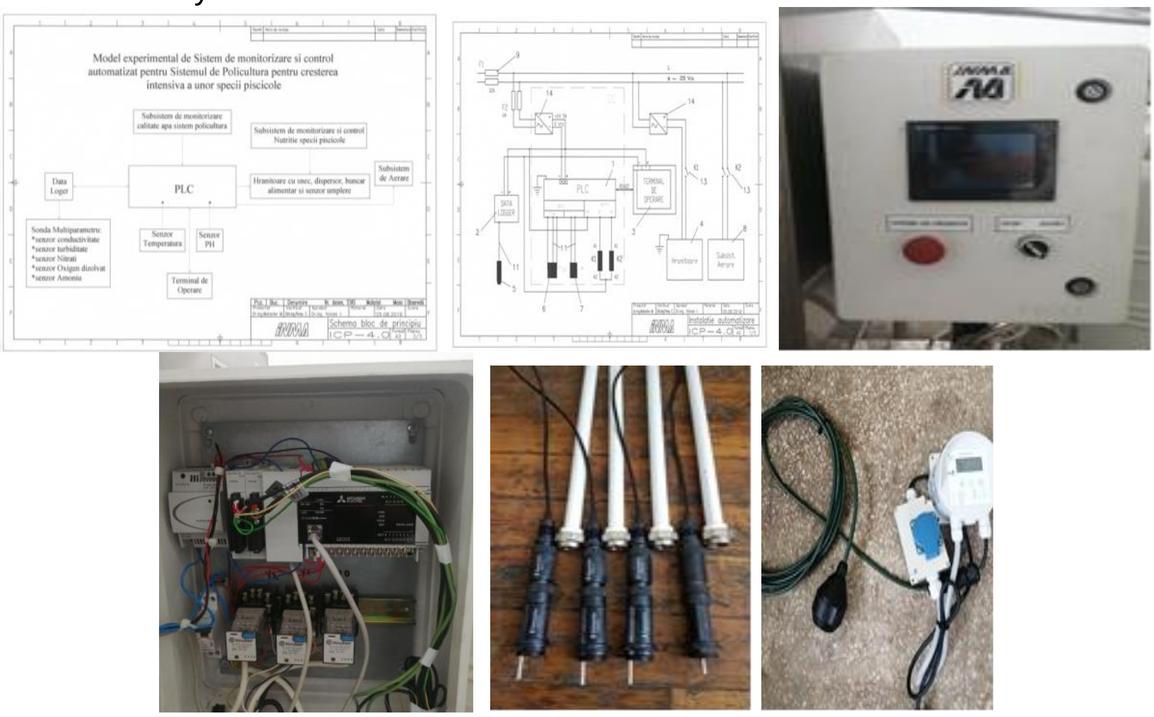

Fig.5. Experimental model of the automated monitoring and control system for the polyculture system for the intensive growth of some fish species (principle block scheme + electrical scheme)

The **multiparameter probe** is equipped with water conductivity, turbidity, nitrites, dissolved oxygen, ammonium and nitrate sensors, the data being collected by a data logger. PH / ISE / EC / DO / GPS Turbidity Multiparameter - HI9829 is a portable, waterproof multiparameter that monitors up to 14 different water quality parameters. The multi-sensor probe with microprocessor allows the measurement of key parameters, including pH, ORP, conductivity, dissolved oxygen, turbidity, ammonium, chlorine, nitrate and temperature. The multimeter is enclosed in a waterproof housing (IP67) and can withstand immersion in water at a depth of 1 m for up to 30 minutes.

The probe has an IP68 rating for continuous immersion in water. The main technical characteristics of the technological system of intensive fish farming in polyculture system and the complex capitalization of aquatic bioresources (plants), ICP 0, are:

Fish pond or basin:
- Width: 14,4 m;
- Length: 57 m;
- Depth: 4,6 m;
- Construction: Waterproof reinforced concrete;
- Concrete thickness: 300 mm.

Feeding system:
- Tank capacity: 5 – 200 kg;
- Feed dispersion radius: 2 - 12 m;
- Pelleted feed size: 0 - 10 mm.

Aerating system:
- Power: 2850 W;
- Supply: 220/380 V;
- Flowrate: 800.000 l/h;

CONCLUSIONS

Acknowledging that European aquaculture needs support for its development, four priority areas of action are identified to unlock the potential of European aquaculture: simplifying administrative procedures, coordinated land use planning, competitiveness and ensuring a level competition playing field.

1. Administrative simplification: by reducing the administrative burden and deadlines for obtaining permits, authorizations and licenses and applying the principles of the Small Business Act, the competitiveness of the sector will increase;

2. Coordinated spatial planning: spatial planning can help reduce uncertainty, facilitate investment and accelerate the development of sectors such as aquaculture;

3. Strengthening competitiveness: EU aquaculture companies will benefit from better market organization and the structuring of producer organizations in the sector;

4. Ensuring a level playing field: exploiting the competitive advantages of EU operators by relying on high standards of environment, animal health and consumer protection are among the EU's main competitive factors in aquaculture and should be exploited more effectively in order to handle competition in the markets. In this context, the general development objective of Romanian aquaculture is represented by stimulating an environmentally sustainable, resource efficient, innovative, competitive and knowledge-based aquaculture.

ACKNOWLEDGEMENT:

This work was supported by the Romanian Research and Innovation Ministry, through NUCLEU Programme, Project " PN 19 10 02 03 : "Researches on the intensive growth of fish in the polyculture system and the complex capitalization of aquatic bioresources (plants)", contract no. 5N / 07.02.2019, and by a grant of the Ministry of Education and Research on the Programme 1 – Development of the national research-development system, subprogramme 1.2 – Institutional performance – Projects for financing excellence in RDI, contract no. 16 PFE.

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