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SALMONIDE GROWTH - A SUSTAINABLE AND VIABLE ALTERNATIVE FOR THE VALORIZATION OF UNPRODUCTIVE AGRICULTURAL LAND

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Abstract

Salmon farming includes concerns about artificially growing and improving the populations of Salmonidae species on specialized trout farms. Due to the improvement of salmonid species, today productions are obtained throughout the year, in a relatively short time and at increasing densities. Thus, in order to obtain high and quality yields, the crop areas are incomparably smaller than those intended for other crop species, being used impracticable lands for agriculture or low yield lands. The study brings to the fore the parameters that must be taken into account, in the project phase, before setting up a farm specialized in trout farming: geotechnical study, water source, physics-chemical parameters and growth basins. The growth of trout is related to the agricultural sector and the technique of the agricultural production process, because knowing the soil and its properties, we can improve the action of bacteria and benthic flora and fauna, important links of the food chain in the ecosystem. The trout farm is a profitable alternative to the traditional farm, because the area needed to set up the fish farm is much smaller.

Keywords: Agricultural land, water, growing, production, Salmon farming

1. INTRODUCTION

Salmon farming defines the area of concern: the study, growth and management of fish populations in the family Salmonidae Fish of the Salmonidae family are predatory fish with a fusiform body covered with small scales with well-developed fins. In Romania, the living environment of salmonids is the flowing waters of the mountainous and pre-mountainous area, the alpine lakes and the accumulation lakes built on Mountain Rivers.

The improvement of the living conditions of the salmonids implies the accomplishment of works for the stabilization of the mountain water courses, for the regularization of their flow, for the reduction of the alluvium transport. Salmon farming includes concerns about artificially growing and improving the populations of Salmonidae species on specialized trout farms. Due to the improvement of salmonid species, production is now obtained throughout the year, in a relatively short time (compared to cyprinids) and at increasing densities.

Thus, in order to obtain high and quality yields, the crop areas are incomparably smaller than those intended for other crop species, being used impracticable land for agriculture or low-yield land. Accumulation lakes in the mountain area can also be exploited from a fishing point of view, growing in floating ponds, resulting in high salmonid production.

For humans, fish generally have multiple uses. Thus, fish meat is an easily digestible, nutritious food with superior taste qualities. Due to the fact that they have a very low content of extractive substances, fish can be used very effectively in the diet of sick people. Omega-3 fatty acids, found especially in fatty fish (salmon, rainbow trout, mackerel and sardines) provide health benefits which cannot be obtained by consuming other foods.

Omega-3 acids in fish are highly polyunsaturated fatty acids that lower triglycerides, reduce abnormal heart rhythms, lower blood pressure and improve the regulation of blood clotting. The trout farm is a profitable alternative to the traditional farm, where cattle or sheep are raised, because the area needed to set up the fish farm is much smaller, if certain conditions are met, such as the land to be located near a watercourse and the owner to take care of the welfare of the fish Regarding the welfare of fish, researchers provide rules for assessing the welfare, indicating that the biochemical parameters of the blood are valuable tools for monitoring the health of fish (Uiuiu P. et al. [11]).

The aquaculture unit under study is located in Dâmbovița County. Moroeni - Pucheni, is located about 120 km from Bucharest, 40 km from Targoviste and 18 km from Sinaia on DN 71 (Figure 1).

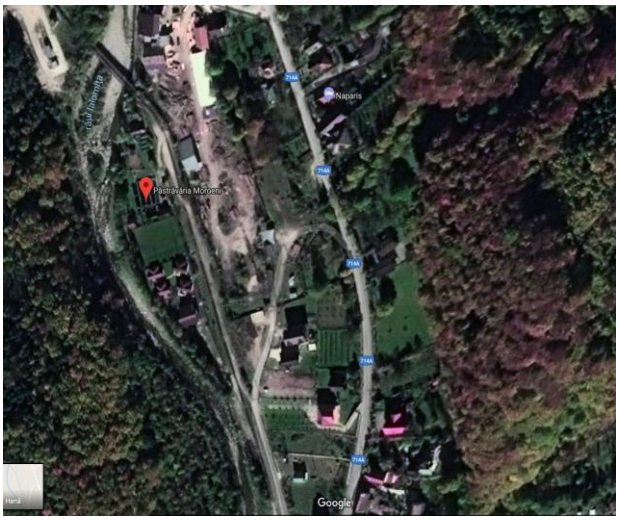


Figure 1: Satellite image. Source: Google maps

The area has tourist, industrial and educational potential. School camps: Caprioara, Cerbul, Vanatorul, Dobresti Lake and hydroelectric power plant, Ialomicioarei cave, Pestera hotel complex located at 1600 m altitude in Bucegi Natural Park.

Tourist routes to Scropoasa, Bolboci, Cota 1000, Ratei and lalomita Cave, Sphinxes and Babble Peaks, numerous springs, chalets and monasteries. The access to the farm is easy.

Possessing a land with very low potential from an agricultural point of view, but suitable for the development of an aquaculture activity, on the banks of the Ialomița River, the company decided to set up a farm to grow trout.

Thus, the technical documentation was made and the construction of the infrastructure of this economic unit began (Aquafarm 2014 [1]).

2. MATERIALS AND METHODS

The working methodology aimed at elucidating the aspects, which must be taken into account from the project phase on the establishment of a trout farm: the geophysical properties of the land from the site, water and the necessary influencing factors in a trout farm:

- The geographical position (longitude and latitude) indicates the location of the ecosystem in an area with certain general climatic characteristics.
- The altitude offers the possibility of detailed climatic characterization (and not only), the aquatic (and terrestrial) ecosystems being extremely different depending on the altitude at which it is located, in a limited geographical area.
- Exposure to the sun and prevailing winds is very important and imprints profoundly different characters on ecosystems.

3. RESULTS AND DISCUSSION

Geophysical properties of the site land

As stated in the topographic study, the land is located in the area of the Southern Sub Carpathians, on the administrative territory of Moroeni commune, Dambovita County, at an altitude of 598.42 m.

From a geomorphological point of view, the studied area is located on the lower terrace on the left side of the Ialomița River, in the upper part of its course.

The land contains Cretaceous deposits that record several sedimentary cycles and Quaternary deposits in the area of the lower terrace. In the terrace area, which has a small development in the surface, given the presence of the mountain area, the deposits made of gravel and sand, deposited by the river Ialomița, are slightly rolled, so there are large stones.

According to the surface observations, it was found that the land is relatively flat and stable, with a slight N-S fall, without physical-geological phenomena of instability or land degradation. (Figure 2)



Figure 2. Water source

Water is a natural element with complex physic-chemical properties, the main component of aquatic biotopes, it is the environment in which life occurs, is organized and develops. Water encompasses characteristics on which the existence of the bio enosis depends, its diversity and the level of biological productivity of the ecosystem. Water is in a permanent and intimate inter-relationship with the bental, taking but, especially, giving it compatible physical and chemical characteristics, so that the two elements, the bental and the pelagic, form a unitary environment - the aquatic ecosystem. Water is manifested in relation to the bio enosis by influencing factors whose permanent dynamics with a regime character, has a positive or tolerant effect, but which can become limiting factors if they exceed certain values specific to each character.

In order to study the physio-chemical qualities of the water from the supply source, the Ialomița River, water sample collections are made. The results of the analysis bulletins are presented in the following table, compared to the data from STAS 4706-74 and to the data of the European Commission regarding the quality conditions of the surface waters, which are suitable for the intensive growth in trout.

Table 1: Results of the analysis bulletin (ICPIL Bucharest)

No	Chemical indicators	Permitted limits		
		Cf. STAS 4706-74 surface waters	**According to the FAO European Commission for Salmon Farming**	**Elements of water quality according to the analysis bulletin**
1	Water harvest time. 0°	-	-	14°
2	Atmospheric temperature. 0°	-	-	30°
3	Oxygen dissolved in water mg/l	6	Adm 7	6,91
4	Oxygen saturation %	-	-	68,40
5	Dissolved oxygen at 5 days mg/l	-	-	5,20
6	CB 05 mg/l	Max 5	-	1,70
7	PH	6,5-8,5	7-8	7,4

8	Alkalinity m val./l	-	Under 20	3,6
9	Bicarbonates mg/l	-	-	468,5
10	Calcium (Ca) 2+ - mg/l	150	60-170	92,10
11	Magnesium (Mg) 2+ mg/l	50	-	32,65
12	Chloride (Cl) – mg/l	250	50	17,13
13	Sulphates (SO4)-2 mg/l	200	10	22,02
14	Organic matter (K MnO4 /mg/l)	-	-	2,1
15	Free carbon dioxide mg/l	50	-	34.0
16	Hydrogen sulfide mg/l	-	-	-
17	Oxidril (OH) mg/l	-	-	-
18	Nitrogen (NO) 2 mg/l	1	-	-
19	Nitrogen (NO) -3 mg/l	10	1-15	13,2
20	Ammonium (NH) 4+ mg/l	1	-	0,4
21	Phosphates (PO4) 3	-	-	-
22	Iron and aluminium oxides	-	-	0,71
23	Iron (Fe) 3+	0,3	-	0,011
24	Aluminium (Al) 3+	-	-	0,317
25	Fixed residue at 105 °	750	-	452,0
26	Suspension	-	25-400	23,9
27	Silicon dioxide			143
28	Total hardness 0 German			20,48
29	Temporary hardness			10,66
30	Permanent hardness			9,7

From the data presented in table 1, it is found that the values of the water parameters used in the trout farm are within normal limits.

In general, physico-chemical analyses will be performed whenever something abnormal is observed, either in the water or in the behaviour of fish or aquatic life. Particular attention will be paid when various constructions have been placed on the respective valley, upstream of the fish farm. In fish farms, the following determinations may be made: The water temperature is run twice daily (morning and evening). Instruments needed: a mercury thermometer for water, which records temperatures from -10 ° C to + 35 ° C

Hydrogen ion concentration, pH scale is widely used as a method of expressing the concentration of hydrogen ions representing the acidity or alkalinity of water. Values can range from 0 to 14, and the neutral point is 7. Higher values indicate alkaline water, while lower values indicate acidic water.

The pH of natural waters varies between 4 and 9, the lower values being characteristic of swampy areas, the highest of the alkaline streams.

Normal values in areas where fish fauna is well represented are from 6.7 to 8.2. The values that come out of this range must be observed (the lower pH, the lower mineral content of the water). In general, slightly alkaline waters support fish growth better than slightly acidic ones. PH, for the farm water source was 7.4 (table 1)

Oxygen in the water

All natural waters contain CO_2, the usual amount and the equilibrium point being about 2 p.p.m. In wells, carbon dioxide can be very high and is associated with a deficiency of dissolved oxygen. Values less than 1 p.m. It usually indicates the presence and activity of algae that tend to absorb free carbon dioxide and release oxygen, so a low CO_2 content is associated with a high oxygen content. Values above 2 p.m. should be kept under observation, usually indicating organic waste, or an oxygen deficiency. The work is carried out whenever necessary and especially when the fish begin to come to the surface of the water or jump out, in summer when there is a flowering of the water (an excessive development of algae and the water acquires a bluish-green appearance) or in winter when water insects appear in the stitches. Usually, the work is done in the morning, before sunrise during the summer, when a large amount of floating or submerged plants or microscopic algae have developed in the water. In winter, in fishponds, when the surface of the water is covered with ice, the determination of oxygen will be performed both in the evening and in the morning. The determination of the amount of oxygen required per kg of fish within one hour can be determined by the formula:

$$Q_{mg/l} = \frac{(n_1 - n_2) * d * 60}{G} \qquad (1)$$

n_1 - the amount of oxygen at the supply mouth, in mg /1;

n_2 = amount of oxygen in the water outlet, in mg / l. It can be dosed according to diphtheria methods

60 = minutes in an hour;

G = total weight of fish, in kg;

d = water flow within one hour. (Voican V. [14])

Solubility of atmospheric oxygen

In general, the solubilisation of oxygen in the atmosphere in water depends on the barometric pressure, the pressure of water vapour in the atmosphere, the water temperature and the concentration of salinity in the water (total salts).

For determinations are needed: a barometer, a psychrometric, a thermometer. After recording the data read on the above devices, the following calculation formula applies: (Voican V. [14])

$$q = \frac{0,678(P-V)(1-S+10^{-5}}{T+35} \quad (2)$$

q = concentration of dissolved oxygen, in mg / l;

P = barometric pressure, in mm Hg;

V = water vapour pressure, in mm Hg;

T = temperature then, in degrees C;

S = salinity concentration, in mg / l.

Salinity is determined per litter according to the formula:

S = (D-1) x 1,309 x 1,000 (3) in which:

S = salinity, per litter / water;

D = water density.

Determining the toxicity of a water

The work is being carried out when it is alleged that there were spills that could have killed the fish. Place 10 fish (in the case of mountain waters) in a small mesh pond, which is anchored in the middle layers of the water, near the mouth of the feeding channel or directly into the channel. The fish are kept for 3-4 days, taking care to check daily and clean the net. When fish start to die, it is established that the water is toxic and the earlier the mortality, the stronger the toxic. However, if after 4 days no mortality is found, the water can be declared non-toxic. With a clean 200 cm^3 container, take water from the pool. Cover with a lid, place on a heat source and allow to warm to about 40-50 C. Take the sample, lift the lid and smell. The following pungent odour's can be distinguished from urine, Stifling, of medicine; Rotten vegetables; Rotten eggs; the faces; Burning sting; of gas; Garlic; Mildly the fish.

Water temperature

The water temperature is run twice daily (morning and evening). Necessary instruments: a mercury thermometer for water, which records temperatures from -10 ° C to + 35 ° C; Given that the expansion or restriction of a fish farm is closely linked to the maintenance of a certain level of water in the pool, the calculation of the maximum and minimum flows will be done from the design phase. To determine the flow it is necessary to know: Watered section surface (filled with water); Average speed of water flow in one second. When calculating the flow, it should be borne in mind that, in addition to maintaining an approximately constant level, it is also necessary to receive water from a fish pond, which is done in a certain number of days, or several times a day, depending on the size of the flow. Flow rates should be determined especially in the hottest and driest month of the year (minimum summer flow); at the beginning of the frost (minimum in winter) and during the spring floods (maximum flow). From the ratio between the average flow (average flows calculated in a few years), in m^3 / sec. and the water surface in km^2 is deduced the specific average flow of the respective water the need for pools and their surface

The trout in a trout farm must ensure the development of the fish at a certain stage in their life. The number of trout in a trout farm is calculated according to the target production, the established stocking densities and the increased trout species (Table 2).

Table 2: Pools needed in a trout farm

Pool category	Used pools		Surface	
	permanent	temporary	Surface each pool (m^2)	Total (m^2)
Incubators	15	-	-	-
Barter	12(24)	-	1	12(24)
Baby pools	5	1	30	180
Pools of youth	3	1	210	840
Consumption trout ponds	4	1	525	2640
Lift pools	1	-	100	100
Breeding ponds	2	-	85	170
Quarantine pools	1	-	50	50
Sport fishing pool	1		220	220

Table 3: Popular densities

No	Category basin	Density	No	Category basin	Density
1	Incubator	10000	6	Consumption trout ponds	40ex m^2
2	Barter 15-30 days	10000	7	Lift pools	0,5ex m^2
3	*Barter 30-60 days	5000	8	Breeding ponds	0,7ex m^2 F 1,4 ex m^2 M
4	Baby pools	700	9	Quarantine pools	-
5	Pools of youth	150	10	Sport fishing pool	-

* The number of barter used when the density is 5000 copies/m^2, the total surface area of the water gloss is 4200 m^2.

A water, even if it meets the optimal physio-chemical conditions, will not contain fish if there is no flora and fauna in it that will be their basic food. Among the most widespread plants that belong to the group of algae are the diatoms, which attach to the rocks towards the shores and form a slippery layer of different colors.

They are important because they host a number of tiny creatures that feed on salmonids. Muscles (Bryophytes) play an important role in the development of nutritive fauna. They attach to rocks and are home to many insects, which are food for fish. They contribute to some extent both to the fixation of the bottom of the riverbed and to the enrichment of water in dissolved oxygen. A water whose bottom stones contain muscles in appreciable quantities is a water with a high biogenic capacity.

Flowering plants grow in shallow water and indicate an optimal environment for salmonids. The presence of the plant Veronica beccabunga (lizard) indicates a cold, clear water with a rich nutritious fauna.

Where the water is calmer, there are the so-called water fleas (Daphnya sp. Figure 3, Bosmina sp., Figure 4, Cyclops sp.), which make up the plankton of the mountain waters and which play an important role in the life of the chicks whose food it constitutes.



Figure 3. Daphnya.sp



Figure 4. Bosmina sp

Water fleas can also be grown artificially to be fed to trout salmonids. Plankton grows very well in stagnant or weak water. It is better represented in ponds, alpine lakes and dams than in running water. Plankton enter the diet of adult trout in a small proportion, feeding on the so-called macro fauna made up of insect larvae, worms, snails and other organisms that live in mountain water.

These organisms live their aquatic life for a certain period of time so that the last stage (of the insect) can spend it in the atmosphere. In both the larval and adult insect stages, they are an excellent food for salmonids.

In order for a fish farm to be able to exist and ensure its production plan, it must have water that contains the substances necessary for the maintenance of fish life and be sufficient in quantity throughout the year in all the basins it has in production.

4. CONCLUSIONS

Fish farming in ponds and ponds, being part of Animal Husbandry, aims to study and develop technical-scientific methods for breeding and raising fish. The creation of highly productive fish breeds is based on their own methods and principles.

Fish farming is related to the agricultural sector and the technique of the agricultural production process, because knowing the soil and its properties, we can improve the fish basins and from here the fish production increases.

The land is located in the area of the Southern Sub Carpathians, on the Territory of Dambovita County, at an altitude of 598.42 m. From a geomorphological point of view, the studied area is located on the lower terrace on the left side of the Ialomița River, in the upper part of its course. The land is suitable for arranging a trout farm.

Climatically, the area is characterized by the following values: average annual air temperature + 8 °C; absolute maximum air temperature + 32 °C; absolute minimum air temperature - 27 °C; annual average rainfall 1000 mm; max depth of frost h = 0.80-0.90 m (STAS 6054/77)

Establishing the characteristics of a water necessary for a good growth of the fish populations can be done even within the respective farm, if the fish farmer acquires the technology of certain analyses,

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