ASSESSMENT OF RISKS OF NET FISH FARMING DEVELOPMENT IN LAKE SEVAN, RA

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Introduction

Fish farming is developing, expanding and becoming active in almost all regions of the world, as the demand for fish products from the world community is increasing. Due to the severe deterioration of the world's ocean ecosystems and the threatened state of about 20% of the area, fishing resources have been significantly reduced and disqualified. In fact, there is an objectively urgent need to develop and implement a series of management decisions aimed at improving the management system of the industry and the differentiated application of economic incentives, which do not contradict the rules of the WTO, and which together: will ensure the further growth of the industry and the growth of its economic income [Krajnij, 2012, 3-4]. Developing manageable pond fish farming or aquaculture, and in recent years also the development of net fish farming, is a means of confronting the formed threats. According to the forecasts of the UN Food and Agriculture Organization (FAO), in order to satisfy the current level of consumption of fish products per capita, the world fish farming production should reach 80 million tons in 2050 [Grigoryan, 2013]. Increasing productivity and international competitiveness and promoting exports are important prerequisites for the economic development of each country. In order to develop and implement policies and practical measures in these directions, it is necessary to collect quality information about branches with development potential, as well as factors hindering or promoting their development, and make comprehensive analytical conclusions, assess possible harmful risks and draw appropriate conclusions accordingly. The trends in the development of fish farming in the Republic of Armenia in recent years indicate that the majority of business entities have rich experience in conducting fish farming and effective management skills, which makes this sector both profitable and long-term growing. Currently, about 20,000 tons of commercial fish are produced annually in the republic, the majority of which is rainbow trout. Due to the high quality characteristics, the fish produced is in great demand in the Russian Federation and other countries, as a result of which around 20-30% of the produced fish products are exported. The main fish species grown in Armenia for industrial purposes are carp, white and spotted bream, white and black sturgeon, Sevan summer trout, grayling, rainbow trout, redfish and sturgeon, Japanese carp (koi) and African catfish.

Methodology

During the analysis of the article, the methods of data collection and comparison, induction and deduction, discussions, brainstorming and scripting were considered as the basis of the study of scientific ideas of data.

Literature review

The scientific source for the research of this article was the studies and recommendations of a number of local and foreign scientists, among which the works of V.K. Zilanov, studiess of I. Yurievna. S. N. Alexandrova, O. O. Vatutina, Y. V, Vertikova and others. Such Armenian scientists as the Head of the Department of Fisheries of RA Zoology and Hydrology Scientific Center, PhD, Professor Bardukh Gabrielyan, have dealt with the issues of researching the assessment of the risks of breeding in the net method of fish production. He regularly presents the problems of Sevan. According to his assessment, the fish grown even in the fish farms are considered competitive in EEU countries. A number of scientific articles about the studied field were also written by the author, which are presented in the list of literature.

Scientific novelty

The main ways to mitigate the negative risks of the development of net fish farming are to consider the creation of centralized systems of breeding, processing and sale of fish products, the organization of local production of equipment used in net farms, the organization of local production of fish feed.

Analysis

The development of intensive fish farming has become an urgent necessity, which enables the introduction of the latest technologies to filter water and keep more fish with the same volume of water intake. With this mechanism, the state provides significant support to the development of fish farming, in particular a 0% subsidized credit program of 3-15 million drams, which also includes the fish farming sector and a licensing support program, within the framework of which fish farmers can purchase up to 1 billion drams intended for fish farming processing device equipment. According to the decision adopted by the government in September 2013, business owners are required to invest water and environment-saving technologies for fish farming, in particular, semi-closed water circulation mode production, for which, according to the business owners' calculations, each fish farmer will be required to invest from 700,000 to 1.5 million US dollars [Health Ministry, 2003]. In the case of intensive water-saving technology, water intake is limited, and the used water is filtered from toxic ammonia, as well as other components, by means of mechanical filtration and biofiltration and is regularly returned to use [Zilanov et al., 2015, 17-22]. These systems have recently become very popular in global fish production, largely replacing traditional open systems, which allow more efficient regulation of water quality and fish production, as well as personal control of solids filtration, bio-

filtration, ozone disinfection, UV disinfection, hydrogen indicator (pH), degassing, oxygen solubility, temperature and lighting. It has a number of advantages over traditional pond farms, including maximum year-round production in conditions of limited water supply and land area, the possibility of locating production structures near large markets, complete and convenient fish collection, fast and effective disinfection, etc. From an environmental point of view, recirculation systems are very beneficial, because their use minimizes the use of water, which has become a limited resource in many corners of the world. In addition, with the moderate use of water, it becomes possible to remove the excreta of fish in an easier way, which is extremely difficult in traditional open systems [Grigoryan, 2013, 172]. Due to these and many other components, recirculation is considered an environmentally friendly method of commercial fish production. The excreta obtained from farmed fish can be used in agriculture as an organic fertilizer, as well as raw material for the production of biogas.

It is a gratifying fact that in order to implement technologies that do not harm the surrounding environment and effective fish farming, in cooperation and financing with the United Nations Food and Agriculture (FAO), it is planned to implement a pilot project of semi-closed water recirculation fish farming in the Ararat Plain, which is being successfully implemented today in "Father and Son Buniatyan", "Mkhchyan Fish", "Inter Aqua", "Crystal Fish", "Hayanist Fish", "Gyumri Eco" farms. Due to modern intensive technologies, water volumes are reduced several times, making it possible to grow up to 600-700 kg of commercial fish in one cubic meter of water, and it is possible to increase fish production volumes under the same water intake conditions. Another important circumstance is noteworthy: cooperative tendencies are observed in the fish farming sector. Very often, farms merge or cooperate on a contractual basis with large farms, which facilitates the acquisition of small fish and compound feeds by small farms, as well as the sale of commercial fish.

It is necessary to carry out even further development of fish farming taking into account the requirements of the EU market standards, which will facilitate the process of obtaining certificates for the export of Armenian fish products and will create a wide opportunity to sell Armenian fish products in world markets [Government Program, 2013, 22]. In terms of international cooperation and customs policy, Armenia has a favorable field for forming trade relations with the CIS countries. Several free trade agreements are signed with Russia, Belarus, Georgia, Kazakhstan, Turkmenistan, Kyrgyzstan, Ukraine, and Moldova. Due to the high quality characteristics, the fish bred in artesian waters is in great demand in the Russian Federation and other countries, as a result of which around 25-30% of the produced fish (mainly crab) is exported to the Russian Federation, Ukraine, Georgia, EU countries, mainly Belgium, France, Germany. Armenia can also benefit from increasing the supply of organic fish products in Western Europe. According to

the operational information received from the RA regional administrations, in 2022 About 169 fish farms are registered in the Republic of Armenia.

Table 1. Volumes of fish production, import and export in RA thousand tons

	Years	Production	Import	Export	Gross supply	Self-sufficiency %	Per capita consumption
1	2019	18,3	3,7	5,8	24,7	113,1	5,3
2	2020	19,1	4,8	11	26,5	148,4	4,4
3	2021	19,7	5,4	11,4	27,3	143,7	4,6
4	2022	19,1	4,8	11	26,5	148,4	4,4

Source: Food security and poverty, 2020, 2021, 2022, 2023. Availability of food, pp.35-40

Notice ➢ Information on fish includes data on live fish, as well as fresh, frozen, dried, smoked, smoked, canned fish, crustaceans, clams, other fish products, fish caviar, processed fish [RA Statistic Committee, pp. 68-76, 2020, 2021, 2022]

As can be seen from the data in the table, in the years under study, the volume of fish production increased by 4.4%, the volume of import increased by 29.73%, the volume of export increased almost twice - 89.7%, which indicates the increase in demand for Armenian fish products. mainly to export to the Russian market and other countries industrial trout and sturgeon fish species. However, the imported fish species is more competitive, and the 31.2% increase in the level of self-sufficiency was achieved mainly at the expense of the imported species, because the local fish has relatively high prices.

In order to make the fishery sector more attractive, the Ministry of Economy of the Republic of Armenia developed and submitted to the Ministry of Finance of the Republic of Armenia the Annex to the Resolution of the Government of the Republic of Armenia "The Amount of Natural Losses Occurring in the Storage of Fish and Fish Products", the Draft Law of the Republic of Armenia "On Amendments to the Land Code of the Republic of Armenia", " Concept of implementation of water-saving technologies, the decision of the Government of the Republic of Armenia, "Program of measures arising from the concept of implementation of water-saving technologies", Decision of the Government of the Republic of Armenia. Adoption of the draft decision of the Government of the Republic of Armenia "On Amendments and Additions to the Decree of the Government of the Republic of Armenia No. 703 of May 22, 2003" will contribute to the introduction of modern technologies, the effective use of water surfaces, and the increase in the volume of industrial fish production and export.

Under the influence of various adverse anthropogenic factors, since the middle of the last century, the number of trout species has decreased sharply and the species has lost its productive importance [Government, 2013, 8]. Currently, trout lacks the ability to reproduce naturally. Two of its four subspecies, winter trout and bojak, are considered to be

completely extinct, while geharkuni and summer trout have survived in insignificant quantities. The bream has lost its industrial importance, and the moray eel is rare. A representative of the white-tailed deer family is a white-tailed deer acclimatized in the lake in the 1920s and 1930s. In order to increase the amount of fishing, new fish species were introduced: whitefish of Ladoga and whitefish of Lake Chud, which established in Sevan and gave birth to a hybrid type of whitefish of Sevan. [Grigoryan, 2013, 11]. If at the beginning of the 90s of the previous century, the fish stocks in Lake Sevan amounted to 28-30 thousand tons, then according to the data of the end of 2012, this number was 80-90 tons. The mentioned factors caused the increase of fish volume to be organized in a grid manner, which will be implemented within the framework of the "Complex Program for Restoration of Trout Stocks and Development of Fish Farming in Lake Sevan". In Lake Sevan, fish farming started in 2013. In the framework of the development of fish farming, the RA government has adopted a program for the recovery of industrial and endemic fish species of Lake Sevan, which envisages the cultivation of fish in nets in unused coastal areas of Lake Sevan. 4 networks were installed, for which the government in 2014 35 billion drams or about 6.25 million US dollars were allocated, in case of positive results, it is planned to expand to 70 networks (management) 50,000 tons per year (until 2025). [Grigoryan, 2013, 41] According to the plan, the total budget of the project will be 66 billion AMD or about 137.5 million US dollars [Grigoryan, 2013]. The volumes of fish produced are expanded exclusively in accordance with international ecological standards, including a maximum of 8 kg of fish are bred in 1 m^3 of area, which is about 5 times less than the average productivity of net fish farming. Reducing density will also have a positive effect in terms of reducing emissions. In 2015 4 grid farms were built and worked from March-April 2016. Later this number continued to grow: in 2016 – 10, in 2017 – 18, in 2018 – 20, in 2021-2022 – 22 grid farms, thus increasing the number of farms to 74, each with an annual productivity of around 668 tons [Grigoryan, 2013]. 770 million drams are required to finance the investment costs of 1 grid economy and the current costs of the initial 2 years. [State program of the government, 2013, 41-45]. The project envisages to realize ecologically sustainable production of about 50,000 tons of Sevan trout in grid farms installed in Lake Sevan over the next 10 years. It is planned to breed 2 subspecies of Sevan trout: geharkuni and summer. The production and sale process will be carried out by:

1. small fish farms,
2. grid economies,
3. the processing plant,
4. the export-import enterprise.

In order to organize the efficient interaction of economies, it is planned to acquire special types of ships - wellboats and cargo ships. The first is planned to supply small fish to net farms, from which the commercial fish will then be transported to the processing

plant. And the cargo ship is planned to be used for the supply of fish feed to the farms and the transportation of labor and other necessary cargo from one shore of the lake to the other.

Conclusions

In order to ensure the effective course of the project, it is necessary to assess the main risks of project implementation related to, first of all, environmental, as well as economic and social sectors, which mainly include:

• Water quality changes in the areas of Lake Sevan, where the establishment of fish farms will be allowed, violation of the ecosystem of Lake Sevan, as a reservoir of fresh water resources of the republic, because the presence of nutrient elements leads to the bloom of algae, which can lead to swamping of the lake;

• Creation of unfavorable conditions for the growth and reproduction of endemic fish species, farmed fish have reduced genetic diversity because they are derived from a limited maternal stock;

• In farms, fish are also bred for specific characteristics (eg, fast growth);

• Stakeholder conflict that may arise from the need to share common resources;

• Users with a coastal zone management (resorts, hotels, etc.) may object to the loss of the aesthetic view from the coast and the reduction of the recreational zone due to the installation of nets;

• The effect of marginal permissible emissions of fish farms to be established in the area of Lake Sevan on the change of the lake's ecosystem

The positive consequences of creating fish farms in Lake Sevan that meet ecological requirements:

• Creation of hundreds of jobs in the total value chain of fish farming;

• Support for equal development of country's marzes;

• Increased demand for fish farming professionals;

• Creation of a broad base for the implementation of scientific research works;

• Alignment of the entire production chain and products with international safety and quality standards (HACCP, ISO 22000, ISO 9001, etc.), work to obtain certificates of compliance with these standards in the coming years, which will allow the products to be exported to the EU and North American and Eastern countries;

• Prerequisites will be created for establishing a factory in Armenia jointly with leading foreign fish feed producing companies. This, in turn, will provide an opportunity to develop the branches involved in the cultivation of agricultural crops used in the production of fish feed. On average, 50,000 tons of fish feed is needed to produce 50,000 tons of fish. More than 50% of the composition of the latter are various agricultural crops, which means that for the production of 50,000 tons of fodder, at least 25,000 tons of agricultural raw materials will be needed. Such an approach will not only improve environmental

sustainability, but also reduce feed production costs and increase the range of feed resources.

The main ways to mitigate the impact of negative risks are:

- Increase food safety requirements for fish production, particularly the need to implement the HACCP system;
- Taking priority measures aimed at preserving the ecological zones and natural environment of Lake Sevan, based on the collection of information on the indicators subject to regular monitoring;
- Training of workforce to improve theoretical and practical knowledge in leading fish farms in Norway, Denmark and Ukraine;
- Creation of scientific research centers in cooperation with international leading companies of the field;
- Installation of high-quality nets, they should have a diameter of 25m and a net depth of 14m. High-density polyethylene tubes filled with polyurethane foam or charcoal, as opposed to galvanized iron frames, provide better buoyancy, are more durable and more common. The advantage of HDPE is that it is very flexible, light, durable and is mainly used for circular netting;
- Development of frequency schedules for cleaning nets to get rid of diseased, dead fish, moss;
- Install collectors in the nets, which will collect hard fish excrement and dead fish and will be regularly cleaned by pumps. If necessary, install oxygen-pumping equipment under the nets, which will contribute to the decomposition of organic matter, use protective film layers;
- Produce 60-70% of the equipment used in networked farms locally, contributing to the creation of new jobs, while reducing costs by 35-40%, contributing to lowering the cost of the final product, making it more competitive;
- To create a centralized system of processing and sale of trout bred in nets;
- Ensuring the security of economies by strengthening the guard service
- Realization of logistics chains of mutually beneficial activities of production infrastructures: refrigeration, storage, transport facilities, exporting and importing companies;
- Active participation in international exhibitions;
- Creation, promotion and positioning of the Armenian Prince (trout) Brand.

To support the solution of net fish production in Lake Sevan, to protect the interests of producers, as well as private for the purpose of effective cooperation between the sector and the state, it is necessary to create a union of legal entities, in which mainly the grid farms of Lake Sevan will be involved. All grid farms must be members of this union.

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Fish farming in mesh ponds is a means of countering emerging threats and a more effective way to develop intensive fishing. This makes it possible to economically use water, the environment, and minimize the environmental recycling system. At the same time, a number of environmental risks arise, especially qualitative changes in the waters of Lake Sevan, genetic changes in endemic fish species, conflict of stakeholders, therefore, the article also proposed the main possible ways to reduce risks. As a scientific novelty, it was proposed to consider the main ways to reduce the negative risks of the development of net fishing by creating centralized systems for the chain of breeding, processing and sale of fish products, organizing local production of equipment used on net farms, and local production of fish feed.