



Problems and Prospects of Growing Carp in Russia and other Countries of the World

Mikhail V. Shatokhin^{1,2}, Anna A. Larionova^{3*}, Natalia A. Zaitseva⁴, Elena A. Gurkovskaya⁵, Alexander I. Romanenko⁶, Oleg V. Gorbunov⁷, Lilya F. Ponomareva⁸

¹Assistant Professor, Hakim Sabzevari University

² K.G. Razumovsky Moscow State University of Technologies and Management (the First Cossack University), Department of ecology and nature management, Moscow, Russia. E-mail: shato-hinm@mail.ru

³ The Kosygin State University of Russia (Technology. Design. Art), Department of economic security, audit and controlling. Moscow, Russia. E-mail: annla@list.ru

⁴ Plekhanov Russian University of Economics, Department of hospitality, tourism and sports industry, Moscow, RUSSIA. . E-mail: zaitseva-itig@mail.ru

⁵ K.G. Razumovsky Moscow State University of Technologies and Management (the First Cossack University), Department of Refrigeration and technosphere safety, Moscow, Russia. E-mail: e.a.gurkovskaya@yandex.ru

⁶ K.G. Razumovsky Moscow State University of Technologies and Management (the First Cossack University), Department of Refrigeration and technosphere safety, Moscow, Russia. E-mail: rai-52@mail.ru

⁷ K.G. Razumovsky Moscow State University of Technologies and Management (the First Cossack University), Department of ecology and nature management, Moscow, Russia. E-mail: singularnost@tochka.ru

⁸ K.G. Razumovsky Moscow State University of Technologies and Management (the First Cossack University) (branch in Meleuz), Department of Food Production Technologies, Meleuz, Russia. E-mail: ponomareva.lilya@mail.ru

Abstract

Purpose: The purpose of this study is to systematize the world and Russian experience in the development of carp cultivation technologies, including those based on intensive fish production in special devices. **Methodology:** The following methods of research were used: methods of studying, analytical, survey and other materials, the results interpretation, the method of statistical data analysis, consolidation and synthesis of information. **Result:** As a result of the research, we generalized the experience of carp production in Japan, Israel and the countries of Europe. We determined the issues and outlined the perspectives of carp production in Russia. The conclusions obtained in this study can be used as a basis for further in-depth development problems for intensive technologies use of fish production. **Applications:** This research can be used for the universities, teachers and students. **Novelty/Originality:** The novelty of the research results consists in systematization of the world and Russian experience in the use of technologies for the intensive production of carp cultivation, including in special devices. The originality of research consists in substantiating the direction of increasing the productivity of production of a map in Russia through the use of biologically active substances and growth stimulants.

Keywords: aquaculture, fish production technology, carp, fish breeding.

1 Introduction

Industrial aquaculture, which, being a relatively new area of fisheries, reached a fairly high level of development in the 70-80s of the twentieth century, is designed to ensure the high efficiency of carp cultivation processes. To date, this component of modern fish farming is represented by fish breeding enterprises operating in fully controlled conditions for the reproduction and cultivation of valuable aquaculture facilities. It is industrial aquaculture in the reports and

documentation of UN experts that play the role of the most promising source of fish products for humanity (21,23).

The regions of industrial aquaculture origin are traditionally considered to be Southeast Asia and the Far East, the warm waters of which contributed to the formation of intensive carp production many centuries ago. However, the main development of this aquaculture area has received in 60's of the twentieth century, due to the lack of natural fish stocks in reservoirs, as well as protein deficiency in the diet of these regions population (22). Nowadays carp is one of the most popular types of fish, and its active implementation is implemented in large quantities not only in the domestic market and within major producing regions (eg., In Asia and Latin America), but also at the interregional level (21)

Corresponding author: Anna A. Larionova, The Kosygin State University of Russia (Technology. Design. Art), Department of economic security, audit and controlling. Moscow, Russia. E-mail: annla@list.ru.

At the same time, the demand for fish products still exceeds supply in most countries of the world, including Russia. Therefore, the search for ways and technologies to improve carp production efficiency as a leader of the global aquaculture production is extremely relevant.

2 Methodological Framework

The scientific basis of this study was the study of Russian and foreign researchers in the field of industrial breeding and carp breeding. In this study, the authors of the article used the methods study of analytical, review and other materials, interpretation of results, method of consolidation and synthesis of information. To assess the prospects for the development of world carp production we used the method of statistical data analysis from the report "The State of World Fisheries and Aquaculture (2014). Achieving sustainable development goals". The information basis for studying carp

production in the Russian Federation was data from the Federal Agency for Fisheries and the period of the Russian press for 2016–2019.

3 Results and Discussion

3.1 Place of Carp Production in the Production of Global Aqua Culture

In the global volume of aquaculture, the leading position is consistently occupied by the cultivation of carp, whose share in world aquaculture production is about 60%. On a global scale, the modern dynamics of aquaculture production within each region is very diverse, but China is the world market leader, with a share of 62% (1,3) (Figure 1). In global aquaculture, carp is dominated by 58% of the total world aquaculture production (6) (Figure 2).

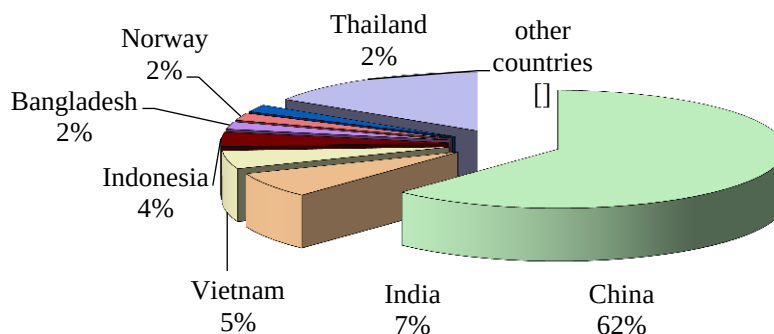


Figure 1: Structure of global aquaculture (7)

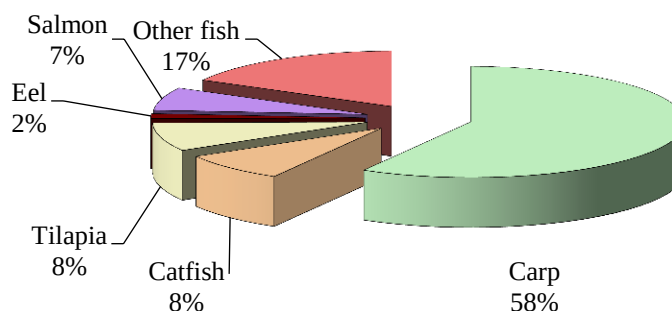


Figure 2: The share of carp production in global aquaculture production

Moreover, as can be seen from the data of Figure 2, the production of carp is more than 7 times higher than the production of the following in mass production of fish - catfish and tilapia. Consequently, the issues of increasing the intensity and efficiency of the industrial carp production are extremely relevant.

3.2 The study of scientific and practical approaches to industrial carp production.

The first work on industrial breeding began in Japan (17). Subsequently, particularly significant progress in carp breeding was achieved in India and China. In the tropical zone, natural fish stocks did not allow the use of artificial fish

farming methods, and only Malaysia, Thailand, Vietnam, Pakistan under these conditions began to engage in pond fish farming in the 40s. Indian, Chinese carp and herbivorous fish are widely cultivated in these countries. Large Indian carp (Katla, Rohu) are bred in small and large (up to 40 hectares) ponds. They are fed with locally available feed, such as rice bran or oilcake. The growth of carp (primarily rohu) in large ponds with low cost in Myanmar is noted. This country exports a significant amount of rohu to Bangladesh, India, to the Middle East, etc. (13).

Breeding methods for carp fish vary by region. In almost all the countries listed, fish feed is made up of cheap products (carps are fed by vegetation, sometimes soybeans, rice bran,

etc. are added to feed, so as not to increase the cost of fish. Inorganic fertilizers are practically not used because of their high cost. In tropical areas, plants grow all year round, and therefore the introduction of inorganic fertilizers is impractical.

Planting material is mined in natural waters. In Japan and Taiwan, juvenile carp are caught during its upstream and river estuaries. Along with this, they use the method of hormonal stimulation of producers - the method of pituitary injections, which gave a rather strong impetus to the development of pond fish farming (9,15,20).

3.3 Carp breeding technology in Japan.

In Japan, carp cultivation is used in small deep ponds with a strong influx of warm water and frequent feeding of fish with complete feed, thereby achieving a high productivity of ponds - up to 200 kg / m². In ponds of oblong area less than 1 m at a water temperature of 15-30°C and a sixfold feeding fish with a mixture of rice, fish meal, shrimp, tomatoes, productivity achieved fish production from 3.5 to 5 t / ha, in small pools with weak flowage - up to 200 kg / m². High productivity here is achieved due to a number of favorable factors, namely: temperature, water quality, composition of artificial feed (5).

Growing carp in cages in Japan began in 1951, when for 85 days of intensive feeding, producers received 11.5 kg / m². The development of cage culture was facilitated by the presence of a large number of artificial reservoirs with stagnant water, the poor bottom of which did not allow for fishing operations in them, but it allowed them to breed carp in cages. Japanese cage is a grid with a flat bottom and an open top, stretched on a frame of bamboo poles. The cage sticks afloat with the help of several steel cylinders and is attached to heavy wooden bars fixed to the bottom of the reservoir. The size of the cage is from 7 to 8 m (surface area), the depth is up to 2 m, therefore it is located near the shore with a depth of water layer of at least 3 m (optimal for growing).

3.4 Carp breeding experience in Israel.

In Israel, one of the leaders in technology development in the fish industry, aquaculture development began with the import of carp into the country in 1927-28(18).

In this country, intensive fish farming is implemented on warm brackish waters, in the specific conditions of the soil, water and climate of this country. In many areas of Israel there is a shortage of water, and in the one that is available, the salt content is very high (up to 1200 mg Cl / l). Such water cannot be used for agriculture, but it is suitable for fish farming. Where there is fresh water, build deep ponds, which are maintained in working condition throughout the growing season. When they are drained, the water is poured according to the principle of communicating vessels with the help of pumps into neighboring ponds, and later used again. Such an operation has been implemented for several years. The natural productivity of fish production in such ponds is 200-400 kg / ha, thanks to artificial fertilizers it is adjusted to 800-1000 kg / ha or more.

In the carp farms of Israel artificial feeding of fish is widely used. For carp, they use cheap grain, oilcake, which greatly increases the productivity of carp. High-protein artificial feed is widely used, which is set once a day (in the

morning) in a mechanized way. The feed coefficient ranges from 2 to 3 (depending on soil fertility and fish size). When the water temperature below 15°C fish cease feeding. The calculations of Israeli scientists found that with a production efficiency of fish 2000 kg / ha, 400 kg / ha - obtained from the natural forage base, 400 kg / ha - due to fertilizers and 1200 kg / ha due to artificial feed. In Israel, fish farming involves the joint cultivation of heat-loving fish species of carp, mullet and tilapia hybrids (in waters with a salinity of 2,000 to 8,000 ml Cl / l (in the Dead Sea region, where water is unsuitable for spawning). In the north of Israel, as a rule, these freshwater fish grown in water with low chloride content (300-400 ml of Cl / l). In total, about 6500 tons of carp are grown in Israel annually, which accounts for 37% of the total fish production in the country (14,19).

3.5 European carp breeding experience.

In Germany, ponds in standing thermal pools; thermal ponds with chilled water; heating equipment; chilled water thermal gutters are used for carp growing. In the thermal gutters, they establish cages from a grid, where fish are harvested and commercial fish is grown with intensive feeding of fish with complete feeds. In Germany, it is considered expedient to grow carp fingerlings in ordinary ponds, and in the fall they are transplanted into thermal ponds, where they are fed up, continuing the growing season. If in the thermal ponds during the winter, the water temperature is maintained close to the summer (due to the constant supply of waste water from the thermal power plants to them), then the pilots grown in such conditions correspond in weight to the two-year-olds grown under normal conditions. Thus, the period from spawning to commercial fish is reduced from 2.5 to 1.5 years, which is of great national economic importance for growing seedlings in the second year of life. Germany ranks second in Europe's freshwater culture (11.5% of all European production), where rainbow trout (24 thousand tons per year) and common carp (13 thousand tons per year) also dominate in aquaculture products. The main importing countries for German-made carp are Belgium and Austria (18).

With regard to European leadership in freshwater aquaculture, the largest producer of freshwater fish in Europe is France. Its share in the total European production is more than 14%. In this country, the main part of fish farming accounts for two species: common carp (5 thousand tons per year) and rainbow trout (41 thousand tons per year).

3.6 Modern state of carp production in Russia.

The first stage of industrial development of industrial aquaculture in Russia was the technology development for growing commercial carp in cages installed in cooling ponds of thermal power plants. At the beginning, the possibility of growing carp in them in the absence of a natural forage base caused quite serious doubts among specialists who were engaged in industrial fish farming in the world, and therefore the first such works were started with two-year carps (4,24).

The first stage of work was associated precisely with working out the issues of feeding fish. Already at this stage, during which the work was carried out in net cages without forced flow, it was determined that carp can be grown exclusively on artificially made feed mixtures only if the temperatures are optimal for carp growth (23-33°C) (8).

Already at 22°C under these conditions, the growth of carp deteriorates significantly and almost stops at temperatures below 20°C. The rations, which were able to ensure the growth of two-year-old carp in the absence of natural feed, were practiced. The most important problem in this matter was the protein and vitamin nutrition of fish.

One of the important conditions for the growth of carp in cages, as was later established, is the need to enrich the feed with vitamins and, above all, with B vitamins, without which the growth of fish stops. In the first stages, protein-vitamin concentrate and hydrolysis yeast were used as such. Along with this, as a source of carotene and, accordingly, fish growth stimulants in diets, we used paste from aquatic vegetation, fish oil (0.02% of the dry weight of the feed), chlorella suspension, the drug avomarin (cellulose hydrolysis enzyme), which has amylolytic pectinolytic and proteolytic activity.

It was also possible to increase fish growth and feed utilization through the use of biologically active substances and growth stimulants. In conditions of high planting densities and high temperatures, the use of preventive measures to prevent fish diseases is also of particular importance. As one of these drugs was applied fodder terramycin, which, moreover, has a growth-promoting effect on fish. The inclusion of terramycin in the feed ration at the rate of 5-10 thousand units / kg of feed provided up to 15% of additional fish products. Biological preparations with enzymatic activity turned out to be quite valuable, which increased the growth of fish to 10% (in particular, tissue preparation). Very positive results were obtained in cages with the use of phosphatides - waste from the fat-processing industry, which contain a complex of biologically active substances (productivity increase up to 15%).

Analysis of the current state of production of the map in Russia shows that if Russia is one of the top ten countries in the world in terms of commercial fish production, then Russia occupies 78th place in aquaculture production (Vasiliev, 2015). The growth rate of aquaculture in the world is 11% per year, and in Russia - only about 5%. According to analysts, in Russia the contribution of aquaculture to providing the population with fish products is minimal (2,11,12). The first place for the volume of aquaculture production is occupied by the Southern Federal District, almost twice ahead following North-western Federal District.

In the Central Black Earth region of Russia two or three year old carp is used. Three-year cultivation (three-year turnover) implies moderate feeding of fingerlings, as a rule, which is a consequence of the increased density of the fry. This direction is considered promising in the I-II fish-growing zones, as well as in large reservoirs of the III-IV zones, where effective carp breeding together with herbivorous fish is possible. Three-year carp are grown at a density of 4 thousand two-year-olds per hectare, while the commodity weight of three-year-olds reaches 1200-1500 g (16,20).

3.7 Actual aspects and problems of ensuring carp production efficiency.

It should be noted that the efficiency of feed use in cage growing carp on the warm waste waters of power plants depends not only on the qualitative composition of animal feed, but also on the technology of feed production. When

using wet pressing granules, the feed costs are 15% lower than when feeding the same composition in the pasty state or in the form of dry pressing granules.

A weighty problem of the industrial cultivation of carp and other fish species in cages is the technology of their feeding, namely, the value of the daily ration and optimization of the feeding regime of fish. By experimenting and searching, optimal feeding rates of carp in cages were worked out. Under conditions of optimal temperature conditions, the mass of food that carp consumes may exceed its own weight. The degree of nutrients use is reduced, which leads to an increase in the feed cost.

Along with the correct rationing of feeding fish, the mode of this technological process is of great importance, namely, the frequency of obtaining food by the fish. Considering that carp is a glandless fish and in natural conditions it consumes food quite often, but in small portions, as well as the fact that its multiple feeding reduces the time the feed stays in water and, consequently, its loss from leaching, it was found that the most rational way is reusable feeding of carp (8-12-14 times a day), which allows halving the cost of feed compared to feeding fish once.

Important when growing carp in cages has a density of its landing. With the deterioration of water exchange, in particular when using fine-capped nylon or fine-meshed metal mesh, with increasing planting density, fish growth slows down, its use of feed nutrients worsens. With good water exchange (in particular in large-cage cages), despite an increase in the density of landing, there is no significant inhibition in the growth of fish. Research has established certain biotechnological parameters with respect to the optimum density of carp planting, which made it possible to obtain up to 150 kg / m² of commodity carp with a feed ratio of about 5.

The domestic experience of cage commercial carp cultivation made it possible to accumulate knowledge for the organization of full-system industrial fisheries in warm water. The work on cooling ponds started in the 60s of the last century in the USSR, the experience of domestic fish farmers was used by foreign specialists who were able to immediately use these opportunities and begin to solve more complex issues related to the reproduction of carp and herbivorous fish waste and geothermal waters.

4 Conclusion

The authors of the article have repeatedly investigated the issues of aquaculture development (10). As part of this study, an assessment was made in regards to breeding carp in the world and domestic experience, which led to the conclusion that the world and domestic aquaculture uses different production systems for growing carp:

- extensive type (natural sources of raw materials, low cost, low yield);
- semi-intensive type (supplementary food is limited, moderate cost of production and moderate result);
- intensive type (artificial granulated feed, high planting density, high cost and high performance).

When choosing a technology, it is necessary to objectively take into account the existing possibilities for ensuring the technological process, and first of all - financial ones. You can gradually intensify the process of fish

production, as production experience and increasing resource capabilities.

Thus, the development of the fish industry in Russia as a whole and carp production in particular is hampered due to a number of problems, such as lack of capacity at fish processing plants, an outdated fleet of ships, remoteness of fish production centers from consumption centers, restrictions on transport infrastructure, insufficient attention states to aquaculture development. Prospects for the development of domestic aquaculture largely depend on the success of solving these problems.

Knowledgegment

The author confirms that the data do not contain any conflict of interest.

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