

## Effects on Ecosystems Exploited Reservoirs in the Saratov Region

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### Abstract

In the framework of environmental toxicology examines the effects of anthropogenic impact on water ecosystems, in particular the Saratov region. In the Saratov region, there are large numbers of small reservoirs and ponds (artificial reservoirs) built for water supply to the population and irrigation of cultivated crops. In the creation of which a ravine-beam network of the territory is used. Directly in the eastern regions of the region only these artificial reservoirs are practically a non-alternative source of water supply. According to the Saratov department of the FGBNU GosNIORKh, industrial use of reservoirs in the Saratov Volga region is characterized by unevenness. In particular, intensive development of the reservoirs of the Trans-Volga region can be traced in the period from 2000 to 2011. The practice of pond fish farming in the Saratov region is realized through a full-system and incomplete economic systems, the formation of which is the amount of investment. The planned indicators of investment attractiveness in relation to the object of research – farming, including three ponds in the city of Saratov (waters of unpc "agrocenter") are calculated. The main morphometric and hydrological characteristics of the ponds of the object of study are determined by mapping, further refined by field measurements and depth measurements. The calculations confirm the confirmation of the effectiveness of the development of paid recreational fish farming (carp, trout) within the object of study.

**Keywords:** Artificial reservoirs; Small reservoirs; Pond; Recreation; Water management complex; Industrial fishery; Species biodiversity; Investment attractiveness

### Introduction

The system of hydraulic structures is a priority component of the water management complex, designed to regulate the flow of rivers, reduce maximum floods and protect territories from flooding. The objects of the system include both the hydraulic structures themselves and the water bodies they transform (rivers and artificially created reservoirs) [1].

The central component of the water-retaining hydraulic engineering structure is considered to be an artificial reservoir, thanks to which the regulation of water resources is realized. An artificially created reservoir allows accumulating water reserves in periods when the inflow exceeds consumption, and is used in cases when water consumption exceeds its inflow. At the same time, it is possible to use an artificial reservoir in order to reduce the maximum outflows of floods and floods in the part of the river located below [1].

Artificial reservoirs are divided into reservoirs and ponds. In turn, reservoirs consider artificially created reservoirs with a total volume of more than 1 million m<sup>3</sup> [1]. Artificial reservoirs with a volume of less than 10 million m<sup>3</sup> and a mirror area of less than 2 km<sup>2</sup> are classified as small reservoirs [1].

**Table 1:** Reservoirs of the Saratov region (including artificial origin) by gradation of areas.

Gradation area (square. km)	>100	50-100	Oct-50	10-May	5-Jan	0,2-1	0,05-0,2	0,01-0,05	<0,01
Number of bodies of water	2	0	1	1	17	240	1175	2120	3450
Area of water cover (sq. M. km)	2300,0	0,0	25,2	6,27	32,8	86,9	109,3	53,0	12,36

The water management complex of the Saratov region is represented by structures: 3045 ponds and reservoirs, 153 engineering protective structures, hydrotechnical structures of wastewater storage tanks, water intake, spillway and

treatment facilities, and 4 systems of inter-basin redistribution of river flow [2]. On the territory of the region in total there are 184 reservoirs with volumes of more than 1 million m<sup>3</sup>, including: 150 reservoirs with a capacity of 1 to 5 million m<sup>3</sup>; 20 reservoirs with a capacity of 5 to 10 million m<sup>3</sup>; 7 reservoirs with a capacity of 10 to 20 million m<sup>3</sup>; 7 reservoirs with a capacity of more than 20 million m<sup>3</sup> [3].

There are more than 7000 reservoirs of different genesis and a size of more than 0.05 hectares [3], including more than 250 lakes with an area of more than 0.01 km<sup>2</sup> and a number of lakes of a smaller size (according to the Institute of Lake Sciences of the Russian Academy of Sciences) in the Saratov Region (**Table 1**). Artificially created reservoirs, in turn, are much more natural, the largest of them are the Saratov and Volgograd reservoirs on the river, The Volga [4].

## Methods

The area and amount of natural and artificial water bodies are not constant and directly depend on natural and anthropogenic factors. For example, the size and location of artificial reservoirs are determined by the features of the relief and structure of the hydrographic network, the conditions of their creation (the dam, built in any part of the stream, from its height, forms reservoirs of different capacities) [1]. The relationship between the size of water bodies and their location in the hydrographic network is also established. The size and location of artificially created reservoirs depend on the requirements of different sectors of the economy for the quality, quantity and timing of water supply. All artificial reservoirs are formed into objects of integrated use with priority use of water resources by any single branch of the economy [1].

Most of the small reservoirs and ponds are gradually surrounded by residential areas with modern buildings and landscaping and changing their economic use is preferable due to the achievement of fishery and recreational purposes.

Prospects for the development of fish farming in adapted ponds in individual and farming enterprises with the receipt of commercial fish of a large scale in the Saratov region have been established by the Concept of the Development of the Fisheries of the Russian Federation for the Period to 2020 [5-9]. According to it, the economy of the country plays an important role as a supplier of food, fodder and technical products, such as fish meal and fat, fodder for fur farming, agar-agar, and various biologically active substances. In the total balance of animal protein consumption, the share of fish proteins is about 10%, and in the meat-and-fish balance - about 25% [10].

The reservoirs of the Saratov region are inhabited by 68 species of fish. A significant variety of species composition is characteristic of the Volgograd and Saratov reservoirs [3].

According to the Saratov branch of the FGBNU "GosNIORH", the industrial use of reservoirs in the Saratov Volga region is characterized by unevenness; intensive development of reservoirs of the Trans-Volga region was observed from 2000

to 2011. The industrial catch of fish in 2011 was 406.7 tons, which is 8 times more than in 2000 (50 tons). Significantly increased and amateur fishing, reaching 55.6 tons. The development of the total allowable catch of aquatic biological resources was 68%, which is higher than the level of previous years. The specialists explain the results achieved by streamlining the fishery and monitoring the use of quotas [11]. The area of reservoirs of the Saratov Zavolzhye, in which potentially commercial fishing is possible in 2017, is 36 thousand hectares. The value of the total predicted catch in 2017 can be determined in 650 tons of fish; incl. the total allowable catch of aquatic biological resources is 214 tons [11].

## The options for using the fund of small reservoirs and ponds include:

- Integrated use of water-coastal lands, in other words, the cumulative cultivation of commercial fish, waterfowl and plants;
- Paid recreational fishing.

## Results

Directly the practice of pond fish farming in the Saratov region is realized through two economic systems: a full-system (full cycle of fish farming) and a non-complete system (growing or fish planting material or commercial fish), the formation of which directly depends on the amount of capital investments.

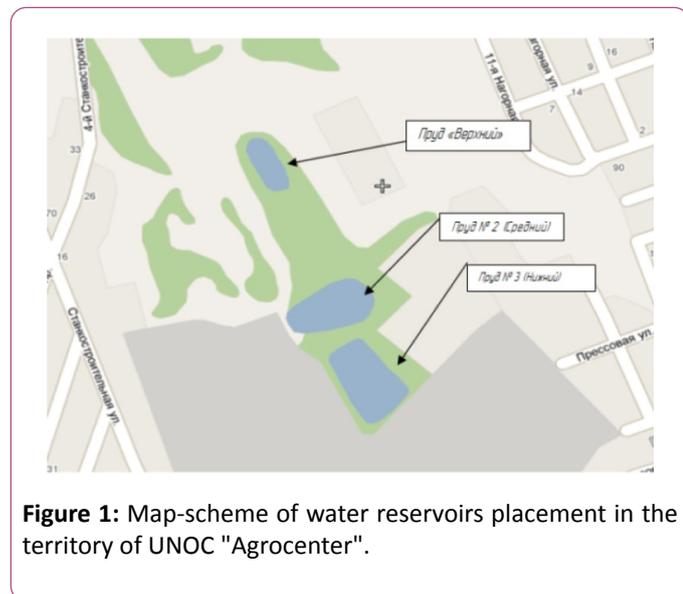
According to the operative data of the Ministry of Agriculture of the Saratov region, 691 ponds with an area of 7.3 thousand hectares are used for the production of aquaculture; more than 290 farms of all forms of ownership are engaged in commodity fish farming. FGBNU GosNIORKh, FGUP Teplovsky Rykopitomnik and Engels Fish Hatchery, which operate 73 ponds with an area of 136.7 hectares, specialize in the production of fish planting material on the territory of the region [12].

The Federal Fishery Agency announced information: in 2016, Saratov enterprises produced 5,025 tons of commercial fish, 2% more than in 2015, 144 tons of fish planting material (1.9 thousand tons of pond fish accounted for by the farms of the Right Bank). The positive dynamics of the volumes of commercial fish and fish-planting material is explained by the involvement in the turnover of unused pond areas, the improvement of the account of pond farms, the implementation of support measures for beginning farmers and the development of family livestock farms [13].

The choice of alternative options for the development of farms is based on indicators of the economic efficiency of creating infrastructure for paid recreational fish farming (carp, trout). Most often, paid recreational fish farming is an incomplete system of farming type. Planned calculations of investment attractiveness were applied to the farm, which includes three ponds in the territory of the city of Saratov (reservoirs of UNOC "Agro center" in Saratov) (**Figure 1**).

The main morphometric parameters characterizing the reservoirs were determined by us according to plans by the

mapping method, refined by field measurements and depth measurements are presented in (Table 2).



**Figure 1:** Map-scheme of water reservoirs placement in the territory of UNOC "Agrocenter".

**Table 2:** Basic morphometric and hydrological characteristics of the ponds of the UNOC "Agrocenter".

Index	Water object		
	Upper	Average	Lower
Area of water area (hectares)	0,17	0,54	0,61
Depth average (m)	2,5	2,6	2,8
Volume (m <sup>3</sup> )	4,1	13,5	17,1

## Discussion

Investment funds amounted to 1806,200 rubles, including the cost of pontoons, tools and tools, a modular prefabricated building, a car. Using the classical method of calculation (Methodological recommendations for the evaluation of the efficiency of investment projects approved by the Ministry of Economics of the Russian Federation, the Ministry of Finance of the Russian Federation, the State Committee of the Russian Federation for Building, Architectural and Housing Policy of 21.06.1999 No. VK 477), the payback period was 3 years and the profitability index 1.81, which in turn confirms the approval of the effectiveness of the development of paid recreational fish farming (carp, trout) within the farm [14,15].

## Conclusion

At the same time, recreational fish farming directly depends on the good condition of the entire complex of structures on ponds and small reservoirs. It should be taken into account that some of the waterworks of these reservoirs do not have a service operation; they have not been repaired for decades. Some of the dams are in a dangerous state and require major overhaul of dams and spillways. Accordingly, the formation of the economic system of fish farming will partially remove the

issues of ensuring the proper operation of the fund of small reservoirs and ponds.

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