Methodology for cadastral valuation of agricultural lands occupied by water bodies

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Abstract. The article considers features of cadastral valuation of agricultural lands occupied by water bodies. The research is based on natural water bodies of the Samara region water fund. A methodology for determining the cadastral value of agricultural lands occupied by artificial water bodies is proposed. The methodology links the land value with the size of the land plot, profit and such objects as dams and other hydraulic structures located within the land plot. The paper confirmed the suggestion that the owner of the land that shall be used for the construction of a pond has the right to the added value of land in the amount of return rate of contributed capital (26.28%). The cadastral value of 1 square meter of agricultural land is 3.11 rubles.

1 Introduction

The fourth type of permitted use of land plots includes agricultural lands occupied by water bodies and used for entrepreneurial activity [1, 2]. Water bodies refer to artificial ponds and impoundments [3]. Natural water bodies refer to the water fund of the Samara region.

In the rural real estate market, only ponds and impoundments that can be used for fish and game farming are traded. These objects are already stocked when sold and have supporting infrastructure. These objects should be considered with respect to business, which contradicts to the purposes of the assessment because business is associated with additional investments not related to the initial acquisition of land and dam construction [4-8].

The cost of these objects ranges from 20 to 50 rubles per square meter of the water surface.

Serviced lands adjacent to water bodies or villages and located 30-40 km from the city cost even more, considering that they can be used for the construction of houses or recreation centres. The cost of these lands ranges from 50 rubles to 200-250 rubles per square meter. In a case such as this not only a land plot is being sold but also a possibility of housing development and reclassification of land. This speculative (subjective) markup should be excluded from the calculations, which is hard to do [9-14].

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2 Methods and Materials

The procedure for calculating the value of land plots of the fourth type of permitted use is similar to the procedure for calculating the value of land plots of the third type of permitted use (lands occupied by manufacturing facilities), however, in this case, the land value is not influenced by the distance factor and population in the municipal district [5, 15-17].

Selling land for construction of a pond or an impoundment, the owner can claim a part of the profit that emerges from the synergistic effect by adding the land to improvements (in this case - dams). Equitable distribution of profit from the joint use of assets can be estimated based on the contribution to the joint affair [18-20]. This proposition can be confirmed by the calculation of the value of a typical fish pond.

3 Results and Discussion

When calculating the dam value, it must be taken into account that carp pond dams are usually earthen dams. They are constructed across the river bed, ravines, draws or flood lands. Impoundments and the majority of finishing ponds are constructed by damming the river bed of a small river or a stream, ravine, draw, or a hollow in the narrowest yet suitable for construction place. The impoundment dam is the largest and most expensive construction of the pond fish culture.

The width of the dam crest (the upper part) should be at least 1-2 meters; if the dam is meant for traffic, it should be 3.5 meters in width and more. The dam should be 0.5-1 meters higher than the flood level, and for impoundments - 1.5-2 meters higher.

The toe of the upstream slope is usually twice or three times larger than its height. The toe of the downstream is usually only 1.5-2 times higher.

The most common type of dam construction is a contour dam. The cross-sectional area of this dam can be calculated given the depth of the pond of 2 meters at the dam [1]. The average depth of finishing ponds should be 1.3-2.2 meters. Hence given the following geometrical parameters:

- dam height - 3.5 meters
- dam crest width - 3.5 meters,
- dam thickness - 20 meters,

the sectional area of the dam body will be approximately 41 square meters.⁴

The size of the dam (width, length) depends on the required volume of water and the backwater effect.

Table 1. Water bodies of the Samara region.

№	Location	Water-surface area, square meters (approximately)	Dam length, meters	Dam length to pond area ratio	Pond area to dam length ratio
1	Bolsheglushitsky District, 6.5 km to the east of Moksha	900000	540	0.0006	1667
2	Bolsheglushitsky District, 4.5 km to the south-east of Malaya Glushitsa (63:14:0705003:52)	56765	280	0.004932617	203
3	Bolsheglushitsky District, ravin Yagodniy	212280	260	0.001224797	816
4	Bolsheglushitsky District, 5.5 km to the north of Malaya Glushitsa (1 pond) (63:14:0301002:24)	298010	300	0.001006678	993

5	The Samara region, Bolsheglushitsky District, 8750 meters to the north-east of Konstantinovka (63:14:0301002:23)	46506	250	0.00537565	186
6	Bolsheglushitsky District, 2.5 km to the south-east of Karalyk (63:14:0609001:28)	1480000	740	0.0005	2000
7	Koshkinsky District, Srednepravaya Chesnokovka	193800	350	0.001805986	554
8	Kinelsky District, Alakaevka	75200	230	0.003058511	327
9	Krasnoarmeysky District, 1.8 km to the north-east of. Sophinsky (63:25:0605016:23)	365253	330	0.000903483	1107
10	Krasnoarmeysky District, (63:25:1005002:0012)	101205	108	0.001067141	937
	Average			0.002047	879

Using the map of the Samara region, we determined the sizes of dams (± 10 meters) and the water-surface area (± 100 square meters) of several ponds with a typical elongated shape. A part of the objects was identified through the use of an accurate public cadastral map. The results of the measurements are presented in table 1.

To calculate the unit cost of construction of the dam, we used the replacement cost aggregates. According to table 2, the total cost of construction of 1 cubic meter of a dam in the Samara region is 442 rubles including VAT.

Table 2. Initial data for calculation of construction costs.

Object of estimation	Pond dam
Unit of measurement	Cubic meters
Main parameter, units	1.0
Year of construction	2011
The number of the compendium of replacement cost aggregates and the table	Compendium №37, table 7b
Characteristics of the analogue from the compendium of replacement cost aggregates	Earthen dams built by means of hydraulicking, odd jobs, excavation and transportation.
Replacement cost according to the compendium, rubles/units	3.00
Correction factor for a climatic region	1.00
Correction factor for durability	1.00
Correction factor for structural volume	1.00
Other corrections	1.00
The adjusted value of an aggregate, rubles/cubic meters in prices of 1969	3.0
The adjusted value of an aggregate, rubles/cubic meters in prices of 1984 (Decree of the State Committee for Construction of 11.05.1983, ratio - 1.2)	3.60
The adjusted value of an aggregate, rubles/cubic meters in prices of 1991 (Letter of the State Committee for Construction of 06.09.1990 № 14-D, ratio - 1.6)	5.76
Construction and installation works index (1991-the date of estimation) (Index of increase in costs of construction and installation works at the date of the estimation. The data is obtained from the Center for Pricing in Construction)	63.687
An aggregate in current prices, rubles/measurement unit	366.8
Total per object of estimation, rubles	367

Total per object of estimation in terms of 2% unforeseen costs, rubles	374
Total per object of estimation, including VAT (replacement cost excluding wear and tear), rubles	442

With the specific indicator of dam construction cost, we can calculate the dam construction cost in our sample, as shown in table 3.

We can determine the size of the synergistic effect and the potential profit of the landowner by taking the value of occupied land as 1.5 rubles/square meters. We also calculated the potential profit of the owner using the construction return rate of 26.28% [21-23].

Table 3. Cost of dam construction for chosen water bodies of the Samara region.

№	Location	Dam volume, cubic meters	Cost of dam construction, thousand rubles
1	Bolsheglushitsky District, 6.5 km to the east of Moksha	41980	18535.4
2	Bolsheglushitsky District, 4.5 km to the south-east of Malaya Glushitsa (63:14:0705003:52)	2648	1169.1
3	Bolsheglushitsky District, ravin Yagodniy	9902	4371.9
4	Bolsheglushitsky District, 5.5 km to the north of Malaya Glushitsa (63:14:0301002:24)	13901	6137.5
5	The Samara riong, Bolsheglushitsky District, 8.7 km to the north-east of Konstantinovka (63:14:0301002:23)	2169	957.8
6	Bolsheglushitsky District, 2.5 km to the south-east of Karalyk (63:14:0609001:28)	69034	30480.4
7	Koshkinsky District, Srednepravaya Chesnokovka	9040	3991.3
8	Kinelsky District, Alakaevka	3508	1548.7
9	Krasnoarmeysky District, 1.8 km to the north-east of. Sophinsky (63:25:0605016:23)	17037	7522.3
10	Krasnoarmeysky District (63:25:1005002:0012)	4721	2084.3

Hence, the value of the improved land plot is identified as the sum of the land plot value calculated based on the value of surrounding land and the additional cost arising from the synergistic effect of investments into property. Therefore, we confirmed the assumption that the owner of the land that shall be used for the construction of a pond has the right to the added value of land in the amount of return rate of contributed capital, which is 26.28%.

Table 4. Calculation of land owner's profit and market value of the land occupied by pond.

№	Location	Value of the land plot occupied by a pond, thousand rubles	Total cost of construction of a water body, thousand rubles	Potential profit of investor, thousand rubles	Land owner's profit share, thousand rubles	Market value of the land plot occupied by a pond, rubles
1	Bolsheglushitsky District, 6.5 km to the east of Moksha	1350.0	19885.4	5225.9	354.8	1.89
2	Bolsheglushitsky District, 4.5 km to the south-east of Malaya Glushitsa (63:14:0705003:52)	85.1	1254.2	329.6	22.4	1.89
3	Bolsheglushitsky District, ravin Yagodniy	318.4	4690.3	1232.6	83.7	1.89

4	Bolsheglushitsky District, 5.5 km to the north of Malaya Glushitsa (1 pond) -63:14:0301002:24	447.0	6584.5	1730.4	117.5	1.89
5	Bolsheglushitsky District, 8.7 km to the north-east of Konstantinovka (63:14:0301002:23)	69.8	1027.5	270.0	18.3	1.89
6	Bolsheglushitsky District, 2.5 km to the south-east of Karalyk (63:14:0609001:28)	2220.0	32700.4	8593.7	583.4	1.89
7	Koshkinsky District, Srednepravaya Chesnokovka	290.7	4282.0	1125.3	76.4	1.89
8	Kinelsky District, Alakaevka	112.8	1661.5	436.6	29.6	1.89
9	Krasnoarmeysky District, 1.8 km to the north-east of. Sophinsky (63:25:0605016:23)	547.9	8070.2	2120.8	144.0	1.89
10	Krasnoarmeysky District, plot 63:25:1005002:0012	151.8	2236.1	587.6	40.0	1.89

The share of land in the total value of the object - 0.0679;

The share of the landowner's profit, rubles/square meter - 0.39.

The equation for the value of land occupied by a water body used for fish farming is as follows:

$$C_{wat.} = C_{surr.} \cdot 1.2628 \tag{1}$$

Table 5. Determination of the cadastral value of land occupied by water bodies of the Bezenchugsky District of the Samara region.

Number of the land plot	Permitted use	Area, square meters	Unit cadastral value of a vacant land plot, rubles/square meters	Enterprenuer's profit, %	Unit cadastral value of land occupied by a water body, rubles/square meters	Cadastral value of the land plot, rubles
63:12:0708005:13	For pond	574	2.46	26.28	3.11	1783.12
63:12:0708005:14	For pond	1020	2.46	26.28	3.11	3168.62
63:12:0708005:15	For pond	339	2.46	26.28	3.11	1053.10
63:12:0708006:4	For pond	12764	2.46	26.28	3.11	39651.21
63:12:0708006:88	For pond	341068	2.46	26.28	3.11	1059523.65

According to table 4, the market (cadastral) value of the surrounding land can be obtained from the results of the valuation of lands of the first type of permitted use. The unit cadastral value is chosen for the evaluated land plot. Usually, it is chernozem soil under the fishing pond, which is very fertile and contributes to the productivity of the pond. Table 5 contains

the calculations of the cadastral value of lands occupied by water bodies for several districts of the region.

4 Conclusion

The proposed methodology links the land value with the objects located within the land plot (dams and other hydraulic structures). In addition, the evaluation uses the cadastral value and size of the adjacent land plot and the entrepreneur's profit. The unit cadastral value of 1 square meter of agricultural lands is 3.11 rubles.

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