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## On the issue of assessing the value of agricultural land in the region based on its economic potential

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**Abstract.** This paper presents a study of the possibilities of using statistical indicators of the functioning of the agricultural sector of the region's economy to estimate the value of agricultural land resources. The emerging market of agricultural land in the Russian Federation is characterized by a small number of annual transactions; therefore, the assessment of the value of land at the territorial and regional level based on the mechanisms of supply and demand is extremely difficult. To substantiate the tax base of land tax and (in some cases) the rent amount, the cadastral value of land plots is used, which is determined by the results of the state cadastral valuation of agricultural land. The methodology for cadastral valuation is debatable, since it does not provide for surveys of specific land plots; at the same time, it relies on indicators of soil quality. Therefore, its results may not be relevant, because they do not take into account important elements of economic fertility. The purpose of this study is to develop a methodological approach for estimating the value of land, which makes it possible to reflect the real economic potential of agricultural land in the region. This approach is based on the method of direct capitalization of the specific conditional net income calculated on the basis of statistical reports of agricultural producers. The methodology was tested on data from the Voronezh region, as a result of which the authors' differentiation of municipal districts was formed according to the estimated value of agricultural land. According to the results of a comparative analysis, it is recommended to consider the issue of the advisability of changing the current methodology for assessing the value of agricultural land.

### 1. Introduction

Currently, the cadastral value of agricultural land in the composition of agricultural land in the Russian Federation is carried out in accordance with the requirements of the Federal Law on State Cadastral Valuation of July 03, 2016 No. 237-FZ, the Federal Law on Valuation Activity of July 29, 1998 No. 135-FZ, Federal Appraisal Standards (mandatory for use by subjects of appraisal activities, approved by the Orders of the Ministry of Economic Development of Russia of May 20, 2015 No. 297, 298, 299, of October 22, 2010 No. 508), Guidelines on State Cadastral Valuation (approved by the Order of the Ministry of Economic Development of the Russian Federation of May 12, 2017 No. 226).

According to the latter, agricultural land belongs to the land plots of the market segment of the "Agricultural Use" real estate, and their cadastral value is determined by capitalizing the land rent,



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calculated “as the difference between gross income and the cost of cultivating and harvesting agricultural products” [1]. In the 2010 “Guidelines,” agricultural land was classified as agricultural land of the 1st group (suitable for arable land, hayfields and pastures occupied by deposits, perennial plantings, etc.), the cadastral value of which was determined based on the capitalization of land rent, calculated in the form of the difference in specific indicators of gross income, the cost of cultivation and harvesting of products, the cost of maintaining soil fertility and entrepreneur profits [2]. The calculation of gross income and production costs in both methods is based on the determination for each soil variety of the estimated site: the most effective crop rotation, taking into account agro-climatic conditions; normative levels of crop yields included in the crop rotation; estimated prices of selected crops; estimated unit costs for the cultivation and harvesting of crops. Forecasted sales prices are recommended to calculate on the basis of the annual average of the market prices of agricultural products, developed over a three-five year period preceding the year of the determination of the cadastral value, projected cost levels are based on the basis of standard routings and average prices for the resources in the same period.

Thus, the basis of the modern cadastral assessment of agricultural land in the Russian Federation is the principle of the formation of land rent, mainly due to soil fertility of specific land plots. The standard productivity directly depends on its level, indirectly - the structure of land use, the size of unit costs. Perhaps the closest to the land rent indicator calculated in this case is the differential land rent I, which is formed due to differences in fertility and the location of land plots. At the same time, putting soil fertility as a key mechanism for assessing the cadastral value of agricultural land is criticized [3–9] for several reasons.

First, most of the fertility indicators used in the calculations, in fact, are indicators of soil quality. According to clause 9.2.2.1.3, these include “the content and thickness of the humus layer, the content of physical clay, the degree of erosion, gleying, alkalinity, salinity, light grain size distribution, etc.” [1]. At the same time, as noted by V. Macht and V. Rudi, “... the objective basis of fertility is not only the qualitative composition of the soil, but also the modern level of agricultural technology and the economic conditions of using the soil in the region” [3, p. 107], which are taken into account very indirectly in the methodology of the state cadastral valuation of land (SCVL) at the planning stage of the specific values of income and expenses. According to R. R. Yarullin, the subject of land valuation should be its “productive, technological and spatial properties ... that determine economic fertility, ease of processing, use and location (generally characterized as use value), and causing differences in productivity and labor costs per unit area ... in agriculture” [5].

Secondly, the method of calculating the normative yield of agricultural crops used in the state cadastral assessment of land raises questions [10]. It is based on taking into account the standard yield of grain crops on the reference soil (33.2 centners per hectare), the coefficient of conversion of yield with intensive cultivation technology (1.4), which, according to some authors, do not have sufficient scientific substantiation [3]. The value of the local agroclimatic potential (ACP) used in the formula is an integral indicator of the sum of active temperatures, the coefficient of moisture and the coefficient of climate continentality [10], which does not allow to take into account the levels of sensitivity and demanding of crops to moisture and solar radiation in different periods of the growing cycle, as well as the difference in the quality of the resulting products, which is an important component of the economic fertility of agricultural land. Correction factors for the content of humus in the arable layer, the thickness of the arable layer, the content of physical clay, and the negative qualities of the soil are called “individual, unprofessional” [3].

In addition, according to the authors, the following shortcomings can be noted in the applied SCVL methodology:

1. Most of the data on qualitative indicators of agricultural land in terms of land differences was collected more than 20 years ago, which, under conditions of transformation of the economy, accompanied by predatory use of land resources in some territories, and agrarian neglect on others, means the inevitable obsolescence of the initial base of assessment soil fertility.

2. Using information from databases of the state cadastre, the relevance of which can be questioned (more on this: [11, 12, 13]).
3. The results of applying the methodology for determining the optimal set of crops, according to which the standard gross income of a land plot is assessed, often differ significantly from those of the actual sectoral structure of a territory [10, 11, Appendix 4] in accordance with the practical guide [10], do not provide for the cultivation of sugar beet in the Olkhovatsky region and sunflower in the Kashirsky district, which contain some of the largest and most modern sugar and sunflower oil production in Russia. But in them the proportion of potatoes is large, which in the commercial sector of the agrosphere of these territories is produced in small quantities.
4. Methods for calculating gross income very indirectly take into account the income received by farmers in the livestock industry. As a rule, a typical crop rotation includes one or two forage crops, the composition of which and the share in the structure of the acreage do not correlate in any way with the needs of a specific territory in their own feed. The resulting feed products are included in gross income almost at cost. Currently, livestock has become a leading agricultural sector in a number of regions of the country, actively reformatting the structure of crop production.
5. Adequate calculation of differential land rents is objectively difficult due to the complex and diversified nature of agricultural production and the innovative nature of economic development. According to the authors, each of the three competing structures of the commercial sector of the agrosphere – agricultural holdings, independent agricultural organizations, peasant (farmer) farms – generates various specific indicators of rents, the comparison of which seems to be incorrect due to the predominance of a particular structure in certain territories of the region. In addition, the rapid spread of innovation in agriculture contributes to the transformation of the II differential land rent into the I differential land rent at the moment when the threshold level of technology diffusion is overcome.

The presence of a large number of contradictions in the methodology of the official assessment of the value of agricultural land resources and the controversial nature of its individual elements determines the relevance of the chosen research topic in the emerging land market in our country. As a hypothesis of the study, it is assumed that the methods of state cadastral valuation of agricultural land used in Russia do not reflect its true, “consumer” value, as well as an adequate differentiation of its value at the territorial level. In accordance with the accepted hypothesis, the purpose of this study is to develop a methodological approach for estimating the value of land, which makes it possible to reflect the real economic potential of agricultural land in the region. In accordance with the designated purpose, the following tasks are supposed to be solved, which logically determine the research structure:

1. Scientific substantiation of the methodological approach for assessing the value of land that does not require a direct account of the quality indicators of specific land plots;
2. Description of the functional dependence of the final indicator of the value of land on the indicators of the structure of agricultural production, standard prices and costs;
3. Testing the proposed methodology for the data of the region with differentiation by municipal areas.

## 2. Methods

As the main approaches used in world practice in the assessment of the value of agricultural land, allocated profitable, comparative, and costly approaches. The methods developed in the framework of the income approach are based on the evaluation and subsequent capitalization of certain elements of the income received in the process of the targeted use of land. Among them we can conditionally distinguish qualitative, statistical, and mixed.

The methodical approach used in this study for estimating the value of land refers to statistical. His choice is motivated by the following prerequisites:

1. The authors suggest that there is a direct and fairly close correlation between the qualitative properties of land and the specific production of agricultural products; therefore, the assessment of the value of agricultural land, based on a statistical analysis of production, will largely take into account quality indicators.
2. The authors believe that the methods of agricultural use for agricultural purposes used in our country may distort the true value of land and its territorial differentiation for the reasons stated earlier.
3. The authors believe that determining the value of land based on the cadastral method of accounting is difficult, labor-intensive, and costly due to the large variety of soil types and qualities, as well as due to the over-complexity of the methodology used for the economic assessment of quality indicators.

The proposed methodological approach is based on the following assumptions:

1. The impossibility of an acceptable measurement of land rent indicators due to the complex nature of agriculture, its diversified structure, the innovative nature of development, the various investment stages of agricultural producers. It is proposed to estimate the value of agricultural land by capitalizing the specific conditional net income calculated using the average regional levels of selling prices and the cost of key types of agricultural products, which allows to substantially reduce the impact on the calculations of the II differential land rent.
2. The impossibility of direct accounting of livestock products in determining the value of land due to the increasing level of industrialization of this industry. Virtually, all large pig and poultry enterprises in developed agrarian regions of Russia are rather weakly tied to the territory in which they are located as the source of food supply, since concentrated feed prevails in the diet. In addition, production cycles in livestock industries can be carried out in different areas, as a result of which there can be a distortion of the land value estimate in those areas where production is completed.
3. The possibility of indirect accounting of the impact of livestock industries on the value of agricultural land by assessing the proportion of forage crops. Placing fodder crops on arable land assumes that as a result of their use, the producer expects to receive in one form or another an income that is at least adequate to the alternative from placing commercial crops on the same area. Therefore, the contribution of fodder crops (hence, livestock industries) to the assessment of the value of land can be taken into account by extrapolating the conditional net income received from marketable crop products to the area under crops of forage crops.
4. In order to take into account the value of agricultural land due to the fact that the plots of land on which it is produced, the inadmissibility of accounting for products produced in households has a different set and structure of cost-forming factors. In addition, the majority of households are predominantly non-marketable; therefore, the use of the category of net income to estimate the value of such lands would be unreasonable.
5. The admissibility of the use of price levels and the cost of products produced in agricultural organizations (AOs) to estimate the net income generated in peasant (farmer) farms (PFF) due to incomplete statistics on the latter.

It is proposed to make an estimate of a unit cost of agricultural land on average in the  $i$ -th municipal district ( $Z_i$ , rubles / sq. m) using the direct capitalization method:

$$Z_j = \frac{u_j}{r} \quad (1)$$

where  $u_j$  is the specific conditional net income in the agricultural production of the  $i$ -th municipal district, rubles / sq. m;  $r$  is the net income capitalization ratio.

The value of the specific net income is calculated as the difference from the division of the total net income in agricultural production ( $U_i$ , rubles) by the area of agricultural land in the  $j$ -th metropolitan area ( $S_i$ , ha.):

$$u_i = \frac{U_i}{S_i} \div 100000 \quad (2)$$

The calculation of the total conditional net income in agricultural production for the  $i$ -th municipal district is carried out according to the formula:

$$U_i = \frac{V_i T_i}{T_i - F_i} \quad (3)$$

where  $V_i$  is the estimate of the average annual gross income in crop production of agricultural organizations and peasant farms in the  $i$ -th municipal district for the period under review, rub.;  $T_i$  is the average annual area of crops of agricultural organizations and peasant farms in the  $i$ -th municipal district for the period under review, ha;  $F_i$  is an average annual crop area of forage crops by agricultural organizations and peasant farms in the  $i$ -th municipal district for the period under review, ha.

Estimated average annual gross income in crop production is calculated as:

$$V_i = \frac{1}{tn} \cdot \sum_{h=1}^t \sum_{j=1}^n Y_{hji} (p_{hj} - c_{hj}) \quad (4)$$

where  $t$  is the number of years included in the period under review;  $n$  is the number of crops by which gross income in crop production is estimated;  $Y_{hji}$  is the gross yield of  $i$ -th crop in the  $h$ -th year by agricultural organizations and peasant farms on  $i$ -th municipal, t;  $p_{hj}$  is an average selling price of  $i$ -th crop products in the  $h$ -th year across the region, rubles / ton;  $c_{hj}$  is the average cost of production of the  $i$ -th culture in the  $h$ -th year in the region, rubles / ton;

The proposed methodology was tested on the data of the Voronezh region in the context of municipal districts for 2012-2014, so that the obtained result was comparable with the result of the Report on the definition of cadastral value No. 36-CXH-2016 [11], where this particular time period was used. Baseline data on the area of agricultural land, area of crops, including the feed in the context of the municipal districts of the region are presented in Table 1.

The gross income was estimated on the basis of data on the production, price, and cost of 9 key commercial crops of the region: winter wheat, spring barley, corn for grain, other grains, sunflower, soybean, sugar beet, potatoes, and open-ground vegetables (Table 2). Estimation of the average annual net income is presented in Table. 1.

As the net income capitalization ratio, it is proposed to use the refinancing rate of the Central Bank of the Russian Federation, which was 8.25% on 01.01.2015. According to the authors, the use of the refinancing rate is sufficient to adequately model the risk-free return on alternative investments.

**Table 1.** The data for calculating the estimated value of agricultural land in the Voronezh region on average for 2012-2014 [12, 14, 15].

No	Municipal district	Area code	Area of agricultural land, thousand hectares	The area of crops in agricultural enterprises and peasant farms, thousand hectares	Area of forage crops, agricultural and agricultural holdings, thousand hectares	Annual gross income in crop production, million rubles.	Average annual costs in crop production, million rubles.	Annual gross income in crop production, million rubles.	Total conditional net income, million rubles.
			$S_i$	$T_i$	$F_i$	$\Sigma Y_p$	$\Sigma Y_c$	$V_i$	$U_i$
1	Anninsky	ANN	156.1	106.6	17.9	2813	1984	829	997
2	Bobrovsky	BOB	140.0	96.0	19.8	2065	1491	575	724
3	Bogucharsky	BOG	154.9	85.9	7.5	1027	734	293	321
4	Buturlinovsky	BUT	123.8	89.1	11.3	1570	1095	475	544
5	Upper Mamon	VMA	86.2	61.3	9.7	859	605	254	301
6	Verkhnekhavsky	VHV	81.9	59.2	1.5	1397	1009	388	398
7	Vorobievsky	VOR	90.6	62.9	5.1	1252	874	378	412
8	Gribanovsky	GRI	116.2	80.5	3.3	1769	1249	520	543
9	Kalacheevsky	KAL	156.7	103.3	16.3	1564	1064	500	593
10	Kamensky	KAM	73.8	37.6	11.9	587	410	177	259
11	Kantemirovsky	KAN	189.0	118.6	18.3	1838	1289	550	650
12	Kashirsky	KAS	78.2	63.3	5.8	1431	1045	386	425
13	Liskinsky	LIS	135.4	90.8	38.6	1691	1226	465	809
14	Nizhnedevitsky	NDV	86.5	56.1	3.4	1314	951	363	386
15	Novousmansk	NUS	78.4	52.0	5.1	1245	898	347	385
16	Novokhopersky	NHP	154.2	85.2	5.0	1576	1116	460	488
17	Olkhovatsky	OLH	78.6	47.9	7.5	963	689	275	326
18	Ostrogzhsky	OST	106.1	62.5	6.3	1211	874	338	375
19	Pavlovsky	PAV	116.2	80.7	14.4	1334	937	397	483
20	Paninsky	PAN	110.3	77.5	3.8	1995	1416	579	608
21	Petropavlovsky	PET	116.3	79.1	4.2	952	678	274	289
22	Povorinsky	POV	77.9	52.2	1.6	951	669	282	292
23	Podgorenskiy	POD	117.0	62.6	12.1	1091	759	331	411
24	Ramonsky	RAM	64.5	43.6	9.1	843	624	219	277
25	Repyevsky	REP	70.4	47.1	3.7	1003	726	277	300
26	Rossoshansky	ROS	177.0	114.0	22.1	1839	1309	530	658
27	Semiluksky	SEM	106.5	78.4	4.2	1557	1105	452	477
28	Talovsky	TAL	146.3	103.6	13.3	2086	1490	596	684
29	Ternovsky	TER	103.3	74.4	4.6	1768	1242	526	561
30	Chokholsky	HOH	91.2	60.9	14.0	1479	1042	437	567
31	Ertilsky	ERT	113.7	83.7	6.4	2008	1430	578	626
33	Borisoglebsky u.d.	BOR	83.3	60.0	1.1	908	652	256	261
	Total area	VRN	3580.5	2376.7	308.9	45987	32683	13304	15429

**Table 2.** The average selling price and cost of crops in the Voronezh region in 2012-2014, rubles / ton (calculated on the basis of [11]).

Culture	Price			Cost price		
	2012	2013	2014	2012	2013	2014
Winter wheat	7191	6162	6769	5186	4786	4552
Spring barley	6849	6261	5025	4945	5131	4317
Corn for grain	6708	4847	6026	4428	4375	5314
Other cereals	6622	6760	6854	5231	6021	5652
Sunflower	14107	11596	13507	7821	7378	8316
Soy	14566	15503	17014	10826	13097	17285
Sugar beet	1460	1713	2039	1043	1165	1244
Potatoes	6519	7275	11247	6203	5799	7139
Vegetables	4556	6913	9028	5095	5733	6915

For the purpose of analyzing and comparing the initial data and the results of the research, the standardization (rationing) method of data was used, which allows to go from the initial values with different units of measurement to dimensionless values with zero expectation and zero dispersion. The standardized value of the k-th value of the variable X is calculated as:

$$\hat{X}_k = \frac{X_k - \bar{X}}{\sigma} \quad (5)$$

where  $\bar{X}$  is an average value of variable X, and  $\sigma$  is the standard deviation of the variable X.

To determine the number of intervals (n) when grouping the data obtained, the Sturges's formula was used:

$$n = 1 + 3,322 \lg(N) \quad (6)$$

where  $N$  is the number of grouped objects.

### 3. Results

The results of evaluating the specific cost of agricultural land, obtained as a result of testing the proposed methodology on the data of the Voronezh region for 2012-14, are presented in Table 3.

On average, in the region this estimate was 5.22 rubles / ha, which is 9.5% lower than the specific cadastral value of agricultural land of 1 type of use, approved by the Government of the Voronezh Region as of 01.01.2015 [13]. In view of differences in the applied methods, the authors consider this value to be a completely acceptable deviation; however, they admit that it may indicate an underestimation of the costs of agricultural producers in the methodology used in the implementation of the state cadastral valuation of agricultural lands in the Voronezh Region. As practice shows, the indices of unit costs calculated on the basis of technological charts are often lower than real ones due to the underestimation of the level of general and general production costs, as well as the cost of repairs and depreciation of agricultural equipment, the actual species and age structure of which cannot be estimated at the regional level. In addition, typical crop rotations for a number of municipal districts of the Voronezh Region, set out in the State Report on SCVL [11], do not provide for the cultivation of sugar beet, which has the highest unit costs among the cultures of the region.

**Table 3.** Estimation of the unit cost of agricultural land in the Voronezh Region on average for 2012-2014.

No	Municipal district	Area code	Specific conditional net income, rub. / sq. m	Estimation of the unit cost of farmland, rubles / sq. m	For comparison				
					Specific cadastral value (FPC), RUB / sq. m		Agriculture products on Wednesday for 2012-14, thousand rubles / ha	Gross margin on Average for 2012-14, thousand rubles / ha	Score of bonitet
					On January 1, 2015	On January 1, 2010			
			$u_i$	$Z_i$					
1	Anninsky	ANN	0.64	7.74	8.22	7.26	26.6	2.7	82
2	Bobrovsky	BOB	0.52	6.27	6.51	5.77	33.2	2.6	76
3	Bogucharsky	BOG	0.21	2.51	2.88	2.57	8.2	1.0	57
4	Buturlinovskiy	BUT	0.44	5.32	6.07	5.61	17.7	0.6	78
5	Upper Mamont	VMA	0.35	4.24	3.72	3.42	13.6	1.2	62
6	Verkhnekhavskiy	VHV	0.49	5.89	8.81	8.17	34.5	3.4	88
7	Vorobievskiy	VOR	0.45	5.51	5.90	5.44	16.3	0.9	76
8	Gribanovskiy	GRI	0.47	5.66	6.04	5.51	15.7	6.1	76
9	Kalacheevskiy	KAL	0.38	4.59	5.69	4.98	18.3	1.6	71
10	Kamenskiy	KAM	0.35	4.25	4.53	4.05	14.4	1.1	68
11	Kantemirovskiy	KAN	0.34	4.17	4.18	3.65	13.2	0.6	65
12	Kashirskiy	KAS	0.54	6.58	8.10	7.69	28.3	1.5	86
13	Liskinskiy	LIS	0.60	7.25	5.42	4.64	81.4	9.8	70
14	Nizhnedevitskiy	NDV	0.45	5.41	6.66	6.03	36.1	7.7	78
15	Novosmanskoy	NUS	0.49	5.95	7.01	6.49	27.8	4.1	80
16	Novokhoperskiy	NHP	0.32	3.84	4.94	4.64	18.2	1.6	68
17	Olkhovatskiy	OLH	0.41	5.02	2.83	2.76	15.7	-0.5	57
18	Ostrogzhskiy	OST	0.35	4.29	4.85	3.86	17.8	1.1	67
19	Pavlovskiy	PAV	0.42	5.04	4.60	3.99	28.4	3.1	68
20	Paninskiy	PAN	0.55	6.68	8.58	8.12	18.7	1.1	90
21	Petropavlovskiy	PET	0.25	3.02	4.49	3.83	9.7	0.9	66
22	Povorinskiy	POV	0.37	4.54	5.72	5.17	12.9	1.1	71
23	Podgorenskiy	POD	0.35	4.25	3.69	3.17	12.1	2.2	61
24	Ramonskiy	RAM	0.43	5.21	5.77	5.16	37.3	-1.3	73
25	Repyevskiy	REP	0.43	5.16	6.24	5.29	16.6	1.8	72
26	Rossoshanskoy	ROS	0.37	4.50	3.49	3.24	19.4	1.1	62
27	Семилукский	SEM	0.45	5.43	7.41	6.87	16.7	0.4	82
28	Talovskiy	TAL	0.47	5.67	6.99	6.41	19.0	1.0	81
29	Ternovskiy	TER	0.54	6.58	6.88	6.22	19.8	0.9	79
30	Chokholskiy	HOH	0.62	7.54	6.69	6.11	28.1	2.0	77
31	Ertilskiy	ERT	0.55	6.67	8.47	7.90	20.9	4.3	84
33	Borisoglebskiy u.d.	BOR	0.31	3.80	5.23	4.33	10.5	2.3	69
Average over the region		VRN	0.43	5.22	5.77	5.12	22.0	2.1	73

In the structure of crop rotations, silage and haylage crops (the most cost-intensive of fodder crops) and pure steam, whose areas do not produce any products, are practically absent. Taking into account these arguments, it seems fair to the authors that, according to the results of the SCVL, the cadastral

value of agricultural land on the average in the Voronezh region is excessive, which means an excessive tax burden for owners of agricultural land in some areas.

The results of the correlation analysis of indicators for assessing the value of agricultural land in the municipal areas of the Voronezh region are presented in Table 4.

**Table 4.** Correlation matrix of indicators for assessing the value of agricultural land in the Voronezh Region.

<i>Indicators</i>	SICV as of January 1, 2015	SICV as of January 1, 2010	Score of bonitet	Gross output on average for 2012-14 on 1 ha	Gross profit on average for 2012-14. on 1 ha	Estimation of farmland value
SICV as of 01.01.15	1					
SICV as of 01.01.10	0.993	1				
Score of bonitet	0.982	0.986	1			
Gross output on average for 2012-14 on 1 ha	0.278	0.255	0.258	1		
Gross profit on average for 2012-14. on 1 ha	0.233	0.205	0.203	0.660	1	
Estimation of farmland value	0.745	0.744	0.728	0.577	0.373	1

First of all, it should be noted the highest level of closeness of correlation between the series of specific indicators of cadastral value as of 2010 and 2015 ( $r = 0.993$ ), as well as between them and the value of agricultural land ( $r = 0.982$  and  $0.986$ ). Consequently, it can be said that the economic and spatial factors of agricultural production are very poorly taken into account in the value of land according to this method. An indirect proof of this is the weak closeness of correlation with the specific indicators of gross output and gross profit of agricultural organizations in the region ( $r$  in the range of  $0.20-0.28$  with  $p > 0.05$ ).

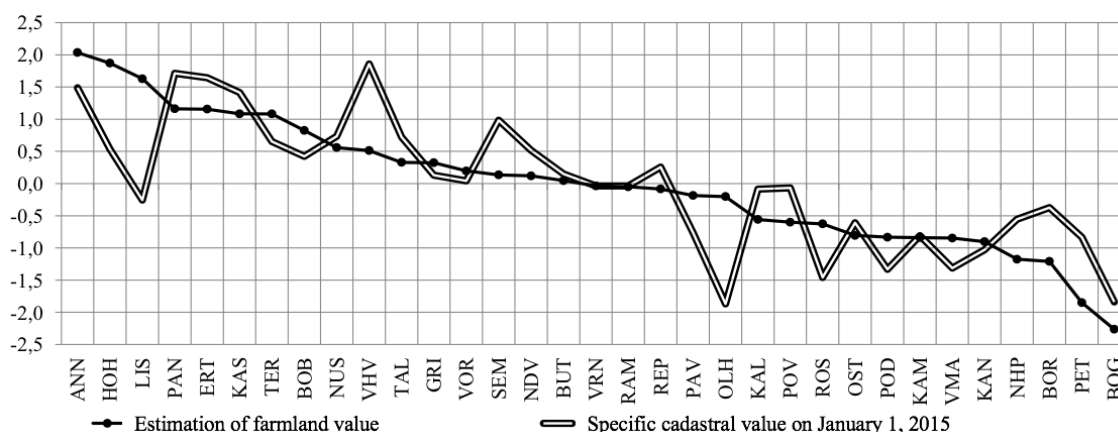
The method proposed in this paper for assessing the unit cost of agricultural land, according to the authors, makes it possible to better take into account the economic and spatial factors of the agrarian sector, despite the significantly smaller calculation volumes and the number of indicators are used. A series of estimates of the unit cost for municipal districts of the Voronezh Region has a strong and significant correlation with a number of bonitet ( $r = 0.728$ ,  $p = 0.000002$ ), which indicates a sufficient degree of consideration for the influence of soil quality. There is a noticeable link with the specific gross agricultural output ( $r = 0.577$ ,  $p = 0.0005$ ) and a moderate link with the specific gross profit ( $r = 0.373$ ,  $p = 0.035$ ). In addition, it should be noted that the indicators of gross output and gross profit are taken “as is”, without clearing the livestock breeding sectors that are not tied to the land (pigs, poultry, fattening cattle in specialized farms). It should also be borne in mind that the gross profit indicator in the districts of the Voronezh region is now seriously dependent on the stages of investment cycles of the largest agricultural producers, whose influence is leveled when calculating the comparable net income underlying the proposed methodology.

The key result of testing the developed methodology, the authors consider a change in the territorial structure of the specific value of agricultural land in the region (Figures 1-2). The most appreciated were the lands located in the northern and central parts of the Voronezh region (Figure 1), where objectively the best agro-climatic conditions are noted. It should also be noted that the highest concentration of highly valued agricultural land is observed in the area of close passage and intersection of federal roads M-4 “Don”, P-298 “Kursk-Voronezh-Kaspiy,” and P-193 “Voronezh-Tambov”, which clearly illustrates the influence of the spatial structure of the region on the level of agricultural development in municipalities.



**Figure 1.** Territorial structure of agricultural land in the Voronezh region according to their unit cost, rubles / sq. m.

Also, the spatial influence is well marked by a decrease in the assessment of the unit cost of agricultural land towards the margins of the region. The lowest level of land value is observed in the southern and eastern regions, which is objectively determined by a combination of agroclimatic, socio-economic, and spatial factors. The change in the territorial structure of the value of farmland is shown more clearly in Figure 2.



**Figure 2.** Comparison of the standardized values of the obtained estimate of the specific value of agricultural land and the specific indicator of the cadastral value of agricultural land of 1 type of use as of 01.01.2015.

Comparison of the standardized values of land obtained as a result of approbation of the proposed methodology and as a result of the SCVL as of January 1, 2015 allows to isolate areas where agricultural land, according to the authors, was relatively underestimated or overestimated. For example, despite the fact that the SICV in the Anninsky district as of 2015 amounted to 8.22 rubles / sq. m. against 7.74 rubles per sq. m. According to the authors' calculations, in relation to the average level in the region, the agricultural lands of this territory were underestimated. The most undervalued land appears in the Khokholsky, Liskinsky, Pavlovsky, Olkhovatsky, and Rossoshansky districts. At the same time, insufficient consideration of economic factors in the SCVL process led to a significant overestimation of the value of agricultural land in the Verkhnekhavsky, Semiluksky, Borisoglebsky, Novokhopersky, and Petropavlovsky districts. There is a general trend of land revaluation in the northern, northwestern, eastern, and southeastern part of the region, and a tendency to underestimate land in the central, southwestern, and northeastern parts.

#### 4. Discussion

According to the authors, the testing of the methodology proposed in this work, in general, confirms the accepted hypothesis that the results of the SCVL do not fully reflect the actual value of land in agriculture and its differentiation at the territorial level. It is shown that the determination of the specific indicators of the cadastral value of agricultural land to the maximum extent based on the indicators of soil quality and assessment of agro-climatic conditions, while almost ignoring the actual sectoral structure of agricultural production, economic, and spatial factors of agriculture. The estimate obtained by the authors for the specific value of farmland is, on average, somewhat lower than the SCVL. However, it differs significantly in its territorial structure, to a greater extent corresponding to the observed specific indicators of gross output and profits in the agricultural sphere.

At the same time, the authors do not claim exclusiveness of the developed methodology for the assessment of agricultural land. The main limitation of the methodology is its mediation: it does not take into account the natural, climatic, soil, and spatial factors that form the value of land directly, suggesting that their influence is to some extent included in the effective indicator calculated on the basis of an assessment of statistical data on the production of main crops by average regional prices and costs. The economic impact of the development of livestock branches spatially related to one or another type of agricultural land is not fully taken into account. The authors deliberately abandoned attempts to allocate and differentiate land rents in order to simplify the study, although it is what is the basis for assessing the value of land under existing legislation. At the same time, the calculation of rent on a land plot, as the difference between gross income and the cost of cultivating and harvesting agricultural products [1] also raises questions.

According to the results of the study, the authors propose to consider the issue of a possible change in the approach currently used to estimate the value of agricultural land for tax purposes and the establishment of rent. According to the authors, it is necessary to abandon the scrupulous consideration of the quality characteristics of land, especially those derived from irrelevant and outdated data. The study shows that the assessment of the specific net income and so allows to take into account a significant degree of their influence on the results of agricultural production. In favor of the simplification of procedures, the SCVL farmland also shows that as the tax base for the calculation of land tax on agricultural land in the municipal district received average values of specific indicators of the cadastral value by type of use. In addition, the assessment of land, by taking into account the specific net income, makes it possible to achieve a more equitable territorial differentiation of the value of land, and consequently, the tax burden, within the region.

On the other hand, it is possible to drastically simplify and cheapen the assessment of the value of agricultural land without losing quality in relation to the results of the methodology used by building a functional model of the dependence of the SICV on the land quality, since these indicators have a very close and significant correlation. From the same standpoint, we can recommend indexing the results of

the previous SCVL based on statistical data on changes in the value of products and agricultural production resources.

## 5. Conclusion

Estimation of the value of agricultural land on the basis of a direct assessment of land fertility seems to be insufficiently adequate in modern economic conditions. The current method of assessment is almost entirely based on the indicators of the qualitative composition of the soil, does not take into account the modern sectoral structure of agriculture in general and crop production in particular, and involves the use of deliberately outdated and irrelevant data. In addition, there are doubts about the validity of the mechanism for calculating the level of fertility on the basis of the used soil and agroclimatic indicators. As a result, a hypothesis has been formed that the current results of the assessment of agricultural land do not reflect its true value, both at the regional and territorial levels.

For a more relevant mechanism for estimating the value of agricultural land, it is proposed to use a methodical approach based on the calculation of the specific conditional net income based on statistical data on crop production, price levels and cost. Income derived in livestock production, which is spatially “tied” to the ground as the source of food supply, is calculated indirectly. Estimation of the specific value of agricultural land is calculated by capitalizing the specific conditional net income using the refinancing rate.

The results of testing carried out on the data for the Voronezh region for 2012-2014 suggest that the proposed method more fully takes into account the economic and spatial factors of land costs, while remaining adequate difference in agro-climatic and soil conditions observed in different parts of the region. The estimate of the average unit cost of agricultural land in the region turned out to be slightly lower than the official one, while at the same time the structure of land value changed significantly.

Considering that the accepted hypothesis is generally confirmed by the results of testing, the authors recommend further consideration of the feasibility of changing the current methodology for estimating the value of agricultural land in order to simplify procedures and obtain relevant results.

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