MODELLING AND ANALYSIS OF COLLECTION OF LAND PAYMENTS IN THE MUNICIPAL AREAS DEPENDING ON ECONOMIC AND GEOGRAPHICAL FACTORS

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Abstract
Taking into consideration all the data of collectibility of land payments (land tax and rent), the dependence of collectibility of land payments on economic and geographical factors is analysed in municipalities of the Samara region. The factors are defined with the help of mathematical methods, which are closely associated with payments growth from the land area of a municipality and the number of residents.
The dependence simulation of the level of land payments on geographical and demographic characteristics has been implemented in a municipality. This model allowed allocating "normative level" for each municipal district which corresponds to the result of the "average area" with given objective characteristics. This assessment allowed the authors to identify the areas with high and low levels of land payments collectibility.
The efficiency assessment of municipality local governments in the Samara region on land management is made taking into consideration objective factors that limit their opportunities.
Key words: land, land relations, management efficiency, land payments, land tax, rents, Samara region.

Introduction

One of the most important objectives of the state policy in the field of sustainable socio-economic development is the involvement of land resources into economic activities and improving the efficiency of their use. Private land ownership in Russia, paid land use, land market development and reforming of taxation system of real estate cause the relevance of efficiency assessment of land management at the level of municipalities (urban and municipal districts) (Voronin et al., 2011; Varlamov, 2014). Effective land management is essential for modern sustainable economy development, as rational land use plays an important role not only in agriculture development, but also in the economic development of the country in general (Taratula et. al., 2015; Baumane, 2016).
One of the criteria for efficiency assessment of land management is to increase the revenues of the federal, regional or municipal budgets. At the local level, this criterion is expressed in the increase of total land payments (land tax and rent) in the municipalities (Galchenko, 2003). Local authorities actively influence the system of land relations in a municipality by issuing regulations that are mandatory for all entities of land relations, as well as performing various socio-economic and economic functions (Vlasov et.al., 2013*)*.
In the Russian Federation the database of the state cadastre of real estate started to be formed and increased (until 2011 it was called the land registry) after the land reform implementation and the emergence of private land ownership in 1990 – 1993. The tax system was changing and increasing together with increasing of database of real estate cadastre that resulted in the growth of land payments collectibility – land tax and rent (Varlamov, 2011).
Land tax is very crucial in the tax system of the Russian Federation as it is a local tax. Therefore, land tax is one of the main sources of filling the budgets of municipalities as well as the source of financial base formation of local authorities. Therefore, the necessity to improve land management efficiency is a key issue in modern conditions.
The aim of the article is the analysis of the dependence of land payments collectibility on economic and geographical factors in the municipalities of the Samara region.
To achieve the aim, the following tasks were set: firstly, to analyse statistics, by the total collectibility of land payments in the municipalities of the Samara region and using various information concerning the municipality (location, total land area of the district, the distance of the territory from the regional capital, number of inhabitants, population density, etc.); secondly, to identify the indicators which influence the volume of land payments; thirdly, to assess the effectiveness of local self-governing authorities of municipalities of the Samara region on land management taking into consideration objective factors that limit their opportunities.

Methodology of research and materials

During the research implementation the methods of mathematical statistics, regression, methods of factor and cluster analysis were used to allocate efficiency levels of municipalities of the Samara region by collectability of land payments, as well as to identify the factors influencing the level and the growth rate of land payments.

Statistical data were analysed on consolidated revenues of land tax and rents on municipalities of the region provided by the Ministry of Finance Management of the Samara region, and the State Tax Inspectorate of the the Samara region. The object of the research was the municipalities of the Samara region (Khasaev et.al., 2016).

Discussions and results

One of the problems arising in the analysis of land payments collectibility by municipalities of the region, is the assessment of the activities of local authorities taking into consideration various factors that limit their opportunities. If one of the districts is significantly ahead of the other one in land payments per unit area, it can be caused by its location, population density, etc. (Konstantinova, 2015). In this case, local authorities do not play a key role. Their efforts in this area can deserve a lower rating in comparison with the second district with adverse objective characteristics (Khasaev et.al., 2016).

There is the problem of separating the influence on land payments collectibility of objective characteristics of a municipality, on the one hand, and quality management of this process, on the other hand (Koryagina, 2008). One of the approaches to its solution is to simulate the dependence of land payments level on geographical and demographic characteristics of the municipality. The construction of such models allows assessing ”regulatory level” for each municipality that corresponds to the result that would ”an average area” have with given objective characteristics. The assessment helps identify areas with high and low levels of land payments collectibility (respectively, ”regulatory level” and below it).

Simulation of this dependence was performed according to the given land payments (per unit area) of twenty-seven municipalities of the Samara region in 2012-2014 (Table 1), and the geographical and economic characteristics of these areas (Table 2).

Table 1

Land payments of the municipalities of the Samara region
(thous. RUB per km^2)

Municipal district	Years			Average over 3 years	Municipal district	Years			Average over 3 years
	2012	2013	2014			2012	2013	2014	
Aleexseevskii	23.0	7.6	8.54	13.0	Krasnoarmeiskii	10.8	10.8	10.4	10.7
Bezenchukskii	16.4	18.4	21.4	18.7	Krasnoyarskii	31.4	33.1	42.3	35.6
Bogatovskii	11.3	12.7	15.0	13.0	Neftegorskii	63.5	55.1	69.0	62.6
B.-Glushitskii	26.6	15.8	12.0	18.1	Pestravskii	27.2	17.6	15.7	20.1
B.-Chernigovskii	15.3	10.6	8.3	11.4	Pochvistnevskii	12.5	14.2	15.5	14.1
Borskii	7.7	8.3	11.0	9.0	Privolzhskii	13.8	11.8	13.9	13.2
Volzhskii	70.0	57.6	83.2	70.3	Sergievskii	20.1	25.8	33.0	26.3
Elchovskii	8.4	9.1	10.4	9.3	Stavropolskii	29.3	30.7	41.4	33.8
Isaklinskii	7.1	10.0	7.8	8.3	Syzranskii	23.2	24.2	29.2	25.5
Kamyshlinskii	41.2	17.2	19.2	25.9	Hvorostyanskii	6.7	7.8	8.0	7.5
Kinelskii	38.0	40.2	41.0	39.7	Ch.-Vershinskii	14.9	15.3	15.3	15.2
K. - Cherkasskii	34.8	40.3	45.4	40.2	Shentalinskii	13.2	12.2	19.2	14.9
Klyavlinskii	22.3	22.9	22.7	22.6	Shigonskii	17.4	20.8	22.6	20.3
Koshkinskii	17.4	14.9	40.0	24.0	TOTAL	623.5	565.2	681.5	623.4

Table 1 shows that in 2013, the volume of land payments fell sharply, and in 2014 it increased again, exceeding the level of 2012 in many (but not all) areas. These effects require further substantial analysis.

Table 2

Characteristics of municipalities of the Samara region used for the analysis of land payments collectibility

Municipal district	Area km^2	Land of village adminis-trations, km^2	Area of inter-settlement territories, km^2	Settlement area, km^2	Population, thous. people	Population density, people per 1 km^2	Number of settlements	Distance to Samara, km
Aleexseevskii	1 891	2548.3	1 827	42	11.6	6.2	28	131
Bezenchukskii	2 020	3712.3	1 690	66	40.9	20.4	49	64
Bogatovskii	824	2798.7	671	49	14.2	17.2	32	93
B.-Glushitskii	2 534	3036.6	2 446	70	19.6	7.6	33	111
B.-Chernigovskii	2 806	2927.9	2 743	40	18.4	6.5	34	144
Borskii	2 103	7378	1 548	95	24.1	11.5	51	122
Volzhskii	2 481	5616.3	2 106	102	84.4	34.8	57	1
Elchovskii	1 201	2992.4	1 086	42	10.0	8.1	39	96
Isaklinskii	1 577	2856.6	1 258	44	12.8	8.1	52	156
Kamyshlinskii	823	1513.1	636	30	11.1	13.4	22	179
Kinelskii	2 104	5703.8	1 649	91	32.4	15.8	63	42
K.-Cherkasskii	2 457	6369	2 127	108	44.9	18.2	50	112
Klyavlinskii	1 256	3108.9	980	48	15.2	12.0	1	211
Koshkinskii	1 647	3684.9	1 418	79	1.0	13.9	82	141
Krasnoarmeiskii	2 129	4386.5	2 030	57	18.7	8.1	43	79
Krasnoyarskii	2 479	5475.3	1 742	98	55.9	22.7	93	41
Neftegorskii	1 408	2585.5	1 302	43	34.0	24.0	19	96
Pestravskii	1 960	4053	1 859	53	18.0	8.8	30	111
Pochvistnevskii	2 105	4703.6	1 444	91	27.9	13.3	80	160
Privolzhskii	1 379	1949.8	1 072	56	24.0	16.6	24	146
Sergievskii	2 756	8977	2 316	108	45.6	16.7	68	136
Stavropolskii	3 662	7349.6	2 602	129	69.4	18.1	52	91
Syzranskii	1 881	4787.2	1 255	38	25.2	15.6	69	138
Hvorostyanskii	1 845	4347.1	1 699	58	15.4	8.6	27	131
C.-Vershinskii	1 162	4341.8	968	62	15.4	13.5	53	186
Shentalinskii	1 338	3340.3	921	68	15.8	11.9	60	189
Shigonskii	2 134	2348.4	1 160	54	20.0	10.1	47	200

To analyse the influence of the factors on the payments' level and simulation of relevant dependencies, the average level of land payments in 2012 - 2014 was used. The coefficients of linear correlation of this average level with different factors, and also factors between them are shown (Table 3).

The calculation of the correlation shows that population density (x_6) and total population (x_5) in the area considerably affect specific land payments (km^2).

We should notice a high level of correlation between the area of the administrative district (x_1) and the area of inter-settlement territories (x_3) therefore the factor x_3 was excluded from the analysis.

Despite the high correlation between the land area of the rural authorities (x_2) and settlement area (x_4) both of these factors were taken into account while constructing the model.

Table 3

Correlation between land payments of municipalities and influential factors

Factor	Coefficients of linear correlation							
	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8
Average land payments for 2012-2014, RUB. per km^2 (Y)	0.249	0.263	0.198	0.380	**0.714**	**0.834**	0.132	-0.519
Area, km^2 (x_1)		0.649	**0.910**	0.683	0.652	0.149	0.367	-0.386
Land of village administrations, km^2 (x_2)			0.522	**0.841**	0.614	0.324	0.531	-0.361
The area of the inter-settlement territories, km^2 (x_3)				0.512	0.504	0.035	0.165	-0.439
The settlement area, km^2 (x_4)					0.721	0.468	0.579	-0.412
Population, thousand people. (x_5)						0.795	0.332	-0.635
Population density, people per 1 km^2. (x_6)							0.283	-0.570
Number of settlements (x_7)								-0.262
The distance to Samara, km (x_8)								

To analyse the dependence of the average level of specific (per km^2) land payments in municipalities in 2012-2014 on seven factors (x_1, x_2, x_4, x_5, x_6, x_7, x_8), three basic mathematical models were built:

- additive linear model of type Y:

$$Y = a_0 + a_1*x_1 + a_2*x_2 + \ldots \quad (1)$$

where Y denotes average land payments for 2012-2014, RUB. per km^2,
a_0, a_1, a_2 denotes factor coefficients determined by regression using the least squares method,
x_1 denotes area, km^2,
x_2 denotes land of village administrations, km^2.

- multiplicative exponential model of type Y

$$Y = a_0 * a_1^{x1} * a_2^{x2} * \ldots \quad (2)$$

Where Y denotes average land payments for 2012-2014, RUB. per km^2,
a_0, a_1, a_2 denotes factor coefficients determined by regression using the least squares method,
x_1 denotes area, km^2,
x_2 denotes land of village administrations, km^2.

- multiplicative power law model of type Y:

$$Y = a_0 * x_1^{a1} * x_2^{a2} * \ldots \quad (3)$$

Where Y denotes average land payments for 2012-2014, RUB. per km^2,
a_0, a_1, a_2 denotes factor coefficients determined by regression using the least squares method,
x_1 denotes area, km^2,
x_2 denotes land of village administrations, km^2.

Figure 1 shows land payments of municipalities in 2012-2014 in comparison with ”typical” level of payments, which was calculated for each district using the specified model. The diagram shows that, despite the same level of payments in Privolzhskii and Chelno-Vershinskii districts, the results of Privolzhskii district is far behind its potential, and the results of Chelno-Vershinskii district fully meet its potential.

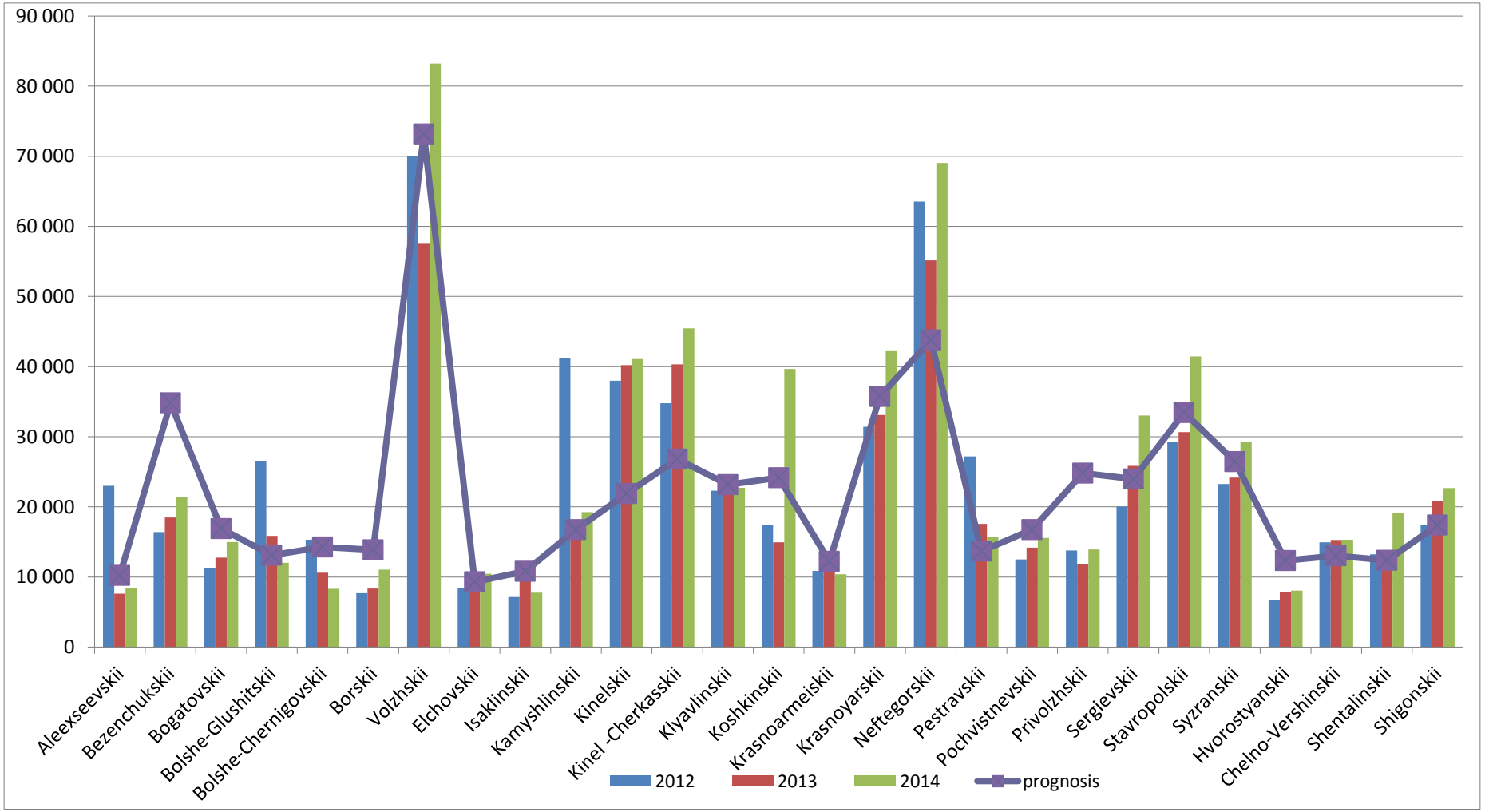

Fig. 1. Specific land payments of municipalities in comparison with the average level for standard models

We can see integral characteristics of the results of applying these models for dependence approximation of average specific land payments on municipality characteristics (Table 4).

Table 4

The results of dependence approximation of specific land payments on municipalities characteristics

The type of model	The coefficient of determination	Correlation of result simulation and the fact	Average absolute percentage deviation of result simulation from the fact
Additive linear	0.754	0.868	32.6%
Multiplicative exponential	0.674	0.821	28.2%
Multiplicative power	0.706	0.840	26.0%

From simulation results given in Table 4 we can conclude that all three models describe the analyzed dependency in details. According to determination coefficient the linear model has turned out to be the best and according to percentage deviation power multiplier is the best one. We chose a multiplicative model power type for further analysis on the basis of the above-formulated main simulation tasks, comparison of municipalities by the efficiency of land payments collectibility. Checking on students t-criterion shows that all the coefficients of the model are statistically significant at a significance of alpha level which is equal to 5%.

Table 5

Analysis of land payments level of municipalities according to approximation models

Municipal district	Deviation of land from the "typical" level, obtained by the approximation model				Rank percentage (relative place) area for land payments collectibility			
	2012	2013	2014	Average for period	2012	2013	2014	Average for period
Aleexseevskii	56%	-34%	-21%	22%	96%	23%	23%	47%
Bezenchukskii	-112%	-89%	-63%	-86%	0%	4%	8%	4%
Bogatovskii	-49%	-33%	-13%	-30%	19%	20%	24%	21%
Bolshe-Glushitskii	51%	17%	-9%	28%	92%	83%	25%	67%
Bolshe-Chernigovskii	7%	-35%	-72%	-25%	69%	17%	4%	30%
Borskii	-81%	-66%	-26%	-54%	8%	5%	14%	9%
Volzhskii	-4%	-27%	12%	-4%	54%	14%	43%	37%
Elchovskii	-11%	-3%	11%	0%	50%	50%	40%	47%
Isaklinskii	-51%	-8%	-39%	-30%	15%	47%	11%	24%
Kamyshlinskii	59%	3%	13%	35%	100%	61%	44%	69%
Kinelskii	42%	46%	47%	45%	85%	100%	100%	95%
Kinel -Cherkasskii	23%	34%	41%	33%	77%	100%	100%	92%
Klyavlinskii	-4%	-1%	-2%	-2%	58%	60%	27%	48%
Koshkinskii	-39%	-62%	39%	-1%	23%	7%	100%	43%
Krasnoarmeiskii	-13%	-13%	-18%	-14%	46%	31%	15%	31%
Krasnoyarskii	-14%	-8%	16%	0%	38%	50%	58%	49%
Neftegorskii	31%	21%	37%	30%	81%	91%	100%	91%
Pestravskii	50%	22%	13%	32%	88%	100%	50%	79%
Pochvistnevskii	-34%	-18%	-8%	-19%	27%	22%	22%	24%
Privolzhskii	-80%	-110%	-78%	-88%	12%	0%	0%	4%
Sergievskii	-20%	7%	27%	9%	31%	71%	86%	63%
Stavropolskii	-14%	-9%	19%	1%	35%	50%	67%	50%
Syzranskii	-14%	-9%	9%	-4%	42%	40%	40%	41%
Hvorostyanskii	-83%	-57%	-53%	-64%	4%	0%	0%	1%
Chelno-Vershinskii	13%	15%	15%	14%	73%	67%	33%	58%
Shentalinskii	7%	-1%	36%	17%	65%	50%	100%	72%
Shigonskii	0%	16%	23%	14%	62%	100%	100%	87%

The table 5 shows the deviation of the level of land payments for each municipality in percentage in 2012-2014 from the calculated potential and the average deviation for the period (Table 5). Positive deviations correspond to the high level of payments (higher than typical), and the negative - to the low one (below ”typical”).

It also shows the percent rank of each district for each year and on the average for the period. If this rank is equal to 100%, the district achieved the best result in the region. And if the rank is 0%, the district has the worst result for the year or period on the average.

Figure 2 shows zones with high and medium levels on the map of the Samara region. A preliminary qualitative assessment of the level of land payments collectibility in municipalities. Thus the municipalities with the rank above 75% (top quarter) are assessed as the districts with high collectibility rates; the districts with the rank lower 25% (lower quarter) are assessed as the districts with low collectibility rates and others with middle collectibility rates.

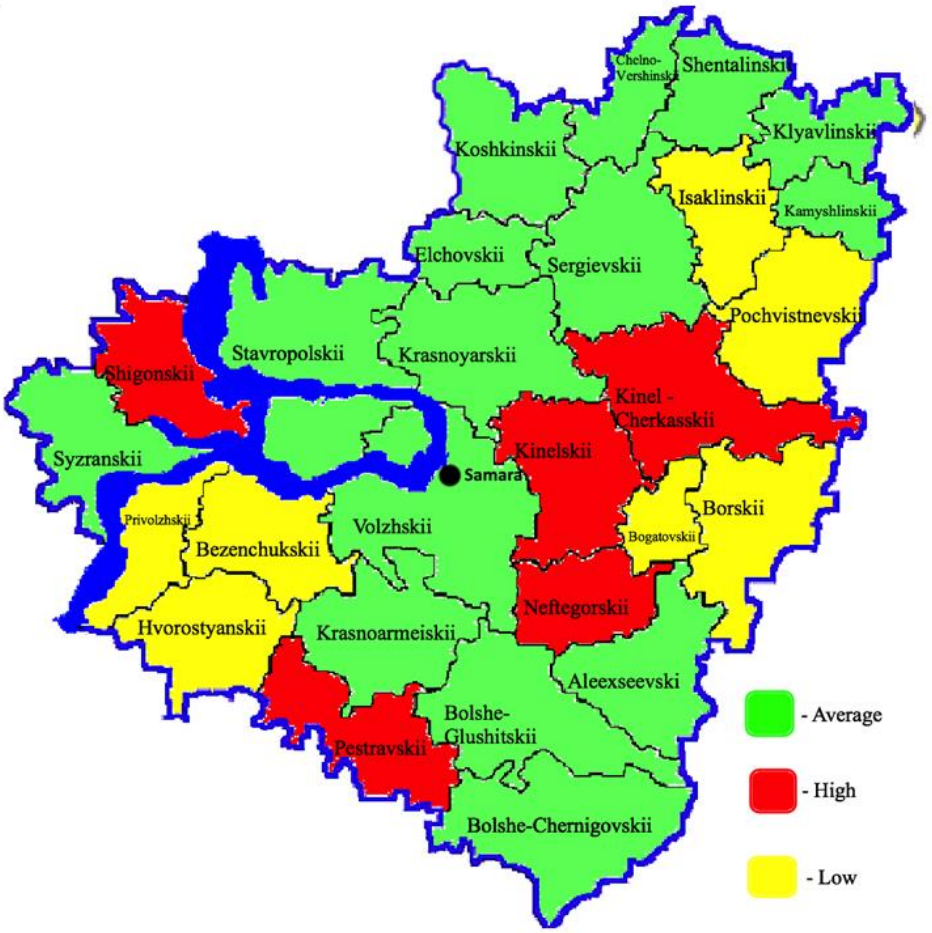

Fig. 2. Distribution of municipal districts of the Samara region by the level of collection of land payments

Of course, to apply the described technique in practice, further analysis is necessary which will take into account more factors and longer periods.

Thus, the issue of efficiency assessment of land management at the municipal level is very important. Land and land relations are one of the defining factors of socio-economic development of the country (Molzhigitova et. al. 2013, Pomelov, 2013). The finances of local budgets are hardly enough for minimal social expenses with the increasing responsibilities of local government, while regional governments are not often able to affect revenue mobilization of their territories. Therefore, more efficient municipal property management is becoming more important. (Khasaev et. al., 2016; Ainur, 2014).

An important issue is land quality accounting for lands taxation of different categories as well as improving the quality of agricultural land. It is necessary to develop measures to ensure rational use of land resources, preservation and increasing of soil fertility, as well as control over the observance of land legislation (Parsova, Cahrausa, 2015).

However, the increase of land payments should be based not only on the change of results of the cadastral assessment, as it occurred in the studied period, but on the involvement of other mechanisms of land management. To improve land payments, the following measures should be taken:

- regular monitoring of the conditions of land resources;
- inventory implementation in order to clarify the boundaries of land sites and other objects of real estate;
- it will enable to correct the database and start the procedure of registration of newly formed land boundaries, to solve the issues with the land rent and buying and as a result increase revenues from land payments (land tax and rent).

Currently, land monitoring is not carried out, which does not allow solving the issue. In addition, despite the fact that at the cadastral assessment all real estate objects are evaluated, registration is implemented according to declarative principle, therefore, the proportion of properties fall out of the tax base.

Conclusions and proposals

According to the results of the conducted research the following conclusions can be drawn:

1. Analysis of statistical data by the total land payments collectibility has shown a steady growth in the studied period, although the growth rate was considerably uneven.
2. Parameters that mostly affect the amount of land payments from the territory of the municipalities in the Samara region are the following: the area of the land fund of the district, the number of population.
3. Taking into account the objective factors that limit management opportunities, efficiency assessment of local self-governing authorities of the municipalities of the Samara region on land management helped identify the areas in which management mechanisms are imperfect and require changes.

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