

Environmental Distribution of Land Plots at Subjects of Russia

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Abstract

It is proposed to identify the hierarchy of the subjects of the federation according to the ecological possibilities of the territory according to places in the ranking according to the sum of the ranks of the fraction of the area of 12 types of land from the land area (total area without land under water). For a scientifically substantiated change in the composition of the territories, it is necessary to identify the patterns of distributions of all types of land in the subjects of the Russian Federation. For this, it should be recognized that the population is not only a person, but also plants (wild and cultivated) and animals (wild and domestic). The article presents trends based on the modified Laplace law (in mathematics), Mandelbrot (in physics), Zipf-Pearl (in biology) and Pareto (in econometrics). The graphs of multiple fractal distribution of the land share according to the modified Mandelbrot law are shown. Due to human intervention, oscillations asymmetric in amplitude and period (wavelet signals) appear in addition to the trend. Together, trend and wavelets give an adequacy in correlation coefficient of more than 0.99.

Key words: Subjects of The Federation, Lands, Area, Share, Patterns

Introduction

Lands systematically used or suitable for use for specific economic purposes and differing in natural and historical characteristics are called land areas [1, 2]. Currently, economic goals are primary. Therefore, anthropocentrism prevails in the use of natural resources. Biological centrism assumes that man, along with others, is a part of nature. From the ecological principle, the article examines the lands of the constituent entities of the Russian Federation. Land resources of Russia according to their suitability for land use are classified as follows [1, 2]: by land categories; by type of land; in terms of quality and ecological condition; by administrative-territorial affiliation; by ownership. The following are distinguished from the structure of land: 1) agricultural land; 2) non-agricultural - types of land that are not used in agriculture.

Farmland includes: 1. Arable land; 2. Deposit; 3. Perennial plantings; 4. Hay spits; 5. Pastures. Non-agricultural land is divided into types: 6. Forest land; 7. Forest plantations not included in the

forest fund; 8. Lands under water; 9. Building land; 10. Land under roads; 11. Swamps; 12. Disturbed lands; 13. Other lands. The purpose of the study is by identification method [3] to identify stable patterns of distribution of the shares of the area on 01.01.2019 [4] land (except under water) from the land area in the constituent entities of the Federation on an ecological basis.

Materials and Methods

Appendix 2 was distinguished from tables [4] by types of land. Then the area of land under water was subtracted from the total area of the territory of the subject of the federation and the area of land on land (thousand hectares) was obtained. After dividing the area of the other 12 lands by the area of su-shi (100), we received (Table 1) the share of lands (%).

Table 1: Fragment of Data on the Constituent Entities of Russia by the Share of Land Types

#	Code	Share of land by species codes, %											
		01	02	03	04	05	06	07	09	10	11	12	13
1	31	61,18	0,00	1,26	2,08	14,85	9,00	3,37	2,72	2,15	0,84	0,24	2,31
2	32	34,03	3,51	0,75	5,95	10,02	34,27	3,51	1,64	2,08	2,17	0,15	1,90
3	33	21,06	1,62	0,70	5,70	5,53	55,04	2,60	1,32	2,61	1,33	0,57	1,92
...
63	17	1,15	0,89	0,01	0,46	20,54	52,11	2,71	0,13	0,18	6,17	0,03	15,63
64	19	11,33	0,66	0,12	2,65	16,88	54,41	0,38	0,50	0,65	0,53	0,24	11,64
66	24	1,37	0,06	0,02	0,34	0,59	53,17	1,40	0,08	0,08	9,98	0,01	32,91
67	38	2,32	0,00	0,04	0,52	0,86	88,29	0,31	0,22	0,35	2,28	0,04	4,77
...
82	87	0,00	0,00	0,00	0,01	0,00	18,67	5,56	0,01	0,03	4,06	0,07	71,58

The shares of types of land (Table 1) are calculated as follows: $a_{jk} = 100S_{jk} / (S - S_{08})$, where j – is the number of the subject of the Russian Federation (Table 1), k – is the number of the type of land (Table 2); S – total area [4].

When ranking in the function = RANK (T5; T\$5: T\$86; 1), the following designations are adopted for the Excel software environment: T – is the identifier of the ranked column; T5, T\$5 – first line; T\$86 – last line; 0 1 – ranking in descending (0) or ascending (1). This program gives ranking places $I=1,2,3$. To get the ranks $R=0,1,2,3$ (more convenient for modeling), you need to apply an expression $R=I-1$.

Oscillations (wavelet signals) are written by the wave formula [3] of the form

$$y_i = A_i \cos(\pi x / p_i - a_{8i}) \quad A_i = a_{1i} x^{a_{2i}} \exp(-a_{3i} x^{a_{4i}}) \quad p_i = a_{5i} + a_{6i} x^{a_{7i}} \quad (1)$$

where Y – is the indicator, i – is the number of the component (1), x – is the explanatory variable, $a_1 \dots a_8$ – are the parameters (1); A_i

– the amplitude (half) of the wavelet, P_i – the half-period of the oscillation.

Results and Discussion

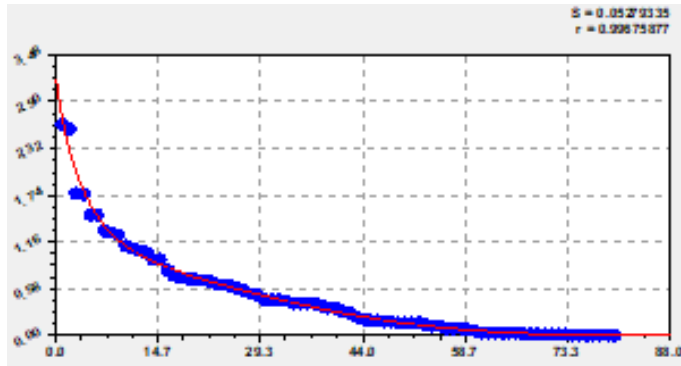
Table 2 gives the ranks for 12 types of land.

The Novosibirsk region takes the first place in compliance with the ecological principle in land use in Russia. The second place is taken by the Tomsk region, and the third - by the Sakhalin region. Novosibirsk and Tomsk regions belong to the Siberian Federal District. Four constituent entities of the Angara-Yenisei region from the same district (Table 3) received the following places in Russia: 11th place with 412 ranks Republic of Tyva (code 17); 22nd place with 439 ranks Krasnoyarsk Territory (code 24); 27th place with 454 ranks Irkutsk region (code 38) and 67th place with a total of 549 ranks in the Republic of Khakassia. The Kaliningrad region received 45th place with a total of 494 ranks. The last 82nd place in 2019 with a total of 622 ranks is occupied by the Republic of Crimea.

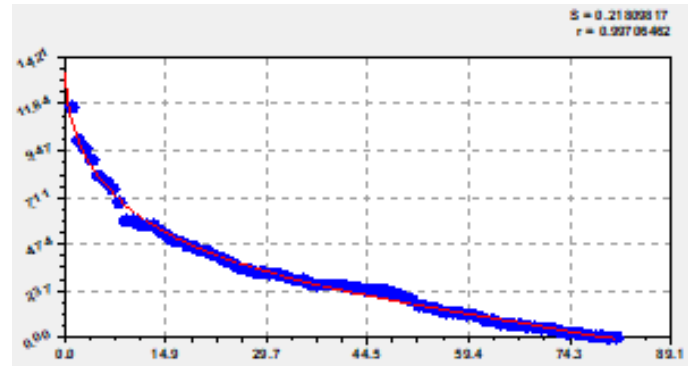
Table 2: Fragment of Data on the Ranking of 12 Types of Land by Subjects

#	Code	Land ranks by their encoding												Sum ΣR	A place
		01	02	03	04	05	06	07	09	10	11	12	13		
1	31	75	0	9	50	26	71	9	75	61	54	67	43	540	63
2	32	56	77	17	10	38	43	8	63	59	40	59	36	506	50
3	33	40	67	20	12	51	25	18	55	74	47	79	37	525	56
...		
63	17	14	64	76	72	13	29	16	9	7	23	20	69	412	11
64	19	31	61	54	41	18	26	74	26	24	63	68	63	549	67
66	24	15	35	72	73	70	28	42	5	5	16	2	76	439	22
67	38	18	21	62	70	66	0	76	13	16	38	22	52	454	27
...		
82	87	0	0	80	81	81	62	4	0	1	27	40	81	457	31

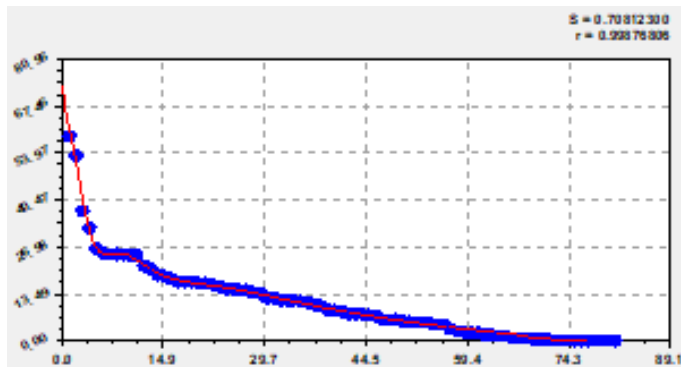
The graphs are shown in Figures 1 and 2, parameters (1) are given in Tables 3 and 4.



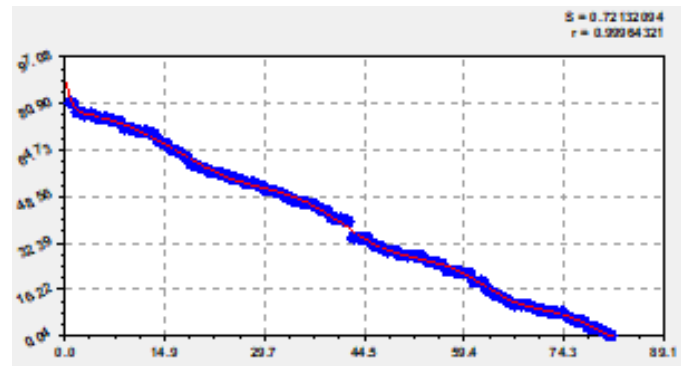
3. Perennial plantings



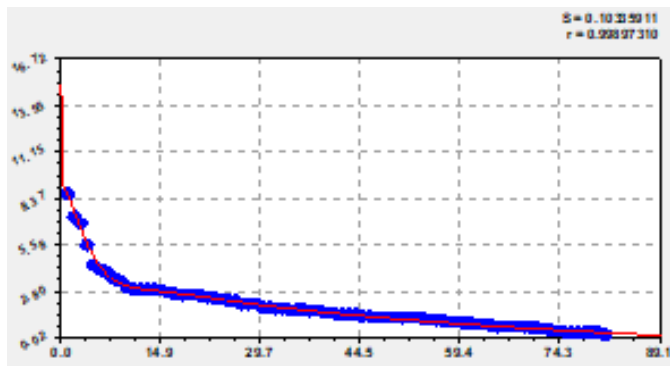
4. Hayfields



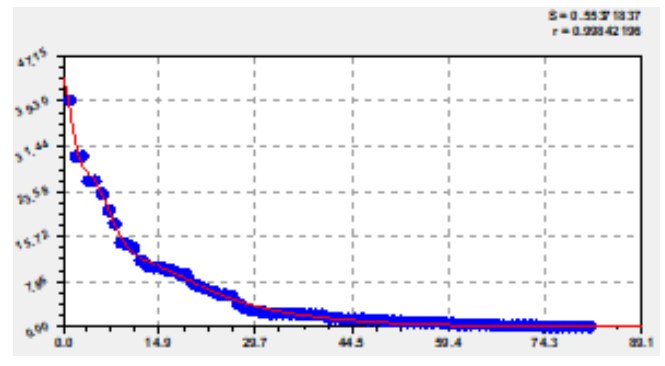
5. Pastures



6. Forest lands



7. Plantations outside the forest fund



11. Swamps

Figure 1: Rank distributions of constituent entities of the Russian Federation by shares of ecological lands

(*S* - standard deviation; *r* - correlation coefficient)

For ecological lands according to the vector "better worse", the ranking is performed in descending order of values of the share of lands in the subject of the federation (Fig. 1). The more such land, the better. And in anthropogenic lands it is customary for the same vector of behavior - the less, the better. Therefore, the graphs in Figure 2 decrease in value.

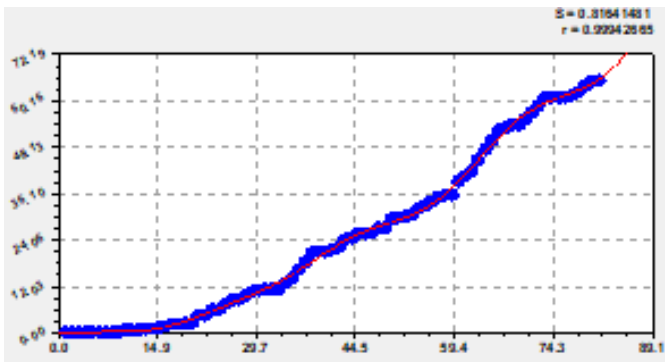
Table 3: Parameters (1) of the rank distribution of the shares of ecological lands,%

<i>i</i>	Amplitude (half) oscillation (1)				Wobble half period (1)			Shift (1)	Coef. corr. <i>r</i>
	a_{1i}	a_{2i}	a_{3i}	a_{4i}	a_{5i}	a_{6i}	a_{7i}	a_{8i}	
Perennial plantings									
1	3,18453	0	0,0047998	1,53969	0	0	0	0	0,9968
2	-0,62544	0,86551	0,15140	0,84417	0	0	0	0	
Hayfields									
1	13,39330	0	0,20034	0,56470	0	0	0	0	0,9971
2	-9,69486e-6	2,68792	0	0	0	0	0	0	
Pasture									
1	73,10386	0	0,18284	0,64442	0	0	0	0	0,9988
2	-0,0018309	1,76995	0	0	0	0	0	0	
3	-14,03369	6,07977	1,61449	0,74027	17,98228	8,58220	1,14441	-1,33910	
4	-98,41738	3,09394	2,47942	0,65827	1,01286	-5,31528e-6	1	4,47383	0,6825
5	0,00015145	2,02706	0	0	1,32429	0,034433	1,05969	1,50216	0,7221
Forest land									
1	82,62557	0	-0,0044463	1,09436	0	0	0	0	0,9998
2	-1,23737	1,07932	0	0	0	0	0	0	
3	6,13370	0	0,21396	1	0,67305	0,81951	1	0,39938	
4	-0,034239	1,84367	0,11904	0,84746	18,79226	-0,11919	0,93652	-2,20810	
Forest plantations not included in the forest fund									
1	15,20810	0	-0,0097796	0,14686	0	0	0	0	0,9990
2	-9,01272	0,11861	0	0	0	0	0	0	
3	23,51400	0,48862	0,16695	1,21718	130,8924	0	0	-1,43487	
Lands under water									
1	23,11249	0	0,092172	0,83609	0	0	0	0	0,9973
2	-3,34963	0,55352	0,057418	1,12309	0	0	0	0	
Swamps									
1	43,58697	0	0,10503	0,93143	0	0	0	0	0,9984
2	-3,33471	3,90445	1,13015	0,88399	0	0	0	0	
2	-70,10418	4,74340	3,58990	0,58236	9,19643	0	0	-1,12281	
4	-3,12349	0	0,22959	1	1,20141	-0,00012075	1,94931	-1,36253	0,7056
5	8,17479e-5	3,77089	0,18883	0,89650	0,93525	0,062988	1,06563	0,054140	0,7018

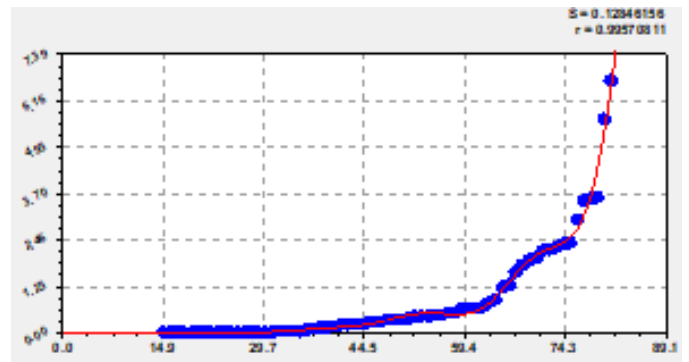
From the data in Table 3, it can be seen that the shares of perennial plantations, hayfields, and lands under water were highly adequately distributed according to two-term trends. Here, the oscillations have a very small amplitude, so the wavelets are of little significance. The first term of the trend is a natural tendency according to our modified Mandelbrot's law. This law shows a non-multiple (real) fractal change in the area (share) of land. The second term is crisis (negative sign) and gives a negative human influence. It has the greatest influence on swamps in Russia.

The influence on a two-term trend is shown in Table 4 for the share of building land. However, the first term is a law of exponential growth. At the same time, arable land and disturbed lands grow ac-

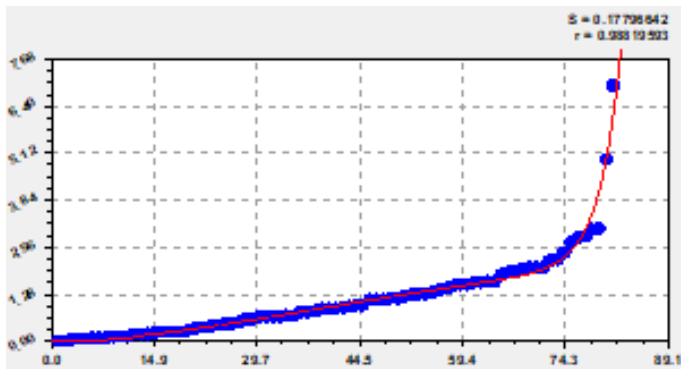
ording to the simplest law of exponential growth. For the share of arable land, the inhibition of steady growth due to the negative sign occurs in two fluctuations, and for the share of disturbed lands, one fluctuation, but in terms of amplitude, also increasing according to the exponential law. The maximum structural uncertainty (six members) is possessed by other lands. The share of other lands has only one trend according to the law of exponential growth, but on the other hand, there are five wavelet signals indicating the clearly unscientific behavior of decision-makers. We have proved that the more asymmetric wavelets, the more complex the processes are. And the higher is the structural uncertainty of the edges of behavior in the conditions of the distribution of land in the constituent entities of the Russian Federation.



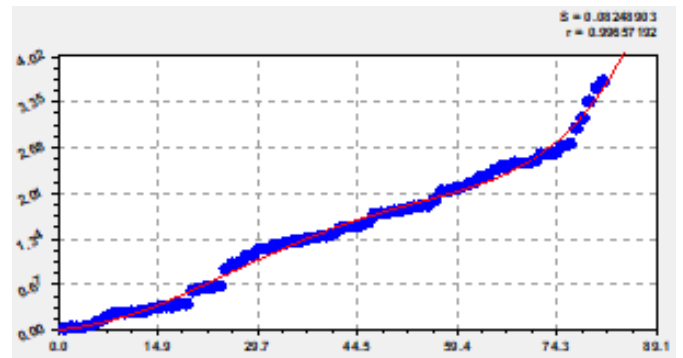
1. Arable land



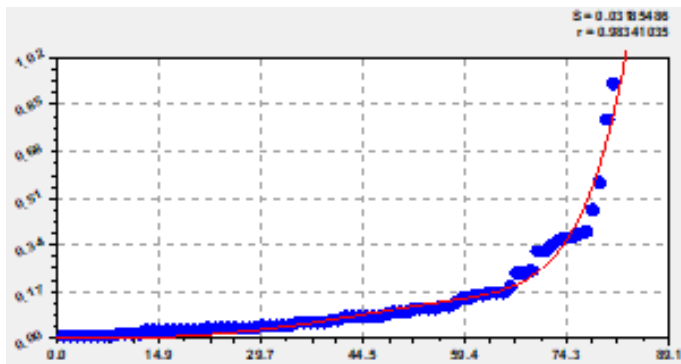
2. Unused arable land



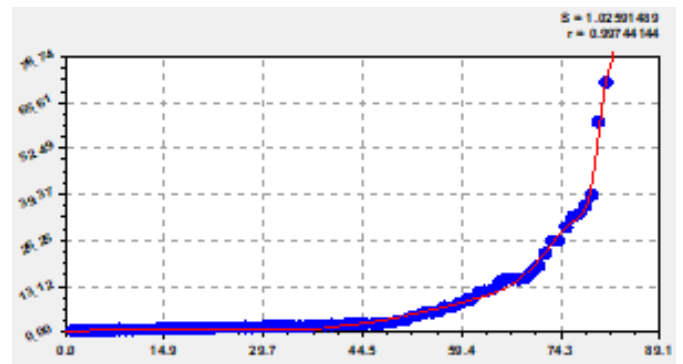
9. Building land



10. Land under the roads



12. Disturbed lands



13. Other lands

Figure 2: Rank distributions of constituent entities of the Russian Federation by shares of an-thropogenic lands

The presence of fluctuations shows the lack of awareness of the territorial distribution of land. Therefore, further we will consider only trends and their adequacy.

The trend with one natural member is observed for a share of five types of land: arable land (expo-nential law 0.9964); deposits (expo-nential growth of 0.9832); under the roads (anomalous biotech law [3] 0.9902); disturbed lands (indicative law 0.8994) and other lands (anomalous biotechnical law 0.9816). In addition to deposits, the other four types of land start from scratch, that is, theoret-ically there should not be a person without a person.

Table 4: Parameters (1) of the rank distribution of the shares of anthropogenic lands,%

<i>i</i>	Amplitude (half) oscillation (1)				Wobble half period (1)			Shift (1)	Coef. corr. <i>r</i>
	a_{1i}	a_{2i}	a_{3i}	a_{4i}	a_{5i}	a_{6i}	a_{7i}	a_{8i}	
Arable land									
1	0,025595	1,79975	0	0	0	0	0	0	0,9994
2	-0,011192	2,10273	0,00074793	2,34425	36,18572	0	0	1.19916	
3	-0,00013607	2,77225	0,050049	0,82299	0,45110	-0,068082	0,81836	2,89761	
Unused arable land									
1	1,87734e-5	0,99687	-0,069976	1,09370	0	0	0	0	069957
2	-3,88078e-6	2,82188	0	0	38,42583	0	0	-5,63421	
3	1,46697e-12	6,24383	0	0	6,81535	0,0078509	1,11936	-3,61012	
Building land									
1	9,61894e-11	0	-0,20592	1,08737	0	0	0	0	0,9982
2	0,0011194	1,98228	0,013657	1,01985	0	0	0	0	
Land under the roads									
1	0,014849	0,71573	-0,0086285	1,30792	0	0	0	0	0,9966
2	-0,038252	1,65766	2,49501	0,017443	14,84200	8,28899	0,45574	-1,81407	
Disturbed lands									
1	5,88839e-6	2,55590	0	0	0	0	0	0	0,9834
2	-2,04415e-17	8,82873	0	0	43,26268	0,13262	1,09795	-3,86653	
Other lands									
1	0,00030370	0,19922	-0,071540	1,16274	0	0	0	0	0,9974
2	-7,20354e-8	4,62349	0	0	38,81640	0	0	1,06054	
3	-0,35453	0,57573	0	0	199,1025	-0,66299	1,27367	-3,61671	
4	-0,11949	0,50711	0	0	33,51576	-0,46864	0,82407	1,18007	0,5829
5	-4,46494e-6	2,87152	0	0	9,83053	-0,014596	1,21507	-1,04920	0,4911
6	6,57897e-17	0,71609	-0,32388	1,07206	1,90002	-0,00093556	1,17081	0,27762	0,7209

The remaining eight types of land received two-part trends. In seven of them, the second member gave a negative sign: perennial plantations (0.9968); hayfields (0.9971); pastures (0.9879); forest lands (0.9982); plantations outside the LF (0.9896); land under water (0.9973); swamps (0.9970). These subtractions produce a concave curve, with concavity showing a decrease in area fraction in subjects with medium ranks.

Building lands are especially distinguished (correlation coefficient 0.9882). The second term gets a positive sign. This fact indicates that medium-ranked entities are trying to increase the share of land for development. This type of land has shallow waves with a very small amplitude. Therefore, the rank distribution obeys only a two-component trend.

The Republic of Karelia has the largest share of land under water, 23.20% of the total area. The largest share of land, 99.53% of the total area, is characteristic of the Republic of Ingushetia. The smallest share of agricultural land, 0.01%, is occupied by the territory of the Chukotka Autonomous Okrug, and the largest, 89.19%,

in terms of the sum of the first five types of land, is the Stavropol Territory. The maximum plowed area (share of arable land) of 65.63% in 2019 was in the Kursk region (the area under farmland is 82.32%). The maximum deposit of 6.72% of the land was in the Kurgan region. The largest share of perennial plantings, 3.16%, is observed in the Republic of Crimea.

The maximum share of hayfields, 12.92% of the land, is located in the Novosibirsk region, and 25.14% of pastures are in the Karachay-Cherkess Republic. Forests are 88.29% of the richest Irkutsk region, and plantations outside the forest fund 15.21% - Pskov region. The largest share of construction is 6.98% and under roads 3.66% of the land area is in the Moscow region. 42.87% of the land is occupied by swamps in the Murmansk region. The most disturbed lands are 0.93% in the Kemerovo region - Kuzbass, and the share of 71.58% of land is the highest in the Chukotka Autonomous Okrug.

Conclusion

All types of land in the constituent entities of the Russian Federation received fractal distributions according to the ecological principle using the modified Mandelbrot law and taking into account fluctuations in nine types of land (arable land, fallow lands, pastures, forests, forest stands, under water, disturbed and other lands) -grew and became more than 0.99.

Consideration of the territorial principle is still taking place, as evidenced by the emergence of a new Arkhangelsk region through the unification of two subjects of the federation. Also, for example, the Republic of Tyva, the Republic of Khakassia, the Krasnoyarsk Territory and the Irkutsk Region entered the new Angara-Yenisei region within the Siberian Federal District to equalize socio-economic development.

Among 82 constituent entities of Russia, the Irkutsk Region has the first place (zero rank according to Table 3) in terms of the share of forest lands.

Four constituent entities of the Angara-Yenisei region received the following places in Russia, taking into account the ecological principle:

- 1) 11th place with 412 ranks Republic of Tyva (code 17);
- 2) 22nd place with 439 ranks Krasnoyarsk Krai (code 24);

- 3) 27th place with 454 ranks Irkutsk region (code 38);
- 4) 67th place with a total of 549 ranks in the Republic of Khakassia.

The methodology for the ranking distribution of the shares of land types proposed in the article can also be used for the municipalities of each subject of the federation.

References

1. GOST 26640-85 (ST SEV 4472-84) of the Earth. Terms and definitions // Protection of nature. Earth: Sat GOSTs. M.: IPK Standards Publishing House, 2002.
2. Land Code of the Russian Federation. No. 136-Ф3 dated 10.25.2001. 2019 as amended.URL: <http://zkodeksrf.ru/> (Date of access 03.03.2020). 195 p.
3. Mazurkin P.M. Economic and statistical modeling: textbook. pos. with the stamp UMO RAE. Yoshkar-Ola: Volga State Technical University, 2016.276 p.
4. The distribution of land of the Russian Federation by category by regions of the Russian Federation (as of January 1, 2019, thousand hectares). Appendix 1 // F. 22 for 2019 (for the subjects of the Russian Federation) .doc (Date of treatment 02.25.2020). M.: Ministry of Agriculture of the Russian Federation, 2019. 17 p.

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