

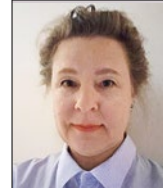
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The territory of the republic of Sakha (Yakutia): a review of the environmental resource

The author has reviewed the indicators characterizing the environmental situation in the Republic of Sakha (Yakutia) and its districts. The indicators include land management, areas of territories, population size and density, car density, the impact of economic activities on natural water bodies and atmosphere air, production and consumer waste management, areas of forest reserves and specially protected natural areas (PNA), investments into environmental protection and rational use of natural resources, and the operating costs of environmental protection. The author applied the system analysis of statistical information and textual methods of extracting knowledge from specialized literature. The author employed sampling and analysis of indicators comprising the index of the quality of urban environment in each city and town of the Republic of Sakha (Yakutia) in 2018–2020. The information about the environment of the Republic of Sakha (Yakutia) and its districts, if taken in aggregate, allows analyzing its environmental resource, the impact on natural constituents of the environment, as well as conducting a comparative analysis with other items, taking into account the availability of forest lands and protected natural areas.

Keywords: *sustainable development, environmental safety, environmental protection, urban economy, specially protected natural area, indicator, ecology, Urban Environment Quality Index*



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The ecological system of an urbanized area evolves under the influence of natural and anthropogenic factors [1–3]. Retrospective and predictive analyses of these impacts and methods of their minimization are relevant for the sustainable development of areas [4, 5]. Given the concentration of economic activities, the density of urban and rural population, as well as harsh environmental conditions in the Republic of Sakha (Yakutia), environmental sustainability of districts is an important factor of the quality of life [6, 7], including urban landscaping coupled with digital transformation and simulation of the urban economy towards the optimal development of urban areas [8–10]. Natural green spaces make populated areas attractive; they include forests, specially protected natural areas, and green planted areas [11–13].

For the purpose of the article, a set of environmental parameters, presented in annual statistics reports, was studied^{1, 2, 3}.

The Republic of Sakha (Yakutia) is located in the north-east of Russia; its territory occupies 1/5 of the country and 50 % of the Far Eastern Federal District. The northern part of the republic is located in the Arctic zone; its central part is located in the subarctic (continental) climate zone, and its southern part is located in the temperate, or continental, zone (Fig. 1). In the areas of extreme continental climate, the difference in air temperatures reaches 100 °C, from +40 °C in summer to –60 °C in winter. The cold pole of the northern hemisphere is located in Oymyakon.

The population of the Republic of Sakha (Yakutia) is 982.0 thousand people, of which the rural

population is 330.9 thousand people (as of January 1, 2021). The population density is 0.32 residents/km².

As of 2019, its GRP amounted to 1,220.3 billion rubles; its GRP per capita reached 1,258.7 thousand rubles.

The republic has one urban district, that is, the city of Yakutsk, and 34 districts (Fig. 2).

The environmental situation in the Republic of Sakha (Yakutia) is being monitored: a set of indicators and their dynamics are regularly monitored; problems are studied and solutions are developed [14] (Fig. 3).

Republican land resources (308,352 thousand hectares) are divided into the following categories (Fig. 4):

- agricultural land (19,446.6 thousand hectares),
- land of settlements (231.1 thousand hectares),
- industrial and other special-purpose categories of land (139.1 thousand hectares),
- protected natural area (PNA) (12,996.9 thousand hectares),
- forest land (252,818.9 thousand hectares),
- waters (2,136.0 thousand hectares),
- reserve land (20,583.7 thousand hectares).

The share of urban settlements in the total area of settlements is 39.7 %, while the share of rural settlements is 60.3 %. Within the boundaries of cities, towns and rural settlements, the area of agricultural land occupies 31.6 %, built-up areas — 25.9 %, forests and shrubs — 18.4 %, water bodies — 5.1 %, roads — 3.3 %, swamps — 2.7 %, disturbed lands — 0.7 %, other areas — 12.3 %.

1 On the state and environmental protection of the Sakha Republic (Yakutia) in 2020: Administration of the Head of the SR (Y) and the Government of the SR : State Report. URL: <https://minpriroda.sakha.gov.ru/uploads/ckfinder/userfiles/2021/08/18/files/%D0%93%D0%94%20%D0%9E%D0%9E%D0%A1%202020.pdf> (access date: 19.03.2022).

2 Statistical Yearbook Republic of Sakha (Yakutia) : Stat. sat. Yakutia, 2021; 560. URL: <https://sakha.gks.ru/storage/mediabank/PDF016.PDF> (access date: 19.03.2022).

3 On the state and environmental protection of the Russian Federation in 2020 : State Report. Moscow, Lomonosov Moscow State University, 2021; 864. URL: https://www.mnr.gov.ru/docs/o_sostoyanii_i_ob_okhrane_okruzhayushchey_sredy_rossiyskoy_federatsii/gosudarstvennyy_doklad_o_sostoyanii_i_ob_okhrane_okruzhayushchey_sredy_rossiyskoy_federatsii_v_2018_/ (access date: 19.03.2022).



Fig. 1. The Republic of Sakha (Yakutia) on the map of Russia: 8 — the Arctic zone of the republic consisting of Abysky, Allaikhovsky, Anabar, Bulunsky, Verkhnekolymsky, Verkhoyansky, Zhigansky, Momsky, Nizhnekolymsky, Oleneksky, Srednekolymsky, Ust-Yansky and Even-Bytantaysky districts



Fig. 2. Districts of the Republic of Sakha (Yakutia)

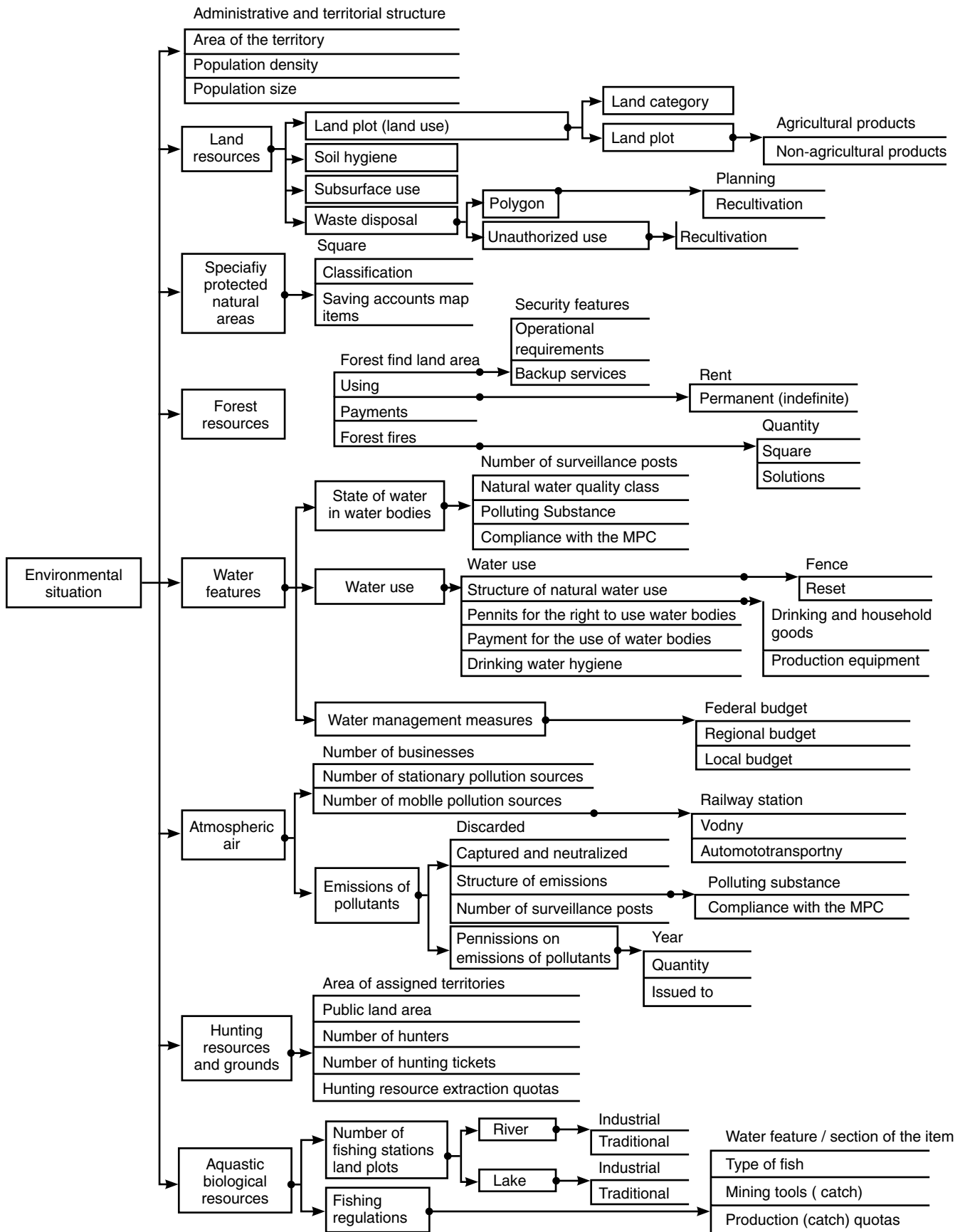


Fig. 3. The block scheme of parameters characterizing the environmental situation in the Republic of Sakha (Yakutia)

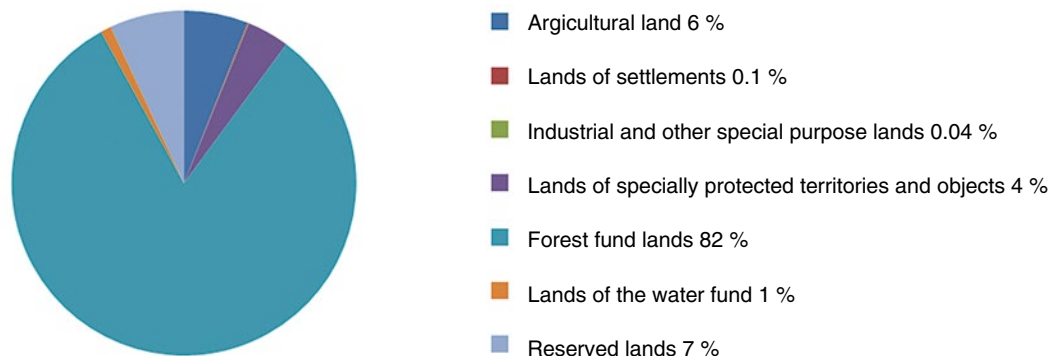


Fig. 4. Categories of land in the Republic of Sakha (Yakutia)

The atmosphere air is monitored at 7 stations in 4 cities of the Republic of Sakha (Yakutia). In 2020, total emissions reached 298.0 thousand tons which was 1.6 thousand tons less than in 2019.

The amount of emissions from stationary sources (288,190 thousand tons in 2019; 286,319 thousand tons in 2020) is largest among the subjects of the Far Eastern Federal District. Compared to 2019, emissions were down by 0.6 %. In 2019, the share of emissions in five large industrial centres was 67.7 %; in 2020, it reached 67.2 % of total emissions in the republic. The largest portion of emissions is attributed to the Mirninsky district (40.7 % in 2019; 28.2 % of the total emissions in the republic in 2020), Neryungrinsky district (9.4 % in 2019; 12.6 % in 2020), Lensky district (9.1 % in 2019; 16.9 % in 2020) and Aldansky district (4.5 % in 2019; 6.0 % in 2020). In Yakutsk, atmospheric emissions were 3.9 % in 2019, and 3.3 % in 2020.

In 2020, atmospheric emissions from mobile sources reached 11.65 thousand tons, including motor transport emissions that reached 10.66 thousand tons, and railroad transport emission of 0.99 thousand tons. In 2016, 318,968 motor vehicles were registered in the republic; 319,585 units were registered in 2017; 322,949 units in 2018; 325,859 units in 2019, 326,573 units in 2020 (Table 1). Road transport emissions rose by 0.2 thousand tons compared to 2019, although they were 8 times smaller than in 2010.

In 2020, the amount of fresh water taken from natural water bodies was 7 % less than in 2010; in 2019, the difference was mere 1 % in Sakha (Yakutia). The total intake of fresh water in 2019 amounted to 211.35 million m³; in 2020 it was 203.77 million square meters. The percent of water taken from natural surface water bodies was 67.81 % / 68.89 %, and the percent of water taken from natural underground sources was 32.19 % / 31.11 %, respectively. Household and drinking water use decreased by 8.48 % compared to 2019. As for agricultural water, its consumption went down by 23.08 %, while water consumption for production needs increased by 0.18 %. In 2020, water recycling and re-supply (1,300.97 million m³) exceeded the figures of 2019 by 33.86 million square meters. In 2020, water consumption was maximal in Mirninsky district (22.64 % of total consumption in the republic), Neryungrinsky district (19.05 %), Megino-Kangalassky district (12.23 %), Yakutsk (13.64 %), Lensky (8.39 %) and Aldansky (6.67 %) districts. The basins of the Lena, Vilyu and Aldan rivers are the largest containers of fresh water in the republic. Household water consumption per capita plummeted from 55.9 million square meters in 2010 to 34.9 million square meters in 2020.

In 2020, the water disposal rate was 3.5 % smaller than in 2019 and 8.1 % higher than in 2010. In 2020, the wastewater discharge into surface water bodies (151,94 million m³) was down by 5.52 million cubic meters compared to 2019. The following types of wastewater are identified according to the degrees of contamination: insufficiently treated wastewater — 47.25 %, standard clean wastewater (untreated) — 48.20 %, contaminated untreated wastewater — 1.63 %, standard treated wastewater — 2.92 %. In 2020, the amount of contaminated wastewater, discharged without treatment (2,48 million m³), was 8.1 % smaller than in 2019 and 75.0 % smaller than in 2010. In 2020, the amount of contaminated and insufficiently treated wastewater, discharged into water bodies (71.80 million cubic meters) was 10.9 % smaller than in 2019 and 5.4 % smaller than in 2010. 86.4 % of wastewater discharged into surface water bodies is generated in Mirninsky district (18.62 % of the total discharge), Ust-Maysky district (16.92 %), Neryungrinsky district (16.75 %), Yakutsk (14.89 %), Megino-Kangalassky district (14.82 %), Aldansky (4.4 %) district, respectively. The largest amount of polluted water was discharged into the basins of the Lena (70.63 million m³), Aldan (37.87 million m³), Vilyu (11.28 million m³) and Indigirka (1.46 million m³) rivers.

In 2020, same as before, the Republic of Sakha (Yakutia) was the largest generator of waste among the subjects of the Far Eastern Federal District. Waste generation has not changed compared to 2019, but it is 4.3 times higher than in 2010 (124,457 million tons). The amount of waste decreased by 6 % compared to 2019 (280,777 million tons), but it exceeds the 2010 figures more than 8 — fold (31.39 million tons). In 2020, the value of the waste storage index exceeded that of 2010 (112,249 million tons) by 26,277. In 2020, the amount of waste went up 1.5-fold in comparison with 2010 (87,358 million tons). The amount of neutralized waste was up 220-fold in comparison with 2010 (0,006 million tons). The total amount of municipal solid waste reached 0,348 million tons. The structure of waste management is shown in Fig. 5.

Given their economic and environmental significance, forests, located on the forest land, are divided into protective forests — 33 million hectares, operational forests — 95 million hectares and reserve forests — 127 million hectares. In the republic, forests are located not only on forest lands, but also on the lands belonging to other land categories, including lands of settlements (0.03 million hectares) and PNA lands (1 million hectares). As the time progresses, the area of forest lands gets smaller due to conversion of its parts into lands of other categories. 50.7 % of the republic's territory is covered with forests.

Table 1. The number of motor vehicles registered in the Republic of Sakha (Yakutia)

Number	District	Population in 2020, thousand persons		Number of motor vehicles, items				
		urban	rural	2016	2017	2018	2019	2020
1	Abyysky	1,973	1,943	415	426	436	436	436
2	Aldansky	34,859	3,957	13,980	13,766	13,800	14,008	14,013
3	Allaikhovskiy	2,111	0,615	349	391	369	375	375
4	Amginsky	–	16,855	3,126	3,222	3,367	3,425	3,419
5	Anabar	–	3,672	480	508	522	532	527
6	Bulunsky	4,745	3,756	473	521	524	533	523
7	Verkhnevilyuytskiy	–	21,180	3,777	3,845	3,837	3,887	3,852
8	Verkhnekolymskiy	2,68	1,304	430	454	497	504	488
9	Verkhoyansky	4,752	6,237	1,066	1,208	1,127	1,146	1,127
10	Vilyuyskiy	13,982	11,125	5,865	5,886	6,030	6,099	5,991
11	Gorny	–	12,264	3,363	3,520	3,577	3,613	3,549
12	Zhiganskiy	–	4,179	431	431	502	518	516
13	Kobyayskiy	3,538	8,537	3,134	3,178	3,278	3,305	3,287
14	Lenskiy	31,767	4,694	20,862	20,991	21,344	7,133	21,406
15	Megino-Kangalasskiy	4,387	27,011	12,424	12,434	12,682	21,568	12,654
16	Mirninskiy	69,524	2,374	43,681	43,965	44,371	44,600	44,600
17	Momskiy	–	4,051	450	386	502	12,778	527
18	Namskiy	–	25,094	6,034	6,084	6,111	540	6,145
19	Neryungrinskiy	73,794	1,107	28,606	28,803	29,041	6,183	29,560
20	Nizhnekolymskiy	2,514	1,714	498	491	552	584	592
21	Nyurbinskiy	9,761	13,982	6,977	7,149	7,089	2,916	6,951
22	Oymyakonskiy	5,065	2,791	2,774	2,537	2,858	3,998	3,260
23	Olenekskiy	–	4,326	400	350	419	9,539	443
24	Olekminskiy	9,102	15,290	3,869	3,875	3,971	425	3,972
25	Srednekolymskiy	3,470	3,842	537	496	563	562	587
26	Suntarskiy	–	23,680	6,264	6,076	6,319	6,374	6,430
27	Tattinskiy	–	16,271	4,663	4,679	4,716	4,754	4,795
28	Thomponskiy	7,176	5,407	3,701	3,300	3,776	3,818	3,908
29	Ust-Aldanskiy	–	20,515	2,642	2,647	2,840	2,878	2,940
30	Ust-Mayanskiy	5,222	2,041	1,525	1,425	1,631	1,658	1,685
31	Ustyanskiy	3,862	3,173	2,276	2,055	2,347	2,381	2,464
32	Khantalasskiy	15,660	17,361	9,244	9,230	9,493	5,298	9,536
33	Churapchinskiy	–	21,107	5,093	5,115	5,223	29,415	5,185
34	Even-Bytantayskiy	–	2,879	287	285	307	307	364
35	Yakutsk	341,126	16,567	119,272	119,818	118,928	119,769	120,755

► The system of specially protected natural areas in the Republic of Sakha (Yakutia) is a regional constituent of the PNA network in Russia. As of 01.01.2021, dimensions of PNA reach 1,166,720 km²,

and it occupies 37.85 % of the region's territory (Fig. 6). If compared to the 2019 figures, the area of PNA of regional and local significance has increased by 52.9 thousand hectares.

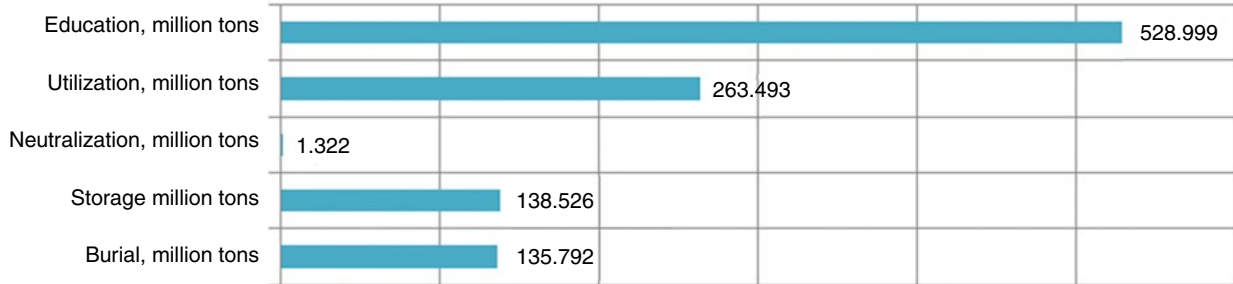


Fig. 5. The structure of waste management in the Republic of Sakha (Yakutia) in 2020

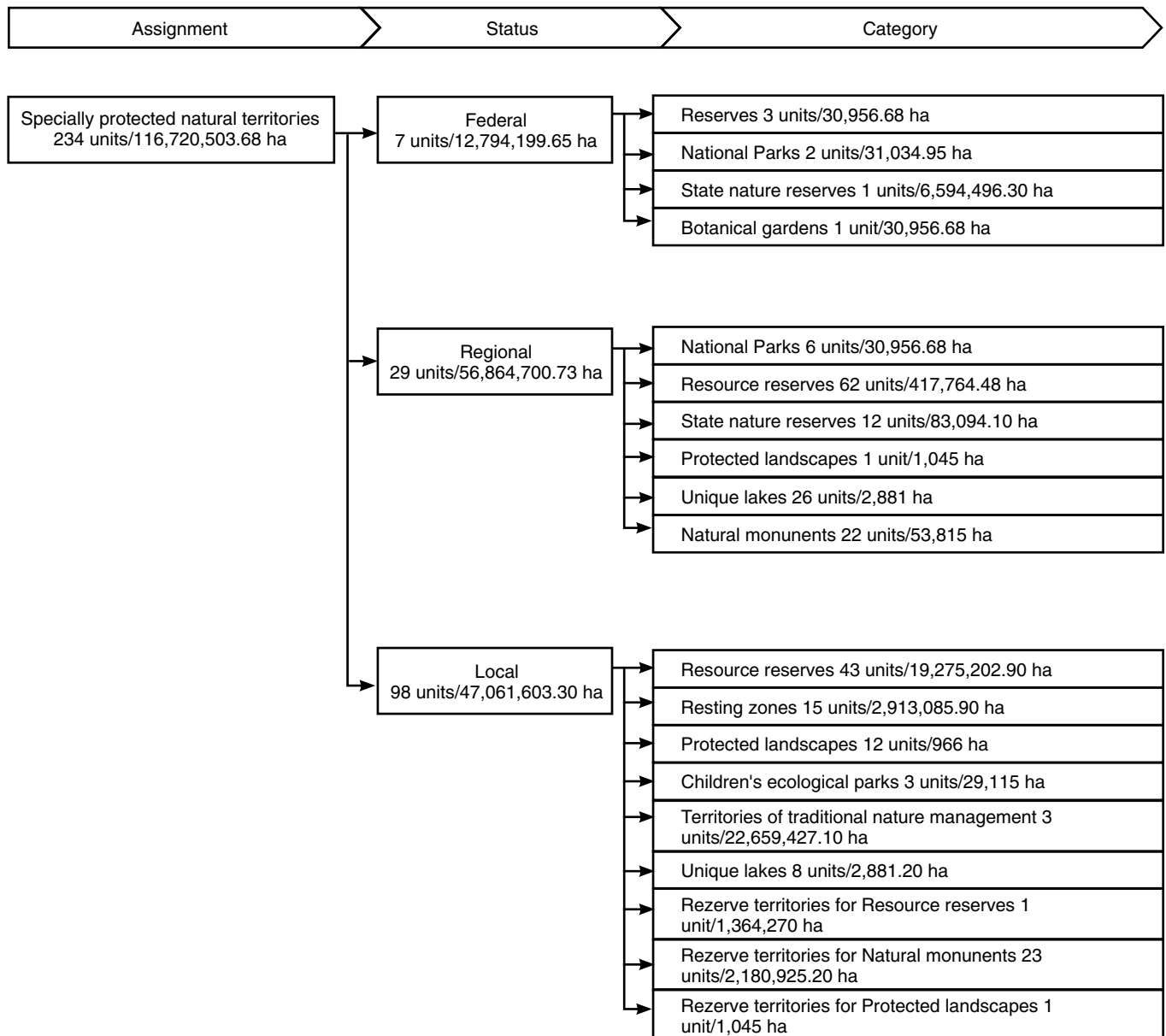


Fig. 6. The structure and composition of protected areas in the Republic of Sakha (Yakutia)

PNAs preserve the species, ecosystems, landscapes and the geographical diversity of the region; it protects the habitats of 134 species of animals and 337 species of plants listed in the Red Books of the Russian Federation and the Republic of Sakha (Yakutia). The PNA of the Aby ulus occupies 24.01 % of its territory, Aldansky ulus — 29.1 %, Allaikhovsky ulus — 41.3 %, Amginsky ulus — 25.3 %, Anabar ulus — 89 %, Bulunsky ulus — 47.4 %, Verkhneviluysky ulus — 23.3 %, Verkhnekolymsky ulus — 34.5 %, Verkhoyansky ulus — 18.2 %, Vilyuysky ulus — 26.9 %, Gorny ulus — 33.9 %, Zhigansky ulus — 35.07 %, Kobyai ulus — 23.3 %, Lena ulus — 19.6 %, Megino-Kangalassky ulus — 20.2 %,

Mirninsky ulus — 18.3 %, Momsky ulus — 34.6 %, Namsky ulus — 13.2 %, Neryungrinsky ulus — 22.9 %, Nizhnekolymsky ulus — 48.3 %, Nyurbinsky ulus — 23.5 %, Oymyakonsky ulus — 16.2 %, Oleneksky ulus — 36.7 %, Olekminsky ulus — 16.6 %, Srednekolymsky ulus — 22.8 %, Suntarsky ulus — 29.2 %, Tattinsky ulus — 37.8 %, Tomponsky ulus — 31.9 %, Ust-Aldansky ulus — 30.8 %, Ust-Maysky ulus — 28.8 %, Ust-Yansky ulus — 22.2 %, Khangalassky ulus — 60.8 %, Churapchinsky ulus — 20 %, Eveno-Bytantaysky ulus — 21.3 %, Yakutsk — 25.7 %.

Table 2 shows dimensions of protected areas and the population of districts in the republic.

Table 2. Socio-ecological indicators of districts in the Republic of Sakha (Yakutia)

Number	District	Area, thousand sq. km	Population, residents	Population density, persons/sq. km	Forest area, million hectares	PNA area, hectares
1	Abyysky	69.4	3,916	0,056	6.7	1,666,300
2	Aldansky	156.8	38,816	0.25	15.56	4,562,611
3	Allaikhovsky	107.3	2,726	0,025	2.28	4,430,836
4	Amginsky	29.4	16,855	0.57	2.81	74,430.8
5	Anabar	55.6	3,672	0,066	0.45	4,840,562
6	Bulunsky	55.6	8,501	0.15	9.0	10,615,755.3
7	Verkhneviluysky	42.0	21,180	0.5	3.8	978,391
8	Verkhnekolymsky	67.8	3,984	0.06	6.6	2,340,717
9	Verkhoyansky	134.1	10,989	0,082	5.1	2,442,274
10	Vilyuysky	55.2	25,107	0.45	5.1	1,486,253
11	Gorny	45.6	12,264	0.27	4.4	1,535,890
12	Zhigansky	140.2	4,179	0.03	13.7	4,915,022
13	Kobyaysky	107.8	12,075	0.1	10.2	2,515,347
14	Lensky	77.0	36,461	0.47	7.4	1,511,704
15	Megino-Kangalassky	11.7	31,398	2.68	0,923	237,169
16	Mirninsky	165.8	71,898	0.4	16.03	3,035,660
17	Momsky	104.6	4,051	0.04	10.4	3,620,388
18	Namsky	11.9	25,094	2.1	0.93	157,381
19	Neryungrinsky	98.9	74,901	0.76	11.67	2,272,465
20	Nizhnekolymsky	87.1	4,228	0.05	1.8	4,206,163.86
21	Nyurbinsky	52.4	23,743	0.45	4.88	1,233,932
22	Oymyakonsky	92.2	7,856	0.09	8.9	1,497,910
23	Oleneksky	318.1	4,326	0.01	29.3	11,665,180
24	Olekminsky	160.8	24,392	0.15	13.1	2,669,841
25	Srednekolymsky	125.2	7,312	0.1	12.2	2,859,772
26	Suntarsky	57.8	23,680	0.4	5.3	1,687,669
27	Tattinsky	19.0	16,271	0.9	1.7	717,897
28	Thomponsky	135.8	12,583	0.1	12.86	4,335,896
29	Ust-Aldansky	18.3	20,515	1.1	1.6	564,638
30	Ust-Maysky	95.3	7,263	0.08	9.3	2,748,589
31	Ustyansky	120.3	7,035	0.06	3.7	2,676,399
32	Khangalassky	24.7	33,021	1.3	1.8	1,503,490
33	Churapchinsky	12.6	21,107	1.7	1.06	252,025
34	Even-Bytantaysky	55.6	2,879	0.05	5.1	1,183,906
35	City of Yakutsk	3.6	357,693	94.4	0.26	92,565

▶ The amount of investments into environmental protection and rational use of natural resources reached 4,188,735 thousand rubles, operating environmental protection costs for the same year were 10,574,974 thousand rubles. The share of waste management costs was the largest one (Fig. 7).

The quality of urban environments has been regularly analyzed by the Ministry of Construction, Housing and Utilities of the Russian Federation. The quality index of the urban environment is published each year. In 2018–2020, the index was calculated for the 13 cities of the Republic of Sakha (Yakutia), including one large city (250 thousand – 1 million residents), 1 medium size town (50–100 thousand residents) and 11 small towns (25–50 thousand residents, 5–25 thousand residents and less than 5 thousand residents) (Table 3). Here is the breakdown of the cities by the number of residents: over 50 thousand — Yakutsk and Neryungri, 10 to 50 thousand — Mirny, Lensk, Aldan, Udachny and Vilyuysk, 5 to 10 thousand — Nyurba, Pokrovsk, Olekminsk and Tommot, 1 to 5 thousand — Srednekolymsk and Verkhoyansk. All cities of the region are located in the conventionally severe climate zone pursuant to the Method⁴ that takes account of the influence of climate features on urban environments.

Hence, some environmental indicators of the Republic of Sakha (Yakutia) and its districts, presented in the article, characterize the anthropogenic loads on its natural water bodies and atmosphere air, as well as local compensatory factors, such as forest lands and PNA.

In the Republic of Sakha (Yakutia), The largest area is occupied by the Oleneksky district (318.1 thousand km²).

The maximum population density is in the city of Yakutsk (94.4 residents/km²).

The maximum population is in the city of Yakutsk (357,693 thousand residents). The maximum number of rural residents is in the Megino-Kangalassky district (27,011 thousand residents).

In the Mirninsky district, atmosphere air (emissions from stationary sources in 2019 — 117,512 thousand tons; in 2020 — 80,925 thousand tons) and water bodies (in 2020, water consumption was 46.13 million m³; wastewater discharges into surface water bodies was 28.29 million m³) are subjected to the maximum anthropogenic load. The maximum number of motor vehicles is registered in the city of Yakutsk (120,755 units).

The largest areas of the forest land (29.3 million hectares) and PNA (11,665,180 hectares) are in the Oleneksky district.

The data submitted by all cities of the republic were used to calculate the urban environment quality index for 2018–2020. Udachny, Neryungri and Yakutsk scored more than half of the maximum number of points in terms of three of six types of urban spaces evaluated to calculate the index. The Republic of Sakha (Yakutia) is one of the largest regions of Russia in terms of forest areas; however, out of 13 cities, only Yakutsk scored more than half of the maximum number of points when green spaces were assessed. Highest quality areas are concentrated in the Lensky, Olekminsky, Ust-Maysky and Aldansky districts. About 90 % of forests have Dahurian larch, pine, cedar, spruce, birch and aspen⁵.

Table 3. Urban environment quality index of the cities of the Republic of Sakha (Yakutia)⁵

District	Urban population, thousand residents	Year	ST, score						Index, score
			ST ₁	ST ₂	ST ₃	ST ₄	ST ₅	ST ₆	
Aldansky	Tommot 6.7	2018	8	13	12	12	8	31	84
		2019	13	22	10	10	15	31	101
		2020	14	26	11	13	18	33	115
	Aldan 20.4	2018	24	26	16	17	21	23	127
		2019	18	26	17	16	18	22	117
		2020	18	31	16	15	20	22	122
Verkhoyansky	Verkhoyansk 1.1	2018	16	22	2	16	7	14	77
		2019	18	23	9	13	15	23	101
		2020	17	26	12	15	19	27	116
Vilyuysky	Vilyuysk 11.3	2018	20	21	9	11	9	15	85
		2019	19	25	8	12	8	23	95
		2020	19	25	8	20	9	27	108
Lensky	Lensk 23.3	2018	26	23	17	13	17	29	125
		2019	25	27	14	13	15	30	124
		2020	22	19	15	22	18	31	127
Mirninsky	Udachny 12.2	2018	37	17	17	12	14	37	134
		2019	39	25	15	11	10	35	135
		2020	31	31	15	15	14	35	141
	Mirny 35.4	2018	24	22	13	16	20	32	127
		2019	23	26	12	16	21	33	131
		2020	20	25	13	23	22	34	137
Neryungrinsky	Neryungri 59.0	2018	32	18	18	29	31	34	162
		2019	41	22	16	22	23	32	156
		2020	42	27	24	28	27	33	181

4 Method of calculation of the urban environment quality index, approved by the Decree of the Government of the Russian Federation dated March 23, 2019. No. 510-r.

5 Urban Environment Quality Index. URL: <https://xn----dtbcccddstypabxk.xn--p1ai/#/regions/483> (access date: 19.03.2022).

End of the Table 3

District	Urban population, thousand residents	Year	ST, score						Index, score
			ST ₁	ST ₂	ST ₃	ST ₄	ST ₅	ST ₆	
Neryungrinsky	Neryungri 59.0	2018	32	18	18	29	31	34	162
		2019	41	22	16	22	23	32	156
		2020	42	27	24	28	27	33	181
Nyurbinsky	Nyurba 9.8	2018	19	16	15	14	11	22	97
		2019	17	19	14	17	10	31	108
		2020	17	28	14	18	16	36	129
Olekminsky	Olekminsk 9.1	2018	13	25	15	17	9	20	99
		2019	14	28	12	17	9	24	104
		2020	18	30	12	21	15	24	120
Srednekolymsky	Srednekolymsk 3.5	2018	13	33	7	16	16	23	108
		2019	14	27	7	18	19	27	112
		2020	14	28	9	22	20	25	118
Khangalassky	Pokrovsk 9.5	2018	21	21	14	14	13	15	98
		2019	21	24	12	12	12	24	105
		2020	19	26	13	17	14	25	114
City of Yakutsk	Yakutsk 330.6	2018	25	23	27	24	20	28	147
		2019	23	20	21	22	16	31	133
		2020	26	29	31	30	26	39	181

The following abbreviations are used in the table: ST — type of urban space, ST₁ — housing and adjacent spaces, ST₂ — street and road network, ST₃ — green spaces, ST₄ — public and business infrastructure and adjacent spaces, ST₅ — social and leisure infrastructure and adjacent spaces, ST₆ — urban space, Index — Urban Environment Quality Index.

Symbols:

14	Scored less than half of the maximum number of points
39	Scored more than half of the maximum number of points

For the protection of atmospheric air and the pievention of climate change,
thousand rubles

For the collection and treatment of wastewater,
thousand rubles

For waste management, thousand rubles

For the protection and rehabilitation of land, surface and groundwater,
thousand rubles

For other directions, thousand rubles

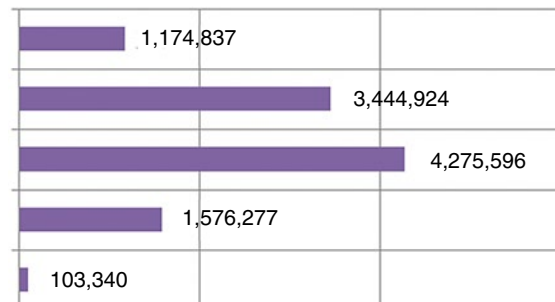


Fig. 7. The structure of operating environmental protection costs in the Republic of Sakha (Yakutia)

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Экологический ресурс территории республики Саха (Якутия): обзор

Выполнен обзор показателей, характеризующих состояние экологической обстановки в республике Саха (Якутия) и ее районах, в том числе рассмотрены землеустройство, площади территорий, численность и плотность населения, обеспеченность жителей автомобилотранспортными средствами, нагрузки от хозяйственной деятельности на природные водные объекты и атмосферный воздух, структура обращения с отходами производства и потребления, площади лесного фонда и особо охраняемых природных территорий, объем инвестиций, направленных на охрану окружающей среды и рациональное использование природных ресурсов, текущие (эксплуатационные) затраты на охрану окружающей среды. Используются системный анализ статистической информации и текстологические методы извлечения знаний из специальной литературы. Разработана интеллект-карта некоторых характеристик состояния экологической обстановки на территории республики Саха (Якутия). Проведена выборка и анализ показателей индекса качества городской среды для всех городов республики за период 2018–2020 гг. Рассмотренные аспекты экологической информации по республике Саха (Якутия) и по районам в комплексе позволяют анализировать экологический ресурс их территорий, влияние на природные объекты окружающей среды, а также проводить сравнительный анализ с другими субъектами, учитывая наличие сохраненного лесного фонда и охраняемых природных территорий и объектов.

Ключевые слова: устойчивое развитие, экологическая безопасность, охрана окружающей среды, городское хозяйство, особо охраняемая природная территория, показатель, экология, индекс качества городской среды

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