

# Comprehensive Environmental Assessment on the Territory of the Chechen Republic

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**Abstract** – The paper presents an environmental study of the air basin, soil cover and large water bodies (Terek and Sunzha) in the territory of the Chechen Republic that was conducted by the authors in 2017. The analysis showed that the ecological condition of the air basin meets the sanitary requirements. The concentration of the main air pollutants does not exceed acceptable standards. Background radiation is normal, while mercury vapor is absent. Over the past decade, a decrease in the concentration of petroleum products in the soil and water bodies can be clearly seen. Their load does not exceed the maximum permissible concentration (MPC). The study of the Terek and Sunzha water revealed a relatively low content of pollutants (chlorides, sulphates, total hardness, permanganate oxidation) in the samples and a high level of dissolved oxygen of 5.8 mgO<sub>2</sub>/dm<sup>3</sup> and 6.3 mgO<sub>2</sub>/dm<sup>3</sup>, which indicates good water quality.

**Keywords** – the Chechen Republic; ecological condition; water bodies; the Terek River; the Sunzha River; pollutants; heavy metals.

## I. INTRODUCTION

In accordance with the Environmental Doctrine of the Russian Federation “the sustainable development of the Russian Federation, the high quality of life and health of its people, as well as national security can be ensured, provided that natural systems are preserved and the environmental quality is promoted. This involves the formulation and consistent implementation of the unified state policy in the field of ecology, aimed at the protection of the environment and rational use of natural resources. The preservation and recovery of natural systems should be one of the priorities of the state and society” [15]. To this end, a series of measures are being taken at the federal level to implement the tasks set. The passport of the National Ecology Project is approved. The Ministry of Natural Resources and Ecology of the Russian Federation has now developed a plan for a phased transition to the best existing technologies. In the regions, there are a number of ongoing programs developed and implemented to address environmental challenges.

In the Chechen Republic, the state program on the Environmental Protection and Forestry Development is currently being implemented.

During the reconstruction of the republic, a number of initiatives were undertaken to eliminate the environmental impact of military operations that caused immense damage to the environment.

All unauthorized landfills within cities and rural settlements were eliminated. The soils polluted with oil were reclaimed and restored; mini-factories for the artisanal petroleum processing were closed down. As a result of the measures taken, the environmental situation has significantly improved in many respects.

## II. METHODS AND MATERIALS

Inorganic pollutants in the air basin were analyzed using a mobile laboratory ATMOSPHERA equipped with a sampler and modern equipment to detect pollutants and specify their concentrations. Water and soil data were obtained in the Laboratory of Environmental Control of the Ministry of Natural Resources and Environmental Protection. The concentration of heavy metals in the soil was determined by an inversion voltmeter, oil products – by a KN-2M concentration meter, whereas hydrochemical parameters – by physicochemical methods: IR spectroscopy, mass spectrometer (ITQ700), spectrophotometer, and an inversion voltammetric analyzer.

## III. RESULTS

Air monitoring of the Chechen Republic was carried out in the territory of Grozny and in the Vedeno, Gudermes, Kurchaloy, Shali and Shelkov districts. The obtained annual laboratory data denoting the load of inorganic pollutants in the air basin of Grozny, in the Zavodskoy, Leninsky, and Oktyabrsky districts, are given in Table 1.

**TABLE I. AVERAGE ANNUAL LOAD OF POLLUTANTS IN THE AIR BASIN OF GROZNY, 2017, MG/M<sup>3</sup>**

No.	Grozny, city districts	Dust	NO	NO <sub>2</sub>	SO <sub>2</sub>	CO	O <sub>3</sub>	H <sub>2</sub> S	NH <sub>3</sub>
1	Zavodskoy	0.02	0.15	0.15	0.01	0.28	0.00	0.00	0.05
2	Leninsky	0.02	0.13	0.10	0.01	0.39	0.00	0.00	0.05
3	Oktyabrsky	0.04	0.08	0.13	0.01	0.25	0.00	0.00	0.01
4	Staropromyslovsky	0.02	0.15	0.25	0.01	0.53	0.00	0.00	0.02

It is evident from the data obtained that the concentration of pollutants and dust varied in the range of 0.01-0.53 MPC and did not exceed the maximum permissible limits. The content of ammonia in the samples of air is 0.01-0.05 MPC, while carbon monoxide – 0.25-0.53 MPC. Hydrogen sulfide and ozone were not detected throughout the year in all air samples on the territory of Grozny (Table 1). The content of mercury vapor in the atmosphere of Grozny does not exceed 12 ng with a maximum permissible concentration of 300 ng.

30 air samples were taken in each of the 5 districts of the republic. In all surveyed districts, the content of inorganic pollutants does not exceed the maximum permissible limits. For example, hydrogen sulfide was not detected in any of the districts except for Shali where its concentration was 0.006 mg/m<sup>3</sup> with MPC to make up 0.008 mg/m<sup>3</sup>. The monitoring of background radiation showed that the level of pollution did not exceed 2–9 µR/h on average with the maximum permissible concentration to make up 20 µR/h.

The extent of soil pollution with heavy metals and petroleum products in the Chechen Republic was studied in three cities (Grozny, Gudermes, Argun) and 12 districts (Groznsky, Sunzhensky, Kurchaloyevsky, Shalinsky, Vedensky, Nozhay-Yurtovsky, Shatoysky, Itum-Kalinsky, Achkhoy-Martanovsky, Urus-Martanovsky, Naursky and Shelkovskoy).

In total, over 200 soil samples were taken in these territories during 2017. The obtained annual laboratory data are given in Table 2.

Waterborne and airborne pollutants are accumulated in the soil. Pollutants end up in the environment resulting from human conduct. Slow soil self-purification contributes to the change in the chemical composition of soil and the accumulation of harmful substances. One of the priority groups of soil pollutants are heavy metals. Therefore, it is imperative to monitor their load in the soil.

**TABLE II. AVERAGE ANNUAL LOAD OF POLLUTANTS IN THE SOIL COVER IN THE CHECHEN REPUBLIC IN 2017, MG/KG**

	Locality	Chemical pollutants								
		Copper	Zink	Lead	Cadmium	Arsenic	Mercury	Nickel	Manganese	Petroleum products
<b>Cities</b>										
1	Grozny	1.00	1.16	1.31	<0.10	0.10	0.10	<0.50	247.70	63.50
2	Argun	1.00	<1.00	1.21	<0.10	<0.10	<0.10	<0.50	236.10	65.90
3	Gudermes	<1.00	1.32	1.64	<0.10	<0.10	<0.10	<0.50	242.60	74.00
<b>Districts</b>										
1	Achkhoy-Martanovsky	<1.00	1.15	1.20	<0.10	<0.10	<0.10	<0.50	338.80	50.00
2	Vedensky	<1.00	1.16	1.03	<0.10	0.10	0.10	<0.50	308.80	75.1
3	Groznsky	<1.00	1.36	0.94	<0.10	0.10	0.10	<0.50	240.00	54.00
4	Itum-Kalinsky	<1.00	1.08	1.25	<0.10	<0.10	<0.10	<0.50	210.60	58.00
5	Kurchaloyevsky	<1.00			<0.10	<0.10	<0.10	<0.50	227.40	72.50
6	Naursky	<1.00	1.32	1.64	<0.10	<0.10	<0.10	<0.50	297.00	98.20
7	Nozhay-Yurtovsky	<1.00	<1.00	1.54	<0.10	<0.10	<0.10	<0.50	342.60	63.50
8	Sunzhensky	<1.00	1.44	0.93	<0.10	0.10	0.10	<0.50	236.90	65.40
9	Urus-Martanovsky	<1.00	1.16	1.25	<0.10	<0.10	<0.10	<0.50	302.40	82.80
10	Shalinsky	<1.00	1.24	1.28	<0.10	<0.10	<0.10	<0.50	242.80	64.02
11	Shatoysky	<1.00	1.36	1.00	<0.10	<0.10	<0.10	<0.50	258.70	50.00
12	Shelkovskoy	<1.00	1.36	1.00	<0.10	<0.10	<0.10	<0.50	258.70	50.00

The extent of pollution with heavy metals and petroleum products was compared with the maximum permissible concentration.

The study of all soil samples on the territory of the Chechen Republic showed that the load of copper, zinc, lead, cadmium, arsenic and mercury did not exceed the maximum permissible concentration in 2017 (Table 2). According to laboratory data, the concentration of manganese in the soil samples on the territory of the Chechen Republic is given in Table 2. The table shows that the concentration of manganese was in the range of 210.6–342.6 mg/kg and did not exceed the maximum permissible concentration (1500 mg/kg)

Petroleum products pose a significant risk to the environment, being a source of pollution of ground and surface water bodies, soil cover and air basin. Today, a serious environmental problem threatening the population of the Chechen Republic is rapidly increasing traffic, insufficient fuel quality and technical condition of fleet vehicles. Therefore, tracking the distribution of petroleum products in all environments (soil, water and air) is imperative. The obtained laboratory data on the load of petroleum products in the soil cover of the Chechen Republic are given in Table 2.

The studies showed that the load of petroleum products in the soil of Argun, Grozny and Gudermes does not exceed the hygienic standard (MPC of 500 mg/kg) and is 63.5; 65.9; 74.0 mg/kg, respectively. In the districts of the Chechen Republic, the load of petroleum products in the samples is within 50.0–98.2 mg/kg, which is at a level well below the MPC (Table 2).

The quality of the habitat determines the most important indicator – the degree of surface water purity. The anthropogenic impact on surface water bodies over the past decades has led to the depletion of their regenerative possibilities. The main water pollutants are sewage, raw and non-decontaminated water as well as waste from agricultural, industrial and other enterprises.

The main assessment criteria for the degree of river pollution are toxic substances, nitrates, chlorides, sulfates, pH, oxygen content, BOD<sub>5</sub> (biochemical oxygen demand), oxidability and organoleptic indicators. Table 3 shows the survey results of the ecological condition of the Terek and Sunzha in 2017.

TABLE III. AVERAGE HYDROCHEMICAL INDICATORS OF WATER IN THE TEREK AND SUNZHA IN 2017, MG/DM<sup>3</sup>

River	Pollutants							
	Nitrates	pH	Chlorides	Sulfates	Oxygen content	BOD <sub>5</sub>	Permanganate value	Dry residues
Terek	19.6	7.5	69.6	237.8	5.8	1.6	1.6	371.0
Sunzha	17.5	7.5	68.5	231.0	6.3	1.3	1.4	344.0

Nitrates are hazardous pollutants that affect the sanitary regime of water bodies. Being accumulated in water bodies, they cause a wide range of metabolic and morphophysiological disturbances in fish and other inhabitants of water bodies, lead to oxygen starvation of the organism and react with blood hemoglobin. In this respect, the assessment of the amount of nitrate anions in water bodies is a necessary condition. The average annual values for the nitrate content in the Terek and Sunzha for the entire 2017 are presented in Table 3.

Permanganate value and chloride content are one of the indicators of river water pollution with domestic sewage. For example, permanganate value depends on the nature of anthropogenic pollutants.

The permanganate value met hygienic standards and remained within 1.4–1.6 mg/dm<sup>3</sup> with a standard of no more than 5.0 mg/dm<sup>3</sup>. The average annual chloride concentration remained at 69.6 mg/dm<sup>3</sup> in the Sunzha and 68.5 mg/dm<sup>3</sup> in the Terek (MPC is 350 mg/m<sup>3</sup>).

Agricultural, industrial and domestic wastewater is the main source of sulfate ions in river water. Over the entire study period, the average annual rate of sulfates did not exceed the maximum permissible concentration of 500 mg/dm<sup>3</sup> and

amounted to 237.8 mg/dm<sup>3</sup> and 231.0 mg/dm<sup>3</sup> in the Terek and Sunzha, respectively.

Natural sources of organic substances that end up in water bodies can be animal and vegetable remains. Agricultural (meat processing plants), wood, pulp-and-paper waste, as well as petroleum products are man-made sources of organic matter. The water quality indicator BOD<sub>5</sub> (biochemical oxygen consumption) is the one to characterize the organic matter content in a water body.

A low average BOD<sub>5</sub> index of 1.3 mgO<sub>2</sub>/dm<sup>3</sup> and 1.6 mgO<sub>2</sub>/dm<sup>3</sup> in the Terek and Sunzha, respectively, (the hygienic standard is no more than 4.0 mgO<sub>2</sub>/dm<sup>3</sup>) indicates a satisfactory quality of the river water throughout 2017.

The concentration of dissolved oxygen in water bodies depends on the amount of toxic substances, partial pressure, water temperature, the number of bacteria and other water organisms subject to chemical and biochemical oxidation. Given that the standard makes up at least 4.0 mg O<sub>2</sub>/dm<sup>3</sup> (Table 3), the average annual concentration of dissolved oxygen in the water of the Terek River was 5.8 mg O<sub>2</sub>/dm<sup>3</sup>, in the Sunzha River – 6.3 mgO<sub>2</sub>/dm<sup>3</sup>. A high average dissolved oxygen index justifies a good quality of river water in 2017. The most

important pH indicator also characterizes good water quality (hygienic standard of 6.5–8.5) in both rivers.

Water salinity (amount of dry residues) in the rivers slightly changed in 2017 and the average annual rate remained within 371.0–344.0 mg/dm<sup>3</sup>, which corresponded to the hygienic standards during the entire study period

It should be noted that the river water had neither smell nor taste throughout the year 2017.

#### IV. CONCLUSION

Thus, the ecological air, soil and water conditions in the republic meet the sanitary requirements. The main source of air pollution in the republic is motor transport. The main sources of water pollution in the Terek and Sunzha in the Chechen Republic are waste water, surface washes and diffuse contamination. The level of chemical pollution of farmsteads, as an indicator of adverse effects on the health of the population, in all the studied settlements falls within the permissible category of pollution.

In general, the ecological situation in the studied areas of the Chechen Republic in 2017 is characterized as stable with no environmental accidents and disasters.

The state of the environment is greatly important for the republic where tourism is rapidly developing.

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