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ASSESSMENT OF THE ENVIRONMENTAL IMPACT OF INDUSTRIAL ENTERPRISES (ON THE EXAMPLE OF KASHKADARYA REGION)

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Abstract
This article discusses the rapid development of industry in the Kashkadarya region, the exploitation of natural resources and environmental degradation, which pose a serious threat to infrastructure, agriculture and human life. The study uses modern geoinformation technologies - GIS (geographic information systems), satellite images, drone (UAV) data and spatial modeling tools to identify risk zones, analyze their ecological footprints and integrate this information into the state cadastral system. The proposed methodological approach serves to make scientifically sound decisions on environmental management and emergency risk reduction.

Keywords: Industrial enterprises, Oil and gas industry, Heavy metals, Geoinformation systems, spatial analysis, man-made hazard zones.

INTRODUCTION

In the 21st century, as a result of the rapid development of industrial production, anthropogenic pressure on the environment is sharply increasing. As a result of population growth, accelerated urbanization processes, expansion of fuel and energy complexes and intensive use of natural resources, the ecological state of atmospheric air, soil cover, water resources and biodiversity is deteriorating. Especially in regions with developed oil and gas, mining, chemical and metallurgical industries, the level of environmental risk is increasing as a result of man-made processes.

According to the United Nations, more than 90 percent of the world's population uses atmospheric air that does not meet sanitary standards. Every year, millions of tons of industrial waste are released into the atmosphere, hydrosphere and pedosphere, negatively affecting human health and natural ecosystems. Globally, the increase in carbon dioxide, nitrogen oxides, sulfur dioxide and heavy metals is causing climate change, acid rain, soil degradation and a decrease in biodiversity. As a result of studying environmental pollution caused by various factors, concepts such as technogenic or technogenesis have appeared in the scientific literature. Technogenesis is a change in natural complexes under the influence of human production activities. That is, technogenesis is a change in the combination of

geochemical processes in the biosphere as a result of human technical and technological activities [120].
According to the UN in 2016, 92% of the world's population directly breathes polluted air, which does not meet sanitary and hygienic standards. If at the beginning of the 20th century, 10 major natural and man-made disasters were recorded on our planet, then by the middle of the 20th century, 65 such cases were observed, by the end of the century, more than 200, and by the beginning of the 21st century, about 250.

Main Part
Aviation occupies one of the leading places in atmospheric pollution. The total number of aircraft in the world is about 10 million, and they emit millions of tons of harmful substances (nitrogen, sulfur, carbon oxides, etc.) into the air every year. According to calculations, each aircraft, when flying a distance of 1000 km, emits more than 9 tons of harmful substances into the atmosphere [55, 68, 104].
Motor transport is also one of the leaders in atmospheric pollution. According to the analytical agency "Avtostat", in 2016 the number of cars in the world reached 1 billion 15 million. units. 25 years ago this figure was 500 million units. The leadership in this place belongs to the USA - 255 million. units of cars, followed by China - 110 million. units, Japan - 80 million units, Russia - about 40 million units [173].
All vehicles consume 3.2 billion. tons of oxygen per year for fuel combustion and emit 2.5 billion. tons of harmful and toxic substances. The composition of exhaust gases emitted by cars is very complex, it includes more than 200 chemical compounds. Most of these compounds are toxic and harmful to the environment. All vehicle emissions from CIS member countries exceed 400 million tons per year [13, 57, 80, 109].
According to Russian scientists, when driving 15 km, one car burns 4.35 tons of oxygen and emits 3.25 tons of CO_2, 8 tons of CO, 0.2 tons of hydrocarbons, 0.04 tons of nitrogen oxides, etc. Only 15% of the combustible fuel is consumed by the car, and the remaining 85% is emitted directly into the air [16, 17, 54, 56]. According to V.N. Kudeyarova [76], the amount of CO_2 emitted into the atmosphere on the territory of Russia is 2-2.5 times higher than the emissions from all enterprises, vehicles and agricultural activities. In Russia, CO_2 emissions falling on the surface of the soil cover for a year are 8 times higher than industrial emissions in this country.
According to data, up to 260 thousand tons of lead are released into the atmosphere in the exhaust gases of motor vehicles every year, and one car annually releases 1 kg of lead into the atmosphere in the form of aerosols. In the USA, more than 90% of

anthropogenic lead pollution occurs in motor transport [80]. According to X.A. Dzhuvelikyan, I.V. Cherepukhina, about 4 million chemicals have been registered in the external environment, and their number is increasing by 6000 every year [54, 55].

Relevance and level of research:

Annual greenhouse gas (GHG) emissions in Uzbekistan increased by 10% between 1990 and 2005. Due to land use change and deforestation, total GHG emissions in million tons of carbon dioxide (CO2) equivalent increased by 10% between 1990 and 2000 and by 9.24% between 1990 and 2005. If land use change and forestry (LUCF) is included, the total increase between 1990 and 2005 is 10.48. Interestingly, 2005 is the year when LUCF contributed to total GHG emissions. This was not the case in previous years. It should be noted that CO2 emissions from aviation, international bunkering and biomass (approximately 6.3 million tonnes of CO2 equivalent in 2005) are methane (CH4) and CO2, the two main components of GHGs, and together accounted for approximately 93% (1990) to 95% (2005) of total GHG emissions.

However, the two GHGs follow different general trends: CO2 has decreased significantly since 1990, both in terms of quantity and as a percentage of total emissions. In particular, CO2 accounted for 61.95% of total emissions in 1990 and its share has been steadily decreasing, falling to 50.25% in 2005. Over the same period, the share of CH4 has increased from 31% in 1990 to 39.36% in 1994, 40.61% in 2000 and 44.69% in 2005. This increase in CH4 emissions is mainly due to a significant increase in natural gas extraction, which has shown a high level of concentration. The concentration of these elements decreases with distance from industrial plants.

Table 1. Average Annual Emissions of Pollutants from Manufacturing Industries

Environmental Sphere Environmental Sphere	Main Pollutants Main Pollutants	Energy Industry							
		Energy Industry	Automotive Industry	Mining Industry	Metallurgical Industry	Construction Materials Industry	Synthetic Fiber Industry	Oil Industry	Gas Industry
Atmosphere	Carbon dioxide (CO_2), billion tons	67.5	65.2	67.0	63.2	42.6	64.6	67.8	68.3
	Nitrogen oxides (NO_2), million tons	18,8	18,6	18,8	18,4	14,6	17,6	19,1	19,8
	Sulfur oxides (SO_2), billion tons	5,1	5,1	5,6	5,4	3,7	4,6	5,8	5,9
	Lead (Pb), thousand tons	-	87	86	90	68	12	81	87
Hydrosphere	Carbon dioxide (CO_2), billion tons	34,4	36,2	37,2	36,1	28,9	28,7	37,2	38,4
	Nitrogen oxides, million tons	12,2	14,3	14,1	13,9	12,4	13,8	14,3	15,3
	Sulfur oxides (SO_2), billion tons	4,9	4,7	5,2	5,4	4,2	4,1	5,4	5,9
	Lead (Pb), thousand tons	-	83	85	89	74	14	72	78
Pedosphere	Carbon oxides, billion tons	44	48,6	51,2	64,6	49,1	57,1	44,8	52,7
	Nitrogen oxides, million tons	21,4	20,1	21,7	20,4	19,3	19,5	22,6	24
	Sulfur oxides (SO_2), billion tons	6,9	7,3	8,2	7,4	6,5	7,1	8,4	8,6
	Lead (Pb), thousand tons	-	84	83	90	68	12	78	84

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The oil and gas industry is one of the most environmentally dangerous industries. According to research, gas industry enterprises annually emit billions of tons of carbon dioxide, millions of tons of nitrogen and sulfur oxides into the atmosphere. During combustion in gas flares, CO_2, SO_2, NO_x, H_2S, CH_4 and other harmful substances are formed, which cause air pollution. It is noted that when one ton of natural gas is burned in a flare, up to 50–80 kg of various harmful compounds are formed. The negative impact of oil and gas industry enterprises is not limited to the atmosphere. Phenols, petroleum products, heavy metals and other toxic substances contained in wastewater generated during production lead to pollution of surface and groundwater. In turn, these substances accumulate in soil cover and vegetation, causing a disruption of the ecological balance.

"Distinctive Features of the Environmental Impact of Gas Industry Enterprises

"Natural Environment Spheres"	Main Types of Pollutants	Pollutant Emissions from Gas Industry Enterprises				
		Shurtan Gas Chemical Complex	Mubarak Gas Processing Plant	Shurtanneftgaz Gas Production Enterprise	Kazakhstan Gas Processing Plant	Astrakhan Gas Processing Plant
Atmosphere	Carbon Dioxide (CO_2) (thousand tons)	106	115	110	123,5	124,7
	Nitrogen Dioxide (NO_2) (mg/m³)	80-135	223	210	214,3	213,7
	Sulfur Dioxide (SO_2) (thousand tons)	2,41	5,6	3,4	7,2	6,8
	Hydrogen Sulfide (H_2S) (thousand tons)	1,3	2,7	1,4	3,4	3,6
Hydrosphere	Carbon Dioxide (CO_2) (thousand tons)	2,3	-	2,8	-	60,7
	Nitrogen Dioxide (NO_2) (mg/m³)	4,5	-	5,2	-	58,2
	Sulfur Dioxide (SO_2) (thousand tons)	0,6	-	0,7	-	2,1
	Hydrogen Sulfide (H_2S) (thousand tons)	1,3	2,7	1,4	-	1,8
Pedosferaga	Carbon Dioxide (CO_2) (thousand tons)	90,4	107	103	116,8	61,3
	Nitrogen Dioxide (NO_2) (mg/m³)	125	210	201	204,5	144,4
	Sulfur Dioxide (SO_2) (thousand tons)	2,3	5,2	3,4	6,1	4,7
	Hydrogen Sulfide (H_2S) (thousand tons)	1,1	2,3	1,4	3,2	2,6

Heavy metal pollution is one of the most pressing environmental problems today. Elements such as lead, nickel, zinc, cadmium, and copper change the physicochemical properties of the soil, reduce its microbiological activity, and negatively affect the productivity of agricultural crops. Studies have shown that heavy metals accumulate in high concentrations in soil and plants in Germany, the Czech Republic, Russia, and other industrialized regions.

In the Republic of Uzbekistan, environmental monitoring has also been carried out around industrial enterprises. In particular, studies conducted in the industrial areas of the Almalyk Mining and Metallurgical Combine, the Navoi Mining and Metallurgical Combine, and the city of Tashkent have shown high levels of lead, zinc,

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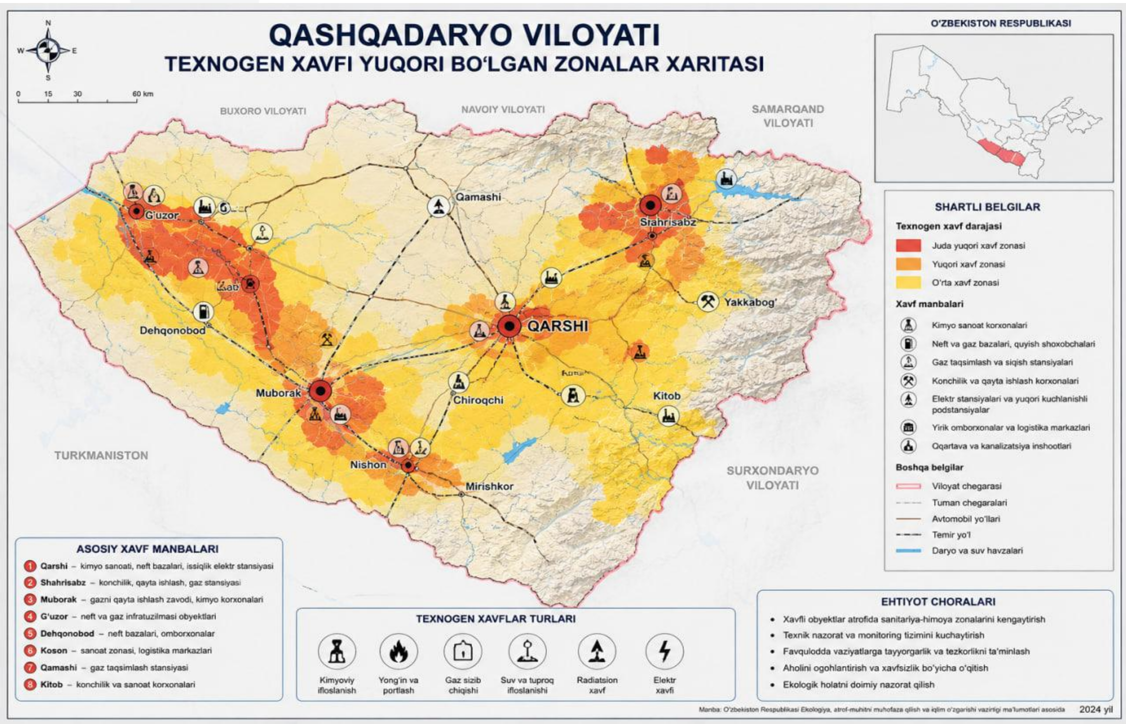
and cadmium in soil and plants. The concentration of these elements decreases with distance from industrial enterprises.

Kashkadarya region is one of the largest oil and gas industry centers of the Republic of Uzbekistan. The Shurtan gas and chemical complex, the Mubarak gas processing plant and other large industrial enterprises operate in the region. These enterprises, along with their important role in economic development, also exert significant technogenic pressure on the environment. Therefore, identifying areas with high technogenic risk, assessing their ecological status and forming a geoinformation base in the state cadastre system are among the important scientific and practical tasks of today. Geoinformation systems create opportunities for collecting, storing, processing and visual analysis of environmental monitoring data. As a result, the efficiency of identifying technogenic risk zones, assessing environmental risks and making management decisions increases.

The purpose of this study is to assess the environmental impact of industrial enterprises on the example of the Kashkadarya region and develop scientific and methodological foundations for the formation of a geoinformation database for the state cadastre of areas with high technogenic risk.



Kashkadarya region is one of the main centers of the oil and gas industry of the Republic of Uzbekistan, where the Mubarak Gas Processing Plant, the Shurtan Gas and Chemical Complex, the Shurtan Oil and Gas Production Department, and a number of large industrial enterprises operate. These enterprises, while playing an important role in economic development, also exert significant man-made pressure on the atmospheric air. The main pollutants emitted into the atmosphere include carbon dioxide (CO_2), nitrogen oxides (NO_x), sulfur dioxide (SO_2), hydrocarbons, hydrogen sulfide (H_2S), methane (CH_4), and particulate matter.

Dynamics of pollutants emitted into the atmosphere in the Kashkadarya region

Years Emission volume (thousand tons)

2010 141.2

2015 176.3

2020 128.1

2024 88.6

According to the table, atmospheric emissions reached their maximum level in 2015, amounting to 176.3 thousand tons. In recent years, as a result of the modernization of production technologies and the strengthening of environmental control, the volume of emissions has decreased to some extent. Despite this, the region remains one of the largest polluting regions in the republic.

Gas flares release many harmful substances into the atmosphere. According to research, 50–80 kg of harmful substances are formed during the combustion of one ton of natural gas. The increase in these substances in the atmosphere leads to acid rain, the greenhouse effect, and a negative impact on human health.

CONCLUSION

This study assessed the environmental impact of oil and gas and gas and chemical industry enterprises located in the Kashkadarya region and developed scientific and methodological foundations for the formation of a geoinformation database of the state cadastre of areas with high technogenic risk. As a result of the conducted research, the following conclusions were drawn: Kashkadarya region is one of the regions of the Republic of Uzbekistan with a developed oil and gas industry, and the activities of industrial enterprises have a significant technogenic impact on the state of atmospheric air, water resources, soil cover and vegetation. Analysis of pollutants emitted into the atmospheric air showed that the volume of emissions in the region has reached high levels in some years, and the main sources of pollution are gas processing enterprises, technological installations and gas combustion processes in flares. CO_2, SO_2, NO_x and other harmful substances emitted into the atmosphere cause deterioration of the ecological environment.

It was found that petroleum products, phenols and heavy metals contained in wastewater generated as a result of the activities of industrial enterprises have a negative impact on the quality indicators of surface and groundwater. This poses a

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threat to the stability of water ecosystems. Thus, the geoinformation database model developed on the example of the Kashkadarya region is of significant scientific and practical importance in maintaining the state cadastre of areas with high technogenic risk, assessing the ecological state and ensuring the rational use of natural resources.

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