THE MINISTRY OF NATURAL RESOURCES AND ENVIRONMENTAL
PROTECTION OF THE REPUBLIC OF BELARUS

STATE SCIENTIFIC ESTABLISHMENT
«INSTITUTE OF NATURAL MANAGEMENT
NATIONAL SCIENCE ACADEMY OF BELARUS»

THE STATE OF ENVIRONMENT IN THE REPUBLIC OF BELARUS

NATIONAL REPORT

Minsk
«Beltamozhservice»
2010

UDC 502(476)(047.1)

Prepared by:
Kadatskaya O.V., Sanets E.V., Bykova N.K., Ovcharova E.P.

The state of environment in the Republic of Belarus: Nat. report / the Ministry of natural resources and environmental protection of the Republic of Belarus, State scientific establishment «Institute of natural management National science academy of Belarus». – Minsk: Beltamozhservice, 2010. – 150 p.

ISBN 978-985-6667-85-8.

In the national report «The state of environment of the Republic of Belarus» there is information which characterizes the condition and change tendencies for last five years (2005-2009) of atmospheric air, surface waters, plant and animal life according to the international ecological indicators are presented. Features of use and protection of water, ground and biological resources of the country are reflected, priority directions of the state policy of the environment protection, including management of nature protection activity, the ecological information, formation and education, international cooperation are shown.

The report is prepared for state structures of management, scientific and public organizations, the country, and also foreign partners by the objective information about the state of environment of the Republic of Belarus, natural resources of the country and their protection.

UDC 502(476)(047.1)

ISBN 978-985-6667-85-8

Introduction

At the present time environmental policy, which is held at the state level, is a key element of sustainable development of the Republic of Belarus. Issues of ecological and economic activity, sustainable usage of natural resources are at the head of the national priorities. Implementation of environmental policy firstly intends to ensure the government bodies, scientific and public organizations, population of the country, as well as foreign partners the objective systematic information about the state of environment, natural resources and its protection.

In contrast to the annual information-analytical publications characterizing the ecological situation the national report «State of the Environment of the Republic of Belarus» leads the results of the environmental assessment for the last five years, reflects the priorities of state policy in the field of environment.

The purpose of the report is to assess the environment of Belarus and to expose the tendencies of changes over a five year period (2005-2009) with application of international environmental indices, to identify causes and effects of present day ecological conditions which allow as the whole to improve and standardize the analytic component of such kind documents.

For the first time the structure and content of the national report are based on the recommendations, which are set out in «Guide on Preparation of Assessment Reports for Protection of Environment , based on Application of Environmental Indicators in the East European States» (ECE/CEP/140) . The proposed environmental indicators are developed by the European Economic Commission of the United Nations Organization and are reflected in document «Recommendations to Governments of Eastern Europe, Caucasus and Central Asia States on Application of Environmental Indicators and Preparation of the Assessment Reports on Environmental Protection on its basis» (ECE/CEP/2007/8).

In accordance with the above mentioned documents the system of key environmental indicators of the Republic of Belarus is prepared, which includes both international and national ecological indicators. The approved ecological indicators allow to compare national indicators with similar indicators for other countries in Europe, to develop priorities and objectives of ecological policy, to evaluate the effectiveness of nature conservation measures. The core list of ecological indicators used in compiling the national report, is structured as separate issues (chapters), which include the following groups of indicators with the priority in terms of national and international requirements. They are: air pollution and ozone destruction, changes of climate, water resources, biodiversity, land resources, agriculture, energy, transport and wastes. Each chapter provides an analysis of key indicators with international status, in some cases supplemented by national of indicators used in Belarus.

Indicators for energy are excluded from the report status, since the time of compiling the report, there were no data to analyze them. In characterizing the other groups of indicators definite difficulties also appeared, linked as a rule with existing non-conformity of proposed indicators and the availability of statistical data for its implementation.

Indicators of the level of current radioactive contamination of air, river water and soil are considered as specific ecological indicators for Belarus.

The national report consists of introduction, conclusion, general part (geographic situation, socio-economic development of Belarus and the country's population), nine chapters, corresponding to a certain group of indicators, and a chapter devoted to questions of management on environmental protection.

Air pollution and the ozone layer are considered for the analysis of air emissions by priority pollutants, quality of atmospheric air in urban areas, atmospheric concentrations of ozone and ground-level ultraviolet. Climate change was characterized using the annual average of indicators of air temperature and precipitation for the five-year period, as well as data on emissions of greenhouse gases. Information about dangerous hydrometeorological phenomena is provided additionally.

Characteristics of water resources include the largest list of ecological indicators. They describe the quantitative parameters of the renewable fresh and groundwater, its use, reflect the level of development of water resources, give an idea about the quality of drinking water and the state of river water.

Analysis of the country's existing protected areas and forest land issues to preserve rare and endangered species of wild animals and wild plants are presented in the chapter «Biodiversity».

According to the recommendations of the above Guide, the state of land resources was considered by indicators such as confiscation of land from productive state and land affected by soil erosion. Available data observations of the chemical pollution of land held under the National Monitoring System Environment Program in the Republic of Belarus allowed to submit a report to provide information on soil pollution in cities.

Agriculture as a factor of pressure on the environment is characterized by two key indicators – using of mineral fertilizers and organic fertilizers.

The main environmental indicators used in the report to assess the impact of transport on the environment are of passenger and cargo handling. Refers to the amount of transport services for passengers and cargo, they can reveal the extent of its impact on the environment (fuel consumption, emissions of pollutants, noise emissions, etc.) Correlation between passenger and freight traffic by kinds of transport makes it possible to evaluate the effectiveness of measures aimed to protect the environment from pollution.

Section «Waste» is based on three main indicators, adapted to the available statistics in Belarus – producing of waste, recycling and use of waste production, final disposal of wastes.

As for Belarus, the contamination of the environment is the most serious environmental problem. In the report there is a special chapter, which deals with the level of radioactive contamination of air, water and soil.

The final chapter is devoted to the environmental management and the effectiveness of environmental policy in Belarus.

Contained in the national report data can be used for various processing steps to improve public policy and regulatory framework in the field of environmental protection. They are necessary for the development of economic instruments to regulate environmental protection, planning and implementation of environmental activities at the national and local levels.

The report uses information materials of the Ministry of Natural Resources and Environmental protection of the Republic of Belarus, the Ministry of Health of the Republic of Belarus, the Ministry of Housing of the Republic of Belarus, the National Statistics Committee of Belarus and State Committee on property of the Republic of Belarus.

Environmental assessment carried out mainly with the use of data published in ecological bulletins «State of Environment of Belarus» for 2005-2009, which are based on material provided by the following institutions and companies:

State institution «National Center for Radiation Control and Monitoring» of Department of Hydrometeorology of the Ministry of Natural Resources and Environment of the Republic of Belarus (Ministry of Nature);

State Institution «National Hydrometeorological Center» of the Department of Hydrometeorology of the Ministry of Nature;

State Scientific Institution «Institute of Physics of NAS of Belarus;

BSU institution «The National Research Center for ozone-stratum monitoring»;

Republican Unitary Enterprise «Central Research Institute of Complex Utilization of Water Resources»;

Forest inventory Republican Unitary Enterprise «Belgosles»;

State Scientific Institution «Institute of Experimental Botany by name of Kuprevich» NAS of Belarus»;

State Scientific-Production Association «Scientific and Production Centre for Bioresources» NAS of Belarus;

Republican Scientific Branch Unitary Enterprise «Institute of Soil and Agrochemistry» NAS of Belarus;

Republican National Scientific Research Unitary Enterprise «Belarusian Research Centre «Ecology».

The National report «State of the Environment of the Republic of Belarus» is prepared at the State Scientific Institution «Institute for Nature Use» NAS of Belarus and compiled by: Kadatskaya O.V., Sanets E.V., Struck M.I., Bykova N.K., Malchikhina A.V., Ovcharova E.P., Savchenko S.V., Zhivnach S.G. and Kavtsevich T.K. (cartographic materials).

General editing and coordination of work on the implementation of the report was realized by Candidate of Geographic Science Kadatskaya O.V.

The results of the analysis of ecological indicators presented in the National report were examined and approved by experts from the Ministry of Natural Resources and Environmental Protection of the Republic of Belarus, comprising: Ambrazhevich M.L, Germenchuk M.G., Dobritsky A.V., Zharkina A.I., Komosko I.V., Kuzmenkov S.K., Panteleyeva O.A., Pilipchuk A.S., Rudko I.V., Rusaya I.E., Savich O.V., Savchenko V.V., Trafimovich T.F. and the editorial board consisting of: Rachevsky A.N., Varavka V.N., Savich O.V.

1. Overview

Geographical location

The Republic of Belarus is situated in the central part of the European continent. The country territory is compact. Her area of 207.6 km2, length from north to south – 560 km, from west to east – 600 km

Among the 50 European states of Belarus is located at the 13th place in the occupied territories and the 14th – in terms of population. The share of country accounts for 2.1% of the area and 1,3 % of the population of the Europe accordingly. Belarus is comparable by area with countries such as Britain and Romania, in quantity of population – with Belgium, Greece, Hungary, Portugal and Czech Republic.

Belarus is a landlocked country and has no way out to sea. The nearest sea ports of neighboring countries are Kaliningrad, Gdansk, Ventspils, Klaipeda, which are located at the distance of 250-350 km from the border of Belarus.

Belarus is a member of the Commonwealth of Independent States (CIS) and is located at the junction of two major interstate associations – the Commonwealth and the European Union (EU). In the north, east and south the border passes by the CIS countries – Russia and Ukraine, in the west and northwest with the EU member states – Poland, Lithuania, Latvia *(Figure 1.1)*. This creates favorable conditions for cooperation with the CIS countries and the EU.

The country has an advantageous economic and geographical position, lying on the intersection of the shortest transportation routes from Central Russia to Western Europe and the Baltic Sea to the Black Sea. Two trans-European corridors – № 2, № 9 pass through the country. The first one goes in the direction «West – East», its length within Belarus – 610 km, the second – «North – South» with a length of 457 km.

Figure 1.1 – Map of Belarus

The energy transit from Russia to Western Europe is provided through Belarus . The country traversed by the main oil and gas pipelines (pipeline the «Yamal — Western Europe» and the «Druzhba» pipeline) and heavy-duty power lines pass through the country.

The territory of Belarus is crossed by the transcontinental railway road, which runs from the Pacific to the Atlantic oceans. It represents the shortest path from the dynamic-developing Asia-Pacific region to one of the world's major economic centers — the European Union.

Natural conditions

The surface of Belarus as a whole is flat. It is characterized by alternation of elevated, flat and low-lying spaces, with swamps and lakes. The main features of the present topography is largely due to the continental icing.

The country climate is moderately continental with Atlantic cyclones. Winters are mild, with prolonged thaws, summer — moderately warm. The average January air temperature in the southwest -4,4 °C and in the north-east of -8 °C; in July, -17.0 and 18,8 °C respectively. The average annual rainfall varies from 550 mm in the south to 700 mm in the uplands median strip. The western transfer of air masses is dominated in Belarus.

The predominant soils are turf-podzolic, peat and alluvial ones. The regulation of the water regime is often required for agricultural use.

As part of the natural vegetation forests are dominated, which alternate with meadow and marsh zones. The main forest tree is the pine. Pine forests cover more than half of the total forested area. The animal world is represented mainly by the species of mixed forest, there are also taiga and steppe species.

The territory of Belarus is a watershed for the basins of the Baltic and Black Seas. Totally in the country, there are 20,8 thousand rivers, the total length of 90.6 thousand km and 10,8 thousand lakes.

The territory of Belarus has a rather high level of conservation of natural complexes. The share of those which are in a natural or near natural state, is 2/3 of the total area of the country. There are large regions (Lake District, Polesie) with conservation of large areas of natural ecosystems — forest, marsh, meadow, which have not only national but also the European importance for conservation of biological and landscape diversity.

The mixture of forests and lakes with rugged relief, which is characteristic of the natural complexes of Belarus, creates favorable conditions for development of ecological tourism. But especially valuable in this respect is the northern part of the country where such combinations are the most numerous.

In the depths of Belarus deposits of various minerals have been found. Especially large reserves are presented in potash and rock salt, and ground and mineral waters, which are of high quality. The country also has large reserves of mineral building materials and peat. In addition, industrial value provides such minerals as oil, brown coal, combustible slates, iron ore, and some others.

However, Belarus has not enough their own hydrocarbons. Therefore, oil and natural gas are imported from abroad.

Socio-economic development

In the 2000's (except 2009) the economic development of Belarus was carried out rapidly. After the recession of 1990-ies, in 2003 the pre-crisis level of 1990 GDP was made. Subsequently, the pace of annual growth amounted to 8.6 — 10.2% *(Figure 1.2)*. In 2009, due to the influence of global financial and economic crisis the country's GDP has remained almost at the level of the previous year, its growth reached only 0.2%.

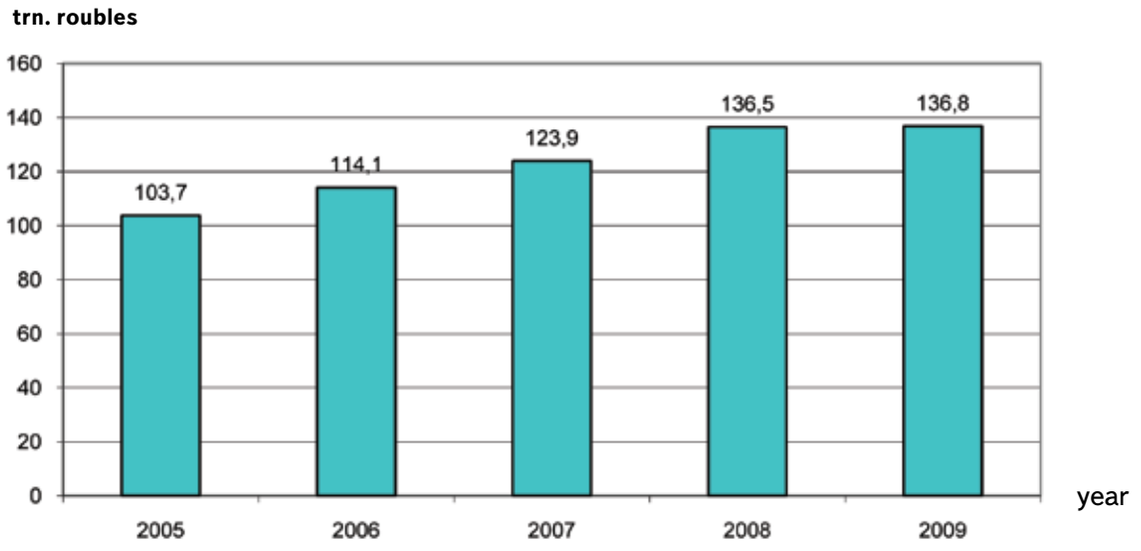


Figure 1.2 – Trends in GDP of Belarus for 2005 – 2009. (Prices 2009)

In 2000-ies, the growth of investments in fixed assets was carried out by faster pace. In absolute terms, they increased over the past 9 years in 3 times; in relative terms – in 1,6 times, with 20% of GDP in 2000 to 31% – in 2009. Such an investment share is close to the optimal value.

In the GDP structure the basic value belongs to the sphere of goods production. In 2009 its share was 44.7% *(Figure 1.3)*. The share of services was 41.2%.

Industry plays the leading role in production sphere. It forms the fourth of GDP. Four industries yield in its internal structure almost 4/5 of production – fuel (about a quarter), mechanical engineering and metalworking (the fifth part), food (almost the sixth part),also chemical and petrochemical (approximately the eighth part) *(Fig. 1.4)*.

In agriculture, crop production predominates in Belarus – 55%, cattle breeding is 45%. The area of 0.90 hectares of agricultural land relates on one inhabitant, 0.57 hectares of this land are arable.

The transport network of the country includes 5,5 thousand km of trunk railways, 85.7 thousand miles of automobile public roads, including 74.3 thousand km of firm covering. Density of rail transport network is 2.6 km/100 km^2, the automobile network – 35.8 km/100 km^2. Belarus has also 7.4 thousand km of gas main lines, about 3 thousand km of pipelines, 1,1 thousand km of oilproductpipes. The length of the airways is more than 5 thousand km.

The economy of Belarus has enough marked export orientation. The share of exports of goods and services in the second

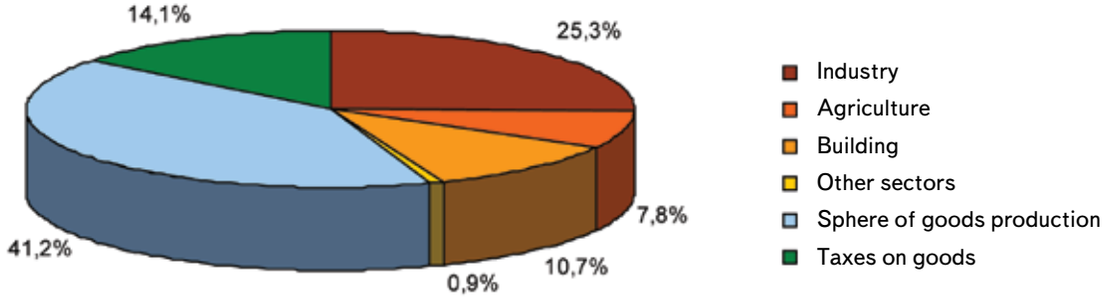


Figure 1.3 – Sectoral structure of GDP of Belarus, 2009

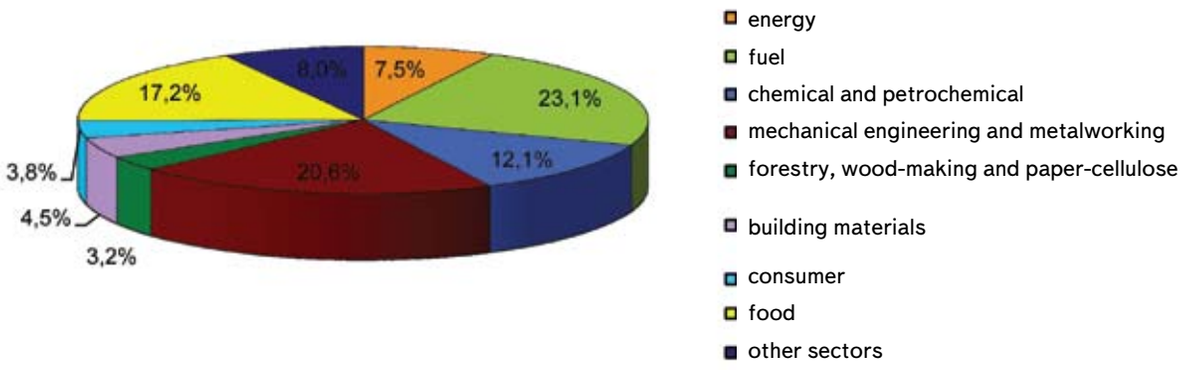


Figure 1.4 – Sectoral structure of industry of Belarus, 2009

half of 2000's. was stable at a high of 60-61% of GDP and only in a crisis in 2009 has decreased to 51%.

Petrochemical products are dominated in the export structure, share of which is almost 2 times higher than the production of any of the other sectors *(Figure 1.5)*. Relatively high parameters are notable also for MPChinery, chemical industry, metallurgy and food industries, which form together half of the exports.

In the commodity structure of imports mineral products dominate, which amounts to exist more than a third of its total value *(Figure 1.6)*. Mainly it is oil and natural gas import are from Russia. In 2008 it amounted to 21.5 million tons and 21.1 billion m^3 respectively. The fourth part of the imported products accounted for MPChinery, equipment and transport means, and about one in eight – of metals and their products, as well as chemical-metal products.

To reduce dependence on external energy supplies the Belarus energy development program is planning to increase the share of local fuels in the fuel balance from 16,5 to 25% to 2012. Such an increase must be reached due to increased consumption of peat, crop residues, as well as production of brown coal and combustible slates. In addition, it is planned to build nuclear power station.

The main foreign trade partners of Belarus exports are countries of the EU and the CIS. The share of exports in 2008 in the EU counters accounted for 46%, that is 2% higher than in the CIS counters, in Russia it was 32%. Petroleum products are dominated in production supplying to the EU, these countries received 97% of their total exports. In cost terms, they are approximately 80% of exports to the EU from Belarus. Engineering products, chemical and food processing industry products are dominated in export structure of the goods to CIS countries.

Among individual countries, the main trade partner of Belarus stands for Russia.

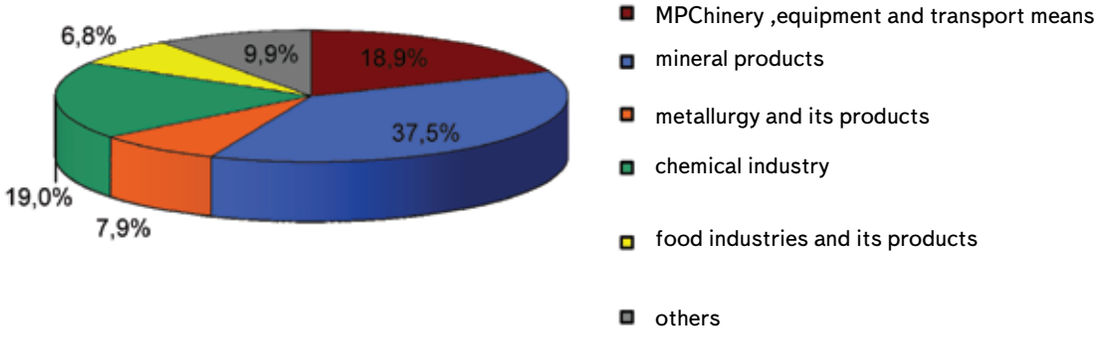


Figure 1.5 – Commodity exports of Belarus in 2008

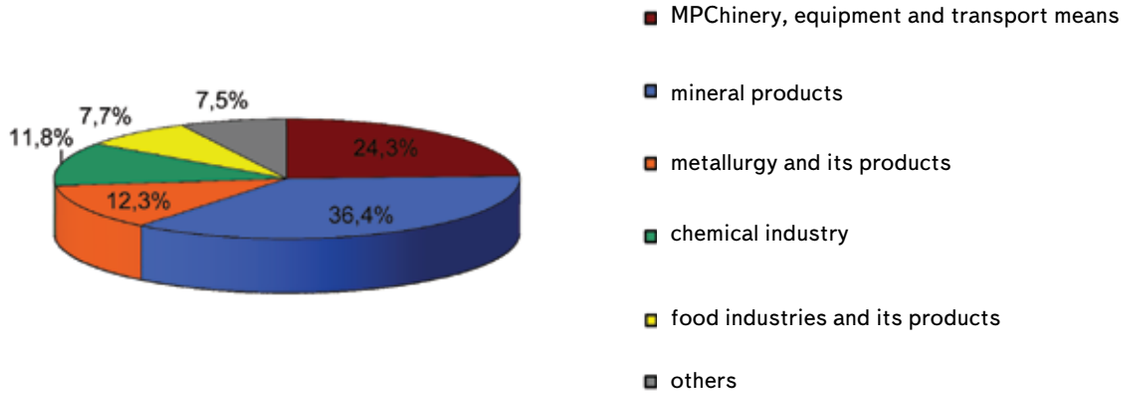


Figure 1.6 – Commercial imports of Belarus in 2008

Its share is 32 % of exports and 60 % for imports.

According to estimates by the International Monetary Fund (IMF),the economic model existing in Belarus looks competitive. The volume of GDP per capita in the country, which is calculated on the base of indicator of the purchasing power parity, amounted $ 12.7 thousand in 2009. This is the second figure in the CIS after Russia, it is also lower compared to the neighboring EU countries, such as Poland, Lithuania, Latvia. According to IMF forecasts, if in Belarus the current economic growth of GDP per capita preserves, purchasing power parity in the country will be higher than in Latvia and nearly matched with Russia and Lithuania by 2015.

Population

The population of Belarus up to the date of 01.01.2010 amounted to 9 480 000 people. Its average density – 46 people/km^2. The share of urban population accounts for 74.5%, rural – for 25,5%. 52% of urban population and 39% of the total population live in big and large cities with the population more than 250 thousand people.

Since 1993 depopulation has been observed in the country. Its total number during this period reduced to 755 thousand people. And the reduction was only at the expense of rural residents.

During the last three years in the demographic situation positive changes manifest. In particular, it has been an increase in birth rate at a relatively stable level of mortality and a slight increase in life expectancy *(Table 1.1)*. Accordingly, the rate of negative population growth also reduced. If in 2005 it was at level of (-5.2) per 1 thousand of the population, in 2009 it was (-2.7). Also infant mortality reduced significantly – in 1,5 times over the last five years. This indicator in Belarus is the lowest among CIS countries and it is close to the level of economically developed countries.

To preserve and promote positive changes in the demographic situation, to pass from a declining population to its stabilization and growth, the country will implement a package of measures on family, tax, housing, health and social welfare, aimed at creating efficient incentives to increase birth rate, to improve health and to reduce mortality of the population.

In the dynamics of the age structure of population of Belarus it has observed an increase in the proportion of people whose age is elder than working age with a decrease in number of children and adolescents *(Figure 1.7)*. In 2009 the proportion of older persons exceeded the same of youngsters in 1,4 times. The share of working-age population remains generally stable.

The country remains at relatively low level of registered unemployment. The corresponding figure at the end of 2009 amounted to 0,9% of the economically active population.

The population of Belarus is characterized by high educational level. At the beginning of 2009 the share of workers with general secondary, vocational, specialized secondary and higher education was, 96.6%, including 23,8% persons with higher education. In

Table 1.1

Dynamics of basic health and demographic indicators of population of Belarus for 2005-2009 (for 1 thousand of population)

Year	Indicator				
	Birth rate	Infant mortality	natural mortality	Natural increase in	life expectancy at birth, years
2005	9.3	14.5	7.1	-5.2	68.8
2006	9.9	14.2	6.1	-4.3	69.4
2007	10.7	13.7	5.2	-3.0	70.3
2008	11.1	13.8	4.5	-2.7	70.5
2009	11.5	14.2	4.7	-2.7	70.5

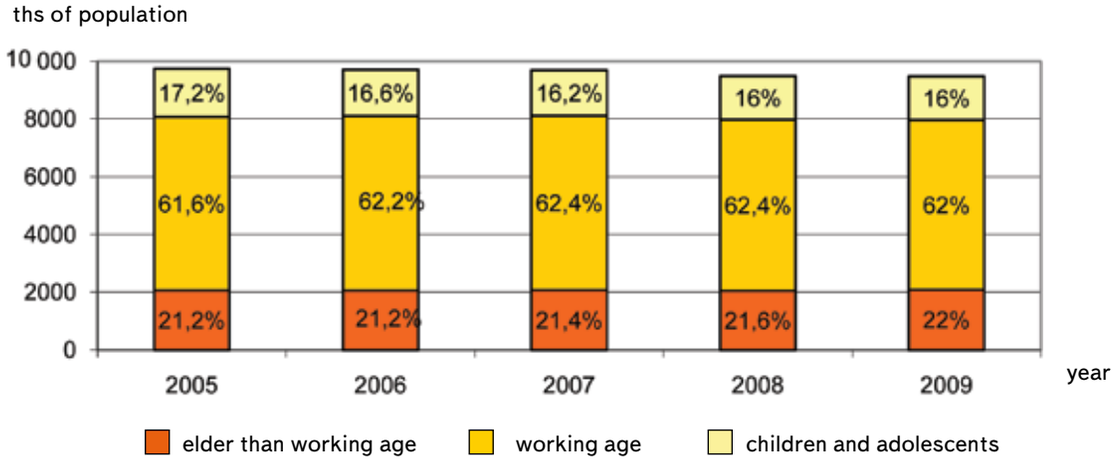


Figure 1.7 – Dynamics of age structure of Belarus population for 2005-2009

due course the number of students in higher education establishments increases. At the beginning of 2009/2010 academic year, their number was 430,4 thousand people or 445 students per 10 thousand of population.

For integrated assessment of life quality it can be used such indicator as an index of human potential development, applied in the UN. Based on this index Belarus with stability is reckoned with the group of countries with high human potential development. In 2009, the country took the 68th place among 182 countries in the world and first among the CIS countries in this rank.

2. Air pollution

Emissions to air

This indicator characterizes the extent of existing and expected impact of emissions of major pollutants to the environment and determines the path for achieving the target values, expressed through national emission limits.

The indicator «emissions» consists of two components: emissions from stationary sources and emissions from mobile sources.

Pollutant emissions from stationary sources

Currently in the Republic of Belarus to receive information on emissions from stationary sources the data of state statistical reports on Form 1-OS (air) is used. Form 1-OS (air) is annually provided by enterprises which emissions exceed 25 tons per year, and if the emission of hazard class substances exceeds 1 tons/year. Pollutant emissions from stationary sources are characterized as the total amount of pollutants got into the air from all organized and unorganized stationary sources.

Pollutant emissions from stationary sources in the territory of Belarus are shown in *Table 2.1.*

Sulfur dioxide emissions from stationary sources in 2006-2008 are characterized by a decline and a sharp increase in 2009, due to the increased level of its revenues from the energy sector. The significant increase in ammonia emissions, noted in 2008 and 2009 compared with previous years was the result of using new method of assessment of emissions from livestock farms.

Emissions of nitrogen oxides, particulate matter and NMVOC from stationary sources for the period remained virtually unchanged and averaged 66.6; 45.7 and 74.4 tons/year, respectively. The volume of carbon monoxide in 2005-2009 was gradually declining and in 2009 was 74.6 tons, which is 29% less than in 2005.

The main volume of pollutant emissions from stationary sources is associated with the industry (including energy) and housing and communal

Table 2.1

Emissions of air pollutants from stationary sources in 2005-2009

Pollutant	2005	2006	2007	2008	2009
Sulphur dioxide (SO_2), ths t	73.80	87.80	80.70	64.00	139.50
Nitrogen oxides are converted to nitrogen dioxide, ths t	67.38	69.94	65.30	65.00	65.38
Ammonia, ths t	7.08	7.64	8.28	16.65	19.61
Solid particles in total, ths t	43.90	45.80	45.10	47.50	46.20
Carbon monoxide (CO), ths t	103.90	107.70	94.40	88.40	74.60
Non-methane volatile organic compounds (NMVOC), ths t	75.43	72.99	74.38	77.33	71.76
Cd, t	0.030	0.030	0.035	0.013	0.002
Pb, t	4.230	3.950	4.317	3.644	3.244
Hg, t	–	–	–	0.002	0.004

services which contribution to total emissions was in average 70 and 14% respectively.

More than half of the total emission to each of the ingredients is from industries, except for hydrocarbons, the volume of which comes from the housing and communal services (50%). Also a significant contribution to hydrocarbons emissions makes transport and communications (20%). Significant sources of solid substances emissions in addition to the industry are the housing and communal services (10%) and agriculture (10%), carbon monoxide – housing and communal services (20%) and transport and communications (about 10%).

Pollutant emissions from mobile sources

Emissions from mobile sources of pollutants are calculated on the basis of fuel consumption and data on the distribution of vehicles in the country, for environmental classes in the percentage of total amount on the basis of data of the Ministry of Transport and Communication of the Republic of Belarus according to records in the field of environmental protection.

Emissions from mobile sources during the period characterized by some growth, which depending on the substance ranges from 8 to 17% *(Table 2.2)*.

The maximum amount of emissions from mobile sources is noted in Minsk and Minsk region, the minimum – in Mogilev region) *(Fig. 2.1)*.

The definitions of the indicator «Emissions of pollutants into the air» are shown in *Table 2.3*.

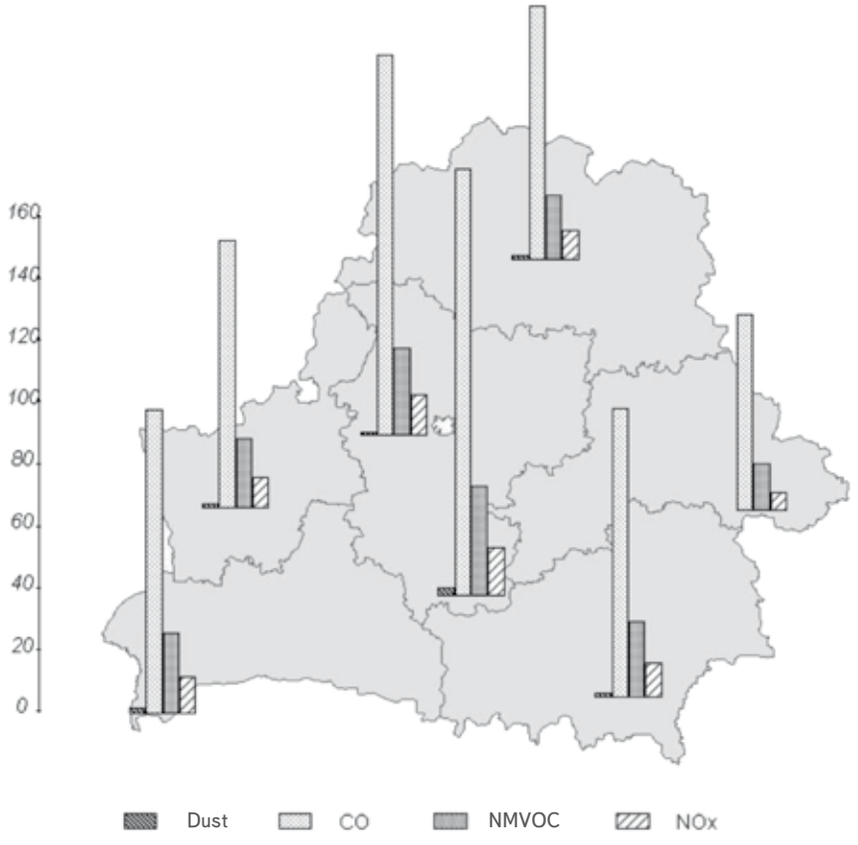


Figure 2.1 – Emissions from mobile sources in 2009, ths t

Total emissions of sulfur dioxide from 2006 until 2008 were reducing, while in 2009 there was a sharp increase in the emissions of this compound (due to emissions from stationary resources). In general, over the past 5 years SO_2 emissions increased by 1.9 times *(Fig. 2.2)*.

Inflow of suspended solids in the five-year period ranged from 73.8 to 85.7 thousand tons (see *Figure 2.2*.). Emissions of nitrogen oxides, carbon monoxide and NMVOC changed slightly – the change was within 10% *(Fig. 2.3)*. It should be noted that compared with 2005 in 2009 the emissions of these compounds increased in 1,1 times.

Inflow of cadmium and lead emissions into the atmosphere during the period decreased by 15 and 1.3 times respectively. According to table 2.3, mercury emissions in 2009 increased by 2 times compared with 2008.

Emissions of all pollutants are characterized by positive dynamics aimed on reducing.

Emissions of major pollutants per unit of the country are increasing: for nitrogen

Table 2.2

Emissions of air pollutants from mobile sources in 2005-2009

Pollutant	2005	2006	2007	2008	2009
Sulphur dioxide (SO_2), ths t	1.3	1.5	1.5	1.6	1.4
Nitrogen oxides are converted to nitrogen dioxide, ths t	94.2	107.1	106.6	116.4	109.8
Solid particles in total, ths t	29.9	34.2	34.3	38.2	34.0
Carbon monoxide (CO), ths t	698.6	780.4	768.5	815.2	777.8
Non-methane volatile organic compounds (NMVOC), ths t	189.9	214.3	212.4	229.2	214.4

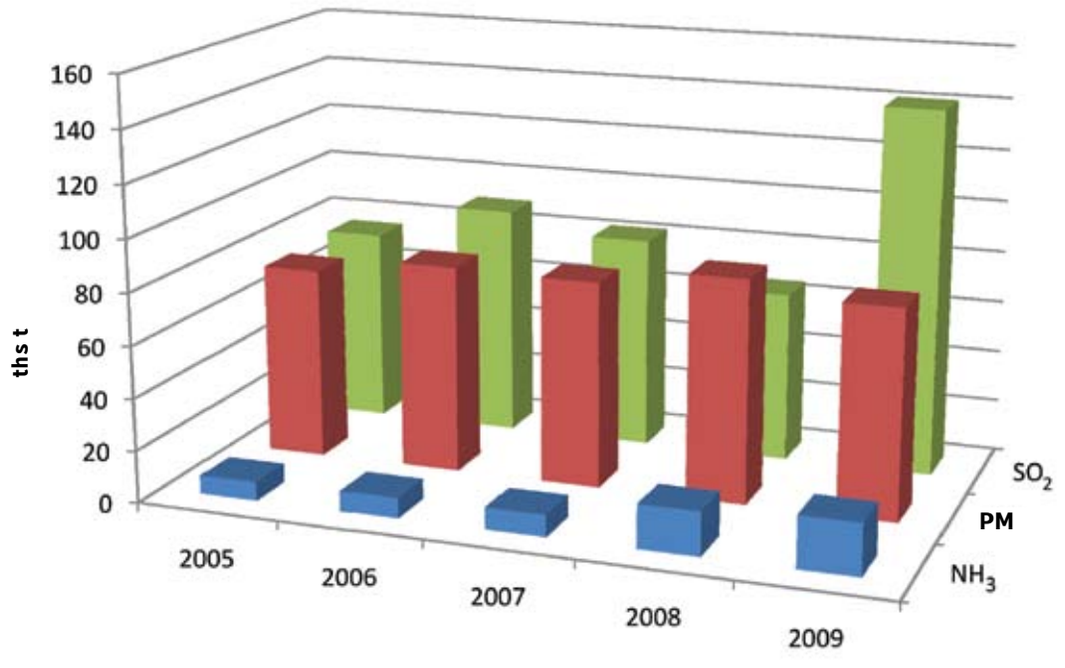


Figure 2.2 – Total emissions of sulfur dioxide, particulate matter and ammonia on the territory of Belarus in 2005-2009

Table 2.3

Dynamics of national emissions of major pollutants into the atmosphere in Belarus in 2005-2009

Pollutant	2005	2006	2007	2008	2009
Sulphur dioxide (SO_2), ths t	75.10	89.30	82.20	65.60	140.90
Nitrogen oxides are converted to nitrogen dioxide, ths t	161.580	177.040	171.900	181.403	175.180
Ammonia, ths t	7.08	7.64	8.28	16.65	19.61
Solid particles in total, ths t	73.80	80.0	79.40	85.70	80.20
Carbon monoxide (CO), ths t	802.50	888.10	862.90	903.60	852.40
Non-methane volatile organic compounds (NMVOC), ths t	265.33	287.29	286.78	306.53	286.16
Cd, t	0.030	0.032	0.035	0.013	0.002
Pb, t	4.227	3.948	4.317	3.644	3.244
Hg, t	–	–	–	0.002	0.004

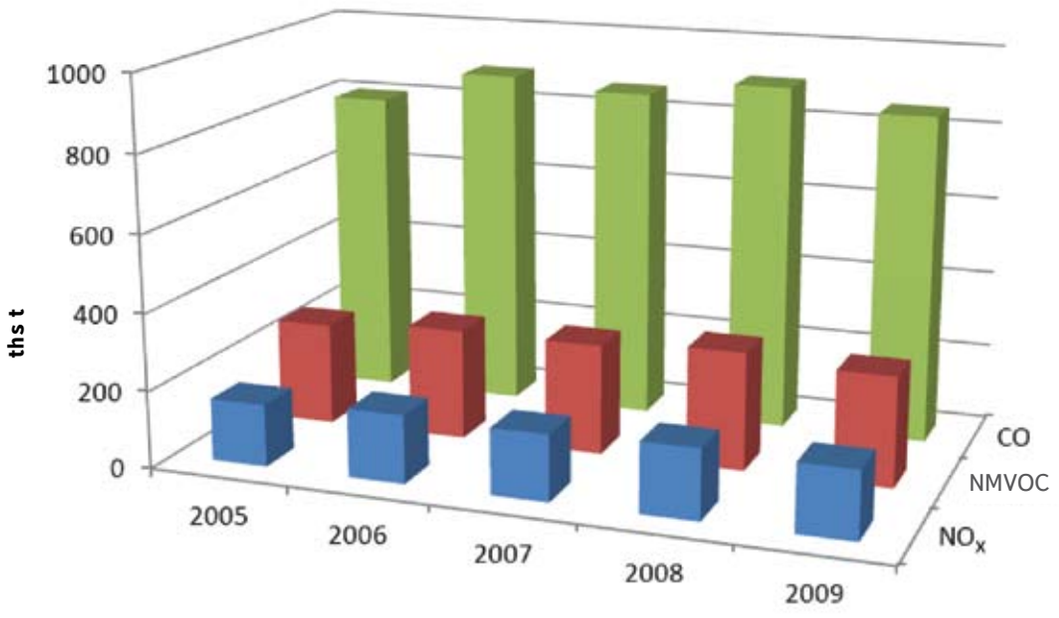


Figure 2.3 – Total emissions of nitrogen oxides, carbon monoxide and NMVOC on the territory of Belarus in 2005-2009

oxides, particulate matter and NMVOC this figure for the last 5 years has increased by 8%, for carbon monoxide – by 6% and sulfur dioxide – by 89%, for ammonia – 200% *(Table 2.4)*.

Minsk region is characterized by the maximum density of carbon dioxide emissions – about 8 t/km^2, followed by the Grodno region – 4,3 t/km^2, for other areas the density does not exceed 3 t/km^2 *(Fig. 2.4A)*. Density distribution of sulfur oxides is different from carbon monoxide. Thus, the maximum density for emissions of SO_x is observed in Vitebsk region (1,1 t/km^2), followed by

Minsk and Gomel regions (0,7-0,9 t/km^2) *(Figure 2.4B)*.

The maximum density of nitrogen oxides and particulate matter recorded in Minsk region – more than 1.1 respectively and more than 0,5 t/km^2. By the value of the density of nitrogen oxides there is Grodno region (0,8-0,9 t/km^2), for all other areas the density of pollutant emissions do not exceed 0.8 t/km^2 *(Figure 2.4C)*.

By the density of particulate emissions besides Minsk region there is Grodno and Mogilev regions – 0.45 and 0.37 t/km^2, for other areas this figure does not exceed 0,3 t/km^2 *(Figure 2.4D)*.

It is determined that emissions of major pollutants the per capita increase: for carbon monoxide this figure for the last 5 years has increased by 10%, for NMVOC – 11, for particulate matter and nitrogen oxides – 12, for sulfur dioxide – by 94, for ammonia – by 188% *(Table 2.5)*.

The highest specific emissions of carbon monoxide have Minsk and Grodno regions (more than 94 kg/person). The inflow of sulfur dioxide is maximum for Vitebsk region (over 30 kg per person.) *(Fig. 2.5)*.

By the emissions of nitrogen oxides in Vitebsk region this figure exceeds 22 kg/person, followed by Grodno (20 kg/pers.), Mogilev and Gomel regions (from 18 to 20 kg/person). For Minsk and Brest regions emissions of nitrogen oxides shall not exceed 18 kg per person.

Quite different is distribution of specific emissions of particulate matter. For Vitebsk, Grodno and Mogilev regions this option is above 10 kg/person. For the rest is less than 8 kg per person.

Forecast of the expected development of pollutant emissions into the atmosphere is presented in *Table 2.6* and *Figure 2.6.*

According to the forecast emissions in 2020 emissions of sulfur and NMVOC will

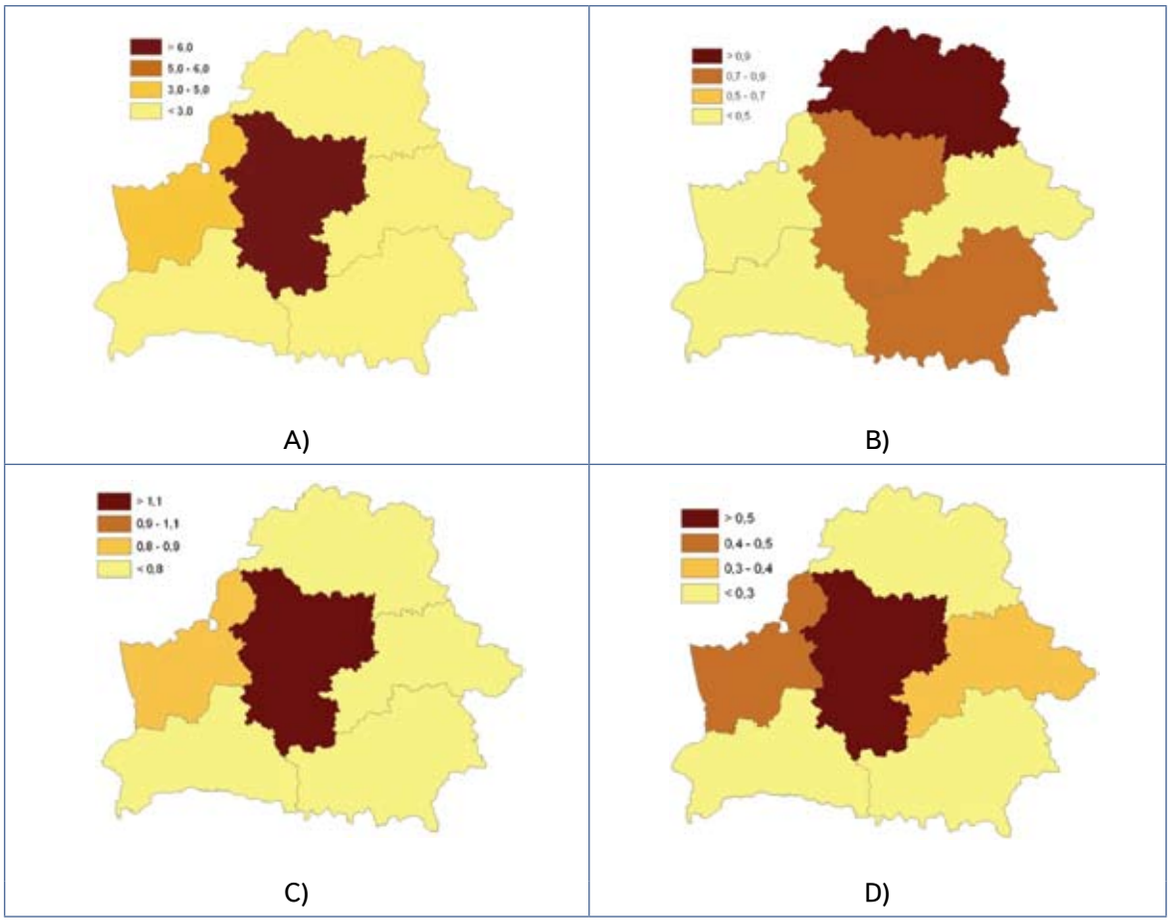


Figure 2.4 – Density of emissions of carbon monoxide (A), sulfur oxides (B), nitrogen oxides (C) and particulate matter (D) in administrative regions of Belarus in 2009, t/km^2

Table 2.4

Emissions of pollutants into the atmosphere per unit area of the country, t/km²

Pollutant	2005	2006	2007	2008	2009
Sulphur dioxide (SO_2)	0.36	0.43	0.40	0.32	0.68
Nitrogen oxides are converted to nitrogen dioxide	0.78	0.85	0.83	0.87	0.84
Ammonia	0.03	0.04	0.04	0.08	0.09
Solid particles in total	0.36	0.39	0.38	0.41	0.39
Carbon monoxide (CO)	3.87	4.28	4.16	4.35	4.11
Non-methane volatile organic compounds (NMVOC)	1.28	1.38	1.38	1.48	1.38
Cd	1.45×10^{-4}	1.54×10^{-4}	1.69×10^{-4}	6.26×10^{-5}	9.63×10^{-6}
Pb	0.02	0.02	0.02	0.02	0.02
Hg	–	–	–	9.63×10^{-6}	1.93×10^{-5}

Table 2.5

Emissions of air pollutants per capita, kg/person

Pollutant	2005	2006	2007	2008	2009
Sulphur dioxide (SO_2)	7.66	9.16	8.46	6.77	14.84
Nitrogen oxides are converted to nitrogen dioxide	16.49	18.16	17.70	18.72	18.45
Ammonia	0.72	0.78	0.85	1.72	2.07
Solid particles in total	7.53	8.20	8.17	8.84	8.45
Carbon monoxide (CO)	81.89	91.08	88.83	93.25	89.79
Non-methane volatile organic compounds (NMVOC)	27.07	29.46	29.52	31.63	30.14
Cd	3.06×10^{-6}	3.28×10^{-6}	3.60×10^{-6}	1.34×10^{-6}	2.11×10^{-7}
Pb	4.31×10^{-4}	4.05×10^{-4}	4.44×10^{-4}	3.76×10^{-4}	3.42×10^{-4}
Hg	–	–	–	2.06×10^{-7}	4.21×10^{-7}

decrease. At the same time will increase emissions of nitrogen oxides. At the same time the excess of target values in the future is not expected.

Currently, the most significant source of air pollution is transport with more than 70% of total emissions.

Particulate emissions are caused by the industrial sector at 34% and mobile sources – 43%. The main contribution to the inflow of nitrogen oxides, NMVOC oxide and carbon makes transportation – 63, 74 and 89% respectively. Industry is also the source of NO_x and NMVOC (32 and 23%). Hydrocarbons mainly got to the atmosphere from housing, transport and communications.

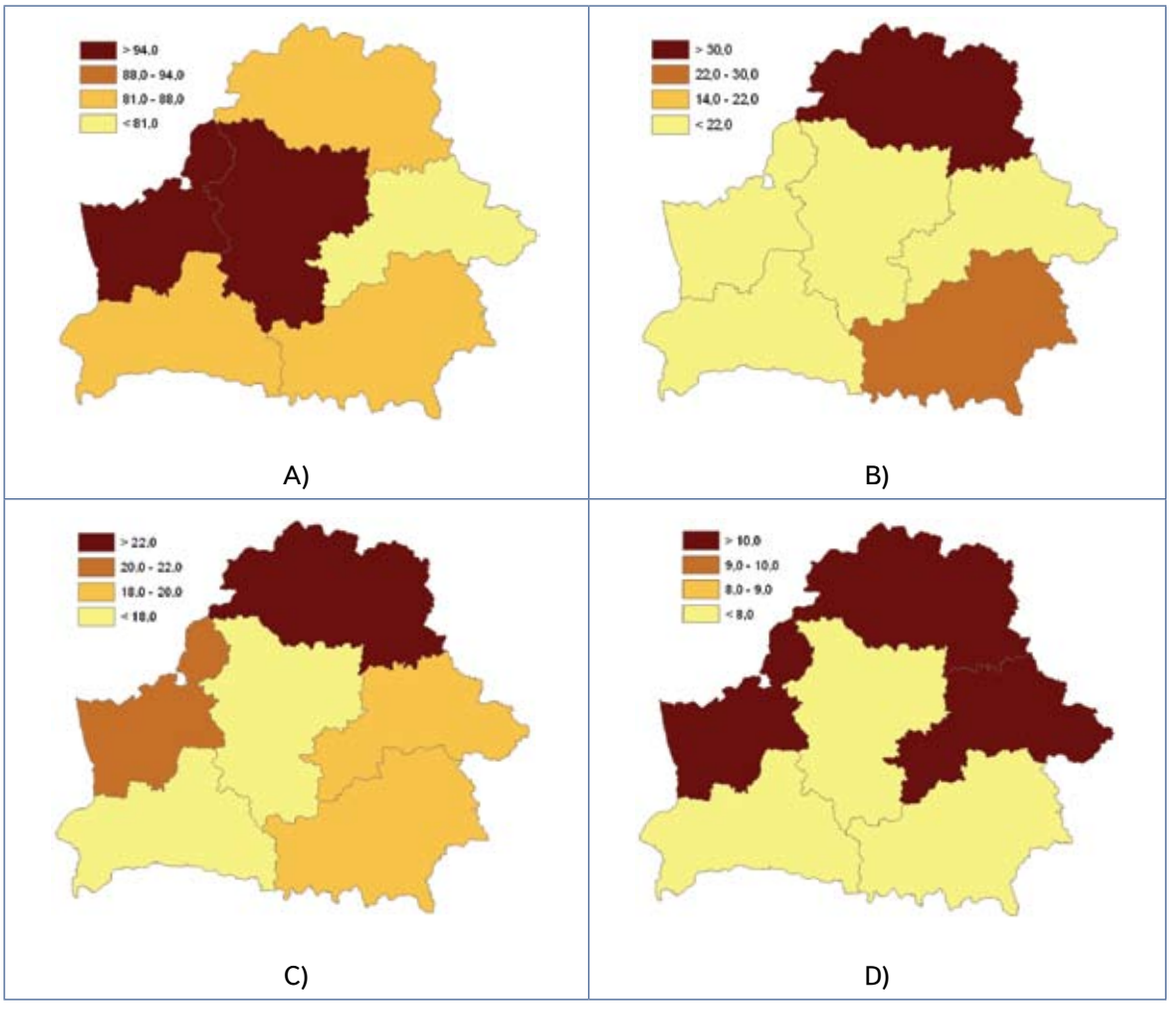


Figure 2.5 — Emissions of carbon monoxide (A), sulfur oxides (B), nitrogen oxides (C) and particulate matter (D) per capita by regions in 2009, kg/person

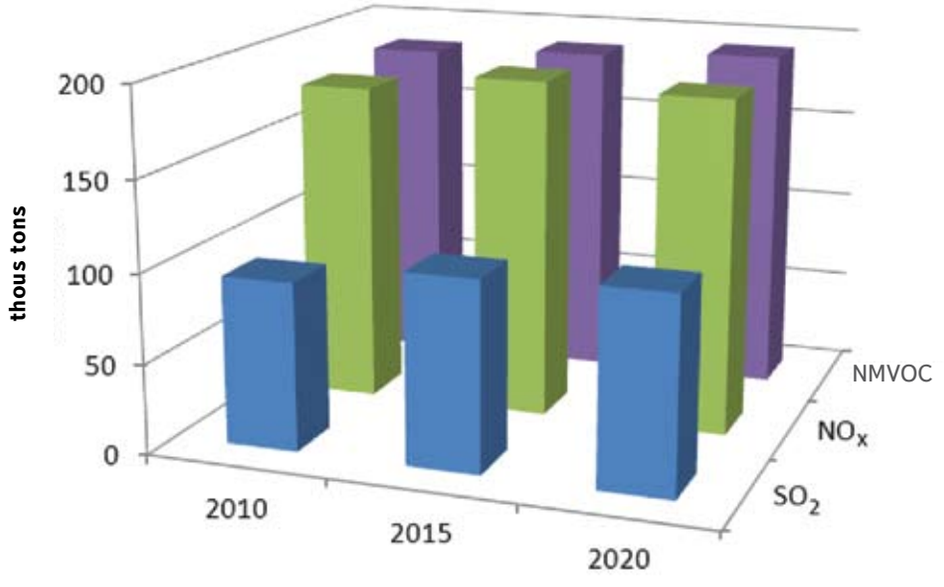


Figure 2.6 — Forecast of pollutant emissions into the atmosphere in Belarus until 2020

Table 2.6

Forecast of development of national emissions of SO_2, NO_x, NMVOC and ammonia in the atmosphere of Belarus by 2020 compared with the last actual and target values, thous tons

Pollutant	Targets	2009	2015	2020
Sulphur dioxide (SO_2)	518	140.90	105.58	108.27
Nitrogen oxides (NO_x converted to NO_2)	263	175.20	189.42	186.31
NMVOC	–	286.16	188.30	192.41

The latest industry includes the transportation of liquid and gaseous fuels through gas flow line. About 50% of ammonia emissions are due to agriculture, 20% – transport and communications, 17% of housing and communal services. The main source of sulfur dioxide and heavy metals serves the industrial sector. In the industrial sector emissions of sulfur dioxide are related to the electric power industry, lead – with the production of building materials, cadmium – from engineering and metalworking industry.

Captured and disposed of pollutants

The effectiveness of existing dust filters provides an analysis of the indicator «captured and disposed of pollutants», which consists of two components:

– the actual number of trapped and neutralized pollutants, in ths t;

– the proportion of trapped and neutralized pollutants in the total amount of walking-pollutant, expressed in % *(Table 2.7)*.

According to the state statistical reporting more than 2.5 tons of pollutants is captured every year by the systems of gas treatment station. The exception was 2009 when this figure decreased to 2.0 ths tons. Perhaps this is due to the fact that the number of enterprises which report on Form 1-OS (air) in 2009 decreased to 1.9 thousand, while in 2005 there were 3.3 thousand of such enterprises, in 2006 and 2007 - 3,0 thousand, in 2008 – 2,1 thousand.

The efficiency of existing systems of gas treatment station ranges from 82 to 88%.

Reducing emissions of pollutants into the air after the activities

The index takes into account the total actual reductions of emissions of pollutants into the air as a result of activities and evaluates the efficiency of conservation measures *(Table 2.8)*.

The maximum number of activities was held in 2006 – 304, the minimum in 2009 – 206. At the same time for one event in 2006 emissions reduction is by 9.5 tons and in 2009 – 19,7 tons. Maximum efficiency is characterized by activities in 2007 (64.6 tons emission reductions for one activity).

Air quality in urban areas

The indicator shows the state of the environment in terms of air quality and the negative impact of elevated concentrations of polluting substances on the population.

Table 2.7

The changes of the «captured and disposed of pollutants»

Indicator	2005	2006	2007	2008	2009
The actual number of trapped and neutralized pollutants, ths t	2901.98	2724.92	2595.92	2540.50	2041.45
Proportion of trapped and neutralized pollutants in the general volume of waste contaminants,%	0.88	0.87	0.87	0.87	0.82

Table 2.8

The changes of the «reduced emissions of pollutants into the air after the activities»

Indicator	2005	2006	2007	2008	2009
Completed activities	299	304	238	223	206
Reducing emissions of pollutants into the air after the activities, tons	5216.7	2880.0	15385.2	1124.5	4055.2

Inhalation of high concentrations of particulate matter during short period of time can cause symptoms of asthmatic diseases and diseases of the respiratory tracts, reducing lung capacity and increasing the risk of cardiovascular diseases. There are numerous data on negative effects on humans of carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen oxides (NO_x), ozone and other compounds presented in atmospheric air.

Currently, air monitoring in Belarus is carried out in 18 industrial cities, including regional centers, as well as Polotsk, Novopolotsk, Orsha, Bobruisk, Mozyr, Rechitsa, Svetlogorsk, Pinsk, Novogrudok Zhlobin, Lida and Soligorsk. Regular observations cover the territory with 81.3% of the population of large and medium-sized cities in the country. Network of air monitoring station includes 61 stations *(Fig. 2.7).* In Minsk, Vitebsk and Mogilev operate automatic stations, which make it possible to obtain information about the content in the air of priority pollutants in real time.

In all the cities in the air the concentration of major pollutants are determined: total particulate matter, sulfur dioxide, carbon monoxide, nitrogen dioxide. The concentration of specific priority pollutants is measured: formaldehyde, ammonia, phenol, hydrogen sulfide, carbon disulfide. In all controlled cities the content in the air of lead and cadmium is defined, in 16 cities – benzo (a) pyrene, in

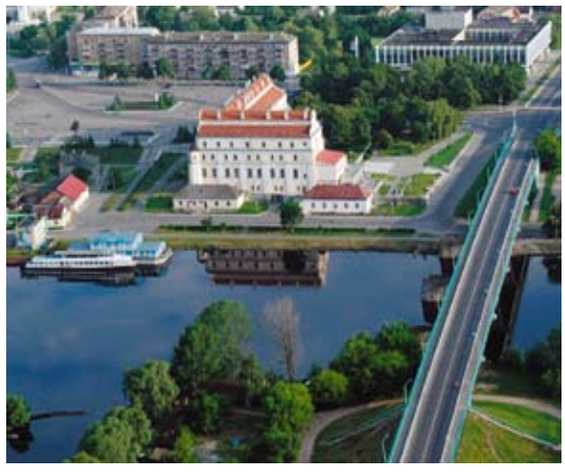


Figure 2.7 – Network monitoring stations of air quality in Belarus

9 cities – volatile organic compounds (VOCs). In accordance with the recommendations of the World Health Organization regular monitoring of concentrations is held with diameter of 10 microns or less (PM-10) in Minsk, Mogilev, Vitebsk, Gomel and Zhlobin.

In assessing the air quality daily average and maximum permissible concentration (MPC) of pollutants is considered. Average annual concentrations of particulate matter fraction PM-10 and pollutants measured on the automatic stations with continuous operation are compared with the average annual MPC. For stations with a discrete sampling of the average annual values it is compared with the MPC mid-day, while the maximum – with a maximum single *(Table 2.9)*.

In addition, to assess the state of air the following indicators are used: such as number of days during which there was the excess of daily maximum concentration limit, and repeatability (share) of samples with concentrations above the maximum single MPC. Data on the number of days with daily average concentration PM-10 above the MPC derived from continuous measurements is compared with the targets adopted in the European Union.

Analysis of data on ambient air monitoring networks in 2009 showed that the average annual concentrations of major and specific pollutants are controlled by the overwhelming majority of cities in Belarus, as in previous years, were below quality standards. In some cities recorded exceedances of daily maximum concentration limit of the total particulate matter, carbon monoxide and nitrogen dioxide. The level of pollution of the air with sulfur dioxide remains stable low: both the average and maximum single concentrations are much lower than the quality standards.

During 2009 there were not fixed any concentrations of any pollutants more than 10 MPC. The excess of maximum single MPC is noted only in 0,25% of the total analyzed samples. The vast majority of exceedances were in amounts from 1 to 2 MPC *(Table 2.10)*.

In some years the period 2006-2009 the percentage of air samples with concentrations of contaminants sculpt substances above the maximum one-time MPC ranged from 0,25 to 0,50%. In this case from 80 to 90% of the exceedances were in the range of 1-2 MPC. Pollutant concentrations above 5 MPC

Table 2.9

Maximum allowable concentrations of priority pollutants in air

Pollutant	Value MPC, mkg/m³		
	Maximum single	Average daily	Average annual
The main pollutants			
Particulates in total	300	150	100
Particulate 10 microns in diameter or less (PM-10)	150	50	40
Dioxidesulfur	500	200	50
Carbon monoxide	5000	3000	500
Nitrogen dioxide	250	100	40
Specific pollutants			
Hydrogen sulfide	8	–	–
Carbon disulfide	30	15	5
Ammonia	200	–	–
Formaldehyde	30	12	3
Phenol	10	7	3
Lead	1,0	0,3	0,1
Cadmium	3,0	1,0	0,3
Benzo(a)pyrene	–	5 ng/m³	1 ng/m³

Table 2.10

Distribution of cases (the number of samples) with high levels of air pollution in cities of Belarus on the extent of exceeding the maximum single MPC in 2006-2009.,%

Concentration	2006	2007	2008	2009
1 MPC < q_{max}* ≤ 2 MPC	89.7	81.3	88.0	89.8
2 MPC < q_{max} ≤ 3 MPC	7.5	12.5	8.7	7.6
3 MPC < q_{max} ≤ 4 MPC	1.7	4.2	2.7	1.9
4 MPC < q_{max} ≤ 5 MPC	0.9	1.2	0.6	0.6
q_{max} > 5 MPC	0.2	0.8	0.0	0.1

* q_{max} – maximum of one-off concentrations.

recorded less than 1% of the excess (see *Table 2.10.*).

State of air in Bobruisk, Grodno, Novogrudok, Svetlogorsk, Lida, Soligorsk and in the majority-controlled districts of Brest, Vitebsk, Minsk, Gomel, Mozyr, Pinsk, and in 2009 was assessed as consistently good. Compared with 2007 the number of «problem» areas in the industrial centers of Belarus decreased by 22% *(Fig. 2.8)*.

However, in some areas of Mogilev, Polotsk and Novopolotsk there is a problem of air pollution with nitrogen dioxide; in Brest, Vitebsk, Orsha, Pinsk – with formaldehyde.

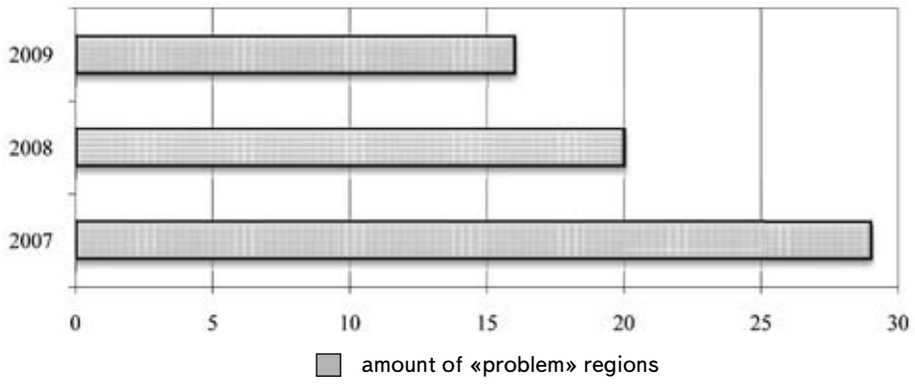


Figure 2.8 – The number of «problem» areas for air pollution in the industrial centers of Belarus in 2007-2009

In cities located in southern Belarus where the large-scale reclamative activities were held (Gomel, Zhlobin, Mozyr, Rechitsa) there is a problem of air pollution with particulate matter *(Table 2.11).* During periods of no precipitation maximum concentrations of total solids in these cities come by 2.6 MPC. In two industrial regions of Minsk elevated levels of contamination of air PM-10 are noted.

Total solids

Analysis of data on the content of total particulate matter in the air during the period 2005-2009 showed that their average concentrations in almost all cities of Belarus are below quality standards *(Table 2.11).* The exception was Rechitsa where in 2007 the annual average content of total particulate matter exceeded the MPC in 1,2 times, and in 2008 – was at the MPC level *(Figure 2.9).*

However, the maximum single concentration of total particulates in the air of most cities in the country during the period were higher than the MPC. The largest pre-elevated quality standards were characteristic for Gomel, Zhlobin, Mozyr and Rechitsa where exceeding the maximum single MPC ranged from 1.5 to 6.0 times *(Fig. 2.10).*

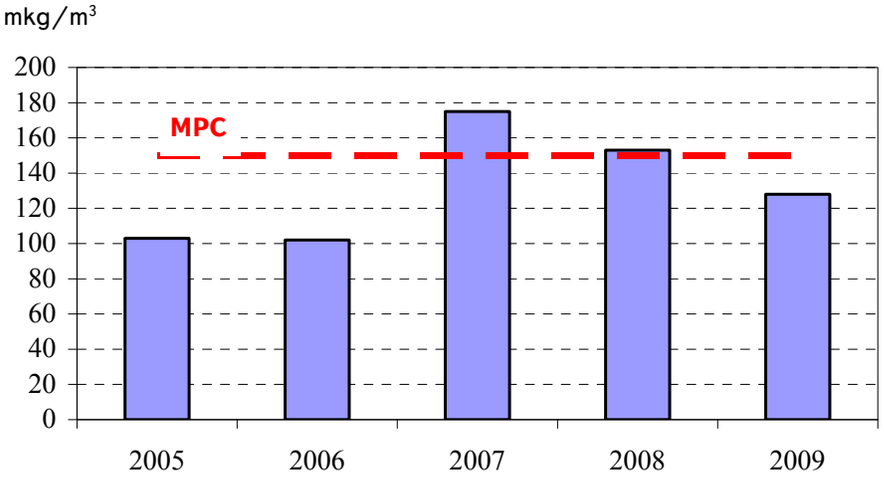


Figure 2.9 - Average annual concentration of total particulate in the air in Rechitsa in 2005-2009

Table 2.11

Average annual concentrations of total particulate in the air of cities of Belarus in 2005-2009, mkg/m³

City	2005	2006	2007	2008	2009
Bobruisk	34	32	21	14	<15
Brest	26	28	23	28	28
Vitebsk	84	110	97	109	117
Gomel	45	29	61	51	63
Grodno	40	33	53	57	51
Zhlobin	–*	–	82	98	97
Lida	–	–	–	53	<15
Minsk	11	–	–	–	15
Mogilev	42	55	43	46	42
Mozyr	39	64	72	59	67
Novogrudok	90	37	40	40	59
Novopolotsk	30	22	21	17	<15
Orsha	7	–	–	24	15
Pinsk	82	76	59	67	57
Polotsk	54	39	31	26	25
Rechitsa	103	102	175	153	128
Svetlogorsk	31	29	36	43	30
Soligorsk	39	55	25	24	<15
MPC	150				

* The substance was not determined.

In addition, for these cities is characteristic the excess of daily MPC of total solids. So, in Gomel during 2009 there were marked 18 days in excess of the average MPC, in Zhlobin – 43 days, in Mozyr – 5 days *(Table 2.12)*. The above data is characteristic for the city as a whole, but for some monitoring stations, they can be much higher than the value.

At other times, the number of days with daily average concentration of total particulate matter higher than MPC was negligible *(Fig. 2.11)*.

During the five-year period (2005-2009) average annual total solid content of particles in the air in Bobruisk, Novogrudok, Novopolotsk, Pinsk, Polotsk and Salihorsk decreased in 1,4-2,6 times; in Vitebsk, Gomel, Grodno, Mozyr, Orsha and Rechitsa – increased in 1,2-2,1 times. The level of air pollution of particulate matter in Brest, Mogilev and Svetlogorsk did not change significantly.

Particulate matter 10 microns in diameter or less (PM-10)

Annual average concentrations of PM-10 in Gomel, Vitebsk, Mogilev, Zhlobin and residential district of Minsk in 2007-2009 were in the range 0,4-0,6 MPCs. In 2009, number of days with daily average concentration above the MPC in Mogilev and Vitebsk did not exceed 3%, in the residential district of Minsk, Gomel and Zhlobin – 8%. At the same time for two

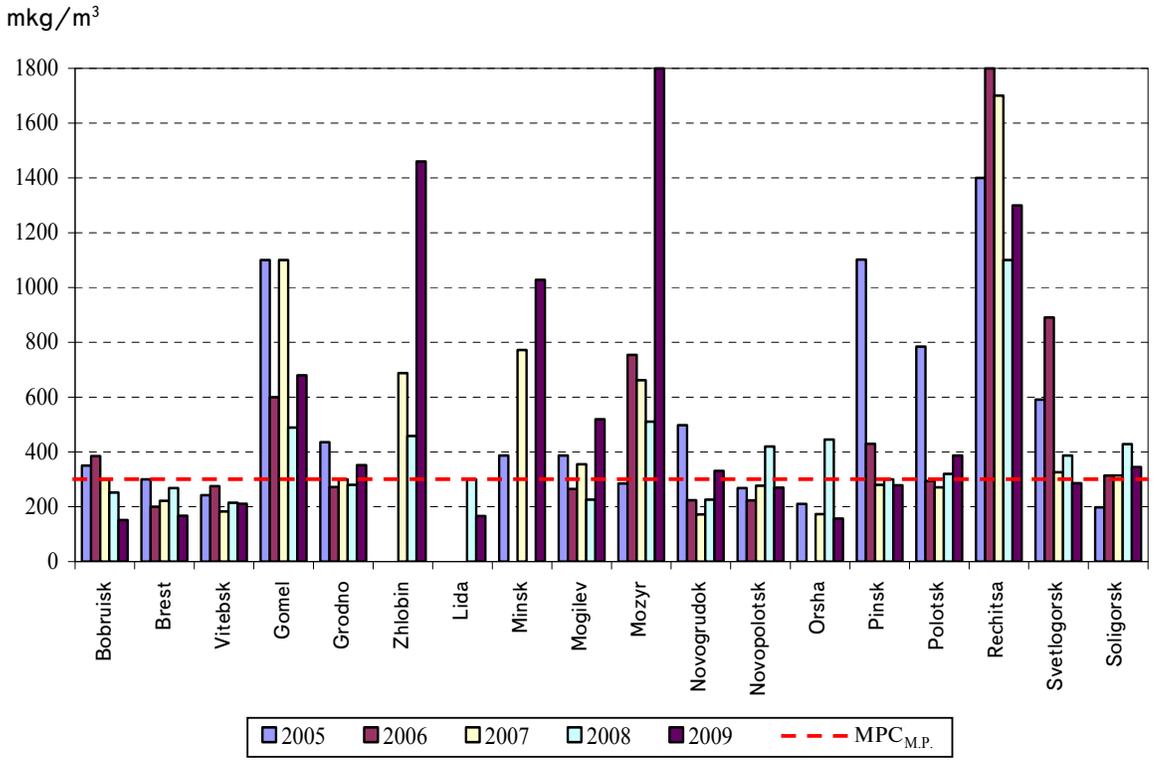


Figure 2.10 - The maximum single concentration of total particulate in urban air in Belarus in 2005-2009

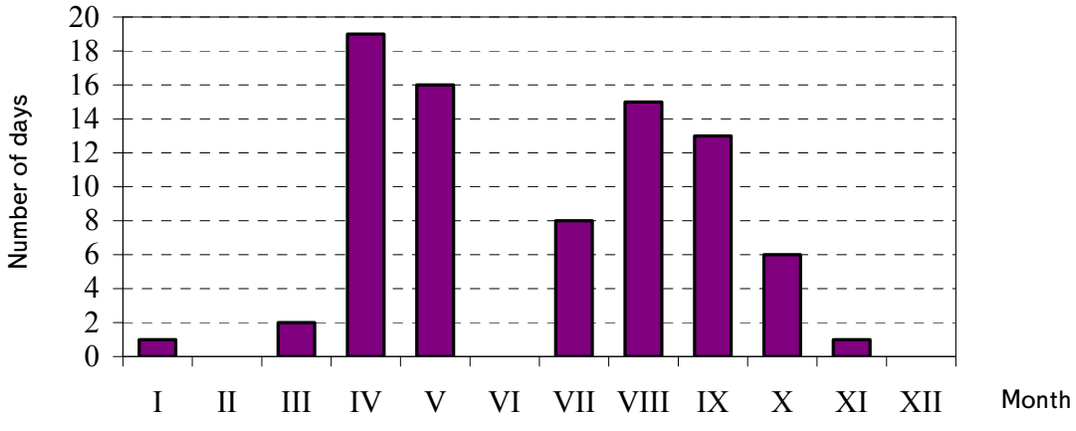


Figure 2.11 – Number of days exceeding the daily average maximum permissible concentration of total particulate in the air in Rechitsa in 2009

Table 2.12

Number of days per year exceeding the daily average maximum permissible concentration of total particulates in the air in Gomel, Mozyr and Zhlobin in 2007-2009

Year	Gomel	Zhlobin	Mozyr
2007	7	32	10
2008	6	46	24
2009	18	43	5

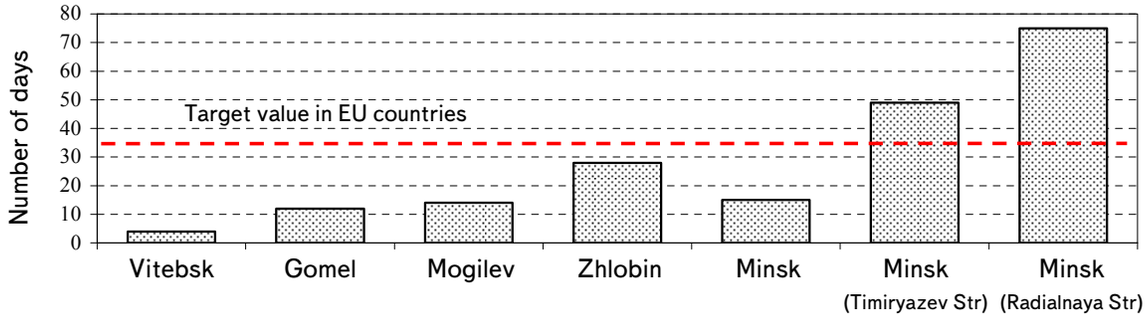


Figure 2.12 – Number of days with daily average concentration of total particulate of PM-10 above the MPC in 2009

industrial districts of Minsk elevated levels of air pollution PM-10 is characterized – the average concentration in 2009 was respectively 0.8 and 1.1 MPC.

According to the Directive of the European Council it is not allowed to exceed the level of 50 mg/m^3 more 35 days (9.6%) during the calendar year. In 2009 the number of days from mid-day concentrations of PM-10 above the MPC in Minsk in the areas of streets Timiryazev and Radialnaya the indicator exceeded in 1,4-2,1 times, Gomel, Vitebsk, Mogilev, Zhlobin and residential district of Minsk – was lower than it *(Fig. 2.12)*.

Nitrogen dioxide

The annual average content of nitrogen dioxide in the atmosphere of controlled cities of Belarus in the period 2005-2009 was substantially below the maximum allowable concentration *(Table 2.13)* In this case, the maximum single concentration of nitrogen dioxide in Minsk, Mogilev and Polotsk during all five years exceeded the MPC from 1,2 to 3,4 times *(Fig. 2.13)*.

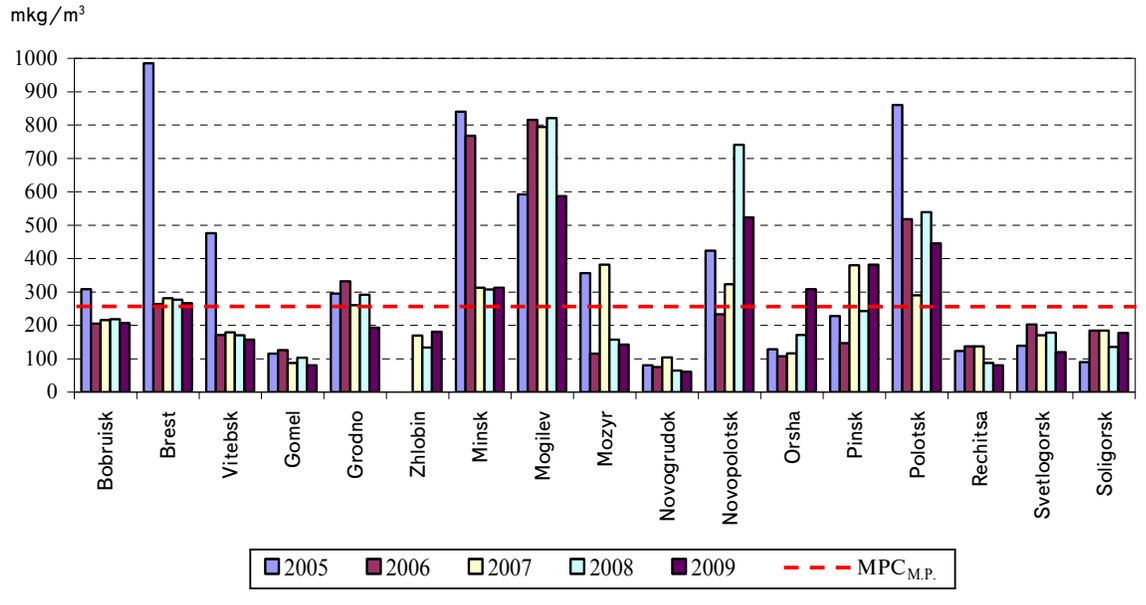


Figure 2.13 – Maximum single concentrations of nitrogen dioxide in the air in Belarus in 2005-2009

Table 2.13

Average annual concentrations of nitrogen dioxide in the air of cities of Belarus in 2005-2009, mkg/m³

City	2005	2006	2007	2008	2009
Bobruisk	26	26	27	44	36
Brest	27	31	29	26	23
Vitebsk	39	40	40	45	41
Gomel	21	23	20	19	21
Grodno	35	33	33	31	24
Zhlobin	–*	–	10	9	11
Minsk	40	39	33	31	34
Mogilev	49	50	57	57	53
Mozyr	18	18	18	24	21
Novogrudok	31	35	41	34	31
Novopolotsk	38	34	37	37	45
Orsha	17	22	20	24	22
Pinsk	19	22	18	27	33
Polotsk	41	42	43	38	52
Rechitsa	24	29	33	27	24
Svetlogorsk	23	45	46	60	46
Soligorsk	49	46	49	43	18
MPC	100				

* The substance was not determined.

In Mogilev, Polotsk and Novopolotsk during the period of 2006-2007 there were fixed from 1 to 12 days per year exceeding the daily average maximum permissible concentration of nitrogen dioxide *(Table 2.14)*. The most urgent situation is typical for Mogilev, where in Ostrovski Str within the specified period there were noted from 43 to 107 days with exceedances of the daily average maximum permissible concentration of nitrogen dioxide.

Interesting situation regarding air pollution with nitrogen dioxide is characteristic for Svetlogorsk. Despite the fact that average and maximum single concentration of the pollutant are below the limit values, during some years there is a record of a few days per year exceeding the daily average maximum permissible concentration of nitrogen dioxide. Moreover, for individual monitoring stations, this number ranges from 1 to 30 days.

During the five-year period (2005-2009) average content of nitrogen dioxide in the air in Brest, Grodno and Minsk reduced in 1,2-1,5 times, in Soligorsk – in 2,7 times. In Bobruisk, Mozyr, Novopolotsk, Orsha, Pinsk, Polotsk and Svetlogorsk it increased by 1,2-2,0 times, in Vitebsk, Gomel, Mogilev, Novogrudok and Rechitsa it did not change significantly.

Table 2.14

Number of days per year exceeding the daily average maximum permissible concentration of nitrogen dioxide in the air in Mogilev, Polotsk, Novopolotsk and Svetlogorsk in 2006-2009

Year	Mogilev	Polotsk	Novopolotsk	Svetlogorsk
2006	8	2	–	0
2007	5	2	1	15
2008	2	1	1	20
2009	12	11	4	1

Sulfur dioxide

The content of sulfur dioxide in the atmosphere of cities of Belarus is low during many years. It should be noted that the «key» is the use of natural gas as a fuel. With the end of heating season the content of sulfur dioxide in the air in most cities is below the limit of the concentration determination. Maximum of one-off concentrations in Novopolotsk and Mogilev in 2009 were at the level 0,3-0,4 MPC, in other cities – is significantly lower.

Formaldehyde

Annual average concentrations of formaldehyde in the air of most of the cities of Belarus in 2005-2009 were below the standard of quality. The only exception was Brest, Vitebsk, Orsha and Pinsk, where the average content of this pollutant over the entire period was higher than the MPC or near to it *(Table 2.15)*.

Regarding maximum single concentration of formaldehyde during the period 2005-2009 it exceeded the maximum permissible concentration in air almost in all the cities in the country from 1,4 to 10,2 times *(Fig. 2.14)*.

Minimum level of pollution is typical for Novogrudok and Zhlobin. Average annual concentrations of formaldehyde in the air in Polotsk, Mozyr, Brest, Pinsk and Vitebsk were carried out within 0,7-0,9 MPCs in other cities – 0,4-0,6 MPCs.

It should be noted that in 2009 the absolute values of maximum concentration of formaldehyde were significantly lower than in previous years. The average annual frequency of samples with concentrations of formaldehyde above the maximum single MPC in Brest was 3,1%, in Mogilev – 1,8%, in other cities – below 1%.

During five-year period the level of air pollution by formaldehyde in Bobruisk, Vitebsk, Gomel, Grodno, Rechitsa and Salihorsk decreased in 1,3-1,6 times, in Svetlogorsk – in 2,3 times. In Minsk, Orsha, Pinsk concentration of formaldehyde increased by 1,1-1,8 times, in Novogrudok – in 2,3 times. In Brest, Mozyr and Polotsk the

Table 2.15

Average annual concentrations of formaldehyde in the air of cities of Belarus in 2005-2009, mkg/m³

City	2005	2006	2007	2008	2009
Bobruisk	9.9	8.7	8.5	7.0	6.2
Brest	9.5	10.7	12.4	11.2	9.9
Vitebsk	14.7	13.4	13.5	11.0	10.9
Gomel	11.8	14.8	11.1	7.1	7.6
Grodno	7.8	4.5	5.7	5.2	5.5
Zhlobin	–*	–	4.8	1.9	2.9
Minsk	4.3	9.9	7.8	7.1	5.9
Mogilev	3.5	4.4	7.6	5.6	6.4
Mozyr	8.5	8.0	9.2	7.6	8.7
Novogrudok	0.7	1.6	2.5	2.5	1.6
Novopolotsk	7.7	8.5	5.5	5.8	7.4
Orsha	11.6	11.3	12.7	14.3	12.4
Pinsk	9.4	12.7	11.7	11.1	10.9
Polotsk	8.1	8.5	6.6	6.2	7.9
Rechitsa	9.6	8.5	8.5	8.6	6.8
Svetlogorsk	11.7	13.4	6.7	5.6	5.1
Soligorsk	7.0	8.9	11.1	9.4	5.0
MPC	12.0				

* The substance was not determined.

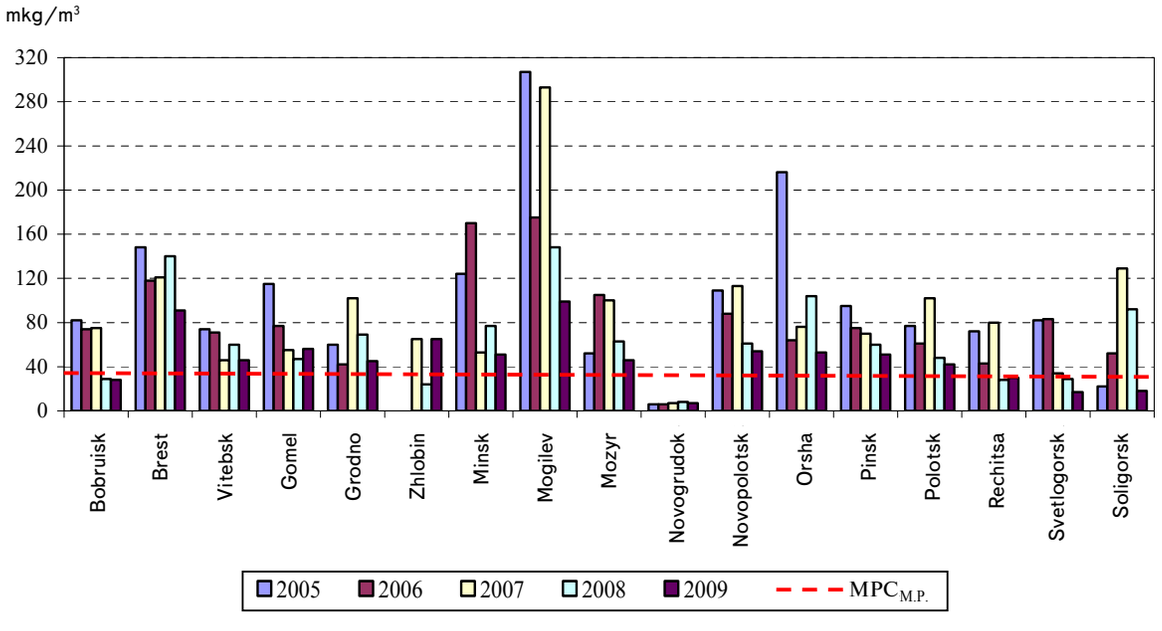


Figure 2.14 – Maximum single concentrations of formaldehyde in urban air in Belarus in 2005-2009

level of pollution by formaldehyde did not change.

The results of stationary observations on ambient air monitoring networks in 2005-2009 show that the state of atmospheric air in the cities of Belarus is good enough:

Annual concentrations of priority pollutants in most cities during the period remained below the quality standards;

Daily average concentration of total particulate matter and nitrogen dioxide exceeded the MPC only in selected cities;

Number of days with daily average concentration of particulate matter fraction PM-10 above the MPC were below the target adopted in the European Union in the Gomel, Vitebsk, Mogilev, Zhlobin and residential district of Minsk;

The maximum single MPC exceeded only in 0,25-0,50% of total number of analyzed samples. From 80 to 90% of the exceedances were in the range of 1-2 MPC, the concentration of pollutants more than 5 MPC were recorded less than 1% of the exceedances;

In 2009 compared with 2007 the number of «problem» areas with air pollution in the industrial centers of the country decreased by 22%.

However, in Orsha, some districts of Brest, Vitebsk and Pinsk for five years the level of air pollution by formaldehyde increased, in Mogilev, Polotsk, Novopolotsk and Svetlogorsk – by nitrogen dioxide. In

cities located in the southern region (Gomel, Zhlobin, Mozyr, Rechitsa) there is a problem of particulate air pollution. In two industrial regions of Minsk exceeds the target for particulate matter fraction PM-10.

According to the stationary observations over a five year period (2005-2009) in the majority controlled cities of the country there is a steady tendency to reduce air pollution by formaldehyde: annual concentrations decreased in average by 1.2 times, the maximum single – by 2,3 times. The content of sulfur dioxide in the atmosphere remains stable low. However, the content of nitrogen dioxide in the air in Bobruisk, Mozyr, Novopolotsk, Orsha, Pinsk, Polotsk and Svetlogorsk increased by 1,2-2,0 times. In the cities of Gomel region (Gomel, Mozyr, Rechitsa), Vitebsk and Grodno there is an increase in concentrations of particulate matter in 1,2-2,1 times.

3. Change of Climate

Air temperature

This indicator shows the average annual air temperature, its change over the certain period of time and deviation from historical averages the country as a whole and for individual regions.

In the period 2005-2009 Belarus climate warming was continued, it began in the late 1980's. The average temperature in these years varied between 6,8-8,0 °C, that is higher than long-term climatic norm for 1,0-2,0 °C *(Figure 3.1)*. At the same time the year of 2008 as well as the year 1989 was the warmest for the entire period of meteorological observations.

Among the regions of Belarus the warmest are Brest and Gomel. During the period 2005-2009 the average temperature were, respectively 7,2-8,8 °C and 6,9-8,7 °C. The coldest is Vitebsk region with an average temperature 5,7-7,4 °C.

As can be seen from *Figure 3.1*, winter was characterized by the greatest temperature contrasts in these years. Average winter temperatures ranged from -1.0 to -6,4 °C for the climatic norm -5,5 °C. Thus, deviations from the climatic norm were from -0.9 to 4,5 °C. In this case, winter of 2005-2006 with an average of temperature of air -6,4 °C and the deviation from the climatic norm -0,9 °C was the coldest one. The winter of 2007-2008 with an average temperature of -1,0 °C and the deviation from the climatic norm 4,5 °C was the warmest one.

For certain regions of Belarus the average winter temperature is varied to a greater extent *(Table 3.1)*. The coldest winter in all years of the period under review were characteristic for Mogilev region (from -1.9 to -7,2 °C) and warmest — for Brest region (from -0,1 to -5,5 °C). For these regions the observed outmost points of average winter temperature for the entire period of meteorological observations is characterized.

Spring in Belarus during the period 2005-2009 was characterized by average temperatures of the air from 5,5 to 8,9 °C and deviated from climate norms from -0.2 to 3,2 °C (climatic norm 5,7 °C). The warmest spring was in 2007, the coldest — in 2006. The spring of 2007 was the warmest for the entire period of meteorological observations in Belarus as for the whole of the country, and so for four of the six regions

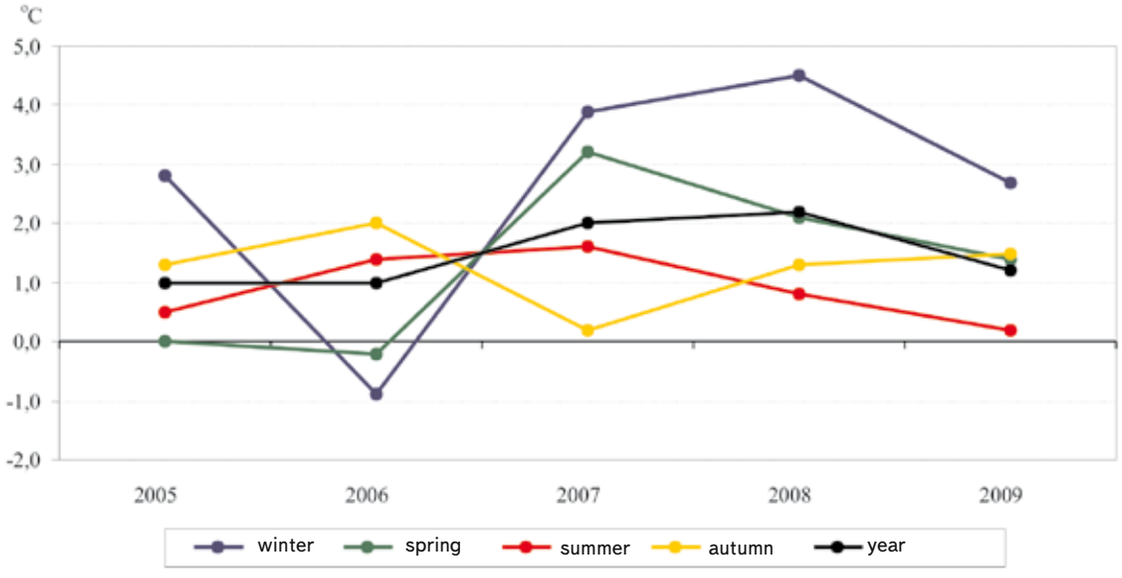


Figure 3.1 — The average deviation and average for the season in air temperature in Belarus from climatic norm in the period 2005-2009

Table 3.1

Average annual temperature in administrative regions of Belarus in 2005-2009, °C

Region	2005	2006	2007	2008	2009	Observed outmost points of maximum average winter temperature			
						maximum	year	minimum	year
Winter									
Vitebsk	-3,3	-7,2	-2,6	-1,3	-3,3	-1,1	1989 / 90	-11,1	1984 / 85
Minsk	-2,8	-6,5	-1,7	-1,0	-3,0	-0,2	1989 / 90	-10,5	1984 / 85
Grodno	-2,0	-5,9	-0,9	-0,4	-2,6	0,6	1989 / 90	-9,7	1962 / 63
Mogilev	-3,7	-7,2	-2,5	-1,9	-3,6	-1,2	1989 / 90	-11,8	1984 / 85
Brest	-1,8	-5,5	-0,1	-0,3	-1,9	1,3	1989 / 90	-9,6	1962 / 63
Gomel	-2,7	-6,0	-1,2	-1,3	-2,7	0,3	1989 / 90	-10,7	1984 / 85
Belarus	-2,7	-6,4	-1,6	-1,0	-2,8	-0,1	1989 / 90	-10,4	1984 / 85
Spring									
Vitebsk	4,7	4,5	8,1	6,9	6,3	8,1	2007	1,7	1952
Minsk	5,4	5,2	8,6	7,5	7,0	8,6	2007	2,6	1955
Grodno	5,7	5,4	8,9	7,6	7,3	8,9	2007	2,9	1980
Mogilev	5,4	5,0	8,6	7,7	6,6	8,7	1975	2,3	1980
Brest	6,5	6,4	9,6	8,2	8,0	9,6	2007	3,6	1980
Gomel	6,8	6,4	9,7	8,8	8,0	9,8	1975	3,6	1952
Belarus	5,7	5,5	8,9	7,8	7,1	8,9	2007	2,9	1980
Summer									
Vitebsk	16,8	17,6	17,6	16,8	16,1	19,0	1999	14,2	1962
Minsk	17,2	18,2	18,4	17,3	16,8	19,7	1999	14,6	1962
Grodno	17,0	18,2	18,1	17,2	16,8	18,8	1999	14,7	1962
Mogilev	17,1	17,8	18,2	17,5	16,8	19,3	1999	14,9	1993
Brest	17,6	18,6	18,8	18,0	17,6	19,4	1999	15,4	1962
Gomel	18,1	18,7	19,4	18,6	18,1	20,1	1999	15,8	1962
Belarus	17,3	18,2	18,4	17,6	17,0	19,4	1999	14,9	1962
Autumn									
Vitebsk	7,1	7,9	5,9	7,1	7,2	8,3	1967	2,3	1993
Minsk	7,5	8,2	6,4	7,5	7,6	8,9	1967	3,0	1993
Grodno	7,9	9,0	6,7	7,9	7,6	9,3	1967	3,8	1993
Mogilev	7,1	7,6	6,1	7,1	7,8	8,4	1967	2,2	1993
Brest	8,1	9,2	7,0	8,1	8,2	9,8	1967	4,6	1993
Gomel	7,8	8,4	7,0	7,8	8,6	9,3	1967	3,5	1993
Belarus	7,6	8,3	6,5	7,6	7,8	9,0	1967	3,2	1993

(Vitebsk, Minsk, Grodno and Brest) *(see Table 3.1).*

Regional differences in spring temperatures were also quite contrasting: the highest temperatures in all years were typical of Gomel region (6,4-9,7 °C), the lowest – for Vitebsk (4,5-8,1 °C). The difference of maximum and minimum average temperatures was 1,6-2,1 °C.

The average air temperature in summer period of 2005-2009 in Belarus ranged from 17,0 to 18,4 °C, the deviations from the climatic norm – from 0,2 to 1,6 °C (climatic norm 16,8 °C). The warmest summer was in 2007, the coldest – in 2009.

Among the regions of Belarus, the warmest summer in the period under review was typical for Gomel region (the average temperature from 18,1 to 19,4 °C), the coldest – for Vitebsk region (the average temperature from 16,1 to 17,6 °C).

Autumn in Belarus in the period 2005-2009 is characterized by the average air temperature from 6,5 to 8,3 °C and the deviations from the climatic norm from 0,2 to 2,0 °C (climatic norm 6,3 °C). The warmest autumn was in 2006, the coldest – in 2007.

Regional differences in average autumn air temperatures in Belarus appear as follows:

the warmest autumn is characteristic for Brest and Gomel regions (average temperature is respectively 7,0-9,2 °C and 7,0-8,6 °C), the coldest – for Vitebsk and Mogilev regions (respectively 5,9-7,9 °C and 6,1-7,8 °C).

Thus, the analysis of data on the average annual and average seasonal air temperatures in Belarus during the period 2005-2009 *(Fig. 3.2)* brings to the following conclusions:

– the period 2005-2009 was not an exception in a series of warm years of a period of warming that began in the late 1980's: the average air temperature during this period exceeded the climatic norm for 1,0-2,0 °C, only winter and spring of 2006 were below the climatic norm;

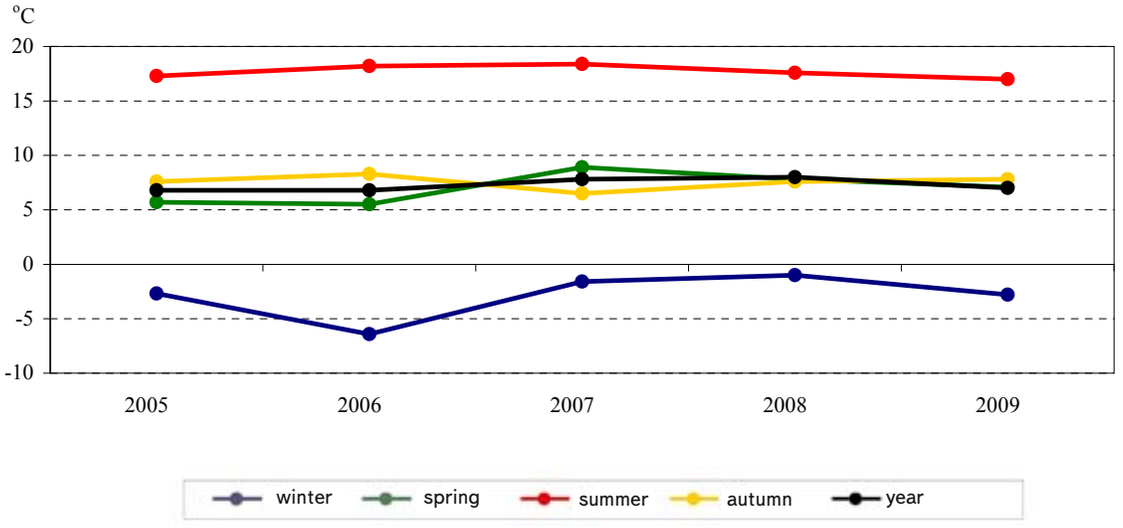


Figure 3.2 – Changes in average and average seasonal in air temperature in Belarus in 2005-2009

– along with 1989 the year 2008 was the warmest for the entire period of meteorological observations mainly due to warm winters;

– spring of 2007 was the warmest for the entire period of meteorological observations in Belarus;

– in the period under review, there are no any exceptional trends of average annual and average seasonal air temperatures.

Precipitation

Analysis of long-term observations of basic climate characteristics, such as precipitation, temperature and humidity can not only to define the structure of precipitation in a certain area, but also to assess the dynamics of change of the rainfall in the future, as well as related climate changes.

During the period 2005-2009 annual rainfall in Belarus generally was varied from 638 to 811 mm. In this case, the most «wet» year was 2009 (124% of the climatic ethical norms). The quantity of rainfall in 2005-2007 was closely to normal (97-99%), and in 2008 it was slightly higher than its norm (105%) *(Fig. 3.3)*.

The spatial distribution of both annual rainfall and rainfall in separate seasons in Belarus regions are more even than the air temperature. It is difficult to single out any regional differences in the features of precipitation for this period of time.

Less than 20% of the total amount of precipitation falling on the territory of Belarus for the year is in winter *(Figure 3.4)*. The winter of 2006-2007 is characterized by the greatest amount of precipitation – 141 mm or 123% of norm. Winters of 2005-2006 and 2007-2008 are characterized by low quantity of precipitation – 99-100 mm or 86-87% of norm. The quantity of precipitation in winter 2004-2005 and 2008-2009 was close to normal – 116-119 mm or 101-103% (norm – 115 mm).

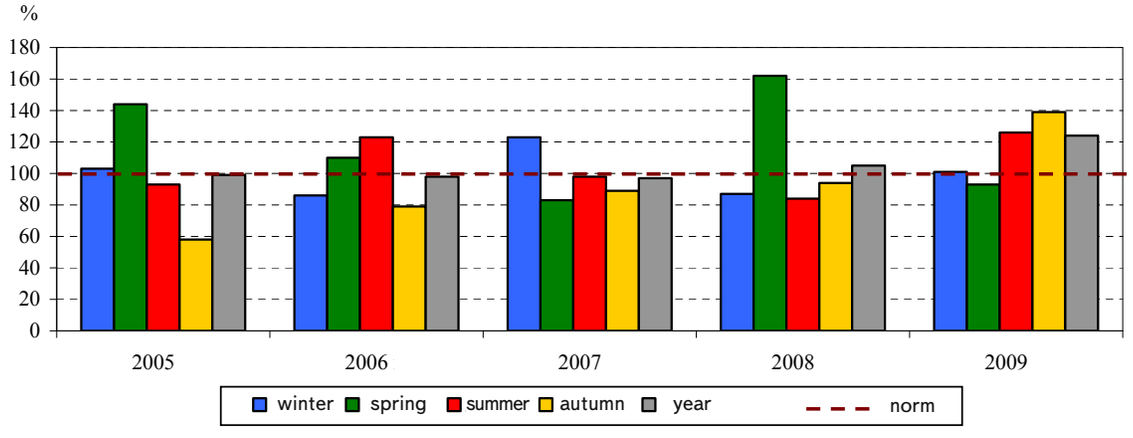


Figure 3.3 – Deviation of annual precipitation and seasonal precipitation from climatic norm in 2005-2009

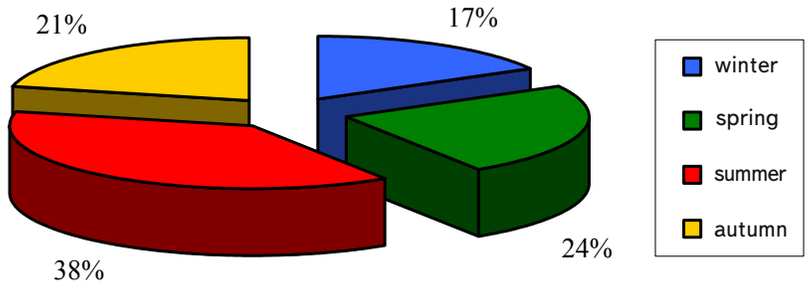


Figure 3.4 – Distribution of annual rainfall in Belarus by seasons in 2005-2009

Approximately one-fourth of the annual rainfall in Belarus fall in spring *(see Figure 3.4)*. In the period 2005-2009 the spring of 2008 was very «wet», when rainfall exceeded the climatic norm by 62%, exceeded to 224 mm (norm – 139 mm). Such rainfall in spring was registered at the first time in Belarus for the entire period of meteorological observations. This «record» on the quantity of air rainfall in spring of 2008 was broken as for the whole country, and additionally for Vitebsk, Minsk and Mogilev regions.

The quantity of rainfall in spring 2005 and 2006 also exceeded the climatic norm (respectively 44 and 10%), amounting to 199 and 152 mm. In 2007 and 2009 the quantity of spring rainfall was below normal – 83 and 93%, or 114 and 129 mm.

The summer period in Belarus takes about 40% of annual rainfall. Summers of 2006 and 2009 were characterized by significant quantities of rainfall – respectively 301 and 306 mm or 123-126% of normal – 243 mm). The «shortage» of precipitation was observed in summers of 2005 and 2008 – respectively 228 and 206 mm or 93 and 84% of normal. The amount of rainfall in summer 2007 – 238 mm was close to the climatic norm.

The quantity of rainfall in autumn period in Belarus is about 20% in the number of annual precipitation. In the period of 2005-2009 the climatic norm for autumn precipitation was exceeded only in 2009 – 139% or 221 mm (at norm of 159 mm). In 2005-2008 the rainfall in autumn remained below normal – 58-94% or 92-150 mm.

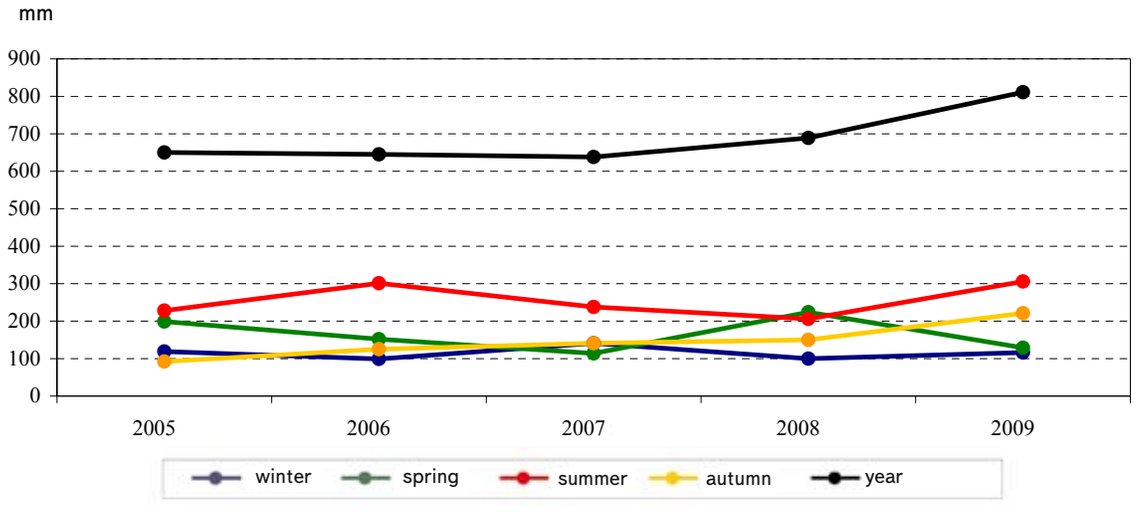


Figure 3.5 – Change in annual and seasonal rainfall in Belarus in 2005-2009

In *Figure 3.5* the dynamics of the annual and each seasons of atmospheric precipitation in Belarus in 2005-2009 is shown. As it is shown in the figure, a slight positive trend is typical for annual precipitation and spring season precipitation.

The analysis of data on the quantity of precipitation in Belarus in the period 2005-2009 brings to the following conclusions:

– annual precipitation of the period of 2005-2008 was close to the quantity of atmospheric norm, in 2009 the norm was exceeded by 24%;

– the maximum rainfall over the entire period meteorological observation not only for Belarus was marked in the spring of 2008, but as well as separately for Vitebsk, Minsk and Mogilev regions;

– for this period of time it is difficult to separate any regional differences in precipitation;

– the period of 2005-2009 is characterized by a slight increase in annual and spring seasonal precipitation in Belarus.

Dangerous hydrometeorological phenomena

Dangerous meteorological phenomena are divided into meteorological, agrometeorological and hydrological. By meteorological hazards we mean strong winds (including squalls and tornadoes), very heavy rain, very heavy rainfall, prolonged heavy rain, very heavy snow, severe storms, heavy icing, large hail, sleet and sticking complex deposition (a complex layer of ice, hoar-frost and sleet), heavy fog, hard frost, intense heat and dust storm; to dangerous agrometeorological – frost and drought; to dangerous hydrological – high water levels in flood-times, rain floods, ice jams and hanging ice dams, low water levels, as well as early formation of ice cover and the appearance of ice on navigable rivers .

Totally for the period from 2005 to 2009 on the territory of Belarus it was observed 72 cases of dangerous hydrometeorological phenomena, that means it were 14 cases annually on the average. The largest number (20 cases) occurred in 2007, the lowest (10 cases) – in 2005 and 2008.

During the specified period dangerous hydrometeorological phenomena in Belarus concerned to 9 types *(Figure 3.6)*. On diagram 3.6 the most widespread dangerous agrometeorological phenomenon as freezing is not specified, which is observed every year in spring and in autumn in many parts of Belarus.

Annually such a dangerous phenomenon, as very heavy rain is often observed. During the period 2005-2009 38 cases of heavy rain were recorded, on the average 8.7 cases each year (the least quantity of cases was in 2005 – 4 cases, the highest in 2009 – 11 cases).

Strong winds with the speed of 25 m/s and more (including squalls and tornadoes) are the most destroying severe weather case. In the period 2005-2009 in Belarus from 2 to 5 cases of strong wind in the year were detected. The exception was 2008, when the dangerous phenomenon was not detected.

In recent years, the number of such dangerous phenomena as very heavy snow increased. During the period 2005-2009 5 cases of heavy snow were recorded.

In addition during this period 5 cases of large hail, 3 cases of adhesion of sleet and complex deposits, 3 cases of extreme heat,

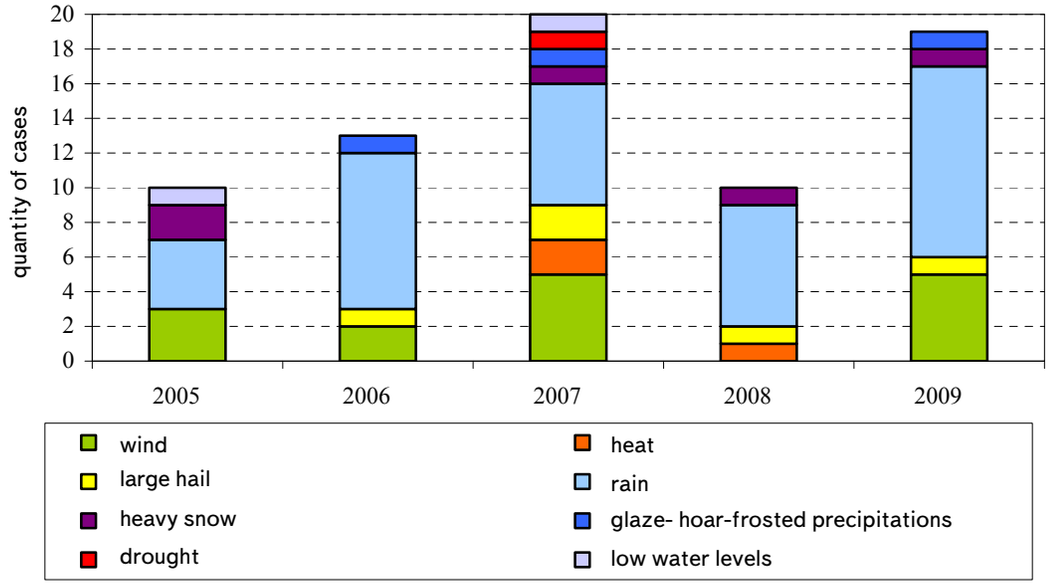


Figure 3.6 – Distribution of the number and types of hazardous weather events on the territory of Belarus in 2005-2009

drought and two cases of low water levels were observed.

It should be noted that the warming climate in Belarus is accompanied by an increase of the number of dangerous meteorological and agrometeorological phenomena (squall lines, heavy rains, frost in the southern part of the country on the land-reclaimed areas, droughts). At the same time the number of other hazards has decreased (hail, fog, glaze-hoar-frosted precipitations.

Greenhouse gas emissions

To greenhouse gases (GHG) emissions include: Carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF_6).

The main sources of greenhouse gases are the following sectors of economy: energy (CO_2, CH_4, N_2O), industry (CO_2, CH_4, N_2O, HFCs, SF_6), the use of solvents (N_2O), agriculture (CH_4, N_2O), land use , changes in land use and forestry (CO_2, CH_4, N_2O), wastes (CH_4, N_2O). Such category as land use, changes in land-use and forestry is also the source of removal greenhouse gases from the atmosphere by absorbing them by vegetation.

Figure 3.7 shows the dynamics of changes in greenhouse gas emissions in Belarus in the period 2005-2008 (2008 was the last year of GHG inventory). As it can be seen from the figure, the total GHG emissions in the period under review increased from 84.5 million tons in 2005 to 91.1 million tons in 2008 (excluding carbon dioxide absorption in the category «land use, changes in land use and forestry»). Taking into account the absorption of carbon

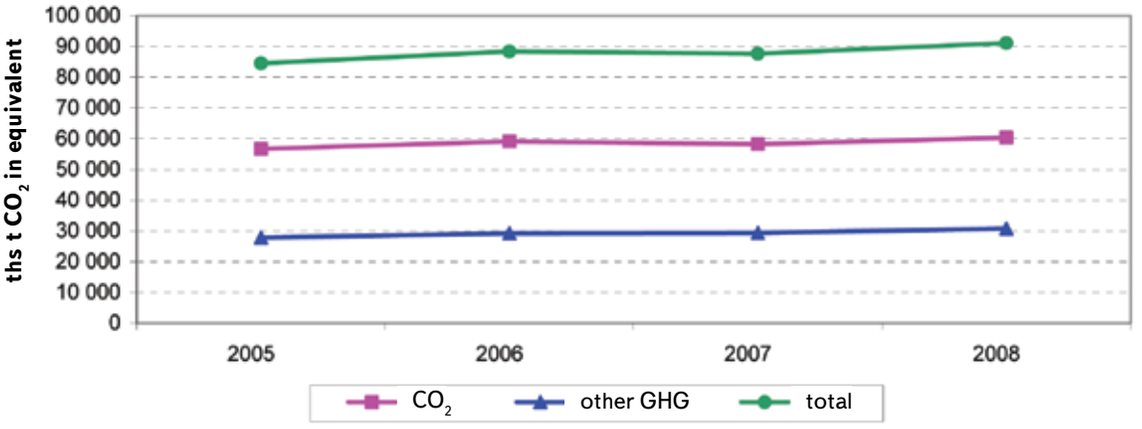


Figure 3.7 – Dynamics of greenhouse gases in Belarus in 2005-2008.
(Without carbon dioxide absorption in the category of land use, land-use change and forestry)

dioxide in this category the total greenhouse gas emissions from 2005 to 2008 increased from 53.7 million tons to 60.0 million tons.

The main greenhouse gas is carbon dioxide. In the overall structure of GHG emissions, its share is about 66% *(Figure 3.8)*. Approximately 17.5% is nitrous oxide, about 16% – methane. Emissions of other greenhouse gases in the amount are less than 1%.

During the period 2005-2008 for both carbon dioxide and other greenhouse gases a small dynamics is noted in increasing of emissions: carbon dioxide – from 56.7 to 60.4 million tons (excluding absorption), nitrous oxide – from 14.6 to 15.9 million tons, methane – from 13.2 to 14.8 million tons, hydrofluorocarbons – from 26.2 to 35.8 thousand tons, sulfur hexafluoride – from 1,5 to 2,4 tons. Taking into account the absorption of carbon dioxide in the category «land use, changes in land-use and forestry», emissions of CO_2 increased from 25.8 in 2005 to 29.3 million tons in 2008.

The leading role of greenhouse gas emissions in the structure in sectors of economy belongs to energy – 64% *(Fig. 3.9)*. Approximately 25% of emissions is in agriculture. Other sectors add up to about 10% of greenhouse gas emissions.

During the period 2005-2008 greenhouse gas emissions in «energy» sector have increased from 55.3 to 58.7 million tons, in «industry» sector – from 3,5 to 4,0 million tons, in the sector «agriculture» – from 21.0 up to 22.7 million tons, in «waste» sector – from 4,6 to 5,6 million tons *(Figure 3.10)*. Greenhouse gas emissions from the sector, «the use of solvents», slightly decreased (from 69.2 to 64.1 tons). The absorption of carbon dioxide in the sector «Land use, changes in

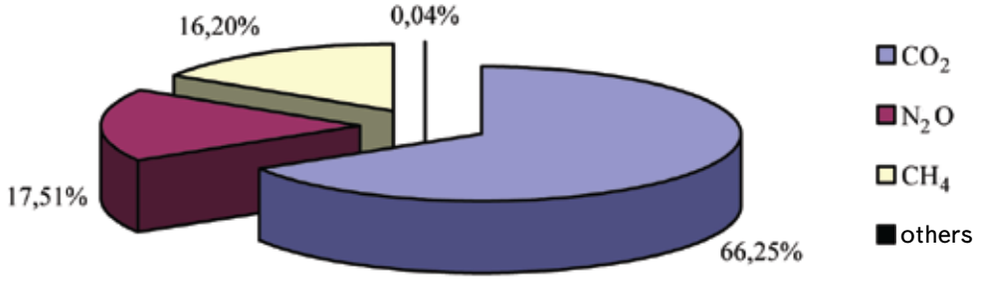


Figure 3.8 – Structure of greenhouse gases in Belarus (according to 2008)

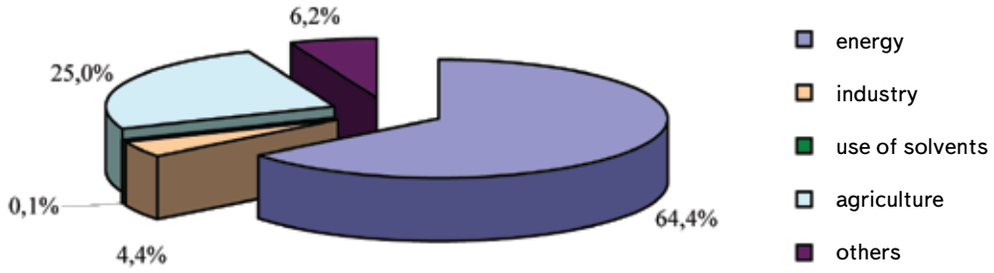


Figure 3.9 – Structure of the greenhouse gas emissions by sector (according to 2008)

land-use and forestry» during the period under consideration was about 29,8-31,9 million tons per year.

For easing the comparison, to estimate greenhouse gas emissions among various countries it used the value of specific emission, that means per unit area of the country and per capita of the population. *Table 3.2* presents the results of the calculation of specific emissions of greenhouse gases for the Republic of Belarus.

In the period 2005-2008 the value of specific emissions of greenhouse gases in Belarus was equal to an average of 423.5 t/km^2 a year without taking into account the absorption and 272.9 t/km^2 a year, taking into account the absorption of carbon dioxide. And from 2005 to 2008, this value has increased accordingly from 407.1 to 438.9 t/km^2 a year and 258.8 to 289.4 t/km^2 a year *(see Table 3.2)*.

The average greenhouse gas emissions per capita in the period under review composed 9.3 tons per capita a year without taking into account the absorption and 6,0 tons per capita a year, taking into account the absorption of carbon dioxide. From 2005 to 2008, this value increased, respectively from 8,9 to 9,6 tons per capita a year, and from 5,7 to 6,3 tons per capita (t/c) a year *(see Table 3.2)*.

The analysis of data on the volume and dynamics of greenhouse gas emissions in Belarus led to the following conclusions:

– during the period 2005-2008 greenhouse gas emissions in Belarus amounted to an average of 87.9 million tons a year without taking into account absorption and 56.6 million tons a year, taking into account the absorption of carbon dioxide;

– in the structure of greenhouse gas emissions more than 65% is carbon dioxide, about 17% – nitrous oxide, about 16% – methane, other greenhouse gases in the amount are less than 1% of total emissions;

– in the structure of sectors of economy about 64% of greenhouse gases are related

Table 3.2

Specific emissions of greenhouse gases in the atmosphere in Belarus in 2005-2009

Единица измерения		2005	2006	2007	2008
t/km^2	without taking into account the absorption	407.1	425.7	422.1	438.9
	taking into account the absorption	258.8	271.7	271.7	289.4
t / c	without taking into account the absorption	8.9	9.3	9.2	9.6
	taking into account the absorption	5.7	6.0	5.9	6.3

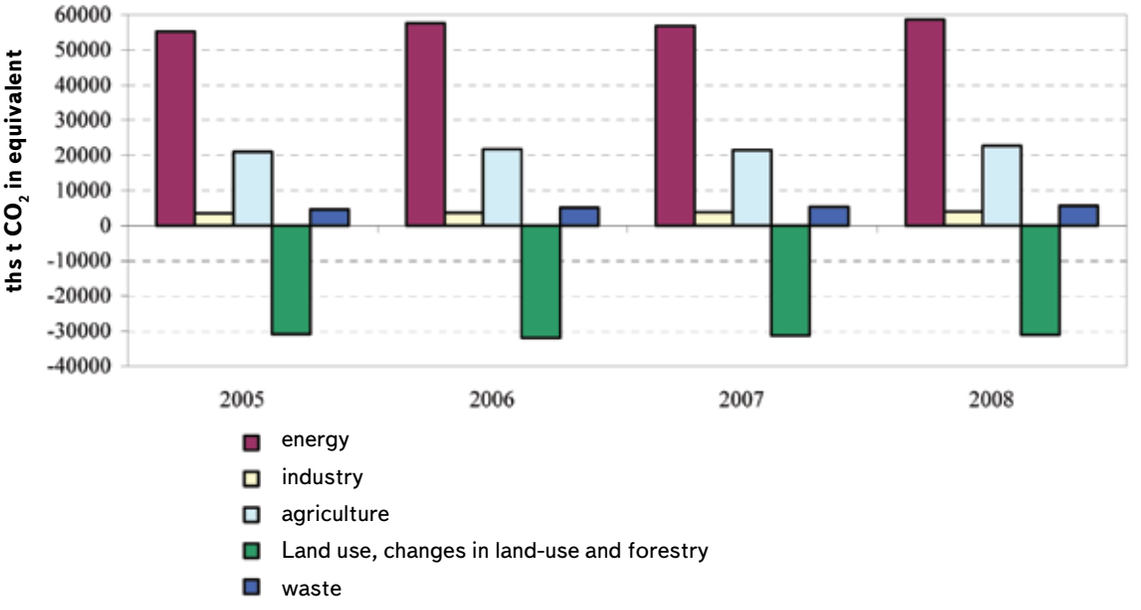


Figure 3.10 – The dynamics of greenhouse gas emissions in Belarus by main sectors of the economy in 2005-2009

with «energy»; 25% – with «agriculture»; «industry», «solvent» and «wastes» totally give about 10% of greenhouse gas emissions;

– from 2005 to 2008, total emissions of greenhouse gases has increased from 84.5 to 91.1 million tons without absorption and from 53.7 to 60.0 million tons, taking into account the absorption of carbon dioxide; the increase occurred in all sectors of economy with the exception of «the use of solvents»;

– the value of the specific greenhouse gas emissions in the period under review amounted to the average of 423.5 t/km^2 a year without taking into account the absorption and 272.9 t/km^2 a year, taking into account the absorption of carbon dioxide; per capita – 9,3 t/c a year without taking into account the absorption and 6,0 t/c a year, taking into account the absorption of carbon dioxide.

4. Water resources

Freshwater resources have great ecological and economic importance. In this regard, effective management of water resources is one of the major challenges of sustainable development in general.

Renewable freshwater resources

Renewable freshwater resources of the Republic of Belarus represented by river run-off and groundwater, the volume of which is formed in natural conditions by precipitation in the country (internal flow), as well as the influx of river water and groundwater from neighboring countries. The total annual flow of rivers is determined by measuring the levels and water flow. The natural resources of fresh groundwater is the total flow rate of underground water, which is provided by infiltration of precipitation. The figure of infiltration recharge aquifers active water exchange zone is 10-20% long-term average values of precipitation. In the general flow of rivers of Belarus on the proportion of groundwater accounts for 27%.

The main source of surface water resources of the country are medium and large rivers, the volume of water runoff, which in water average years, usually not more than 57.9 billion m^3 per year. In wet years the total runoff is increased to 92.4 billion m^3 per year, and in dry (95% availability) decreases to 37.2 billion m^3 per year In this case, the rivers of the Black Sea account for 55% of total annual runoff, the Baltic Sea basin – 45%.

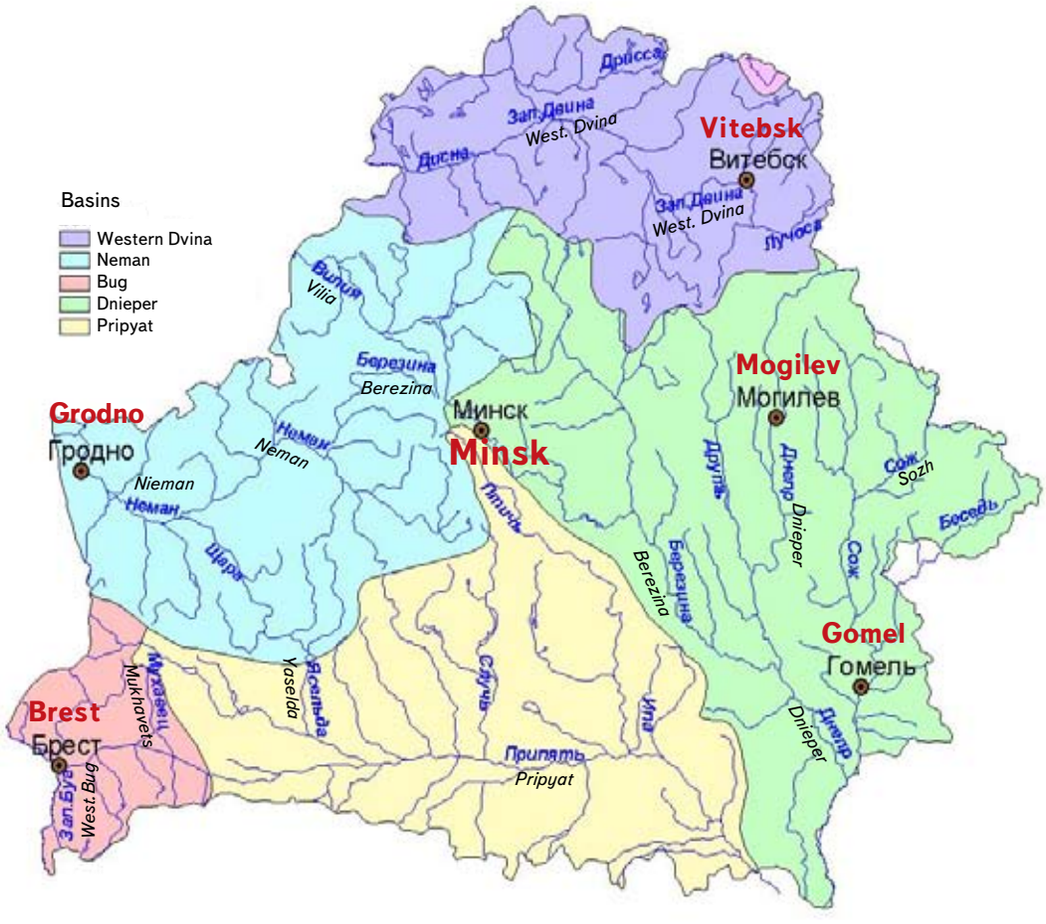


Figure 4.1 – The main rivers of Belarus

Across the country seven major rivers are longer than 500 km: the Western Dvina, the Neman, the Vilia, the Dnieper, the Berezina, the Sozh and the Pripyat, six of them (except for the Berezina) are transboundary ones *(Fig. 4.1)*. There are totally 20.8 thousand rivers of different sizes with the total length of 90.6 km.

Most of the river runoff (34 billion m^3 or 59%) is formed within the country (local stock). Inflow of water from neighboring states (Russia and the Ukraine) is 41% or 23.9 billion m^3 per year *(Table 4.1)*.

The bulk of the local river runoff (73%) is formed in the catchments of the Western Dvina, Neman and the Dnieper. Predominant part of the transit flow enters the Dnieper (32%), the Pripyat (31%) and the Western Dvina (28%).

Distribution of local runoff within the year is very uneven. Over the three spring months on the rivers of western and central parts of the country (the basins of the Neman, the Vilia, the Berezina) takes on average 42-47% of annual flow, while the rest – up to 56-62%.

Irregularity of the annual flow is compensated to some extent, by the construction of reservoirs. Belarus has created 153 reservoirs, the total volume of water is 3.1 billion m^3, useful – about 1240 million m^3, accounting more than 3% of the runoff, formed in the country. Dominated reservoir of the channel (river)-type for water inlet is 35% and lake type – 13% respectively.

In Belarus there are about 10.8 thousand lakes, the vast majority of them (75%) belongs to small, having a surface area up to 0.1 km^2. Resource importance of lake with area over 1.0 km^2, is totaled 6000-7000 million m^3 of water. The largest volume of water enclosed in a lake basins of the Western Dvina (72% of all stocks) and the Neman (20%), followed by basins of the Pripyat and the Dnieper.

Table 4.1

Resources of streamflow

Administrative Regio	Local watershed runoff, million m^3		Total stock, million m^3	
	Average long-term	95% provision	Average long-term	95% provision
Western Dvina	6800	4300	13 900	8600
Neman (without Vilia)	6600	5200	6700	5300
Vilia	2300	1800	2300	1800
Western Bug (incl. Narew)	1400	800	3100	1700
Dnieper (excluding Pripyat)	11 300	7600	18 900	12 800
Berezina	4500	3300	4500	3300
Pripyat	5600	3100	13 000	7000
Total	34 000	22 800	57 900	37 200

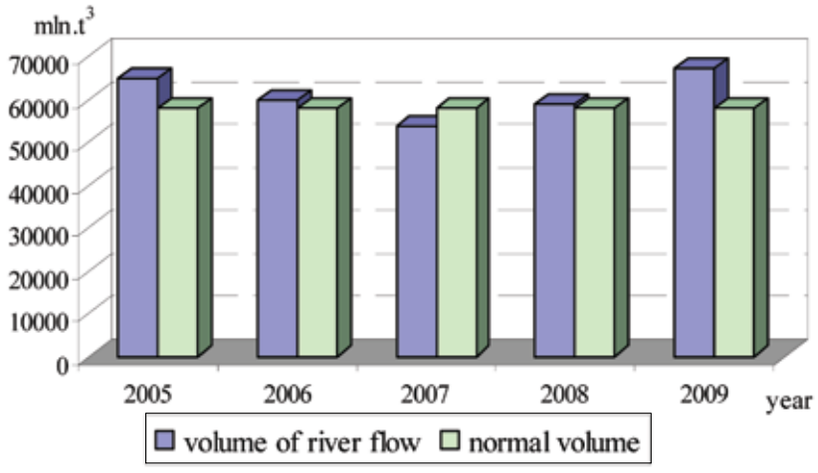


Figure 4.2 – The dynamics of river flow for the period 2005-2009

In 2009 the total in Belarus amounted to 67.6 billion m^3 and was higher long-term average values over 17% *(Fig. 4.2)*.

During the period 2005-2009. total volume of runoff was slightly lower than the average long-term value only in 2007, accounting for 93% of the norm.

Largest water resources of rivers of Belarus ranks the fourth place in Europe after Norway (376 billion m^3 per year), UK (152 billion m^3 per year) and Poland (85.4 billion m^3 per year).

Natural resources of fresh groundwater is 15.9 billion m^3 per year, the forecast – 18.1 billion m^3 per year. Distribution of water resources across the country is very uneven, owing to the nature of the relief capacity of the aeration zone, lithological composition of land and water-bearing rocks. At the level of the administrative regions of the country by the number of natural resources is allocated Minsk region, the least ensured Brest *(Table 4.2)*.

At the level of river basins the most significant amount of water found in the watershed of the Dnieper (including the Pripyat) and the lowest – in the watershed of the Western Bug *(Table 4.3)*.

Sufficiency of water in the world is estimated using specific indicators of water

Table 4.2

Groundwater resources within the boundaries of administrative areas

Administrative Region	Freshwater groundwater mln m^3 /y		ratio of operational resources to the natural,%
	natural	forecast	
Brest	1584	2045	129
Vitebsk	3357	3486	104
Gomel	1929	3094	160
Grodno	2613	2806	107
Minsk	4134	4360	105
Mogilev	2283	2310	101
Total	15 900	18 100	114

Table 4.3

Groundwater resources within the boundaries of basins of major rivers

Basin	Freshwater groundwater, mln m^3/y		Ratio of operational resources to the natural,%
	Natural	Forecast operational	
Western Dvina	2690	2970	110
Neman (without Vilia)	3601	3510	97
Vilia	1330	1670	126
Western Bug	510	662	130
Dnieper (without Pripyat)	5200	5528	106
Pripyat	2559	3750	147
Total	15 900	1810	114

availability (the ratio of average annual runoff to the number of the population).

Water availability per capita in Belarus (6,1 thousand m^3/person/year) is close to the average, but significantly higher than in neighboring countries – Poland (1.7 thousand m^3/person) and the Ukraine (4,1 thousand m^3/person).

Freshwater water

Data on water intake coming from enterprises and organizations established by the state reporting form, store in the system water inventory. They are compiled and published in the annual information-analytical publications.

According to the water inventory, total intake of surface and groundwater in 2009 was 1.573 billion m^3 and in comparison with 2008 decreased by 65.5 million m^3. Reducing the quantaty of water is steadily observed over the past five years. In relation to 2005, the total water intake decreased by 200 million m^3, that means more than 10% *(Fig. 4.3).*

From water natural objects are taken 715 million m^3 of water, from underground sources – 858 million m^3. The structure of the total water intake on the proportion of groundwater in all the considered years accounted for more than 50%, and in recent years has tended to reduce groundwater consumption.

Along with the decrease in the amount of consumption of water in general, there was a decrease in the rate of water consumption per capita *(Table 4.4).*

The main quantity of natural water is taken in Belarus for the needs of utilities. In 2009, for the industry, «public utilities and public services» was withdrawn 761 million m^3; for

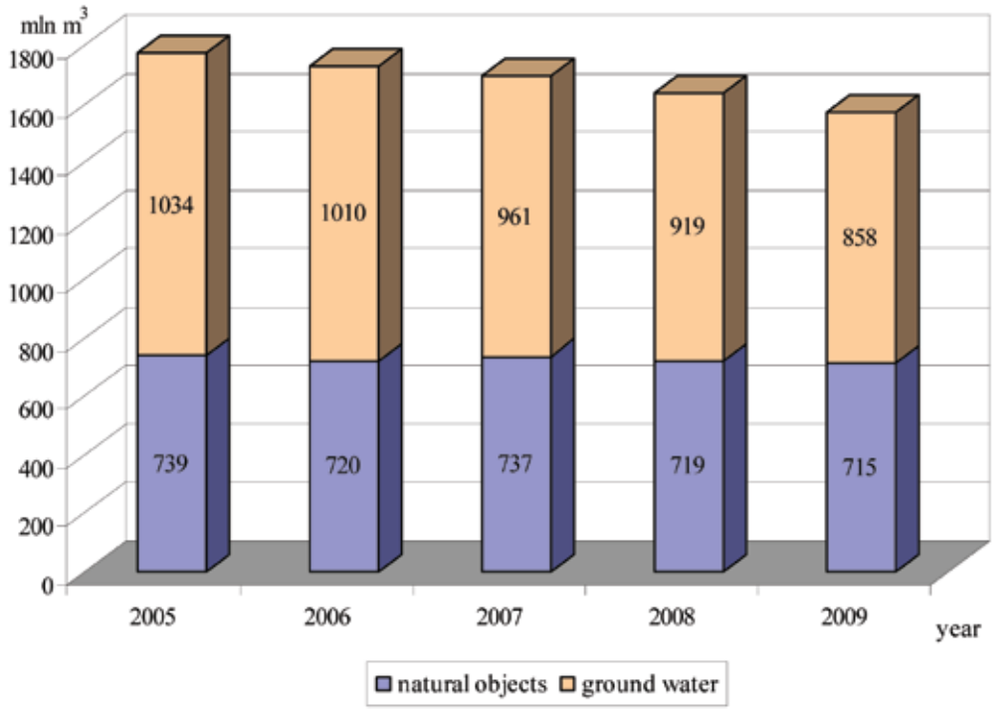


Figure 4.3 – Dynamics of water consumption from natural objects and ground water sources

Table 4.4

Dynamics of water intake per capita over the period 2005-2009

Year	Total abstraction, mln m³	Country's population, ths	Water intake per capita, m³
2005	1773	9800	181
2006	1730	9756	177
2007	1698	9714	175
2008	1638	9690	169
2009	1573	9490	166

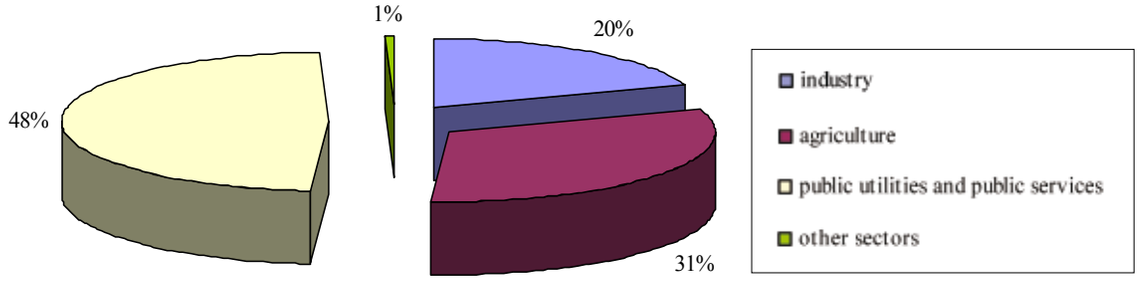


Figure 4.4 – Total water consumption by sector of economic activities

agriculture – 492 million m^3 and the industry – 310 million m^3. Water consumption by sector of economic activity in percentage terms is shown in *Figure 4.4.*

Representation of the pressures on water resources at national and regional levels can get the index of exploitation of water resources (IEVR), which is calculated as the ratio of total annual intake to a multiyear average annual volume of renewable freshwater resources. IEVR threshold value, which is the basis for comparing different countries and regions with a unstressed and water stressed conditions is about 20%. Water stressed conditions are noted in cases where IEVR exceeds 40%.

IEVR in considered years changed very little (2,8-3,0%) at the national level, and the total water consumption for all sectors of economic activity has no significant pressure on available water resources in the country. IEVR values increase somewhat when considering the sampling of natural waters at the river basin.

According to IEVR the most intensively at the regional level, water resources are exploited in the basins of the Berezina river (a tributary of the Dnieper), the Vilia and the Neman, much less – the Western Dvina, the Sozh and the Western Bug. In general, water resources are exploited in a normal mode.

Domestic water consumption per capita

Water consumption for household and drinking purposes by an average of every citizen of Belarus in 2009 did not exceed 145 L/24 hours/person. In comparison with 2005 it decreased by 30% *(Fig. 4.5)* and corresponded to the level of water consumption in most European countries (120-150 L/24 hours/person).

Compared with the average set for Belarus, in the cities of water consumption per capita is still quite high, approaching the European level only in Brest *(Table 4.5)*.

The largest amount of water consumed per capita is in Minsk, however, in recent years,

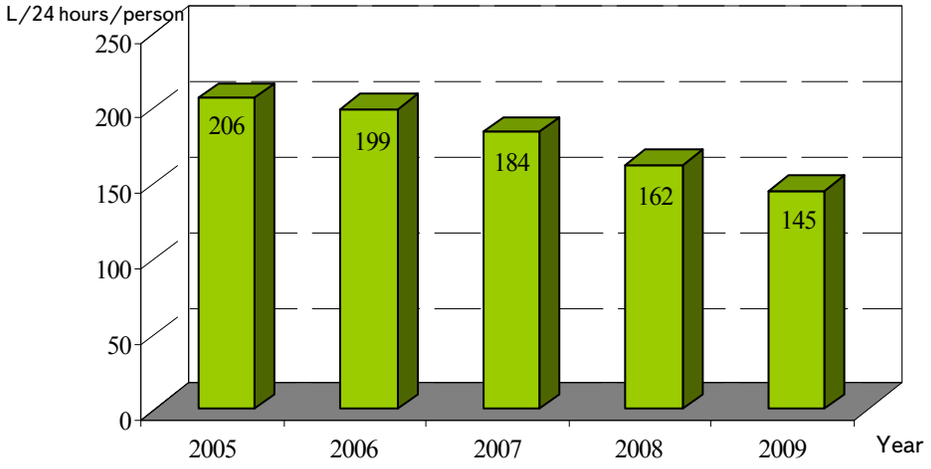


Fig. 4.5 – Water consumption in Belarus in 2005-2009

Table 4.5

Water consumption per capita in major industrial centers of Belarus in 2005-2009, L/24 hours/person

City	Year					Reduced to the level of 2005,%
	2005	2006	2007	2008	2009	
Brest	264	227	204	181	149	44
Vitebsk	250	241	217	185	166	34
Gomel	262	245	228	198	179	32
Grodno	302	265	245	214	193	36
Mogilev	298	275	252	213	176	41
Bobruisk	256	271	238	207	182	29
Borisov	224	216	201	204	153	32
Mozyr	293	231	196	195	165	44
Novopolotsk	255	208	190	170	153	40

domestic water consumption in the capital of Belarus has been reduced. Thus, in comparison with 2005 it decreased by 35%.

A similar situation is typical of other cities, where per capita consumption of water for municipal needs has decreased over the past five years at 29-44%.

Reducing domestic water consumption has become possible due to the introduction of metering of water used in the residential sector of the city, as well as measures aimed at the development of water conservation in the housing and communal services.

For municipal water supply for cities and all other settlements are mainly underground sources, with the exception of Minsk and Gomel, which partly receive drinking water from surface water objects. The provision of population with centralized water supply in Belarus is 86%, including the rural population – 57% (1.4 million people from 2.5 million rural population).

The quality of drinking water

The population of Belarus is provided with drinking water primarily from groundwater sources, sanitary conditions in which basically meet the requirements, except for the high content of iron and manganese, in some cases, boron, fluoride and some other components. This is a consequence of the hydrogeological features of the country.

An increase in the content of ammonium, nitrate, chloride and other components in groundwater is observed in the areas subject to anthropogenic pollution.

In 2009, the results of monitoring the drinking water quality standards established in Belarus, the deviations of microbiological indicators of water supplied by public water

Table 4.6

Specific volume of samples of drinking tap water in 2006 and 2009 which do not meet hygienic requirements,%

Region	Mains municipal water pipes			Departmental pipes		
	on microbiological criteria	for the sanitary-chemical indices (total)	iron (total)	on microbiological criteria	for the sanitary-chemical indices (total)	iron(total)
Brest	0,6	24,9	55,4	1,0	51,9	63,0
Vitebsk	0,2	16,0	15,5	0,7	17,3	16,2
Gomel	1,6	25,6	34,5	1,6	37,8	56,2
Grodno	0,9	19,7	25,2	3,2	33,2	40,7
Minsk	1,0	12,4	19,7	2,2	26,7	37,7
Mogilev	0,7	17,6	18,2	0,6	19,5	19,6
Minsk-city	0,7	5,0	4,3	2,9	13,1	15,0
In total, Belarus	0,8	18,4	22,2	1,4	27,8	36,3

pipes were found in 0.8% of cases, by departmental – 1,4% *(Table 4.6)*.

Obtained figures demonstrate the safety of municipal water supply in Belarus.

On sanitary and chemical standards water in public waterpipes in 2009 did not meet the standards in 18.4% versus 22.4% in 2006, in a departmental pipelines – in 27,8% (30,7% in 2006) from the total number of samples.

According to the guidelines for drinking water quality by WHO, the concentration of iron in water of 2 mg/L is not harmful to human health. At the same time in Belarus, the maximum allowable concentration of iron for drinking water is 0,3 mg/L.

Based on the more stringent requirements for drinking water in Belarus, the number of water samples which do not meet hygienic standards for the iron content of public water in 2009 amounted to 22,2% (28,2% in 2006), departmental water – 36,3% (38,2% in 2006).

Thus, in comparison with 2006 the proportion of water samples that do not meet hygienic requirements decreased in municipal water at 6% for iron and 4% for the sanitary-chemical indicators, in departmental pipelines – on 1,9 and 2,9% respectively.

Despite the considerable amount of work in recent years on the development of centralized water supply and sanitation, about 2 million people in the country continue to use water with iron content higher health standards (0.3 mg/L), adopted in Belarus.

Nowadays non-centralized water supply sources (water wells) are used by 1.4 million people including the rural population – 1.1 million

people. Of the 42.6 thousand controlled sources of uncentralized water supply about 11% do not meet hygienic requirements for the sanitary-chemical and microbiological standards. Discrepancy on chemical indicators is recorded in almost 40% of samples, and microbiological – 16%.

Deterioration of water quality in water wells due to both agricultural activities (introduction of organic and mineral fertilizers), and lack of hygiene rules when locating, equipment and operation of wells.

Despite some difficulties with the quality of drinking water, according to the report of the UN/UNDP «Human development indicators», Belarus is a member of the 34 countries whose population is 100 per cent sustainable access to improved water sources (quantity, quality and proximity of finding water sources).

Water loss

The efficiency of water use plays a key role in balancing the performance of water supply and water consumption. This can be achieved by reducing losses of water during transportation to the places of use and maintenance of pipe systems in good technical condition.

In 2009 losses of water during transportation to the places of use reduce as compared with 2008 for 47 million m^3 и was 84 million m^3. In this case, the amount of loss does not include the number of unaccounted-for water from public water supply systems, which accounted for 56 million m^3. Water loss during transportation in different years varies from 5 to 8 % *(Fig. 4.6)*.

Water losses during transport within the region varies from 7 to 17 million m^3: the greatest loss of water observed in the Vitebsk and Mogilev regions. The lowest quantity of losses is observed in Grodno region. The number of loss in Minsk accounts for more than 30% of the reported loss of water. However,

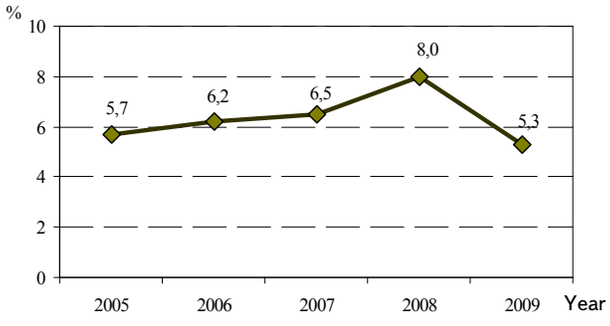


Figure 4.6 – Share of loss of fresh water in transit in 2005-2009

there is a tendency to reduce water leakage in Minsk, as well as in all regions of Belarus.

Re-use and recycling of freshwater

The index «re-use and recycling of fresh water» describes sharing of reusable and recycled water in the total volume of water consumed for industrial purposes. It determines the percentage of water saved through the use of recycling and reuse of water in the whole country and by sectors of economic activity.

In 2009, as compared with the previous year, the decline in water use is noted by 8,4% in the systems of recycling and re-using of water supply *(Table 4.7)*.

Reduction of the absolute values of this indicator was noted in all regions and

Table 4.7

Dynamics of water in the recycling and re-supply

The dimension of the index	Year				
	2005	2006	2007	2008	2009
million m^3	6369	6522	6349	6697	6134
%	93	94	94	94	94

Minsk. Reasons for reduction of reusable and recycled water, usually caused by a change of technological parameters of the enterprises, changes in production technology, etc. At the same time the proportion of water used in the systems of recycling and re-using water used for production practically unchanged over the five year period.

Waste water discharge into water objects

The index «wastewater into water bodies» determines the level and nature of the load on the rivers and reservoirs of the country, provides information to improve the mechanisms for the protection of water bodies and evaluation of measures taken to improve the level of wastewater treatment.

The total amount of wastewater collected in the rivers of Belarus in 2009 increased compared with 2008 to 6 million m^3 and reached 996 million m^3. In this case, at the regional level, the amount allocated to water waste water increased only in the Brest and Minsk regions. Here, with respect to 2008, it increased by 26% and 10% respectively In comparison with 2005 the number of discharged wastewater in these areas increased by 21 and 4% respectively *(Table 4.8)*.

For the remaining regions and Minsk a tendency to reduce the amount of allocated in the river of sewage is noted. Compared with 2005 the volume of wastewater in the Vitebsk region decreased by 32%, Gomel – 26, Mogilev – 13, Minsk – 26%.

In the sectoral structure of wastewater is the largest amount of wastewater, usually falls on housing and communal services (HCS) and personal services. Thus, in 2009, the share of housing accounted for 60% of wastewater; for industry and agriculture – on 16 and 24% *(Fig. 4.7)*.

In industrial production the major suppliers of wastewater into water bodies are chemical and petrochemical industry, and electricity *(Fig. 4.8)*.

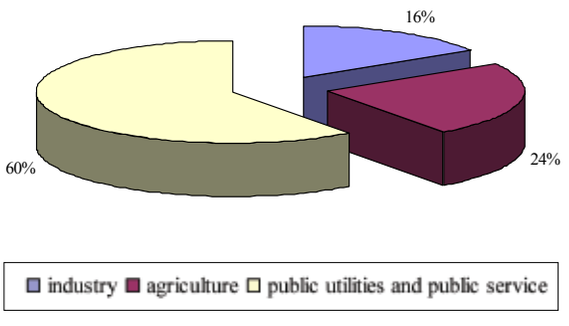


Figure 4.7 – Waste water discharge into water sectors of the economy in 2009

Table 4.8

Waste water discharge into water bodies in the regions and Minsk in 2005 – 2009, mln. m³

Region	Year				
	2005	2006	2007	2008	2009
Brest	160	154	157	154	194
Vitebsk	172	141	134	132	117
Gomel	189	173	170	156	140
Grodno	97	97	97	94	89
Minsk	159	158	151	151	166
Mogilev	115	111	106	106	100
Minsk-city	254	248	223	197	188
Total, Belarus	1146	1082	1038	990	996,6

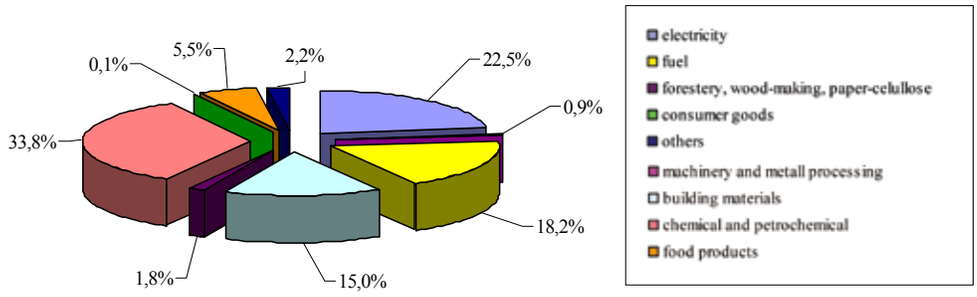


Figure 4.8 – Waste water discharge into water by industries in 2009

Among the categories of wastewater discharged into water objects, as previously, regulatory purified water quantitatively dominated, although its volume in comparison with the previous year decreased by 25 million m³. At the same time significantly (by 39 million m³) increased the number of legal and clean (unpurified) water. The volume of water without purificatin and inadequately purified, reduced to 3 million m³ if compared to 2008 it decreased by 3,7 times *(Fig. 4.9)*.

The basic amount of wastewater discharged into water bodies, formed in seven cities (Brest, Vitebsk, Gomel, Grodno, Mogilev, Bobruisk and Novopolotsk) and in Minsk, its share in the total amount of wastewater in 2009 was 48% and in the volume of norm-and purified water – 66%.

Surface water

In Belarus there is a well-formulated network of surface water monitoring, which in 2009 totaled 276 sites of observations located at 142 water bodies (81 of rivers and 61 of the lakes) in the basins of the Western Dvina, the Neman, the Western Bug, the Dnieper and the Pripyat. In addition, the observations covered 35 areas of transboundary watercourses located in areas of the state border.

The basic standard for river water quality in Belarus is the maximum permissible concentration of chemicals (MPC) established for the fishery.

Assessment of surface water in the basins of the Western Dvina, the Neman, the Western Bug, the Dnieper and the Pripyat was

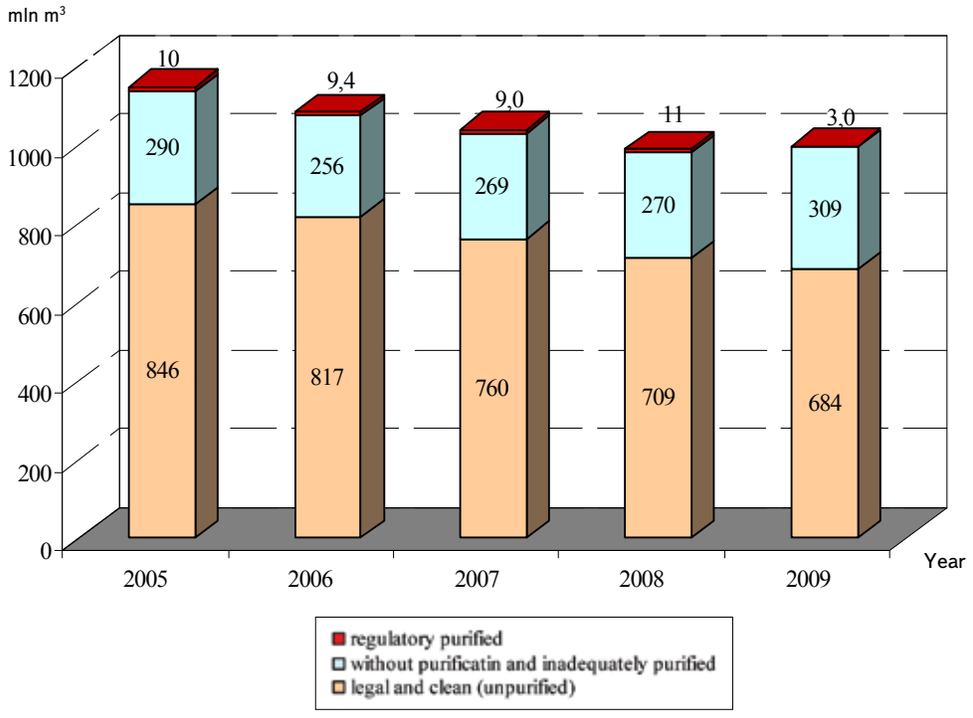


Figure 4.9 - Dynamics of wastewater into water bodies for 2005-2009

conducted according to the analysis of average values of BOD_5 (biochemical oxygen demand), annual average concentrations of ammonia nitrogen and nutrients (nitrate and phosphate phosphorus).

Biochemical oxygen demand in river water

Determination of biochemical oxygen demand (BOD_5) in rivers is necessary for assessment of biochemical oxidation of organic matter, water species conditions of living and as an integral index surface water pollution. This indicator is very sensitive to the level of water pollution. The value of BOD_5 in the range of 3,00-3,90 mgO_2/L identifies polluted waters, 4,00-10,0 mgO_2/L – dirty waters. In Belarus, for the assessment of river water pollution with organic substances adopted by the maximum permissible concentration values for BOD_5, which amounts to 3.00 mgO_2/L.

According to the data *(Table 4.9)* annual average BOD_5 exceeding the MPC in long-term series of observations are set out in the water of the Western Bug on virtually all controlled part of the river, some sections of rivers the Mukhavets, the Dnieper and the Svisloch. By the rivers, the annual average concentration of organic substances in water which during the period was below the MPC include the Western Dvina, the Berezina, the Pripyat.

Contamination of the Dnieper with organic matters for the entire observation period, according to the values of BOD_5 (3,13-4,55 mgO_2/dm^3) was observed only on the

Table 4.9

Minimum and maximum values of the average annual values of BOD_5 in the water of the main rivers of Belarus in the period 2005-2009., mgO_2/L

River	2005		2006		2007		2008		2009	
	min	max	min	max	min	max	min	max	min	max
Western Dvina	2,00	2,44	2,08	2,60	1,56	2,08	1,66	2,51	1,51	2,49
Neman	1,63	3,36	2,16	2,90	1,40	2,79	1,39	2,86	1,67	3,24
Western Bug	3,76	4,68	3,09	4,54	2,86	4,23	2,75	4,42	3,57	4,72
Mukhavets	2,54	3,55	2,75	3,50	2,56	3,25	2,66	3,32	2,43	3,53
Dnieper	1,25	3,56	1,35	4,55	1,33	4,10	1,06	4,24	1,50	3,13
Berezina	1,46	2,32	1,74	2,29	1,57	2,70	1,76	2,50	1,53	2,19
Svisloch	1,52	6,63	2,01	5,57	1,43	4,57	1,81	7,04	2,15	5,68
Pripyat	2,33	3,67	2,21	3,77	1,77	2,87	1,91	2,74	1,86	2,96
MPC	3,00									

segment of the river below Loyev. And in 2009 the situation has improved, the annual average organic matters content decreased to 3.13 mgO_2/dm^3.

Based on the average figures of BOD_5, the situation for the rivers the Pripyat, the Neman on the content in river water organic matters seems to be quite normal. Thus, in the last three years in the water of the Pripyat organic substances do not exceed the MPC. With regard to the Neman, the contamination of organic substances in 2009, recorded in the upper parts of the river, near the town of Stolbtsy.

Heavy pollution of river water, according to the annual average BOD_5 is typical for the Svisloch river below Minsk (site of Korolischevichi).

The concentration of ammonia nitrogen in the river water

Ammonium nitrogen is included in the list of priority pollutants of the rivers in Belarus. Measured concentrations of the pollutant can determine the level of change in river water quality.

As the data in the *table 4.10*, the average concentration of ammonia nitrogen excessed the level of MPC is found in water of all rivers and considered to be the evidence of pollution of river water, which is expressed differently for each water objects as for years, and in the areas of the pollutant spreading.

The average content of ammonia nitrogen in water of the Western Dvina exceeding MPC installed in all the years of a five-year period, mainly on the segment of the river from Polotsk to Verhnedvinsk, with the observed decrease in the concentrations of the pollutant: in 2006 they exceeded the guideline data in 1,6-2,0 times, in 2009 – 1,3-1,4 times, which indicates a slight

Table 4.10

Minimum and maximum values of annual average concentrations of ammonia nitrogen in the water main river in Belarus in 2005-2009, mgN/L

River	2005		2006		2007		2008		2009	
	min	max	min	max	min	max	min	max	min	max
Western Dvina	0,23	0,51	0,15	0,77	0,14	0,44	0,17	0,60	0,16	0,56
Neman	0,23	0,51	0,37	0,51	0,17	0,35	0,16	0,34	0,18	0,62
Western Bug	0,24	0,53	0,28	0,59	0,26	0,51	0,26	0,53	0,21	0,51
Mukhavets	0,26	0,38	0,38	0,64	0,35	0,61	0,40	0,52	0,34	0,88
Dnieper	0,37	0,78	0,34	0,83	0,26	0,70	0,22	0,77	0,26	0,89
Berezina	0,65	1,15	0,69	1,49	0,45	1,89	0,53	1,37	0,58	1,06
Svisloch	0,28	3,82	0,32-	4,46	0,31	4,08	0,18	3,06	0,28	2,38
Pripyat	0,37	1,32	0,45	1,57	0,35	1,39	0,25	0,77	0,26	0,75
MPC	0,39									

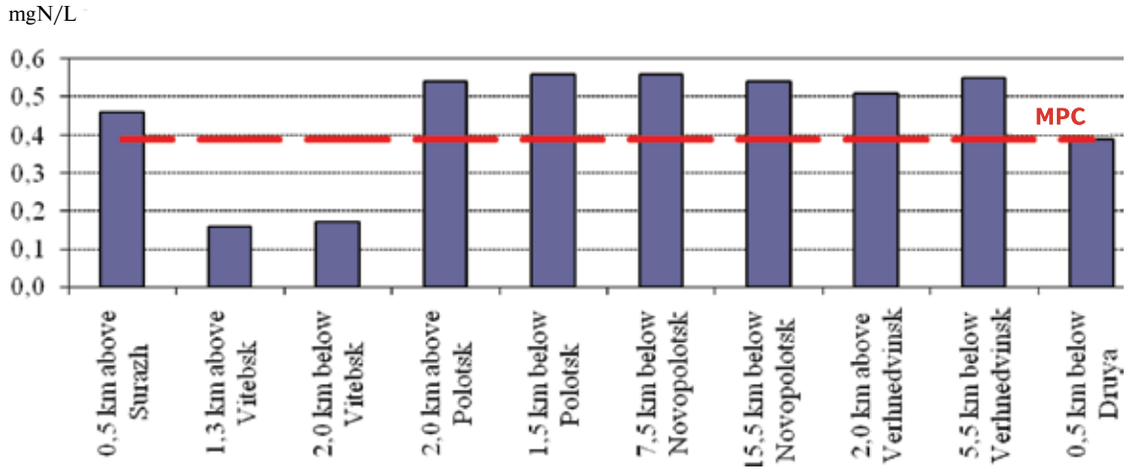


Figure 4.10 – The average content of ammonia nitrogen in water Western Dvina in 2009

improvement in river water. At the same time a new hotbed of ammonium nitrogen pollution of the river formed in the area of cross-border point (p. Surazh), which controls the flow of contaminants of the river waters from the territory of Russia *(Fig. 4.10)*.

To a greater degree of contamination of ammonium nitrogen is expressed for the tributaries of the Western Dvina – r. Polota around and Polotsk, r. Ushachi southwest Novopolotsk *(Fig. 4.11)*.

According to the annual average concentrations, good state of the Neman river

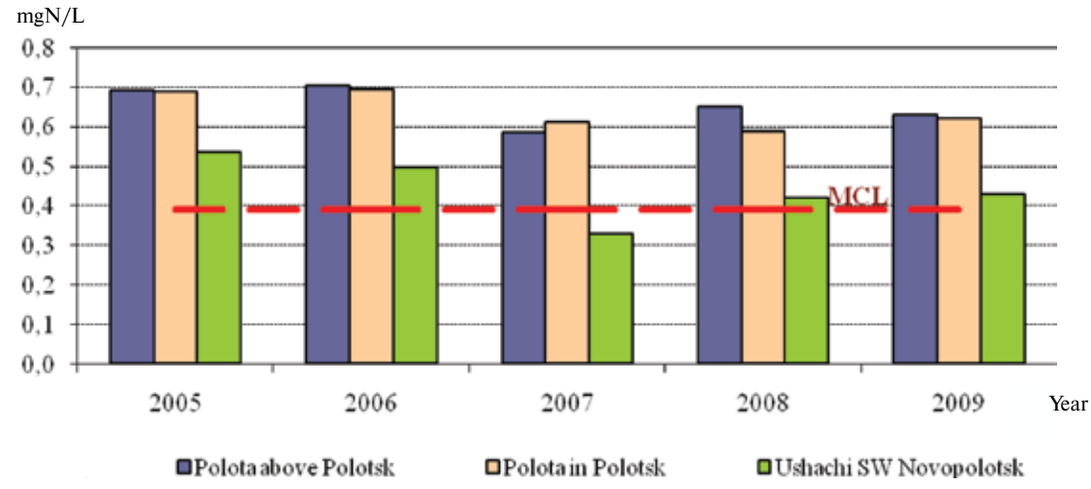


Figure 4.11 – Change in annual average concentrations of ammonia nitrogen in water r.Poloty around and Polotsk, r.Ushachi southwest Novopolotsk in 2005-2009

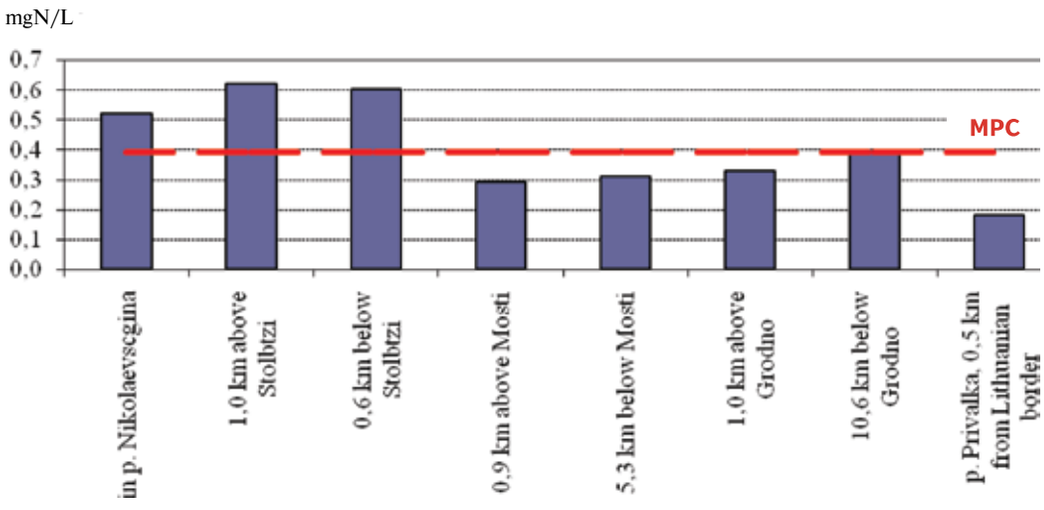


Figure 4.12 – The average content of ammonia nitrogen in water Neman river in 2009

on the content of ammonia nitrogen in water, set in 2007-2008 was broken in 2009. The upper part of the Neman river water is characterized by a yearly average of contaminants in 1,1-1,6 times the maximum allowable concentration *(Figure 4.12).*

Analysis of longitudinal data on the annual average content of ammonia nitrogen in the water of the Western Bug showed a tendency for reduction of spreading of halo of pollution below the stream.

During 2006-2009 elevated concentrations of ammonia nitrogen in almost all observation

Table 4.11

Average content of ammonia nitrogen in water r. Muhavtsa in 2006-2009, mgN/L

Point	Year			
	2006	2007	2008	2009
1.8 km above Kobrin	0,77	0,52	0,49	0,76
1.7 km below Kobrin	0,69	0,61	0,52	0,88
1.0 km upstream. Zhabinka	0,84	0,51	0,50	0,59
2.0 km downstream. Zhabinka	0,81	0,50	0,48	0,59
0.8 km upstream from Brest	0,64	0,52	0,49	0,55
within the boundaries of Brest	0,38	0,35	0,40	0,34
MPC	0,39			

points was in the Muhavets *(Table 4.11)*.

The content of ammonia nitrogen in the water of the Dnieper in concentrations exceeding the maximum allowable concentration, was observed in almost all observation points in the controlled section of the river in 2006 and 2007, with an average concentration of the element more normative level in the 1,6-2,1 and 1,3-2,3 times, respectively. In subsequent years, the state of river water has improved significantly *(Table 4.12)*.

Nowadays ammonium nitrogen pollution of the Dnieper River is most clearly manifested in the lower segment of the controlled part of the river *(Figure 4.13)*.

Table 4.12

Average annual concentrations of ammonia nitrogen in water of Dnieper River in 2006-2009, mgN/L

Point	Year			
	2006	2007	2008	2009
in p.Sarviry	0,34	0,26	0,35	0,29
1.0 km above Orsha	0,68	0,51	0,50	0,37
0.5 km below Orsha	0,83	0,60	0,43	0,34
1.0 km above Shklov	0,70	0,54	0,28	0,29
2.0 km below Shklov	0,67	0,50	0,31	0,30
1.0 km above Mogilev	0,70	0,52	0,22	0,26
25.6 km below Mogilev	0,70	0,60	0,36	0,27
1.0 km above Bykhov	0,63	0,57	0,43	0,27
2.0 km below Bykhov	0,75	0,56	0,46	0,28
0.8 km above Rechitsy	0,80	0,70	0,70	0,85
5.6 km below Rechitsy	0,79	0,63	0,61	0,89
0.8 km above Loev	0,76	0,68	0,77	0,81
8.5 km below Loev	0,83	0,67	0,68	0,53
MPC	0,39			

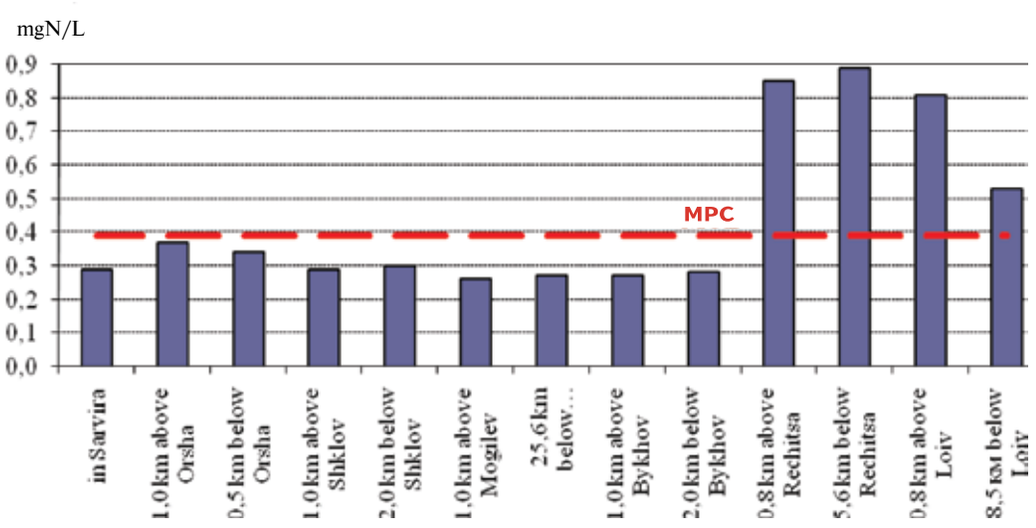


Figure 4.13 – The average content of ammonia nitrogen in the water in the Dnieper River in 2009

The quantity of ammonia was formed here on the background of its elevated concentrations throughout the year. In the vast majority of water samples (90%) sampled in 2009 in the river by Rechitsy to p. Loev, found excessive amounts of ammonia nitrogen.

Analysis of annual average concentrations of ammonia nitrogen in water of the large left tributary of the Dnieper – the Sozh showed that the most unfavorable hydrochemical situation occurring in the region of Gomel, where during the period from 2006 to 2009, there is large contamination of river.

However, it should be emphasized that the overall condition of the river as compared to 2006 significantly improved: significantly space boundaries of contamination reduced .

The chemical composition of water which is formed in conditions of considerable anthropogenic pressure among the rivers of the country in the first place is the Svislach in the watershed of which Minsk is located. The part of the Svisloch below Minsk Purification Station (MPS) is most vulnerable to the negative effects of water quality here is assessed as unsatisfactory.

Annual average concentrations of ammonia nitrogen in water the Svisloch river below the MPS (p.Korolischevichi), exceeding the MPC 10,5-11,4 times in 2006-2007 in recent years decreased to 3,06-2,38 mgN/L (7,8-6,1 MPC).

According to *table 4.13* pollution of the Pripyat by ammonium nitrogen is well expressed in 2006: Annual mean concentrations of the element were more than MPC in 1,2-4,0 times, contamination enveloped almost the entire segment of the controlled river.

Nowadays the content of ammonia nitrogen in water of the Pripyat characterized by considerable variability in annual average concentrations (0,26-0,7 mgN/dm^3) *(Table 4.13).*

Higher average concentrations of ammonia nitrogen observed in 2009 in the water of number of tributaries of the Pripyat – rivers the Cna, the

Table 4.13

Average annual concentrations of ammonia nitrogen in water p. Pripyat River in 2006-2009., mgN/L

Point	Year			
	2006	2007	2008	2009
0.5 km NE p.B.Dikovichi	0,33	0,45	0,37	0,46
1.0 km above Pinsk	0,67	0,53	0,42	0,47
3.5 km below Pinsk	1,57	1,39	0,77	0,75
1.0 km above Mozyr	0,45	0,35	0,25	0,26
1.0 km below Mozyr	0,45	0,37	0,27	0,26
45.0 km below Mozyr	0,47	0,38	0,29	0,29
2,0 km E p.Dovlyady	0,51	0,39	0,34	0,40
MPC	0,39			

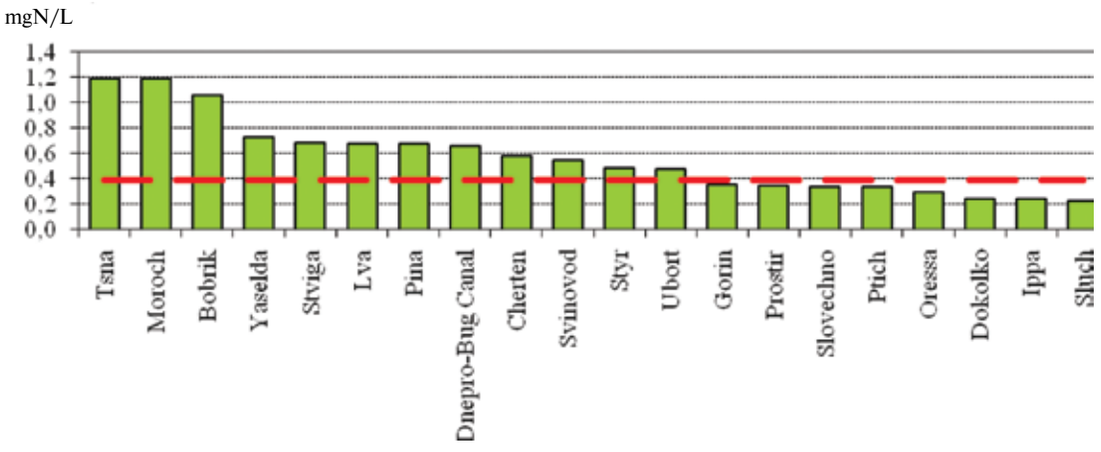


Figure 4.14 – average concentrations of ammonia nitrogen observed in 2009 in the water of number of tributaries of the Pripyat

Morochi, the Bobryk, the Yaselda, the Stviga, the Lva, the Pina, etc. *(Fig. 4.14)*. The most stressful situation was revealed for the rivers the Bobryk, the Morochi, the Pina, the Stviga, the Cna and the Dnieper-Bug Canal, where the process of «ammonia» contamination was stable throughout the year.

Thus, analysis of annual average concentrations of ammonia nitrogen in the water of the rivers of the country allows to mark the main features of pollution of rivers in Belarus in recent years.

Pollution of the Western Dvina by ammonium nitrogen is clearly traced to a segment of the river from Polotsk to Verhnedvinsk. In 2009, the annual average content of ammonia nitrogen pollution of the river varied in the range 0,51-0,56 mgN/dm^3.

Elevated concentrations of ammonia nitrogen (up to 2.2 MPC) in water of Polota is observed through the year, that means the steady pollution of the Western Dvina.

For the Western Bug river water pollution from ammonium nitrogen clearly detected in the area p. Rechitsy, some years it is noted in the vicinity of Brest and further downstream. With regard to the Mukhavets, its water is polluted by ammonium nitrogen from Kobrin to Brest.

Water pollution of the Dnieper by ammonium nitrogen in 2009 was observed mainly in the cities Rechytsa and Loev, the Sozh river – in the Gomel region.

Contamination of the Berezina was observed throughout the controlled area of the river, it is most clearly manifested lower Borisov and Svetlogorsk, where the content of ammonia nitrogen in the water exceeded the MPC, respectively, 3,2 and 2,7 times.

Contamination of the Pripyat is marked only in the river near Pinsk.

Nutrients in rivers

Nowadays the problem of pollution of river water with nutrients is a key in protecting aquatic ecosystems from eutrophication, which causes ecological changes in aquatic ecosystems and have an adverse impact on the use of water for human needs and business.

This indicator includes the values of average concentrations of nitrates and phosphates (phosphorus phosphate), which compares with the national water quality standards (MPC).

Average annual concentrations of nitrates in the water of rivers, according to data

Table 4.14

Minimum and maximum values of annual average concentrations of nitrates in the water main river in Belarus in 2005-2009., mgN/L

River	2005		2006		2007		2008		2009	
	min	max	min	max	min	max	min	max	min	max
Western Dvina	0,29	1,74	0,49	1,95	0,22	1,73	0,22	2,13	0,22	1,73
Neman	0,58	6,16	0,53	5,18	2,66	6,55	3,94	6,24	4,30	8,10
Western Bug	3,86	4,57	4,65	8,19	6,07	8,06	5,09	6,38	4,12	5,09
Mukhavets	3,18	5,17	2,70	6,91	4,03	6,51	3,99	6,55	3,85	5,76
Dnieper	2,34	5,90	2,21	7,44	2,61	8,15	2,13	7,93	1,06	6,11
Berezina	2,67	9,78	3,28	8,41	2,35	9,61	2,66	12,44	1,24	9,08
Svisloch	2,29	14,27	2,48	14,08	2,75	17,23	1,64	16,52	2,35	13,91
Pripyat	1,35	36,42	1,52	31,79	1,64	27,86	2,57	2,88	1,33	2,88
MPC	40,0									

presented in *Table 4.14*, change in a very wide range, but exceedings of the maximum allowable concentration are not established.

The most serious situation exists in respect of phosphate phosphorus, annual average content in a number of rivers exceeds the MPC. The rivers with a busy multi-mode phosphates are primarily the Western Bug and Mukhovets. Prosperous enough environment is characteristic for the Western Dvina and the Neman in part *(see Table 4.15)*.

Based on annual average concentrations of pollution of the Western Bug phosphorus phosphate is observed to weaken in recent years (2006-2009). In 2009, the annual average phosphorus content of phosphate exceeded the MPC in 1,8-2,7 times, while in 2007 the excess amounted to 2,6-3,4 times.

However, contamination of the Western Bug in 2009 was more significant compared to other rivers. In this case, the sharpness of the situation regarding «phosphate» pollution increased downstream the river *(Fig. 4.15)*.

The average annual phosphorus concentration of phosphate recorded in the water of the Dnieper, show a decrease in the level of pollution of the river and on the reduction of

Table 4.15

Range of average phosphorus content of phosphate in the water of rivers of Belarus for the period 2005-2009, mgP/L

River	2005	2006	2007	2008	2009
Western Dvina	0,017–0,051	0,027–0,047	0,014–0,039	0,014–0,044	0,020–0,050
Neman	0,015–0,046	0,025–0,060	0,024–0,043	0,021–0,040	0,020–0,080
Western Bug	0,148–0,177	0,147–0,186	0,169–0,225	0,157–0,212	0,120–0,180
Mukhavets	0,046–0,090	0,051–0,124	0,059–0,139	0,036–0,108	0,070–0,140
Dnieper	0,061–0,166	0,071–0,169	0,062–0,169	0,056–0,151	0,040–0,150
Berezina	0,017–0,152	0,016–0,152	0,011–0,205	0,016–0,106	0,015–0,150
Svisloch	–	0,008–0,416	0,012–0,578	0,007–0,417	0,020–0,720
Pripyat	0,036–0,135	0,032–0,155	0,010–0,064	0,023–0,134	0,030–0,050
MPC	0,066				

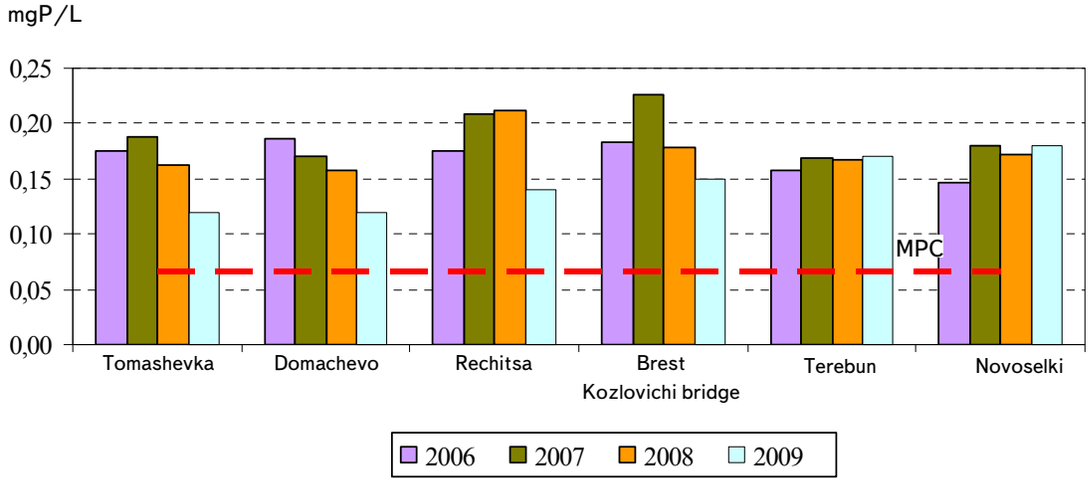


Figure 4.15 – Average phosphorus content of phosphate in water of the Western Bug in 2006-2009

area of contamination. In 2005-2007 pollution of the river was noted everywhere, the average figure of an item exceeded the MPC to 2,6 times.

A high phosphorus content of phosphate in the water of the Dnieper remains in Loev, with an annual mode of pollutant clearly increased the concentration of it in all phases of the hydrological regime.

Annual average phosphorus content of phosphate in water-controlled part of the Pripyat river pollution was found just below the Pinsk *(Figure 4.16)*.

Thus, the most the Dnieper the situation with phosphorus of phosphate is typical at present for the Western Bug, the Muhavets, the Dnieper below Loev, as well as for the Berezina – on the part of the river below the city of Borisov-above Svetlogorsk. Pollution of the waters of the Western Dvina and the Neman by phosphorus of phosphate has not been established.

Waste water

Indicator «waste water» determines the level and nature of the pressures on surface waters, to evaluate the measures taken to improve the level of wastewater treatment. The volume of wastewater containing pollutants decreased in comparison with 2005 by 11% *(Fig.4.17)*.

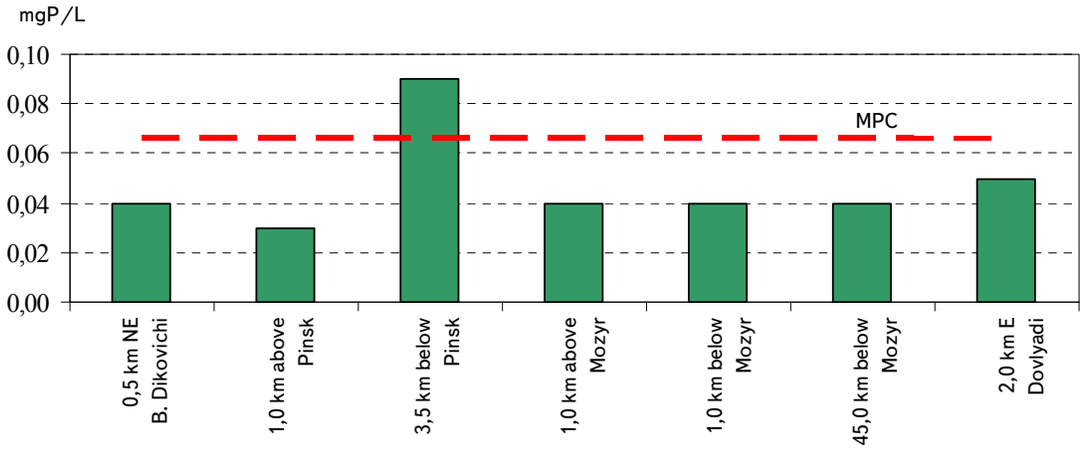


Figure 4.16 – Average phosphorus content of phosphate in water of the Pripyat in 2009

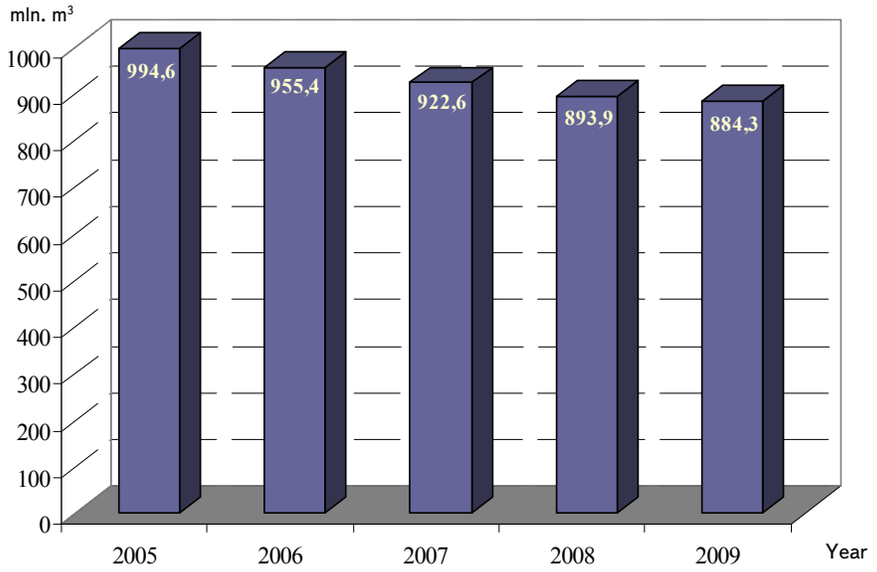


Figure 4.17 – Dynamics of wastewater containing pollutants in 2005-2009

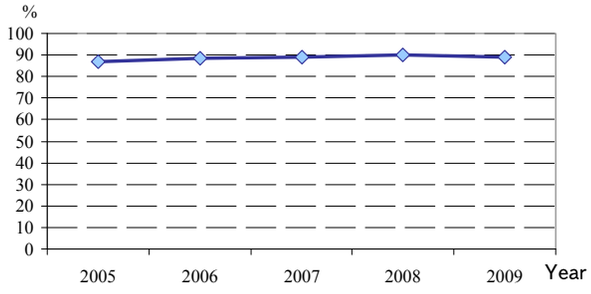


Figure 4.18 – Percentage of wastewater containing pollutants in the total volume of water abstraction

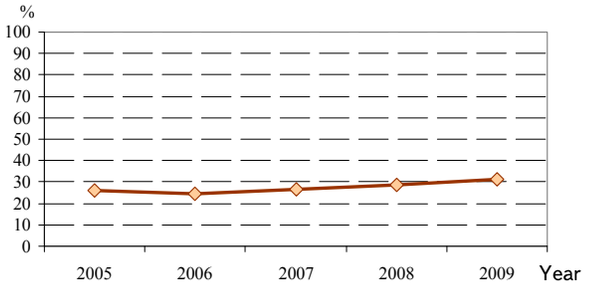


Figure 4.19 – Percentage of waste water allocated to water bodies without treatment at wastewater treatment plants

At the same time the share of wastewater containing pollutants in the total volume discharged into water bodies of wastewater during the reporting period of five years has not changed *(Figure 4.18).*

With regard to waste water allocated in the river of the country without any treatment, there is a tendency to a slight increase in their volume *(Fig. 4.19).*

Reducing the amount of waste water containing contaminants, has not resulted in a significant reduction of certain pollutants

Table 4.16

Discharge of pollutants in the wastewater into water bodies of Belarus in 2006-2009

Index	Dimension	Year				
		2005	2006	2007	2008	2009
Organic matter (BOD_5)	Tons, ths	9,0	8,9	8,3	8,1	7,9
Petroleum products	Tons, ths	0,16	0,20	0,15	0,14	0,13
Particulate matter	Tons, ths	13,8	14,6	13,6	12,0	12,6
Sulfates	Tons, ths	63,7	62,7	59,5	60,7	63,5
Chlorides	Tons, ths	73,9	74,4	71,3	72,8	72,9
Ammonia nitrogen	Tons, ths	6,0	6,4	6,0	5,6	5,4
Nitrogen nitrite	Tons, ths	0,59	0,34	0,25	0,20	0,19
Nitrate nitrogen	Tons, ths	2,9	3,7	3,4	3,7	3,7
Copper	Tons	9	9,8	10,0	7,6	6,7
Other metals (Iron, zinc, nickel, chromium)	Tons	415	518,0	449,0	438,0	421,1

collected in natural water bodies of Belarus *(Table 4.16).*

Basic amount of wastewater containing pollutants formed in the housing and communal services (HCS) (in 2005 they accounted for 75%, 2009 – 66,9%).

In 2009, the water bodies of the country received 91% of all dumped into the rivers of ammonia nitrogen, 89% nitrite nitrogen, 90% phosphorus phosphate, 81% organic matter, 83% surfactants, 82% chloride, 85% oil, 72% suspended solids and 48% sulphate.

In agriculture, through large volumes of wastewater leads pond fish farming, which accounts for 87% of sulfates, chlorides 93%, 87% organic matter, 91% of suspended solids and 67% of ammonia nitrogen from the total amount of pollutants generated in the branch of industry.

Nowadays the main chemical pressure on the rivers of the country is due to such local sources of pollution, as provincial towns and city of Minsk, which accounted for 63% of the total load on water bodies of nitrate nitrogen, 61% for ammonium nitrogen, 54% of suspended solids, 54% petroleum, 52% organic matter,

42% of nitrite nitrogen and 37 % of heavy metals (iron, nickel, zinc, chromium).

In general, the country's 20 major enterprises with sewage purification plants, divert about 58% of the total volume of wastewater containing pollutants. In their structure contains 71% organic compounds, 83 % – petroleum products, 82 % – ammonia nitrogen and 57% of basic metals.

Typical pollutants in the discharged wastewater is phosphate-phosphorus, ammonia nitrogen, nitrite nitrogen and organic matter (BOD_5). Excessive concentrations of them are found in the waters of many rivers of the country *(Table 4.17).*

Table 4.17

Discharge of pollutants in the wastewater into the main basin of Belarus in 2009, t

Basin	Organic matter (BOD_5)	Nitrogen ammonia	Nitrogen nitrite	Phosphorus phosphate
Dnieper	5140	3240	140	650
Pripyat	1300	600	20	150
Berezina	2600	2130	70	340
Svisloch	2010	1420	60	210
Sozh	740	190	10	100
Neman	1400	860	40	190
Vilia	140	100	10	50
Western Dvina	770	500	20	120
Western Bug (including Narew)	620	790	0	160
Mukhavets	40	40	0	20
Belarus	7930	5390	200	1120

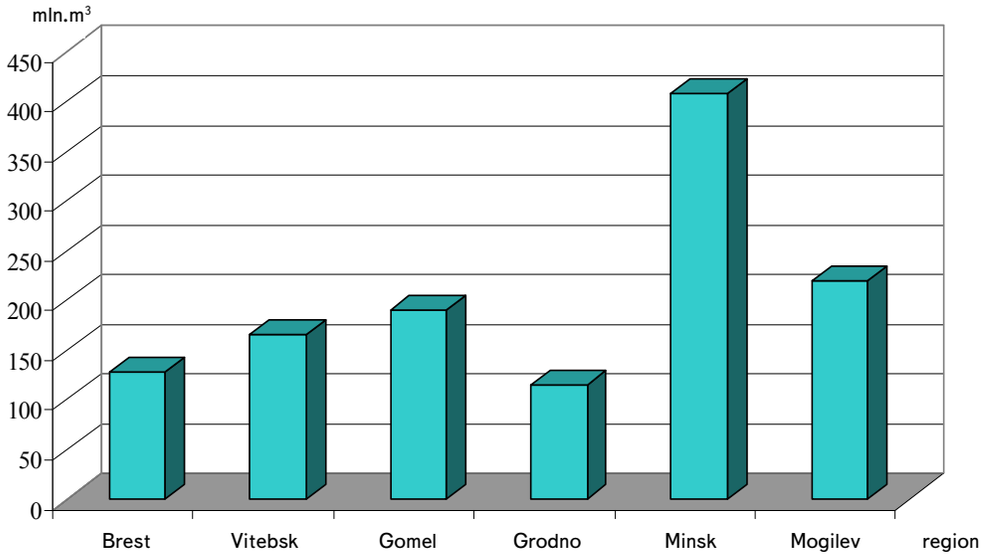


Figure 4.20 – Capacity of sewage purification plants in the fields (million m³ per year)

In order to reduce pollution of rivers measures to intensify the cleaning and purification of wastewater, primarily from nitrogen and phosphorus, heavy metals, petroleum products, and organic surface-active substances are necessary.

Capacity of purification facilities

A modern sewerage system provides, as a rule, the joint wastewater purification of industry

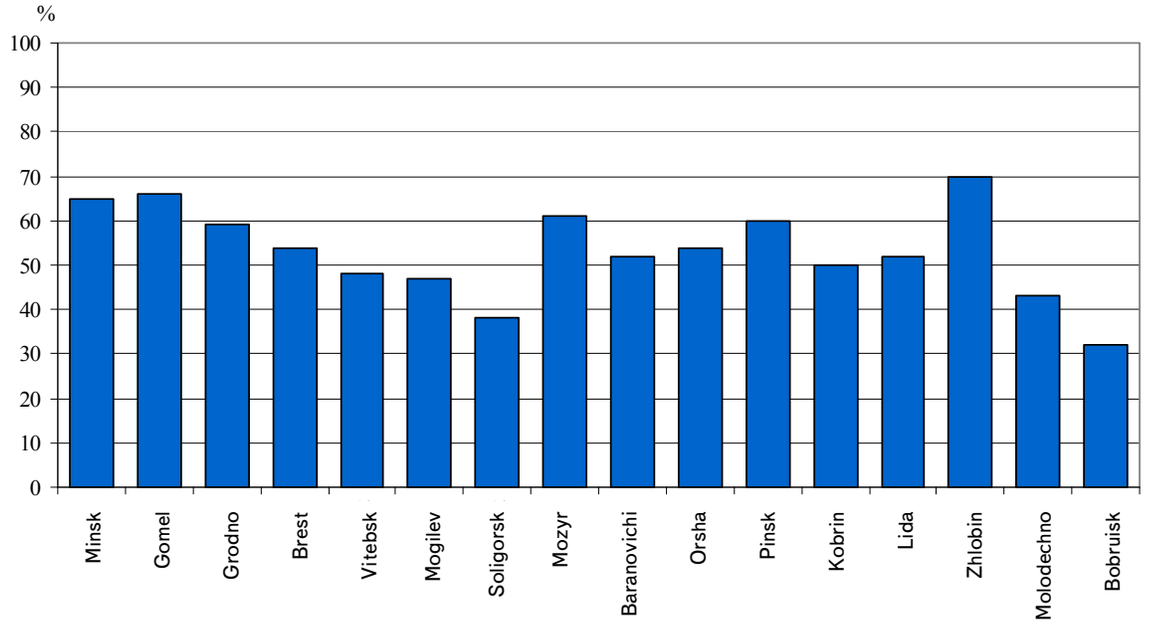


Figure 4.31 – The load on purification facilities in cities across the country, %

and housing and communal services of cities of Belarus on the uniform purification plants, total capacity of which is 1,532,800,000 m^3. At the same time, the actual amount of regulatory peeled and insufficiently treated waste water collected in water bodies in 2009, does not exceed 687 million m^3.

Capacity of purification facilities for the administrative regions of Belarus is shown in *Figure 4.20*.

Wastewater purification facilities in cities across the country, as a rule, are not used to full capacity. The load on purification facilities in cities across the country varies from 32 to 70% *(Fig. 4.21).*

Many purification facilities accept waste water with a concentration of some ingredients, exceeding the norm data. In addition, there are cases of overloading of purification facilities that require renovation or are in the process of reconstruction, (e.g., in Grodno). As a result, insufficiently pured wastewater containing various pollutants come in water bodies.

Municipal and industrial waste water entering the drainage system before discharge into water bodies are usually cleaned in artificial (about 90% of the total waste water) or in natural conditions in the fields of filtration (up to 1,5% of the total volume of wastewater), followed by filtration in the soil. Up to 30% of biologically treated wastewater subjected to further purification in natural

conditions (in biological ponds of additional purification).

Since all operated by the city's sewage purification facilities designed to purify municipal wastewater, waste water of industrial enterprises on the specific ingredients and reduced concentrations of contaminants of toxicological parameters must be carried out local purification plant enterprises.

However, more than 80% of the local sewage purification facilities built in the 1970's and 1980's, is largely required reconstruction and transition to new, more effective methods for wastewater purification. To improve the efficiency of sewage purification, reducing the discharge of pollutants into water bodies and reduction of groundwater contamination from leach fields must continue building new and upgrading of the existing sewage purification plants, pumping stations and sewerage networks in urban and rural settlements, including in agro-towns.

5. Biodiversity

The geographical position of Belarus in the East European Plain in the forest area at the junction of the taiga and deciduous areas led to formation on its territory wide variety of natural landscapes.

The most contrasting combination of landscapes characteristic of the north of the Belarusian- lake area, where among the widespread landscapes stand out lake-glacial, moraine-lake and hilly-moraine-lake landscapes. Naroch, Braslov, Ushachi and other lake groups are located there. Lake-marsh complexes are typical and they are presented as a rule by combination of unique landscapes of upper marshes and lakes. Forest communities are often presented with fir and broadleaved-fir forests.

Central, the most sublime part of Belarus has a strong rugged landscape. Hilly-moraine-erosion, kamov-moraine-erosion and secondary-moraine landscapes are widespread here. Loamy soils are predominant with pine or broadleaved-fir forests on them. In the eastern part of Belarus the development of forest landscapes with typical plateau-like for them (on the watershed) and wavy-ridgy (near the river valleys) terrain, with the presence of suffosional dishes and ravine-beam system.

Unique landscape of the south – the Belarusian Polesie, which is represented vast swampy lowlands (Polesie and the Dnieper), dissected by rare moraine ridges. The typical feature of Polesie – wide floodplains with an abundance of oxbow lakes, wet meadows with preserved bottomland oak forests and lowland marshes.

Specially protected areas

In the conservation of biological and landscape diversity in Belarus a major role plays Specially Protected Natural Areas (PNAs). In accordance with the Law of the Republic of Belarus «On Specially Protected Natural Territories» (October 20, 1994) PNAs are part of the territory of the Republic of Belarus with unique reference or other valuable natural complexes and sites of special ecological, scientific and (or) the aesthetic value, for which established a special regime of protection.

To date various forms of protected areas have been developed. On the functions and regimes these areas are divided into the following categories:

– reserve;
– National Park,
– wildlife sanctuariy,
– natural monument.

Currently Belarus has a reserve – Berezinsky Biosphere Reserve, 4 national parks – Belovezha Forest, Pripyat, Braslav *(Figure 5.1)* and Narochansky *(Figure 5.2)*, wildlife sanctuaries and natural monuments of national and local area. The quantity of them has been changing from year to year. Basic information about the reserves and national parks of Belarus are given in *Table 5.1.*

The total number and area of protected areas for the period from 2005 to 2009 were unstable, in general, there was a decrease of both parameters. Thus, the number of protected areas has decreased by 160 of units (from 1,445 in 2005 to 1,285 in 2009), the change in the area varied from year to year: marked decrease in the period from 2006 to 2008 at 146.0 thousand hectares and a slight increase in 2006 and 2009. Major changes in the structure of PNAs associated with a decrease in the number and area of reserves of the republican and local importance. Number and area of nature reserves and National Parks for 2005-2009 remained relatively stable. As a whole in the structure of protected areas Belarus accounted for the largest area of nature reserves (*Table 5.2* and *Figure 5.3*).

In 2005-2009, the share of reserves accounted for from 4,5 to 4,0% of the country. In the this category of protected areas in 2007 was 31 landscape reserve, 38 biological and 15 hydrological reserves an area of 643.7, 119.8 and 71.0 thousand hectares, respectively

Figure 5.1 – Braslav National Park

Figure 5.2 – Narochansky National Park

Table 5.1

Wildlife and National Parks of Belarus (as at 01.01.2009)

Name	Area, ths ha	Year	Purpose
Berezinsky State Biosphere Nature Reserve	80.9	1925	Preservation of typical and unique natural landscapes are sub-broadleaved-spruce forest subtaiga, a study in which natural processes and phenomena, development of scientific bases of conservation and environmental education
Bialowiezha Forest	152.2	1939	To preserve the unique natural complex, which is typical for the Republic of Belarus and Europe, and ensuring the natural processes of evolution
Pripyat	82.3	1969	Pripyat conservation in their natural state unique to the Belarusian Polesie landscapes and studies on its basis the changes in nature due to agricultural drainage Polesie lowlands
Braslavskie Lakes	71.5	1995	Preservation of the natural complex Braslavskaya group of lakes and the genetic fund of flora and fauna
Narochansky	94.0	1999	Preservation of unique natural complexes, a more complete and efficient use of natural resources, recreational opportunities Myadel distric

(Figure 5.4). Among other categories of protected areas a substantial proportion fall for reserves and national parks, the lowest – in the natural monuments of national and local importance.

Within the regions the equity of PNAs is significantly different. Thus, over the considered period under review, their highest proportion occurs in Brest (from 13.4 to 14.1%) and Grodno (9,3-10,5%) regions,

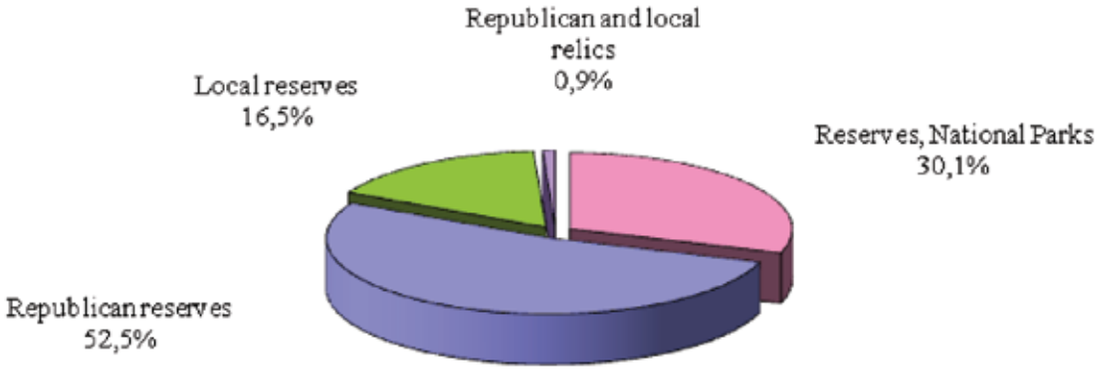


Figure 5.3 – Structure of the protected areas of Belarus in 2009

Table 5.2

Protected areas of Belarus* in 2005-2009

Category PAs	Number					Area (ths ha)					% of total area Belarus				
		2006	2007	2008	2009	2005	2006	2007	2008	2009	2005	2006	2007	2008	2009
Reserves and National Parks		5	5	5	5	480,1	478,6	480,9	480,9	480,9	2,3	2,3	2,3	2,3	2,3
Republican reserves	99	99	84	84	85	936,3	936,3	834,6	834,5	837,1	4,5	4,5	4,0	4,0	4,0
Preserves local	428	414	403	349	348	295,0	292,4	245,8	250,5	263,4	1,4	1,4	1,2	1,2	1,2
Natural monuments of republican importance	337	337	306	305	305	16,6	16,5	16,5	11,9	14,3	1,0	0,1	0,1	0,1	0,1
Natural monuments of local importance	576	586	489	544	542										
Total	1445	1441	1287	1287	1285	1675,5	1723,8	1577,8	1577,8	1595,7	8,0	8,3	7,6	7,6	7,7

* Exclude Polesky Radiation Ecological Reserve.

Table 5.3

Area and percentage of protected areas in areas of Belarus in 2005-2009

Region	Protected areas,ths ha					Percentage of all area, %				
	2005	2006	2007	2008	2009	2005	2006	2007	2008	2009
Brest	464,3	463,9	438,5	441,9	441,9	14,1	14,1	13,4	13,5	13,5
Vitebsk	348,1	348,1	343,9	354,3	351,8	8,9	8,7	8,6	8,8	8,8
Gomel	278,4	279,3	212,0	212,0	211,5	7,0	6,9	5,2	5,2	5,2
Grodno	253,5	262,0	261,7	261,4	261,4	9,3	10,5	10,5	10,5	10,4
Minsk	224,9	277,1	245,1	246,6	250,7	5,3	6,9	6,1	6,2	6,3
Mogilev	106,3	93,4	76,7	61,4	78,4	3,7	3,2	2,6	2,3	2,7
Belarus	1675,5	1723,8	1577,8	1577,8	1595,7	8,0	8,3	7,6	7,6	7,7

the lowest – in the Mogilev (2,3-3,7%) *(Table 5.3)*.

In terms of regions also noted the uneven distribution of protected area categories. In general, for the period from 2005 to 2009 distribution of categories of protected areas on administrative region vary slightly. In Brest, Vitebsk, Grodno and Gomel regions it falls for the nature reserves of national significance, in Minsk region the largest area are occupied by nature reserves and national parks, in the Mogilev – reserves of local importance *(Figure 5.5)*.

In accordance with the laws in national parks and sanctuaries biological and landscape diversity are protected, combined with limited economic activities and development of ecological tourism.

Within the boundaries of protected areas provided protection of landscapes, the most valuable plants of the communities, rare and endangered species of wild plants and animals included in the Red Data Book of Belarus. A number of protected areas has an international nature protection status: eight national reserves («Olmanskie swamp», «Mean Pripyat», «Prostyr», «Kotra», «Osveysky», «Elnya», «Sporovsky» and «Zvanets») included in the list of wetlands of international importance (Ramsar sites), six protected areas have the status of important plant areas, and fourteen – are included in the list of territories that are important for the conservation of wild birds in Europe.

When planning the development of the PNA system it used a number of international of criteria: the criteria of the International Union for Conservation of Nature, Important Bird and Botanic territories, the criteria of the Convention on Wetlands, with internationally

Symbols:

Natural Reserve: I – Berezinsky;

National Parks: II – Braslav; **III** – Narochansky; **IV** – Belovezha Forest; **V** – Pripyat;

Sanctuaries of national importance:

a) landscape: 1 – Babinovichsky; 2 – Vygonoshchanskoye; 3 – Vydritsa; 4 – Grodno Forest; 5 – Elnya; 6 – Kozyansky; 7 – Cawthra; 8 – Krasny Bor; 9 – Kupala; 10 – Lipichanskaya Forest 11 – Mozyr ravines; 12 – Nalibokskaya 13 – Novogrudok, 14 – Ozery; 15 – Olmanskie marshes; 16 – Osveysky: 17 – Pribuzhskoye Polesie; 18 – Prilepsky; 19 – Prostyr; 20 – Radostovsky; 21 – Sweetyazyansky; 22 – Selyava; 23 – Sinsha; 24 – Smychok; 25 – Sorochanskie lakes; 26 – Mid-Pripyat; 27 – Starica; 28 – Strelsky; 29 – Stronga; 30 – Treskovschina; 31 – Chernevichsky;

b) biological: 32 – Babinec, 33 – Bor-sky, 34 – Buda-Koshelevo; 35 – Bukchansky; 36 – Buslovka; 37 – Volmyansky; 38 – Glebkovka; 39 – Denisovichsky, 40 – Dnipro-Sozh; 41 – Dokudovskoye; 42 – Dubatovskoe; 43 – Elovskikh; 44 – Zamkovy Les, 45 – Zapolsky; 46 – Zvanets; 47 – Kopyshev; 48 – Lebyazhy; 49 – Lonno; 50 – Lukovo; 51 – Luninsky; 52 – Mateevichsky; 53 – Meduhovo; 54 – Moshno; 55 – Oktyabrsky, 56 – Omelnyansky; 57 – Pekalinsky; 58 – Podsady; 59 – Prilukskiy; 60 – Ruzhanskaya Forest; 61 – Slonimsky, 62 – Sporovsky; 63 – Stiklevo; 64 – Tyrvovichi; 65 – Falichsky Moss; 66 – Chernevsky; 67 – Chirkovichsky; 68 – Chistik; 69 – Yukhnovsky;

c) hydrological: 70 – Beloe; 71 – Marsh most; 72 – Verhnevileysky; 73 – Glubokoe – Big Ostrovito; 74 – Dolgoe, 75 – Zaozerye; 76 – Korytensky Moss, 77 – Krivoe; 78 – Miranka; 79 – Islands of Duleby; 80 – Podveliky Moss; 81 – Richie; 82 – Servech; 1983 – Sosno; 84 – Shvakshty.

Figure 5.4 – Natural Reserve, National Parks and republican reserves of Belarus, 2007

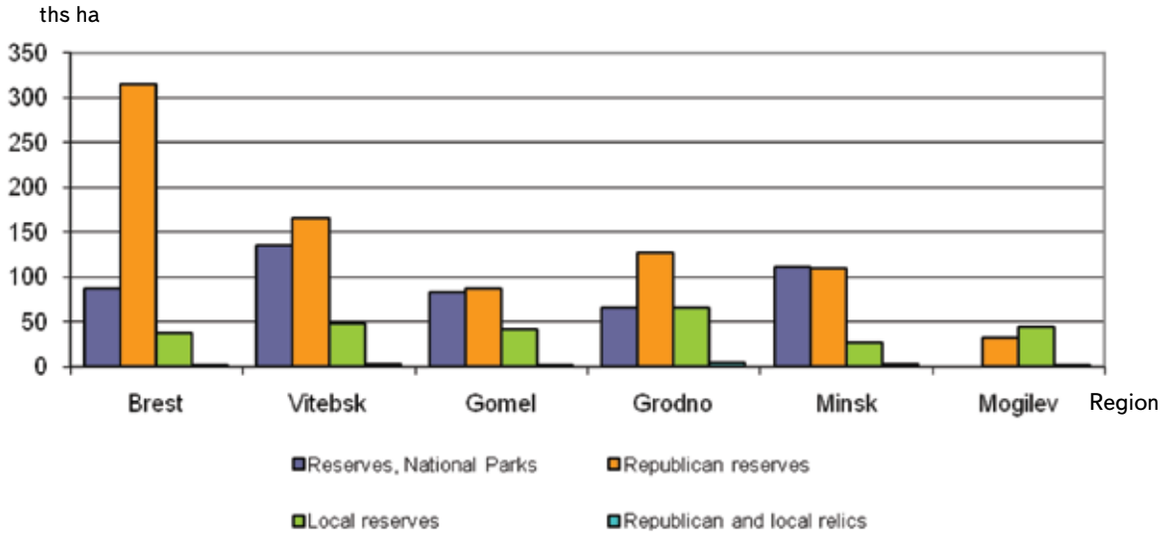


Figure 5.5 – Distribution of various categories of protected areas in administrative areas Belarus (without Polesie radiation-ecological reserve)

importance especially as water fowl being.

As a prospective PNAs were considered natural areas, within the which distributed unique and rare landscapes, valuable plant communities, are places of growth and habitat of rare and endangered plant and animal species listed in Red Data Book of Belarus, a place concentration of wild animals (primarily birds) in the period of breeding, wintering, migration, and the territory of which play an important role in the ecological system formed, are important for research.

Conservation of natural ecosystems, biodiversity and landscape of the Belarus will ensure the national ecological network. Placing the main elements of an ecological network is defined «Scheme of ecological network in the Republic of Belarus», developed by the National Academy of Sciences of Belarus in 2005.

Planned environmental network is linked to national environmental networks Poland, Lithuania, Ukraine. The placement of key elements (cores) of the ecological network, as well as list of the most important protected areas that form the core of international and national values, enshrined in the State of the complex scheme of territorial organization of the Republic of Belarus, approved by Presidential Decree on January 12, 2007 № 19. Practical measures are taken to further the formation of the National Ecological Network, as well as its integration into the European ecological network

In the framework of UNESCO's «Man and the Biosphere» a regional ecological network Polesie (Belarus-Poland-Ukraine) is formulated, as well as the concept and scheme of the formation of cross-border ecological corridors of Belarus and Russia.

On the territory of the Republic of Belarus it is established Biosphere Reserve «Pribuzhskoje Polesie». Efforts to establish a transboundary biosphere reserve (TBR) of UNESCO Western Polesie (Belarus-Poland-

Ukraine) are provided. By 2015 it provides to establish a number of transboundary protected areas, including «Cothren Chapkelyay», «Vileity-Adutishkis», «Prostyr-Pripyat-Stokhod», «Osveysky-Krasny Bor-Sebezhsky and TBR «Grodno-Augustów Forest» (Belarus-Poland- Lithuania).

PNA management is provided by government agencies in the operational management they are transferred. It is created and functioning state environmental agencies reserve, national parks and 24 nature reserves of national significance, which main tasks are to implement the measures for the conservation of natural systems, conducting observations of the state of ecosystems, and ecotourism.

The National Environmental Monitoring System in the Republic of Belarus (NEMS) in protected areas is monitored flora and fauna, forests. Moreover, in the protected area, a system of integrated monitoring of ecosystems is provided. As of 01.01.2009 monitoring systems are organized in Berezinsky biosphere reserve, national park Pripyatsky and 19 sanctuaries of Republican values.

Forest land

The composition of forest land includes forest and non-forest land. To forest lands belong lands covered by forest and not covered with forest, but intended for his regeneration (cutting, burning, dead stands, vacant lots, clearings, areas occupied by forests not united as a whole, etc.).

For non-forest lands include lands used for agricultural purposes, cuttings, roads, fire breaks, the network of reclamation, etc., as well as other lands within the boundaries of forest reserves (wetlands, ponds and streams, and other inconvenient for the cultivation of forest lands) provided for the needs of forestry.

With the aim of sustainable use of forests, their reproduction, protection, planning, forestry development and the development of cutting fund activity public accounting of forests implements and keeps state forest inventory (SFI).

The state forest inventory contains information about the environmental, economic and other quantitative and qualitative characteristics of the forest fund. Inventory data is used by the public-use forest management, the organization of its management, change the forest land to other land categories for purposes not connected with forest management, as well as withdrawal and granting of land participating, relating to forest land, determining the size of payments

for the use of wood, funds for damages forestry production, evaluate the activities of the economic forest and legal persons who engage in forestry.

Inventory is conducted since 2002 under the provisions of the Forestry Code of the Republic of Belarus and the Council of Ministers of the Republic of Belarus of July 12, 2001 № 1031.

These documents compiled for the entire forest reserve of the country on administrative-territorial units (118 administrative districts, 10 towns of regional subordination, and Minsk) on the basis of information provided in the prescribed manner 118 entities, leading forestry, in the various ministries and departments.

Over the period of 2006 to 2009 **the total area** of forest land has changed insignificantly and amounted to 9416.6 thousand hectares in 2009, that compared with 2007 more than 31.0 thousand hectares *(Table 5.4)*.

Table 5.4

Dynamics of forest land in Belarus

Forest lands	Area, ths ha			
	2006	2007	2008	2009
Forest land, total, including:	8506.0	8532.0	8560.6	8598.2
wooded, including:	7883.7	7914.3	7955.0	8002.3
cultural	1776.6	1797.1	1817.3	1838.5
sparse forests	279.5	291.0	302.0	304.0
forest plantations	4.5	4.7	4.8	4.7
non-forest, inc.:	338.3	321.9	298.9	287.2
died plants (fired)	8.0	7.1	7.1	6.7
cutting	86.0	86.0	81.8	81.5
clearings, wastelands	244.2	228.8	210.1	199.0
Non-forest land, all of which:	908.2	853.6	844.1	818.4
arable land	16.4	14.6	13.4	11.8
land under permanent crops (orchards, berries)	0.2	0.2	0.1	0.1
grasslands inc.:	28.7	24.9	20.5	17.9
hay	24.0	20.8	17.9	15.5
pasture	4.7	3.9	2.6	2.4
land swamps	546.6	544.1	542.0	527.9
lands under water bodies	72.5	72.7	70.0	69.6
land under roads, cuttings and other transport routes	169.8	125.8	124.3	122.2
land under building	2.9	2.6	1.9	1.7
broken land	6.1	5.4	4.8	3.2
unused land	20.6	23.7	31.5	33.8
other land	44.4	39.7	35.5	30.2
Total area of forest land	9414.3	9385.6	9404.7	9416.6

Changes in forest resources are due to economic activities of the forest-economic organizations, leading forestry and the natural processes of growth. During the period from 2006 to 2009 increased the area of forest (from 90.4 to 91.3%), including forested lands, and reduced the area of non-forest land (from 9,6 to 8,7%) *(Table 5.4)*.

According to the SFI there is a tendency to an increase **forest cover** on 01.01.2010 which reached the highest figure for the last 110 years – 38,5% (1901 – 37%). Forests in the regions of the country ranges from 34.8 to 45.0%. As in previous years, in 2009, the most forest cover are characterized by Gomel and Vitebsk region (45.0 and 39.5% respectively), the smallest – Grodno and Brest region (34, 8 and 35,6% respectively).

Areas with the highest percentage of forest cover (50% or more) are located in the Gomel region (Lelchitsy, Zhitkovichi, October, Mozyr, Yale and Narovlya), the central part of Vitebsk (Rossony, Polotsk, Ushachy,

Dokshitsy and Lepel areas), north-eastern part of Minsk region (Logoisk, Borisov, Krupsk and Berezinsky areas) and the western regions of Mogilev (Belanichy, Klichev, Osipovichsky and Glusk areas). Percentage of forest cover of 20-30% is typical for administrative areas are located mainly in the Brest region, areas with forest cover below 20% have all areas, except in Gomel *(Figure 5.6)*.

Based on the assessment of forest resources of Belarus, as a result of natural growth

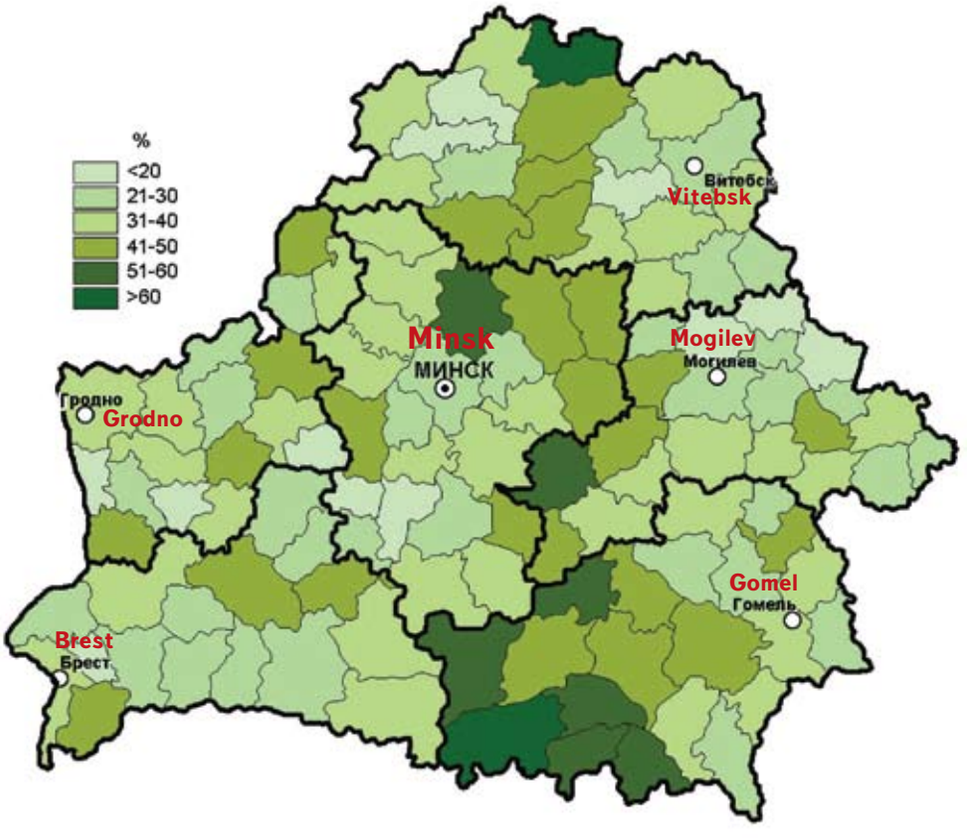


Figure 5.6 – Percentage of forest in Belarus (a division of administrative areas)

and un-use of the current year growth for the period from 2006 to 2008 there was an increase in **total timber reserves** at 99.1 million m^3 (from 1466.4 to 1.5655 billion m^3). An increase in all species groups, including mature and overmature is observed. Also noted there is an increase in potential for exploitation of stocks – from 1197.0 million m^3 in 2006 to 1.2756 billion m^3 in 2009 (at 78.6 million m^3) *(Table 5.5).*

Timber reserves are largely attributable to **the age composition**. In turn, the number of maturing and mature stands identifies opportunities for further exploitation of forests. So according to forest inventory on 01.01.2009 the average age of the Belarusian forest is 51,3 years.

During the period from 2006 to 2009 by **age category and total stocks** plantation forest area varied within the following ranges: young forests occupied from 21.2 to 21.5% of the area and were 8,1-8,7% in margin, middle-aged – 49,1-50 , 7% of the area and 53,4-55,2% in margin of ripening – 19,0-20,4% of the area and 24,6-25,9% in margin, while the share of mature and overmatured had from 8.7 to 10.1% of the area and 11,5-12,6% in margin *(Table 5.6).*

In general, during the period, the largest area of forested land and plantations accounted for the main tree species (99.5 and 99.9% respectively of the total area of wooded land and planting stock), the bushes – 0,5 and

Table 5.5

Overview of timber resources in Belarus, million m^3

Greenery	Stock timber				Suitable for exploitation			
	2006	2007	2008	2009	2006	2007	2008	2009
Main tree species, total, including:	1466.4	1497.2	1534.8	1565.5	1197.0	1220.7	1250.2	1275.6
mature and overmature	169.1	176.7	187.9	196.1	135.1	139.2	146.7	154.1
conifers, including:	975.7	997.7	1024.9	1046.6	798.0	815.7	836.1	853.4
mature and overmature	77.1	81.1	86.7	91.8	60.4	63.2	66.3	70.9
hardwoods, including:	53.8	54.4	54.8	55.7	35.6	36.0	37.0	38.0
mature and overmature	10.3	10.6	11.0	11.1	5.5	5.4	5.7	5.8
deciduous, including:	436.9	445.1	455.1	463.2	363.3	369.0	377.1	384.2
mature and overmature	81.6	85.0	90.3	93.2	69.3	70.6	74.7	77.4
Other wood species	0.03	0.03	0.04	0.04	0.0004	0.008	0.008	0.0006
Shrubs, including:	0.89	0.84	0.79	0.62	0.001	0.002	0.0006	0.0004
mature and overmature	0.87	0.81	0.75	0.59	0.001	0.002	0.0006	0.0004
Timber reserves total, including:	1467.3	1498.1	1535.6	1566.1	1197.0	1220.7	1250.3	1275.6
mature and overmature	169.9	177.5	188.7	196.7	135.1	139.2	146.7	154.1

Table 5.6

Area of forested land and stock of plantations by age of forests in 2006-2009

Greenery	Year	Forested land, ths ha	Reserve plantings million m³
Saplings	2006	1685,6	127,8
	2007	1697,7	130,4
	2008	1678,3	128,9
	2009	1656,7	127,5
Middle-aged	2006	3979,9	808,9
	2007	3945,2	815,8
	2008	3928,7	826,3
	2009	3928,2	836,7
Ripening	2006	1495,5	360,7
	2007	1527,8	374,4
	2008	1570,7	391,7
	2009	1613,1	405,2
Mature and overmature	2006	722,8	170,0
	2007	743,7	177,5
	2008	777,2	188,7
	2009	804,4	196,7
Total	2006	7883,7	1467,3
	2007	7914,3	1498,1
	2008	7955,0	1535,6
	2009	8002,4	1566,1

0,04%, respectively. Among the main tree species and the largest area of plantation stock falls on pine and aspen *(Table 5.7)*.

Forest fund, in accordance with its economic, ecological and social values of it, the location and her function is divided into two **groups of forests.**

The first group of forests includes:

– forests located in protected natural areas;

– forests of valuable forest sites, with genetic, scientific, and historical to the cultural value;

– riparian forests (the forbidden band of forests and forest within the boundaries of

Table 5.7

Area of forested land, stock, and the average age of trees in 2006-2009*

Greenery	Measu-rement	Total				Middle age			
		2006	2007	2008	2009	2006	2007	2008	2009
The main tree species	ths ha	7844,0	7878,6	7920,0	7964,6	51,7	51,7	51,5	–
	million m³	1466,4	1497,2	1534,8	1565,5				
pine	ths ha	3961,9	3977,5	3993,5	4016,7	58,4	57,9	58,2	59,0
	million m³	807,2	825,2	849,4	869,5				
fir	ths ha	742,1	743,5	747,3	747,9	54,3	54,1	54,2	55,0
	million m³	168,3	172,4	175,5	177,0				
oak	ths ha	278,0	279,6	280,2	281,1	68,1	67,8	68,1	70,0
	million m³	45,0	45,6	46,1	47,1				
birch	ths ha	1787,2	1805,6	1819,4	1834,4	40,5	40,2	40,4	41,0
	million m³	273,1	279,0	284,8	288,7				
black alder	ths ha	672,9	675,2	680,2	685,2	41,2	41,4	41,3	42,0
	million m³	111,6	113,7	116,8	119,9				
asp	ths ha	161,5	163,8	168,3	168,7	37,7	37,4	37,3	38,0
	million m³	29,1	29,7	30,8	31,3				
Other timbers	ha	537,0	538,0	536,0	536,0	25,5	26,3	25,9	27,0
	million m³	33,7	34,3	35,1	38,5				
Shrubs	ha	39 132,0	35 243,0	34 273,0	37 241,0	10,8	9,8	9,5	10,0
	million m³	897,1	848,4	793,6	617,0				
Total	ths ha	7883,7	7914,3	7955,0	8002,4	51,5	51,5	51,3	–
	million m³	1467,3	1498,1	1535,6	1566,1				

* The top line – the area of forested land, the lower – stock plantings.

protection zones for the banks of rivers, lakes, reservoirs and other water bodies);

– protective forests (protection-erosion forests, protective forest belts along the railroads and national highways);

– hygiene and health of the forest (urban forests, forest green areas around city, other settlements and industrial enterprises, including forests forest-park parts of green areas, forests, the first and second zones of sanitary protection zones sources of water supply and forest districts of sanitary protection of resorts (spaforests).

The second group of forests, which are not included in the first group are production forests.

In the forests of the first and second groups can be allocated special protection areas (forest areas along the slopes of ravines, riparian strips along water bodies, habitat and distribution of rare and endangered wild animals' and plants, protected part of the reserve, forest edge along the boundary settlements, etc.).

According to information on the distribution of forests by groups and categories

of protection, forest groups I and II for the period from 2006 to 2009 varied slightly. It is marked the reduction of area in 2007 (28.7 thousand hectares compared to 2006), and then an increase of 31.1 thousand hectares (compared to 2009) *(Table 5.8)*.

Assessing the current **state of forests** in Belarus is based on:

– observations on the objects of the National Environmental Monitoring System in the Republic of Belarus;

– materials of forest pathology monitoring, including general, detailed supervision;

– data of forest pathology surveys of plantations, reservations and hotbeds of pests, forest areas, plantations, nurseries and young stands for «Alert information»;

– reports on prophylactic, destroyers, and sanitary and recreational activities in forests;

– regional reviews of the health condition of forests and forest pathology, prepared-

represented state production forestry associations (GPFA);

– review the sanitary condition of forests and forest pathology legal entities;

– data of state statistical reporting.

Change of the main tree species in time estimates firstly on the basis of **defoliation** (the degree of loss of tree foliage). Forests in Belarus – one of the youngest in Europe and this is why they are in fairly good state

Table 5.8

Distribution of forests in Belarus by groups and categories of protection

Categories of protection forests	Area, ths ha			
	2006	2007	2008	2009
Whole forests of group I, including:	4870,0	4842,9	4806,6	4823,7
forest natural monuments of national importance	1,8	1,8	1,7	1,7
forest reserves	301,5	301,6	301,6	301,6
forest parks	348,1	348,6	348,6	348,6
urban forests	6,4	7,7	7,8	7,8
part of the forest-park green zones	255,4	250,7	251,0	251,3
forest 1-2 belts of sanitary protection zones of water sources	13,4	13,3	13,3	13,3
forest 1-2 zones of sanitary protection counties resorts	24,4	26,2	26,0	26,1
protective forest belts along railways and highways	324,9	320,4	328,3	326,2
forest reserves of the republican importance	798,4	782,5	687,9	689,2
forest third zone of sanitary protection counties resorts	17,1	17,1	17,1	17,2
forests of green zones	1308,2	1303,5	1329,0	1333,6
forbidden band of forests and forest within the boundaries of protection zones	1470,4	1469,6	1494,3	1507,1
Whole of 2nd group	4544,3	4542,7	4598,1	4593,0
Whole of 1st and 2nd groups	9414,3	9385,6	9404,7	9416,7

of individual tree species (pine, birch, black alder), determined on the basis of defoliation of crowns, which represents the sum of total long-term adverse effects. With increasing of age of trees their viability decreases and defoliation increases.

In addition to defoliation, consider **dehromation** (yellowing of foliage), which characterizes the state of the vegetation period and may be the result of exposure over a shorter period of time.

The overall level of defoliation for the period from 2006 to 2008 increased from 16,3 to 17,7%. An increase in the defoliation observed in all species except for the hardwood, where it fell slightly. Also observed reduction of dehromation for all species. In the whole country the level of dehromation decreased from 0,3 to 0,2% *(Figures 5.7* and *5.8)*.

The main factors determining the damage and destruction of forests in Belarus are outbreaks of forest pests, diseases of trees, hurricanes and fires. In 2009, in forest pathology is observed deterioration of the

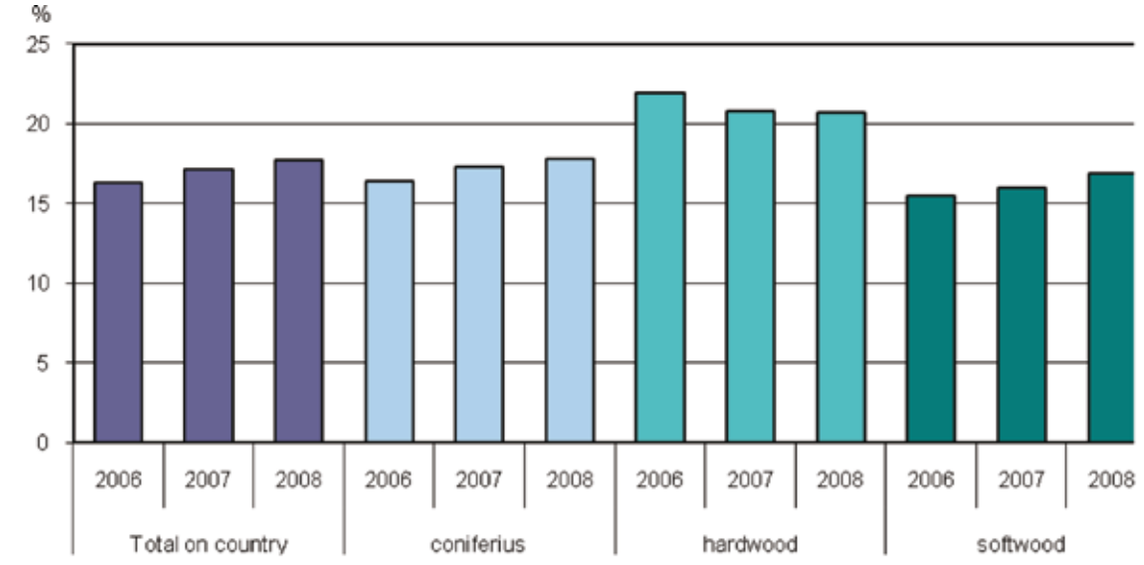


Figure 5.7 – The average percentage of defoliation of forests in 2006-2008

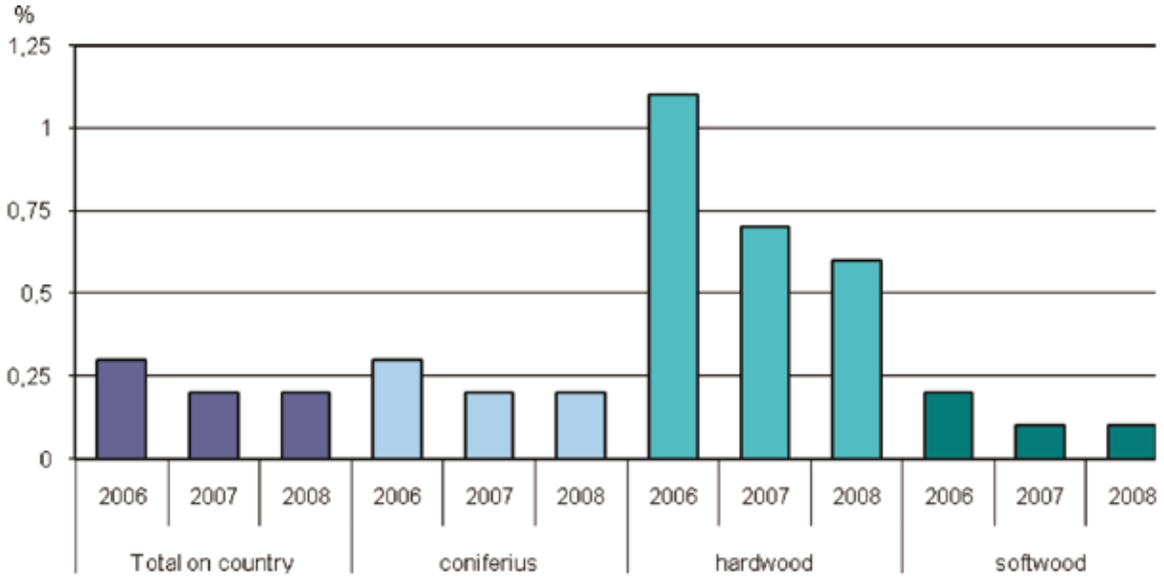


Figure 5.8 – Mean percentage of dehromation forests in 2006-2008

situation compared to previous years. During the period from 2006 to 2008 there was a reduction in the area of forest plantations is almost dead from all causes, except for the effects of adverse weather conditions, which disrupt the stability of forest ecosystems and cause deterioration in health-state forests in general. In 2009, it marked the increase in the area of forest dead from forest fires (on 593 hectares compared with 2008), from adverse weather conditions in (to 3,544 hectares compared with 2006), the damage of insect pests (44 ha compared to 2008) *(Table 5.9)*.

Timely and qualitative **regeneration of forests** is a fundamental requirement for the principle of permanence and sustainable forest management, conservation of bio-diversity of forest flora and the genetic potential of forests.

In general, for the period from 2006 to 2009 reduction of the area of reforestation and afforestation is marked. Works on reforestation and afforestation in 2009 were

held in a total area of 40760 ha, which is 15,457 hectares less than in 2006 *(Table 5.10)*.

By planting and sowing in 2009, it were established forest plantations in the area of 34,320 hectares (14,342 hectares less than in 2006), of which 16,535 hectares (less 7,306 hectares) were planted on the cuttings, on lands contaminated by radionuclides – 8721 hectares (less than in 2006 to 4,087 ha). It was established that the promotion of natural

Table 5.9

Area of dead forest plantations in the forest of Belarus, ha

Reason	Area, ha							
	total in country				including coniferius			
	2006	2007	2008	2009	2006	2007	2008	2009
Forest fires	1630	723	647	1240	1465	694	609	1207
The impact of adverse weather	2217	3084	4512	5761	1896	2702	3712	4701
Diseases of forest	616	844	638	330	509	502	393	222
Excessive humidity	606	190	173	110	404	105	115	74
Damage of wildlife	217	37	7	5	160	22	7	5
Damage by harmful insects	24	12	4	48	24	12	4	48
Anthropogenic factors	15	3	3	3	2	2	2	2
Total	5379	4893	5984	7497	4460	4039	4842	6259

Table 5.10

Change in the total area of reforestation and afforestation for 2006-2008, ha

Indicator	2006	2007	2008	2009
Total reforestation and afforestation, including:	56 217	54 988	50 006	40 760
planting and sowing, including:	48 662	48 069	43 135	34 320
clearings	23 841	21 767	20 671	16 535
on land contaminated with radionuclides	12 808	12 321	9817	8721
promoting natural forest regeneration and preservation of growth	7555	6919	6871	6440

regeneration was carried out on 6,440 hectares, which is 1,115 hectares less than in 2006.

Rare and endangered species of wild animals and wild plants

One of the areas of environmental activities is the conservation of rare and being endangered species of wild animals and wild plants.

Legal basis for the conservation of rare and endangered species of animals and wild plants are set forth on the Red Book of Belarus, approved by the Council of Ministers of the Republic of Belarus of December 27, 2007 № 1836, and the Laws of the Republic of Belarus of November 26,1992 «On the protection of environment» (Article 64), on July10, 2007 № 257-3, «On Fauna» (Article 17), on June 14, 2003 «On the vegetable world» (Article 24) and from May 5, 1998 «On the objects, which are only owned by the state» (Articles 2 and 3).

The basis of the Red Book of Belarus is a list of rare and endangered species of wild animals (188 species) and the list of rare and carbon rose species of wild plants (274 species, including fungi and algae), asserted of the decree of the Ministry of Natural Resources and protection of Environment of Republic of Belarus on June 9, 2004 № 14 «On approving the list of rare and endangered species of wild animals and wild plants are included in the Red Book of Belarus».

In order to ensure state control over the of captive animals listed in the Red Book, in 2008, it was organized the registration of animals which are in the possession of legal organizations and individuals.

State program of development of hunting on 2006-2015 approved by Presidential Decree of December 8, 2005 № 580, provides for the development of management plans of the European populations of lynx, brown bear and badger.

For the protection of European bison the Ministry of Natural Resources and Environment Program of the Republic of Belarus has developed a plan for the conservation and rational use of bison for 2010-2014.

As a result of measures taken to protect rare species, as well as strengthening state enforcement of environmental legislation over the past few years, there were positive trends in the number of species threatened with extinction, restored and expanded natural areas of their living.

To preserve wild animals and wild plants belonging to the species, including the result obtained in the Red Book, the work on the inventory, identification and transfer of custody of new areas of their living *(Table 5.11)*. On January1, 2009 the 3078 places of habitats of wild animals and habitats of wild plants belonging to the species included in the Red Data Book of Belarus (2039 habitats of 71 species of wild animals and 1039 habitats of 103 species of wild plants) were taken under protection.

Animal world – one of the most important biological resource, our national and world domain. Exceptionally important is the ecological value of wild animals that ensure soil fertility, clean water, pollination of flowering plants, the transformation of organic matter in natural and man-made ecosystems. The important role of animals is known in quality and dynamics of the environment. Unquestionable is their significance as a source of esthetic and emotional climate necessary for normal human existence.

According to the 2006 Fauna of Belarus includes 467 species of vertebrate animals and over 30 species of invertebrates of various groups. As we know, all kinds as a whole, play functionally biocoenotic role in maintaining the stability of natural-term protection.

Table 5.11

Plant and animal species included in Red Data Book of Belarus in 2005-2007

Region	2005				2006				2007			
	Plants		Animals		Plants		Animals		Plants		Animals	
	number of species	habitats of species	number of species	habitats of species	number of species	habitats of species	number of species	habitats of species	number of species	habitats of species	number of species	habitats of species
Brest	40	240	26	211	48	285	33	285	49	426	49	467
Vitebsk	36	101	37	451	47	118	41	450	43	725	48	227
Gomel	25	38	10	296	27	89	10	297	11	297	33	139
Grodno	20	74	17	140	20	74	17	140	17	140	20	74
Minsk	41	130	25	241	41	132	25	206	24	206	43	132
Mogilev	19	46	11	111	19	73	12	113	11	113	19	73
Total	86	629	71	1450	183	771	125	1491	79	1907	100	1112

Among *invertebrates* in Belarus the highest quantity of species is distinguished in diversity of insects. So far this class has the following major units: coleoptera (over 3200 species), lepidopterous (1600), hymenopterous (about 800), hemipterans (about 100), opterous (800), dipterous (200), orthopterous (58 species). From other arthropods are known more than 400 species of spiders, and about 600 mites, of soil invertebrates – 13 species of earthworms, more than 270 oribatid mites, 200 nematodes and other.

From parasitic invertebrates inhabiting organisms are noted more than 600 species of helminths, more than 100 mites that cause or are transfer different including dangerous diseases for animals and humans.

In the composition of the zooplankton of lakes and rivers of Belarus the most diverse are three groups, a leading role in aquatic ecosystems – rotifers (398 species), cladocera (over 100) and copepods (70), as well as several representatives of the benthos (crustaceans and mollusks).

Fauna of *fish* is represented by 58 species. From 46 species of native fauna 24species are widespread in the country's reservoirs, several species have limited distribution. Belarus is located in the two zoogeographic provinces – the Ponto-Caspian-Aral Sea and the Baltic. Ichthyofauna of reservoirs of Baltic province is allocated by the presence of salmonids, whereas water Ponto-Caspian-Aral Province are characterized by great variety of carp fish.

A distinctive feature of the fish fauna of Belarus is the presence within it of representatives of the both marine and freshwater faunal assemblages. In the twentieth century have disappeared the stone eel and 9 species of fish: the Atlantic sturgeon and Russian sturgeon, carp, Black Sea roach etc. During this period 11 new species have acclimatised, introduced white amur, goby, goad goby, Perpilus alepidotus, sandpiper, amur sleeper, bullhead, rainbow trout, white and silver carp, trout, carp white .

In the Red Book species such as sturgeon *(Figure 5.9)* atlantic salmon, brown trout *(Figure 5.10)*, brook trout, European grayling.

Amphibians and reptiles are represented respectively 13 and 7 species. From the amphibole 2 species are found caudiferous (eft) and 11 species of the order of tailless (frogs, toads). Of the reptiles found one species of turtles, 3 species of lizards and snakes. On the territory of Belarus there are limits of distribution of 4 types: fresh-water turtle, red-bellied toad, common hyla, natterjack. The Red Book includes 2 species of amphibians

Figure 5.9 – Sturgeon

Figure 5.10 – Trout

triturus cristatus, natterjack and 2 species of reptiles.

Status of herpetofauna of Belarus, even taking into account the identification of negative trends in the last 20 years as a result of increasing economic burden, implies satisfactory.

Fauna of *birds* have the highest diversity among vertebrates. It includes 309 species, of which 227 nest on the territory of Belarus and are presented in of core forest species and inhabitants of moist habitats – coastal rivers and lakes. Over the past 1,5-2 centuries in the country disappeared some 10 species of birds, and over the past 50 years of XX century there were 27 new nesting species, including and the previously extinct species – common cormorant, gray goose, mute swan, which indicates that the active processes of the dynamics of fauna. In this century firstly are registered pond heron, marsh crake, polar bunting, sociable lapwing, more than 100 years after its last meeting was marked ibis, 92 years – spoonbill. Particular importance has territory of Belarus for 17 endangered bird species in Europe due to the preserved here on a significant area of their habitats. Within the country is concentrated at least 5% of European populations of these species, including more than half the population of the globally disappeared specie – aquatic warbler. The third edition of the Red Book to the category № I of national environmental importance ferruginous duck *(Figure 5.11)*, greater spotted eagle, erne *(Figure 5.12),* booted eagle, red-footed falcon, duck hawk, thick-knee, roller, etc.

Mammal fauna is represented by 6 units, which include 77 species: insectivorous-12 species, bats – 18, predatory – 15, double-toothed rodents – 2, rodents – 25, artiofdactyes – 5. Raccoon dog, raccoon, mink, muskrat are acclimatized. In the middle of the XIX century elk was reakklimatized. The Red Book includes the European mink, *(Figure 5.13)*, European lynx *(Figure 5.14)*, a badger, several species of bats.

One of the most unique species of mammals is the Belovezha bison. Its numbers on 01.01.2010 amounted to 937 individuals.

Belarus has the southern boundary of

Figure 5.11 – Ferruginous duck

Figure 5. 12 – Erne

Figure 5.13 – Brown bear

Figure 5.14 – European lynx

area of brown bears. Belarusian population of this specie for 2006 estimated at 110-120 individuals, and represented as four spatially separated subpopulations, defined by large forests in the northern part of the country.

Another protected species – the European lynx in Belarus, met throughout the territory, but very rarely. Totally it counted no more than 450-500 lynxes each year.

Extremely important group by number of members of rare and endangered species are bats. Currently it is known 18 species, of which 6 species are included in the Red Book of Belarus -pond bat *(Figure 5.15)*, Nutter and Brandt bat, barbastelle *(Figure 5.16)*, lesser noctule and northern leather figure).

Animal world is an integral part of the natural environment and biodiversity, an important regulating and stabilizing component of ecosystems.

In Belarus, considerable attention is given to improving the regulatory framework aimed at ensuring the conservation of biological diversity and sustainable use of animal resources. Currently there are over 30 standard-setting instruments of different levels, governing the protection and use of animal resources.

For the protection and sustainable use of wildlife by the Ministry of Natural Resources and Environmental Protection of the Republic of Belarus provides control over the account

Figure 5.15 – Pond bat

Figure 5.16 – Barbastelle

of wild animals, relating for hunting, in the fund reserve hunting areas, hunting grounds in the fund provided in free of payment, as well as in other areas (nature reserves, national parks, the other in protected natural areas).

One of the important types of biological resources is the resources of hunting fauna. According to the Rules of game management and hunting in the Republic of Belarus approved by the Presidential Decree № 383 of July 23, 2010 classified 50 species (21 species of animals and 29 species of birds) related to hunting animal species. Of these, 3 species of wild animals and 4 species of birds classified as undesirable for hunting or fishing industry. From wild game to the resource and significant objects and the mass hunting first and foremost, include elk, red deer, roe European, wild boar, and hares, some types of fur-bearing animals; from birds – great grouse, black grouse, hazel grouse, partridge and ducks. The object of the mass hunting is the geese, but the main hunting takes place outside the country. In this connection, the number of geese slightly

depends on the established regime of their use, and more rational management of populations is not possible without the agreed policy of the countries where the wintering birds, breeding, growing and migration routes take place.

To monitor the status of populations and retirement planning in the hunting took into account the number of the most valuable species of game animals.

Total number of game farms in 2009 amounted to 255 (for 3 more than in previous

Table 5.12

Number of major species of game animals in hunting in 2005-2009, thousands of individuals (according to the Ministry of Statistics and Analysis)

Species	2005	2006	2007	2008	2009
Elk	15,6	16,2	17,7	19,6	21,1
Deer	4,9	5,7	6,8	8,1	8,7
Boar	38,6	43,2	47,9	56,0	63,9
Roe	50,4	50,9	53,0	59,1	64,3
Protein	105,9	101,5	113,4	127,3	127,8
Hare	206,5	198,7	181,3	179,0	170,7
Fox	39,3	47,1	40,0	41,0	46,0
Muskrat	70,9	59,9	54,4	50,3	42,0
Mink	20,5	19,7	19,3	20,3	21,6
Beaver	48,0	52,5	58,8	59,6	62,3
Capercaillie	9,1	9,3	9,2	8,9	8,6
Blackcock	47,0	45,7	41,6	41,2	37,9

Table 5.13

Dynamics of mining of the main species of game animals in 2005-2009, individuals (according to the Ministry of Statistics and Analysis)

Species	2005	2006	2007	2008	2009
Elk	659	744	990	1159	1318
Deer	186	412	329	441	613
Boar	5826	7861	13 371	18 914	24 105
Roe	3105	2912	3562	4402	5073
Protein	2220	1859	2220	2555	2896
Hare	53 130	43 432	55 804	53 710	50 612
Fox	22 790	28 040	31 999	25 838	25 258
Muskrat	2903	2506	3409	2860	1932
Mink	1682	1765	2267	2309	2435
Beaver	243	413	2129	2220	3494
Capercaillie	123	81	140	151	154
Blackcock	1179	314	247	332	364

year), the total area counts of 16.8 million hectares (2008 –16.5 million hectares). The nature of the state of the main resource species hunting fauna and the dynamics of their population according to data presented in *Tables 5.12* and *5.13.*

According to the Ministry of Statistics and Analysis, in 2009, hunting farms in the country remained with positive trends in population dynamics and production of key resource species of game animals.

Significant population growth occurs in a wild boar. Thus, from 2005 to 2009 the number of wild boars has increased by 25.3 thousand individuals. This is primarily due to weather conditions, conditions (mild winters), the availability of sufficient fodder, increased control over the exploitation of its population (the fight against poaching, the increase in penalties for non-legitimate prey).

There is also growth in population and other hoofed animals. From 2005 to 2009 number of elk increased by 5,5 thousand

individuals, roes – on 3,8, deer – by 13,9 thousand individuals.

A continuing decline in the number of hares – with 206.5 thousand individuals in 2005 to 179.0 in 2008 and up 170.7 thousand individuals in 2009 is probably due to the large number predators (foxes, wolf, raccoon dog, prey birds).

The number of foxes during the period from 2005 to 2009 increased by 6,7 thousand individuals.

Of the wetland animals, marked the high rate of growth of a beaver. Only in the last

5 years its population increased by 14.3 thousand individuals, which is associated primarily with the reduction of hunting and the great plasticity of the specie.

Significantly reduced the number of muskrats – from 70.9 thousand individuals in 2005 to 42,0 thousand individuals in 2009 (to 28.9 thousand individuals). The number of minks varied slightly from year to year and remained relatively stable.

The most massive group of birds used for sport hunting are water-floating. A marked reduction of most species of waterfowl in Belarus and all the neighboring regions occurred in 1950-1960. In 1970 the number of basic duck hunting species of birds has begun to stabilize, and the rare protected species, and some not very popular object of hunting – even increase. The main reasons are:

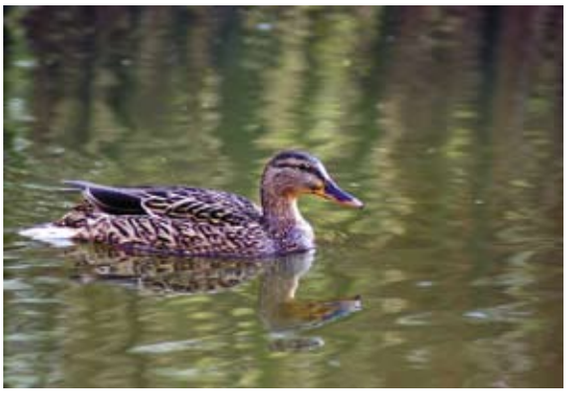
– development in Belarus a network of protected wetlands and the strengthening of common measures of bird protection;

– improving game management, regulation of time periods of hunting and size of game;

– increasing the degree of adaptation of birds to the economic changes the environment;

– extension of wintering waterfowl in the country, which under-led to a rapid increase in species diversity of wintering birds and their numbers.

Among the most abundant bird for hunting is absolutely dominated by mallard.



For waterfowl species uneven distribution on the territory in accordance with the location of the wetlands is characterized.

Among all species of upland game grouse is of special importance and is the most well-hunting trophy. Since mid-1960 in Belarus there was a noticeable reduction of the number of grouse, which have affected and protected areas. By the 1990's, the negative trend has slowed, the number of species has been stabilized and in some places has increased. This is attributed to the fact that cover of large areas of post-war plantings of pines have reached an optimal age for grouse, which increased the area of land suitable for him.

The number of great grouse in recent years (2005-2009) rests on a fairly stable level. However, in 2009 was a slight reduction in its size – up to 8,6 thousand from 9.1 thousand individuals in 2005.

Tends to decrease and the number of black grouse, which is mainly related to in weather conditions during the breeding season. So, in 2009, its population was 37.9 thousand

individuals, which is 9.1 thousand individuals less than in 2005.

Dynamics of production of game animals over the past 5 years is shown in *Table 5.13*.

According to available data for 2005-2009 it marked the increase in production of almost all major species of game animals. The exception is the hare, fox and muskrat. Maximal number of prey individuals of these species of animals has been achieved in 2007. Thus, bagging of hare in 2009 compared with 2007 decreased by 5,192 individuals, muskrats – in 1477 and foxes – to the 6741 specimen.

Among the hoofed animals in 2009, significantly increased production of wild boar – in comparison with 2005 by 4 times (18,279 individuals), 2 times – elk, more than 3 times – deer and in 1,5 times – roe (*see Table 5.13*).

In 2009 compared with 2005, a 14-fold increased production of beaver (compared to 2008 – in 1,6 times) is observed.

Extraction of great grouse and black grouse in recent years has remained relatively stable (*see Table 5.13*). It is mainly produced by foreign hunters.

According to the 2005 **fauna** of Belarus includes 11.5 thousand species. In the natural flora includes 1638 species of vascular plants, 430 bryophytes, 477 lichens, 2232 algae, fungi up to 7000. Diversity of plant communities is represented on 29 classes of themselves, 50 orders, 78 alliances and 233 associations.

As the food can be used about 400 wild plant species, technical – over 300, for medicine drugs – 900. Reserves of natural plant materials equal to or lower exceeded 1 million tons. Substantial deposits of technical tanning materials: bark of willows, oaks, buckthorn. From industrial plants are the most important tann oak, pine and spruce resiniferous; fibrous reed, cattail, big rush, sedges, nettles, reed.

Most economically important are the berry plants: blueberry, cranberry, blueberries and other; from fruit-trees- rowan.

From aromatic plants of natural flora reserves allocated calamus, river avens, water pepper, caraway,wild leek, coriander, absinthium, hops, marjoram, thyme. There are substantial deposits of black and red currant, cherry, water bean, nymphaea,common merilot.

Natural plant resources have considerable economic potential. There are significant reserves in growth and an assortment of pieces of medicinal plants and technical raw materials, food plants.

The third edition of the Red Book of Belarus are a list of plants and fungi, underlying the protection, expanded to 60 species relative to the 2nd edition. Changes in the list of protected species of plants and fungi can be represented as follows: number of species of vascular plants increased to 173 (was 156; ruled out 24 and added 41 new species), bryophytic – up to 27 species (it was 15, added 12), algae – up to 21 species (there were 9, added 12), lichen – up to 24 species (there were 17 , ruled out 4, added 11), mushrooms – and 29 (was 17, ruled 3, added 15). Totally there were excluded 31 and added 91 new species. For example, for the protection of Category I are Christopher

Figure 5.17 – Christopher herb

Figure 5.18 – Dark-winged orchis

herb *(Figure 5.17)*, bladder fern, dark-winged orchis (*Figure 5.18*), yellow marsh saxifrage, kauliniya small, shilling grass, gagea, saw grass and other.

Among plants and fungi, which were firstly included in the Republican Red Book, in overwhelming majority are extremely rare and very rare species, existing in small quantities and/or on very limited areas, resulting in the structure of biodiversity, they are the most vulnerable components with a high degree of extinction risk under the influence of adverse natural and anthropogenic factors.

One of the most significant factor of flora depletion of Belarus should be a violation or destruction of habitats of plants as a result of increasing anthropogenic impacts. The second important factor – the direct destruction of plants due to excessive production. At the same time nature transformation can lead to appearing conditions under which the form is eliminated naturally. Many rare species are characteristic of communities with sparse grass cover, have a reduced ability of a competitive and can thrive in anthropogenically disturbed areas, where there are reduced number of competitors. From this it follows that the issue of protection of species should be treated differentially based on their responses to various forms of anthropogenic impact action.

6. Land

Lands are the national treasure of Belarus and major natural resource for the development of the country. The Earth acts as a component of environment, the material basis of economic activities, means of production in agriculture and forestry, as well as the object of land and property relations.

For environmentally sound and sustainable use and protection of land resources it is necessary to form the optimal structure of land use, minimization of negative impact on the land of diverse business activities, improvement of normative and methodological support of the use and protection of land and soil.

To characterize the country's land resources and assess the influence of varied economic activities the data of land types and categories of land users are used which is represented in the annually published State Land Cadastre of the Republic of Belarus. These values allow to identify the proportion of land saved in natural and semi-natural state,

as well as land seized from productive turnover for construction, transport infrastructure, streets, squares and other public places and to characterize the level of socio-economic development of the country.

Seizure of land from productive use

According to the State Land Cadastre as on January 1, 2010 the area of land in Belarus is 20759.8 hectares. The structure of land fund in 2009 is shown in *Figure 6.1.* Structure of land fund for the period 2005-

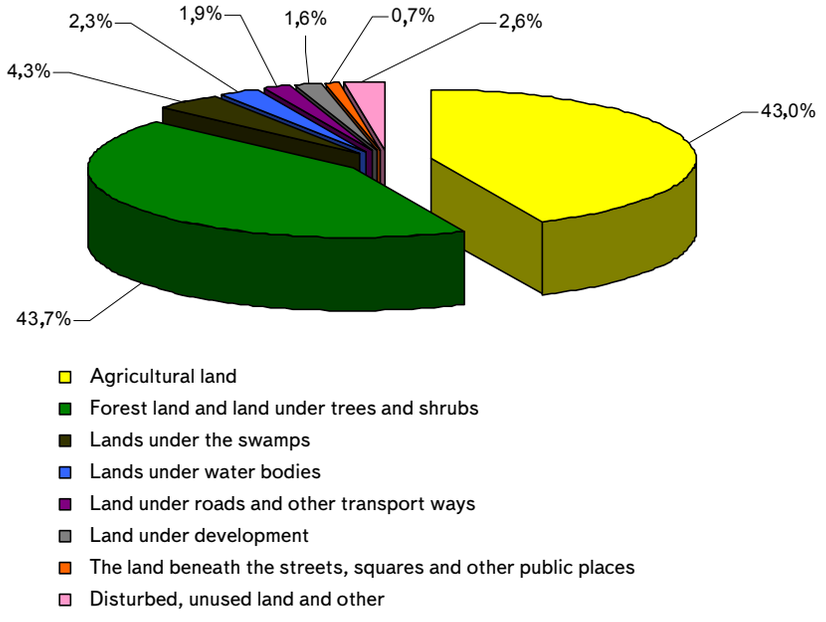


Figure 6.1 – Structure of land fund of Belarus by type of land (on 01.01.2010)

Table 6.1

The structure of land fund of Belarus by type of land in 2005-2009

Type of land	Area, ths ha				
	2005	2006	2007	2008	2009
Agricultural land	9011.5	8984.9	8968.0	8944.7	8926.9
Forest land and land under trees and shrubs	8892.3	8979.9	9008.1	9035.0	9064.8
Bog lands	900.1	901.5	894.6	894.1	889.6
Lands under water bodies	476.7	469.6	469.9	469.8	470.2
Lands under roads and other transport ways	364.4	371.9	386.1	391.7	391.0
Lands under construction	323.9	327.6	331.5	330.7	337.2
Lands under the streets, squares and other public places	148.3	142.5	147.0	148.9	147.7
Disturbed, unused and other lands	642.6	581.9	554.6	544.9	532.4

Table 6.2

The structure of land resources in Belarus by land types for the period 2005-2009

Type of land	Area, ths ha			
	2006 +/- compared with 2005	2007 +/- compared with 2006	2008 +/- compared with 2007	2009 +/- compared with 2008
Agricultural land	-26.6	-16.9	-23.3	-17.8
Forest land and land under trees and shrubs	+ 87.6	+28.2	+26.9	+29.8
Bog lands	+ 1.4	-6.9	-0.5	-4.5
Lands under water bodies	-7.1	+0.3	-0.1	+0.4
Lands under roads and other transport ways	+7.5	+14.2	+5.6	-0.7
Lands under construction	+ 3.7	+3.9	-0.8	+6.5
Lands under the streets, squares and other public places	-5.8	+4.5	+1.9	-1.2
Disturbed, unused and other lands	-60.7	-27.3	-9.7	-12.5

2009 and the change is illustrated in the *Table 6.1* and *6.2*.

During the period of 2005-2009 in the structure of land resources by types of land substantially changes occurred. There was a steady downward trend in agricultural lands, the area of which over a five year period decreased by 84.6 thousand ha, and the increase in the land under forest and shrub vegetation, the area of which increased to 172.5 thousand hectares. There was a reduction in the land occupied by marshes and water bodies – on

10,5 and 6,5 thousand hectares respectively. The main reasons for the redistribution of land are associated with the implementation of complex measures to optimize the structure of land use, the part of which was the withdrawal from circulation of low productivity, overgrown and bog farmlands and their transfer to other types of land.

The seizure of land from productive use for transport infrastructure and for construction for the period 2005-2009 was 39.9 thousand hectares. The area of land under the streets, squares and other public places did not change. The total types of land occupy 4.2% of Belarus territories. By 2009 significantly reduced the area of disturbed, unused and other lands – to 110.2 thousand hectares or 17,1% to the level of 2005.

The structure of land by categories of land users for five years changed. The structure of land fund for land users in 2009 is shown in *Figure 6.2*, its changes over the past five years – in *Tables 6.3* and *6.4*.

Through the reallocation of land among the categories of land users for the period of 2005-2009 the amount of lands belonging to agricultural organizations and peasant (farmer)

economies increased. In 2009 compared with 2005 through the transfer of unused lands and reserved lands the area of these lands increased by 169.9 thousand hectares or 1.9%.

The lands of state forestry organizations and environmental, recreational, historical and cultural organizations for a five-year period also increased by 100 thousand hectares (1,2%) and 48.9 thousand hectares (5,6%) respectively. The significant increase of public forest lands organizations was in 2008. The same year the lands of the following organizations were reduced: enterprises, transport, connection, power industry, military and other. During 2005 – 2009 this category of land users decreased by 92.3 thousand hectares or 13,4%.

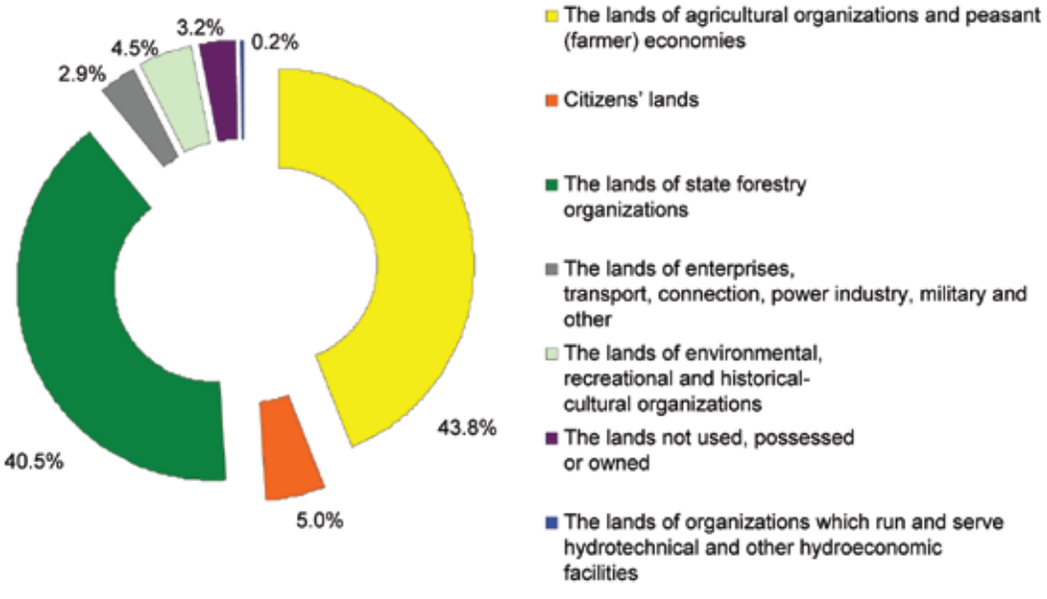


Figure 6.2 – The structure of land fund of Belarus by categories of land users (01.01.2010)

Table 6.3

The structure of land by categories of land users in the Republic of Belarus in 2005-2009

The lands by land users categories	The area, ths ha				
	2005	2006	2007	2008	2009
The lands of agricultural organizations and peasant (farmer) economies	8920,1	8959,9	9007,7	9062,7	9090,0
Citizens' lands	1284,1	1218,6	1145,0	1086,1	1035,8
The lands of state forestry organizations	8299,5	8317,7	8286,5	8422,4	8399,5
The lands of enterprises, transport, connection, power industry, military and other	690,1	683,1	723,1	598,0	597,8
The lands of environmental, recreational and historical- cultural organizations	879,2	887,1	887,1	886,8	928,1
The lands of organizations which run and serve hydrotechnical and other hydroeconomic facilities	39,9	40,1	39,5	39,3	39,7
The lands not used, possessed or owned	646,9	653,3	670,9	664,5	668,9

Table 6.4

Dynamics of land fund structure of Belarus by land users categories for the period 2005-2009

The lands by land users categories	The area, ths ha			
	2006 +/- compared with 2005	2007 +/- compared with 2006	2008 +/- compared with 2007	2009 +/- compared with 2008
The lands of agricultural organizations and peasant (farmer) economies	+39,8	+47,8	+55,0	+27,3
Citizens' lands	-65,5	-73,6	-58,9	-50,3
The lands of state forestry organizations	+ 18,2	-31,2	+135,9	-22,9
The lands of enterprises, transport, connection, power industry, military and other	-7,0	+ 40,0	-125,1	-0,2
The lands of environmental, recreational and historical- cultural organizations	+7,9	–	-0,3	+41,3
The lands of organizations which run and serve hydrotechnical and other hydroeconomic facilities	+0,2	-0,6	-0,2	+0,4
The lands not used, possessed or owned	+6,4	+17,6	-6,4	+4,4

From the land of citizens to other categories of land 248.3 hectares of land (19,3%) moved during 5 years. The decrease was primarily due to transfer of these lands to agricultural organizations.

The area of land not used, possessed or owned increased to 22 thousand ha or 3.4%. The greatest increase occurred in 2007 and amounted to 17.6 thousand hectares.

The lands of organizations which run and serve hydrotechnical and other hydroeconomic facilities were modified slightly.

Significant impact on the structure of land resources in Belarus still has the consequences of the Chernobyl disaster. On 01.01.2010 from economic turnover derived 248.7 thousand hectares of contaminated land or 1.2% from the total area of Belarus lands. 41.6% of the derived area refers to the lands of forestry organizations, 37,2% – lands of environmental, recreational and historical-cultural organizations, 16,3% – the land of agricultural organizations and farms, 4,9% – lands lands not used, possessed or owned.

The data on the structure of land by types and categories, the results of analysis of existing and prospective situation are the basis for the formation of public policy on environmentally sound use and protection of land and soil and improvement of the mechanism of state management of land resources and regulation of land relations.

Degradation of soil cover

One of the major factors to constrain land use and deteriorate ecological condition of soil is the process of land degradation. To degradation process associated with economic activities refer water and wind erosion, mineralization of drained peat soils, the transformation of land caused by mining and construction, the loss of productivity of agricultural land, radioactive and chemical pollution, discoloration of drained peats and forest lands. Land degradation process causes significant economic, environmental and social harm, making adjustments in land and environmental policies of the country.

Water and wind erosion

Of all the types of land degradation in Belarus erosion is the most evident. According to the National Action Plan on Rational Use of Natural Resources and Environment of the Republic of Belarus for 2006-2010 the total area of eroded and erosive dangerous lands in the country is more than 4 000.0 thousand hectares, including arable – about 2,600 thousand hectares. For eroded soil there are 556.5 hectares of land, including 479.5 thousand hectares of arable land. In this case, the share of water erosion is 84%, wind – 16%.

The erosion process is regional in nature. In Belarusian Poozerie and the central part of Belarus the most actively flow water and erosion processes. In Belarusian Polesie the process of wind erosion developed *(Fig. 6.3)*. Erosive processes are mostly evident on agricultural lands, because of constant transformation the upper soil horizon as a result of plowing.

According to the RUE «Institute of Soil Science and Agricultural Chemistry» the largest areas of agricultural land affected by erosion processes are typical for Minsk and Vitebsk region, the lowest – for Gomel and Brest. The distribution of eroded agricultural land by administrative areas of Belarus is shown in *Figure 6.4* and *Table 6.5*.

Erosion types and its intensity on the agricultural lands

The rate of erosion and deflation of soil cover	The share of erosion and deflation soil covers, % from the area of agricultural lands	Water erosion	Wind erosion (deflation)
weak	1,0–5,0		
middle	5,1–10,0		
strong	10,1–20,0		
very strong	>20,0		

The territories with almost non-erosive or non-deflated soil cover (soil erosion missed or <1,0 %).

Forestry and other wood covered lands.

Figure 6.3 – Soil erosion map of the Republic of Belarus

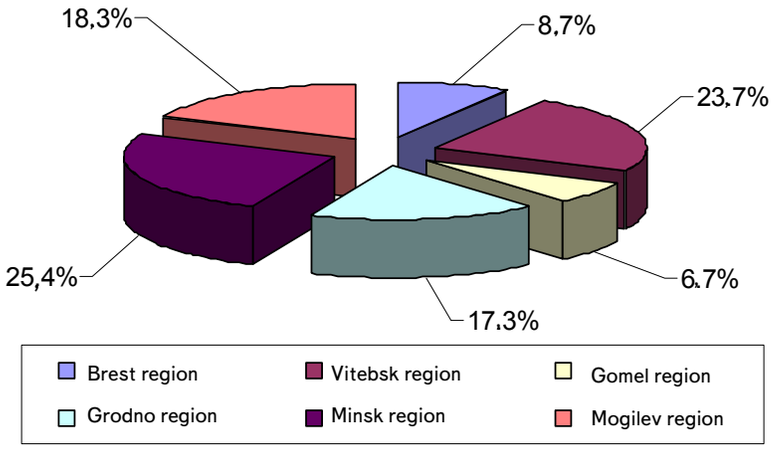


Figure 6.4. Distribution of eroded lands by administrative regions of the Republic of Belarus (from total area of eroded lands)

By weight eroded lands in total area of farmland administrative regions are as follows: Vitebsk – 7,3%, Minsk – 6,6, Grodno and Mogilev – 6,4, Brest – 2,9, Gomel – 2,4%.

The largest land area affected by water erosion is located in Vitebsk region and constitutes 7.0% of total agricultural land area. In Mogilev, Minsk and Grodno regions water-erosion processes are characteristic respectively for 6,2%, 5,5 and 5,0% of farmlands. The minimum area of agricultural lands subject to water erosion are located in Brest and Gomel regions – 2,2 and 0,8% respectively.

Area of land affected by deflation are small and geographically confined mainly to Grodno, Gomel and Minsk regions, where occupy respectively 1,7%, 1,6 and 1,1% of total agricultural land. In other areas the share of such lands does not exceed 1% of farmland.

It was determined that the way of use of erosive dangerous and erosion lands

Table 6.5

Distribution of agricultural land in Belarus on types of erosion

Region	Lands subject to water erosion		Lands subject to wind erosion	
	ths ha	%*	ths ha	%**
Brest	31.3	7.7	11.3	13.7
Vitebsk	112.0	27.4	4.2	5.1
Gomel	10.9	2.7	21.8	26.4
Grodno	63.6	15.6	21.3	25.8
Minsk	103.6	25.4	21.4	25.9
Mogilev	87.1	21.3	2.7	3.3
Total in Belarus	408.5	100.0	82.7	100.0

* % of total agricultural land affected by water erosion.
** % of total agricultural land affected by wind erosion.

with washed off and blown soil each year in average 10-15 tons of solid phase is wafted from one ha, 150-180 kg humic substances, 10 kg of nitrogen, 4-5 kg of phosphorus and potassium, 5-6 kg of calcium and magnesium which negatively affect the soil. There is a significant reduction of crop yields on eroded soils from 5 to 60%.

In order to control erosion there must be the system of organizational economic, technological, agricultural, forest and hydromeliorative anti-erosive activities which fulfillment will help to preserve and rehabilitate erosive dangerous and eroded lands.

Soil pollution

According to the National Report of the Republic of Belarus on the implementation of the UN Convention to Combat Desertification/ Land Degradation (2006), one of the factors of degradation is chemical contamination of lands. Available data monitoring of land and local monitoring of NEMS, as well as the results of ecological and geochemical studies of soils indicate that chemical contamination is characteristic mainly for cities and its areas, roadsides, the zones of influence of waste disposal, agricultural lands and industrial areas.

According to the National Plan of Action for the sustainable use of natural resources and environmental protection of the Republic of Belarus for 2006-2010 the area with dangerous levels of soil pollution in urban areas is 78 thousand ha, in roads zones – to 119 thousand, within the agricultural land – 10 thousand, in the zones of landfill influence – 2,5 thousand ha.

According to observations of the chemical pollution of land, conducted as part of NEMS, for five year period 44 cities of Belarus there is accumulation in soils of petroleum products and heavy metals, to a lesser extent – of sulfates and nitrates.

Soil pollution with oil products is characteristic for all surveyed cities. In 50% of settlements maximum oil content in soil exceeds the maximum permissible concentration for 5-15 times.

Heavy metals main pollutants are cadmium, zinc and lead. Soil pollution by cadmium is typical for 72% of the surveyed cities, zinc – 77%, lead – for 61% of the cities. Exceeding the permissible level of cadmium in 2 times or more was noted in 8 cities, zinc – in 14, lead – in 9 cities.

Copper in high concentrations was in 4 cities. Soil pollution with nickel and manganese in the surveyed cities was not mentioned.

Isolated cases of soil pollution with sulfates in 1,0-1,5 times higher the permissible level

reported in 39% of the cities. Exceedance of the standards of the nitrates is characteristic for the soil of only 3 cities.

According to the results of local monitoring of land held in the framework of NEMS from 2007 it was revealed that contaminants in the soil at the industrial areas of machine building and metal work are zinc and cadmium, in a lesser degree copper, nickel, lead and chromium. On selected areas metal concentrations exceed the standards of admissible standards in several dozen times.

Priority pollutants in the enterprises of fuel and energy, chemical and petrochemical industries are the polycyclic aromatic hydrocarbons (PAHs), petroleum products, polychlorinated biphenyls (PCBs).

At the enterprises specializing in the manufacture of varnishes and paints, most pollutant substances are PCBs which concentrations in some cases are 100 times higher than the permissible level.

On the industrial areas of enterprises specializing in production of building materials, soils are contaminated with arsenic. The average content of elements in soils on some industrial areas is several times higher than the norm.

In general, chemical contamination of land is local and has no significant effect on the ecological state of the environment on the regional level.

7. Agriculture

Formation and implementation of effective policies on the use and protection of agricultural land, acception of valid management decisions to preserve their productivity and improvement of its quality, assess of the negative impact exerted by agricultural activities on soils in the application of fertilizers and plant protection are impossible without adequate and reliable data on soil fertility, quantitative and qualitative composition used in plant-growing branch of mineral and organic fertilizers.

However, application of fertilizers is one of the indicators, which makes it possible to assess the pressure exerted on the environment by crop industry.

By cadastre assessing the land, arable soil in Belarus as a whole is estimated at 31.2 points. Arable areas with fertility estimated as 25-35 points occupy 46.4% of arable land, 20,1-25,0 points occupy 16.3%, and 20 points and lower – 7.6% of arable land.

Productive capacity of arable land in Belarus for the five-year period increased by 1,4 times and now stands at 4.54 t/ha of fodder units, varying on administrative areas from 3.20 t/ha in the Vitebsk region to 5.27 t/ha of fodder units in Grodno *(Table 7.1)*.

By area of the productive capacity of agricultural soils for the period from 2005 to 2009 increased: in the Brest region – at 0.96 t/ha of fodder units, Vitebsk – 0.43, Gomel region – 1.55, Grodno – 0.64, Minsk – 1.01, Mogilev region – 1.55 t/ha of fodder units, which indicates the improvement of the ecological state of intensively used for agricultural production land.

Increasing the productivity of arable land and obtaining high and stable yields can only be a subject to sufficient doses of mineral and organic fertilizers, which ensure a positive balance of major nutrients.

The use of mineral fertilizers for the production of competitive products in foreign

Table 7.1

Production capacity of arable land in the Republic of Belarus 2005-2009, t/ha of fodder units

Areas	2005	2006	2007	2008	2009
Brest	35.7	37.0	41.7	49.0	45.3
Vitebsk	27.7	30.8	36.3	38.9	32.0
Gomel	27.8	31.3	33.2	41.6	43.3
Grodno	46.3	48.4	53.2	67.0	52.7
Minsk	33.8	40.3	43.6	52.0	43.9
Mogilev	29.5	35.4	39.8	45.7	45.0
Total in Belarus	33.4	37.4	41.5	49.2	45.4

markets should be at a level of 200-250 kg/ha of agricultural land on the background of integrated plant protection.

During the period from 2005 to 2009 the national average amount of fertilizer application (NPK) has increased by 132 kg/ha and reached 288 kg/ha in 2009, which corresponds to the required level *(Table 7.2).*

Within the bounds of administrative areas the extention of using fertilizers over five year period was in Brest region at 138 kg/ha, Vitebsk – 134, Gomel – 140, Grodno – 113, Minsk – 138, Mogilev 133 kg/ ha.

It is very important to the use the fertilizers in balance. In recent years, chemical fertilizers are often used in violation of the ratio of nutrients. In some cases, there are attempts to replace the lack of one of element, mostly phosphorus, by nitrogen or potassium, which lead to loss of crops of agricultural crops and reduction of soil fertility. Thus, in 2006 the average percentage of potash in the country was 46% of all mineral fertilizers. For nitrogen and phosphorus fertilizers, the figure is 36, and 18% respectively. In 2008 the share of phosphate fertilizers has decreased by 15% due to the increase of nitrogen fertilizers, which accounted for 39% of all mineral fertilizers *(Table 7.3, Fig. 7.1).*

Within the bounds of administrative regions the least amount of phosphate fertilizers in 2008 applied on farmland to the Vitebsk

Table 7.2

The application of mineral fertilizers on arable land in administrative regions of Belarus in 2005-2009, NPK kg/ha per year

Region	2005	2006	2007	2008	2009
Brest	165	262	259	253	303
Vitebsk	117	207	189	202	251
Gomel	162	249	234	259	302
Grodno	197	267	239	277	310
Minsk	156	254	266	258	294
Mogilev	140	239	216	253	273
Total in Belarus	156	247	236	250	288

Table 7.3

Application of potash, nitrogen and phosphorus fertilizers on arable land in the administrative regions of Belarus in 2006-2008, kg/ha

	Nitrogen			Phosphorus			Potassium		
Region	2006	2007	2008	2006	2007	2008	2006	2007	2008
Brest	99	93	93	43	45	33	120	121	127
Vitebsk	76	70	82	35	27	25	96	92	95
Gomel	78	75	94	51	44	45	120	115	120
Grodno	103	94	115	47	35	41	117	110	121
Minsk	95	96	103	42	53	41	117	117	114
Mogilev	83	78	95	48	37	45	108	101	113
Total in Belarus	89	85	97	44	41	39	114	110	114

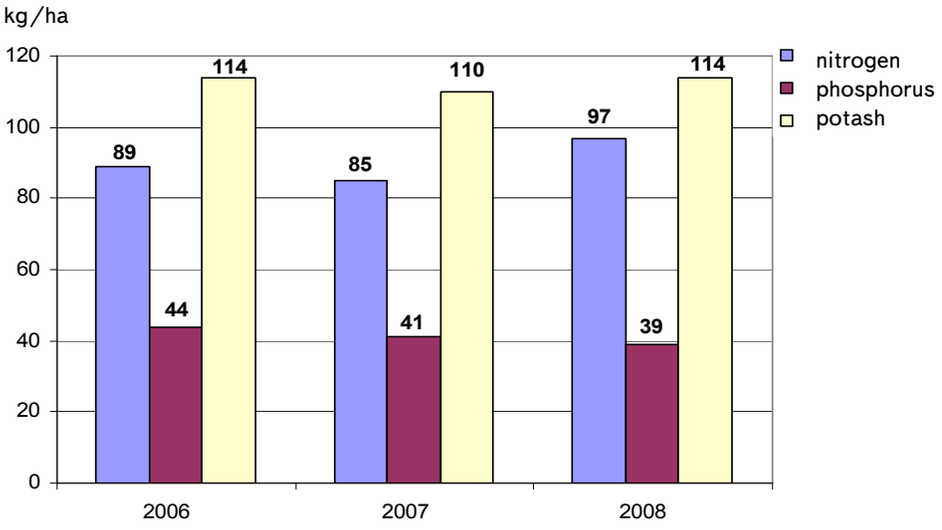


Figure 7.1 – The application of mineral fertilizers on arable land in Belarus in 2006-2008

region – 12% of all fertilizers in the region, the largest – in the Mogilev, where their share reached 18%. Nitrogen fertilizer applied on the fields varies from 36 to 42%. The maximum amount of applied potassium fertilizers were in Brest region (50%), minimum – in Grodno (43%).

To improve the quality of agricultural land and increase their productive capacity, along with mineral fertilizers organic ones are applied *(Tabl. 7.4).*

In 2005-2009 the tendency to increase the use of organic fertilizers was outlined. The national average application of organic fertilizers for the five-year increased by 2.6 tons/ha (40%) and reached in 2009, 8.9 tons/ha. The increase of organic fertilizers within the bounds of administrative areas made in: Brest – 4,1 tons/ha, Vitebsk – 2,7, Gomel – 2.6, Grodno – 0.1, Minsk – 3,4, Mogilev – 2, 3 tons/ha.

Regulations are developed to determine the need for organic fertilizer according to the ratio of areas. These regulations provide an undeficit humus balance in arable soils of organic fertilizers in Belarus as 12.0 tons/ha, or 58.8 million tons *(Table 7.5).*

The average doses of organic fertilizers for ensuring undeficit humus balance per hectare of crop rotation area of administrative areas of the country considerably vary. They depend on the granular structure of soils and corelation

Table 7.4

Application of organic fertilizers on arable land in the administrative regions of Belarus in 2005-2009, tons/ha

Region	2005	2006	2007	2008	2009
Brest	7,9	8,8	8,9	10,4	12,0
Vitebsk	3,3	3,5	3,8	4,1	6,0
Gomel	6,0	5,8	6,4	7,9	8,6
Grodno	11,0	11,0	6,4	11,1	11,1
Minsk	6,3	5,8	9,1	9,3	9,7
Mogilev	3,7	3,7	5,1	5,5	6,0
Total in Belarus	6,3	6,3	7,5	8,1	8,9

Table 7.5

Needs and possible production of organic fertilizers in the Republic of Belarus

Region	Need for undeficit humus balance		Possible accumulation of organic fertilizers, million tons of hypothetical manure	
	million tons	t/ha	million tons	t/ha
Brest	10,7	14,0	10,3	13,4
Vitebsk	7,3	9,5	7,6	9,9
Gomel	11,0	14,8	8,9	11,9
Grodno	9,5	13,2	9,6	13,4
Minsk	12,4	10,7	14,2	12,2
Mogilev	7,9	11,0	8	11,1
Total in Belarus	58,8	12,0	58,6	12,0

between row crops and perennial grasses – from 9.5 tons/ha in Vitebsk to14.8 tons/ha in Gomel. At present the applying of organic fertilizers in all administrative areas are lower than the standards, and this threatens the maintenance of undeficit humus balance in arable soils.

The most important agrochemical intake efficiency and potential fertility of soil is liming of acid soils. In the period 2005-2009 the amounts of liming were on a level 417,7-433,0 ths ha.

Liming of soils helped to reduce areas with acidic soils, which allowed to pass on to the concept of supporting liming, the main purpose of which is to maintain a certain level of soil acidity of agricultural land. Now in most parts of the country the soil acidity is optimum for plant level and averages 5.9.

Currently, 27, 9 % of agricultural land needs the chemical melioration. The need in lime fertilizers is 2199.5 thousand tons, including for arable lands – 1401.9 thousand tons, for ameliorated hayfields and pastures – 593.1 thousand tons, for contaminated land – 205.3 tons. The indicated amounts of lime are optimal for supporting the systematic liming.

In general, due to measures for increasing the volume of mineral and organic fertilizers, there has been some positive trends soils in Belarus to improve the agrochemical properties of arable. At the same time, the negative influence that might impact on the environment by using of mineral and organic fertilizers, which can deteriorate soil quality, surface and ground waters, crop production, yet has no significant ecological consequences, as introduced the present volumes of fertilizers correspond or even below the needs of the agricultural industry. However, analysis of data on fertilizer application allows to monitor their impact on environmental components and in proper time to develop a strategy to combat the negative processes that may occur as a result of fertilizer application.

8. Transport

Transport is one of the most important indicators of economic and social development of any country. However, it consumes a significant amount of energy and natural resources At all stages of operation and subsequent disposal operations have an impact on the environment, which manifests itself in air pollution (emissions from mobile sources account more 70% of the total emissions of pollutants), vehicle noise and vibration, electromagnetic missions, sewage pollution, violation of landscapes with road maintenance, pollution of ground waste transport companies and services.

The territory of Belarus is covered by sufficiently dense network of railways and roads, due to its position at the intersection of major trans-European communication axes *(Figure 8.1).* Across the country there are the shortest transport routes linking Western and Eastern Europe to Central and Eastern regions of Russia, on the one hand, the Baltic and Black Seas – on the other.

Among the sectors of transport complex of most dangerous are vehicles. The main types of its negative impact on the environment and humans are:

- air pollution;
- water pollution from sewage;
- solid waste;
- accidents with injury and death;
- removal of large areas for construction of transportation facilities.

In the last decade the car park of Belarus is growing. Thus, according to the Ministry of Transport and Communications of Belarus as on 0101.2010 it has 3433.0 thousand vehicles (ATM), the share of which 83.6% were cars. Dynamics of ATM for the period 2005-2009 is shown in *Figure 8.2.*

As shown in *Figure 8.2* in 2005-2009 a steady upward trend in the total number of growth of quantity of ATM continued, mainly due to increase in the number of cars. Thus, for the period under review the number of its had risen to 2,269.5 to 2,870.7 thousand units or

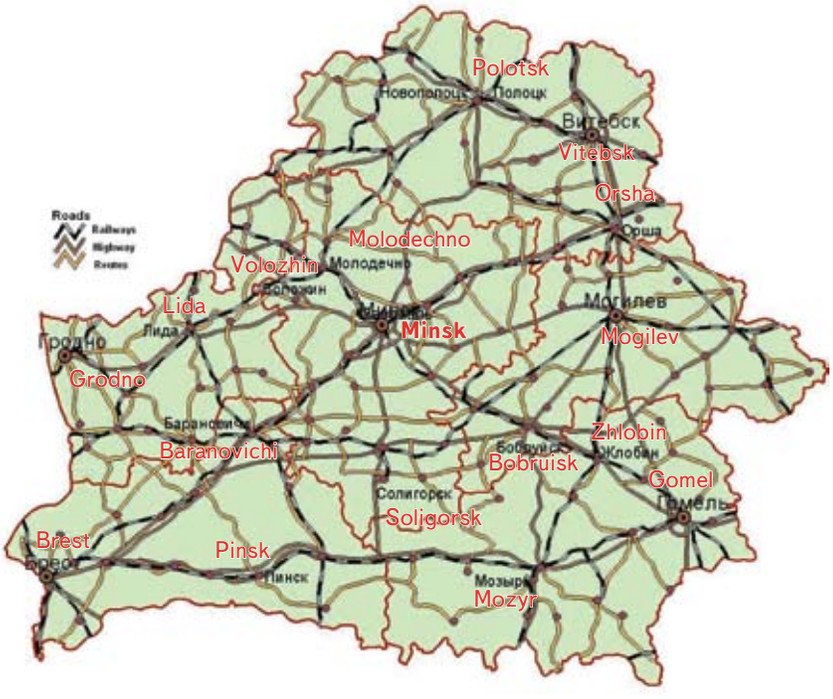


Figure 8.1 – Scheme of the main railways and roads in Belarus

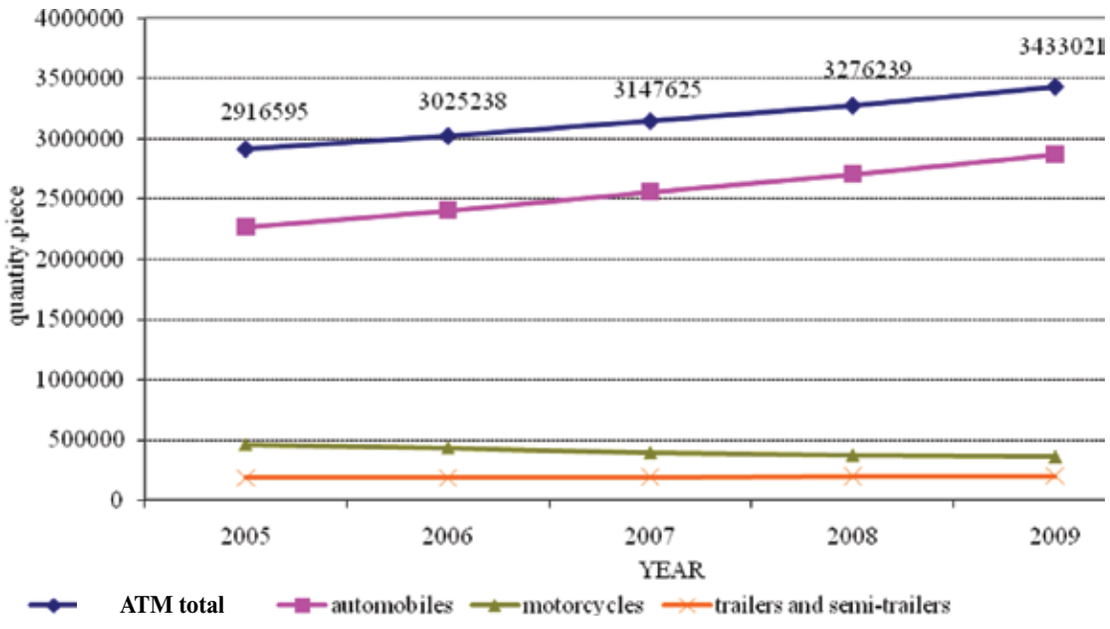


Figure 8.2 – Dynamics of ATM for the period 2005-2009

it was over 21%. The number of motorcycles fell by 28% (from 461.5 thousand to 360.4 thousand units). Over the past 5 years, the motorization of the population of Belarus has increased from 280 to 340 vehicles per one thousand of the population.

It is worth to note the natural tendency to upgrade the car park of the country. So, as on 01.01.2010 the share of motor vehicles engaged in international transport and related to environmental standards Euro-3 standard was 32.5%, Euro-4 – 6 %, and Euro-5 – 12.6% *(Table 8.1)*.

According to 01.01.2010 from the administrative regions of Belarus, the largest number of vehicles was accounted for Minsk region and Minsk – its amount is 36,7% *(Figure 8.3)*. The second place is occupied by Brestregion–15,4%.Theremainingareasarebetween 9.9 (Mogilev) to 12,9% (Grodno).

The basic environmental indicators approved in the country to assess the impact of transport on the environment are of passenger and cargo handling. These figures reflect the volume of transport services for passengers and cargo handlings, which provides to assess

Table 8.1

Number of cars registered to engage in international transport and related environmental requirements, «Euro» for the period 2005-2009

Standard	2005	2006	2007	2008	2009
Euro-5	0	0	0	757	1119
Euro-4	0	0	262	666	533
Euro-3	1049	1966	2692	3003	2885
Euro-2	1621	1593	1429	1125	950
Others	5795	4614	4150	3719	3392
Total	8465	8173	8533	9270	8879

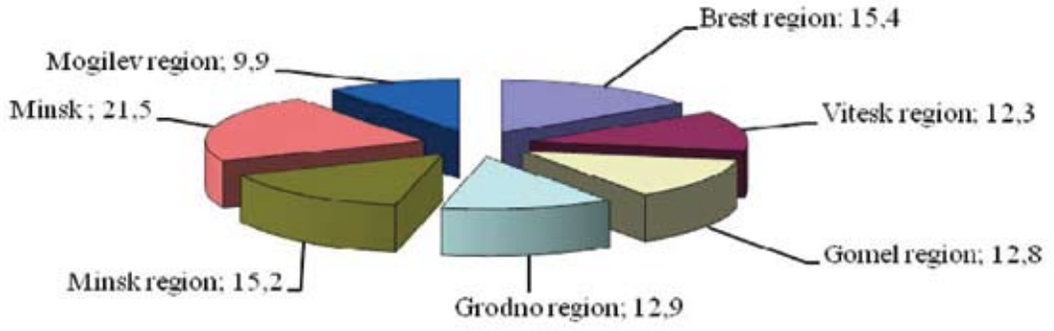


Figure 8.3 – Distribution of vehicles by administrative areas on 01.01.2010 in per cent of total

a measure of its impact on the environment (fuel consumption, pollutant emissions, noise emissions, etc.). Value for passenger and freight by kind of transportation helps to evaluate the effectiveness of measures aimed at protecting the environment from pollution.

Means of convenience are an important component of economic and social life. The continued growth in demand for transport, especially in road transport contributes to the sharpening of environmental and health problems. The importance of policy of the split of passenger transport in terms of its impact on the environment is caused by unequal «ecology» of different modes of transport (resource consumption, pollutant emissions, noise emissions, accidents, etc.). So, electric modes of transport are more environmentally «clean» in comparison with other species. Thus the country's policy in this area should contribute to a reduction of travel requirements, and to shift towards more environmentally «clean» means of transport.

Data analysis of passenger public transport during the last five years showed a steady trend towards reducing it from 24.354 million passenger per km in 2005 to 19.824 million passenger per km in 2009 or 18.6% *(Table 8.2)*.

The passenger rail transport degree decreased from 10.351 million passenger per km in 2005 to 7.401 million passenger per km in 2009, or 28,5%. The same trend is also typical for road transport: over the period 2005-2009 passenger numbers fell from 9.231 to 7.247 million passenger per km or 21,5%. The increase in passenger air transport should

Table 8.2

Passenger traffic by type of public transport for the period 2005-2009, thousand passenger per km

Transport type	2005	2006	2007	2008	2009
In total, of which	24 354 000	24 108 000	23 906 000	21 619 000	19 824 000
Railway	10 351 000	9 968 000	9 366 000	8 188 000	7 401 000
Car (bus)	9 231 000	9 343 000	9 353 000	8 184 000	7 247 000
Air	684 000	754 000	975 000	1 280 000	1 284 000
Interior water	2000	2000	3000	3000	3000

be noted. Thus, in the analyzed 5 years it has grown in 1,9 times from 684 to 1.284 billion passenger per km. Passenger turnover of water transport is at the level of 2-3 million passenger per km.

The proportion of each type of transport in total passenger numbers, as at 01.01.2010 its volume (about 74%) is in approximately equal proportions accounted for rail and road (bus) transportation *(Figure 8.4)*. The share of air transport is about 7% of the total passenger traffic.

Analysis of the data share mode of transport in total passenger traffic has shown that over the period 2005-2009 the contribution of rail transport has decreased from 42.5 to 37.3%, road (bus) – from 37.9 to 36.6%, and air, in contrast, increased from 2,8 to 6,5%.

Analysis of data freight transport over the period 2005-2009 showed that prior to 2008 there was a steady tendency to increase with 53.059 million ton-kilometers in 2005 to 62.924 million ton-kilometers in 2008, or by 15,7%. In 2009, turnover fell to 56.418 million ton-kilometers, or 10,3% compared with 2008. The same trend is typical for rail, road and inland waterway transport, the maximum value of turnover which, recorded in 2008 – respectively 48.994 million ton-kilometers, 13,742 and 132 million ton-kilometers *(Table 8.3)*. In 2009 the fall in turnover was 12,7% for rail, road and 1.5 to 37.1% for interior waterway transport. The maximum throughput of air transport was recorded in 2006 (92 million ton-km). In the period 2007-2009 there is a tendency to its decrease to 50 million ton-km.

An important strategic element of transport policy in the sphere of freight traffic is a shift from road to more ecological water and rail transport.

On 01.01.2010 unlike passenger turnover the main contribution to the turnover (75,8%)

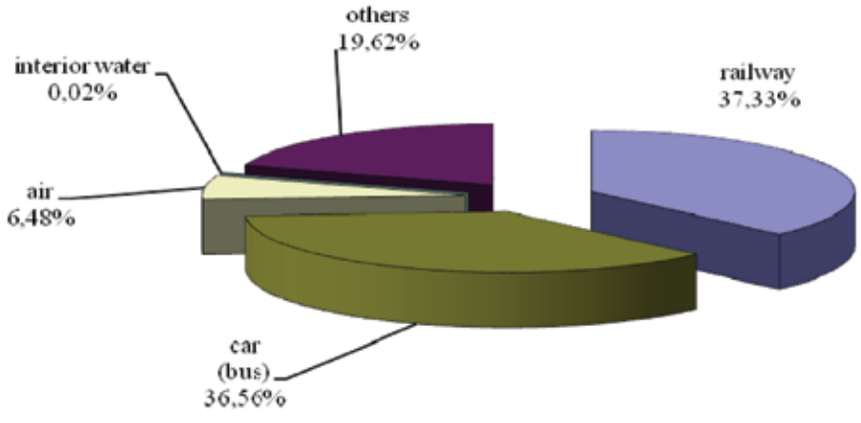


Figure 8.4 – The proportion of each type of transport in total passenger numbers, % (as at 01.01.2010)

Table 8.3

Freight turnover by types of transport for the period 2005-2009., ths t/km

Transport type	2005	2006	2007	2008	2009
In total (without pipeline) including the following:	53 059 000	54 863 000	60 033 000	62 924 000	56 418 000
railway	43 559 000	45 723 000	47 933 000	48 994 000	42 742 000
car (bus)	9 351 000	8 939 000	11 941 000	13 742 000	13 543 000
interior water	90 000	109 000	93 000	132 000	83 000
air	59 000	92 000	66 000	56 000	50 000

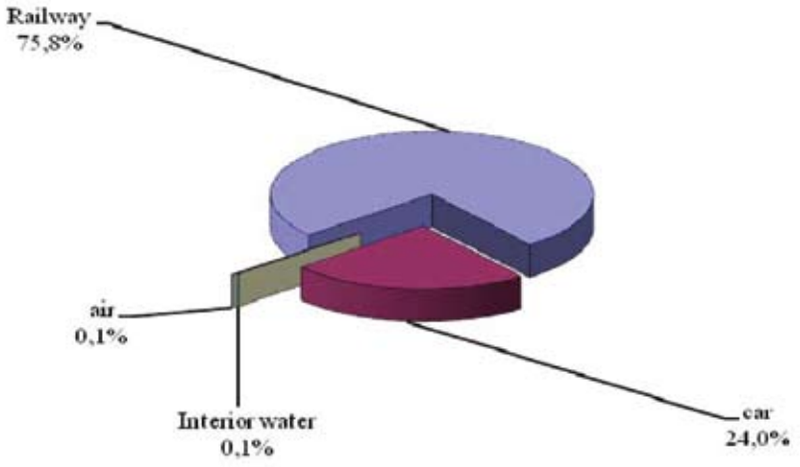


Figure 8.5 – Percentage of types of transport in total freight turnover, % (as on 01.01.2010)

makes rail transport *(Figure 9.5).* The second place is occupied by road transport, its share is 24%. Air and water transport accounts for only 0,1% of total turnover.

Analysis of data over a five year period showed that the proportion of rail transport in total freight traffic is gradually decreased from 82.1 % (2005) to 75,8% (2009). Meanwhile the share of road transport, in contrast, increased from 17.6 % (2005) to 24.0% (2009), which is not entirely corresponds to the goals of sustainable development.

In general, for the period 2005-2009. the following trends are characteristic for transport:

– increase of the number of vehicles;

– update of the car park of the country;

– reduction of passenger public transport;

– the main passenger almost equally accounted for rail and road (bus) transportation;

– reduction of the share of rail and road transport in total passenger traffic and increasing of air transport;

– the growth of freight transport by 2008 and its reduction in 2009;

– main cargo turnover falls on the railway transport;

– reduction of the share of rail transport in total freight turnover and increase of the share of road transport.

9. Waste

Annual volume of wastes

Rational and efficient use of natural resources is an important element of stable development. Waste is a considerable loss of material and energy resources.

Production wastes

The volume of wastes includes wastes generated in the process of economic activities (production of goods, energy, work process, services), side and accompanying products of mining and minerals' enrichment. During 2005-2009 in Belarus about 34,656 tons of wastes were processed annually, about 23901 tons (68%) out of them were the halite wastes and halite slimes clay-salt formed in the RUE «Production Association «Belaruskali».

Totally about 1,4 thousand of wastes is formed in Belarus with a wide range of morphological and chemical properties. If we consider the structure of industrial wastes properties without taking into the consideration the potassic recycling, the total of mineral wastes is about 53%, wastes of plant and animal origin – 35%, vital life wastes and similar, as well as chemical production and associated with it – from 5 to 6%, the wastes of water boiler and drinking water, wastewater, rainwater and the water use in power plants – about 1,4%, medical waste – less than 1% *(Fig. 9.1)*.

From 2005 to 2008 there was a gradual increase in the volume of industrial wastes *(Fig. 9.2)*. In 2009 industrial wastes fell mainly due to the reduction of wastes in the halite formation in RUE «Belaruskali» – by 52% compared to 2008. The volume of other wastes was gradually increasing and in 2009 was 13810 tons, that is 1,5 times more than in 2005. This increase was mainly due to the growth of mineral wastes (from 4619 to 7305 tons) and plant and animal origin

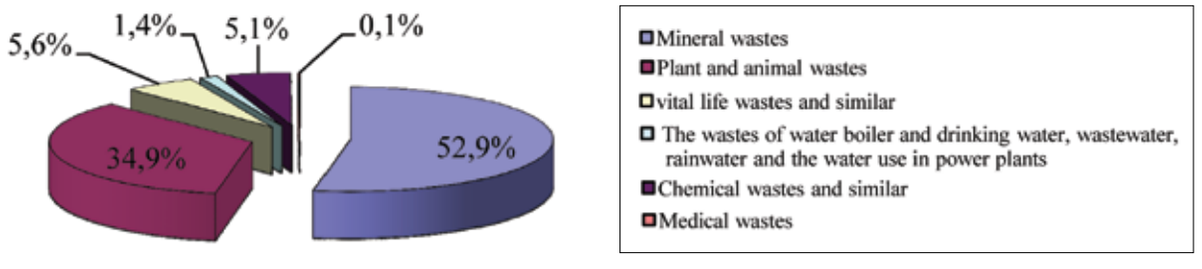


Figure 9.1 – The structure of industrial wastes in Belarus in 2009 (Excluding halite wastes and halite slimes clay-salt)

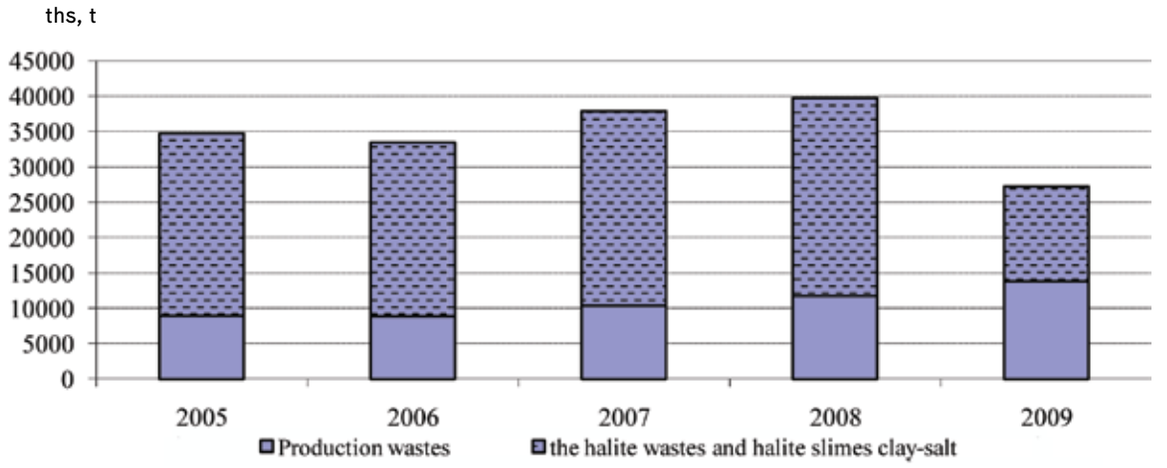


Figure 9.2 – The dynamics of industrial wastes in Belarus in 2005-2009

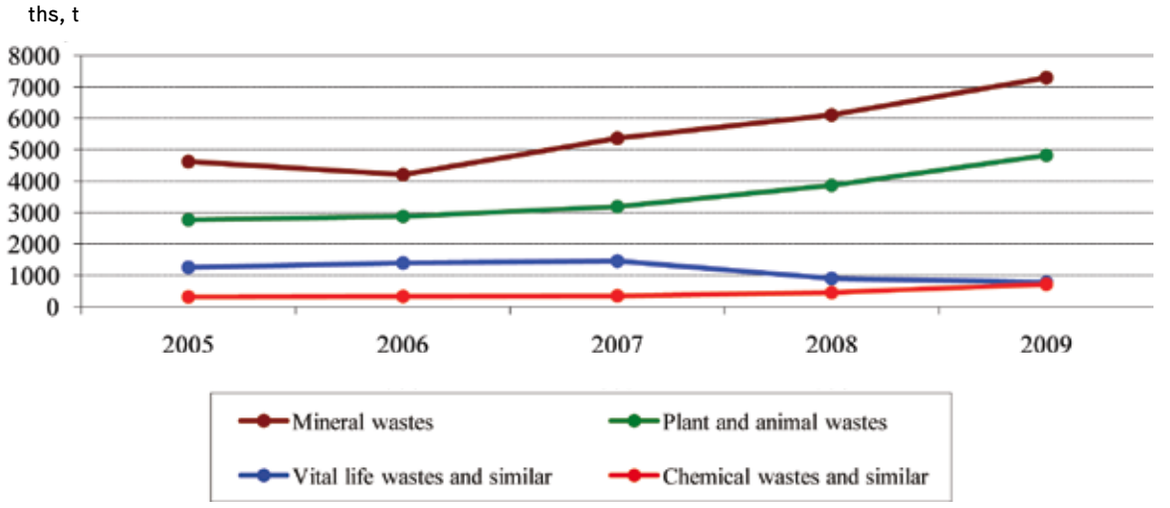


Figure 9.3 – Dynamics of the formation of some types of industrial wastes in Belarus in 2005-2009

wastes (from 2763 to 4819 tons) *(Fig. 9.3)*. The volume of vital life wastes and similar, decreased slightly over the period – from 1248 to 773 tons or 1,6 times.

Municipal solid wastes

Municipal solid wastes (MSW) are the wastes generated in the process of human life, not related to the economic activities, the wastes in the garage cooperatives, garden communities and other consumer cooperatives, street and backyard sweepings produced on the public, as well as waste products, such as vital activities wastes. The list is approved by the Ministry of Municipal Affairs and Housing of the Republic of Belarus and the removal of which is organized the local executive and administrative bodies.

During the period of 2005-2009 in Belarus 3248 tons of municipal solid wastes were produced annually.

In the last decade there is increase in the formation of municipal solid waste – the indicator increased in this period from 0.485 kg/person per day to 0.877 kg/person per day, it means almost 2 times and

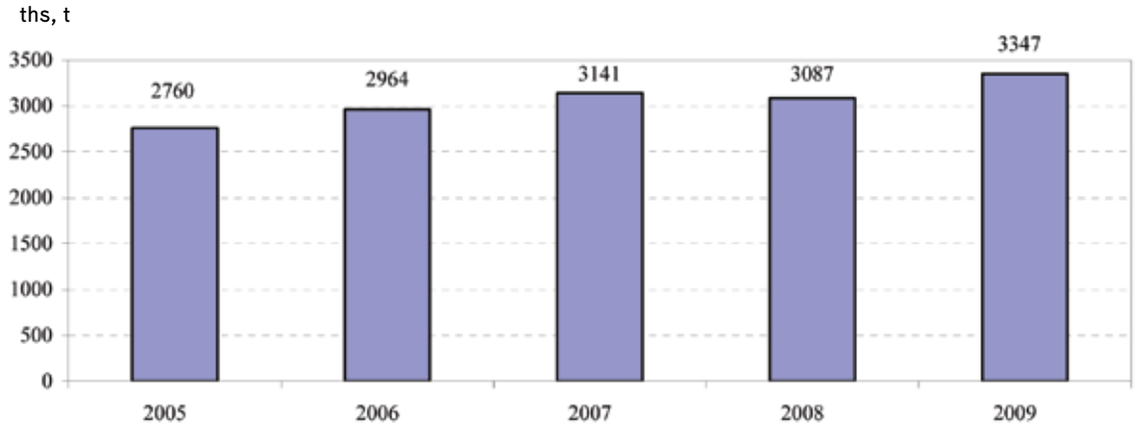


Figure 9.4 – The dynamics of the formation of municipal solid wastes production in Belarus in 2005-2009

approached the value characteristic for the EU countries (0,85-1,70 kg/person per day). From 2005 to 2009 the amount of municipal solid wastes in Belarus increased from 2760 to 3347 tons or for 21% *(Fig. 9.4)*.

According to the experts in the structure of municipal solid wastes the proportion of polymeric materials and waste from packaging and glass increased in the recent years.

Thus, our analysis of wastes volume in Belarus in 2005-2009 led to the following conclusions:

– In the reporting period the volume of industrial wastes in Belarus was about 34,656 tons, out of which about 68% were halite wastes and halite slimes clay-salt.

– The total mass of wastes (excluding potassic wastes) the proportion of mineral wastes is about 53%, plant and animal origin wastes – 35%, vital life wastes and similar, as well as chemical production and associated with it – from 5 to 6%, the wastes of water boiler and drinking water, wastewater, rainwater and the water use in power plants – about 1,4% , medical waste – less than 1%;

– In 2009 compared with 2005 the volume of production wastes (excluding potassic wastes) increased by 1,5 times mainly due to the growth of mineral wastes, as well as plant and animal origin wastes;

– The formation of municipal solid wastes in Belarus during this period was equal to the average of 3248 tons per year;

– For the past ten years, the specific indicators of MSW increased from 0.485 to 0.877 kg/person per day and approached the value characteristic to the EU (0,85-1,70 kg/person/day);

– From 2005 to 2009 the amount of municipal solid wastes in Belarus increased from 2760 to 3347 tons or for 21%.

Recycling and use of wastes products

Recycling and using wastes means the involvement of wastes to the economic

circulation where they are used in the manufacturing of products, energy, work process, services. This indicator characterizes the level of wastes and the effectiveness of measures to prevent environmental pollution by wastes.

The level of industrial wastes, or, in other words, the weight of recycling and using wastes in total in the period 2005-2009 was in average 26.2%, increased from 21.0% in 2005 to 42,9% in 2009.

Figure 9.5 shows the direction of wastes use in Belarus in 2005-2009. In the considered period most part of wastes (53,8%) was used for the needs of the enterprises, 46.2% transferred to other enterprises, implemented or exported for further use.

The level of production wastes excluding halite wastes and halite slimes clay-salt in 2005-2009 ranged from 68.0 to 77.6%, in average 72.7%. In absolute terms, the use of industrial wastes in the reporting period varied from 5652.2 to 10210.1 tons per year, in average 7385.5 tons per year *(Fig. 9.6)*. As shown on *Figure 9.6*, the level of production wastes use in 2005-2009 increased proportionally to the volume of their formation.

Mostly plant or animal origin wastes are fully recycled *(Fig. 9.7)*. Wastes from the production of food and flavoring products are used in agriculture, woodworking wastes are recycled or burnt for energy. In the volume of mineral wastes about 70% is

stripping soils which are almost fully used for backfilling quarries and restoration of disturbed lands

Other types of wastes are less used *(see Fig. 9.7)*. Out of the total amount of wastes during 2005-2009 (53639.1 ths t) 16711.8 tons remained unused (excluding potassic wastes). Main unused mineral waste is phosphogypsum (from 2921.5 tons used 37 thousand tons or 1.3%). The wastes of the following kinds are mostly unused: water boiler and drinking water, wastewater, rainwater and the water use in power plants.

The use of halite wastes in 2005-2009 varied from 3,4-8,0% – from 827.9 to 1036.4 thousand tons per year were implemented by public utilities of Belarus, Ukraine, Russia and Moldova.

Thus, the analysis of wastes volume of reuse and recycling in Belarus during the period 2005-2009 led to the following conclusions:

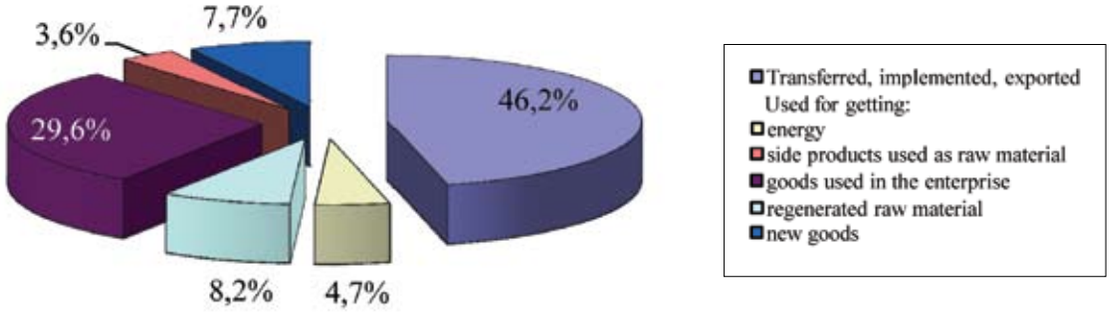


Figure 9.5 – The structure of the industrial wastes in Belarus in 2005-2009

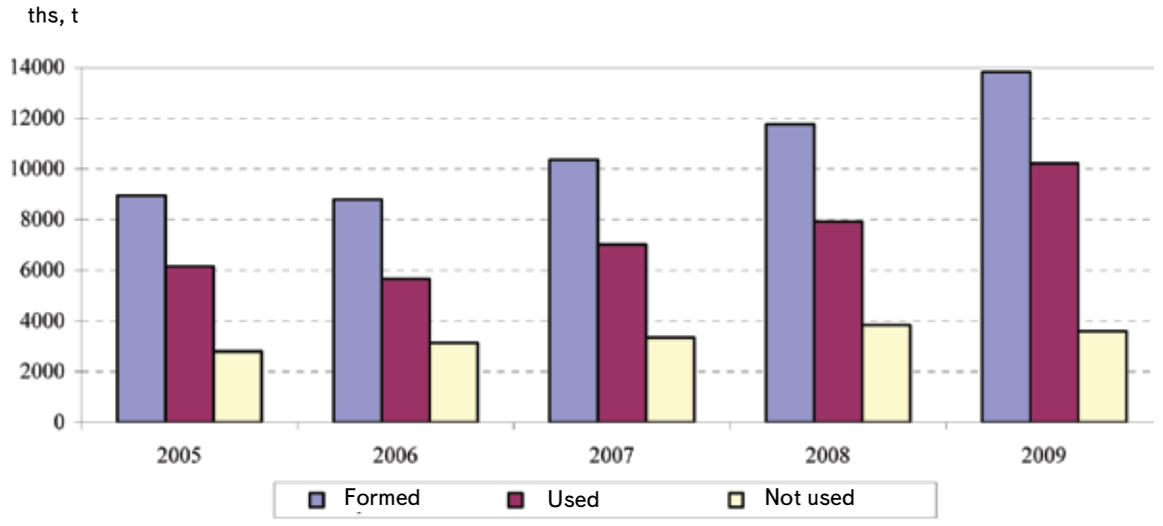
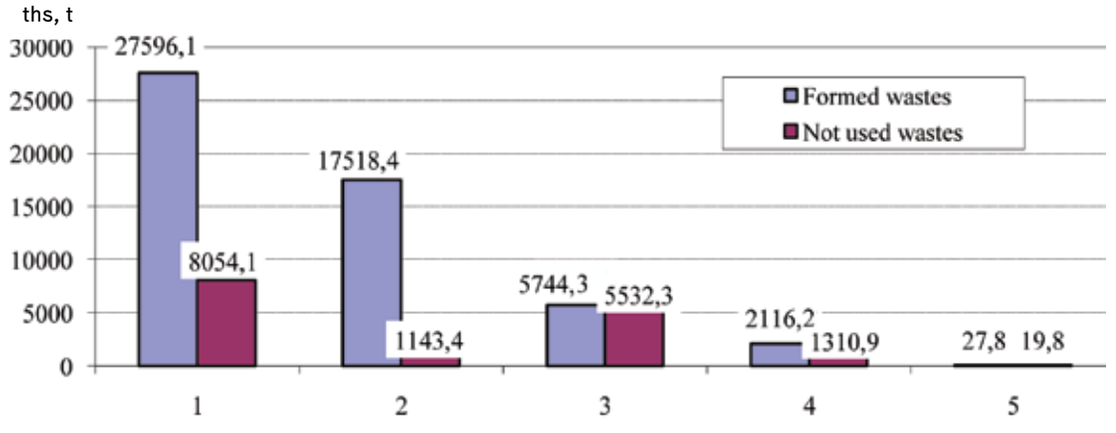


Figure 9.6 – The dynamics of formation and use of industrial wastes in Belarus in 2005-2009 (Excluding halite wastes and halite slimes clay-salt)



1 – mineral wastes
2 – plant and animal wastes
3 – vital life wastes and similar
4 – chemical wastes and similar
5 – medical wastes

Figure 9.7 – The proportion of formed and unused industrial wastes of various kinds in 2005-2009 (Excluding halite wastes and halite slimes clay-salt)

– The weight of recycling and using wastes in total in the period 2005-2009 was in average 26.2%, increased from 21.0% in 2005 to 42,9% in 2009; excluding halite wastes and halite slimes clay-salt this indicator ranged from 68.0 to 77.6%, in average 72.7%;

– In absolute terms, the use of industrial wastes in the reporting period varied from 5652.2 to 10210.1 tons per year, in average 7385.5 tons per year.

Final waste disposal

This indicator allows to determine the impact on the environment of the waste disposals and the effectiveness of the measures to prevent and reduce environment pollution.

Industrial wastes

Unused industrial wastes in Belarus are stored in departmental stores and enterprises. At the end of 2009 the total volume of wastes at storages was 911600 tons. The largest volumes of wastes are characteristic for RUE «Production Association «Belaruskali» (876947 ths tons) *(Table 9.1)*, and phospho-gypsum (19614.3 tons) and hydrolytic lignin (4267.5 tons) *(Figure 9.8)*.

Unused industrial wastes (3-4 classes of hazard and non-hazard) are mainly disposed at landfills of municipal solid wastes. This is characteristic for cities where there is a lack of capacities or there are not specialized facilities for storing wastes.

In 2009 compared with 2005 the volume of wastes at storage facilities increased from 817400 to 911600 tons or 11.5%. The annual waste accumulation in the considered period ranged from 13300 to 29200 tons. The amount of wastes in the salt dumps of RUE «Belaruskali» in 2005-2009 increased annually in average 19222.4 ths t, and the total amount of halite slimes clay-salt – to 2584.3 ths tons.

The weight of finally disposed industrial wastes in the total volume of wastes during 2005-2009 ranged from 48.8 to 72.9%, in average 66.5%. For halite wastes and halite slimes clay-salt this figure was even higher – from 92.8 to 97.0% in average 95.6%.

Table 9.1

Amount of halite wastes at salt dumps and sludge depository of RUE «Belaruskali» in 2005-2009 (details at end of year), ths t

Year	Total amount of wastes in the salt dumps	Total amount of halite wastes and halite slimes clay-salt
2005	703 383,6	83 536,8
2006	724 216,7	86 335,2
2007	747 885,9	89 444,8
2008	771 988,9	92 460,2
2009	783 073,2	93 873,8

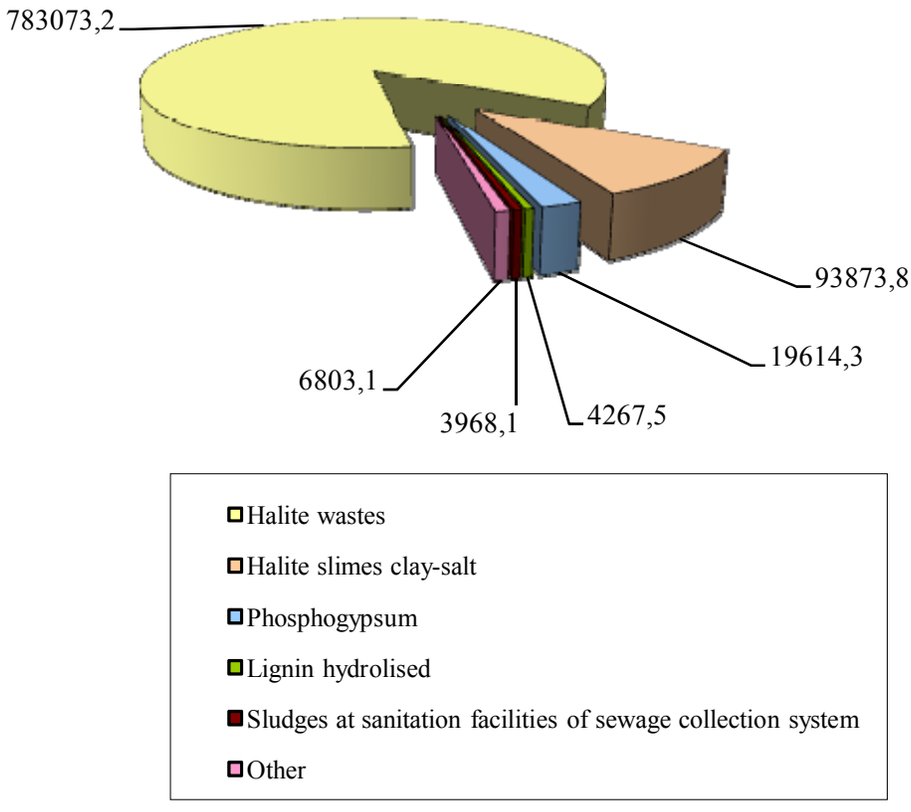


Figure 9.8 – The volume of accumulated wastes in the enterprises of Belarus (The end of 2009), ths t

Municipal solid wastes

Municipal wastes are disposed at landfills of municipal solid wastes (about 90,4%) and at mini-landfills. The amount of disposed wastes at landfills during 2007-2009 is given in *Table 9.2.* As the table shows, the volume of MSW disposed at landfills in 2009 increased compared with the two previous years in 1,2 times mainly due to consumption waste.

Totally in Belarus there are 164 landfills of MSW serving regional and district centers and large urban settlements. Each

Table 9.2

The volume of municipal solid waste disposed at landfills of MSW and the mini-landfill in 2007-2009 ths m^3/ths t

Year	Municipal solid waste		
	Total	including:	
		consumption wastes	industrial wastes, similar to vital life wastes
2007	12 383	9428	2955
2008	13 584	10 342	3242
2009	16 739	11 772	4967

district has one, rarely 2-3 landfills. There is centralized export of municipal wastes in all settlements for which were created 3710 mini-landfills.

The total area of land for landfills of MSW is about 900 hectares, more than 50% of which is full with wastes. Mini-landfills have about 3 hectares of land.

Thus, the analysis of final waste disposal in Belarus in 2005-2009 led to the following conclusions:

– In 2009 compared with 2005 the volume of wastes at storage facilities increased from 817400 to 911600 tons or 11.5%; the annual waste accumulation in the considered period ranged from 13300 to 29200 tons;

– The amount of wastes in the salt dumps of RUE «Belaruskali» in 2005-2009 increased annually in average 19222.4 thousand tons, and the total amount of halite slimes clay-salt – to 2584.3 thousand tons;

– The weight of finally disposed industrial wastes in the total volume of wastes during 2005-2009 ranged from 48.8 to 72.9%, in average 66.5%. For halite wastes and halite slimes clay-salt this figure was even higher – from 92.8 to 97.0% in average 95.6%;

– The volume of MSW disposed at landfills in 2009 increased compared with the two previous years in 1,2 times mainly due to consumption waste.

10. Radiation situation

Radioactive contamination of the environment is the most serious environmental and socio-economic problem.

The monitoring of the environment organized in Belarus after the Chernobyl disaster allows to assess regularly the radiation situation in areas affected by radioactive contamination and to predict the change of radioactive-ecological condition of environment in the future for the purpose of working out the recommendations for administrative decisions.

As on January 1, 2009 the area of pollution in Belarus with cesium-137 with level above 37 kBq/m^2 (1 Ci/km^2) is 41,11 ths km^2, or 19,75 % of the territory *(Table 10.1)*.

Pollution of atmospheric air

Key indicators to assess the contamination of atmospheric air are **the dose of gamma radiation (MD)** and **total beta activity** of natural atmospheric precipitation.

Nowadays 55 dosimetry positions operate in the country with daily MD level measures, at 27 positions the precipitations from the atmospheric boundary layer are controlled. At 21 dosimetry positions the total beta activity tests are taken daily, 6 stations operate in standby mode (tests are taken once in 10 days).

In seven cities – Braslav, Gomel, Minsk, Mogilev, Mozyr, Pinsk and Mstislavl – the tests of radioactive aerosols in the atmospheric surface layer using filter-plants are taken. In Mogilev and Minsk the tests are taken in a standby mode (once in 10 days), at other locations in the zones of influence of nuclear power plants of neighboring states the tests are taken daily.

In samples of radioactive aerosols total beta activity and content of short-lived radionuclides are measured daily, particularly iodine-131. The isotopic composition of gamma-emitting radionuclides is analyzed monthly in the monthly samples of radioactive aerosols, as well as in monthly samples of atmospheric precipitation, which are grouped by territories.

Table 10.1

The areas polluted with cesium-137 after the Chernobyl disaster as on January 1, 2009

Region	Polluted areas, total		Including the level of pollution on the territory, ths km^2			
	ths km^2	% from total area	1–5 Ci/km^2	5–15 Ci/km^2	15–40 Ci/km^2	40 end more Ci/km^2
Brest	3.55	10.82	3.38	0.17	–	–
Vitebsk	0.02	0.04	0.02	–	–	–
Gomel	25.91	64.13	17.13	5.61	1.69	1.48
Grodno	1.35	5.40	1.35	<0.01	–	–
Minsk	1.44	3.53	1.44	<0.01	–	–
Mogilev	8.84	30.48	5.86	1.80	0.81	0.37
Republic of Belarus	41.11	19.75	29.18	7.58	2.50	1.85

All information about the levels of MD, the value of total beta-activity and content of gamma-emitting radionuclides in the atmospheric air tests is recorded into the automated data bank.

Analysis of the data for the period 2005-2009 showed that the levels of MD, the radioactivity of natural precipitation and aerosols in the air on the territory of Belarus corresponded to the established long-term values. The radiation situation in the country remains stable.

The levels of MD which exceed the pre-accident values are recorded in the cities located in the zones of radioactive contamination – Bragin, Narovlia, Slavgorod, Khoiniki, Chechersk *(Table 10.2).* During 2005-2009 in regional cities the average level of MD ranged from 0.10 to 0.13 μSv/h.

In other controlled cities MD did not exceed the level of natural gamma-ray background (up to 0.20 μSv/h).

Table 10.3 shows the annual average total beta activity tests of radioactive precipitation from the atmosphere for some of the cities of Mogilev and Gomel regions.

The largest monthly levels of total beta activity are recorded in the cities of Mogilev and Gomel regions (Mogilev, Narovlia, Slavgorod and Kostiukovichi).

Table 10.4 shows the average values of total beta activity and the content of cesium-137 in the radioactive aerosols of the atmospheric boundary layer tests in 2006-2009.

The results of the gamma-spectrometric analysis in 2005-2009 in the aerosol tests

Table 10.2

Maximum values of MD in some cities in Belarus over the period 2005 – 2009, μSv/h

City	2005	2006	2007	2008	2009*
Bragin	0.82	0.64	0.67	0.70	0.60
Narovlia	0.70	0.64	0.59	0.58	0.52
Slavgorod	0.26	0.24	0.25	0.24	0.22
Hoiniki	0.29	0.27	0.24	0.26	0.24
Chechersk	0.30	0.26	0.25	0.25	0.26

* Presents the average values.

Table 10.3

The average value of total beta activity of samples of radioactive precipitation from the atmosphere in some cities in Belarus over the period 2005 – 2009, Bq/m² day

City	2005	2006	2007	2008	2009
Mogilev	1.30	1.20	1.10	1.30	1.49
Narovlia	0.60	0.70	0.60	0.70	0.69
Hoiniki	0.50	0.60	0.60	0.70	0.72
Bragin	0.40	0.60	0.60	0.60	0.65
Chechersk	0.60	0.50	0.50	0.60	0.59
Vasilevichy	0.50	0.50	0.50	0.60	0.57
Mozyr	0.40	0.40	0.60	0.50	0.48

Table 10.4

The average values of total beta activity (Σ β) and cesium-137 (^{137}Cs) in radioactive aerosols of the atmospheric boundary layer tests in 2006-2009

Year	Mozyr		Braslau		Gomel		Minsk		Mogilev		Mstislavl		Pinsk	
	$1 \cdot 10^{-5}$ Bq/m^3													
	Σ β	^{137}Cs	Σ β	^{137}Cs	Σ β	^{137}Cs	Σ β	^{137}Cs	Σ β	^{137}Cs	Σ β	^{137}Cs	Σ β	^{137}Cs
2006	–	–	12.40	0.23	14.80	1.28	15.50	0.74	26.80	1.14	17.50	0.65	14.00	0.66
2007	17.80	2.40	9.30	0.24	11.60	1.19	13.80	1.18	21.90	1.19	14.60	1.01	29.10	1.45
2008	16.80	1.46	9.00	0.20	12.40	0.90	11.70	1.22	24.70	0.98	15.40	0.74	12.50	1.11
2009	15.40	1.46	11.40	0.20	14.30	0.90	17.00	1.22	24.80	0.98	18.20	0.74	13.70	1.11

the following radionuclides were identified: cesium-137, potassium-40, beryllium-7 and lead-210.

Over the period 2005-2009 in radioactive aerosols and atmospheric precipitations tests there were not detected any changes in the behavior of cesium-137 in the air compared to previous years. The activity of natural radionuclides in the atmospheric surface layer corresponds to historical averages.

If control index of total beta activity exceeds protective measures are carried out:

– For radioactive precipitation from the atmosphere – 110 Bq/m^2 day;

– For radioactive aerosols – $3700 \cdot 10^{-5}$ Bq/m^3.

Pollution of surface waters

Key indicators to assess the contamination of surface waters are **the concentration of cesium-137** and **strontium-90**.

Monitoring of radioactive contamination of surface water is held in Belarus since 1987, that allows us to estimate the transfer of radioactive substances through trans-border cross-sections of rivers flowing through Belarus, Russia and the Ukraine.

In 2005-2009 monitoring was held on 6 Belarusian rivers flowing through the territories contaminated as the result of the Chernobyl disaster: the Dnieper (Rechitsa), the Pripyat (Mozyr), the Sozh (Gomel), the Iputs (Dobrush), the Besyad (Svetilovichi), the Lower Braginka (Gden) and lake Drisvyaty (Drisvyaty).

Every month on the main rivers the tests of controlled water were taken with simultaneous measurement of costs. On the river Nizhney Braginka the test was taken 4 times a year. The water samples were analyzed for cesium-137 and strontium-90. The relative error in measuring low activity levels of cesium-137 in surface waters was 25-30%.

The analysis of radioactive contamination of the rivers in 2005-2009 showed that the radiation situation in the controlled water bodies remained stable *(Figure 10.1-10.2)*. Through processes of water transport, sedimentation of suspensions at the bottom of ponds and natural decay of the concentration of cesium-137 and strontium-90 in medium and large rivers dropped considerably. However, for most controlled rivers their activity is higher than the pre-accident levels.

During last 5 years annual average concentrations of cesium-137 and strontium-90 in the water of the rivers within Gomel region were significantly lower sanitary standards stipulated by Republican permissible levels for drinking water (RDU-99 for Cesium-137 – 10 Bq/L and strontium-90 – 0.37 Bq/L).

A higher concentration of radionuclides

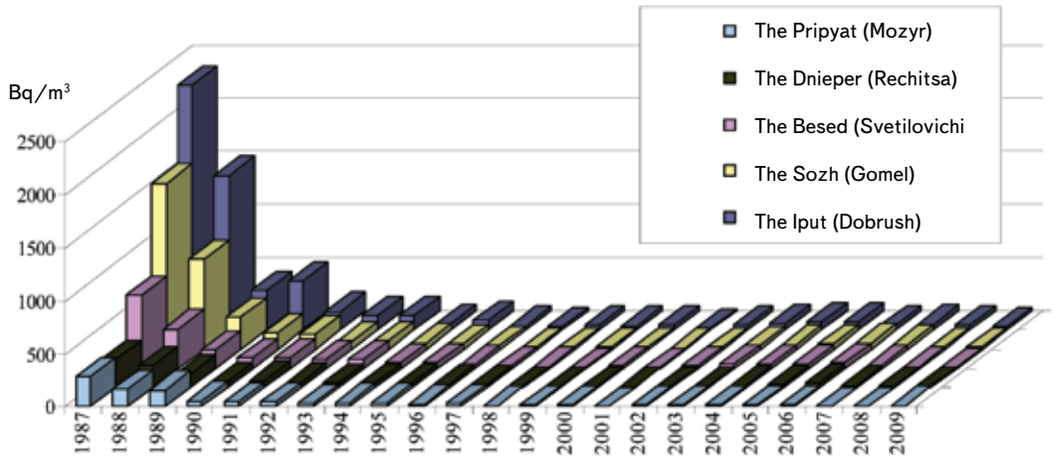


Figure 10.1 – Change in annual average concentrations of cesium-137 in the waters of rivers of Belarus during 1987-2009

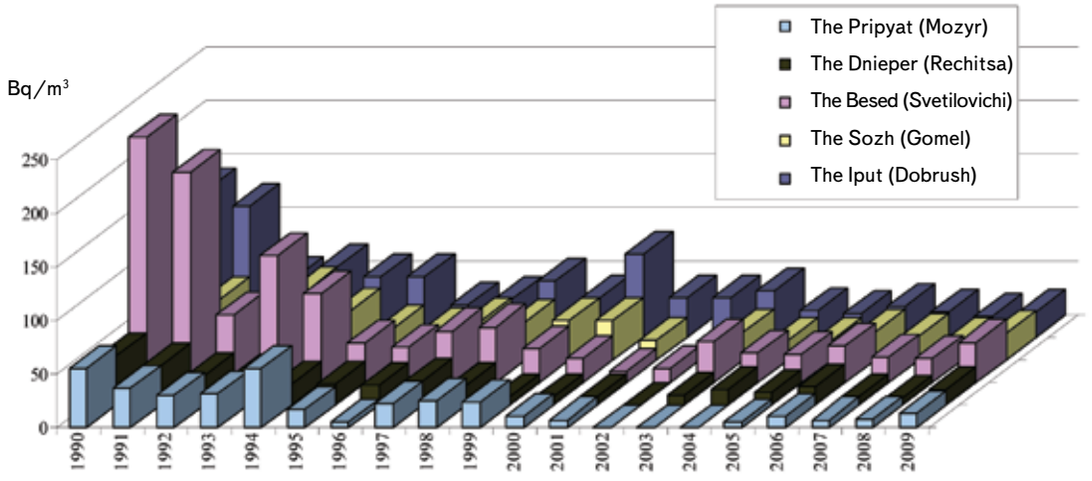


Figure 10.2 – Change in annual average concentrations of strontium-90 in the waters of rivers of Belarus during 1987-2009

is observed during the flood waters of rivers, watersheds of which are wholly or partially located in the 30-km Chernobyl zone. Thus, the increase in the activity of strontium-90 in the water of the Lower Braginka (Gden) is noted during spring and autumn floods, as the result of flooding there is a flush of this radionuclide. During period 2005-2009 exceeded hygienic standards of the RDU-99 for strontium-90 are recorded for 2-15 times. Despite the fact that cesium-137 in approximately 7-10 times higher compared with its content in water and other controlled rivers the exceedance of RDU is not observed.

Outside the zone of the Chernobyl nuclear power plant the radiation situation remains stable. However, water bodies, which watersheds are wholly or partially located in the zone of the Chernobyl nuclear power plant, require constant supervision.

The assessment of the transfer of contamination through trans-border cross-sections is carried out on the rivers the Pripyat, the Iputs and the Besyad. Beginning in 1991 there is a tendency of decreasing in removal of cesium-137 through the cross-sections of the Belarusian rivers flowing on the territories of Russia and Belarus. The main factor reducing the amount of cesium-137 in rivers is to reduce its metabolic forms in the soils of watersheds, as well as natural decay. If during first few years after the disaster significant

cross-border transfer was marked by rivers the Iputs and the Besyad, nowadays it is insignificant.

As shown in *Figure 10.3* the trans-border transfer of cesium-137 by the Pripyat river through the cross-section «the border Belarus-Ukraine» significantly decreased. Total removal of radionuclide by the river for the period 1987-2008 was 36.49 TBq.

In general, the total removal of cesium-137 by the Pripyat river through the cross-section «the border Belarus-Ukraine» for the period 1987-2008 was about 0.75% from its storages in the Chernobyl exclusion zone within Belarus.

In contrast to the removal of cesium-137, strontium-90 removal by the rivers is largely dependent on the dryness of the year, as its flush with the catchment area is in soluble form. Despite the fact that the average content of strontium-90 has a tendency to decrease, from time to time the rise of its concentrations in river waters is observed, as the result of flushing by melt and rain waters from the catchment area. Thus, the total removal of strontium-90 by a river for the period 1987-2008 was 67.63 TBq (the calculation of the removal for 1986-1999 was carried out according to UkrNIGMI, for 2000-2008 – according to RCRCM). The dynamics of average annual removal of

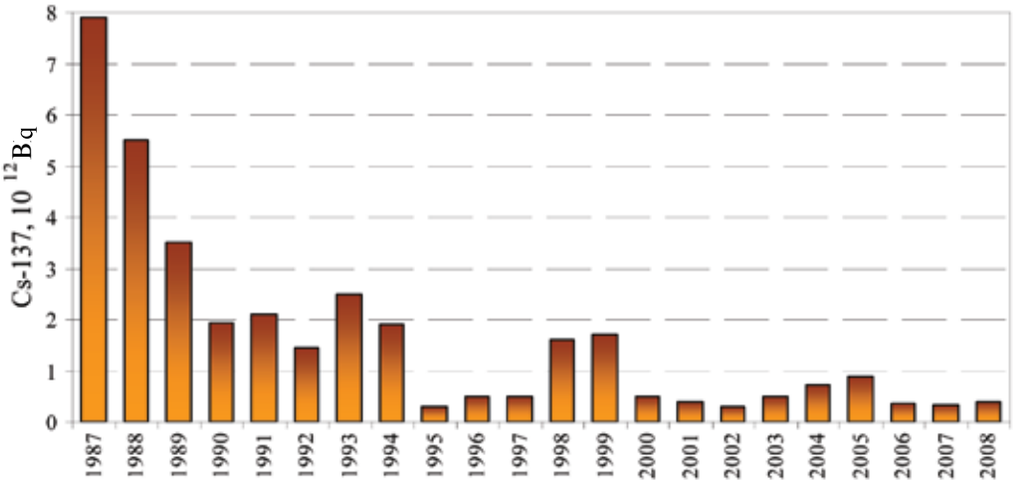


Figure 10.3 – The dynamics of the average annual removal of cesium-137 by the Pripyat river through the cross-section «the border Belarus-Ukraine» in the period 1987-2008

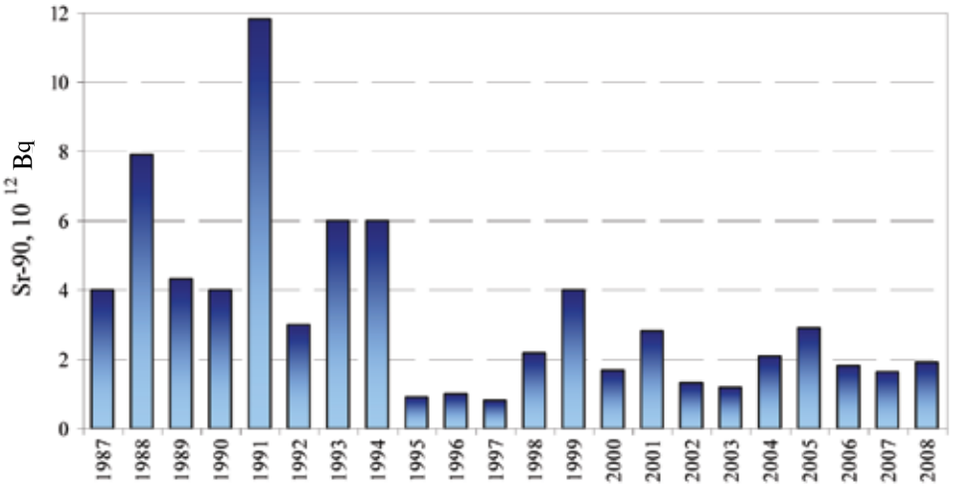


Figure 10.4 – The dynamics of the average annual removal of strontium-90 by the Pripyat river through the cross-section «the border Belarus-Ukraine» in the period 1987-2008

strontium-90 by a river during this period is shown in *Figure 10.4.*

The rivers the Iputs and the Besyad are the most important tributaries of the Sozh which flow on the Belarus-Bryansk «cesium spot» with the levels of contamination with cesium-137 from 37.0 to 2220.0 kBq/m^2. Constant monitoring of the radionuclide content in water and sediments of these rivers is carried out on cross-sections in Dobrush (the Iput river) and Svetilovichi village (the Besyad river).

During the first years after the disaster there was a significant trans-border transfer of cesium-137 with the waters of the river Iput (Dobrush) and the river the Besyad (Svetilovichi village), nowadays it is insignificant. The main factor reducing the concentration of cesium-137 in water is a significant decrease in washout of the radionuclide from the surface catchment area associated with a decrease in the number of its metabolic forms in soils, as well as its natural decay.

As shown in *Figure 10.5* during the first two years after the Chernobyl disaster there was a significant removal of cesium-137 through the wing of Dobrush town. In the following years it gradually declined and now its value depends on the hydrological regime of the river.

Total removal of cesium-137 by trans-boundary rivers (Russia-Belarus) in all cases is about 1% of its common stock in the affected watersheds.

Contamination of agricultural land

The main indicator for assessing radioactive contamination of agricultural soils is the density of land contamination with cesium-137 and strontium-90. The importance of these indicators is due to the fact that in the case of Belarus, about 70% of the collective dose is formed due to radionuclide intake with food. The problem of reducing radiation dose to the population was most acute during the first ten years after the disaster, but it remains relevant in the present. The main criterion of the effectiveness of protective measures is the reduction of the intake of radionuclides from the soil into the food chain and getting products containing radionuclides within acceptable levels which are periodically reconsidered. During the post-accident period in Belarus the transition of cesium-137 from soil to agricultural products declined more than an order of magnitude. According to expert assessments about half of this decline is due to the countermeasures, the other half is due to the natural factors of decay and fixation by soil cesium radionuclides.

Nowadays the radiation situation on the agricultural lands of Belarus has improved considerably. There was a disintegration of

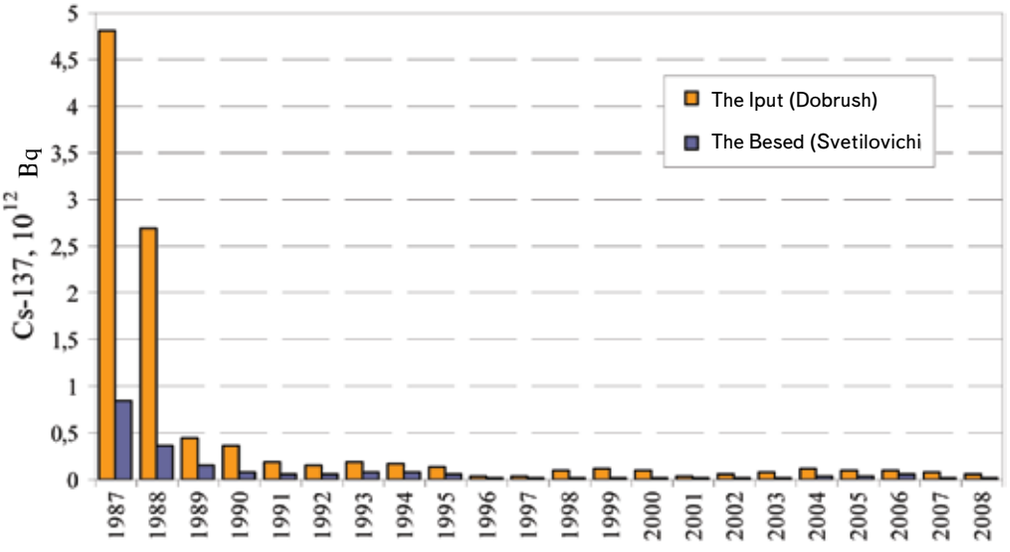


Figure10.5 – The dinamics of removal of cesium-137 by the waters the Iput river (Dobrush) and the river Besyad (Svetilovichi) during 1987–2008

short-lived radionuclides. The concentration of long-lived radionuclides cesium-137 and strontium-90 in the soil decreased by about 40% only because of natural decay. A gradual decrease in the area of contaminated land is observed with controlled minimum density of cesium-137 with more than 37 kBq/m^2 and strontium-90 with more than 5.5 kBq/m^2 due to the natural decay of radionuclides and the transfer of some land in the category of non-contaminated *(Figure 10.6).*

Over the past 18 years into the category of non-contaminated 424 hectares of land were transferred previously contaminated by cesium-137, and the area contaminated with strontium-90 decreased by 295 ha. Agricultural production as on 01.01.2010 is on 1014.2 thousand hectares of land contaminated by ^{137}Cs with a density of 37-1480 kBq/m^2 *(Table 10.5).*

In cultivated sod-podzol sandy loam soil about 90% of the gross margin of cesium-137 and 75% of strontium-90 is in the plow layer 0-25 cm. The biggest transition of radionuclides from soil to vegetation is noted on sandy and peat soils in natural conditions, the lowest – on the cultivated lands. In general after 24 years after the disaster the principal amount of radionuclides cesium-137 and strontium-90 is in the root zone and is included in the biological cycle.

On uncultivated lands the principal amount of cesium-137 (70-85% of its gross content) and strontium-90 (58-61%) is concentrated in the upper 0-5 cm root zone.

The main arrays of agricultural land contaminated with cesium-137 are concentrated in Gomel (47,3% of total area) and Mogilev (23.6%) regions. In Brest, Grodno and Minsk regions the proportion of contaminated land is small and is respectively 6,1%, 2,6 and 3,6%.

Contamination of strontium-90 has a local character. Radionuclide contamination of soil data with a density of more than 6 kBq/m^2 is detected on 10% of the total land area. Maximum levels of strontium-90 in the soil are typical for a 30-km zone around Chernobyl and reach 1798 kBq/m^2 in Khoiniki district of Gomel region.

Lands contaminated with strontium-90 are located within the areas contaminated by cesium-137 that makes agricultural production very difficult. *Table 10.6* shows the distribution of agricultural land contaminated with strontium-90 with a density of more than 5.6 kBq/m^2 (0,15 Ci/km^2).

From the total area of land contaminated with strontium-90, 331.0 hectares of agricultural land including 190.8 thousand hectares of arable land and perennial plantations are concentrated in Gomel region. Here, the

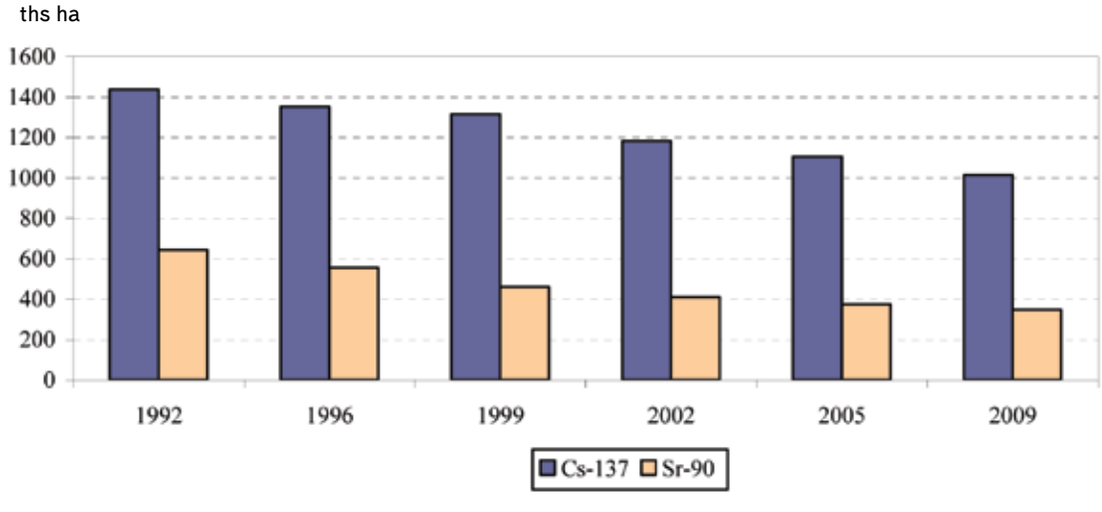


Figure 10.6 – The dynamics of the area used by the contaminated land in Belarus for the period 1992-2009 (Cesium-137 with a density> 37 kBq/m^2, strontium-90> 5.5 kBq/m^2)

Table 10.5

The density of contamination of agricultural land in Belarus by Cesium-137 in 2007-2009*

Year	Area, ths ha	Total contaminated >37 kBq/m² (>1,0 Ci/km²)		In % of contaminated zones, kBq/m² (Ci/km²)		
		ths ha	%	37–184 (1.0–4.9)	185–554 (5.0–14.9)	555–1476 (15.0–39.9)
Agricultural land						
2007	7584.0	1026.6	13.5	77.0	20.0	3.0
2008	7634.8	1018.8	13.3	77.3	20.1	2.6
2009	7634.8	1014.2	13.3	77.8	19.5	2.7
Arable						
2007	4657.1	596.6	13.0	76.5	21.0	2.5
2008	4696.1	596.6	12.6	77.0	21.0	2.0
2009	4696.1	595.6	12.6	77.3	20.2	2.5
Hayfield and pasture						
2007	2926.70	429.95	14.70	77.50	19.50	3.00
2008	2938.7	425.0	14.5	78.0	19.0	3.0
2009	2938.7	418.6	14.2	78.5	18.6	2.9

* According to the Ministry of Agriculture of the Republic of Belarus.

share of polluted arable and grassland soils is 27,2% of the total area used by agricultural land. In Mogilev region the share of arable and grassland soils contaminated with strontium-90 is much lower – respectively 1,2 and 1,7%.

Particularly problematic are 347.9 thousand ha of agricultural land with a density of strontium-90 0,15-3,0 Ci/km² simultaneously contaminated with cesium-137 with a density of 5-40 Ci/km².

Soil pollution with plutonium isotopes with a level of more than 0.37 kBq/m² was found in 2% of Belarus. These areas are mainly in Gomel region and Cherikov district of Mogilev region. The content of plutonium in the soil more than 3,7 kBq/m² is characteristic only for the 30-km zone. Polesye State Radiation Ecological Reserve (PSRER) was created on the territory of 2.162 thousand km² of Belarusian sector 30-km zone around Chernobyl and its adjacent lands where the population was resettled.

In 2007-2008 a detailed re-examination of radiological lands of PSRER was carried out in step of 1 km and the maps of pollution on a scale of 1:200 000 were created.

The main part of agricultural lands taken out of use was included in the exclusion zone and is now the part of PSRER. Main exclusion zone cannot be returned to agricultural use even in the distant future, due to the high density of contamination of many long-lived radionuclides – cesium-137, strontium-90 and plutonium-238, 239, 240, 241, americium-241. The part of lands adjacent to evict settlements with a lower density of contamination, was included in the evacuation zone.

Measures for the rehabilitation of contaminated areas

Measures to ensure the country's ecological security in connection with the radioactive contamination of the territory are provided by

Table 10.6

The density of contamination of agricultural lands in Belarus by Strontium-90 in 2007-2009*

Year	Area, ths ha	Total contaminated >5,6 kBq/m² (>0,15 Ci/km²)		In % of contaminated zones, kBq/m² (Ci/km²)		
		ths ha	%	5.6–11.0 (0.15–0.30)	11.1–37.0 (0.31–1.00)	37.1–107.0 (1.01–2.99)
Agricultural land						
2007	7584.0	343.7	4.5	58.0	35.0	7.0
2008	7634.8	347.1	4.6	57.0	36.0	7.0
2009	7634.8	347.9	4.6	56.8	36.4	6.8
Arable						
2007	4601.5	194.6	4.2	58.0	34.0	8.0
2008	4696.1	198.5	4.2	58.0	34.0	8.0
2009	4696.1	199.6	4.2	58.9	34.1	7.0
Hayfield and pasture						
2007	2926.7	149.1	5.1	57.0	37.0	6.0
2008	2938.7	148.6	5.1	55.0	38.5	6.5
2009	2938.7	148.3	5.0	54.1	39.4	6.4

* According to the Ministry of Agriculture of the Republic of Belarus.

the State program of overcoming the effects of the Chernobyl disaster during 2001-2005 and for the period up to 2010. It includes the following main activities.

The first direction refers to decontamination area, recycling and disposal of radioactive waste. Decontamination of social objects – kindergartens, schools, health institutions was scheduled to finish in 2005. By 2010 it was expected to complete dumping yards and industrial buildings.

The second direction is related to farming in contaminated areas. Protective measures in agriculture are the set of institutional, agricultural, agro-chemical and veterinary measures aimed at obtaining food and raw materials that meet sanitary and hygienic standards for the content of radionuclides, radiation safety of agricultural work.

The third direction is associated with protective measures in forestry, contributes to the ecological role of forests as a biogeochemical barrier for the removal of radionuclides beyond the contaminated area, prevents the loss of forests from fires, pests and diseases, radiation safety of workers in the forest, local population and products consumers.

The fourth direction includes the measures for the rehabilitation of contaminated territories and the contents of exclusion, includes control over the use of evacuated areas, compliance with fire safety, protection of property, historical monuments, culture and architecture, places of military graves and cemeteries, works to transfer radioactive land in agricultural use.

11. Environmental management

Legal regulation, planning and funding of Environment

State environmental policy defines the national environmental legislation. It is intended to provide enshrined in the Constitution of the Republic of Belarus the right of citizens to a healthy environment.

To date, the country formed a sufficiently developed legal framework in the field of environmental protection and rational use of natural resources. Leading position in it is the Law «On Environmental Protection» (1992, amended 2002), which has universal significance. Other laws and codes are more narrow focus and regulate, respectively, the mechanisms of environmental protection, rational use and protection of individual natural resources, the solution of individual problems and other issues.

Prior to the 1990 environmental management of natural resources in Belarus is carried out almost exclusively on the use of administrative methods. In 1991, after the adoption of the Law on Tax on Natural Resources, the economic mechanism was used in this area. Over time, as the development of market relations in the country, its scope is expanding.

Together with the laws governing environmental protection and rational use of natural resources in Belarus are worked also a number of special laws aimed at ensuring the ecological safety of population. They are related to radiation, sanitary, industrial safety, protection of population and territories from emergency situations of natural and manmade.

Environmental legislation of Belarus is developing on several fronts. They are

associated with the updating of existing and new legislation, as well as the introduction of environmental standards in legislation relating to economic and other spheres of activity.

Over the last five years the country adopted a series of new laws on environmental protection and rational use of natural resources. Thus, in 2006, it joined the Law of the Republic of Belarus «On hydrometeorological activity», in 2007 – Law «On Wildlife» and «On treatment of Waste Management», in 2008 – Law on Air Protection and the Code of the Republic of Belarus on the interior and on the ground, in 2009 – Law «On State Ecological Expertise».

Significant changes and additions were made to the Law of the Republic of Belarus «On Environmental Protection». In 2007

it introduced provisions that reflect the mechanisms for ensuring public access to environmental information and participation in environmental decision-making. In addition, for the first time legally enshrined the concept of «harm caused to the environment» and «environmental damage» determine the order size, how and when compensation for the harm caused to the environment.

The effectiveness in individual organizations, which is the source of impacts on the environment must ensure for effective environmental management in the whole country. With this purpose in Belarus conducted environmental certification of environmental management systems of organizations in t.ch using the international standard ISO 14001.

The number of organizations, where the certification of environmental management systems of organizations meets the requirements of the international standard reached 219 on the beginning of 2010. In this case, the rate of this type of activity increases with time. If during the period 2001-2005, undergo an annual certification of an average of 22 organizations in the period 2006-2009 — 33 organizations or 1,5 times more.

For successful implementation of environmental policies, a priority to address the most important environmental problems, the optimal expenditure for these purposes in the country is planning for environmental protection and rational use of natural resources. Nowadays the basic document for long-term conservation planning — Main policies of Environmental Protection of Belarus until 2025 is worked out. It covers the most important environmental issues to ensure implementation of environmental interests of the individual, society and state.

The strategic goal of environmental protection in the long term to 2025 determined to achieve new, higher its quality, providing an environmentally friendly living conditions, promoting solutions to global and regional environmental issues, sustainable social and economic development of the Republic of Belarus.

Achieving this goal should be achieved by reducing harmful environmental impacts and restore natural systems, radical improvements in waste management sustainable territorial development, conservation of biological and landscape diversity, minimize the impact on climate and adaptation to changes.

Strategic issues in the field of environmental protection and rational use of natural resources linked with social and economic development provides a national strategy for sustainable socio-economic development, which is being developed for 15 years. To address medium-term objectives in the environmental field developed and implemented five-year National Action Plan on Rational Use of Natural Resources and Environment, and Environmental Health.

Territorial environmental planning is carried out within the framework of territorial complex schemes of environmental protection. In addition, environmental issues are also included in the developed integrated circuits of the territorial organization of administrative units at various levels, as well as schemes of land management areas.

To address some of the most significant problems the country faces environmental safety, environmental protection and rational utilization of natural resources are taken special purpose programs. These include the State Program for overcoming the consequences of the Chernobyl disaster, the State Program on Water and Sanitation «Clean Water», National Program for management of municipal waste management schemes placement of specially protected natural areas. In 2005-2008 the state implemented a program to improve the environmental situation in Naroch Lake.

Scientific support of environmental policy is part of the state of scientific and technical

programs. Crucial among them is the State Scientific-Technical Program «Ecological Safety».

Implementation of programs and activities on environmental protection and rational use of natural resources should be based on adequate funding. His sources, according to national environmental legislation, are the republican and local budgets, state budget funds of nature protection, legal persons and individual entrepreneurs, citizens, bank loans, foreign investments and other non-budget sources.

In the last five years, annual spending on environmental protection has changed in the direction of increasing or decreasing *(Figure 11.1)*. The difference between the maximum (2005) and minimum (2006), their value was 25%. Characteristically, during the crisis of 2009 funding of environment is not only not decreased but even increased in comparison with the previous three years.

Relative measure of the cost of environmental protection, marked proportion of GDP, considered a five-year time period had a maximum value in 2005 – 1,5% In subsequent years it decreased and stabilized at the level of 1,1-1,2%.

As the costs of environmental protection are of special importance investments in fixed assets, which characterize the renewal of fixed assets of environmental and material prerequisites for the appointment of innovative development of this sector. Over the last five years the share of investment in the total value of expenditure on environmental protection amounted to an average of 30%. The maximum value of its accounts for 2009 – 37%. Preservation of positive dynamics of indicators of investment in fixed capital nature conservation has a positive meaning, since updating the material base of environmental protection is an urgent task for Belarus.

In the cost structure of the components of the environment is dominated by the cost of protection and rational utilization of water resources. Over the last five years, they accounted for more than half of the total value of environmental financing *(Figure 11.2).* The fifth of the cost falls on air protection, the sixth – the prevention of pollution of waste production.

In general, the current funding environment reduces specific emissions and discharges of pollutants and a relatively stable environment in the camp at high rates of economic growth.

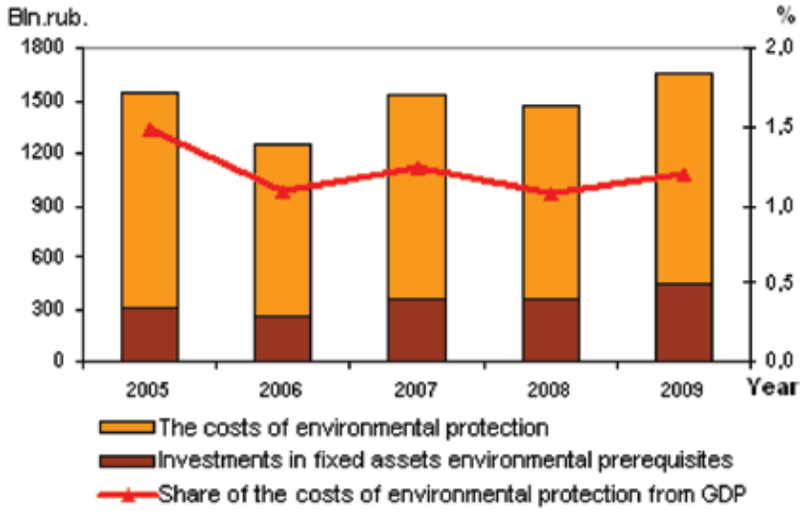


Figure 11.1 – Dynamics of the costs of environmental protection of Belarus, their share of GDP (%) and environmental investments in 2005-2009 (Prices 2009).

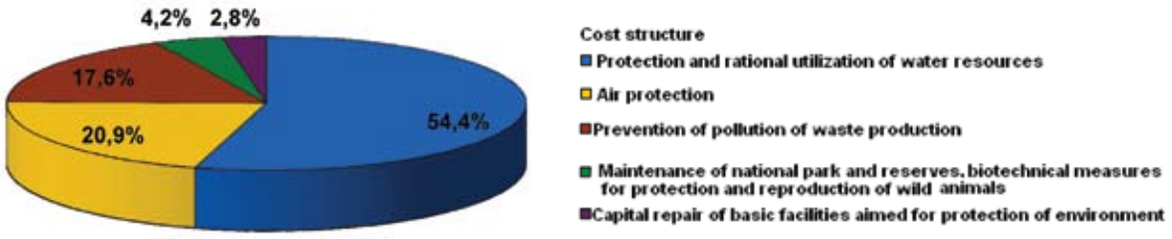


Figure 11.2 – The cost structure for environmental protection of Belarus for 2005-2009

The economic mechanism of nature and the environment

Introduction of economic instruments in environmental management in Belarus is at the beginning of 1990. It includes the planning and financing of environmental activities; concessional lending taxing and other payments for the use of natural resources, emissions (discharges) of pollutants into the environment, compensation in the prescribed manner of harm caused to the environment *(Figure 11.3)*.

An economic incentive of environmental protection is based on:

– The establishment of a separate categories of businesses and individuals tax and other benefits in the implementation of low-emission, energy-saving technologies, special equipment, reducing harmful impact on the environment by using waste as secondary raw materials and implementing other environmental activities;

– Accelerated depreciation of equipment and other facilities designed to protect and improve the environment.

Initially, the system of economic regulation of natural resources was of rather a fiscal, than stimulatory, as environmental payments had no real impact on the technical and financial status of polluters. It subsequently improved and its effectiveness increased, developed principles of payment for environmental management and compensation for harm caused to the environment, strengthening the role of environmental tax. Currently the system is largely aimed at encouraging business entities to reduce environmental impacts by reducing

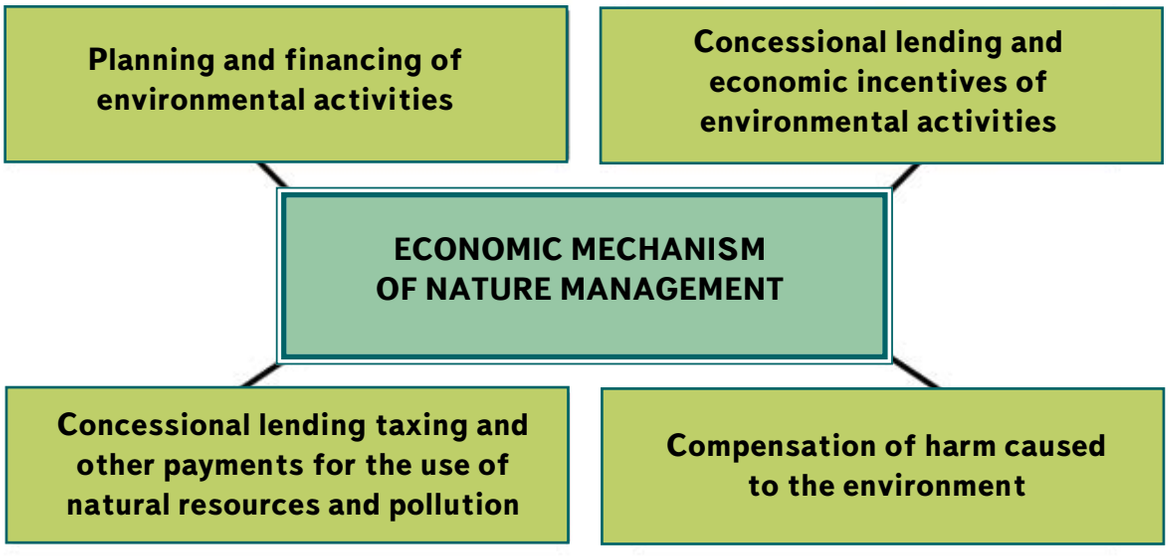


Figure 11.3 – The economic mechanism of nature management

energy and resource consumption, preventive measures to ensure environmental safety.

Part of the economic mechanism of nature and the environment – the ecological tax consists of the following types of payments:

– for the use (retrieval, extraction) of natural resources, pollutant emissions into the air, discharges of wastewater or pollutants into the environment, placing waste;

– for production and (or) import of plastic, glass containers, container-based paper and paperboard and other products, after the loss of consumer properties that generate waste, which have harmful effects on the environment and require the organization of systems of collection, disposal and (or) use as well as the importation of goods packed in plastic, glass bottles and containers on the basis of paper and paperboard;

– for the import and manufacture of products containing more than 50% of volatile organic compounds;

– for import into the territory of the Republic of Belarus of ozone-depleting substances.

To enhance the catalytic role of the environmental tax rate is adjusted periodically to. There is also a simplification of the tax system. With this purpose in 2008 the list of taxable environmental tax of pollutants released into the air is significantly (11 times) reduced. Simultaneously the tax rate for emissions of those substances has increased.

In 2009, legislation has adopted to improve the business aimed at reducing the number of eco-tax payers. From the environmental tax payers are excluded business entities whose annual volume of non-hazardous wastes such as waste generated during the life activities is 50 tons or less. Amounts of water used for technological purposes in the manufacture of alcohol, soft drinks and beer also excluded from the objects of taxation.

The country established a system of privileges for the categories of environmental tax payers engaged in environmental activities. These activities should be aimed at reducing emissions of pollutants into the air (construction and reconstruction of gas purification equipment, the creation of automated systems for emissions control), discharges of wastewater (construction and renovation of facilities for sewage treatment) and the volume of waste (construction and reconstruction of the placement and removal of waste). Tax incentives also apply to enterprises introducing international environmental standards ISO 14000.

In Belarus environmental tax does not fully compensate for the costs of environmental protection. And over time, there is a decrease in its share of these costs. So, if in 2006 it was 43%, in 2009 – only 30% *(Figure 11.4)*. There is also a decrease in the absolute magnitude of the environmental tax. During the period from 2006 to 2009 it decreased by 6.3%. Its share in the revenue part of the country's budget has decreased from 1,5 to 0,9%, and relative to GDP – from 0.47 to 0.36%.

For funding for natural resource management and environmental protection in the country are state budget environmental funds. Sources for their formation are the taxes, funds received as compensation for environmental damage, fines for pollution and other violations of environmental laws, etc. In recent years, the means of environmental funds are spent to ensure the uninterrupted supply of quality drinking water to the population, the introduction of advanced wastewater treatment technologies, reducing air pollution, the problem of dumping of toxic waste into the commercial production of secondary material resources, increased use of renewable energy sources, improvement of recreation areas and other activities.

Further development of the economic mechanism of nature and the environment involves the development of a system of economic stimulation for the introduction of environmental technologies and equipment

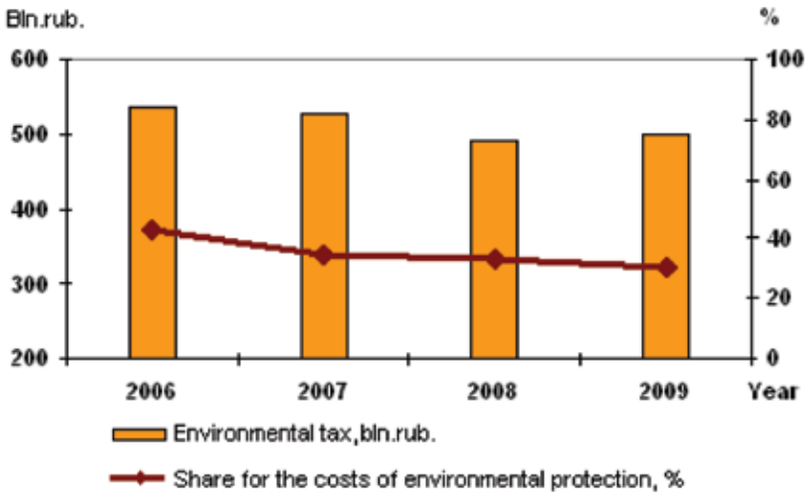


Figure 11.4 – The dynamics of the ecological tax in Belarus for 2006-2009 (at 2009 prices) and its share in the costs of environmental protection

with the use of differentiated credit. A promising direction is to introduce the rating of bank interest, depending on the environmental soundness of a nature. One should observe the principle of «credit neutral», which provides for the imposition of economic sanctions in the form of increased interest for lending to environmentally unsafe companies and their compensation through concessional lending companies successfully address environmental challenges.

The integration of environmental requirements in the privatization of enterprises using part of the proceeds to improve the environmental performance of production is the necessary element of the economic mechanism. Economic instruments are designed to provide the benefits of nature users, implementing effective business with a permanent reduction of environmental impacts. It is required to undertake a shift in priorities from economic instruments of negative motivation (payments for environmental pollution, the compensation of economic damage) in the direction of extension of positive motivation for nature, introducing technologies with minimal impact on the environment.

To improve fiscal management of natural resources requires the orientation of taxation on the following tasks:

– shift the tax burden towards those sectors which do the most damage to the environment;

– tax incentives for investment in environmental protection in energy sector, transport and agriculture;

– taxes on use of pesticides, nitrates, substances that deplete the ozone layer, etc.;

– development trade of rights to carbon dioxide using emissions, sulfur oxides, and water use;

– the inclusion of costs to eliminate the damage to the natural environment of harm in the price of goods or services, production of which caused the damage.

Used in the country an economic mechanism of nature and the environment helps to reduce specific indicators of environmental impacts. The future of its role should be strengthened in order to ensure translation of environmental policy on the principle of preventing environmental problems instead of removing them.

Environmental monitoring

The main objective of environmental monitoring – monitoring her condition and cause harmful effects on the environment to ensure those government agencies and other entities and individuals complete and accurate

information in this area. Achieving this goal ensures the functioning of the National Environment Monitoring System (NEMS), established in 1993.

Ensuring continuous operation of NEMS is one of the main directions of state policy on environmental protection. The country has developed legal and regulatory framework, including regulations governing the operation of NEMS as a whole and individual monitoring of its member.

The organizational structure of NEMS considers the distribution of competencies of national government bodies responsible for organizing and monitoring for each of his mind. As a single coordinating authority defined the Ministry of Natural Resources and Environmental Protection. Ensure the functioning of interagency coordinating council, created by the chief information-analytical center of NEMS and information centers monitoring activities.

NEMS comprises 11 institutional identity, but operate and interact on the general principles of environmental monitoring *(Fig. 11.5)* and is based on an orderly system for collecting, processing, analysis and evaluation of information received by science-based network of more than 3500 monitoring stations included in the National Register of observation NEMS

For a complete and integrated information on the state of the environment and the factors influencing it NEMS interacts with the system of socio-hygienic monitoring system for monitoring and forecasting of emergency situations of natural and man-made.

Surface water monitoring is a system of regular observations over hydrological, hydro chemical and hydro biological indicators of surface water in order to timely identify negative processes, prediction of their development, the prevention of harmful effects and determine the degree of effectiveness activities aimed at the rational use and protection of surface waters.

In samples of surface water is determined up to 90 hydro chemical parameters and ingredients, including such hazardous pollutants as heavy metals and persistent organic pollutants List of observed hydro chemical data on surface water monitoring network complies with international requirements.

Groundwater monitoring is carried out to analyze and evaluate changes in the quality and level of ground water and artesian water in the natural weak damaged conditions. Objects of observation for monitoring groundwater in the country are groundwater and artesian water.

In 2009 observations were carried out at 92 posts from 363 hydrogeological regime observation wells. The quality monitoring of ground water was conducted at 258 wells; for the level regime – by 363 wells. The chemical composition of groundwater was determined for 33 macro-and micro indicators.

Land monitoring – a system of regular observations of the state and change of land under the influence of natural and anthropogenic factors, as well as the changing composition, structure, condition of land resources, land distribution by categories and types of land users

Monitoring of background pollution of soil is carried out on the observational network, consisting of about 100 stations located throughout the country. Observations on the chemical contamination of soils in urban and agricultural lands and in the zone of highways are maintained by 182 points. There are also 12 observation stations for changes in agrochemical properties of soil of agricultural land, 20 observation stations for the reclamation and erosion-prone land.

In the system of **air monitoring** has monitored pollutants in ambient air,

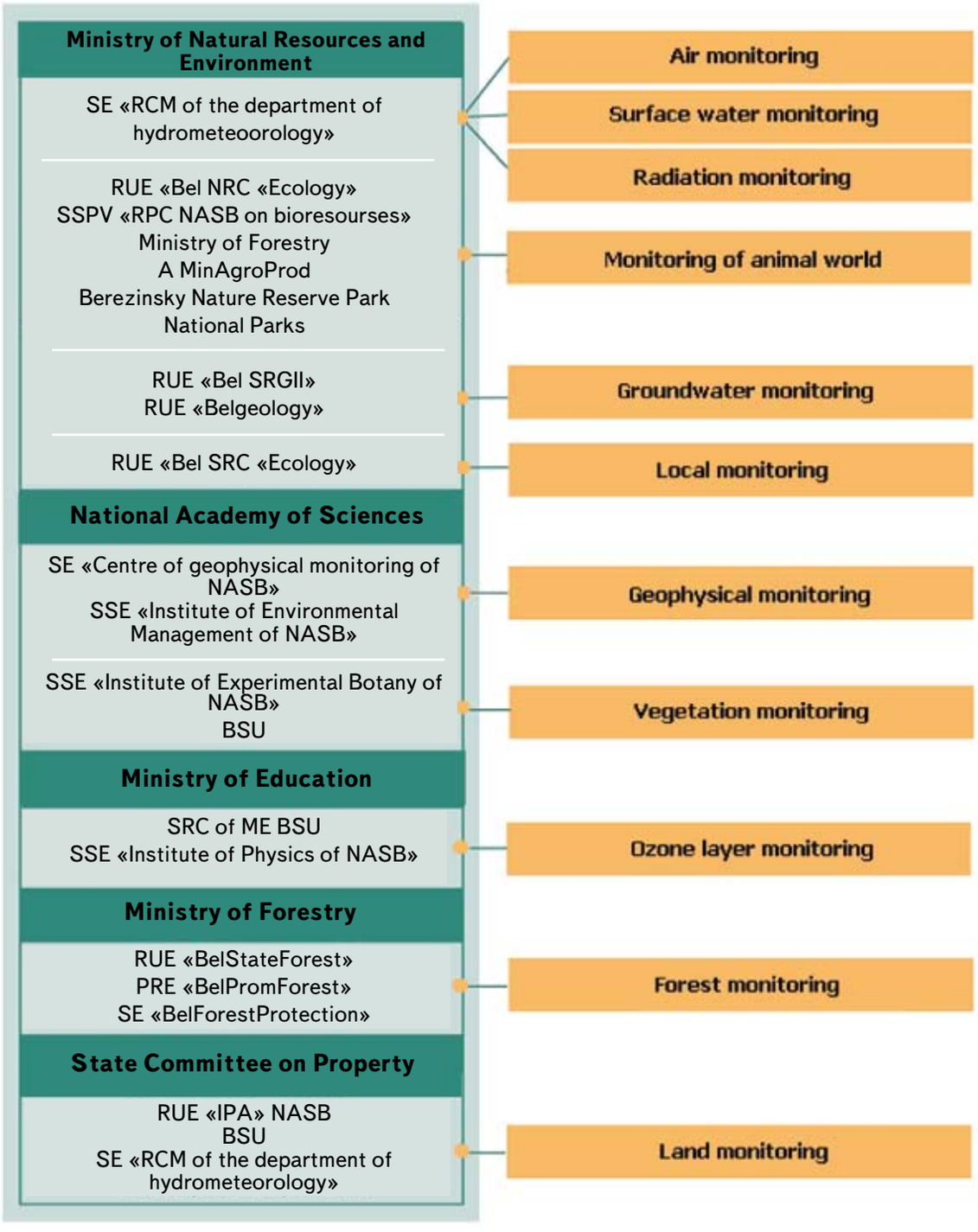


Figure 11.5 – Block diagram of the organization of the National Environmental Monitoring System in Belarus

precipitation and snow cover. Evaluation of long-range atmospheric transport of pollutants is conducted at a specialized cross-border station «Vysokoe» (western boundary of the country). At the station, integrated background monitoring «Berezinsky reserve» the state of air and precipitation was analyzed on program of the Global Service of Atmosphere.

Monitoring of vegetation is a system of observation of the flora of the world and the environment of their habitat, as well as assessment and prediction of their changes

in order to conserve biological diversity, sustainable and efficient use of state resources, flora.

In 2009, the monitoring of fauna conducted in 6 areas:

– monitoring of the meadow and meadow-marsh vegetation (7 key areas);

– monitoring of aquatic vegetation (12 key areas);

– monitoring of protected (Red Book) species of plants and fungi (130 permanent observation points);

– monitoring resource plants (berries and mushrooms) (15 permanent observation points);

– monitoring of protective tree plantations;

– monitoring of green space on land settlements.

As part of **monitoring of forest** monitoring the general condition of forests, including the effect of air pollution (monitoring of forests), as well as state forests under the influence of insect pests and diseases (forest pest monitoring).

Monitoring of fauna conducted in two areas:

– observation of wild animals belonging to hunting, and their habitats;

– observation of wild animals included in the Red Data Book of Belarus and their habitats.

Monitoring of the ozone layer was held in 2009 at the Minsk ozone station of the National Research Center for ozone monitoring BSU. It included regular measurements of total ozone column, surface ozone concentrations and the levels of surface ultraviolet solar radiation.

Geophysical monitoring is conducted annually by 87 points in the following areas:

– seismic monitoring;

– geomagnetic monitoring;

– monitoring the Earth's gravitational field.

As part of the radiation monitoring determined the levels of radioactive contamination of air, surface water and soil in areas affected by radioactive contamination as a result of the Chernobyl disaster.

Local monitoring is carried out to monitor the environment in the vicinity and the impact of sources of harmful impacts on the environment. Within its framework in 2009, carried out surveillance:

– emissions of pollutants into the air (160 companies);

– disposal of wastewater into surface water and surface water quality in the field of abstraction (136 companies);

– the groundwater conditions in areas of influence of the enterprises – sources of pollution (250 objects);

– state land in the zone of influence of the largest sources of pollution (10 objects).

Environmental education

One of the conditions for successful environmental policy is to increase the environmental awareness of the population, the extensive public involvement in decision-making process on environmental issues. This requires the organization of environmental education, public education.

Education and training in the field of environment is carried out in Belarus in 1991 under the national education system as a single and continuous process. It covers all levels of basic education from preschool to postgraduate, including non-school education and training, system training and retraining. At each level it should be given the opportunity to receive the mandatory minimum of knowledge, as well as the possibility of in-

depth and profile of training in the field of environment within the required and optional training programs.

In preschool institutions of the country, environmental education and training is carried out in all age groups on the basis of an updated version of the National program for education and learning «Praleska», one of the most important sections of which is devoted to environmental education of children.

In general secondary education system in accordance with the objectives of reform schools is considerably strengthened the environmental component.

A special role in the system of environmental education facilities is owned by non-formal education and training. According to the Ministry of Education in Belarus there are 351 agencies of non-formal education and training: children's creativity centers, tourism and regional studies centers, including independent tourist bases, environmental centers, associations for the organization of extracurricular activities with children and adolescents. In the system of school education there are 25 ecological and biological centers and 78 tourist centers.

Environmental education, training and education is a compulsory part of vocational and specialized secondary education in the training of all categories, regardless of their future profession. In these institutions, environmental education is carried out either through general education and through special courses. In the special disciplines are considered environmental protection, improvements in technology, methods of treatment of polluting emissions, waste water, disposal of obsolete NiCd toxic industrial waste.

A special place in the system of continuous environmental education is given to institutions providing higher education. In the country's universities mandatory environmental training is carried out both by the ecologizing of the educational process and through the introduction of integrated courses. Mandatory environmental training in higher education is carried out primarily on the basis of the course «Fundamentals of Ecology». A number of special disciplines of environmental profile are introduced in the curricula of agricultural and forestry specialties. Legal aspects of environmental management are studied at the universities on juridical specialties, and specialties that are subject to management training.

The 13 universities of the country prepare environmental experts on a wide range of specialties – «Bio-ecology», «Geo-ecology», «Medical Ecology», «Radioecology», «Environmental protection and rational use of natural resources «, «Chemistry. Environmental Protection, «Environmental management and audit in industry», «Environmental monitoring, management and audit», «Ecology of Agriculture», «Environmental Economics», etc.

In the system of advanced training special attention is focused on training teachers in environmental education and upbringing of children and youth. For all categories of teachers appropriate courses, seminars and meetings are organized, methodological associations operate. With the aim of improving the environmental profile of specialists established State Educational Establishment of the «Republican Centre for training, advanced training and retraining of personnel in the field of environmental protection «of the Ministry of Natural Resources and Environment of the Republic of Belarus.

Environmental instruction

System of environmental instruction complements the educational system. It provides an opportunity for every citizen, regardless of age and social status, receive the necessary information about the environment.

Environmental instruction contributes to the creation of a new scale of social values and creating a model of human behavior, focused on the careful and responsible attitude towards the environment, awareness of natural heritage as a national treasure. It is conducted through the dissemination of environmental information.

Education in the field of environmental protection, including informing citizens about the national environmental legislation, implemented by the Ministry of Natural Resources and Environmental Protection of the Republic of Belarus and its territorial bodies, the republican state bodies, local and self-government, public associations, mass media and educational institutions, health care, museums, libraries and other cultural institutions, organizations, sports and tourism, other legal entities.

For a long time the Ministry of Natural Resources and Environmental Protection of the Republic of Belarus carries out systematic work to implement a set of activities to raise awareness about the environment, measures taken for its protection and improvement, promoting environmental awareness.

In order to implement the Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters in December 2007 in the Law of the Republic of Belarus «On environmental protection» amendments on environmental information. The Council of Ministers of the Republic of Belarus of 24.05.2008 № 734 approved the Regulation on the formation and maintenance of the State Fund of data on environmental conditions and impacts, as well as of environmental information in general purpose, subject to mandatory distribution, the holders of such information, are obliged to distribute it, and the frequency of its distribution.

It is available for public the information about the environment or causing injury, the emission of pollutants into the air and

wastewater into water bodies with excessive regulations; on discharges into the water of chemicals and their mixtures, articles or waste on introducing chemicals into the soil, resulting in the deterioration of its quality or groundwater quality; about ionizing and electromagnetic radiation, noise or other physical effects in excess of standards.

Belarus has established regular production of informational materials as air and surface water (Yearbook of air pollution and surface water in the territory of the Republic of Belarus), the data obtained from NEMS (National Environmental Monitoring System of the Republic of Belarus: Results observations). Every year since 1991, published an environmental bulletin «The state of the environment in Belarus». Basic information about the environmental situation included a separate section in the annual statistical compendium published by the National Statistical Committee of the Republic of Belarus.

A major step towards improving the information management of environmental activities was the development of electronic communication. Increased number of national environmental web resources along with significant growth in the country the number of users the World Wide Web has significantly expanded opportunities to provide operational information to the public and allow access to electronic versions of already adopted regulations legal acts, as well as print production environment, produced on paper limited edition.

The Ministry of Natural Resources and Environmental Protection of the Republic of Belarus opened in 2003 a public reception and converted it in 2005 to The Aarhus Centre in the Republic of Belarus, which allows citizens to directly receive environmental information of interest to them. A similar function is performed by «hot» phone lines are working in the Ministry, as well as in all the Regional Committee of Natural Resources and Environmental Protection.

In Belarus, has spread the practice of various environment-related forums. Since 2003, the annually held National Environmental Forum In the framework of organized scientific conferences and exhibitions of modern technologies in environmental protection and rational use of natural resources summarizes the environmental competitions and other activities are carried out. Finals forums held in various cities across the country.

Like the Environmental Forum of the same regular character is an international cinema-TV forum dedicated to the environment. In 2009, Minsk hosted the Vth International Ecological cinema-tv forum «EcoWorld 2009. Environmental security – the basis of human life». In the framework of a conference titled «Environment and security» and review competition video environmental documentaries, television programs and commercials from the Russian Federation, Slovakia, Finland, Ukraine, Lithuania, the Czech Republic and the Republic of Belarus.

Due to the fact that the 2009 presidential decree on 29.12.2008 № 710 was declared as the Year of the native land, was it implemented a set of activities in engaging the population to the national spiritual and cultural heritage, historical heritage and natural resources, distinctive traditions of the Belarusian people. Also, close attention was paid to public participation in improving human settlements and impose order on the ground.

Progress on the implementation of national, regional and sectoral activities to celebrate the Year of the native land was widely reported in the media – radio, television, print and Internet.

During 2009, in all institutions of education events were held on the Year of the native land, including the various aspects of restoring order to the lands occupied by them

and adjacent territories. Particular attention was paid to care for the graves of soldiers killed in WWII, storage space and military glory.

In general, operating in Belarus, public information system on environment guarantees the right of citizens to receive such information. According to the evaluation of the UN EEC, the level of environmental education and education of people in the country is quite high.

Public ecological associations

Providing of favourable environment involves public participation in environmental decision-making.

Legislative strengthening also has the right of citizens to exercise social control in the field of environmental protection and rational use of natural resources. Such control is carried out primarily in order to realize the right of every citizen to a healthy environment and prevent the violation of Belarusian legislation on environmental protection. Social control can be implemented through a public environmental review, public participation in the environmental review and assessment of the environmental impact of planned economic activity, as well as in other ways.

The basis of the legal regulation of direct public participation in environmental decision-making based on the provisions of the Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (Aarhus Convention). Aarhus Convention was ratified by Presidential Decree of 14.12.1999 № 726. It is part of the current legislation of the country and is subject to immediate execution. Under the provisions of this Convention effective participation of society in decision-making depends on important elements such as access to information, which provides public awareness and access to justice, ensuring real participation in decision-making. Condition as the effectiveness of this participation is to work in partnership with public bodies.

To implement the provisions of the Convention in the country was created and operates the Aarhus Centre of the Republic of Belarus. Its purpose is to ensure public rights to timely and accurate information about the environment, the proposed and existing activities which may have a significant impact on her. In particular, in 2009 in connection with alleged construction on the territory of Belarus nuclear power plant Aarhus Centre was carried out the work on informing the public on the evaluation of its impact on the environment.

Currently, in Belarus there are about 65 public organizations that operate in the field of environmental protection. Such organizations exist in all areas of the country, more than half of them are in Minsk.

In order to ensure cooperation under the Aarhus Convention, public associations with the state government in 2001 under the Ministry of Natural Resources and Environmental Protection of the Republic of Belarus was established the Public Environmental Coordination Council. The Council holds regular meetings at which invited representatives from various environmental organizations for a joint discussion on important issues of environmental protection and rational use of natural resources and develop coordinated solutions.

In 2009, at meetings of public Environmental Coordination Council under the Ministry consider assessing the environmental impact of building nuclear power plants in Belarus and the activities of Aarhus Centre, the preparation and holding of events to mark the celebration of World Environment Day Council. The members also participated in the seminar «Problems of Nuclear Power

Development in Belarus» which was organized in order to familiarize the participants with advanced technologies in nuclear power, issues of radiation monitoring, the effect of radiation on human health, psychological aspects of related activities the use of atomic energy.

In June 2009, the Berezina Biosphere Reserve held a forum of environmental organizations in Belarus. The event was organized by leading environmental non-governmental associations and organizations in the country: international humanitarian and educational fund «Living Partnership», the environmental association «Green Network, a non-profit institution» Center for Environmental Solutions «, public organization «APB Birds of Motherland», Public Association «Eco House», an international public association «Ecoproject Partnership». Among the guests of the Forum was attended by representatives of the Ministry of Natural Resources and Environmental Protection of the Republic of Belarus, the International State Environmental University A.D Sakharov, the Norwegian Society for the Protection of the environment.

The Forum was attended by over 120 participants from 59 different organizations. It became a platform for discussion of public participation in solving the most pressing environmental issues like sustainable energy and climate change, biodiversity, sustainable consumption and production, chemicals and waste. The issues of effective interaction between civil society organizations, governments, business community and the media were also the subject of the discussion.

Forum contributed to the consolidation of decisions on topical environmental issues and partnership arrangements to address them. This kind of consolidation enhances public influence on environmental decision-making, promotion of public environmental values.

International Cooperation

Belarus actively participates in international environmental partnership International cooperation is carried out of the country in the following areas:

– implementation of international treaties in the field of environment and natural resources, and in the first place, together with the states bordering the Republic of Belarus;

– the development of contractual relations on a bilateral and multilateral basis

– attracting funds from international financial organizations and donor countries to implement activities under the implementation of obligations under international legal instruments (conventions, protocols and agreements) to implement plans and programs of environmental orientation.

The Republic of Belarus on a regular basis working with major international organizations in the field of environment: the United Nations Environment Program (UNEP), Economic Commission for Europe (UNECE), UN Development Program (UNDP), World Bank and the Global Environment Facility (GEF), World Weather Organization (WMO), World Health Organization (WHO) and others.

Belarus is a Party to the 13 global and 9 regional and international agreements and 34 bilateral and multilateral treaties. The scope of international cooperation, the countries in the field of environmental protection is constantly expanding. So, on 12.09.2009 Agreement between the Government of the Republic of Belarus and the Government of the Republic of Poland on cooperation in environmental protection, 02.07.2009 Agreement entered into force with the Ministry of Environment and Natural Resources of the Republic of Moldova on cooperation in environmental protection.

Particular attention is paid in the international cooperation on the settlement of various issues of nature protection and environmental management in transboundary areas. In particular, it were prepared to sign an agreement with the Ministry of Environmental Protection of Ukraine on cooperation in the protection and sustainable use of transboundary conservation areas, as well as between the Government of the Republic of Belarus, the Republic of Poland and the Government of Ukraine to establish Transboundary Biosphere Reserve «West Polesie». Together with Latvia developed a draft agreement on cooperation in the protection and sustainable use of transboundary protected areas.

One of the priority areas of cooperation with neighboring countries – Lithuania, Russia and Ukraine – is the protection of transboundary water bodies from pollution and implementation of joint monitoring of their condition.

Actively developing cooperation in the field of environmental protection with the Republic of Lithuania Thus, together with the Ministry of Environment of Lithuania prepared and signed cooperation plan for 2009-2011. In addition, a draft Agreement between the Government of the Republic of Belarus and the Government of the Republic of Lithuania on the implementation of the Convention on Environmental Impact Assessment in a Transboundary Context.

Further developed relations in the field of environmental protection with the Republic of Poland The negotiations resulted in the MEP, the Brest Regional Executive Committee and Regional Committee of Natural Resources and Environmental Protection with the Polish National Fund for Environmental Protection of the Republic of Poland approved the project on the allocation of financial resources for the reconstruction of treatment facilities in Brest in 2009-2010 to $ 550 thousand U.S. dollars. At the meeting the two ministers (Poland and Belarus) in the town Bialowieza (Poland), September 12, 2009 decided to intensify work on preparation for signing of agreements: on cooperation in transboundary waters on cooperation in the conservation and sustainable use of transboundary protected areas the establishment of a transboundary Biosphere Reserve «West Polesie».

Cooperation with the Swedish Environmental Agency allowed the development of a draft memorandum on cooperation in the field of ecology.

In the area of international technical cooperation for 2009 actively works on projects of international technical assistance, during which the country attract funding, UNDP/GEF, the World Bank, European Commission (Program ENPI and the TACIS) and the OSCE.

The main areas of project activities were issues relating to:

– biodiversity conservation;

– the formation of institutional and legislative framework for the implementation of integrated environmental permits;

– mitigation of climate change and the Kyoto Protocol;

– introduction of cleaner production methods and pre-treatment plants in small enterprises, aimed at reducing industrial pollution of the Dnepr River Basin;

– strengthening of the technical capacity to manage water resources;

– treatment of persistent organic pollutants Improving the network of meteorological and radar stations in the Baltic Sea region;

– sustainable development at local level and build capacity in strategic environmental assessment.The successful development of international cooperation in environmental protection and environmental management must ensure that;

– conducting meetings and negotiations with potential donors to raise funds in aid of Belarus, as well as coordination of all departments of the Ministry on this direction;

– the implementation of measures to ensure the management and coordination of the implementation of multilateral treaties (conventions), and bilateral environmental agreements at the international and national levels, and linkages with international organizations;

– establishing and improving of legal framework for the protection of the environment through the preparation for the signing of new agreements with Ukraine, Poland, Latvia, as well as further work with the projects of international treaties (Ukraine, Lithuania, Poland)

Ministry of Natural Resources and Environmental Protection of the Republic of Belarus is the body authorized to perform the following global environmental international agreements:

– Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal;

– Vienna Convention for the Protection of the Ozone Layer and Montreal Protocol on Substances that Deplete the Ozone Layer;

– Convention on the Conservation of Migratory Species of Wild Animals;

– Convention and the Cartagena Protocol on Biosafety to the Convention on Biological Diversity;

– Convention and Protocols to the Convention on Long-range Transboundary Air Pollution;

– Convention on Wetlands of International Importance Especially as Waterfowl Habitat;

– Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters;

– Convention on International Trade of Endangered Species of Wild Fauna and Flora;

– Convention on Environmental Impact Assessment in a Transboundary Context;

– United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa;

– Convention on the Protection and Use of Transboundary Watercourses and International Lakes;

– the Framework Convention and the Kyoto Protocol to the United Nations Framework Convention on Climate Change;

– Stockholm Convention on Persistent Organic Pollutants.

Conclusion

The Republic of Belarus is situated in the central part of the European continent. Among the 50 European states Belarus is located at 13th place in the occupied territories and the 14th – in the total population.

According to estimates by the International Monetary Fund (IMF) existing in Belarus economic model looks competitive. GDP per capita calculated at purchasing power parity amounted in 2009 12.7 thousand $. This is the second figure in the CIS after Russia, it is also lower compared with the neighboring countries of EU – Poland, Lithuania, Latvia.

According to IMF forecasts, if in Belarus will continue the current pace of economic growth, then by 2015 rate of GDP per capita in the country at buyer-term capacity will be higher than in Latvia and nearly matched with Russia and Lithuania.

Air pollution. The main source of pollution of atmospheric air is transport. The contribution of mobile sources of emissions of the particles is 43%, oxides of nitrogen – 63%, and carbon monoxide – 89%.

Hydrocarbons, mostly goes into the atmosphere from the housing and public utilities-households and transportation of liquid and gaseous fuels by pipes.

Ammonia emissions are mainly caused by agriculture (50%); transport and communications accounted for 20%; of housing and communal services – 17%.

Sulfur dioxide emissions associated with electric power, lead – with the production of building materials, cadmium – from engineering and metalworking industry.

Every year dust cleaning system is captured more than 2,5 tons of pollutants, the effectiveness of existing systems is 82-88%.

State of atmospheric air in cities is good enough controlled: the average concentration of pollutants were generally below the established standards of quality, daily average concentration of total particulate matter and nitrogen dioxide exceeded the MPC only in some cities.

Number of «problem» areas with respect to air pollution in industrial centers of the country in 2009 decreased in comparison with 2007 by 22%.

In most controlled cities strong tendency to a reduction in levels of air pollution by formaldehyde is revealed. The content of sulfur dioxide in atmospheric air is steadily low. On the contrary, the content of nitrogen dioxide in air has increased in some cities by 1,2-2,0 times. In the cities of Gomel Region (Gomel, Mozyr, Rechitsa), Vitebsk and Grodno an increase in air concentrations of particulate matter is observed in 1,2-2,1 times.

Climate change. 2005-2009 were not an exception of a series of warm years. Period of warming that began in the late 1980's: the average annual air temperature is higher than the climatic norm on 1,0-2,0 °C, only winter and spring of 2006 were below normal.

Since 1989 for the entire period of meteorological observations, the warmest was 2008 mainly due to warm winter. Spring 2007 was the warmest for the entire period of meteorological observations in Belarus.

It should be emphasized that during the period 2005-2009 it has not been established clearly marked trends of annual and seasonal average air temperatures.

Annual rainfall for the period 2005-2008 was close to normal, in 2009 the rate was exceeded by 24%.

In the spring of 2008 for Belarus in general and a number of individual regions (Vitebsk, Minsk and Mogilev) as the period under review, and for the entire period of meteorological observations was marked the maximum rainfall.

It should be noted that the warming climate in Belarus is accompanied by an increase in the number of dangerous meteorological and agro-meteorological phenomena (squall lines, heavy rains, frost in the southern part of the country on the reclaimed areas, droughts).

Emissions of greenhouse gases amounted to an average of 87.9 million tons per year without considering the absorption and 56.6 million tons a year, taking into account the absorption of carbon dioxide. In the structure of emissions more than 65% is carbon dioxide, about 17% of nitrous oxide, about 16% – methane; other greenhouse gases in the sum is less than 1% of total emissions.

About 64% of greenhouse gases has originated in the energy, 25% – for agriculture, in industry, solvent use and waste add up to about 10% of greenhouse gas emissions.

Total greenhouse gas emissions from 2005 to 2008 increased from 84.5 to 91.1 million tons without absorption and with 53.7 to 60.0 million tons, taking into account the absorption of carbon dioxide, the increase occurred in all sectors except the sector «the use of solvents».

The specific emissions of greenhouse gases amounted to an average of 423.5 t/km^2 a year without taking into account the absorption and 272.9 t/km^2 a year, taking into account the absorption of carbon dioxide, per capita – 9.3 tons/person per year without taking into account the absorption and 6,0 m/person per year, taking into account the absorption of carbon dioxide.

Country's water resources are sufficient to meet current and promising water needs. According to the index of exploitation of water resources (2,8-3,0%), total water consumption for all sectors of economic activity does not provide substantial pressure on available water resources in the country.

Domestic water consumption per capita average for Belarus in 2009 did not exceed 145 liter/person per day and night. That corresponded to the level of water consumption in most European countries (120-150 L/person per day and night).

Drinking water supply of settlements is carried out mainly by groundwater. Surface water is partially used in Minsk and Gomel.

The quality of drinking water is primarily are in norm of sanitary requirements, except for high natural content in the water of iron and manganese in some cases, boron, fluoride and some other components.

So, about 2 million people in the country use water of higher iron content than the sanitary norm (0,3 mg/L), adopted in Belarus.

The provision of population with centralized water supply is 86%, including the rural population – 57%. Non-centralized water supply sources use about 1.4 million people, including the rural population – 1.1 million people. About 11% of the 42.6 thousand controllable mine wells do not meet hygienic requirements for the sanitary-chemical and microbiological levels.

Discharge of waste water into water bodies tend to decrease, with diminishing of regulatory-treated wastewater and increasing of the standard-setting (without treatment) water.

The annual average content of organic matter (BOD_5) in water of rivers, usually does not exceed the MPC, with the exception of the Western Bug and some sections the Mukhavets, the Dnieper and the Svisloch where recorded higher annual average BOD_5.

The annual average water content of ammonia nitrogen more MPC noted, for some sections of the river the Western Dvina and its tributaries – the Polota and the Ushachi and the Neman (Stolbtsy). For the Western Bug is installed downward trend in the contamination of ammonia nitrogen. Elevated concentrations of contaminant detection in water the Mukhavets on a segment of the river from g.Kobrina to Brest.

Significantly improved the state of the Dnieper, the pollution of nitrogen ammonium in 2009 noted only in the area of Rechitsa and.Loev. Elevated levels of it is observed in water the Sozh in the Gomel. Unfavorable gidrochemical parameter of ammonium is typical to the Berezina. Contamination of the Pripyat found only on the stretch of river in the area of Pinsk.

Average annual concentrations of nitrates in the water of the rivers did not exceed the MPC. However, in some of rivers marked the annual average phosphorus content of phosphate, which is greater than MPC. To the rivers with busy phosphate mode the Western Bug and the Mukhovet are included, the Dnieper below Loev, as well as on the part of the river the Berezina below Borisov and above Svetlogorsk. Pollution of the waters of the Western Dvina and the Neman is not revealed.

Assigned phosphate phosphorus pollution of the rivers is low. However, the reference conditions for the functioning of river ecosystems to some extent are upset and there are real preconditions for the eutrophication of watercourses.

The main amount of wastewater containing pollutants formed in the housing and communal services, in 2009 in rivers stepped of 91% of all ammonia nitrogen, nitrite nitrogen 89%, 90% of phosphorus of phosphate and 81% are of organic origin.

Wastewater treatment facilities in cities across the country, as a rule, are not used to full capacity. The capacity on municipal wastewater treatment plants varies from 32 to 70%.

Biodiversity. In the conservation of biological and landscape diversity in Belarus a major role Specially Protected Natural Areas (PNA) plays. Currently, Belarus has a protected park, 4 national parks, reserves, as well as natural monuments of national and local, area and number of years of change.

A number of protected areas has the international nature of protection status: eight national reserves included in the list of wetlands of international importance (Ramsar sites), six protected areas have the status of important plant areas, and fourteen – are included in the list of territories with large importance to the conservation of wild birds in Europe.

The area of forest, including forested lands increases in the country. The tendency to increase forest cover has reached 38,5%.

Forest is characterized fairly by good state of individual tree species (pine, birch, black alder), determined on the basis of defoliated crowns. Average percent of defoliation in all major forest-forming species was 17,7% in 2009.

Over the past few years, there were positive trends in the number increasing of species threatened with extinction; restore and expand the natural areas of their residency.

On January 1, 2009 under the protection of 3,078 wildlife residencies and the residencies of wild plants belonging to the species included in Red Data Book of Belarus were placed (2039 residencies 71 species of wild animals and 1039 residencies 103 species of wild plants).

Land Resources. Over the past five years the area of «forest» and «forest-covered» land increased by 172.5 thousand hectares, the farm land has decreased by 84,6 thousand hectares. The area disturbed, unused, and other lands significantly reduced. Lands of conservation organizations, recreation, recreational, historical and cultural purposes increased by 8.9 thousand hectares (5,6%).

Total area of eroded and erosion-prone land in the country is more than 4 000.0 thousand hectares, including arable – about 2,600 hectares. The share of water erosion is 84%, wind erosion – 16%.

In the soils of examined over a five year period, in 44 cities of Belarus noted the oil and heavy metals, and a lesser extent of sulfates and nitrates.

Chemical contamination of land is usually local in nature and does not turns out to be a significant impact on the ecological state of the environment.

Agriculture. The use of organic and mineral fertilizers in Belarus has significant environmental impacts at the present level of agricultural production.

Transportation. The main passenger about equally necessary to train and automobile (bus) transportation, with a five-year period revealed-Lena downward trend in the share of rail and road transport in the total volume of passenger traffic and the increase in air transport

The main contribution to turnover (75,8%) makes rail, second place is taken by car (24%). However, the trend towards a decrease in the share of rail transport in total freight traffic and an increase in the share of road.

Waste. During the five-year period the volume of waste production in Belarus amounted to an average about 34,656 tons annually, about 68% of which are halite wastes and sludge from clay-halite salt. And the volume of formation of production waste (excluding wastes from potash ore) in 2009 compared with 2005 increased in 1,5 times mainly due to the growth of waste of mineral origin, as well as waste vegetable and animal origin.

The formation of municipal solid waste averages 3,060 tons a year. Over the past ten years the share of specific formation of waste increased from 0.485 to 0.877 kg/person/day and approached the figure characteristic of the EU (0,85-1,70 kg/person/day).

The volume of waste at storage facilities in 2009 compared to 2005 increased by 11,5% and reached 911,600 tons. Amount of waste in the salt dumps RUE «Belaruskaly» increased annually by an average of 19,222.4 thousand tons, and the total amount of sludge halite clay-salt – to 2,584.3 thousand tons.

Specific level of finally disposed waste in the total amount generated from the industry averaged over last five years to 66.5%; for halite wastes and halite clay-salt waste – from 92.8 to 97.0% with an average of 95, 6%.

The volume of municipal solid waste disposed at landfills in 2009 was 16,739.1 m^3, an increase compared with the two previous years in 1,2 times mainly due to consumption waste.

Radiation situation in the country over the past five years has remained stable. The levels of dose, the radioactivity of natural precipitation and aerosols in the air, were constant with the established long-term figures.

In towns Bragin, Narovlia, Slavgorod, Khoiniki, Chechersk located in zones of radioactive contamination, levels of doses are typical for the country towns before the accident at the Chernobyl nuclear power plant.

Concentration of cesium-137 and strontium-90 in water of medium and large rivers have dropped considerably, but for most controlled rivers data of radio nuclides remains above the levels typical before the accident.

Radiation situation on the agricultural lands of the country has improved significantly. The content of long-lived radionuclides cesium-137 and strontium-90 in the soil decreased by about 40% due to natural decay.

The main areas of agricultural land contaminated by cesium-137 concentrated in Gomel (47,3% of total area) and Mogilev (23.6%) regions In Brest, Grodno and Minsk regions the proportion of contaminated land is small and amounts to 6.1%, 2,6 and 3,6% respectively.

Contamination of the strontium-90 has more local character. Radionuclide contamination of soil by the strontium-90 with a density of more than 6 kBq/m^2 was detected in 10% of the total area of the country. Maximum levels of strontium-90 in the soil are typical for a 30-km zone around Chernobyl and reach 1798 kBq/m^2 in Khoiniki district of Gomel region.

Environmental management. Fairly well-developed legal framework in the field of environmental protection and rational use of natural resources are formulated in the country.

Financing of environmental protection in general reduces the specific emissions and discharges of pollutants and provides relatively stable state of environment in the country in terms of high economic growth.

The current system of economic regulation designed to stimulate existence of business is aimed to reduce environmental impacts by reducing energy and resource consumption, adoption of preventive measures, to ensure environmental security.

Ensuring continuous operation of the National Environmental Monitoring System of the Republic of Belarus is one of the main directions of state policy on environmental protection.

Education, training on the environment security is effected in Belarus within the framework of the national education system as a single and continuous process.

The current system in Belarus of environmental information guarantees the right of citizens to receive such information.

According to the evaluation of the UN EEC, the level of environmental education and training of citizens of the country is quite high.

The Republic of Belarus on a regular basis interacts with major international organizations in the field of environment: the United Nations Environment Program (UNEP), Economic Commission for Europe (UN ECE), the Development Program (UN DP), World Bank and the Global Environment Facility (GEF), World Meteorological Organization (WMO) and others.

Belarus is a Party to the 13 global and 9 regional international agreements and 34 bilateral and multilateral treaties.

The list of the used sources

1. The state water cadastre. Water resources, their use and quality of waters (for 2006) / the Ministry of natural resources and environmental protection, the Ministry of Health. — Minsk, 2007.

2. The state water cadastre. Water resources, their use and quality of waters (for 2007) / the Ministry of natural resources and environmental protection, the Ministry of Health. — Minsk, 2008.

3. The state water cadastre. Water resources, their use and quality of waters (for 2008) / the Ministry of natural resources and preservation of the environment, Ministry of Health. — Minsk, 2009.

4. The red book of Byelorussia [the Electronic resource]. — an access mode: http://redbook.minpriroda.by. — access date: 29.10.2010.

5. The red book of Byelorussia: kinds of wild animals Rare and being under the threat of disappearance. — Minsk: BelEn, 2004. — 320 p.

6. The red book of Byelorussia: kinds of wild-growing plants Rare and being under the threat of disappearance. — Minsk: BelEN, 2005. — 456 p.

7. National system of monitoring of environment of Byelorussia: results of supervision, 2005 / under the editorship of S.I.Kuzmin, S.P.Utochkinoj. — Minsk.: RUE «Bel NRC «Ecology», 2006. — 272 p.

8. National system of monitoring of environment of Byelorussia: : results of supervision, 2006 / under the editorship of S.I.Kuzmin, S.P.Utochkinoj. — Minsk.: RUE «Bel NRC «Ecology», 2007. — 290 p.

9. National system of monitoring of environment of Byelorussia: results of supervision, 2007 / under the editorship of S.P.Utochkinoj. — Minsk.: RUE «Bel NRC «Ecology», 2008. — 290 p.

10. National system of monitoring of environment of Byelorussia: results of supervision, 2008 / under the editorship of S.I.Kuzmin, S.P.Utochkinoj. — Minsk.: Minsk.: RUE «Bel NRC «Ecology», 2009. — 340 p.

11. National system of monitoring of environment of Byelorussia: results of supervision, 2009 / under the editorship of S.I.Kuzmin. — Minsk.: RUE «Bel NRC «Ecology», 2010. — 346 p.

12. The national plan of action on rational use of natural resources and preservation of the environment of Byelorussia for 2006-2010 — Minsk: RUE «Bel NRC « Ecology», 2006. — 124 p.

13. National statistical committee of Byelorussia (an official site) [the Electronic resource]. — an access mode: http://belstat.gov.by. — access date: 26.10.2010.

14. Minerals of Belarus: To the 75 anniversary of BeNRGEI / editorial board: P.Z.Homich [etc.]. — Minsk: Education and Upbringing, 2002. — 582 p.

15. Rules of calculation of emissions from cattle-breeding complexes, fur farms and poultry farms: R 17.08-11-2008 (02120). — Int. 01.03.09. — Minsk: the Ministry of natural resources and environmental protection of the Republic of Belarus, 2008. — 46 p.

16. Legal bases of protection and rational use of especially protected natural territories: digest of Standard documents / pr. by N.V.Minchenko. — Minsk: Altiora — Vivid Paints, 2009. — 72 p.

17. Wildlife management: ecology, economy, technologies: materials of International Scien. Conf., Minsk, 6—8.10.2010 — Minsk: Minsktipproekt, 358 p.

18. A condition of environment of Belarus: ecol.bul., 2005 / under the editorship of V.F.Loginov. — Minsk: Minsktipproekt, 2006. — 324 p.

19. A condition of environment of Belarus: : ecol.bul., 2006 / under the editorship of V.F.Loginov. — Minsk: Minsktipproekt, 2007. — 366 p.

20 A condition of environment of Belarus: ecol.bul., 2007 / under the editorship of V.F.Loginov. — Minsk: Minsktipproekt, 2008. — 376 p.

21. A condition of environment of Belarus: ecol.bul., 2008 / under the editorship of V.F.Loginov. — Minsk: Minsktipproekt, 2009. — 406 p.

22. A condition of environment of Belarus: ecol.bul., 2009 / under the editorship of V.F.Loginov. — Minsk: Minsktipproekt, 2010. — 324 p.

23. The spontaneous hydrometeorological phenomena in territory of Belarus: the Directory/ the Ministry of natural resources and environmental protection of the Republic of Belarus / under gen. ed. of M.A.Golberg — Minsk: RUE «Bel NRC « Ecology », 2002. — 132 p.

24. Instructions on filling of the form of the state statistical reporting of 1-OS (air) «the Report on emissions of polluting substances and carbon dioxide in atmospheric air from stationary sources of emission»: appr. by decision of National statistic committee of Belarus of 28.05.2010 № 61//the National register of legal certificates of Byelorussia. — Minsk, 2010. — 7/1250.

25. Actual water use and dump of sewage in Belarus (for 2005) / the Ministry of natural resources and Republic preservation of the environment, RUE «the Central scientific research institute of complex use of water resources». — Minsk, 2006.

26. Actual water use and dump of sewage in Belarus (for 2006) / the Ministry of natural resources and Republic preservation of the environment, RUE «the Central scientific research institute of complex use of water resources». — Minsk, 2007.

27. Actual water use and dump of sewage in Belarus (for 2007) / the Ministry of natural resources and Republic preservation of the environment, RUE «the Central scientific research institute of complex use of water resources». — Minsk, 2008.

28. Actual water use and dump of sewage in Belarus (for 2008) / the Ministry of natural resources and Republic preservation of the environment, RUE «the Central scientific research institute of complex use of water resources». — Minsk, 2009.

29. Actual water use and dump of sewage in Belarus (for 2009) / the Ministry of natural resources and Republic preservation of the environment, RUE «the Central scientific research institute of complex use of water resources». — Minsk, 2010.

30. Officially Reported Emission Data // Convention on Long Range Transboundary Air Pollution, EMEP [Electronic resource]. — mode of access: http://www.ceip.at/emission-data-webdab/emissions-as-reported-by-parties. — date of access: 12.05.2009.

31. United Nations Framework Convention on Climate Change [Electronic resource]. — mode of access: http://unfccc.int/2860.php. — date of access: 28.10.2010.

Content

Introduction	3
1. Overview	6
2. Air pollution	12
3. Change of Climate	31
4. Water resources	41
5. Biodiversity	66
6. Land	91
7. Agriculture	100
8. Transport	104
9. Waste	109
10. Radiation situation	117
11. Environmental management	126
Conclusion	142
The list of the used sources	147

Production-practical edition

THE STATE OF ENVIRONMENT IN THE REPUBLIC OF BELARUS
National report

Translator Buglak E.I.
Responsible for edition
Proofreader Kuzhel I.V.
Computer design and layout Zhuchkevich E.A.

Ready for the press 17.12.2010.
Format 60x84 /8. Paper coated.
Offset process.
Con. press. p. 17,44. Est.-publ. p. 5,42.
Circulation 520 cop. Order 1738.

Publisher RUE «Beltamozhservice».
LP № 02330/0552909 from 16.03.2009 till 01.04.2014.
Chicherin Str 19, 220029, Minsk, Republic of Belarus.

Printed in Ltd «Justmazh».
LP №02330/0552734 from 31.12.2009.