MINISTRY OF ENVIRONMENTAL PROTECTION OF UKRAINE

State Environmental Protection Administration
in Donetsk Oblast

THE LAND OF OUR CONCERN

based on material from the Reports
on the State of the Natural Environment
in Donetsk Oblast in 2007-9

Donetsk, 2010

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This publication provides information on the state of the environment in Donetsk Oblast in 2007-9. Readers can get acquainted with the region's geographical characteristics, natural conditions, infrastructure and economy, the ecological and economic situation and analysis of the impact of the industrial complex on the environment of Donechchyna.

The book contains comprehensive data on environmental pollution in Donetsk Oblast, complex retrospective analysis and forecast of climatic conditions, state of the atmospheric air, surface water bodies, land resources and biodiversity. The system of solid domestic and industrial waste management is defined and assessed.

Much of the book is devoted to analysis of social and demographic indicators, and the impact of environmental pollution on public health, with a comparative assessment of key environmental indicators of Donetsk Oblast.

Problems of technogenic safety, state control, management and monitoring in the sphere of environmental protection are considered; priorities for regional environmental policy are also defined.

The book is intended for specialists in the sphere of environmental safety and protection, scientific workers, post-graduate and university students.

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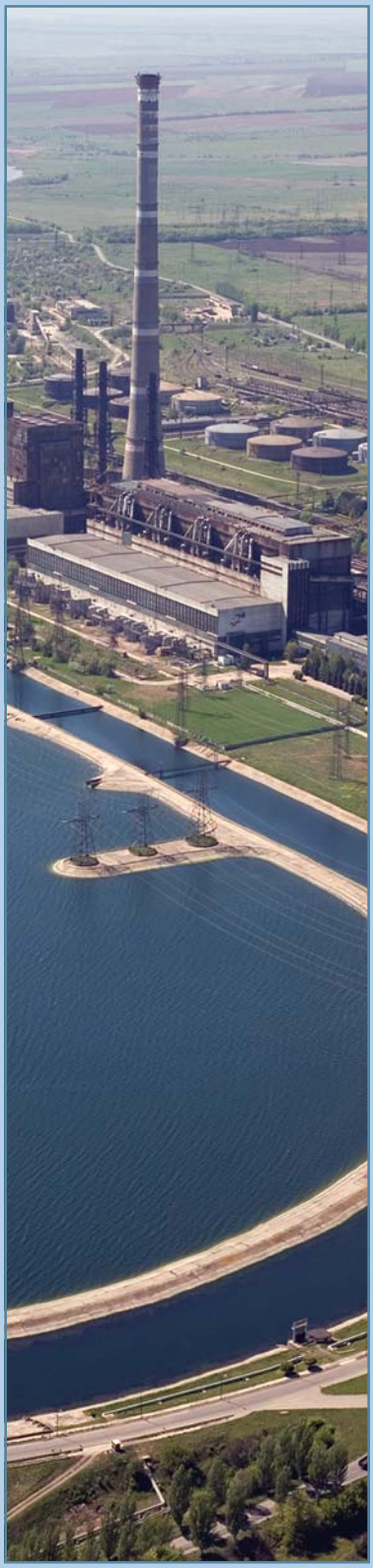
Content

SECTION 1

GENERAL OVERVIEW OF THE ENVIRONMENTAL SITUATION



Donetsk Oblast occupies a prominent place in the Ukrainian economic potential. A substantial industrial community which includes more than 1,100 industrial enterprises of mining, metallurgical, chemical, power and heavy engineering industries has developed within its territory, with about 300 mineral deposits being exploited. The high concentration of industrial and agricultural production and transport infrastructure in combination with the considerable density of the population has created a huge impact on the biosphere – the highest one in Ukraine and Europe.

One-fifth of the state's industrial potential – of which 78% consists of environmentally hazardous production facilities of metallurgical and extractive industries, electricity generation and coke industry – is concentrated within the territory of Donetsk Oblast which makes up only 4.4% of the total area of Ukraine. Enterprises of these particular industrial sectors have the greatest impact on the region's environment.

Intensive exploitation of natural resources for a long period of time has resulted in changes in all the environmental components in Donetsk Oblast: climate, atmospheric air, surface and ground water, soil, landscape and biodiversity.

Climate. Over the period from 1936 to 2008 the average annual temperature in Donetsk Oblast decreased from 9.4°C to 9.0°C. The dynamics of average annual precipitation during this period shows a significant increase in values: from 500 to 615 mm per year, substantially changing the region's climatic conditions. The agro-climatic conditions in Donetsk Oblast favour the growth of heat-loving crops, however, if the described trends continue, climate change will affect the production of agricultural goods in the region. Global climate change raises the problem of how to face this challenge at a regional scale.

Atmospheric air. Pollution of the atmosphere by harmful substances has a significant effect on the health of the region's population and ecosystems. According to the State Statistics Committee, Donetsk Oblast accounted for 33.9% of total emissions of harmful substances from stationary sources in Ukraine in 2008. The corresponding 1,533,400 tonnes of emissions are produced by more than 1,140 enterprises in various industrial sectors. From 2008 a tendency towards a reduction in gross emissions of harmful substances in the region was observed, related to the onset of the global financial crisis. However, the level of air pollution in industrial cities remains high.

Analysis of the represented data shows that gross emissions of harmful substances increased during the period from 2000 to 2007. Furthermore emissions from industrial enterprises increased by 4% and transport emissions by 6%. In 2008 industrial emissions decreased and transport emissions increased by 7.3% compared to 2007. The air is most polluted in the region's cities where coal, iron and steel, and energy enterprises are located, namely Mariupol (21.9% of total emissions in the region), Donetsk (9.3%), Makiivka (7.2%), Debaltseve (6.6%) and Yenakiieve (4.6%).

Carbon monoxide (32.9% of total emissions) represents the highest specific weight in the structure of pollutants, followed by methane (23.3%) and sulphur dioxide (21.7%). Analysis of the structure of emissions into the atmosphere testifies that emissions of carbon monoxide in 2008 dropped (by 3.7%) compared with 2000, but emissions of nitrogen dioxide increased (by 21.6%) and emissions of sulphur dioxide remained at the same level.

Historically, many industrial enterprises are located in urban areas

Dust, nitrogen dioxide, sulphur dioxide, carbon monoxide, formaldehyde, phenol, ammonia, heavy metals, benz(a)pyrene and hydrogen sulphide are the main atmospheric pollutants in the region. Analysis of data on the pollutants in the region's atmospheric air in 2000-8 shows that despite a fall in gross emissions, the overall situation regarding air pollution has not improved. The level of air pollution by the most hazardous substances, such as formaldehyde, nitrogen dioxide and dust, remains high.

Water resources. Donetsk Oblast is one of the regions in Ukraine with the largest shortage of freshwater. Several industrial sectors, which have developed here over the last two centuries, are characterized by significant water consumption. There is consequently an acute problem of water-resource pollution in the region and a corresponding shortage of good quality fresh water for the domestic needs of the population, for farming, processing industries, etc.

Industrial waste occupies about 2% of the territory of the region

Under current conditions the regime of almost all rivers has been changed by the construction of artificial water bodies – ponds and reservoirs. Some 157 reservoirs have been built in the region. The entire water supply per capita (180 m^3) is five times less than the average in Ukraine. Over the last 18 years household water consumption per capita has dropped from 135 m^3 in 1990 to 58 m^3 in 2008.

In-spite of the decrease in the volume of water consumption the intensity of water resource usage in the region is still the highest in Ukraine. According to the data from statistical reporting in Donetsk Oblast there are 279 enterprises consuming water which discharge return water into the rivers and water bodies of the region. In 2007 and 2008 the total volume of waste water discharged into surface water bodies amounted to 1,699 million and 1,546 million m^3 respectively. Moreover, with the drop in industrial output in the second half of 2008, discharge of polluted waste water decreased from 1,438 to 615 million m^3.

A substantial amount of pollutants flows into the water bodies of the region together with waste water. In 2007 and 2008 discharge included respectively 516,000 and 485,000 tonnes of sulphates, 192,000 and 287,000 tonnes of chlorides, 14,000 and 13,500 tonnes of nitrates, and 103 and 113 tonnes of petroleum products. The concentration of salts in the water of almost all the region's rivers has increased. The main pollutants of the region's surface water are sulphates and biogenic substances (nitrogen and phosphor compounds) and other organic substances. The concentration of specific substances of toxic action (heavy metals, petroleum products, phenols, synthetic surface active substances) in the surface and ground water of the majority of water bodies is not critical.

The ecological situation regarding the pollution of water bodies should be characterized as complex, requiring the development and implementation of a package of measures to improve the ecological state of the region's rivers and water bodies.

Land resources and soils. The current ecological state of land and soil cover in Donetsk Oblast is the result of urban and industrial development, as well as agricultural activity. Farmland accounts for the largest share of land, with 79% of the total area (2,096,000 ha) under cultivation.

At the end of 2008 25,000 ha of agricultural land were disturbed in the region as a result of the production activity of enterprises. During 2008 526 ha of lands were disturbed, 652 ha of disturbed lands were exhausted, which is 2.7 times more than in 2007, and 155 ha were reclaimed.

Almost all the soil (more than 95%) in the region may be classified as technogen-

Donetsk Oblast is situated at the intersection of main railway lines and trunk roads

ically transformed due to intensive industrial and agricultural activity. The soil in the cities of the region is characterized by local pollution with heavy metals and petroleum products, by disorders in the acid-base balance and physical-mechanical properties (decreased soil moisture, higher soil compaction, stoniness), occurrence of fragments of construction and household wastes, low concentration of nutrients in soils, all of which is connected with intensive technogenic impact.

Waste. The accumulation of waste is one of the most convincing factors of environmental pollution and its adverse impact on all its components. Donetsk Oblast accounts for 31% of industrial and toxic waste in Ukraine and 28% of its annual generation.

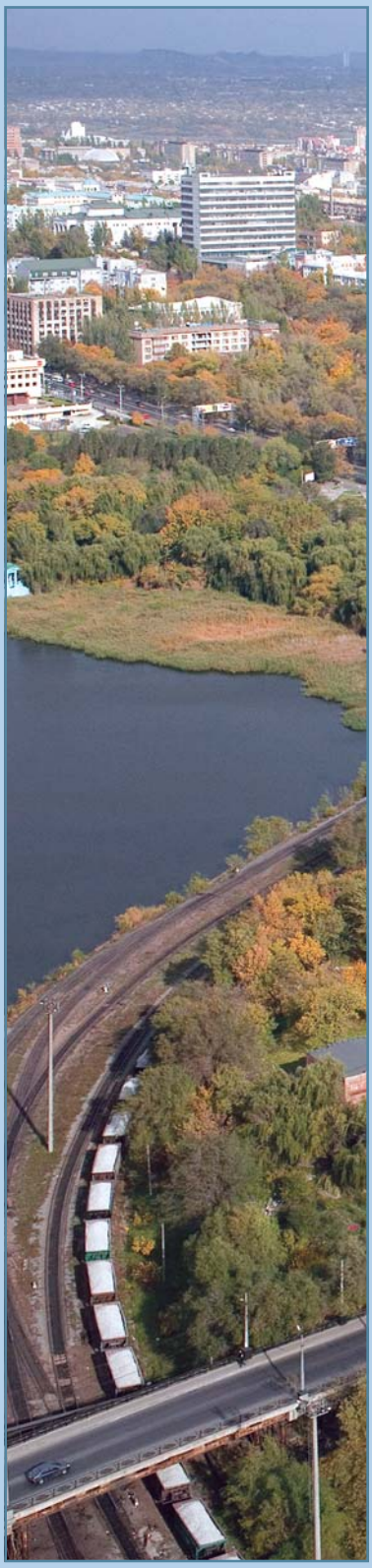
In the past few years there has been a tendency in the region towards a reduction in waste output (as much as 10% of the 2002 level), with an increase in hazardous waste output and its share of the total. Class I-III waste represents an immediate danger, 6,515.2 ktonnes having accumulated by the end of 2008. Within the territory of the region there are 240 warehouses, where 507.6 ktonnes of unusable, prohibited pesticides and agrochemicals are in storage. According to the statistical reports, 297.4 ktonnes of solid domestic waste was produced in 2008, making an accumulated total of 5,998.8 ktonnes. Overall, about 2% of territory of the region is occupied by waste.

The Volgograd-Schastia-Pervomaisk-Artemivsk-Zaporizhia 700 kV power line and other high-voltage 330-500 kV transmission lines cross the region's territory

The current environmental situation in Donetsk Oblast is the legacy of 200 years of intensive use of natural resources. To improve the current state of the region's ecological networks and reverse the negative trends observed in natural environments it will be necessary to raise substantial funds and material resources, and completely change the public attitude to the environment.

SECTION 2

DONETSK OBLAST: NATURE, ECONOMY AND RESOURCES



Donetsk Oblast is the largest Ukrainian administrative district in terms of population, economic potential and natural resources. The oblast is situated in the south-east of the country and has direct access to the border with the Russian Federation and the Sea of Azov coast.

Donetsk Oblast was established in its existing political division on 17 July 1932. The oblast occupies an area of 26,517 km^2, making up 4.4% of the territory of the country. It is the largest region in Ukraine for the size of its population with 4,519,700 people. The region boasts 52 cities, 28 of which are subordinated to the oblast, 131 towns and 1,121 villages. The administrative centre of the region is Donetsk with a population of 994,000 people. In terms of ethnic composition there are 50% Ukrainians and 42% Russians; the region is one of the main areas of settlement for Greeks, Armenians, Belorusians and ethnic Germans in Ukraine.

Donetsk Oblast is historically called the Land of Coal and Metal: one-fifth of the industrial potential of the country is concentrated here. More than 1,100 industrial enterprises representing the main industrial sectors such as coal mining, metallurgy, chemicals, engineering, energy and construction are located here. About 70% of the products manufactured in the region are exported.

2.1. Geographical characteristics of the region

Donetsk Oblast is situated in the steppe zone of south-eastern Ukraine. The oblast borders on Dnipropetrovsk and Zaporizhia Oblasts to the southwest, Kharkiv to the northwest, Luhansk to the northeast, and Rostov Oblast in the Russian Federation to the east. The Sea of Azov washes its southern shore.

The territory of the region reaches 240 km from north to south, 170 km from west to east. The oblast occupies the western part of the Donetsk ridge and the eastern half of the Azov Upland. The river watershed of the Azov-Black Sea basins extends over the territory of the region.

Relief. Donetsk Oblast is characterized by flat-undulating land with specific acute soil erosion. The Donetsk ridge forms the northern and central part of the oblast, the Azov Upland the southern part.

The regional landscape is dominated by steppe elevations and slopes, plain steppe complexes of terraces, as well as hilly, sandy, woody plains, river valleys and gullies (see Figure 2.1.1). Typical landscapes of the oblast are plains and uplands divided by gullies that merge into floodplain landscapes of river valleys and estuary plains on the Sea of Azov coast.

The Donetsk ridge occupies a large part of Donetsk Oblast. It is mostly a rolling plain. At its highest points the Donetsk ridge rises to 200-270 metres (Saur-Mogila, 277m), with an amplitude of no more than 200 metres, all that is left of a once rather lofty massif. At its edges the Donetsk ridge loses its modest height and merges with surrounding river valleys. Only at Severskiy Donets does it fall in a steep ledge exposing ancient chalk deposits.

The far north of the oblast is formed by the Donetsk terrace plain, a Severskiy Donets valley located between the Donetsk plateau and ridge of the same name. The width of the valley ranges from 4 to 26 km, and it is 200 km long. The impressive size of the valley indicates that the Severskiy

Background of Donetsk Oblast

Recent archaeological research shows that Donetsk Oblast is one of the regions of Ukraine which were inhabited in ancient times, beginning from the Palaeolithic era. In later periods mostly nomadic tribes lived here: Scythians, Sarmatians, Pechenegs and Cuman.

Mongol-Tatar invasions of Eastern Europe caused major political and demographic upheaval. During the Baty-khan conquest of the eastern European steppe land, the surviving population was bound to the Golden Horde. After Mengly-Girey's campaigns against Kiev in the 11th century, the steppe population had to retreat to better defended places, which explains why Ukraine's steppe was named "wild field".

In the 16th century Ukrainian Cossacks engaged in military service settled along the banks of Severskiy Donets, as well as runaway peasants from the right-bank of Ukraine and Russia. Svyatogorsk Monastery is thought to be one of the first settlements, with written records dating back to 1642.

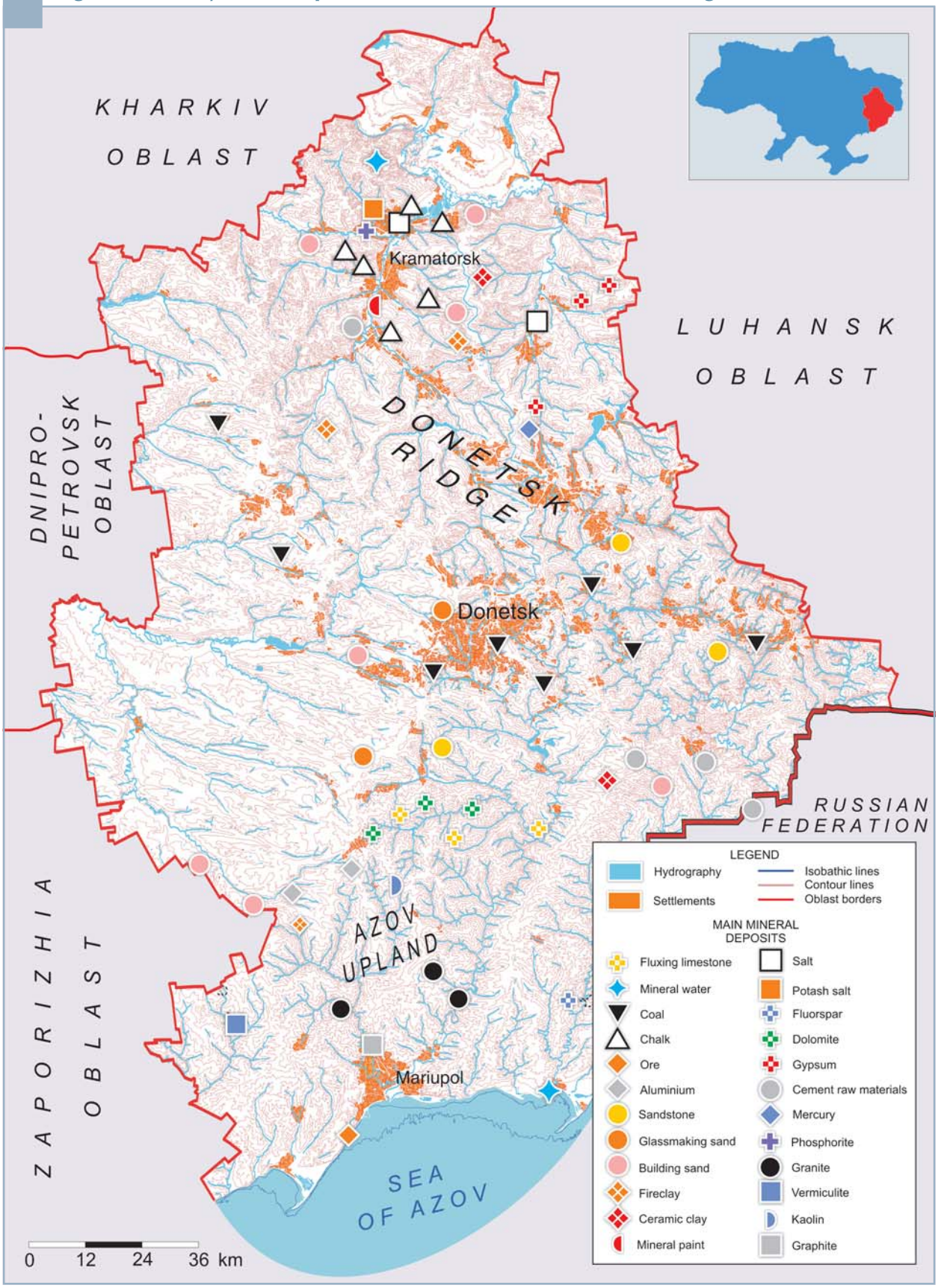
In the 17th century rock salt mining became very profitable for our region. The first Donbas town Solianoye was founded at salt lakes in 1676. In 1715 on the basis of government salterns the first saltworks of Donetchina were built in Bahmut and Torsk. The second Donbas town, Bahmut, was founded by salt workers in 1702.

In 1721 coal was found in Donetchina. In connection with its commercial production an intensive reclamation of the regional territory began at the end of the 17th century.

In the first half of the 19th century the first big industrial enterprises were established, geological surveys of Donbas were carried out, new towns appeared and trade developed.

In the second half of the 19th century, along with the development of capitalism, rapid modernization of Donbas industrial production occurred, railways were built, metallurgical and metal-working industries were founded, new mines and plants were opened.

Fig. 2.1.1. Physical map and minerals of the Donetsk region



Source: Atlas of Donetsk Oblast, The State Administration of Environmental Protection in Donetsk Oblast, 2009

Donets once carried much more water than nowadays, due to a more humid subtropical climate.

The Azov upland is situated in the south, forming an undulating plain with a few isolated hills jutting out. They are called "mogilas" (the highest point is Mogila-Gonchariha, 278m).

The Azov upland is also divided by ravines and gullies, but far less than the Donetsk ridge. The granite and gneiss bedrock of the upland is exposed in some places. Gently sloping southward, the Azov upland turns into the narrow Azov lowland, part of the vast Prichernomorskiy plain which covers all of southern Ukraine. The tilled steppe flatland slopes down to the Sea of Azov.

Karstic forms of relief are predominant in the areas where limestone (Volnovaha district) and salt (Artemivs'k and Slovians'k regions) are prevalent.

The relief of Donetsk oblast is peculiar due to human technogenic activity, with hundreds of waste heaps, in some places more than 100 metres high.

Geological structure. Donetsk oblast is situated at the south-eastern edge of the Eastern-European platform – one of the largest, comparatively stable expanses of the Earth's crust. The foot of the platform includes schist, gneiss, archean and Proterozoic granites. Sedimentary cover consists of Palaeozoic, Mesozoic and Cainozoic formations, about 3-5 km deep. Numerous salt domes with oil, gas and salt deposits are found in the Dniepr-Donetsk hollow that occupies the north of Donetsk oblast.

A special feature of the geological structure is the existence of huge coal deposits in central and eastern parts of the region and intrusive formations of crystalline plate coming to the surface in southern and western parts. The tectonic and geological structure of the Earth is shown in Figure 2.1.2.

Hydrography. Rivers account for most of the surface water reserves of Donetsk oblast, with 247 rivers in the region. Only eight of them exceed 40 km in length (see Figure 2.1.3). All rivers are fed by precipitation, melted snow water, springs and industrial drainage.

The Severskiy Donets is the main river artery, flowing through the region for 95 km. Its total length is 1,053 km, with a basin covering 100,000 km^2. Its main left-hand tributaries are the Zherebets and Oskol, with the Kazionniy Torets, Bahmut and Lugan' on its right bank. The Severskiy Donets is part of the Don basin.

Rivers such as the Samara and the Volchia, which are part of the Dnieper ba-

Places of interest

There is no more valuable ecosystem in the world than the steppe. At the present day steppe part of Ukraine occupies 40% of the territory and natural steppe – about 1% of the whole country territory. About 10% of natural steppe has remained in the east of Donetsk oblast. The Donetsk Ridge regional landscape park, which covers 3,952 hectares was decided by the Donetsk Regional Council to preserve this unique ecosystem. The park is located at the southern end of the Donetsk Ridge, its northern edge rising with cone-shaped hills above the slope running south, revealing a picturesque forest-steppe landscape with ravines and gullies. The borders of the park are near the basin of the river Krynka. Two small rivers – Sevostianivka and Kamyshevaha – run from north to south across the park.

Places of interest

The Meotida regional landscape park straddles the territory of the Novoazovskiy and Pervomaiskiy raions of Donetsk oblast, along the Azov Sea coast. It extends over 13,017 ha.

The park became the first eastern part of the Azov-Black Sea ecological corridor covering the whole coastline, except Mariupol. About 13,000 ha of sea water area has been taken under its protection, as one of the most ecologically valuable regions of Ukraine.

Experts from the Donetsk botanical garden of the National Academy of Science singled out 49 formations of saline, steppe, marsh, water, sand and synanthropic vegetation. In May-June strips of land, that are suitable for nesting are carpeted with sandpipers and ducks, but they only represent a small part of the million-strong army of migratory birds. During the migration season bustards, black storks, red-breasted geese, vultures and (in winter) white snowy owls may be seen.

Furthermore 79 species of fishes can be found in the water enclosed in the Meotida park. Many of them contributed to the fame of the Sea of Azov, as the most productive sea in the world.

sin, rise on the Donetsk ridge. The rivers Kal'mius with Kal'chik, Mius with Krynka and other small rivers flow into the Sea of Azov. The natural flow of the region's rivers is 550-900 m^3 a year.

There are few natural lakes in the oblast. These small water bodies are scattered in high-water beds. Most of such lakes are located in the flood plain of the Severskiy Donets. There are three famous salt lakes – Repnoye, Slepnoye and Veysovo – in the Kazionniy Torets basin near Slovians'k.

It is worth noting that among the water bodies of the oblast 1,804 artificial reservoirs cover more than 1 ha (each) and there are eight reservoirs exceeding 6 km^2, as well as 1,650 ponds. The total volume of reservoirs is 1,100 million m^3. The main reservoirs are Kurakhiv, Vuglegirs'k, Pavlogradsk, Starobesheve, Kleban-Byk, Volyntseve, Karlove, Starokryms'k and Krasniy Oskol.

A large part of the Donetsk oblast water supply comes from the Severskiy Donets-Donbas canal built in 1953-58. It is 131 km long and with a flow rate of 43 m^3 a second.

The southern shores of Donetsk oblast

Places of interest

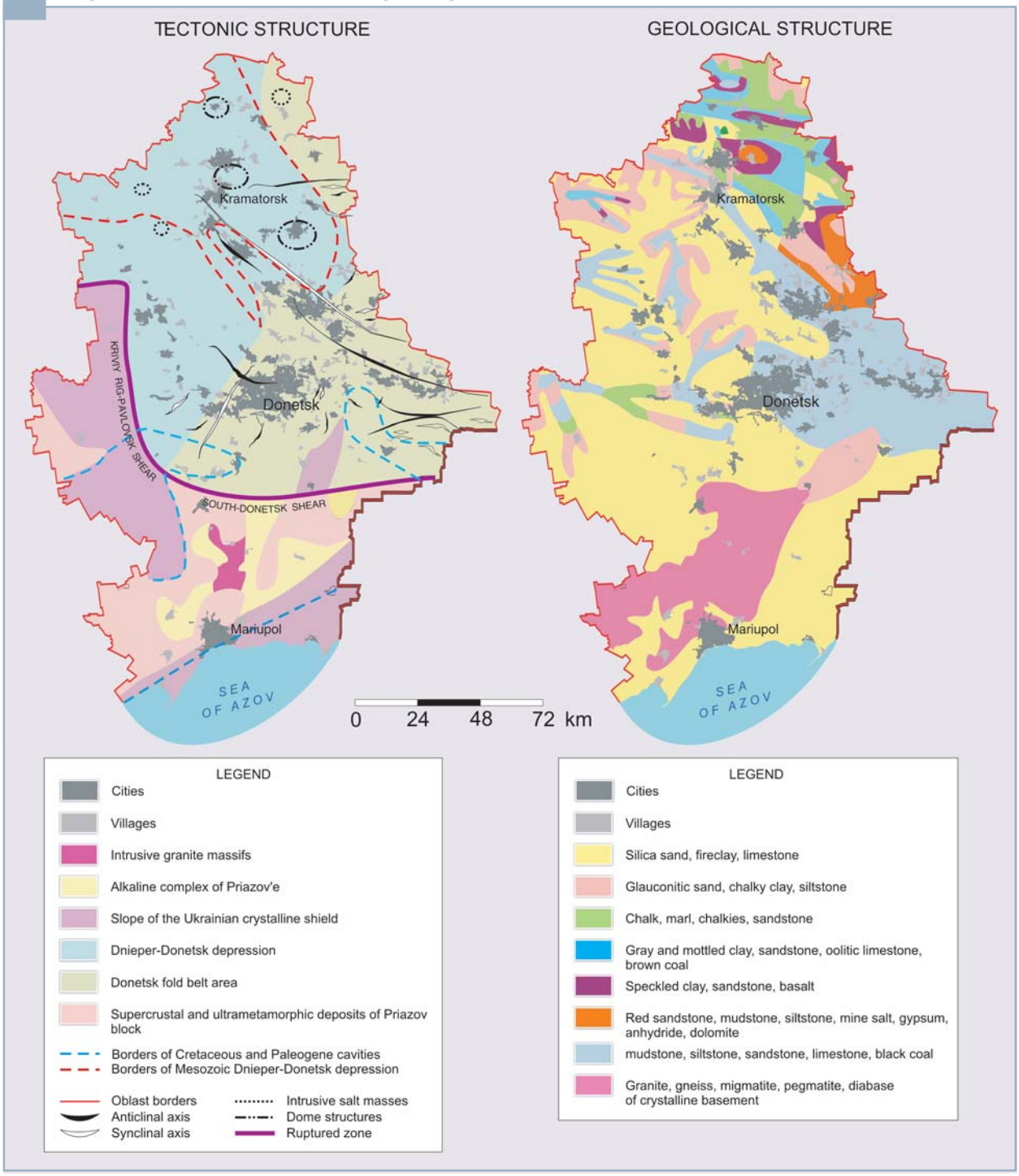
The Kleban-Byk regional landscape park is in Konstantinovka district. The park features picturesque hilly landscape, once covered by shallow warm sea in the carboniferous period.

The history of the park is closely related to the history of Zaporozhskaya Sech. Not far from the confluence of the Krivoy Torets and Bychok rivers there was a Cossack outpost named Zheleznaya. Nowadays the name corresponds to a small settlement near Dzershinsk.

The mountains here have served as a place of worship in many cultures. Along the perimeter of the reserve there are burial mounds built by Skiff tribes. Near the reserve's central estate stand ancient Kamennye baby statues, transported from other parts of the region.

Historians tend to think that this was the site of an altar to the Skiff god Ares. On 31 May 1223, during the Battle of Kalka River, Mstislav, Prince of Kiev built a fortified camp here.

Fig. 2.1.2. Tectonic and geological structure of Donetsk Oblast



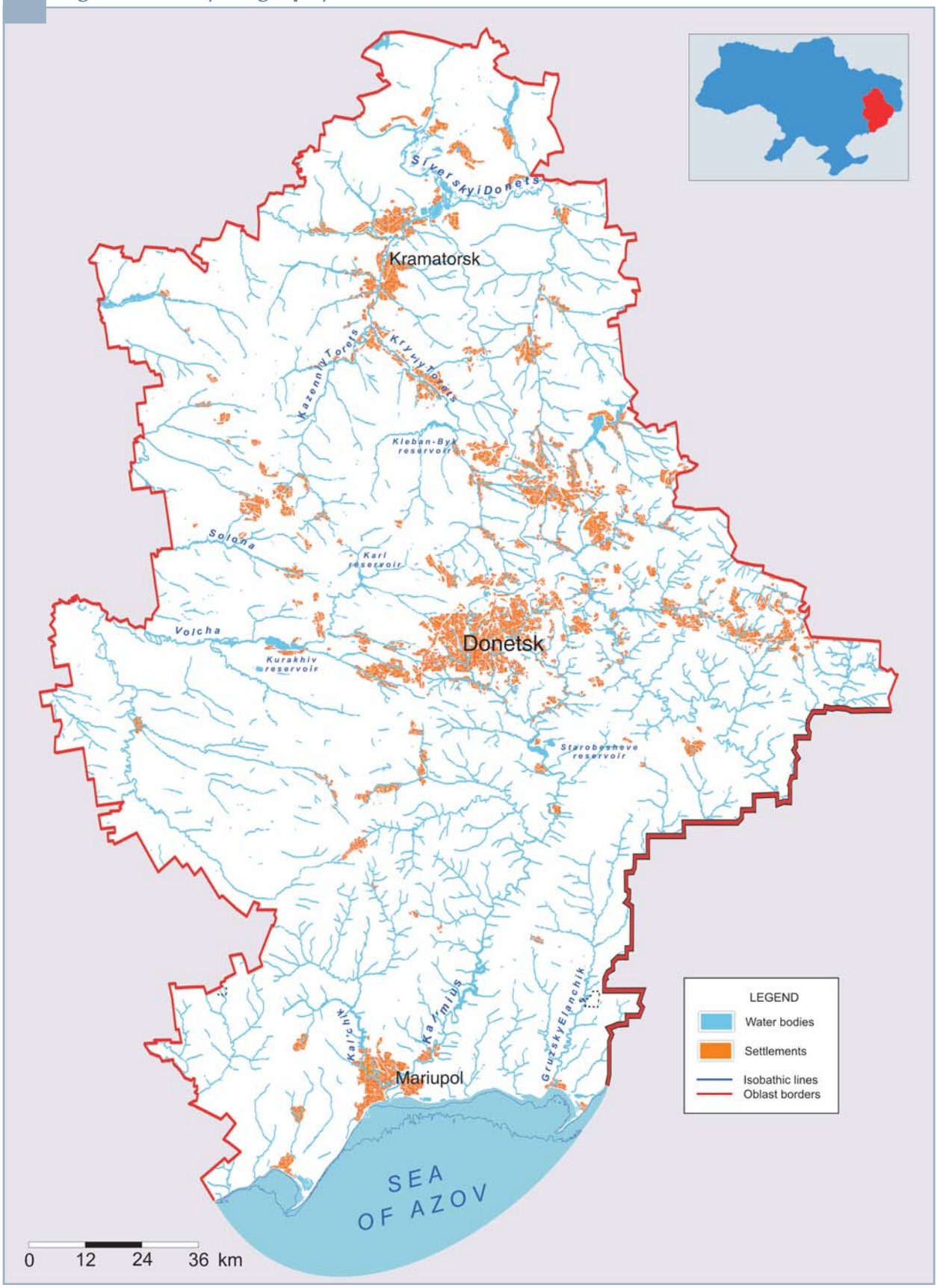
Source: Atlas of Donetsk Oblast, The State Administration of Environmental Protection in Donetsk Oblast, 2009

are washed by the Sea of Azov. Its extends over only 38,000 km^2, and its depth does not exceed 14 metres.

Minerals. There are about 750 mineral deposits with 36 kinds of raw materials that have government and local significance in the territory of Donetsk oblast. Some 355 deposits with 25 kinds of mineral raw materials are exploited (see Figure 2.1.1).

The oblast's natural resources are mainly concentrated in the Donetsk coal

Fig. 2.1.3. Hydrography of Donetsk Oblast



Source: Atlas of Donetsk Oblast,
The State Administration of Environmental Protection in Donetsk Oblast, 2009

field, one of the largest coal deposits in Europe. It also boasts substantial deposits of salt, gypsum, cement raw materials, fluxing limestone and dolomite, granite, fireclay and high-melting clay, among others.

Exploration continues to find new deposits of iron ore, fluorite, alkaline kaolins, basalt, ornamental stone material, phosphorite, vermiculite, aluminium raw materials, mercury, graphite, rare elements and rare earth elements. New deposits of gold, cuprum and lead have been discovered in Ukraine. Kimberlite pipes with fragments of fine diamond crystals were discovered in the north of the Azov crystalline massif. In the north and south of the region oil and gas fields have also been found. Free natural gas fields, representing 1,200 million m^3 are being prospected here, Fifteen other gas reserves have already been discovered with expected reserves of 30 billion m^3. According to various estimates the coal fields of the oblast contain as much as 11.5 trillion m^3 of methane, a valuable energy raw material and potential substitute for natural gas (see Part 4.1).

Commercially mined minerals include rock salt (Artemovsk and Slavyansk rock salt deposits) and coal (Donetsk Coal Basin deposits). The coal mined in Donetsk Oblast contains germanium, a valuable element. Germanium concentrate is obtained by way of the coke-making process.

With regard to mineral raw materials serving as a basis for production of building materials and steel, the oblast has considerable dolomite and fluxing limestone deposits (Elenovskoe and Novotroickiy deposits), apyrous clay beds (Druzhkivka-Chasov Yar deposits) and gypsum (Artemovsk gypsum and anhydrite deposit). Deposits of chalk, building and glass-making sands, quartzite and granite have also been developed.

2.2. Natural conditions

Soil and land resources. Donetsk Oblast is renowned for its chernozem (black earth) with a fertile stratum that sometimes reaches down deeper than one metre. The north and north-east of the oblast has fertile soil such as typical, common and medi-humous chernozem; poor-humous chernozem is most common in the south and south-west (see Figure 2.2.3). Along the valleys of rivers and ravines we find meadow and bog-meadow chernozem, mainly saline and bog-meadow soil; on the spits of the Sea of Azov and along the banks of the Severskiy Donets river there is sand and sandy loam. The map of the oblast shows about 60 soil and ground types.

The land stock of Donetsk Oblast as of 1 January 2009 is 2,651,700 ha. Agricultural holdings occupy 2,096,000 ha with 79% used as arable land. The structure of the land stock of Donetsk Oblast is shown in Figure 2.2.1.

There is practically no natural, undisturbed earth in Donetsk Oblast today. Natural territory only survives in national parks and in some areas along the flanks of the Donetsk ridge and Azov upland. Branches of the Ukrainian Steppe Natural Reserve, which includes the Khomutovsky steppe (founded in 1926) and the Stone Tombs (founded in 1927; part of this reserve lies in Zaporizhia Oblast) are situated in Donetsk Oblast. In addition to the Ukrainian Steppe Natural Reserve there also seven independent institutions operating as national and local nature reserves: The Svyati Gory national park, the Donetsk botanical garden, the Meotida, Kleban Byk, Zuevsky, Kramatorsky and Slavyansky Kurort regional landscape parks. The structure of the region's nature reserves is shown in Figure 2.2.2.

In all the structure of nature reserves in Donetsk Oblast amount to 17 bodies of state concern and 80 bodies of local con-

Figure 2.2.1 The structure of the land stock of Donetsk Oblast

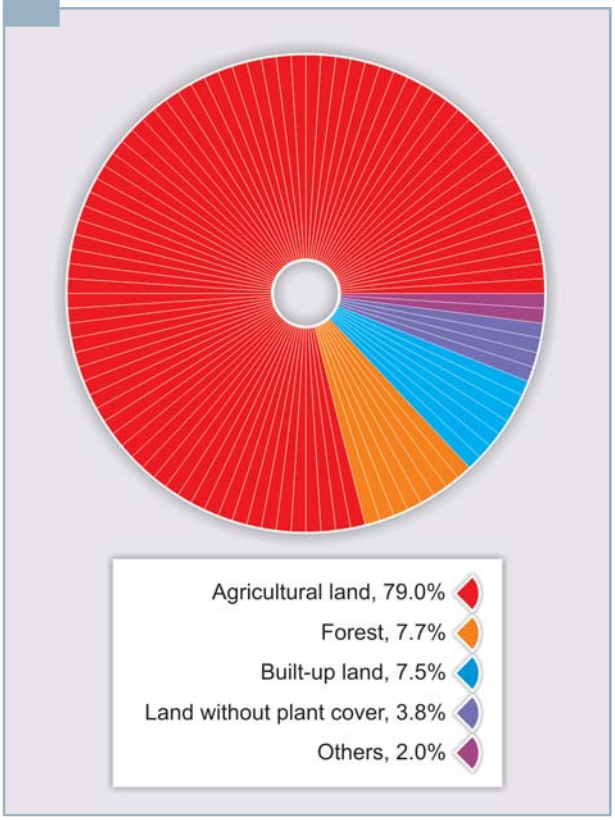
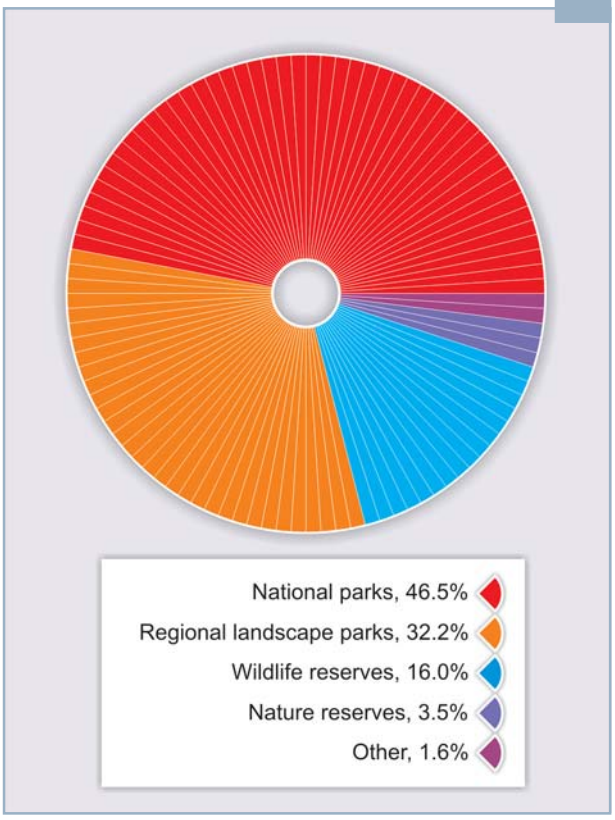


Figure 2.2.2 The structure of the natural reserve fund of Donetsk Oblast



Source: State Statistics Committee of Ukraine, 2009

cern, including 49 wildlife reserves, 36 natural monuments, 12 protected tracts and one monument of landscape architecture (see Figure 2.2.3).

Flora. In their heyday the Donetsk steppe was famous for the diversity of its plant life. Before the start of the 19th century it was a virgin natural territory. Today the Donetsk region is one of the Ukrainian regions where human activity has had the most prominent impact on nature. The major part of the steppe has been ploughed up and plots of natural vegetation, typical to the south-western zone of the eastern European plain, are very rarely found outside national parks. The Donetsk ridge still has oak forests and small woods in steppe ravines. Pine and flood plain forests grown on the banks of Severskiy Donets. Forests occupy 8% of the oblast's surface area (213,200 ha). Forests in the oblast are labelled as the first forest group and perform exclusively conservation and recreational functions. More than 70% of woodland is artificial in origin. The distribution of forests between users is shown in Figure 2.2.4.

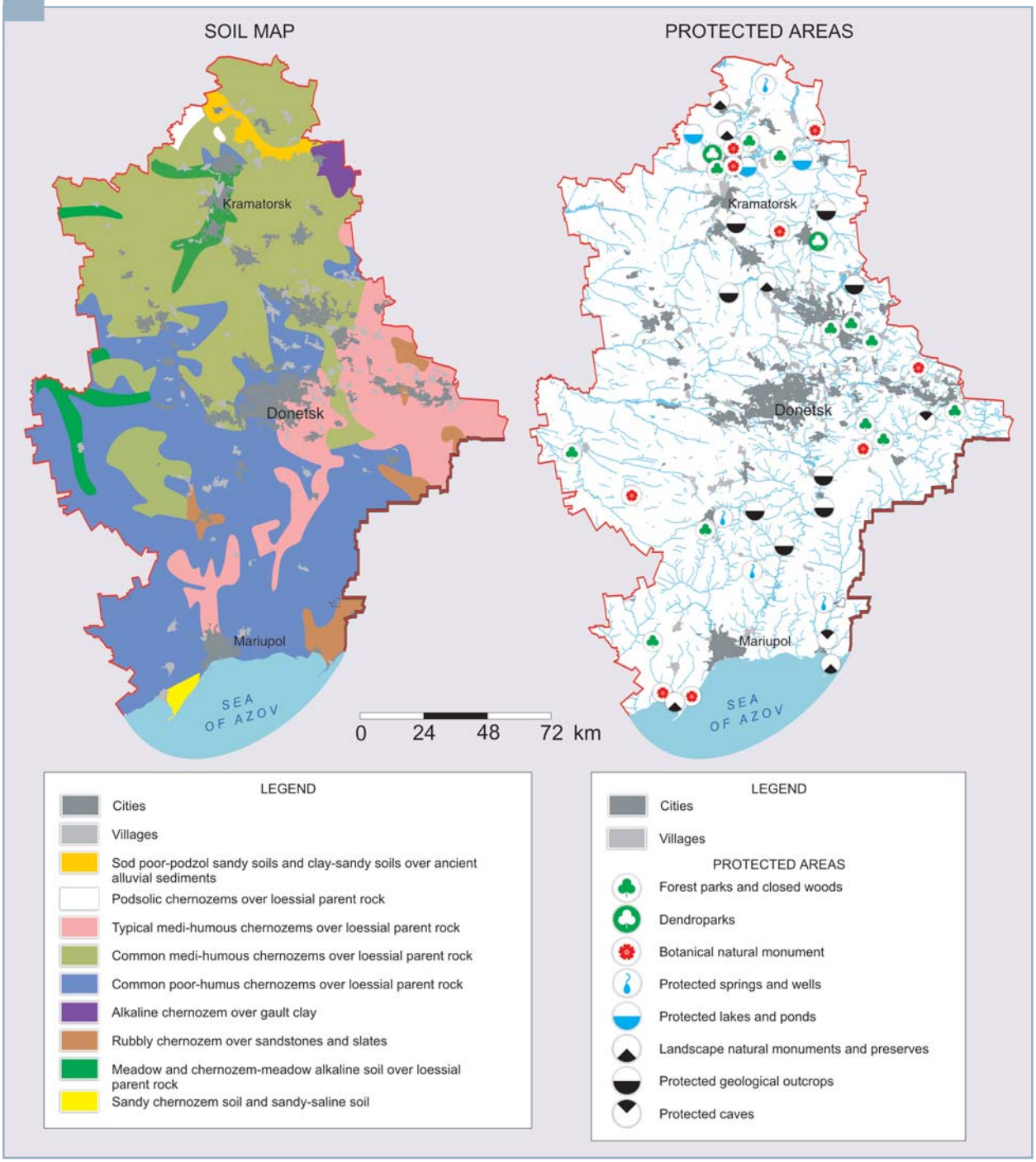
Owing to its special features Donetsk

Historical background of Donetsk steppe

"I need to write much, but the material is notably draining. I should leave Lopas'nia and live somewhere else. If it were not for bacilli, I would settle in Taganrog for two or three years and work on the Taganrog-Kramatorovka-Bahmut-Zverevo region. It is a fantastic land. I like the Donetsk steppe and long ago I felt at home there and I knew every gully. When I remember these gullies, Saur-Mogila, stories about Zuy, Khartzis, General Ilovaiskiy, and recall how I went by oxcart to Krinichka and Count Platov's Krepkaya, I am sad and it is a pity that there are no belletrists in Taganrog and this very nice and valuable material is of no use to anybody".

Taken from A.P. Chekhov's letter to P.F. Iordanov, 25 June 1898.

Figure 2.2.3 Map of soils and protected areas of Donetsk Oblast

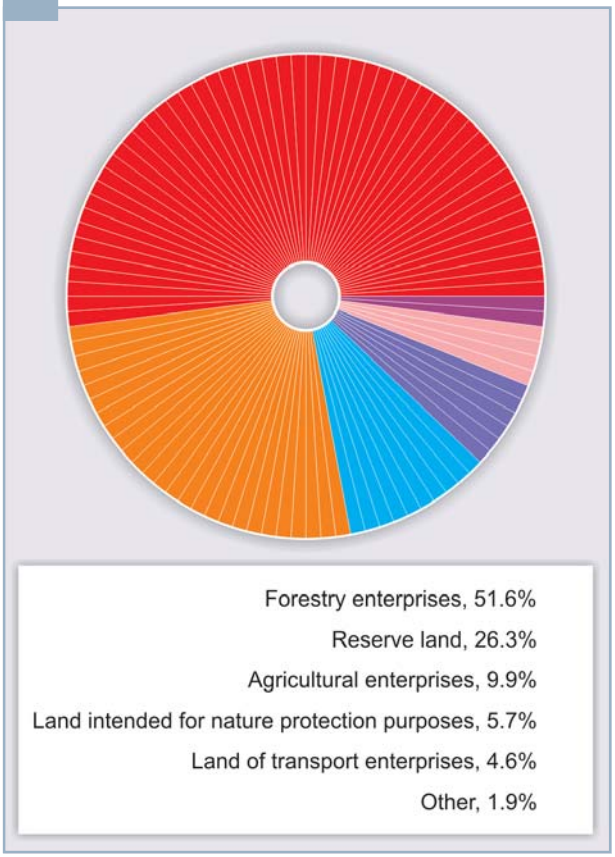


Source: Atlas of Donetsk Oblast, The State Administration of Environmental Protection in Donetsk Oblast, 2009

region refers to zone that is sufficiently favourable to vegetation growth. The location of areas of vegetation over the territory of the region is shown in Figure 2.2.5. Some 1,870 different species of flora are registered in Donetsk oblast, 40% of the species found in Ukraine. Oak, maple, ash and elm trees grow mostly on the Donetsk ridge, pine, alder and elm grow along the banks of Severskiy Donets, and oak, English field and Tatar maple, ash, black locust, apricot and mulberry trees grow in sheltered belts.

In spring rich motley grasses can be observed on the steppe, with colonies of

Fig. 2.2.4. Distribution of forests between users



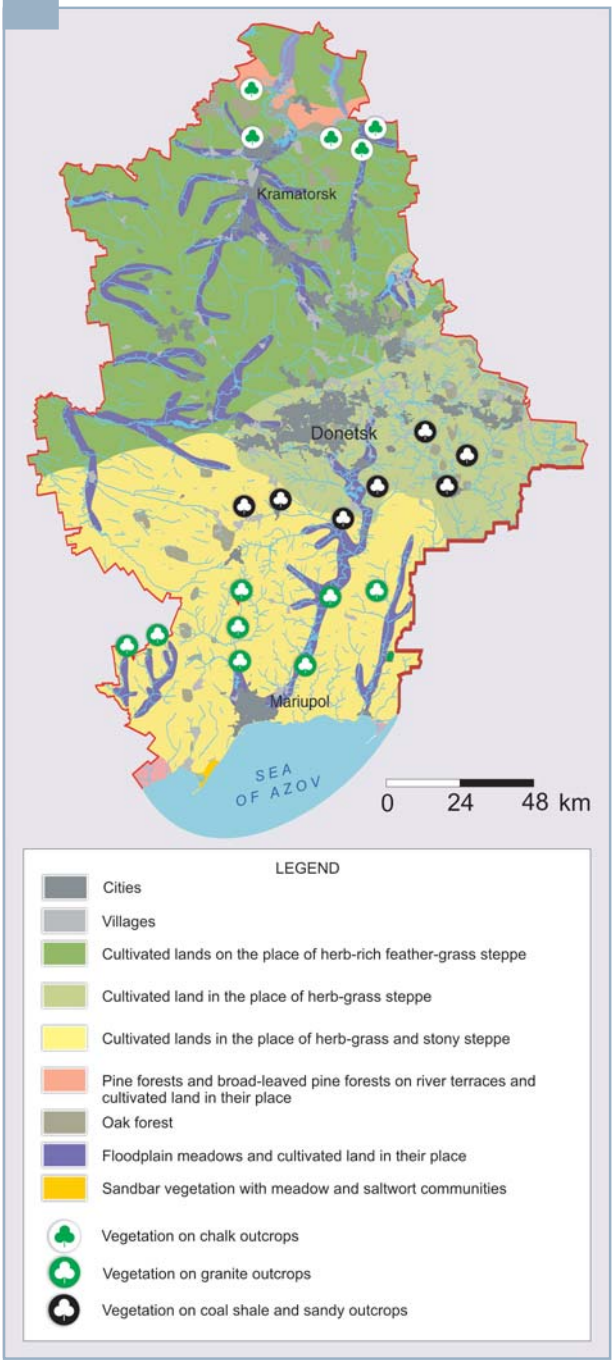
Source: State Statistics Committee of Ukraine, 2009

feather, fescue and couch grass, meadow fescue, forget-me-not and yellow grass. These and other herbs give unique fragrance to steppe. Far less common are arum, bellflower, veronica, wormwood and so on, which came to the region from the Crimea and the Caucasus. In general, the steppe has now been by ploughed up for crop growing. In the last 100 years the feather grass of the past has been irretrievably lost. Feather grass, a unique Alpine fern only found in a few places on Earth is now in the Red Book as well as growing on the territory of the Ukrainian Steppe Reserve.

Fauna. Just two to three hundred years ago the Donetsk region was called the "wild field". This vast expanse of steppe, with its rich motley grasses, brushwood, marshy and reedy river banks and flood plain forests, was almost empty of humans, leaving real freedom to countless animals and birds. Historical evidence show that saiga antelopes, wild tarpan horses, bears, wild swans and other types of fauna which long ago disappeared from the oblast, were found on the Donetsk steppe.

Nowadays there is little diversity in the fauna of this industrial region, with just a few steppe and forest animals. About 50

Fig. 2.2.5. Flora



Source: State Statistics Committee of Ukraine, 2009

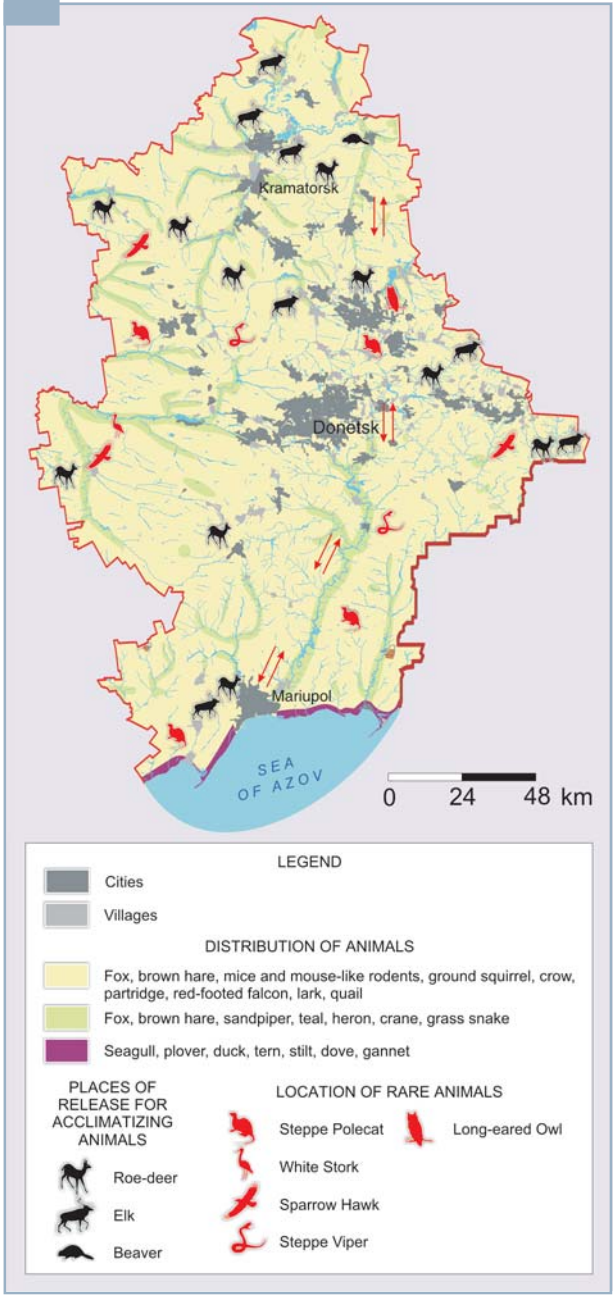
mammal species, 38 fish species, 12 reptile species and 300 bird species are found in the region. Species distribution over the region is presented in Figure 2.2.6.

In Donetsk forests and steppes visitors may encounter foxes, wolves, badgers, elk, sika and roe-deer, wild hogs, squirrels, hedgehogs, owls, nightingales, woodpeckers, doves, starlings, cranes, larks and tits. Desman (moles) are found on the shores of Severskiy Donets, with a large mole population in the Veliko Anadol forests, while in the Drobyshevo tracts there are coypu. The reptile population of the steppe includes black-whip snakes, Orsini's vipers, grass snakes and lizards, with freshwater turtles in steppe lakes.

Many aquatic birds are established on the banks of lakes and Sea of Azov spits, particularly during the migration season, notably geese, ducks and sandpipers. Seagulls, terns and plovers are common on the Sea of Azov coast, and (azovka) dolphins live in its waters, in addition to 79 other fish species. Some of them have commercial value: kilka, Azov anchovy, bullhead, herring, mullet, flatfish and sturgeon.

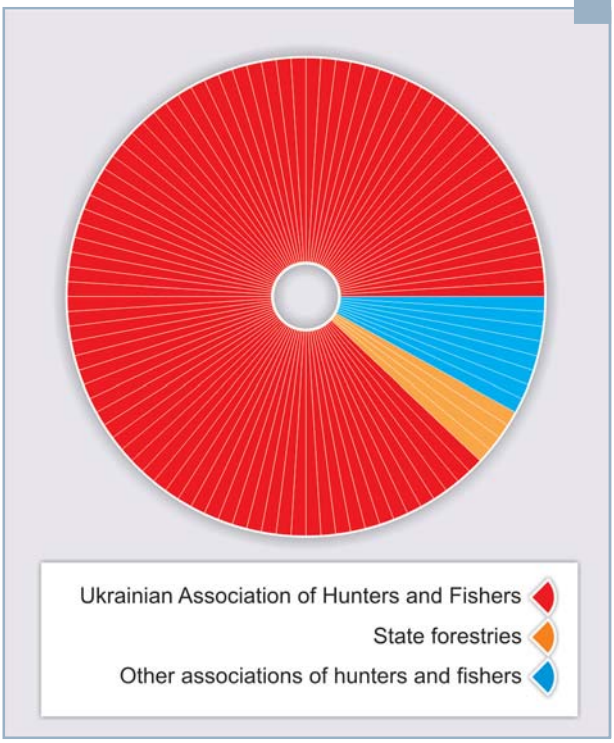
The total area of hunting land in the region is 2,018,900 ha, 80% of which is covered by fields, 13% by wetlands, and 7% by woods and forest. The distribution of hunting lands between users is shown in Figure 2.2.7.

Fig. 2.2.6. Fauna



Source: The State Administration of Environmental Protection in Donetsk Oblast, 2009

Fig. 2.7.7. Distribution of hunting lands between users



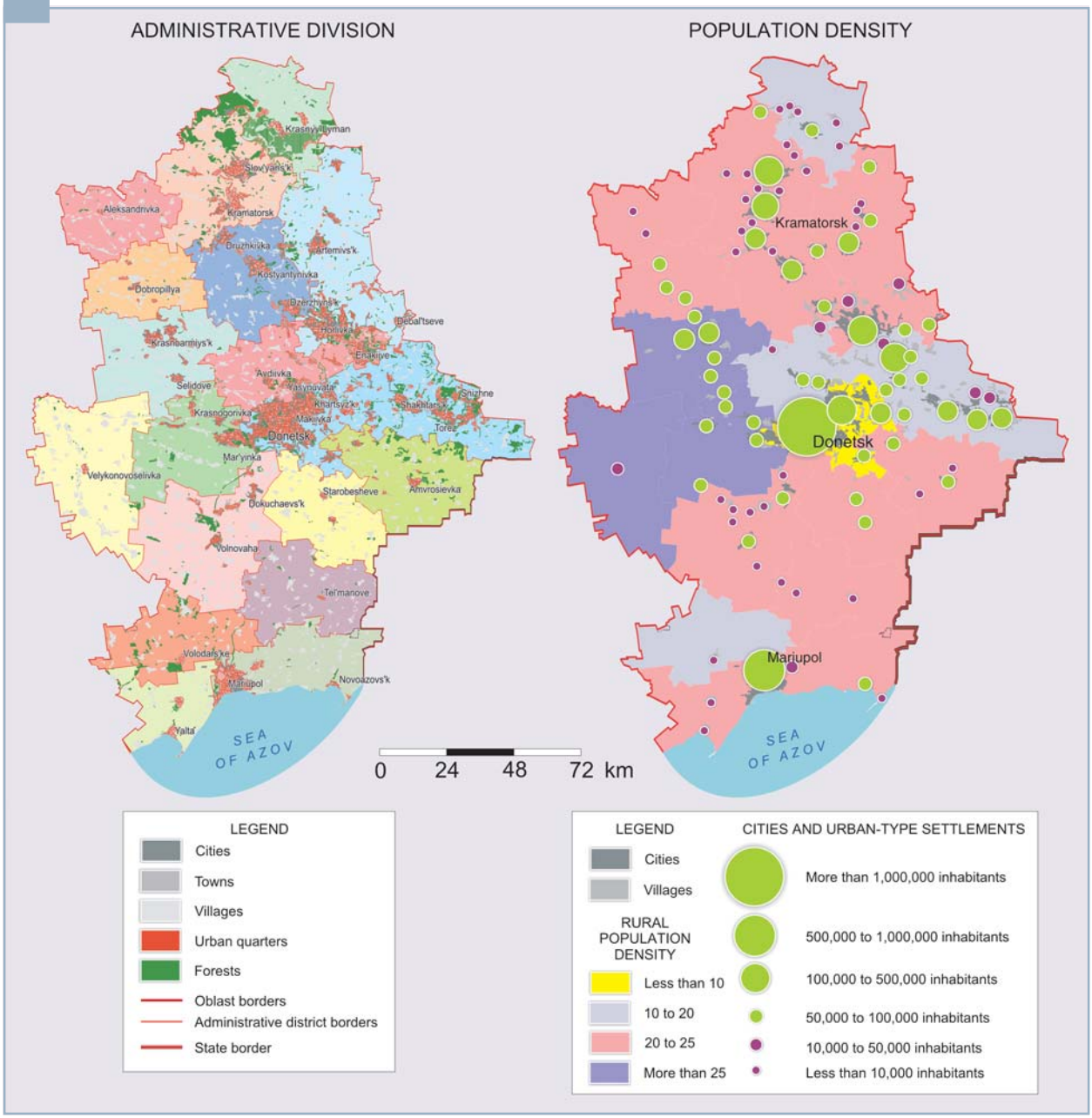
Source: State Statistics Committee of Ukraine, 2009

2.3. Infrastructure and economy

Administrative division. Donetsk oblast is currently the largest Ukrainian region by area (26,517,000 kml), population (4,519,700 people), urbanization (91%) and domestic product. The oblast is subdivided into 17 raions (administrative districts) and 33 territories of city subordinance. Some 52 settlements enjoy city status, with a further 131 urban-type settlements. The administrative division of the oblast is shown in Figure 2.3.1.

The largest cities of the oblast are: Donetsk (994,000 people), Mariupol (495,300 people), Makiivka (404,600 people), Horlivka (288,500 people), Kramatorsk (203,500 people), Enakiive (140,200 people), Slov'yans'k (141,400 people) and Khartsyz'k (107,100 people). They are di-

Fig. 2.3.1. Administrative division and population density of the oblast



Source: Atlas of Donetsk Oblast, The State Administration of Environmental Protection in Donetsk Oblast, 2009

Fig. 2.3.2. Share of Donetsk Oblast in Ukrainian industry

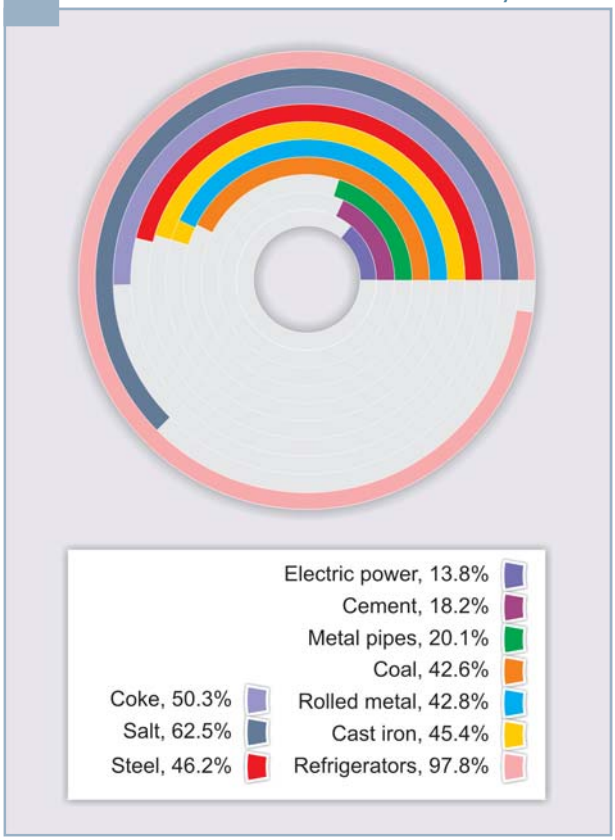
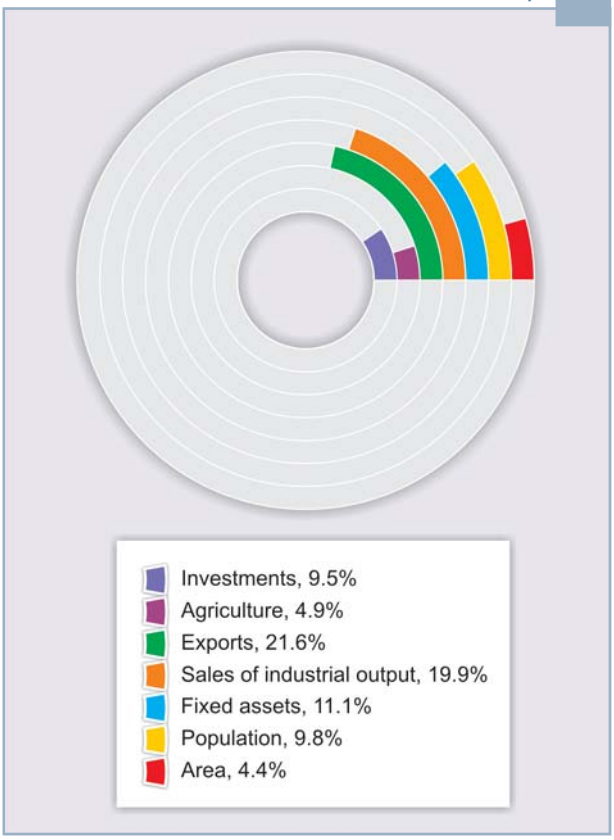


Fig. 2.3.3. Share of Donetsk Oblast in Ukrainian economy



Source: State Statistics Committee of Ukraine, 2009

versified industrial centres. Population density is shown in Figure 2.3.1.

Industry. Branches of heavy industry based on the mineral and raw material resources of the Donetsk ridge are predominant in the oblast's economy: coal mining, ferrous metallurgy, mechanical engineering and metal working, chemical industry, production of building materials, construction of housing and industrial plant. Some 85% of the oblast's working population is engaged in these branches.

The Donetsk region is at the top of the country's economy, but the economic complex of the oblast is characterized by a major imbalance between industry and agriculture. The Donetsk region has the highest per capita gross regional product in Ukraine. Key figures for Donetsk oblast, compared with Ukraine as a whole, are presented in Figures 2.3.2 and 2.3.3. The economic characteristics of the oblast are shown in Figure 2.3.4 and the location of key enterprises in Donetsk oblast is shown in Figure 2.3.5.

A hundred and nine mines are operating in the oblast, of which 87 belong to eight holding companies and six industrial associations. Nine mines and one mine office operate as independent organizations. Furthermore, 20 coal-preparation plants belong to holding companies. The total production capacity of coal producers amounted to 34 Mtonnes in 2007-8.

Metallurgy in the oblast is represented by a powerful industrial complex which includes 39 metallurgical, pipe, hardware, fireproof and non-metallic enterprises, and various repair and scientific organizations. About half of metal production, more than half of coke output, three-quarters of refractory products made in Ukraine are produced by Donetsk metallurgy enterprises. The sector is the main exporter, with three-quarters, by volume, of all exports from the oblast. Metal products are sold to more

Historical background of Donetsk industry

The rapid development of industry in the Donetsk region in the 19th century was connected with the building of railways and coal mines in 1868-78. By 1890 coal production in Donbas had increased eighteen-fold to reach 2.9 Mtonnes, making up 85% of all the coal mined in the Russian empire. By the end of the 19th century six metallurgical works had been built in Donetsk region. By 1913 there were 12 works, employing 45,000 workers and producing more than 2 Mtonnes of cast iron and 4.3 Mtonnes of coke. At the time the largest enterprises were the metallurgical works at Petrovsk, Yuzovka and Makeevka.

Reconstruction of the Donbas industry after the first world war and the Russian revolution began in the 1920s. By the Great Patriotic (second world) war new mines and power stations had been built, metallurgical and coke by-product plants had been rebuilt and production boosted. In 1940 85 Mtonnes of coals were mined in the Donetsk region, half of coal production in the Soviet Union. Similarly the region's metallurgical enterprises were producing 30% of the cast iron, 20% of the steel and 22% of the rolled metal produced in the USSR.

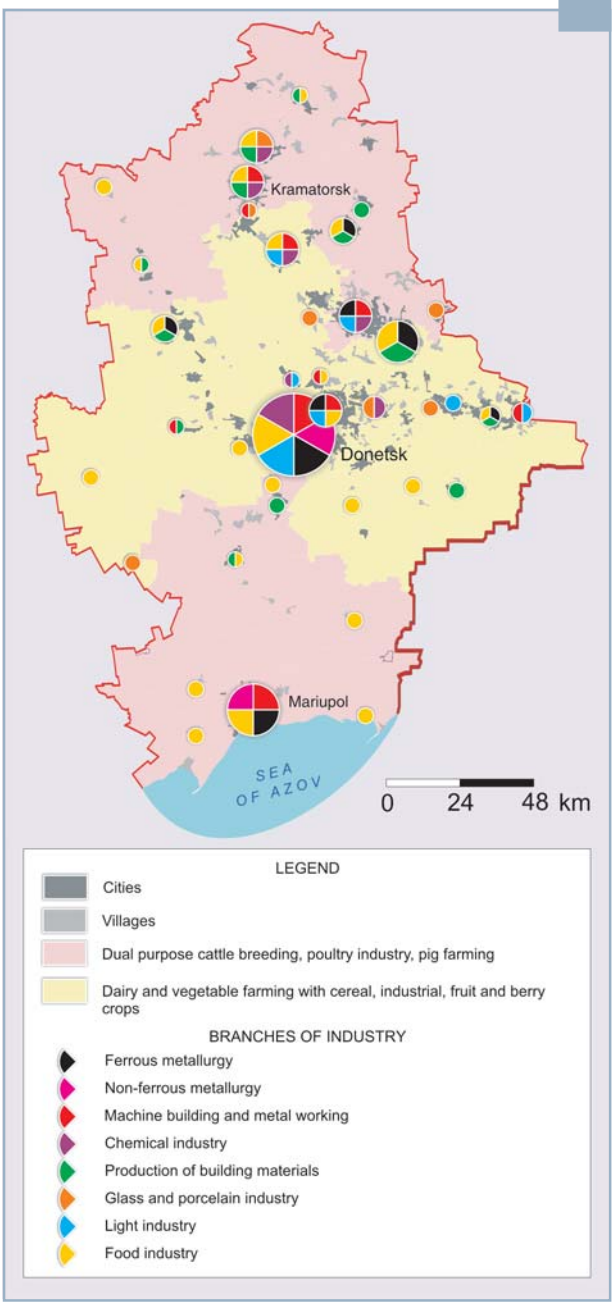
During the second world war Donbas industrial enterprises were completely destroyed. After the war regional cities and enterprises had been rebuilt by 1950, but pre-war levels of production in many branches were only reached in 1953. In the post-war years the volume of regional industrial output increased by 50-70% every five years. By the early 1960s the 131-kilometre Severskiy Donets-Donbas canal had been built, new thermal power plants and mines had been commissioned, and output at all metallurgical works had been restored. The volume of housing and school construction grew rapidly in the region, with new high, secondary and primary schools (respectively 16, 120 and 4,000).

than 50 countries worldwide. In 2007-8 Donetsk metallurgy enterprises produced 17-20 Mtonnes of steel, 14-16 Mtonnes of cast steel, 9-10 Mtonnes of rolled metal and 10 Mtonnes of coke.

The Azovstal and Ilyich integrated iron and steel works, respectively, are best known in the world market for ferrous metal. The metallurgy complex also includes the Khartsyzsk pipe plant, one of the main producers and suppliers of heavy-gauge gas and oil pipelines; the Silur plant in Khartsyzsk, the largest producer of steel cable and wire; and the Druzhkivka hardware plant. Moreover, the oblast produces more than half the total volume of non-ferrous metal produced in Ukraine.

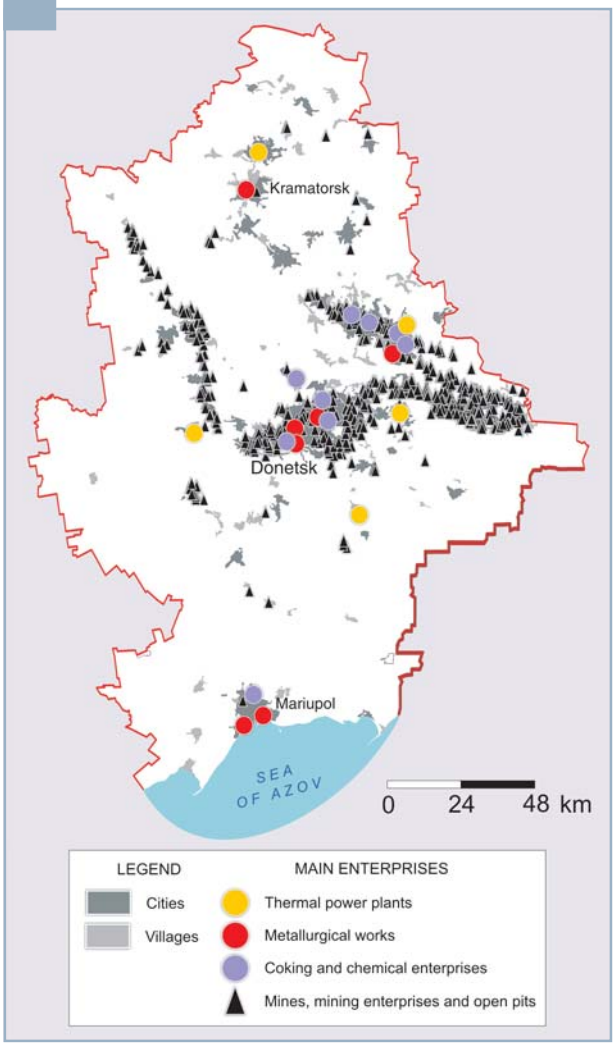
The chemical branch is represented by 15 enterprises which produce mineral fertil-

Fig. 2.3.4. Economic characteristics of the region



Source: The State Administration of Environmental Protection in Donetsk Oblast, 2009

Fig. 2.3.5. Main enterprises in Donetsk Oblast



Source: The State Administration of Environmental Protection in Donetsk Oblast, 2009

izers, plastics, soda, acid, high explosive and household cleaning goods. One-third of nitrogen fertilizers, ammonia and sulphuric acid produced in Ukraine are made here. The oblast's leading chemical enterprise is the Stirol concern, which exports about 80% of its output. The Kostyantynivka chemical plant is another successful venture, exporting almost half its output. In 2007-8 the oblast's chemical branch produced 580 ktonnes of chemical fertilizers, 70 ktonnes of plastics, 350-380 ktonnes of sulphuric acid.

The mechanical engineering complex consists of 207 enterprises in different branches of national economic. The largest coal engineering enterprises are the Druzhkivka and Horlivka mechanical engineering plants, the Donetskgormash and Artemivs'k Labour Victory machine building plants, also at Novogrodivka and Yasinuvataya. The main mechanical engineering enterprises supplying equipment to metallurgical works are NovoKramatorsk Machine-building Plant (NKMZ) and Staro-Kramatorsk Machine-building Plant (SKMZ), Azov, Slavtyazhmash, Debaltseve Metallurgical Engineering Plant. Machine building accounts for 10.1% of total industrial output in Donetsk oblast.

More than 60 plants are related to the general machine building branch (military industrial complex and conversion enterprises). The largest of them are the Tochmash plant in Donetsk, Energomashspetsstal Heavy Engineering Plant in Kramatorsk and Donbaskabel Machine-Building Plant.

Donetsk oblast is one of the largest contributors to foreign trade in Ukraine, with a share of total exports exceeding 21.6% and 5.8% of imports of manufactured goods. More than 1,000 enterprises and organizations are involved in export trade, with partners in 190 countries worldwide. More than 1,500 economic agents handle imports. Raw materials play a predominant part in the breakdown of export and import commodities. Ferrous metal and associated manufactured goods make up 80% of exports, while fuel accounts for half of all imports.

Energy

The energy branch of the region is represented by eight thermal power plants producing 20-25 billion kW per hour. The location of the largest thermal power plants in the region is shown in Figure 2.3.5.

The region consumes 10-11 billion m^3 of natural gas, 180-200 ktonnes of petcoke, 550-600 ktonnes of petrol and 25-30 ktonnes of liquefied propane and butane gas every year. Industry accounts for the largest share of energy and fuel usage, absorbing 88.2% of electric power, 99.4% of coal, 98.3% of natural gas and 39% of petrol.

Transport

Donetsk oblast has important traffic centres, connected by various means of transportation. The region is situated at the intersection of major railway lines and roads carrying traffic to other industrial regions and traffic centres of Donbas, Ukraine, the former Soviet Union and beyond. In 2007-8 freight traffic volume by all kinds of transport amounted to 280-300 Mtonnes of freight, with 885 million passengers transported.

The transport system of the oblast consists of a dense network of roads and railways of national and local importance. The road network extends over more than 8,000 km, and the railways reach over 9,500 km. A map of transport infrastructure is shown in Figure 2.3.6. There are 540 transport structures (bridges, overpasses, etc), including 467 on local roads.

Road transport is represented by 51 open joint-stock companies and four government motor transport enterprises. They handle 13% of all cargo traffic and 70% of passenger transportation. In 2008 there were 87,600 lorries and 15,800 buses.

Donetsk Railways operates five regional offices, 14 stations, 34 motive-power depots and car houses, 44 divisions as well as a number of structural secondary departments.

The main marine transport enterprise in the oblast is the Azov Sea Shipping Company Joint Stock Co. The enterprise has in balance 53 vessels with a total deadweight tonnage of 462.4 ktonnes. The fleet consists of general shipping and special-purpose vessels: automobile-carriers, bulkers, wood-cargo vessel, etc. Vessels of the company operate almost all over the world. The main goods transported are coal, metal, timber, cement, cotton, grain, citrus fruit and containers. The annual volume of cargo transportation is 12 Mtonnes.

The biggest traffic centre and base for the vessels of the company is Mariupol merchant shipping port. The port handles more than 2,000 vessels and more than 190,000 railroad freight cars every year.

Donetsk airline is one of the five largest airlines in Ukraine. Donetsk airport is international. Customs and medical aid post function in it. The airport is equipped with modern instrument landing systems and traffic control facilities. Air transport service accounts for more than 70% in total volume of international passenger transport.

Historical background of the development of the energy complex

In 1922 construction of the first power plant in Donetsk oblast – Shterovsk GRES – began on the left bank of the river Mius. At the beginning of 1927 power started to flow to Bokovo, Kadievka, Krasniy Luch, Chistyakovo and Snezhnoe. More than 150 km of power lines were built, with six substations.

In April 1930 work on the foundations of the main building of the Zuevsk thermal power plant began in the valley of the river Krynka. In August 1939 the first turbogenerator in Ukraine and the largest in Europe, rated at 100,000 kW, started producing power for industry.

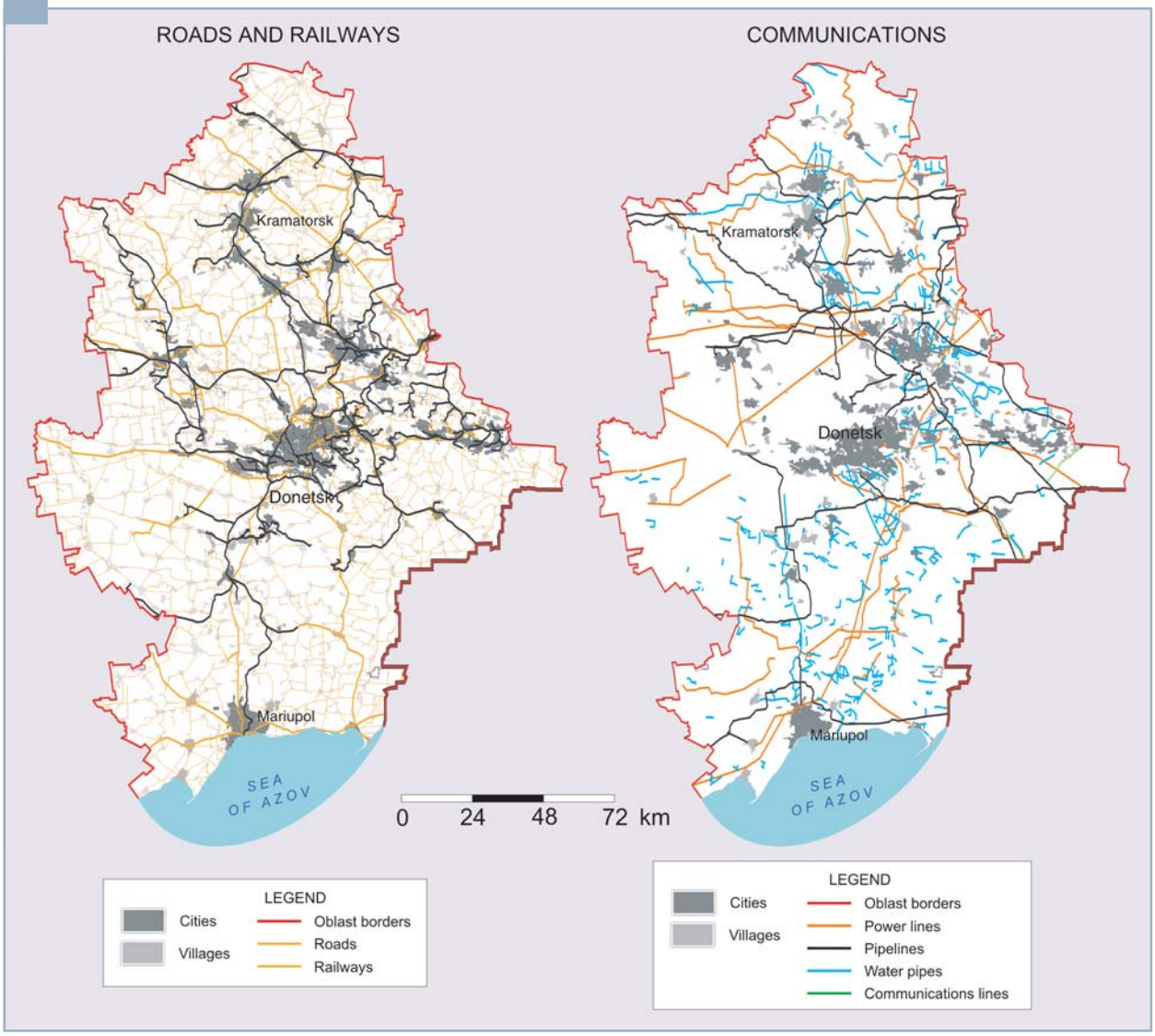
The rapid development of Donbas industry after the second world war demanded a reliable, regular power supply. The Mironovka thermal power plant was the first to be built, as a prototype, and equipped with 100 000 kW turbogenerators. Power plants followed at Slavyansk, Starobeshevo and Uglegorsk.

The Uglegorsk power plant was one of the largest thermal power plants in the world, producing 3,600 MWt, after several single-shaft power generating units came into service in 1975-7.

At present nearly all the oblast's electrical power is produced by thermal power plants. One wind farm is operating in Novoazovs'k. The largest electricity producers in the oblast are the thermal power plants at Vuglegirs'k (3.6 million kWt), Starobesheve (2.0 million kWt), Slovians'k (1.8 million kWt) and Kurakhiv (1.46 million kW).

A reconstruction project is underway at Starobesheve thermal power plant, to allow use of waste coal for energy production, with a reduction in emissions of pollutants into the atmosphere of the oblast. In 2009 it is planned to rebuild the Kurakhiv thermal power plant, increasing the capacity of the power generating unit.

Fig. 2.3.6. Road and communications map of Donetsk Oblast



Source: The State Administration of Environmental Protection in Donetsk Oblast, 2009

Agriculture

Donetsk oblast has a sizeable fund of lands, owned by agricultural enterprises and farms. Ploughed fields make up 81%, hay-fields and grass lands make up 16.1% of total territory of cultivated land. In general, land is characterized by high natural fertility that makes favourable conditions for stock raising and crops. More than 3,000 farms and agricultural enterprises provide the oblast with agricultural goods, accounting for 4.9% of branch.

The soil of Donetsk oblast is rich in humus that makes ideal conditions for producing a wide variety of agricultural commodities. The main farm crops are winter wheat, sunflower seeds, fruit and vegetables. Main part of area under crops is given to raising of cereal crops (52.8%). At sunflower part falls 30,8% of total area, at potato and vegetable – 6,4% and at feed crop – 9,4%. In 2008 the average crop capacity amounted to 3,080 kg per hectare for cereals, 1,690 kg for sunflower seeds, 1,027 kg for potatoes, and 1,516 kg for vegetables.

Stock raising concentrates on dairy and meat production. Pig, poultry and sheep farming are developing. Every year the region produces 140-150,000 tonnes of meat, 370-400,000 tonnes of milk, 9-11,000 tonnes of fish and 130-150 tonnes of wool.

SECTION 3

ECOLOGICAL AND ECONOMIC SITUATION

Technogenic impacts have shaped the territory of Donetsk Oblast, much as many other industrial regions. For many decades industrialization has been one of the region's development priorities.

Only in the course of time has the community understood the need for a new development pattern focussing on reduced environmental impacts and sustainable use of natural resources. Many industrial regions of the world have passed this way and Donbas is no exception.

In Donetsk Oblast the key factors impacting adversely on the natural environment are urbanization processes and human economic activities. The main economic activities, in order of the importance of their impact, are mining and smelting, energy, agriculture and transport.

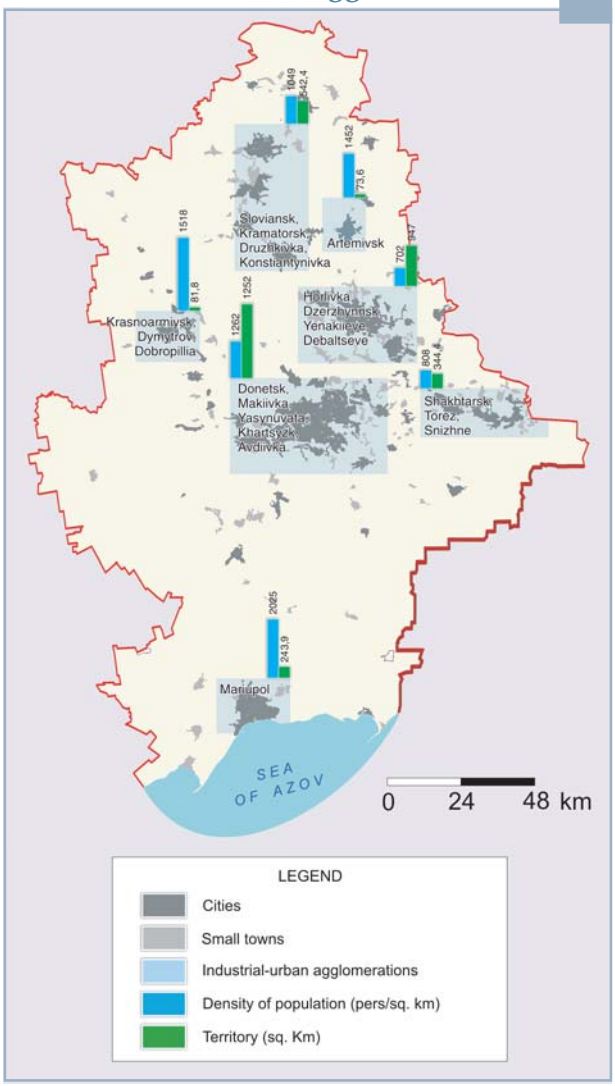
Plausible scenarios for the economic development of the region are not always favourable to the region's environment. Production declined in 1991-7 and 2008 reducing environmental impacts, but there has still been no radical change in public attitudes to the problems of environmental protection. The future of the region's environment depends on a radical change in industrial technology, rejection of consumer behaviour and sustainable treatment of nature by the community.

3.1. Regional development

The future of the region and its development prospects depend on rising living standards, human development, industry restructuring, the region's ability to attract investment, the environment and social conditions.

According to demographic forecasts the population of Donetsk Oblast will decrease over the next 15 years by 8% to 10%, totalling 4.1 to 4.2 million people by 2020. Moreover, the share of the population having reached retirement age will increase from 21% to 34-35%. But at the same time the share of children and adolescents, and also of the working population, will decrease.

Fig. 3.1.1. Location map of industrial-urban agglomerations



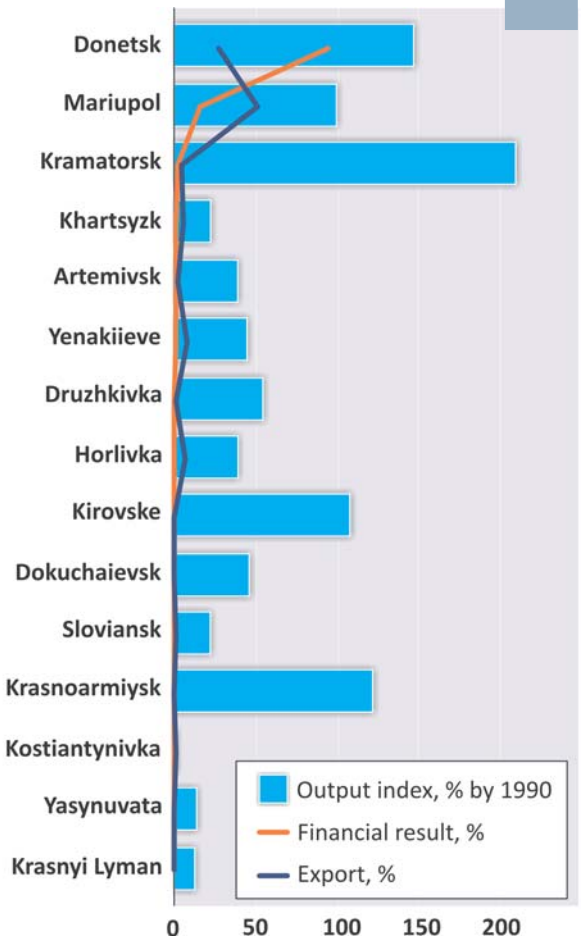
Source: State Environmental Protection Administration in Donetsk Oblast, 2009

At present the region has 22 major centres of population, which locally and economically form seven large industrial-urban agglomerations (Fig. 3.1.1). In demographic and migratory terms most of the large urban agglomerations are in a state of long-term stagnation. On the whole, since 1990-2008, the number of city-dwellers has shrunk by 850,000 people, equivalent to about 16% of the regional population.

Assessing regional development in Donetsk Oblast with a view to deploying environmentally-oriented policies is a complex, multidimensional task. Industrial-urban agglomerations generally develop slowly, a process predetermined in most cases by their tendency to specialize, concentrating on the activity of large enterprises which are conservative in development. Changes in the economy over the last 20 years have increased the share of metallurgy, energy, mining and heavy engineering in industrial output, whereas the share of light industry, food processing and agriculture has declined. As a result cities with large, heavy-industry enterprises have enjoyed economic growth whereas the economic development of small towns without such industries (Druzhkivka, Krasnyi Lyman, Kirovske etc.) has slowed dramatically. At the same time the leading cities in the region's economy have little impact on the development of other territories. More attention should be paid to analysing urban development patterns. For several years economic and social development programmes have been suspended in many population centres. At present only the city of Donetsk has a forward-looking plan up to 2026 providing for complex improvements in urban areas based on environmentally-oriented development.

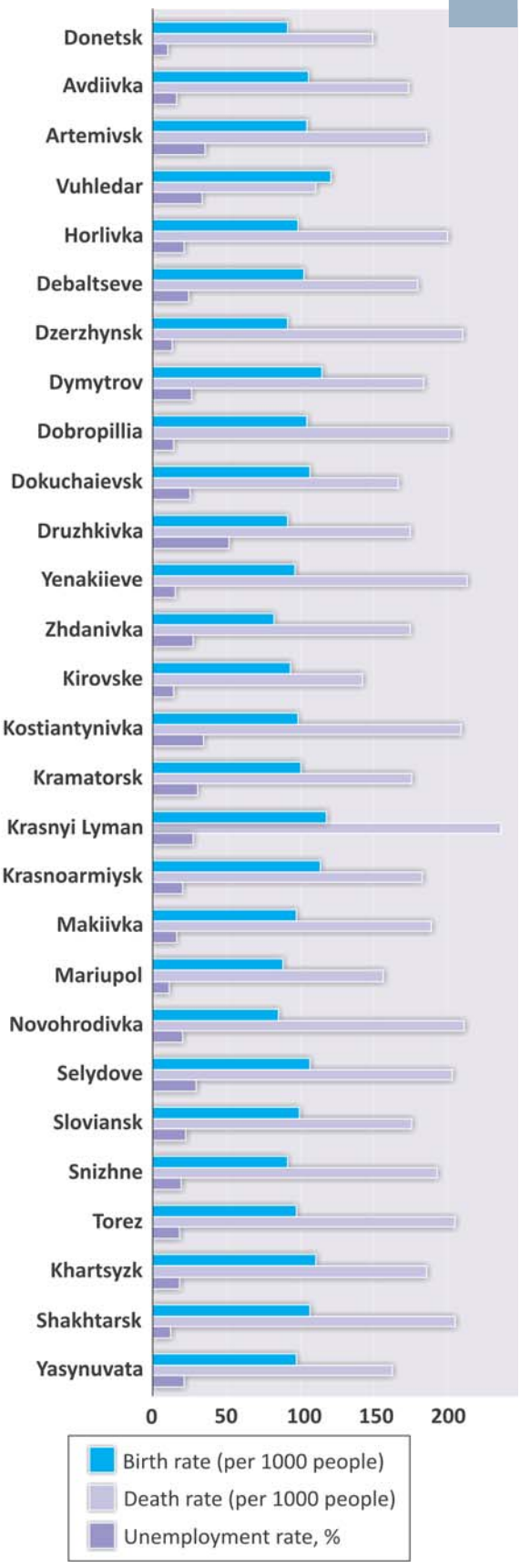
The current specialization of districts

Fig. 3.1.2. Economic indicators of the cities



Source: State Environmental Protection Administration in Donetsk Oblast, 2009

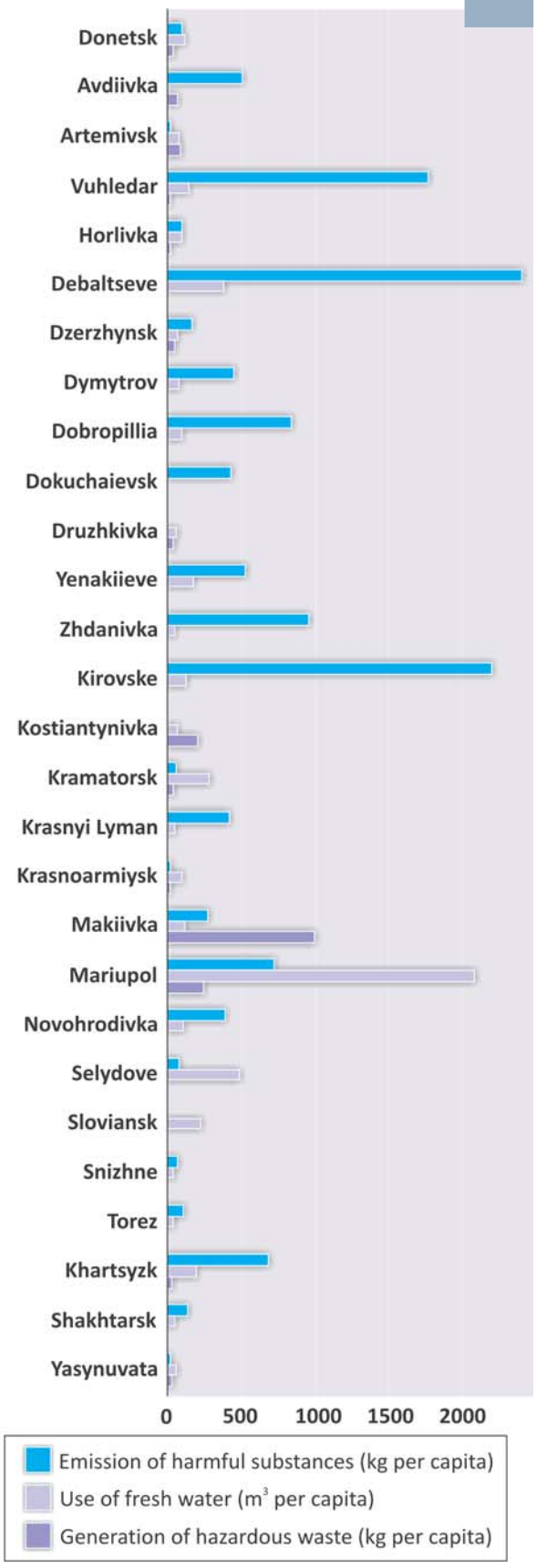
Fig. 3.1.3. Social indicators of the cities



and their environmental and social situation are often restrictive factors determining the specific development of big cities. The observed differences in the development of the region's main cities are shown in Fig. 3.1.2 and 3.1.3. It is clear from this data that two cities of Donetsk Oblast (Donetsk and Mariupol) provide major revenues (about 95%) and only five cities (Donetsk, Mariupol, Kramatorsk, Kirovsk and Krasnoarmiysk) have increased or maintained industrial production at the same level as in 1990. In all other cities there has been a dramatic drop in industrial output. The financial result of the 13 cities of Donetsk Oblast, not shown in Fig. 3.1.2, was negative in 2008.

All this points to the fact that the transi-

Fig. 3.1.4. Environmental indicators of the cities



Development priorities for environmentally-stressed regions

1. Develop extensive forward planning for the region's industrial cities, focusing on the environmental development of urban areas.
2. Stop new construction and expansion of operational capacities of environmentally-harmful production activities.
3. Reduce the share of production polluting the environment in the structure of industry.
4. Increase environmental protection charges for harmful industrial enterprises.
5. Increase the share of existing clean activities in overall industrial output.

tion by Donetsk Oblast to market principles of economic management has resulted in substantial disparity in regional development and a great difference in economic growth rates between certain territories. The uneven social and economic development of the territories of the region has increased over the last 20 years. For example the maximum output index in the region's cities is 10 times greater than the lowest figure, unemployment varies by a factor of eight, and population density by a factor of four. Yet more glaring disparities are observed when comparing environmental indicators for the region's cities (Fig. 3.1.4). Maximum emissions of harmful substances per capita are more than 240 times higher than the lowest value, with the amount of hazardous waste generated per capita varying by a factor of more than 3,000.

In keeping with sustainable development principles regional environmental policies must aim to eliminate obvious disparities in regional development and smooth out the environmental impacts of economic activity. Environmentally-stressed territories must therefore subscribe to specific priorities. The environmental development of cities will thus contribute to the whole region's sustainable development, a civilized strategy designed to improve the living conditions of the region's population.

3.2. Industry

The mining and metallurgy complex, which accounts for almost two-thirds of industrial production, forms the basis of the industrial potential of Donetsk Oblast. More than half the region's working population is employed by these two sectors. They are the main consumers of products and services of the engineering, energy and construction industries; many enterprises and financial bodies work for it.

In most of the region's cities metallurgy, mining and coke by-product industries account for 80-90% and more of total industrial output. The work of the mining and metallurgy complex consequently shapes the main economic and financial indicators in the region's cities and territories.

Today Donetsk Oblast supplies 42.6% of the coal produced in Ukraine, 45.4% of the cast iron, 46.2% of the steel, 42.8% of the rolled stock of ferrous metals, 20.1% of the steel tubes and more than 50% of all the coke. However, due to the territorial and economic organization the region has inherited, the oblast specializes primarily in raw materials. Environmentally hazardous products account for more than 82% of total industrial sales - metallurgy (48%) and mining (12%), electrical-energy (10%), chemical, petrochemical and coking by-products (13%).

A dramatic drop in production was observed in Donetsk Oblast from 1990 to 1998. The volume of industrial products in different branches reached its lowest point in 1994-8. In 1997-8 the trend of sustained growth in industry, especially metallurgy and coking by-products, returned and entrenched itself. Between 2000 and 2007 industrial production in the region increased by a factor of nearly 1.6 (Fig. 3.2.1); then in 2008 production fell by 7% on 2007.

Overall the value of production sold by the region's industrial enterprises in 2008 amounted to 160.9 billion hrn. Metallurgy still accounts for most of this value (45.6%), followed by machine-building (10.6%), electrical energy production and distribution (10%), coal (8.3%), coke and refined products (7.8%), chemicals and petrochemicals (4.4%) and food (4.3%).

Ferrous metallurgy in Donetsk Oblast consists of three metallurgy combines, five metallurgy works, two hardware plants, a tube works, a tube-casing plant and a metal works. One-third of basic industrial assets are concentrated in ferrous metallurgy, which also employs one-fifth of the region's industrial-production workforce. This sector underpins the region's export potential.

The volume of production of the metallurgy complex dropped in 2008 due to declining demand and prices on international markets, coupled with insufficient capacity in the domestic metal market. The volume of output from all branches of metallurgy declined. Overall 14.1 million tonnes of cast iron was smelted in the region in 2008, 2.5 million tonnes (14.9%) less than in 2007. In 2008 steel output fell by 2.6 million tonnes (13%) compared with

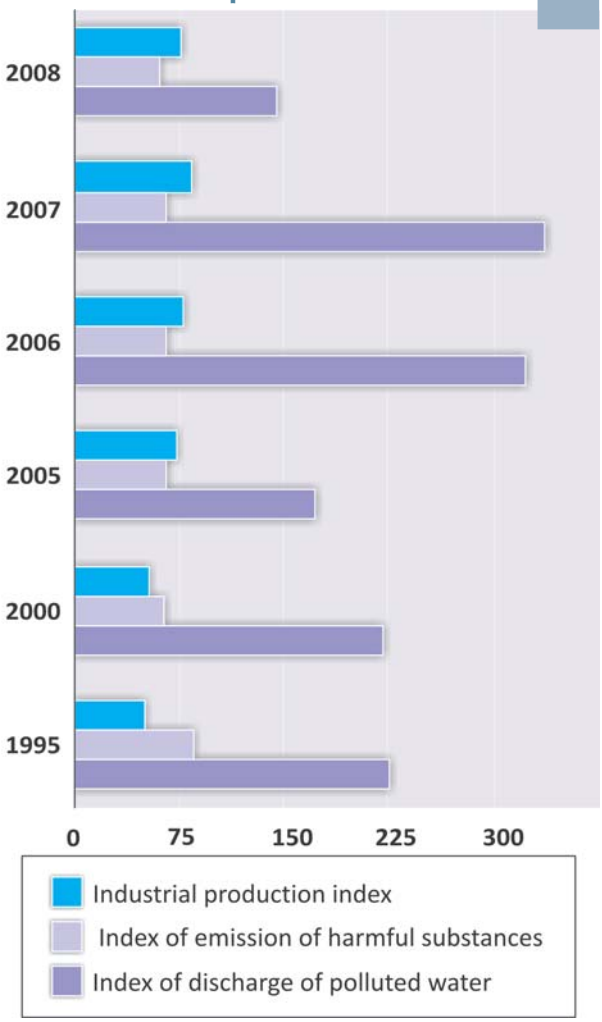
Economic and social trends typical of the mining and metallurgy complex of the oblast

1. Improved economic indicators for the work of iron and steel plants, but decline in the efficiency of the coal industry.
2. Growth in the volume of exports of metallurgy products, but high dependence on the climate in the world metals market.
3. High energy consumption in the mining and metallurgy complex and inefficient use of labour and material resources.
4. Low level of modernization of metallurgy production and insufficient share of competitive products.
5. Regional economy largely centred on the activity of large enterprises (13 enterprises, also the main polluters, generate 65-70% of the region's total profits).

the previous year, totalling 17.6 million tonnes. Moreover steel production using continuous casting machines fell by 2.5% on 2007, totalling 10.8 million tonnes or 62% of all the steel smelted in the region. Output of finished ferrous rolled stock fell by 17.2% in 2008 to 8.8 million tonnes, as did the amount of flat stock, the share of which amounted to 68% of the total volume of finished rolled stock, down by 17.7% compared with the previous year, the amount of bar-rolled stock by 16.3%. Annual output of metal tubes fell by 20.1% compared with 2007, amounting to 512,000 tonnes.

Coking by-products account for 9% of the region's industrial production, by volume, the same share as coal. From 1999 to 2004 production by the coke and chemicals branch increased, followed by a drop which has persisted up to the present day, due to the appreciation of energy carriers. The coal industry has experienced a long-term decline since 1994 with a severe reduction in output. The drop is due to increasingly difficult mining and geological conditions, but also to the closure of a large number of unprofitable mines. In 2008 annual mining output fell by 2.7% on 2007, with a 1.6% decrease in coal output and a 7.3% drop in non-fuel mining. Annual production of rough coal fell by 1.8% to 34.2 million tonnes, and the amount of raised coking coal dropped by 12.3%. At the beginning of 2009 remaining rough coal, mined but not shipped, amounted to 600,000 tonnes. In 2008 42.8 million tonnes of coal (imported from other regions) was processed at the region's coal-preparation plants, up 2.7% on 2007. Production of preparation products increased by 1.3% to 26.1 million tonnes. At the same time the volume of finished coal (preparation products received by mines and rough coal shipped to consumers for further preparation) fell by 3.5% compared with 2007 to 25.2 million tonnes. In 2008 the amount of finished coal for coking fell by 17.8% to 12.2 million tonnes.

Fig. 3.2.1 Industrial production indices and environmental pollution indicators



Source: State Statistics Committee of Ukraine, 2009

By developing a mono-economy focused on mining and metallurgy, Donetsk Oblast is adding to its environmental problems. Pollution of the region's water resources by industrial waste has manifestly degraded many water bodies. The environmental impact of displacing massive amounts of rock through coal mining and accumulating huge metallurgy slag heaps is comparable to natural geological processes. Air pollution is so acute in some industrial cities it is seriously damaging public health.

Currently 4 billion tonnes of waste have accumulated in the region, occupying

Fig. 3.2.2. Structural change in emissions of harmful substances by branch of economy

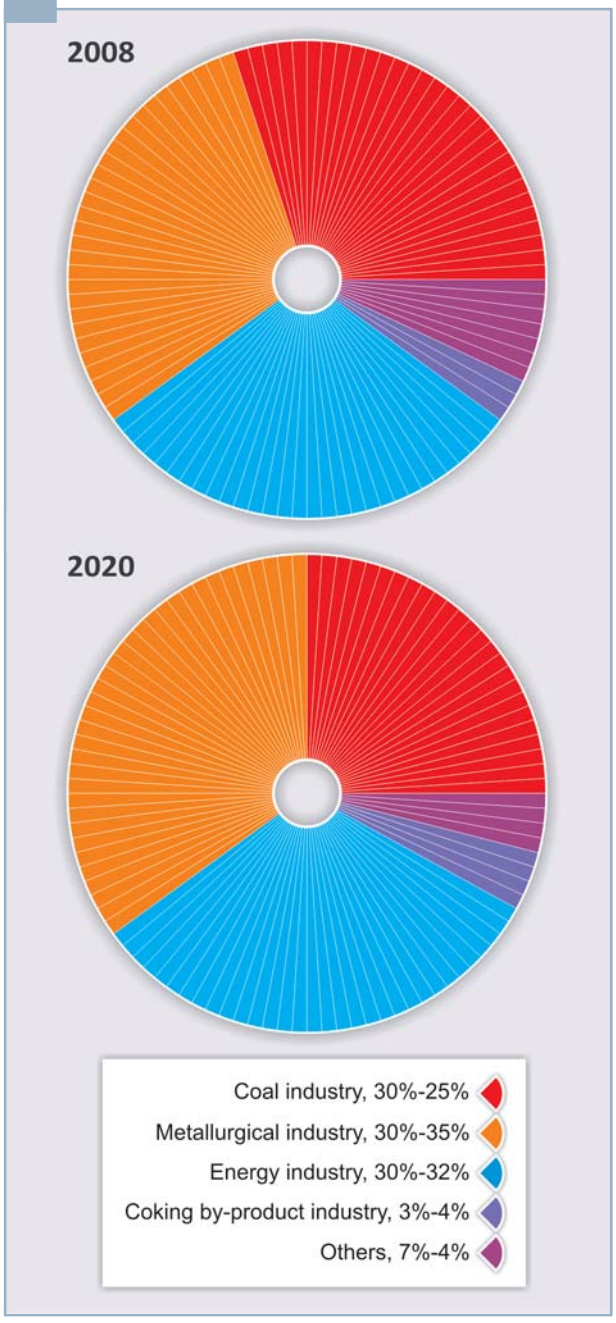
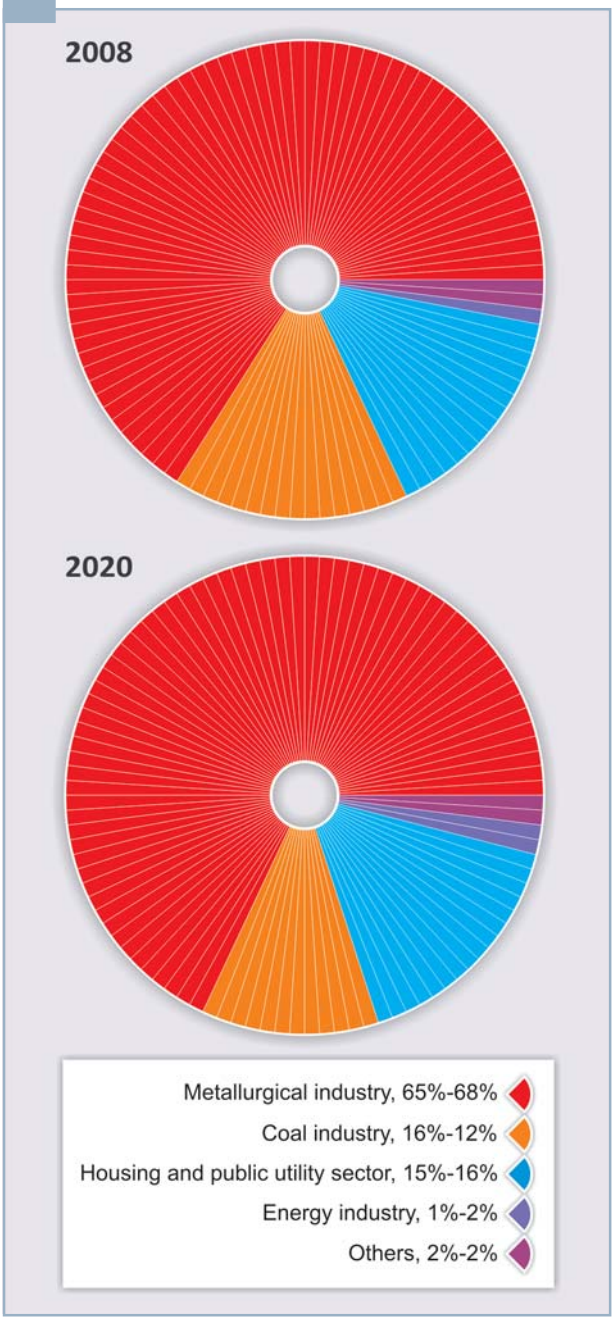


Fig. 3.2.3. Structural change in discharges of waste water by branch of economy



Source: State Environmental Protection Administration in Donetsk Oblast, 2009

nearly 2% of the territory of the oblast. The main sources of waste are the coal, metallurgy and energy industries.

The density of emissions from stationary pollution sources amounts to 57.8 tonnes of harmful substances per square kilometre of the territory of the oblast and 339.3 kg per capita, which exceeds the average level in the country by a factor of 7.7 and 3.5 respectively. The metallurgy, energy, coal and coking by-product industries account for 95% of emissions of harmful substances.

The sufficiency of the water supply by natural river flow per inhabitant of the oblast is five times less than the average

for Ukraine. The volume of waste water in the region exceeds 1.5 billion cubic metres per annum. The main sectors using fresh water are the metallurgy, energy and coal industries, housing and public utilities.

Analysis shows that of the 21 enterprises which are the main sources of air pollution, accounting for 60-70% of emissions of harmful substances from stationary sources, 16 belong to the mining and metallurgy complex. Similarly, of the 30 largest sources of water pollution, discharging 60-70% of the total volume of waste water, 22 belong to the mining and metallurgy complex. The structure of emissions of harmful substances and discharge of waste water may change in the future, as can be seen in Fig. 3.2.2 and 3.2.3.

The metallurgy and coking by-product industries now work quite efficiently. Many enterprises have achieved a substantial level of production, operating at full capacity. But these sectors are working to obtain quick results, so solving the problem of modernizing equipment is often postponed.

In 2008 metallurgy and coking by-product enterprises emitted 475,000 tonnes of harmful substances into the atmospheric air, amounting to 31% of gross emissions. In the 1980s the oblast produced 25 million tonnes of cast iron, about 30 million tonnes of steel and more than 20 million tonnes of rolled stock per annum. Emissions from the metallurgy and coking by-product industries amounted to 0.9-1.1 million tonnes per annum. In recent years output of cast-iron, steel and rolling stock has significantly decreased. Given that the development strategy of the region's metallurgy and coking by-product industries aims to modernize its various sectors and make greater use of capacity, the impact of the metallurgy and coking by-product complex on the environment may increase in severity by 10-15% by 2020.

On the other hand, with the closure of several mines and the continuing decline in coal output there is no growth trend of the level of impact on the environment in coal industry of the region for the nearest 10 years.

The closure of coal mines has an adverse effect on the region's environment. Closure has caused complex environmental problems related to the rising level of ground water and waterlogged land in mining districts. Progress implementing environmental measures at almost all the mines that have closed has been unsatisfactory. Only 6% of the environmental activities provided for in the mine-closure projects have been implemented.

Trends in the environmental impact of the region's mining and metallurgy complex

1. The owners of mining and metallurgy enterprises do not pay enough attention to solving environmental problems.

2. Expenditure connected with fixed capital assets intended for nature protection amount to only 0.3-0.4% of overall fixed capital investments.

3. In the last five years the current expenditure connected with the main environmental measures doubled, whereas the financial efficiency of enterprises increased by a factor of 4.5.

4. In the metallurgy industry the share of energy-consuming and environmentally harmful open-hearth steelmaking practices remains high (about 50%) and practically unchanged for many years.

5. In ferrous metallurgy 60% of all emissions of harmful substances is caused by sintering plants, coke-oven batteries, open-hearth and blast furnaces. Nor is this share decreasing.

6. With regard to the use of fresh water, and the discharge of waste water into surface water bodies, the trend has been towards an increase in metallurgy and a reduction in the coal industry.

7. Losses of fresh water during conveyance increase, while re-use and recycling of water in industry remain at a constant level.

8. Adverse factors related to the environmental impact of mine closures have emerged in the last 10 years. These processes are still only developing. Many adverse consequences will become apparent in the near future.

3.3. Energy industry

Donetsk Oblast has significant electrical power potential, second only to Zaporizhia Oblast in volume, producing one-seventh of Ukraine's electrical power.

The region's energy industry consists of eight thermal power plants operating on domestic fuel. Among the largest power plants are Vuhlehirsk HPP (the largest in Europe with a rated capacity of 3.6 million kW), Starobesheve HPP (2 million kW), Sloviansk HPP (1.8 million kW) and Kurakhove HPP (1.5 million kW). The four other power plants (Zuivka HPP-1 and HPP-2, Myronivka HPP and Kramatorsk HPP) have a capacity of less than 1 million kW each.

Transmission lines with voltage of 700 kV and 330-500 kV cross the territory of the region, connecting power plants to large industrial hubs and to thermal and nuclear plants in other regions. Alongside the mining industry, thermal plants in Donetsk Oblast are significant sources of environmental pollution. The energy sector accounts for 29.75% of emissions of harmful substances. Thanks to recycling of its water supply the share of the total discharge of polluted waste waters amounts to only 15% and the share of power plants in waste generation is about 13%.

Total production of electrical energy in the oblast increased up to 2008, with the highest rise achieved in 2006 (15.7%). In 2007 electrical energy output increased by 9.7% compared to 2006, amounting to 28.3 billion kW-hours. In 2008 the dynamics of electrical energy production displayed a significant drop in output, down almost 6% on 2007. The fall in electrical energy consumption was due to the drop in output by the metallurgy complex.

To increase the operating efficiency and improve environmental indicators the production potential of the region's energy complex requires technical re-equipment, depreciation of fixed assets in this sector standing at 77%. However, in 2007

Fig. 3.3.1 Consumption of fossil fuels and electrical energy

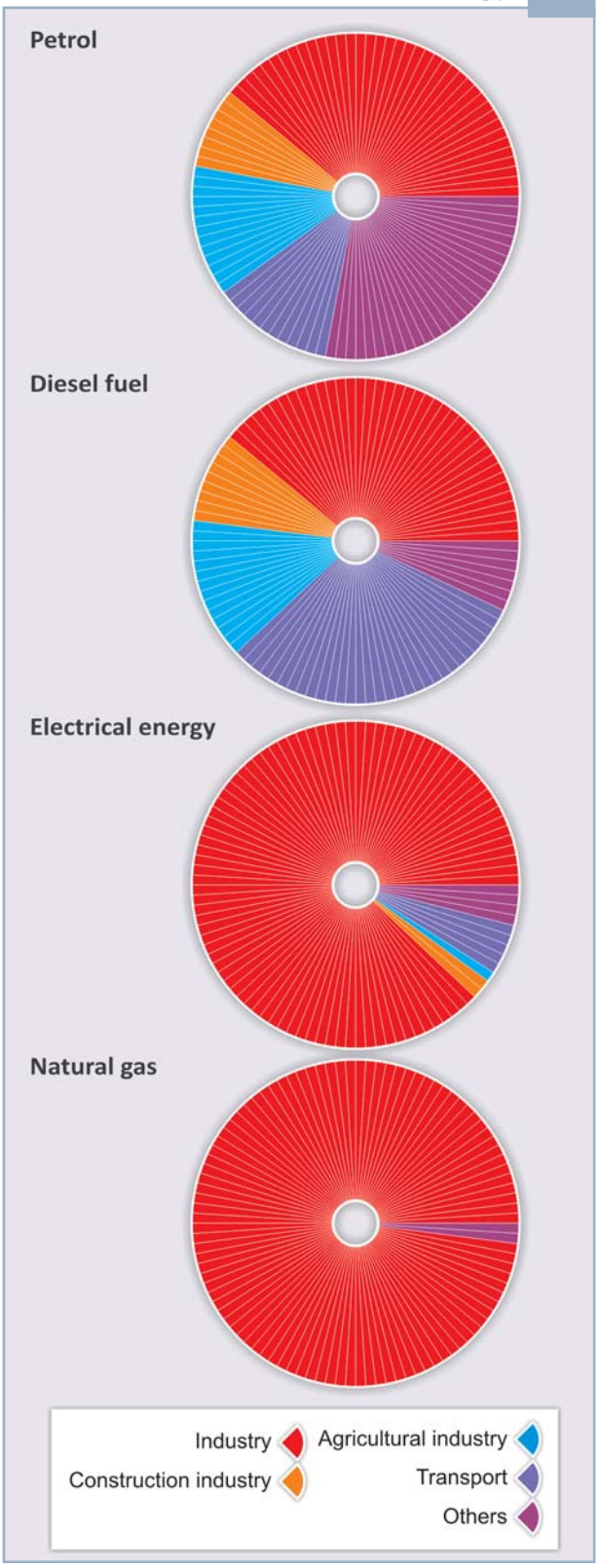


Fig. 3.3.2. Consumption of energy resources in Donetsk Oblast (% from 1990)

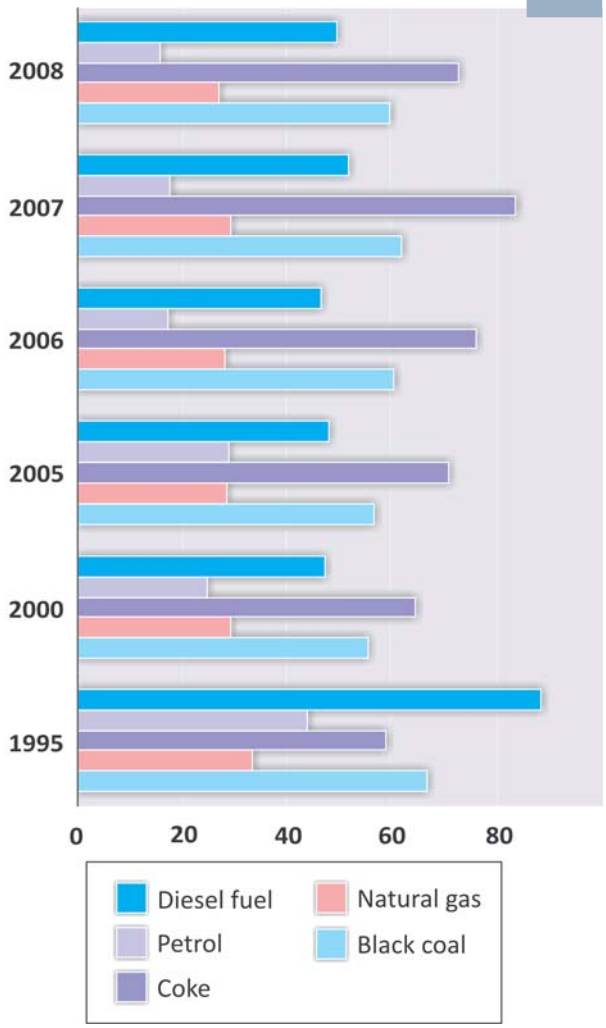
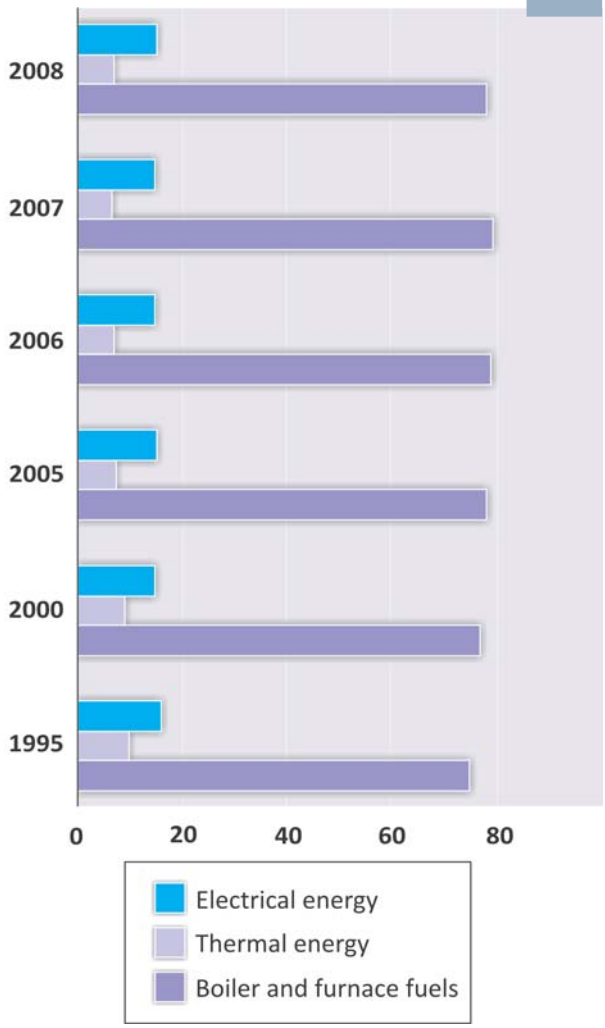


Fig. 3.3.3. Energy consumption by enterprises in Donesk Oblast (%)



Source: State Statistics Committee of Ukraine, 2009

the fixed capital investments of enterprises producing and distributing electrical energy contracted by 12% compared with the previous year, and in 2008 they remained at the same level.

The main users of electrical energy in the region are the coal, metallurgy and machine-building industries and also transport. Similarly industry is the main consumer of coal, with industry and transport also the largest consumer of gas and petroleum products (Fig. 3.3.1). The dynamics of energy consumption in the region is shown in Fig. 3.3.3, with all categories of energy consumption shown in Fig. 3.3.2.

The pattern of energy consumption has changed in recent years. On the whole, coal consumption has fallen, but with the appreciation of petroleum products increasing consumption of this type of fuel is possible in the future.

Consumption of natural gas has fallen by a factor of almost 3.5 since 1990; consumption of propane and butane by a factor of 5 and consumption of petroleum products more than two-fold. Energy consumption in the region will increase in the future, but by 2015 it will still not have reached its 1990 level. The share of electrical energy and coal in energy consumption will increase compared to 1990, and the share of petroleum products will fall

Fig. 3.3.4. Consumption of electrical energy by economic activity (% from 1995)

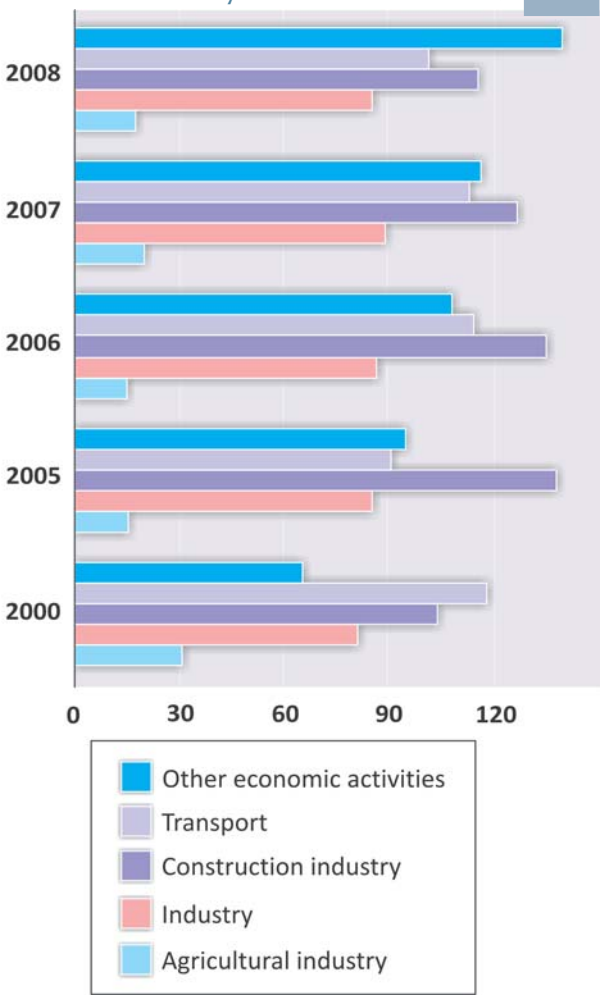
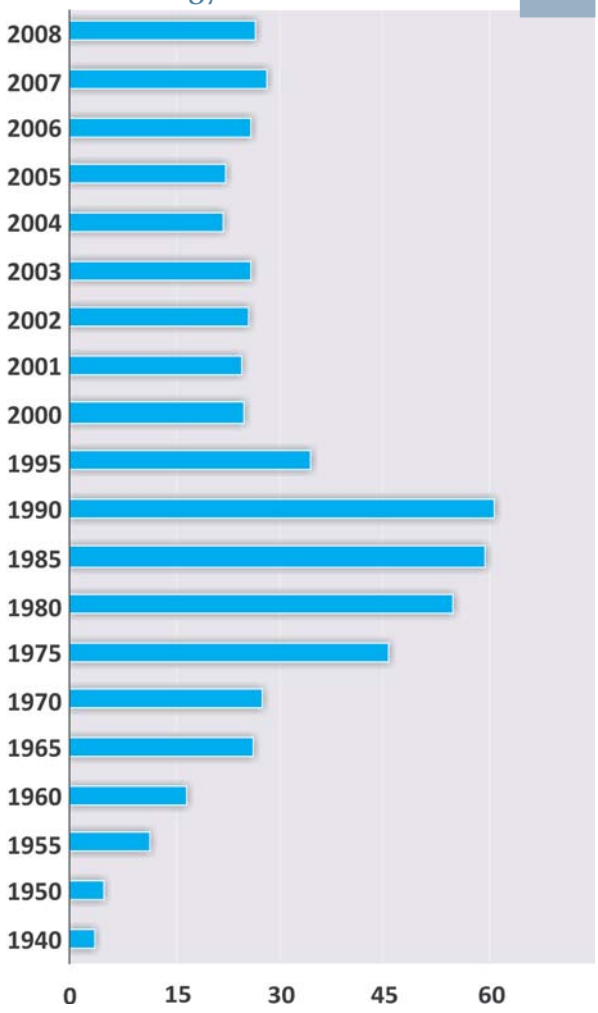


Fig. 3.3.5. Dynamics of production of electrical energy (billion kW-hour)



Source: State Statistics Committee of Ukraine, 2009

due to a significant decrease in the use of fuel oil, though the amount of petrol and diesel fuel consumed will approach the 1990 level.

The region's industrial complex distinguishes itself by higher consumption of resources and energy. The characteristics of electrical energy usage by economic activity are shown in Fig. 3.3.4. Fig. 3.3.5 shows the dynamics of electrical energy production in the region. Overall, specific energy consumption has fallen by 16% to the 1995 level, a change connected to structural changes in the economy rather than an increase in industry's energy efficiency or a reduction in the energy intensity of processes.

Energy consumption in the region has decreased, and so has the environmental impact of air pollution, waste generation and waste water discharge. Lower consumption of energy resources has resulted in a reduction in greenhouse gas emissions, primarily carbon dioxide.

The main objectives of energetics and industry with respect to reducing environmental impacts are closely related to increasing the efficiency of energy and fuel resource usage. In this respect the region has plenty of scope for action. Experience from the energy-saving policy in 2000-1 showed that the energy intensity of domestic regional product could really be cut by 4-6% per year. Reducing the energy inten-

sity of gross domestic product in a country cuts expenditure related to product costs, while boosting earnings and the profitability of production. Any change in the region's energy consumption processes must start in industry. Today the production of metal products in Donetsk Oblast is characterized by high energy intensity; expenditure connected with consumed energy resources in the cost breakdown of output by various enterprises ranges from 30% to 50% and more, which is 20-25% higher than global standards. Experts estimate the metallurgy industry's overall share of national consumption of electrical energy and natural gas at 15-20% and 9-10% respectively. The share of electrical energy and natural gas in material expenditure connected with the production of metal products amounts to about 8%. There are also large energy-saving reserves in the region's housing and public utility sector, in construction, energy and the coal industry.

Consequently improving energy-saving policies is one of the important regional environmental objectives to reduce environmental impacts.

3.4. Transport

Transport represents an 8% share of the economy of the oblast. The majority of goods are transported by rail and road. Passengers use road, tram, trolley and rail transport. Air transport mainly concerns international travel and trade, with a relatively small share of goods and passenger transport, as little as 1.6%. The dynamics of goods and passenger transport is shown in Fig. 3.4.1 and 3.4.2.

Since 1995 the share of goods transport by rail has increased by 12%, with a 90% decrease in sea transport. On the oth-

Fig. 3.4.1. The changing structure of overland goods transport (index 100% - 1995)

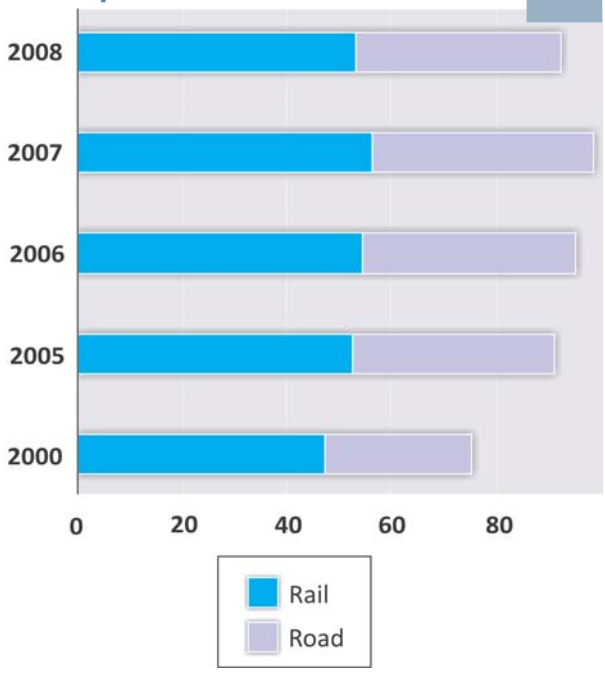
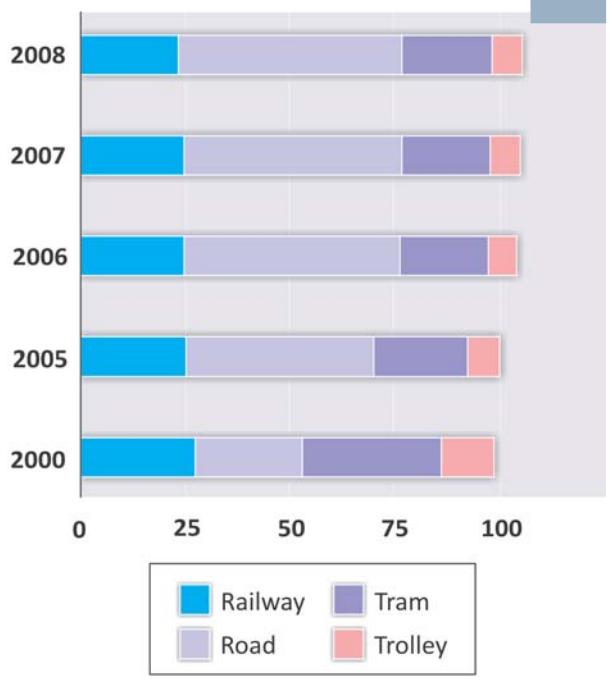
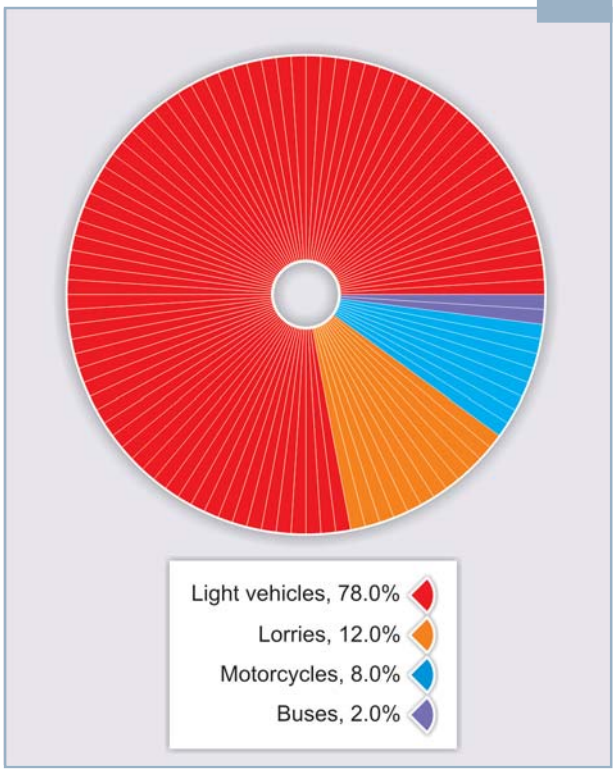


Fig. 3.4.2. The structure of changes in the transportation of passengers by various modes of transport (index 100% - 1995)



Source: State Statistics Committee of Ukraine, 2009

Fig. 3.4.3. The structure of the vehicle fleet in Donetsk Oblast



Source: State Statistics Committee of Ukraine, 2009

er hand passenger traffic tends to travel more frequently by road, and the share of journeys by trolley and tram transport has changed little.

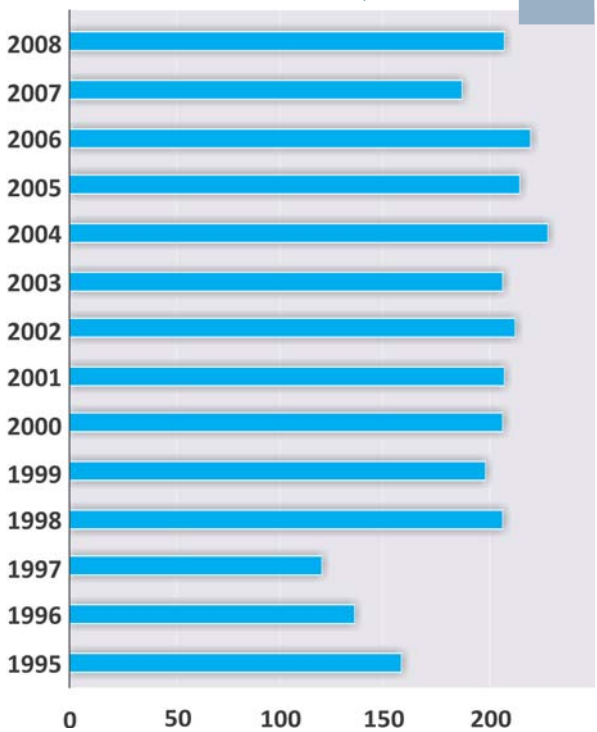
In recent years the number of motor cars has increased. In towns the number of light vehicles amounts to 100-150 units per 1,000 inhabitants, the growth rate of the vehicle fleet ranges from 5% to 10-15% per annum. The share of public transport is tending to fall, whereas the number of small private transport operators is increasing, with a vehicle fleet consisting mainly of minibuses. The structure of the vehicle fleet in Donetsk Oblast is represented in Fig. 3.4.3.

In 2008 the total amount of goods transported by all modes of transport in the region was 159.6 million tonnes, 4.5% less than in 2007. Transportation of goods by rail also fell, by 5.7%, to 111.2 million tonnes. The total amount of goods transported by road transport in the region has decreased by 2.1%, amounting to 48.1 million tonnes.

In 2008 16.8 million tonnes of goods were handled at marine terminals, down by 9.6% on 2007. Export goods accounted for 76.6% of the total, goods in transit 18.1%, inland goods 2.9%, and imported goods 2.4%. Handling of export goods has decreased by 8.8%, transit goods by 12.2%, and inland goods by 31.6%. Handling of import goods has increased by 43.2% compared to 2007, reflecting changes in the structure of imports and exports in Donetsk Oblast and Ukraine as a whole under the influence of the global financial crisis.

In 2008 the number of transported passengers increased slightly (by 1.1%), totalling 992.1 million people. The share of rail traffic in passenger transport fell by nearly 5%, whereas road travel increased by 1.8%. In 2008 municipal electrical transit services carried 413.9 million passengers, up 0.9% on 2007.

Fig. 3.4.4. Dynamics of pollutant emissions from mobile sources, ktonnes



Source: State Statistics Committee of Ukraine, 2009

The impact of transport on the environment and population is connected with air pollution, noise, greenhouse gas emissions, the rising number of road accidents, etc. The dynamics of emissions of harmful substances from mobile sources in the region is represented in Fig. 3.4.4.

From 1998 to 2006 год the dynamics of pollutant emissions into the atmospheric air from mobile sources showed growth, increasing by 2-4% per annum. Since 2007 emissions have decreased, primarily due to rising prices for petroleum products, the switch to cheaper, environmentally-friendly fuels, and gradual replacement of vehicles.

Emissions related to the use of petrol (89%) prevail in the structure of emissions of harmful substances from road transport. The share of emissions connected with the use of diesel fuel and liquefied gas amount to 8% and 3% respectively. Private cars account for about 60% of pollutant emissions from mobile sources.

The main priorities for decreasing the environmental impact of transport are to reduce emissions of harmful substances and greenhouse gases, improve air quality in residential areas along motorways, improve traffic safety, develop public transport and improve the technical state of the vehicle fleet.

3.5. Agriculture and food industry

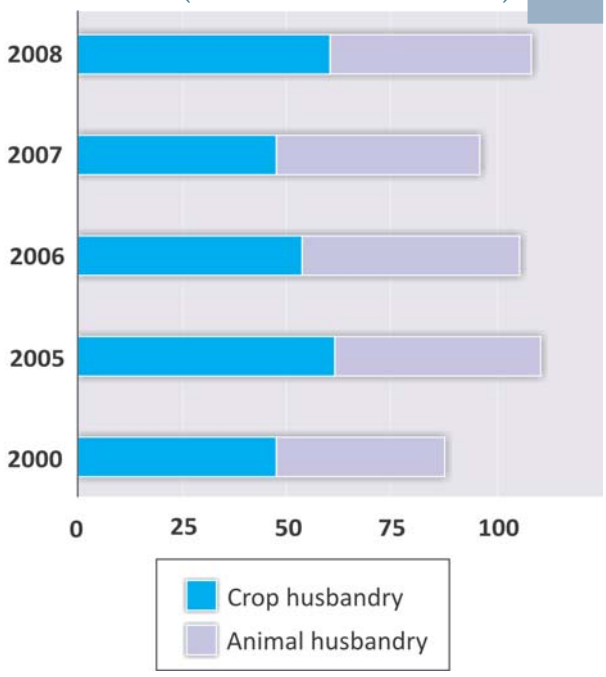
Agricultural production in Donetsk Oblast only accounts for 4.9% of the total volume produced in Ukraine. Some 174,500 workers are involved in this sector, 8.1% of the region's labour force. In recent years structural changes in the output and redistribution of land ownership have affected agriculture (see Fig. 3.5.1 and 3.5.2).

Economic and social trends in the agricultural industry:

1. The number of workers in agriculture remains almost constant while the number of agricultural enterprises has sharply increased (almost six-fold).
2. The area of agricultural land has not changed, but the share of land in household plots has increased five-fold due to the decrease in the amount of land held by agricultural enterprises.
3. The output capacity of agriculture has decreased three-fold, highlighting the development of less industrialized agricultural production in the region.
4. Structural changes are apparent in crop husbandry, with the share of the cultivated area of several crops (wheat, sunflower and barley) increasing by a factor of 1.5 from 1990 to 2008.

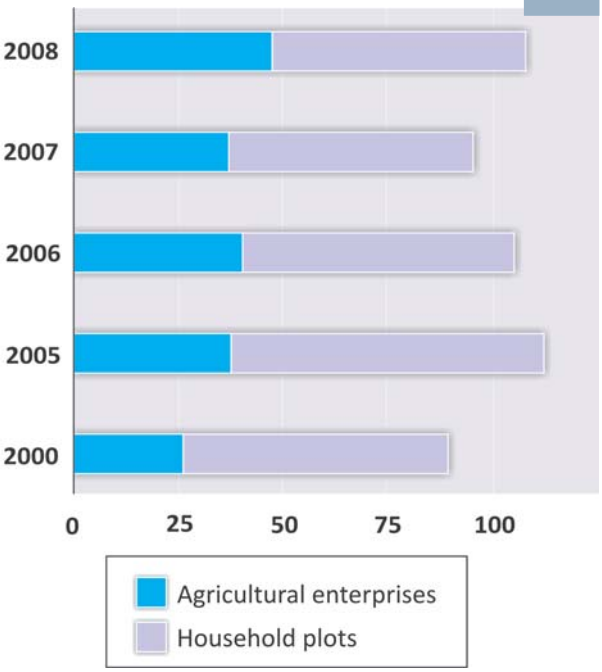
It is clear from the represented data that since 1995 the share of arable products has increased by a factor of 1.2, due to the decline in stock-related products. There is a trend in agriculture to increase the land area used for grain and technical crops (primarily sunflower), due to the

Fig. 3.5.1. Structure of gross agricultural output, (index 100% - 1995)



Source: State Statistics Committee of Ukraine, 2009

Fig. 3.5.2. Structure of gross agricultural output by category of household, (index 100% - 1995)



Source: State Statistics Committee of Ukraine, 2009

drastic reduction in forage crops (see Fig. 3.5.3).

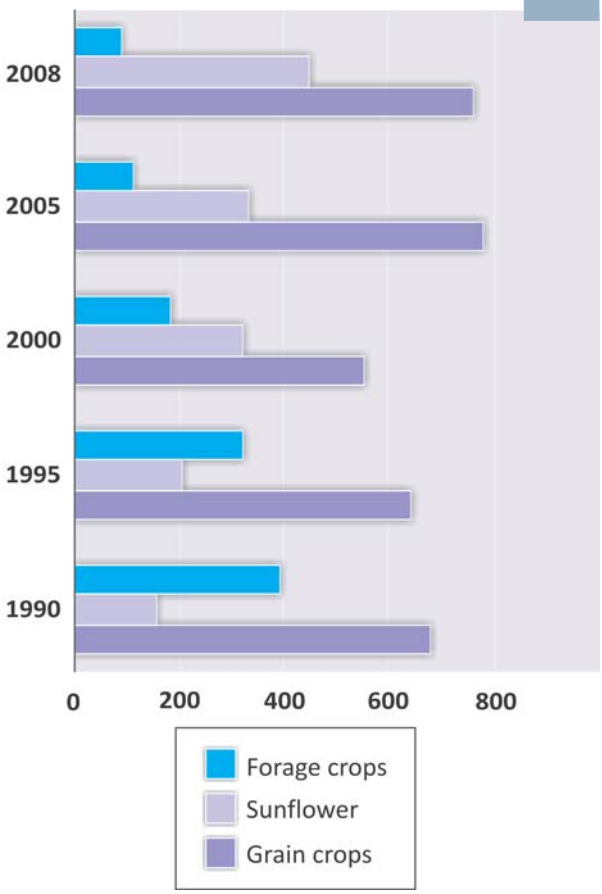
These trends are leading to more intensive use of agricultural land and the exhaustion of chernozems. In addition since the closure of large agricultural enterprises, the share of small farms has increased, but they lack the resources to carry out environmentally safe production. Over the last 15 years the number of agricultural enterprises has increased from 500 to 3,800 units.

Because of the heavy yield of grain crops and sunflower agricultural output in the region increased in 2008 by 13.3% compared to 2007. Moreover, the output of crop products increased by 27.1%. The total yield of grain and pulse crops amounted to 2.3 million tonnes, twice as much as the previous year. This result was obtained thanks to a 9% increase in the harvested area and a rise in land productivity by a factor of 1.8, reaching 30.8 centners per hectare. The total sunflower yield increased by a factor of 1.5 to 747,300 tonnes.

In 2008 the output of animal products was 2% down on the previous year. Meat production fell by 7% and sales of cattle and poultry for slaughter by dropped 5.4%. All categories of household reduced milk production: during 2008 the milk yield amounted to 371,200 tonnes, 8.3% less than the previous year.

By 1 January 2009 the cattle population had dropped by 8.9% compared to the same date in 2008 and amounted to 163,600 heads. The cow population had declined by 7.5%. At the same time the pig and poultry population has increased, respectively by 8.1% and 7.2%. Changes in

Fig. 3.5.3. Cultivated area of agricultural crops, thousand ha



Source: State Statistics Committee of Ukraine, 2009

Fig. 3.5.4. Population dynamics of cows, pigs, sheep and goats, thousand head

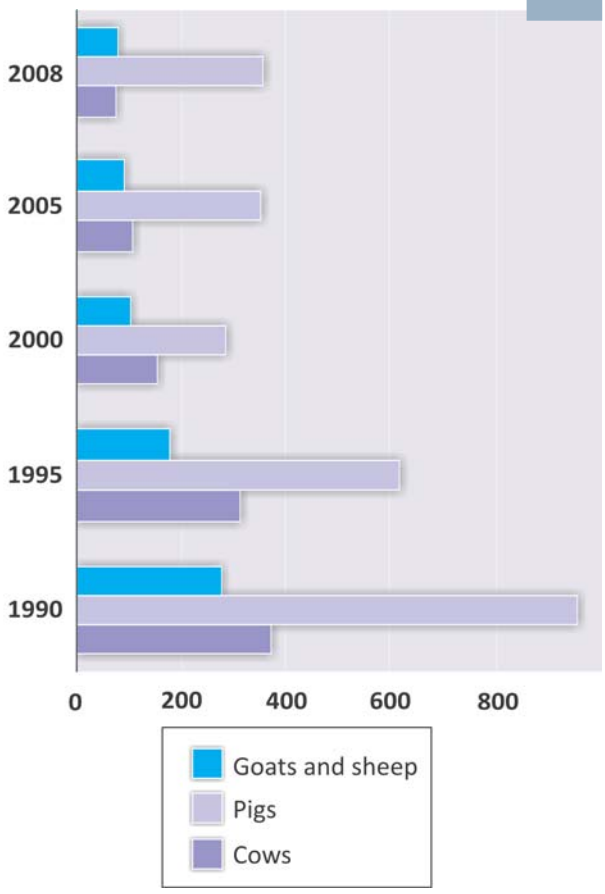
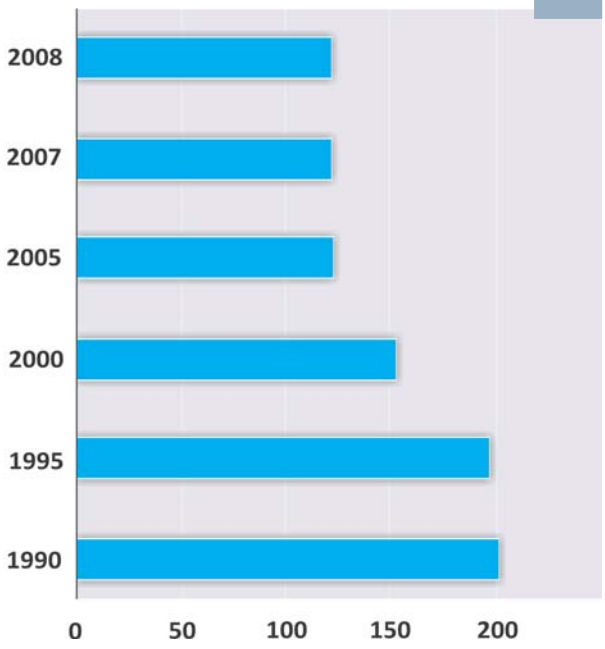


Fig. 3.5.5 Area of irrigated land, thousand ha



Source: State Statistics Committee of Ukraine, 2009

the cattle and pig population are represented in Fig. 3.5.4.

The rate of application of mineral fertilizers and pesticides in regional agriculture is falling. Thus 147,750 tonnes of mineral fertilizers and 10,496,500 tonnes of organic fertilizers were applied to the soils of the oblast in 1990. By 2008 the equivalent figures had fallen to 38,630 tonnes and 482,800 tonnes respectively, 26% and 4.6% of the 1990 level. The same trend is observed in the use of irrigated land (Fig. 3.5.5).

The represented data reveals a trend towards a reduction in environmental impacts in a context of total degradation of agricultural production and a reduction in measures to maintain soil fertility.

Trends for the environmental impact of agriculture in the region

1. The use of mineral fertilizers and pesticides decreased respectively by a factor of 4 and 3.5, which is a positive trend from the environmental point of view, but the rate of application of organic fertilizers has decreased by a factor of 20, reducing soil fertility.

2. The transition in agriculture to growing only a few crops on cultivated land, reducing fertilizer application and cutting per capita electricity consumption for agriculture suggests a trend towards heavy use of land without the best available agricultural technology being used.

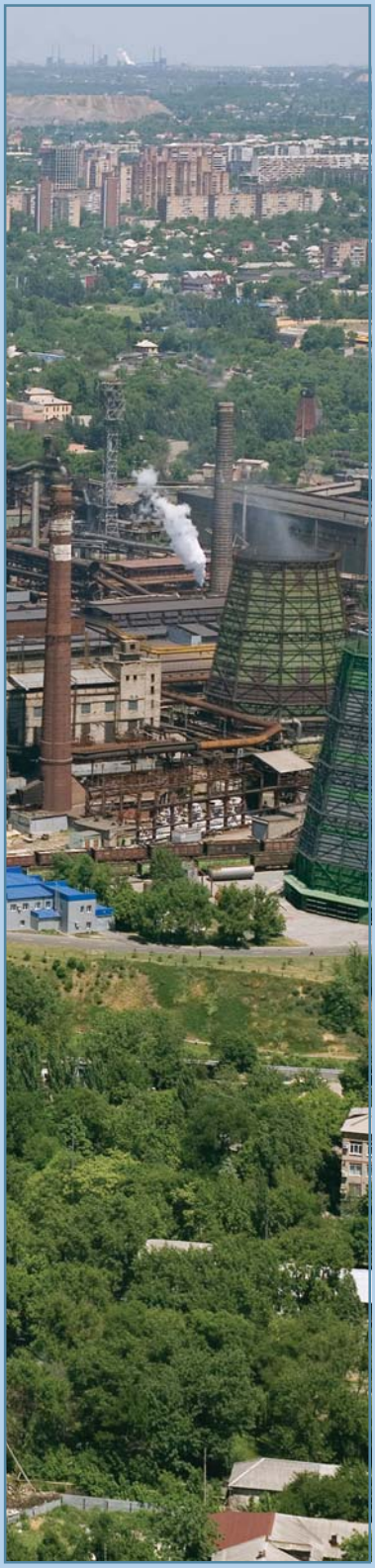
3. The amount of irrigated land has decreased by a factor of 1.6. On the one hand, this reduces impacts connected with soil salination and waterlogging of lands; on the other hand it reflects the degradation of the agricultural production.

4. The cattle population has decreased four-fold, resulting in a simultaneous reduction in animal products and an impact on the environment.

5. Unconventional trends such as village tourism, production of bio-energy products, etc are not developing sufficiently in the agriculture of the oblast.

SECTION 4

STATE OF THE NATURAL ENVIRONMENT



Donbas is among the Ukrainian regions subject to the most extreme environmental pressure. This region is the largest industrial centre with highly developed heavy industry. A complex ecological situation has developed in the region during the many years of industrial growth. The most acute problems are pollution of air and river basins, the accumulation of industrial and household waste, and the need to adapt to climate change.

Effective economic and sustainable development of the region contributes to environmental improvements. On the one hand, with this aim in mind, it is important to understand the trends for environmental pollution and potential public risks. On the other hand, global climate change demands urgent measures to adapt industry and agriculture to new climatic conditions.

In a constantly changing ecological and economic situation, decisions for managing environmental protection must be guided by analytical assessments and calculations based on authentic multi-year data from ecological monitoring.

Several million observations reaching back 70 years were used in the preparation of this section. It currently constitutes the most accurate assessment of the state of the natural environment in Donetsk Oblast.

4.1. Climate change

The Donetsk region is situated in the western part of the continental steppe zone and has a temperate continental climate.

Summer in Donetsk Oblast is usually hot and subject to drought; winter is cold with little snow. The period with temperatures above +10°C lasts about 170 days and the frost-free period lasts 160-170 days. Total rainfall averages 370-550 mm/year, 75% of which occurs in the warm season. The average depth of snow cover varies from 10 to 19 cm. For a climatic map of Donetsk Oblast with the characteristics of meteorological indicators, see Figure 4.1.1.

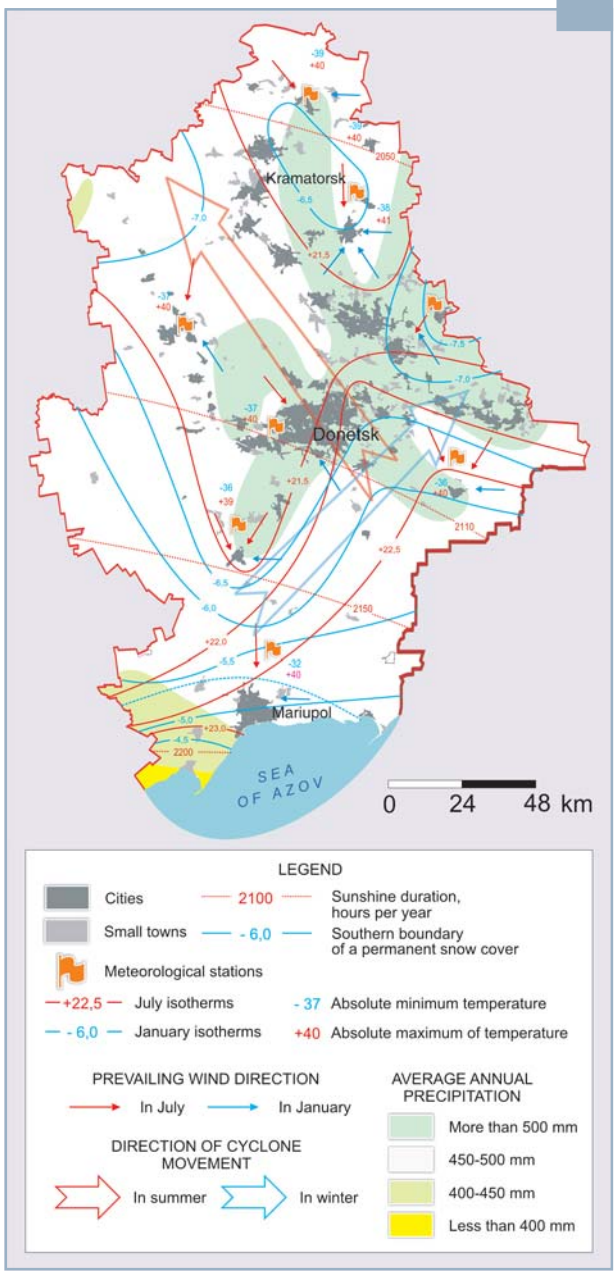
The dynamics of average annual precipitation in Donetsk Oblast in 1936-2006 is shown in Figure 4.1.2. As can be seen from the trend, the amount of precipitation increased during this period from 500 to 615 mm. This increase has changed the region's climatic conditions, primarily affecting agriculture.

Figure 4.1.3 shows average annual temperature values in 1936-2006. During this period the trend decreased from 9.4°C to 9.0°C. Positive average annual temperatures in the region have varied slightly over the last nine years, and the overall dynamics of their decrease is 0.5°C for 10 years. According to the received trend the level of negative annual average temperatures decreased more significantly – by 1.4°C (Fig. 4.1.4). According to the 10-year trend this leads to a 1.1°C decrease in average annu-

Ecological indices for assessment

1. Emissions of greenhouse gases caused by anthropogenic activity (million tonnes CO_2): by sector of economy, per capita, per unit of GRP.
2. Average free-air temperature (°C): per year, in warm and cold seasons, average daily data.
3. Heat, humidity and meteorological parameters of air: atmosphere relative humidity (%), atmospheric pressure (kPa), wind speed (m/s), wind direction (grades), annual precipitation (mm/year) and average daily data.
4. Data on dynamics that characterize climate change (according to paragraph 1-3) in the last 70 years.

Fig. 4.1.1. Climatic map of Donetsk Oblast



Source: Atlas of the Donetsk region, The State Administration of Environmental Protection in Donetsk Oblast, 2010

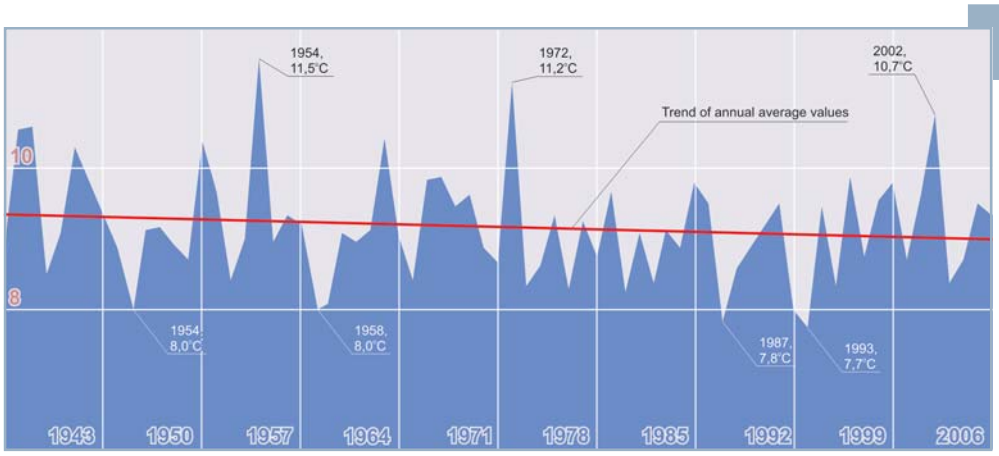


Fig. 4.1.2. Dynamics of average annual precipitation in Donetsk Oblast in 1936-2006, mm

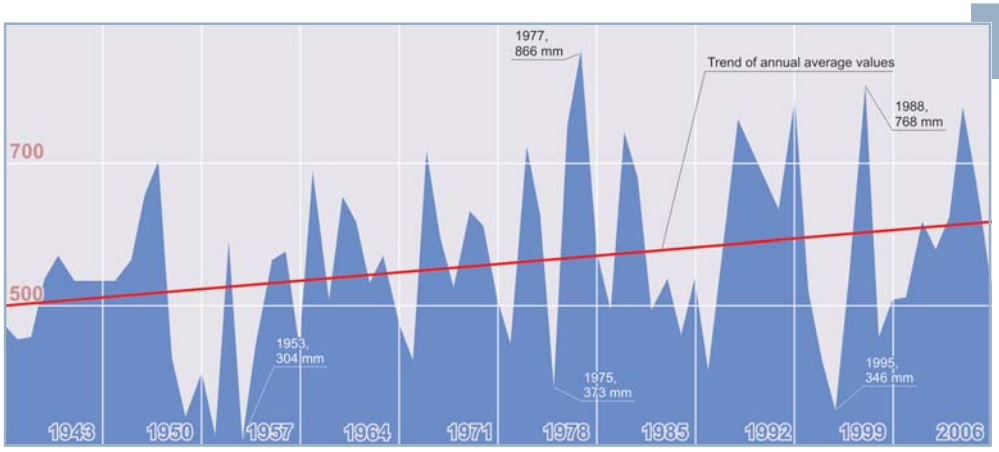


Fig. 4.1.3. Dynamics of average annual temperature in Donetsk Oblast in 1936-2006, °C

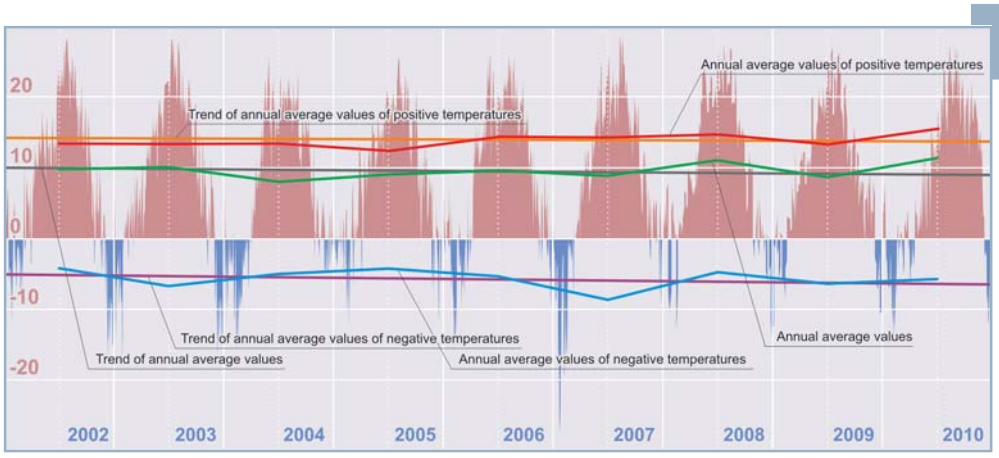


Fig. 4.1.4. Dynamics of daily average temperature in Donetsk Oblast in 2001-9, °C

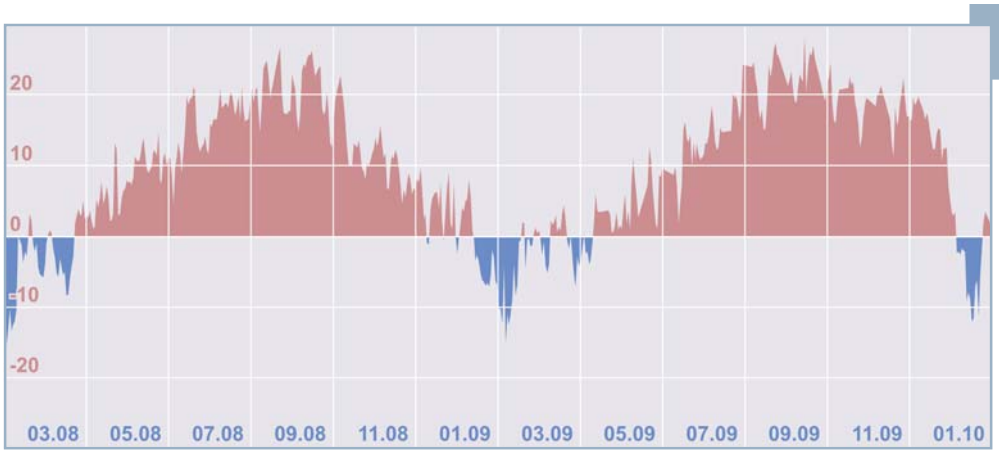


Fig. 4.1.5. Dynamics of daily average temperature in Donetsk Oblast in 2008-9, °C

Fig. 4.1.6. Dynamics of daily average relative humidity in Donetsk Oblast in 2001-9, %

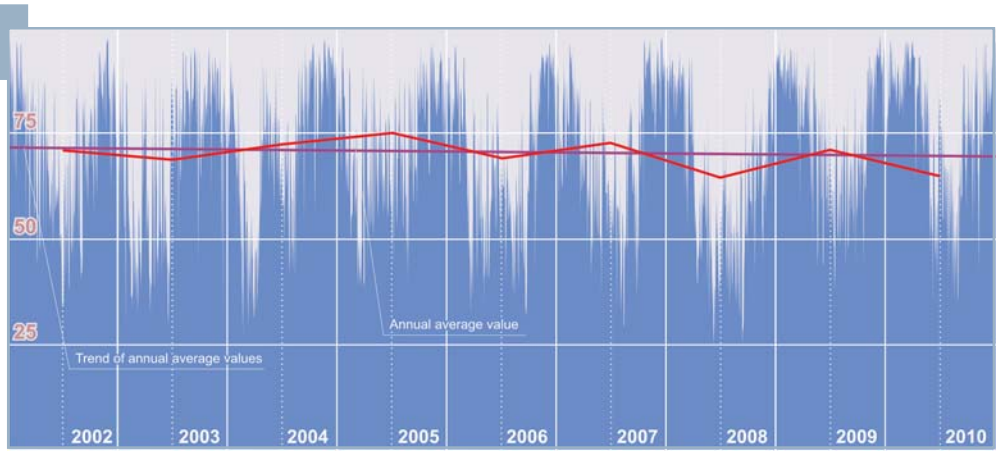
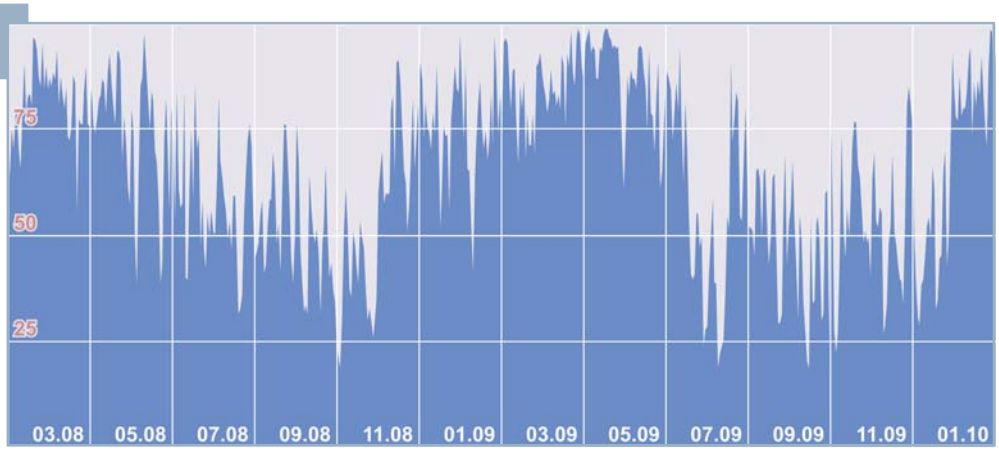


Fig. 4.1.7. Dynamics of daily average relative humidity in Donetsk Oblast in 2008-9, %



Source: Donetsk Centre for Hydrometeorology, The State Administration of Environmental Protection in Donetsk Oblast, 2010

al air temperature in Donetsk Oblast in 2000-8. These findings suggest that climate change has accelerated recently.

Average annual temperature in 2007 and 2008 was 11°C and 8.6°C respectively. Besides, the positive average annual temperature in 200 and 2008 was, respectively, 14.5°C and 13.2°C, and negative average annual temperature -4.5°C and -6.1°C, as shown in Figure 4.1.5.

In 2007 average annual relative humidity was 66% and 71% in 2008, as can be seen in diagrams 4.1.6 and 4.1.7. The general tendency over the 2000-8 period shows that average annual relative humidity has decreased by 1.6% in 10 years.

Average wind speed in 2007 and 2008 was 4.2 m/s and 3.9 m/s respectively. Over the last nine years the dynamics of change in average annual wind speed shows a 0.4 m/s decrease in 10 years, as shown in Figures 4.1.8 and 4.1.9.

During the cold season east, southeast and northeast winds, which are formed under the influence of Asian anticyclones, prevail in Donetsk Oblast. In winter they bring frost and blizzards, and in spring dry out the soil, causing dust storms. West and northwest winds, which frequently cause droughts, prevail in summer. In 2008-9 southeast, west and northwest winds were mainly observed. The wind rose in Donetsk Oblast in 2008-9 is shown in Figure 4.1.10.

Such adverse climate events as winter thaws, glaze, freezing of soil, spring frost, dry hot winds, dust storms, rainstorms, hail and fogs can be observed in the region. Generally days with fine weather prevail in the region (75-80%); fog, fumulus, rain and snow occur quite often. Percentage distribution of atmospheric phenomena in 2008-9 is shown in Figure 4.1.11.

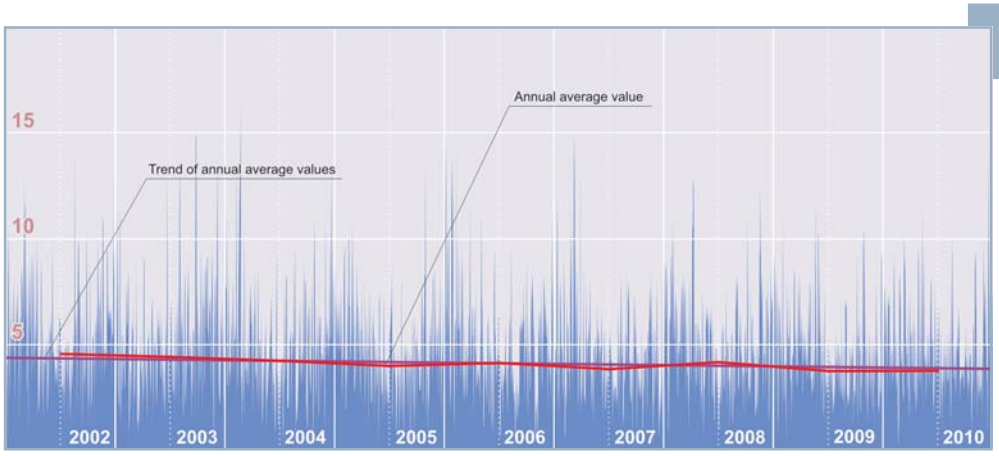


Fig. 4.1.8. Dynamics of daily average wind speed in Donetsk Oblast in 2001-9, m/s

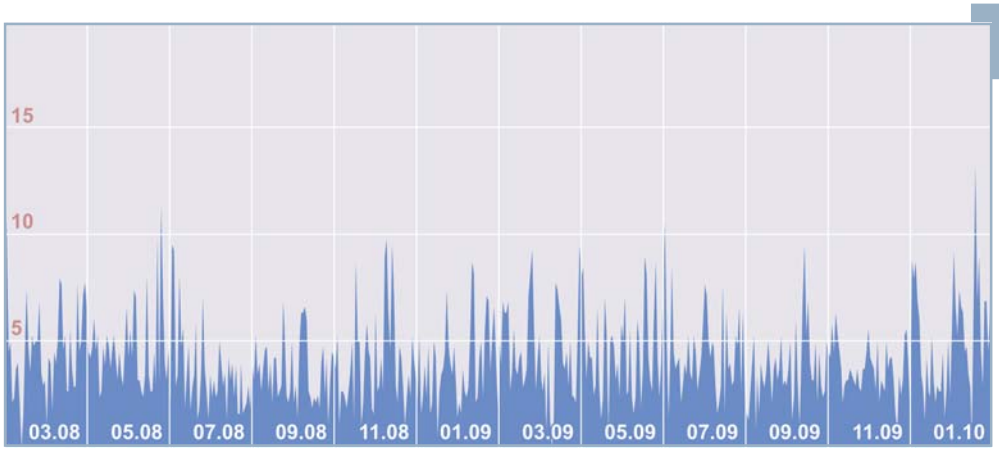


Fig. 4.1.9. Dynamics of daily average wind speed in Donetsk Oblast in 2008-9, m/s

Source: Donetsk Centre for Hydrometeorology, The State Administration of Environmental Protection in Donetsk Oblast, 2010

Global climate change raises the problem of how to face this challenge at a regional scale. The agroclimatic conditions in Donetsk Oblast favour the growth of heat-loving crops (sunflowers, grapes, melons and gourds). However, as it is clear from the trend for average annual temperatures (Fig. 4.1.3), if the trend continues, climate change will affect the production of agricultural goods in the region. At the same time the trend for average annual precipitation (Fig. 4.1.2) shows that Donetsk Oblast will not lack fresh water, its supply being renewed by atmospheric precipitation. Continuation of this tendency may make production of agricultural goods in the region cheaper and increase its competitive advantage.

Recent studies confirm that greenhouse gases are the main cause of global warming. Methane is one of the most dangerous gases, with a severe incidence on climate change. As is clear from Figure 4.1.12, the peak of gross methane emissions in Donetsk Oblast was in 2005. In 2008 there was a certain reduction of emissions, which resulted from a shift in demand for the products produced in the region, following the global financial crisis. According to analytical forecasts, in 2009 gross greenhouse gas emissions will fall by 20% compared to 2008. However, if industrial production increases, the volume of emissions will return to the 2007 level.

The energy industry is the main source of methane released into the atmosphere of the region due to coal production. Every year the region's coal mines emit 1.5 to 2.2 billion m^3 of methane. Although the gas is a promising energy vector, only 5 to 8% of its total volume is used in industry. The Donetsk basin has estimated methane reserves of 11.5 trillion m^3.

Introduction of modern resource-saving technologies for purification and pro-

Fig. 4.1.10. Wind rose in Donetsk Oblast, m/s

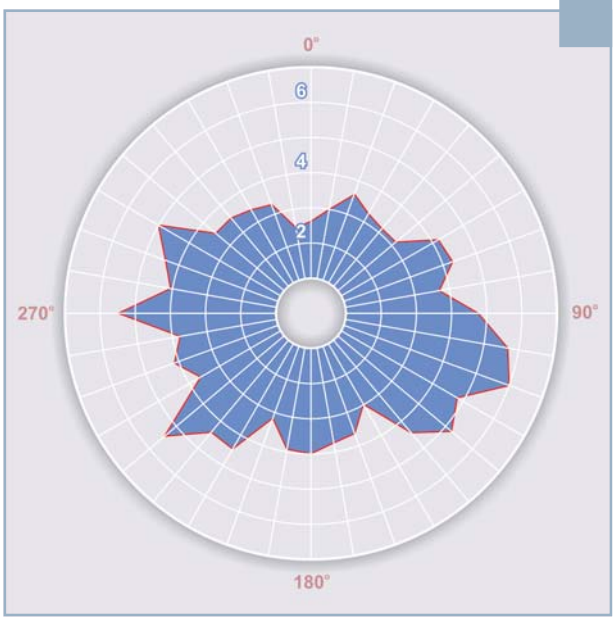
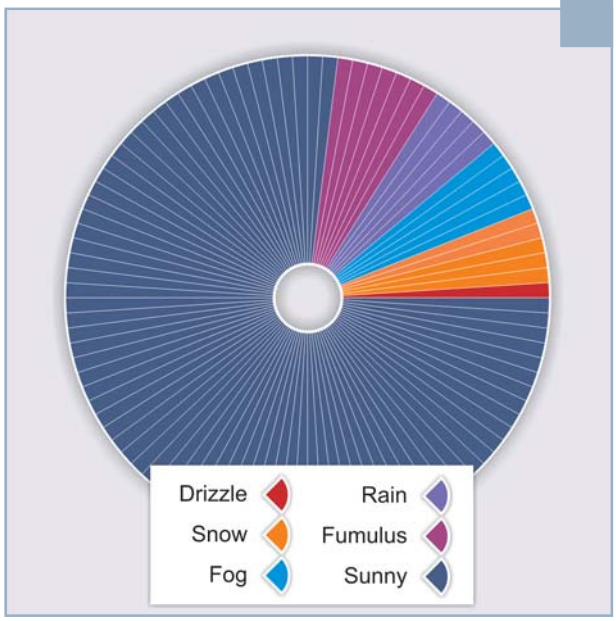


Fig. 4.1.11. Distribution of atmospheric phenomena, %

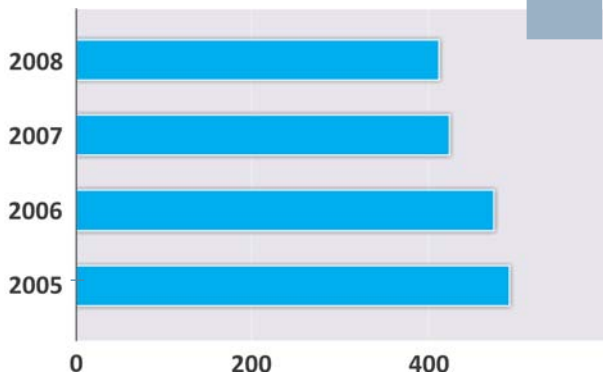


Source: Donetsk Centre for Hydrometeorology, The State Administration of Environmental Protection in Donetsk Oblast, 2010

duction at regional enterprises and also management of automated monitoring systems for production technologies will help to reduce greenhouse gas emissions. Analysis shows that about 70% of the region's large industrial enterprises are not currently ready to lower limits on emissions of greenhouse gases.

To reduce greenhouse gas emissions in the region the provisions of the Kyoto protocol must be implemented, involving the use of financial instruments which allow economic agents to issue calls for investments to help implement projects which directly or indirectly cut greenhouse gas emissions. The A.F. Zasyadko mine is an example of how environmentally friendly energy-saving technologies can be implemented thanks to financial instruments under the Kyoto protocol. Under the terms of the futures contract with Austrian and Japanese government bodies a methane-utilization facility was installed and a cogeneration power plant was started. Some 41 million m^3 of methane has been processed, with 194.24 million kW of electrical energy and 168,320 Gcal of thermal energy produced at the mine.

Fig. 4.1.12. Methane emission, ktonnes



Besides projects on methane utilization at mines such as Kholodnaya balka, OAO Komsomolets Donbasa, № 22 Kommunarskaya, Krasnoarmiyskaya-Zapadnaya №1, YuzhnoDonbaskaya №3, a project to reduce carbon dioxide emissions at the Stirol concern is underway. Work is in progress to improve the efficiency of energy use at ZAO Mini Steel Mill ISTIL, with a regional project to improve the heating supply, among others. In all Donetsk Oblast has prepared 27 projects to bid for investments under the Kyoto protocol.

4.2. Atmospheric air

Pollution of the atmosphere by harmful substances has a significant effect on the health of population and ecosystems of the region. According to the State Statistics Committee, Donetsk Oblast accounted for 33.9% of total emissions of harmful substances from stationary sources in Ukraine in 2008. The corresponding 1,533,400 tonnes of emissions are produced by more than 1,170 enterprises in various industrial sectors (Fig. 4.2.1-4.2.3).

From the second half of 2008 a tendency towards a reduction in gross emissions of harmful substances in the region was observed, related to the onset of the global financial crisis. However, the level of air pollution in cities such as Donetsk, Dzerzhynsk, Yenakiieve, Makiivka, Horlivka and Mariupol remains high. The state of the air is one of the region's most acute environmental problems. Figure 4.2.4. maps atmospheric air pollution in the region.

The main atmospheric air pollutants of Donetsk Oblast, producing 91% of gross emissions of harmful substances, are seven coke-chemical enterprises, five thermal power stations, six metallurgical plants, 120 mines and mining enterprises. The dynamics and forecast of gross emissions of harmful substances into the atmosphere in the region are shown in Fig. 4.2.5. In turn Figure 4.2.6. highlights the dynamics of changes in emissions of priority harmful substances from stationary sources in the region, with forecasts up to 2020.

Analysis of the represented data shows that gross emissions of harmful substances increased during the period from 2000 to 2007. Furthermore emissions from industrial enterprises increased by 4% and transport emissions by 6%. In 2008 indus-

Fig. 4.2.1. Chemical composition of emissions of harmful substances in Donetsk Oblast in 2008

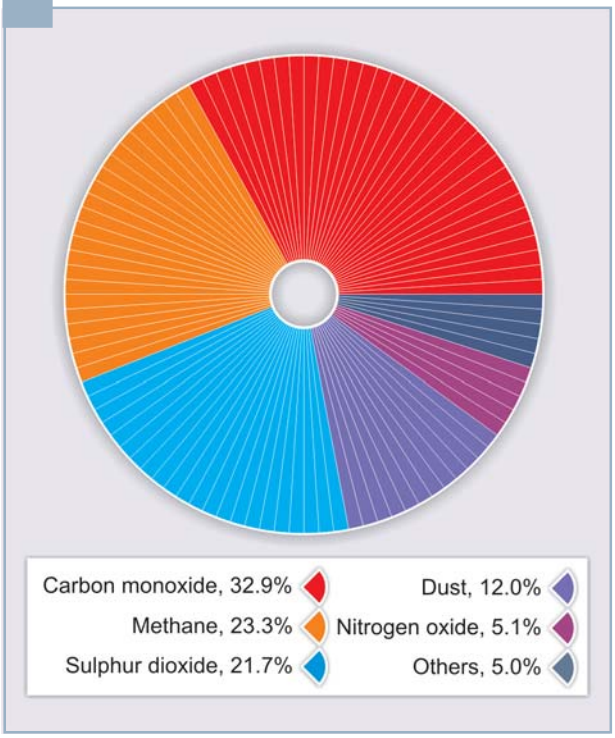
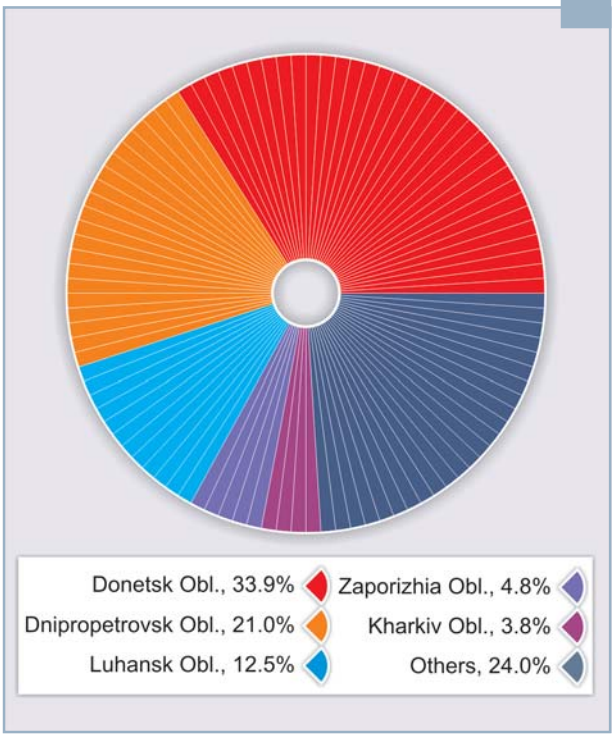
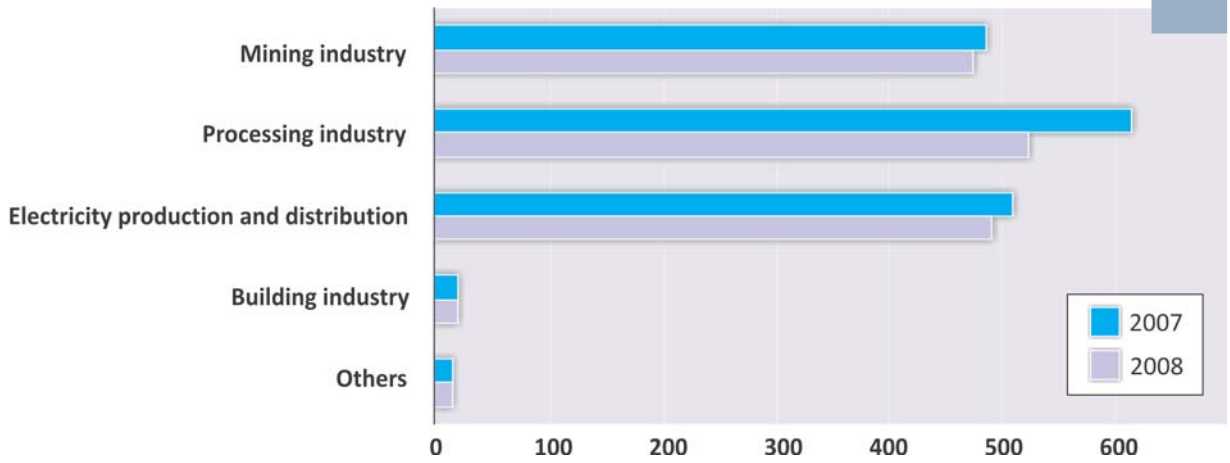


Fig. 4.2.2. Structure of emissions of harmful substances from stationary sources by region of Ukraine in 2008



Source: State Statistics Committee of Ukraine, 2009

Fig. 4.2.3. Emissions from stationary sources in Donetsk Oblast by branch of economy, ktonnes



Source: State Statistics Committee of Ukraine, 2009

trial emissions fell by 7.3% compared to 2007 and transport emissions increased by the same amount. If current trends continue, emissions of harmful substances from stationary sources by 2020 will amount to 1,615,600 tonnes/year, with 1,885,700 tonnes/year in the region as a whole including emissions from mobile sources.

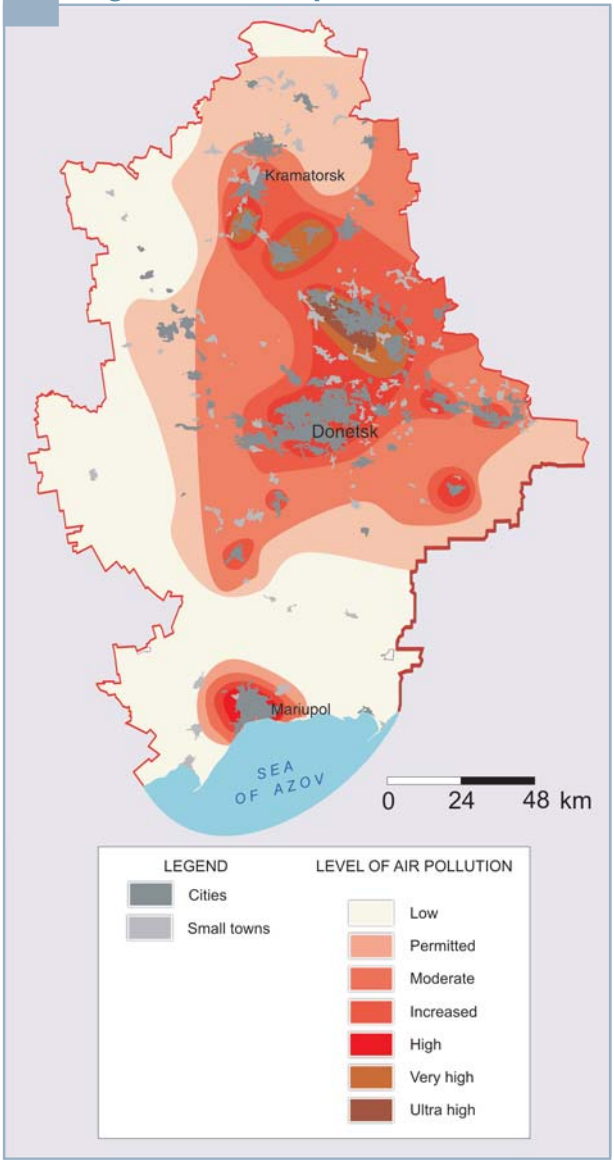
The air is most polluted in the region's cities where coal, iron and steel, and energy enterprises are located, namely Mariupol (21.9% of total emissions in the region), Donetsk (9.3%), Makiivka (7.2%), Debaltseve (6.6%) and Yenakiieve (4.6%). The distribution of emissions of harmful substances over industrial cities in the region is shown in Fig. 4.2.7. Carbon monoxide (32.9% of total emissions) represents the highest specific weight in the structure of pollutants, followed by methane (23.3%) and sulphur dioxide (21.7%). Analysis of the structure of emissions into the atmosphere testifies that emissions of carbon monoxide in 2008 dropped (by 3.7%) compared with 2000, but emissions of nitrogen dioxide increased (by 21.6%) and emissions of sulphur dioxide remained at the same level.

The State Administration of Environmental Protection in Donetsk Oblast, and the Donetsk Regional Centre for Hydrometeorology and regional sanitary and epidemiological station are responsible for monitoring atmospheric air in the region. Monitoring bodies carry out initial observations of pollutant emissions from stationary and mobile sources, check air quality at stationary sites and perform analysis of the state of atmospheric air.

Dust, nitrogen dioxide, sulphur dioxide, carbon monoxide, formaldehyde, phenol, ammonia, heavy metals, benz(a)pyrene and hydrogen sulphide are the main atmospheric pollutants in the region. The substances monitored at observation stations in Donetsk Oblast and the number of observation stations by city are shown in Fig. 4.2.8.

Figures 4.2.9-4.2.22 represent the dynamics of changes in average daily and annual concentrations of harmful substances in Donetsk and Makiivka as typical examples. It is apparent that a hazardous situation may occur when the daily average concentration of pollutants on certain days substantially exceeds the average annual background value. Air pollution in the region is not homogeneous; there are significant differences in the quality of air in industrial cities. Table 4.2.1. shows the estimated probability of exceeding the permissible standards enforced in Ukraine for the average daily concentration of harmful substances. It highlights the high

Fig. 4.2.4. Air pollution



Source: Atlas of the Donetsk region, The State Administration of Environmental Protection in Donetsk Oblast, 2009

risk of air pollution by dust, nitrogen dioxide, phenol and formaldehyde.

Figures 4.2.23-4.2.24 feature a complex environmental assessment of the state of the region's atmospheric air and analysis of air pollution hazards in the cities of Donetsk Oblast in 2008-9. The state of the atmospheric air of Donetsk Oblast was estimated on the basis of data from the Donetsk Centre for Hydrometeorology on average daily values of concentrations of harmful substances at monitoring sites. Air-monitoring data from 2000-9 were used in this process.

Ecological indices for assessment

1. Indices for impact assessment

1.1. Gross emissions of pollutants into the atmosphere of the region, ktonnes/year: aggregate emissions, emissions from stationary and mobile sources, gross emissions by individual harmful substance and by group of substances (nitrogen compounds, sulphur compounds, carbon monoxide, carbon dioxide, hydrocarbons, dust, soot, light organic compounds, metals and their compounds, methane, resistant organic compounds, chlorine and fluorine compounds, cyanides and freons);

1.2. Specific emissions of harmful substances: emissions per capita (kg), emissions per square kilometre (tonnes);

1.3. Emissions of pollutants into the atmosphere (according to paragraph 1.1) by branch of industry, production process and processing installation, by city and district of the region;

1.4. Data on dynamics of emissions of pollutants over the last 20 years (according to paragraph 1.1-1.3).

2. Indices for assessment of quality and hazard of air pollution

2.1. Concentration of pollutants in the atmospheric air, rg/m^3: average annual, monthly and daily concentrations by main harmful substance (nitrogen oxide, nitrogen dioxide, sulphur dioxide, dust, ammonia, phenol, carbon monoxide, hydrogen sulphide, benz(a)pyrene, formaldehyde and heavy metals) at stationary sites, average concentrations of pollutants within the territory of cities;

2.2. The level of excess of concentrations (danger coefficient, chronic exposure) of pollutants over the maximum allowable average daily concentration (MAC_{AD}) of main harmful substances (according to paragraph 2.1), share of MAC_{AD};

2.3. The level of excess of concentrations (danger coefficient, acute exposure) of pollutants over the maximum allowable maximum one-time concentration (MAC_{MOT}) of main harmful substances (according to paragraph 2.1), portion of MAC_{MOT};

2.4. Probability of excess of concentration of pollutants higher than the MAC_{AD} and MAC_{MOT};

2.5. Data on dynamics of air quality and hazard of air pollution (according to paragraph 2.1-2.4) over the last 20 years.

State of air pollution in the cities of the region in 2000-8 is characterized by the following tendencies.

Donetsk. For many years dust, nitrogen dioxide, phenol, ammonia and formaldehyde have been among the main most dangerous pollutants of the atmospheric air. Concentrations higher than permissible standards (higher than MAC_{AD}) are observed for these substances. Recently there has been an increase in concentrations of phenol and nitrogen dioxide. The level of air pollution by formaldehyde, dust and ammonia remains constant. Carbon monoxide, sulphur dioxide, nitrogen oxide and heavy metals are among harmful substances, for which the probability of exceeding permissible concentrations is comparatively low. There is a tendency toward a decrease in the level of air pollution by carbon monoxide. In recent years air pollution by heavy metals has stayed at a constant level.

In 2007-9 there were hazardous situations for nitrogen dioxide, dust and phenol, when their concentrations exceeded the MAC_{MOT} with a probability of 87.5%, 10% and 21% respectively. The dynamics of air pollution by harmful substances in Donetsk-Makiivka region is represented in Fig. 4.2.9-4.2.22.

Fig. 4.2.5. Dynamics of emissions of harmful substances into the atmosphere of the region, ktonnes/year

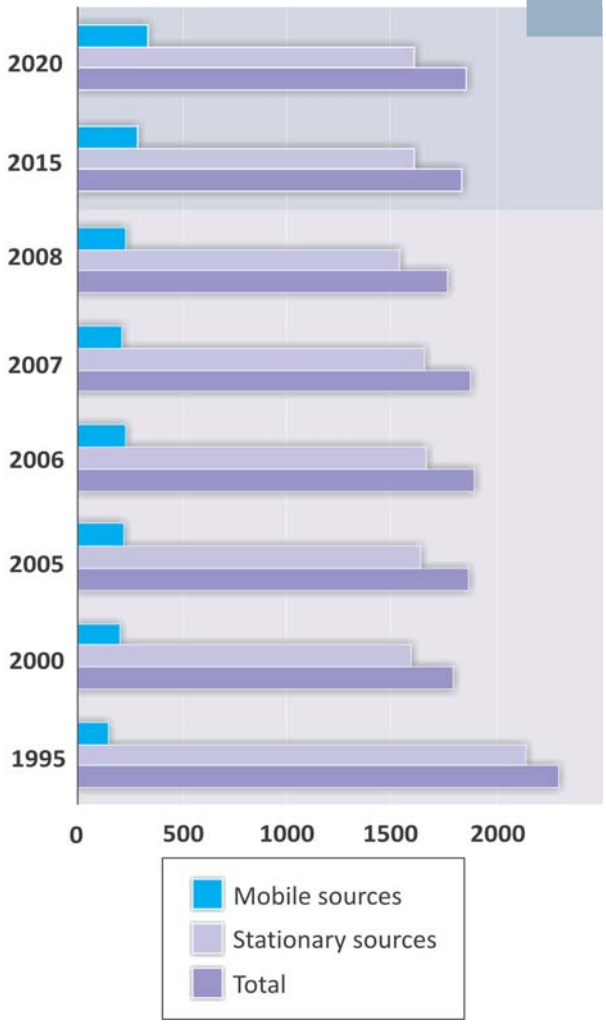
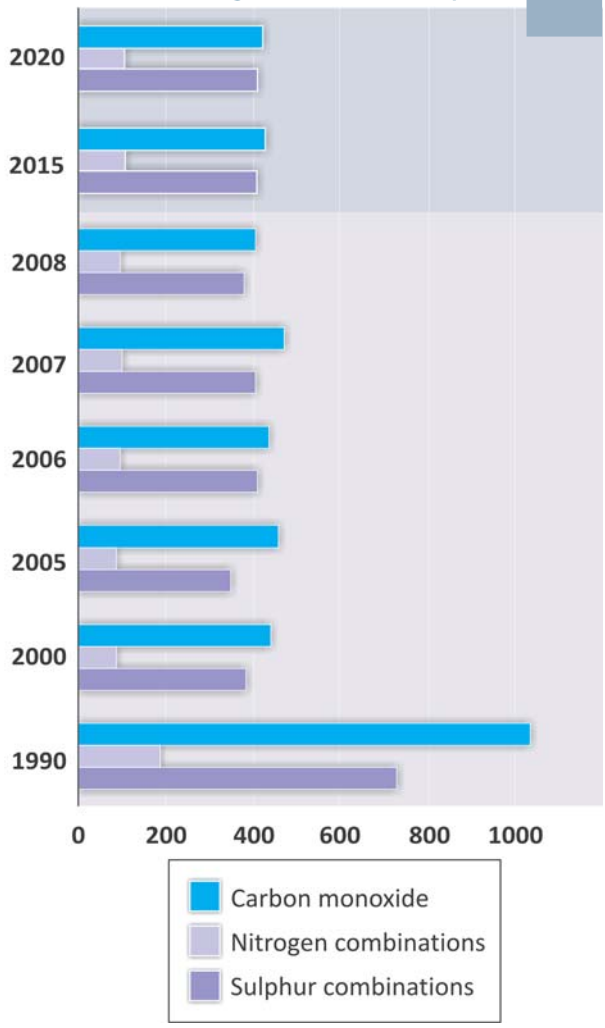


Fig. 4.2.6. Dynamics of emissions of priority harmful substances into the atmosphere of the region, ktonnes/year



Source: State Statistics Committee of Ukraine, 2009

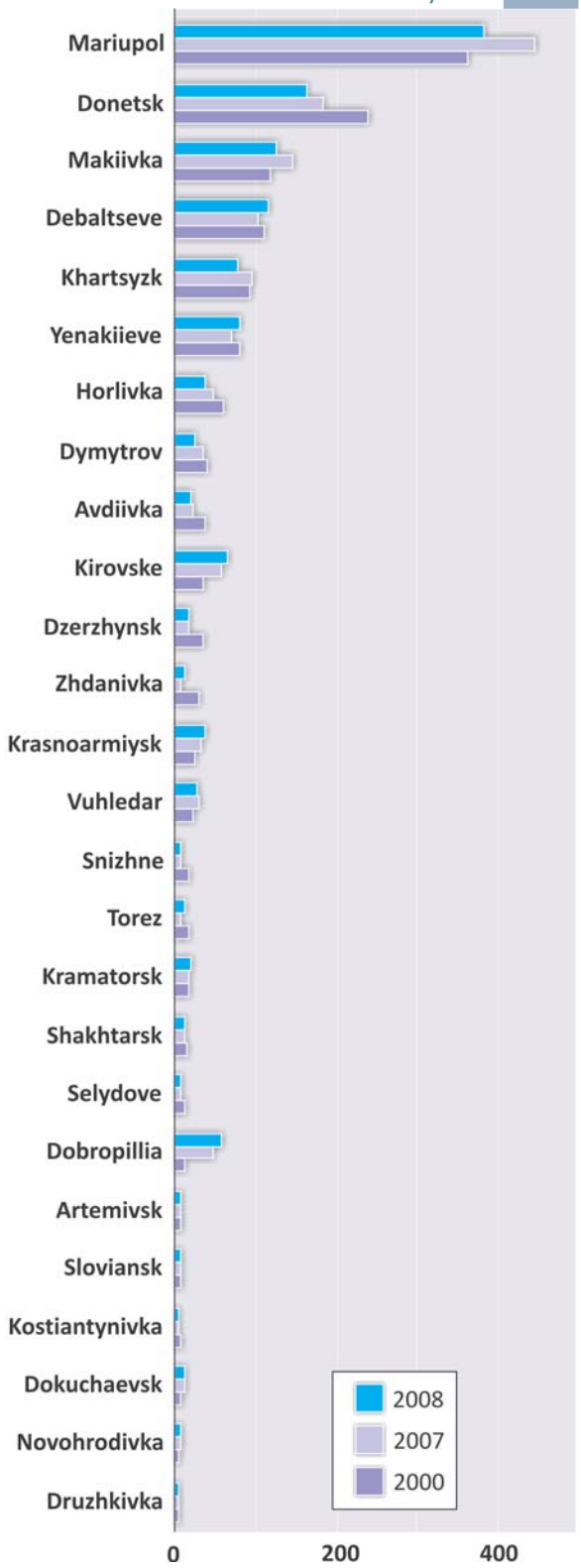
Makiivka. Depending on the level of pollution, dust, nitrogen dioxide and formaldehyde can be hazardous substances in the city, because their average daily and annual concentrations exceed the MAC_{AD}. There is a marked tendency toward an increase in the level of air pollution by dust up to 2007. The level of air pollution by nitrogen dioxide and formaldehyde remained constant in 2000-6, decreasing slightly in 2008.

The average annual content of other pollutants (sulphur dioxide, carbon monoxide, phenol and heavy metals) in 2000-9 was mainly below the MAC_{AD}. While the average annual concentration of sulphur dioxide was lower than the $MAC_{AD,}$ on certain days of 2001 and 2003 there were high one-time concentrations. However these values did not exceed the one-time maximum allowable MAC_{MOT}. In 2007-9 there were hazardous situations for nitrogen dioxide, dust and phenol, when their concentrations exceeded the MAC_{MOT} with a probability of 39.7%, 36% and 9.8% respectively.

Horlivka. Dust, nitrogen dioxide, ammonia, formaldehyde, phenol, hydrogen sulphide and carbon monoxide are among the main air pollutants. Average annual concentrations of these substances exceed the MAC_{AD}. Levels of pollution by these harmful substances have been almost constant for 10 years.

Only for air pollution by sulphur dioxide and heavy metals is the situation less hazardous. In 2007-9 the most hazardous substances polluting the atmosphere of the city were dust, nitrogen dioxide, carbon monoxide and phenol, for which a probability of exceeding the MAC_{MOT} was 14%, 52%, 7% and 7% respectively. For other components the probability of these events did not exceed 1-2%, though the MAC_{MOT} was exceeded. The atmosphere of the city is heavily polluted. Furthermore the average annual concentration of nitrogen dioxide exceeds the MAC_{MOT}, which is extremely dangerous for the population.

Fig. 4.2.7. Dynamics of emissions of harmful substances by city in the region, ktonnes/year



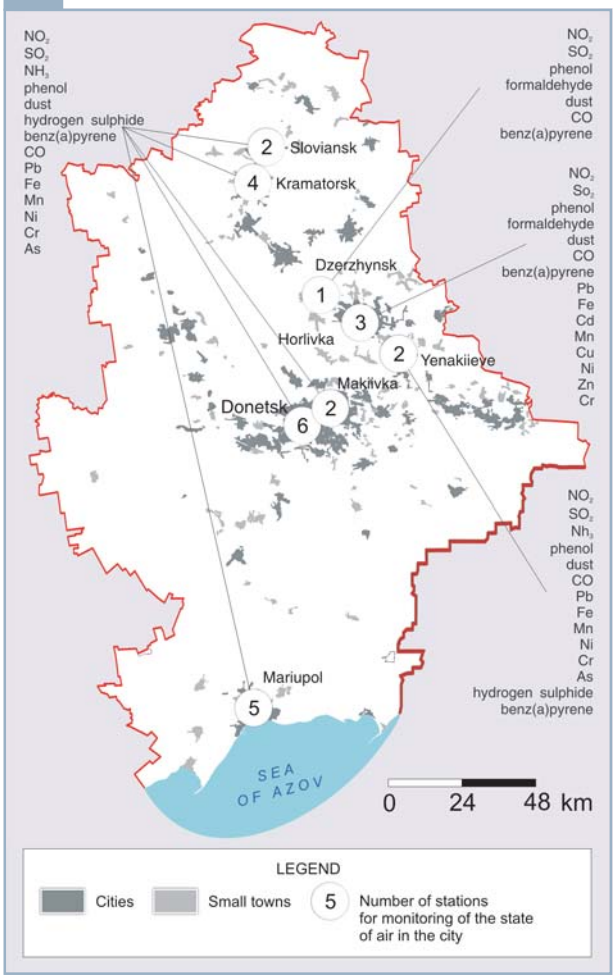
Source: State Statistics Committee of Ukraine, 2009

Yenakiieve. The main hazardous substances polluting the atmosphere of the city are dust, nitrogen dioxide, hydrogen sulphide, phenol, carbon monoxide and formaldehyde. The tendencies of air pollution by these substances have been steady for 10 years. In 2007-9 hazardous situations occurred for dust, nitrogen dioxide, carbon monoxide and phenol, with their concentrations exceeding the MAC_{MOT} with a probability of 12%, 34%, 4% and 8% respectively. In 2008 there was a decrease in the formaldehyde concentration by the MAC_{AD} value.

Dzerzhynsk. The level of air pollution in the city due to dust, nitrogen dioxide, phenol, formaldehyde and carbon monoxide is rather high. In 2007-9 there were hazardous situations for dust, nitrogen dioxide, carbon monoxide and phenol, with their concentrations exceeding the MAC_{MOT} with a probability of 15%, 30%, 10% and 6% respectively.

Mariupol. Dust, nitrogen dioxide, ammonia and formaldehyde are hazardous pollutants. The average annual concentrations of these substances exceed the MAC_{AD}, and the high level of pollution has been steady for many years. In Mariupol there has been a tendency toward a decrease in the level of ammonia and formaldehyde pollution since 2000, though average annual concentrations remain

Fig. 4.2.8. Main substances controlled at monitoring stations in Donetsk Oblast



Source: The State Administration of Environmental Protection in Donetsk Oblast, Donetsk Centre for Hydrometeorology, 2009

Table 4.2.1. Probability of air pollution in Donetsk Oblast cities exceeding MAC_{MOT} in 2007-9

	Dust	Sulphur dioxide	Carbon monoxide	Nitrogen dioxide	Ammonia	Phenol	Formaldehyde
Horlivka	0.141	0	0.074	0.521	0.034	0.069	0
Dzerzhynsk	0.151	0.002	0.107	0.304	-	0.063	0
Donetsk	0.099	0	0.009	0.875	0.004	0.209	0.042
Yenakiieve	0.121	0	0.038	0.342	-	0.077	0
Kramatorsk	0	0	0	0.168	-	0.073	0.009
Makiivka	0.361	0	0	0.397	-	0.098	0.007
Mariupol	0.084	0	0.017	0.201	-	0.085	0.036
Sloviansk	0	0	0	0.064	-	0.099	0

Source: The State Administration of Environmental Protection in Donetsk Oblast, Donetsk Centre for Hydrometeorology, 2010

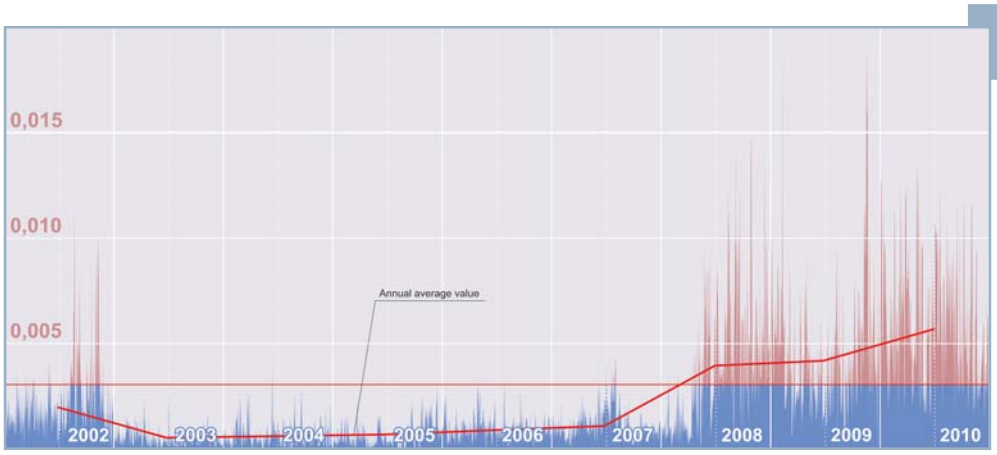


Fig. 4.2.9. Dynamics of average daily concentration of phenol in 2001-9, mg/m³

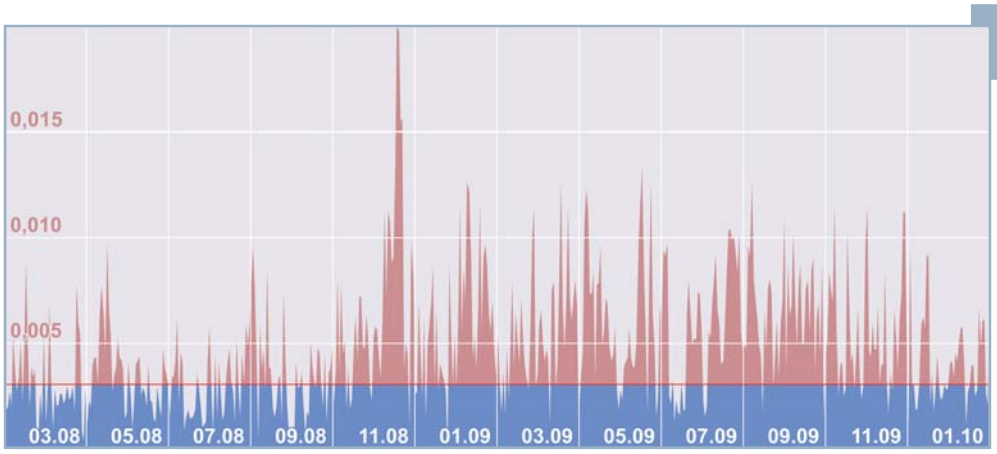


Fig. 4.2.10. Dynamics of average daily concentration of phenol in 2008-9, mg/m³

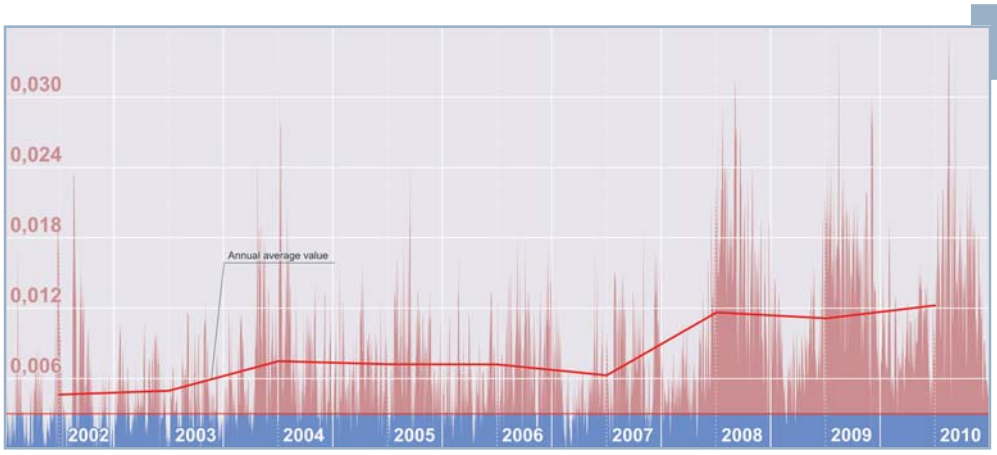


Fig. 4.2.11. Dynamics of average daily concentration of formaldehyde in 2001-9, mg/m³

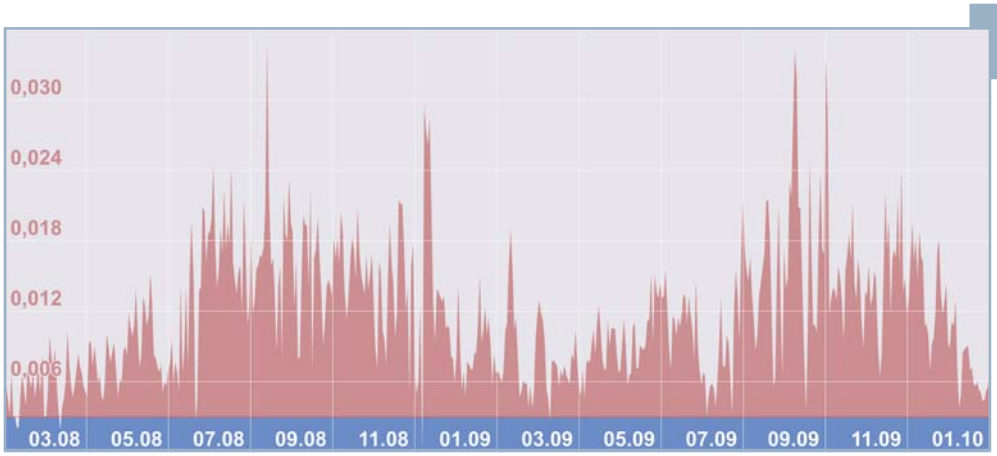


Fig. 4.2.12. Dynamics of average daily concentration of formaldehyde in 2008-9, mg/m³

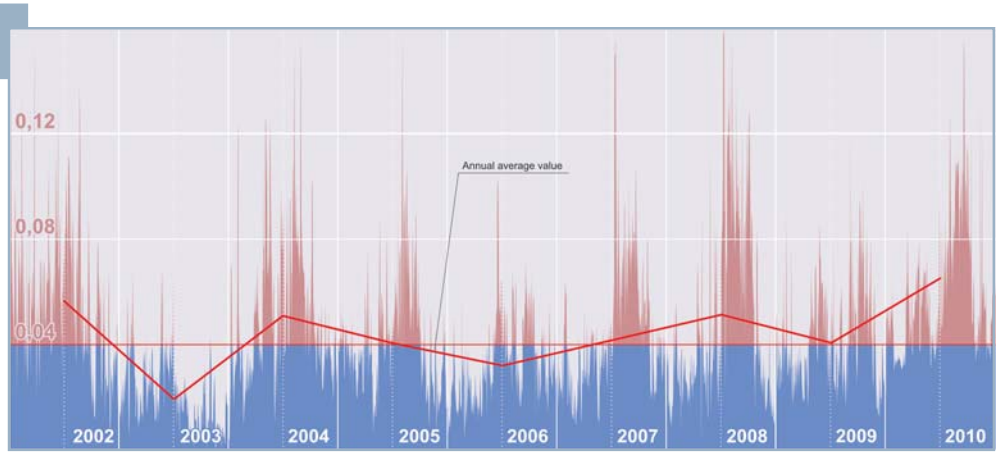


Fig. 4.2.13. Dynamics of average daily concentration of ammonia in 2001-9, mg/m³

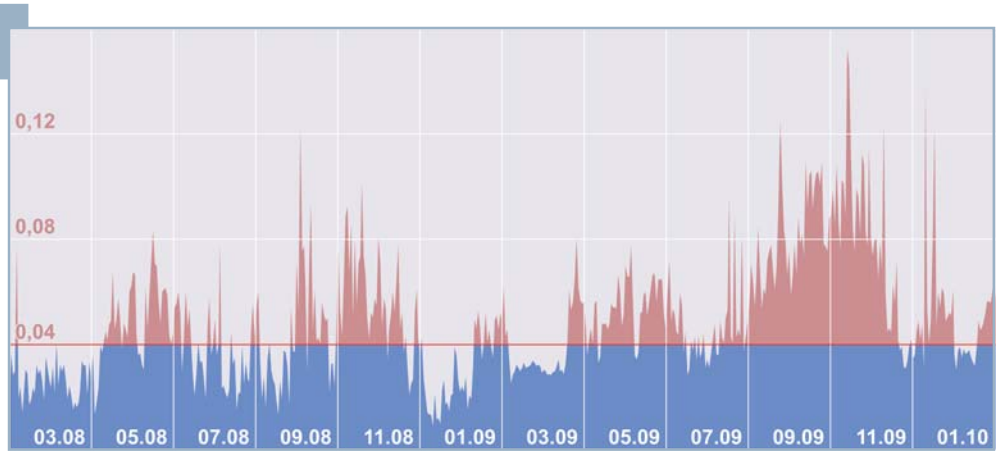


Fig. 4.2.14. Dynamics of average daily concentration of ammonia in 2008-9, mg/m³

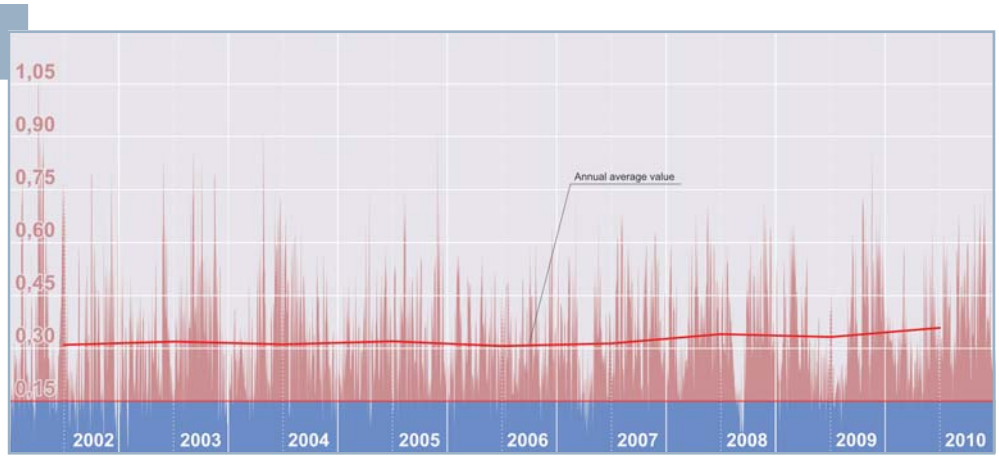


Fig. 4.2.15. Dynamics of average daily concentration of dust in 2001-9, mg/m³

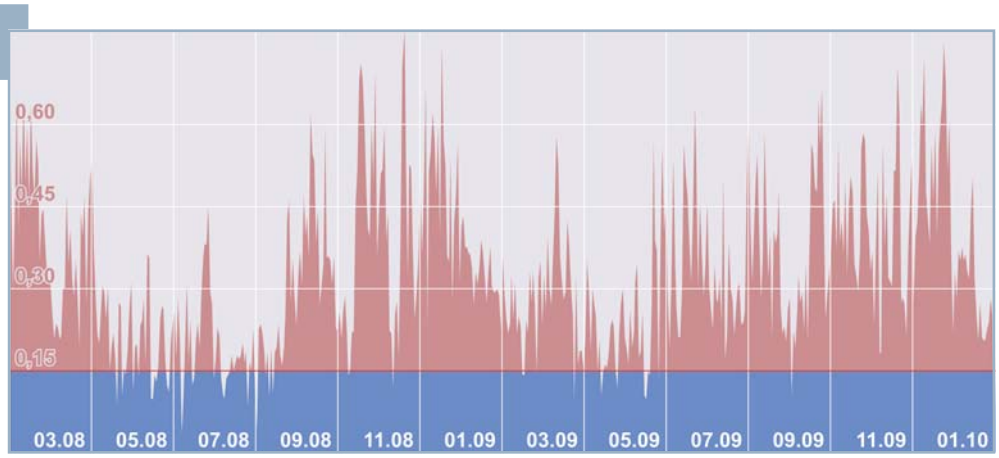


Fig. 4.2.16. Dynamics of average daily concentration of dust in 2008-9, mg/m³

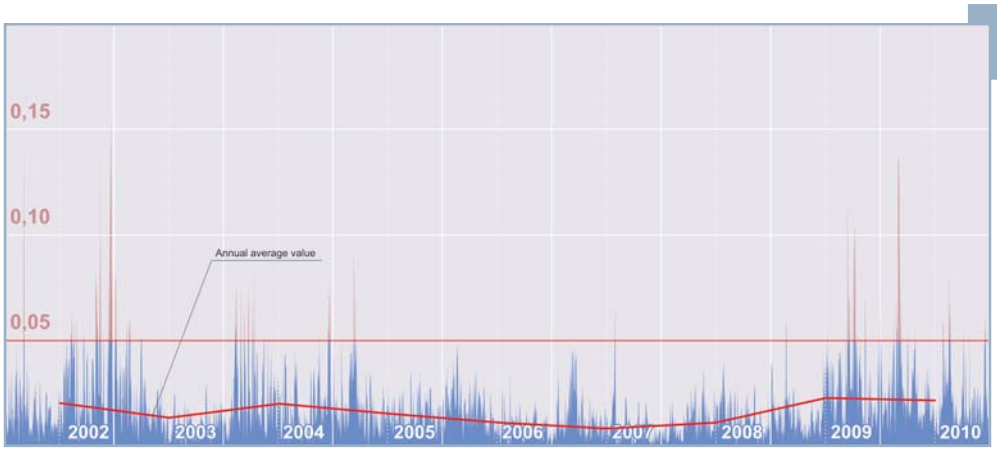


Fig. 4.2.17. Dynamics of average daily concentration of sulphur dioxide in 2001-9, mg/m³

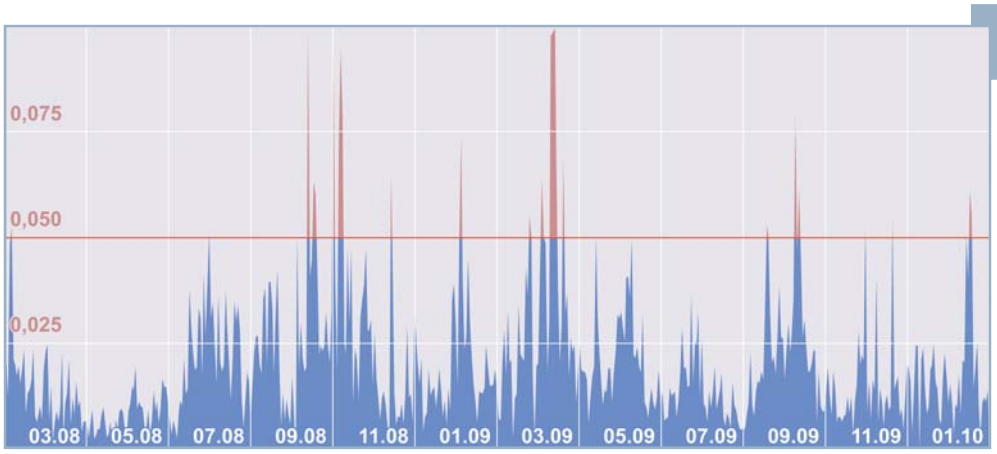


Fig. 4.2.18. Dynamics of average daily concentration of sulphur dioxide in 2008-9, mg/m³

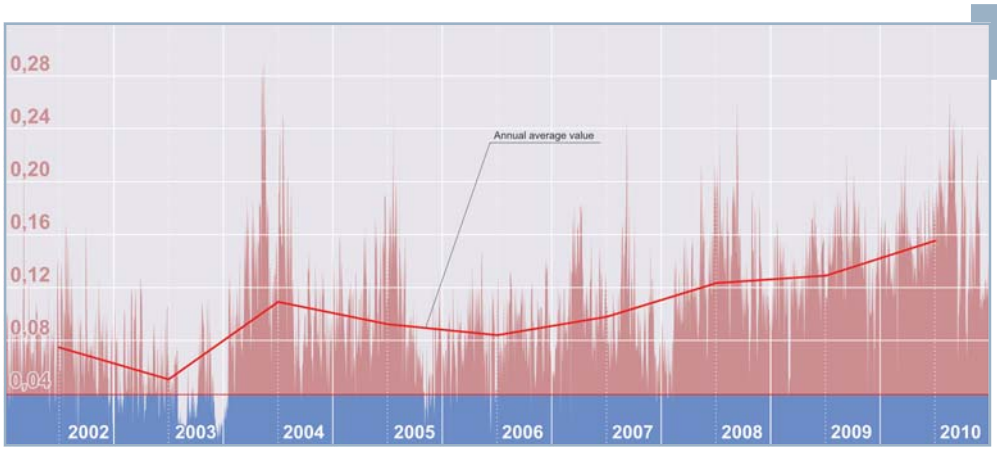


Fig. 4.2.19. Dynamics of average daily concentration of nitrogen dioxide in 2001-9, mg/m³

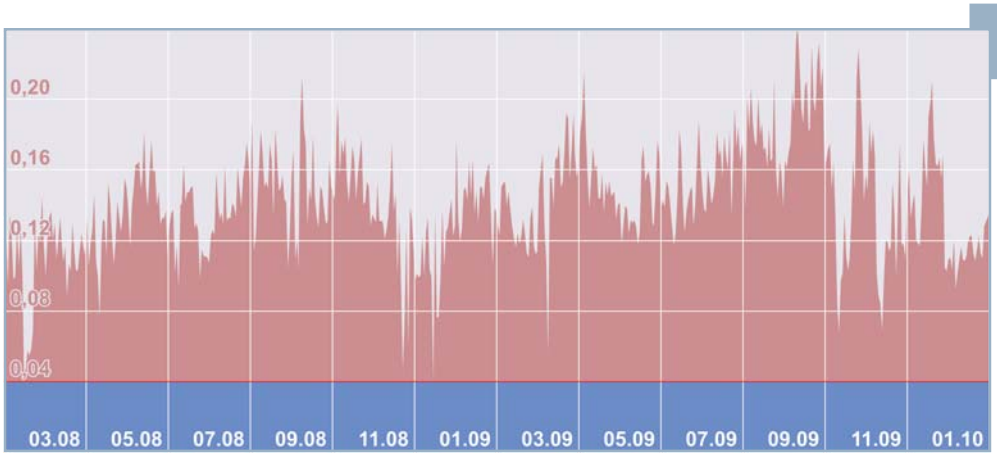


Fig. 4.2.20. Dynamics of average daily concentration of nitrogen dioxide in 2008-9, mg/m³

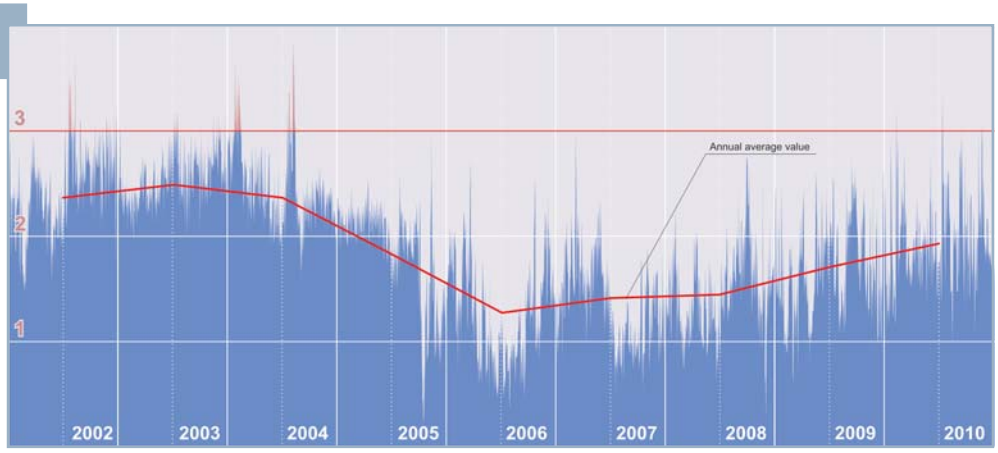


Fig. 4.2.21. Dynamics of average daily concentration of carbon monoxide in 2001-9, mg/m³

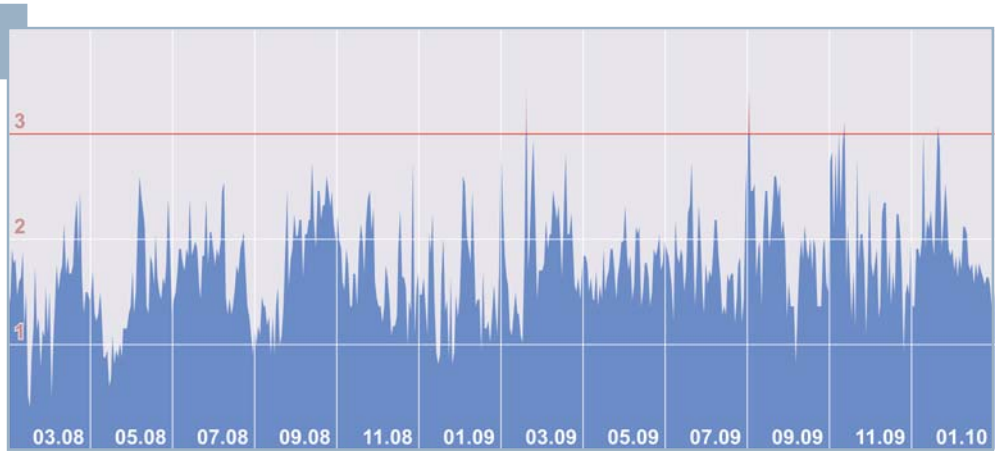


Fig. 4.2.22. Dynamics of average daily concentration of carbon monoxide in 2008-9, mg/m³

Source: Donetsk Centre for Hydrometeorology, The State Administration of Environmental Protection in Donetsk Oblast, 2010

higher than the MAC_{AD}. In 2007-9 there was a tendency toward increasing of dust concentration, though the level of air pollution by this substance remained lower than in Horlivka and Makiivka. There were hazardous situations when the average daily concentrations of dust, nitrogen dioxide and phenol exceeded the MAC_{MOT} (see Table 4.2.1).

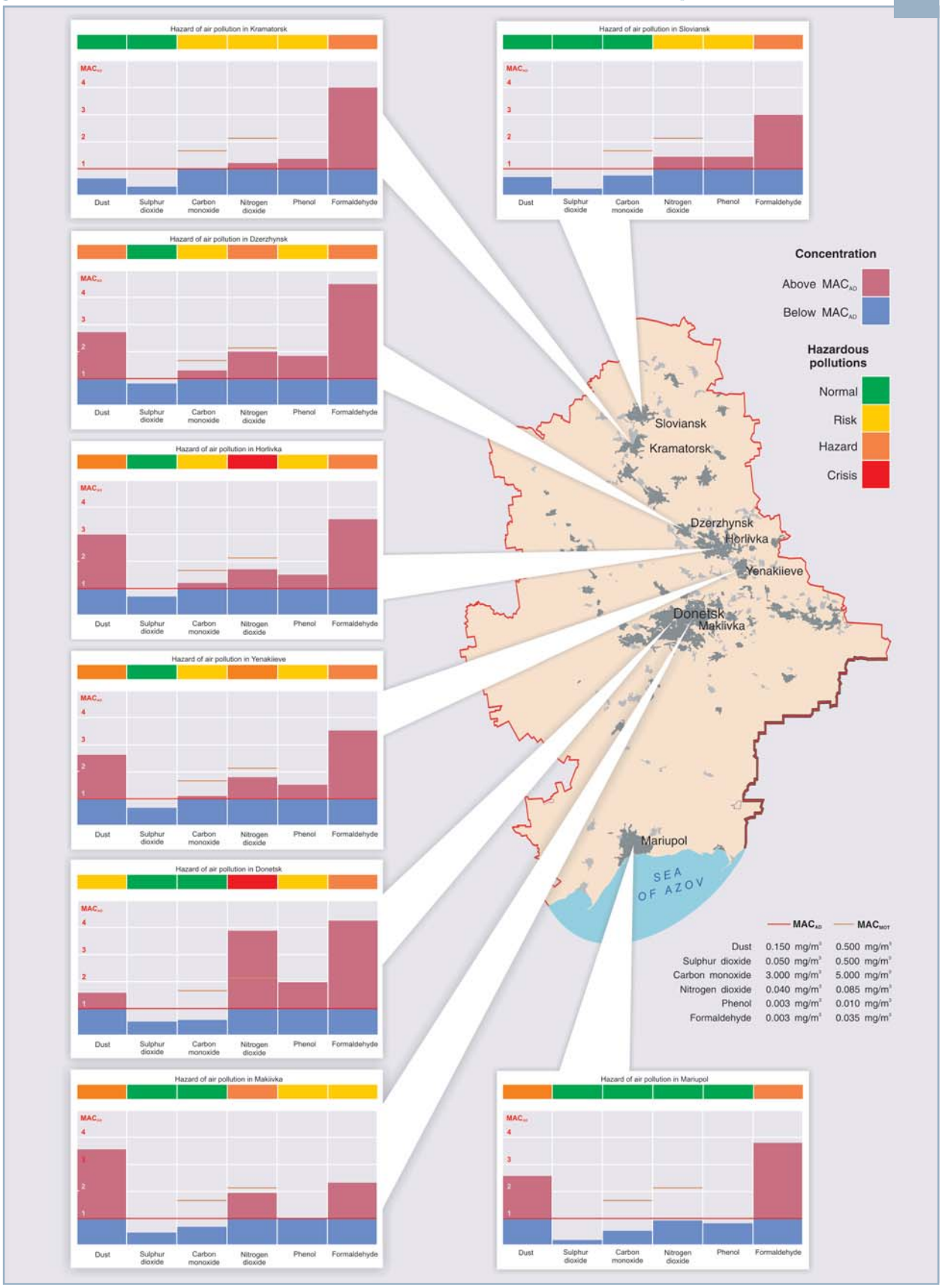
Kramatorsk and Sloviansk. Nitrogen dioxide, phenol and formaldehyde are hazardous substances polluting the atmospheric air of these cities. The situation regarding air pollution by other components is comparatively good. The probability of nitrogen dioxide and phenol concentrations exceeding the MAC_{AD} is 7-17% and 6-10% respectively. There is a high average annual concentration of formaldehyde, 3.5 higher than the MAC_{AD}.

Analysis of data on the pollutants in the region's atmospheric air in 2000-9 shows

Priorities for improving air quality in Donetsk Oblast

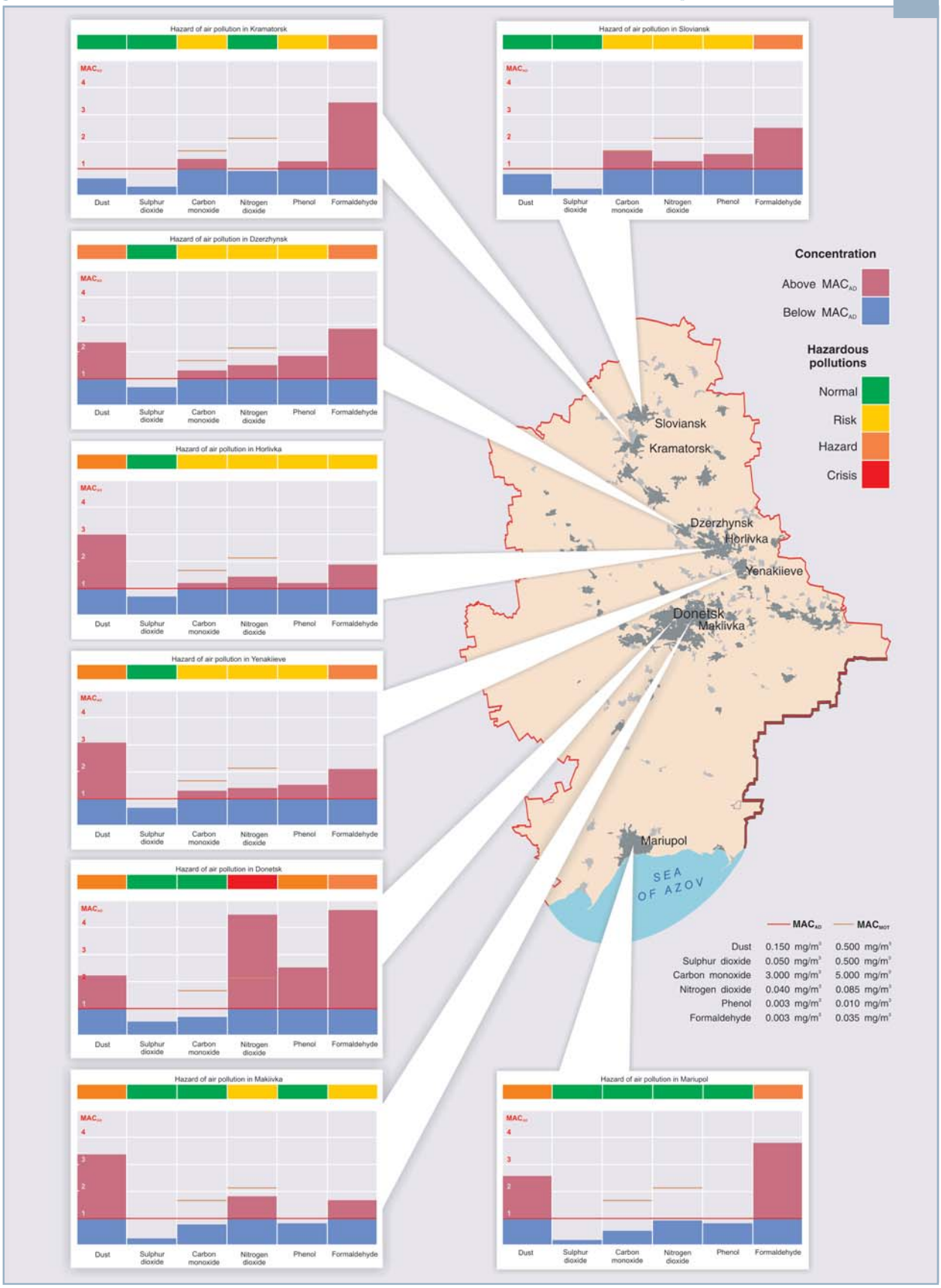
1. Reduce the level of nitrogen dioxide, dust, ammonia, benz(a)pyrene and formaldehyde air pollution in the cities of the region.
2. Take measures, in terms of organization and technology, to prevent an increase in emissions of harmful substances from stationary sources.
3. Control emissions of harmful substances from mobile sources.
4. Direct regional environmental policy to maintain the trend towards a decrease in emissions from enterprises, thanks to legislative and economic measures.
5. Improve the quality and representativity of data collected as part of environmental monitoring of atmospheric air.
6. Continue development of automated systems for monitoring atmospheric air in Donetsk Oblast.
7. Control air pollution by ozone, $PM_{2.5}$ и $PM_{5.0}$.

Fig. 4.2.23. Environmental assessment of the state of the atmospheric air in 2008



Source: The State Administration of Environmental Protection in Donetsk Oblast, 2010

Fig. 4.2.23. Environmental assessment of the state of the atmospheric air in 2009



Source: The State Administration of Environmental Protection in Donetsk Oblast, 2010

that despite a fall in gross emissions, the overall situation regarding air pollution has not improved. The level of air pollution by the most hazardous substances, such as formaldehyde, nitrogen dioxide and dust, remains high. The forecast of emissions of harmful substances into the atmosphere of the cities took into account estimates of the future level of overall emissions of harmful substances (Fig. 4.2.25). If the current trend towards a decrease in overall emissions continues, the situation regarding dust, nitrogen dioxide, benz(a)pyrene and formaldehyde air pollution in the cities of the region may improve, remaining constant for sulphur dioxide and carbon monoxide.

Thus nearly all industrial cities of Donetsk Oblast have a high level of air pollution, but the most severe pollution is in Donetsk. Makiivka, Horlivka, Dzerzhynsk and Yenakiieve.

Fig. 4.2.25. Forecast of emissions of harmful substances into the atmosphere, ktonnes/year

4.3. Water resources

Donetsk Oblast is one of the regions in Ukraine with the largest freshwater shortage. Historically large mineral reserves in the Donetsk coal basin contributed to rapid development of industry and dense concentration of population in the region. Several industrial sectors which have developed here over the last two centuries are characterized by significant water consumption. There is consequently an acute problem of water-resource pollution in the region and a corresponding shortage of good quality fresh water for the domestic needs of the population, for farming, processing industries, etc.

The first ecological-hydrochemical investigations in Donetsk Oblast date back to the early 18th century. In a letter by Peter the Great dated 14 November 1704 there is a reference to the presence of saline waters in the valley of the river Zherebets – the right hand tributary of the river Siversky Donets. Current chemical analysis of aquifers in this region also indicates the presence of saline ground water at a depth of 1.25 metres with a 39g/l salt content and sodium chloride ions.

The region currently has 55 stationary sections for monitoring surface-water quality and about 100 wells for monitoring ground-water quality. The Siversky Donets Basin Authority of Water Resources and Donetsk Centre for Hydrometeorology are tasked with monitoring surface water in the territory. Monitoring of ground water is carried out by the State Regional Geological Enterprise Donetskgeologiya.

The start of systematic study of river run-off and the development of hydrochemical monitoring station network in Donetsk Oblast spans the period between 1904 and 1930. Long-term average annual characteristics of the run-off of main rivers of Donetsk Oblast are represented in table 4.3.1. Total run-off of rivers of the region ranges from 1.5 to 2.0 km^3/year.

The bulk of river water, reaching 60-70% of the average annual total, runs off in winter and spring. The rivers are fed by snow melting in the spring, accounting for 40-80% of annual run-off. The contribution of rainfall is insignificant, despite the fact that precipitation in the region is increasing. The inflow of ground water into rivers plays a significant role for the rivers of the Donetsk Ridge, where valleys cut deeply into the rocks and drain the aquifers. Ground water run-off ranges from 50% of the volume of run-off for the rivers of the Donetsk ridge to 10% for other rivers. The salinity of ground water ranges from 800 to 2,700 mg/l.

Waste water discharged by mines and industrial enterprises – its annual amount is comparable to annual river run-off – is essential to maintain the flow of many rivers of the region.

Under current conditions the regime of almost all rivers has been changed by the construction of artificial water bodies – ponds and reservoirs. Some 157 reservoirs have been built in the region, one with a total capacity of 162.0 million m^3 of water, 15 with a capacity of 427.8 million m^3, and others containing 285.7 million m^3 of water. The entire water supply per capita amounts to 180 m^3, five times less than the average in Ukraine. Over the last 18 years household water consumption per capita has dropped from 135 m^3 in 1990 to 58 m^3 in 2008.

In spite of the decrease in the volume of water consumption (less than half the amount consumed in 1990) the intensity of water resource usage in the region is still

Table 4.3.1. Long-term average annual characteristics of the run-off of main rivers of the region

River	Station	Annual run-off: Drainage area, km^2	Annual run-off: Water discharge, m^3/s	Annual run-off: Volume, Km^3	Fresh water resources (km^3), accessible for use during part (%) of the time: 50	75	95
Siversky Donets	Izium	22,600	51.9	1.64	1.52	1.07	0.61
Siversky Donets	Lysychansk	52,400	112	3.53	3.28	2.41	1.48
Kazenny Torets	Rayske	936	1.83	0.058	0.052	0.034	0.017
Kazenny Torets	Sloviansk	5,350	8.8	0.278	0.25	0.163	0.071
Kryvyy Torets	Oleksiyevo-Druzhkivka	1,530	3.69	0.116	0.111	0.073	0.031
Sukhyy Torets	Cherkaske	1,340	2.07	0.065	0.055	0.032	0.012
Bakhmut	Siversk	1,560	2.92	0.092	0.078	0.045	0.017
Zherebets	Torske	857	1.56	0.049	0.043	0.029	0.016
Kalmius	Avdotyine	263	2.41	0.076	0.069	0.047	0.025
Kalmius	Rozdolnoe	1,960	6.63	0.209	0.192	0.132	0.072
Kalmius	Prymorske	3,700	8.77	0.227	0.25	0.165	0.083
Mokra Volnovakha	Mykolayivka	194	0.46	0.015	0.015	0.0098	0.0025
Kalchik	Kremenivka	469	0.94	0.03	0.027	0.021	0.014
Kalchik	Peremoga	164	0.28	0.0088	0.0079	0.005	0.0024
Kalchik	Mariupol	1,250	1.68	0.053	0.045	0.029	0.015
Gruzskiy Yelanchik	Guselnikove	1,190	0.91	0.029	0.022	0.011	0.0029
Mius	Stryukove	142	0.51	0.016	0.014	0.0092	0.0044
Mius	Dmytrivka	2,090	5.73	0.181	0.161	0.109	0.06
Krepynka	Chuguno-Krepynka	264	0.93	0.029	0.027	0.019	0.011
Krynka	Novoselivka	582	2.4	0.076	0.068	0.045	0.022
Krynka	Blahodarne	1,690	4.74	0.15	0.131	0.081	0.038
Vilkhivka	Oleksiyevo-Orlivka	272	1.21	0.038	0.032	0.02	0.0095

Source: The State Administration of Environmental Protection in Donetsk Oblast, 2009

the highest in Ukraine: the region leads in the discharge of polluted waste water. In 2007 and 2008 the total volume of waste water discharged into surface water bodies amounted to 1,699 million and 1,546 million m^3 respectively. Moreover, with the drop in industrial output in the second half of 2008, discharge of polluted waste water decreased from 1,438 to 615 million m^3.

The dynamics and forecasts for the main indices of abstraction, use and discharge of water in the region are given in Fig. 4.3.1 and 4.3.2. The trend for abstraction of water from surface water sources is clearly negative, yet water losses during transport are increasing.

The main pollutants of water bodies are still metallurgy and coking by-product enterprises (factories in Mariupol, Makiivka, Avdiivka and Donetsk), and the coal and energy industries.

A substantial amount of pollutants flows into the water bodies of the region together with waste water. In 2007 and 2008 discharge included respectively 516,000 and 485,000 tonnes of sulphates, 192,000 and 287,000 tonnes of chlorides, 14,000 and 13,500 tonnes of nitrates, and 103 and 113 tonnes of petroleum products. The concentration of salts in the water of almost all the region's rivers has increased. One of the main reasons for this is the discharge of

Ecological indices for assessment

1. Indices for assessment of water use.

1.1. Long-term renewable fresh water resources in the region, million m^3.

1.2. Total volume of river and ground water run-off, million m^3/year: total run-off volume, run-off volume by river, volume of surface and ground water run-off.

1.3. Abstraction and use of water from natural water bodies, million m^3/year: abstraction and use of surface and ground waters, abstraction and use of water by branch of industry and by water body.

1.4. Discharge of water into natural water bodies, million m^3/year: total discharge of waste waters, discharge of waste waters by branch of economy and by water body, discharge of waste waters treated to standard quality and polluted waste waters (insufficiently treated or without treatment), portion of polluted waste waters in total water discharge (%), share of reused and successively used water in industrial water consumption (%).

1.5. Household water consumption per capita (m^3/year) and water losses during conveyance (million m3/year).

1.6. Data on dynamics of indices over the last 20 years (according to paragraph 1.1-1.5).

2. Indices for assessment of water quality.

2.1. Portion of samples, which do not meet the standards of maximum allowable water pollution, in the total number of samples of surface and ground waters, %: by index of chemical and bacterial pollution.

2.2. Biochemical oxygen demand (BOD_5) and concentration of ammonia nitrogen in river water, mg O_2/l and mg/l.

2.3. Amount of nutrients in fresh water, mg/l: concentrations of nitrates and phosphates in water.

2.4. Water pollution index (hazard index):

$$I_{3B} = \frac{1}{6}\sum_{n=1}^{6}\frac{C_i}{MAC_i},$$

where C_i – concentration of ammonia nitrogen, nitrite nitrogen, petroleum products, phenols, dissolved oxygen and also BOD_5; MAC_i – maximum allowable concentrations of pollutants in water, according to national standards.

2.5. Water quality index:

$$I_e = \frac{1}{3}(I_1 + I_2 + I_3),$$

where $I_1 = \frac{1}{3}\sum_{n=1}^{3}\frac{C_i}{C_{fi}}$ – saline contamination index, C_i – composition of salt (mg/l): salinity, sulphates, chlorides, $I_2 = \frac{1}{11}\sum_{n=1}^{11}\frac{C_i}{C_{fi}}$ – index of ecological sanitary state, C_i – suspended substances, ammonia nitrogen, nitrite nitrogen, nitrate nitrogen, phosphates phosphor, dissolved oxygen (mg/l), pH (units), oxygen saturation (%), permanganate oxygen consumed (mg O/lm^3), biochemical oxygen demand (mg O_2/l), $I_3 = \frac{1}{8}\sum_{n=1}^{8}\frac{C_i}{C_{fi}}$ – specific pollution index, C_i – copper, zinc, total chromium, total ferrum, manganese, petroleum products, Synthetic Surfactant (mkg/l). The value of C_{fi} is a minimal observed value of the corresponding index by water body pollution over the last 50 years.

2.6. Data on dynamics of indices over the last 20 years (according to paragraph 2.1-2.5).

Fig. 4.3.1. Abstraction and use of water, million m^3

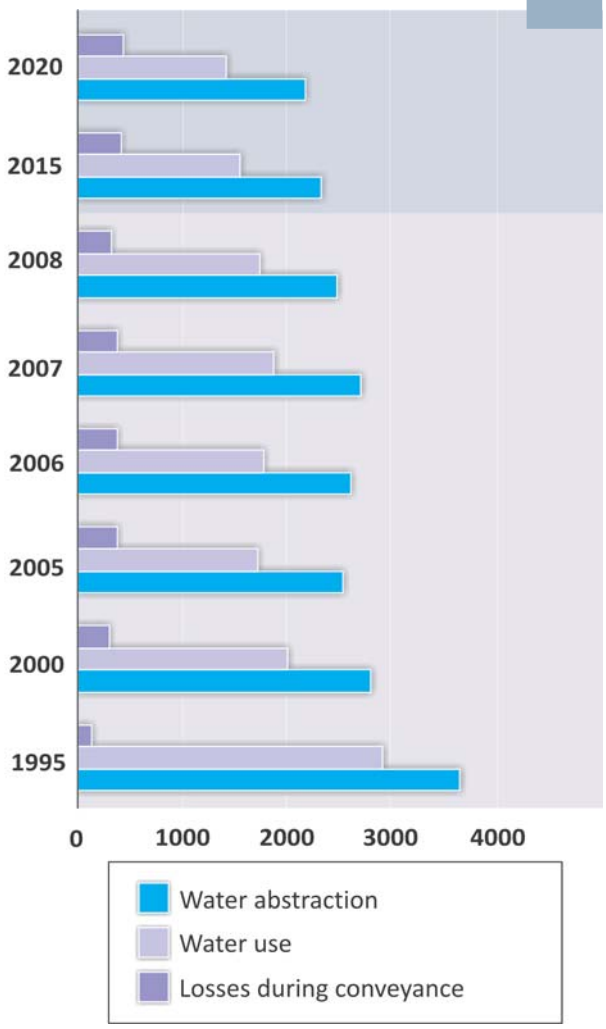
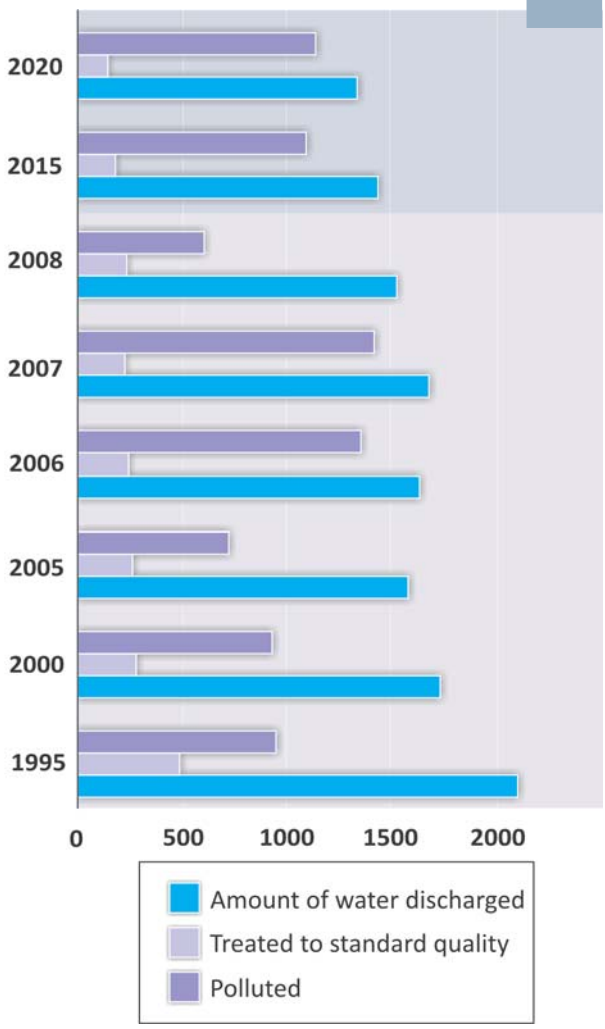


Fig. 4.3.2. Water discharge, million m^3



Source: Siversky Donets Basin Authority of Water Resources, the State Administration of Environmental Protection in Donetsk Oblast, 2009

mineral-rich mine waters, dumping more than 1 million tonnes of salts into the rivers. Use of fresh water and discharge of waste waters by enterprises of branches of economy in 2008 are illustrated in Fig. 4.3.3 and 4.3.4.

Abstraction, use and discharge of water by water body of the region are represented in Fig. 4.3.5. According to the data from statistical reporting on use of water resources in Donetsk Oblast there are 279 enterprises consuming water which discharge return water into the rivers and water bodies of the region. Over the last 18 years the amount of used water decreased by 47% and the volume of waste water discharged by enterprises decreased by 41%. The increase in the share of polluted waters discharged into surface water bodies over this period is a negative factor. In turn the share of polluted waste water in the total volume of discharged water increased from 16% in 1990 to 40% in 2008. Therefore, despite the decrease in the overall volume of waste water, many water bodies of the region have been suffering from a high anthropogenic impact for a long period of time. Rivers and water bodies have been silted up, with a high level of bacterial and chemical pollution.

Monitoring bodies using 33-35 indicators and characteristics keep track of the

Fig. 4.3.3. Water use by branch of economy in 2008

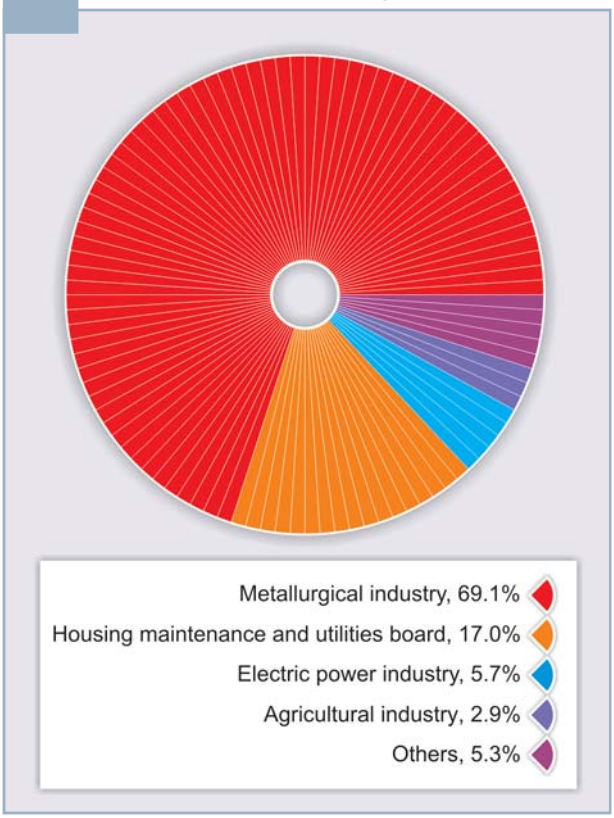
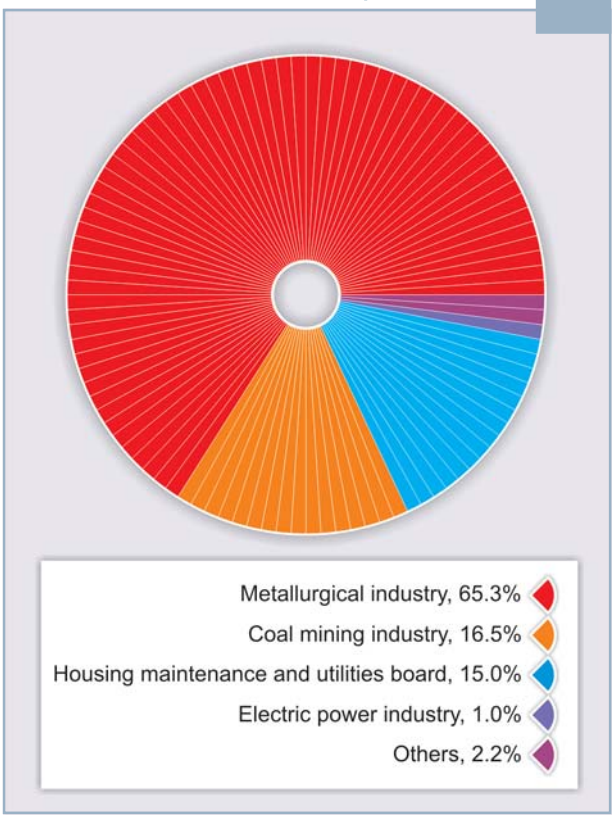


Fig. 4.3.4. Water discharge by branch of economy in 2008



Source: Siversky Donets Basin Authority of Water Resources, the State Administration of Environmental Protection in Donetsk Oblast, 2009

quality of surface and ground waters in the region. Complex environmental assessment of water quality in rivers and water bodies of Donetsk Oblast by indicators, as recommended by the UN European Environmental Committee and the European Environmental Agency, is represented in Fig. 4.3.6 and 4.3.7.

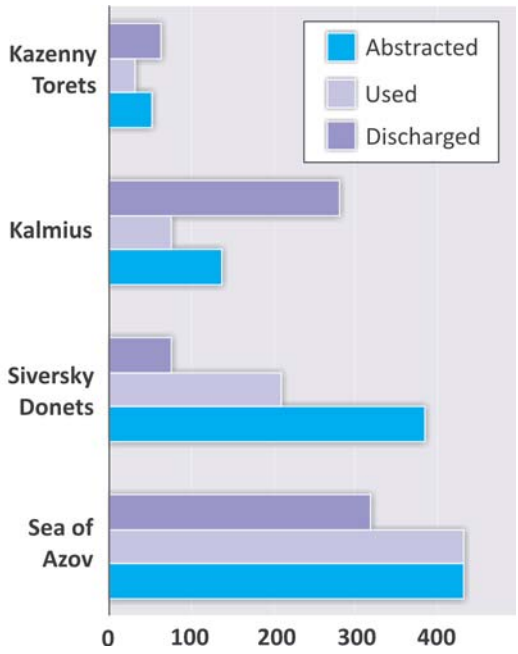
Over the last two years, as it is clear from the analysis of indices of water quality of rivers in Donetsk Oblast, the situation for pollution of the water environment by some substances has improved but it has deteriorated for other substances and indices. In the majority of rivers biochemical oxygen demand, sulphates and ions of ammonium exceed current standards. This indicates a higher concentration of easily oxidizable organic substances in the river water and a significant part of discharge of sulphate-contaminated mine and industrial water in the total river run-off in 2007-8.

Chemical composition of precipitation

City	pH	Salinity, mg/dm³	Sulphates, mg/dm³	Calcium ions, mg/dm³	Magnesium ions, mg/dm³
Donetsk	5.57	49.5	27	5	4.23
Krasnyi Lyman	6.07	75.7	26.3	4.32	5.85
Volnovakha	5.74	36.6	16.6	2.59	2.3
Amvrosiivka	6.41	56.1	20.8	5.78	4.1
Krasnoarmiysk	5.98	105.4	52.8	6.72	10.6

Source: State Environmental Protection Administration in Donetsk Oblast, 2009

Fig. 4.3.5. Abstraction, use and discharge of water by water body, million m³



Source: State Statistics Committee of Ukraine, The State Administration of Environmental Protection in Donetsk Oblast, 2009

The poor ecological state of the water resources in the region is due to environmental conditions and the high anthropogenic impact on the environment. It should be noted, that the problem of water quality in Donbas rivers has existed for more than 50 years. Changes to the flow regime of the majority of rivers, due to reservoirs, has reduced the abundance of water. For instance until 1958 (before the Siversky Donets-Donbas canal was opened) the run-off of the river Siversky Donets was almost at its natural level and irretrievable water abstraction amounted to 2-3 m^3/s. By 2000 it had increased to 23.2 m^3/s. Recent data indicate that the concentration of calcium ions and total water salinity in the Siversky Donets have substantially increased. A change in the salt composition is unusual in natural processes and must to a large extent be caused by human economic activity in the river basin.

Constant water enrichment by mineral forms of nitrogen has been recorded in the rivers of Pryazovia over the last 10 years. In 1989 their concentration amounted to about 2 mg N/l, but in 2000 more 3.5 mg N/l and 3.6 mg N/l in 2008. As for heavy metals, their concentration, as well as petroleum products, has tended to decrease since the beginning of 1990. Saline pollution of the region's surface waters is primarily due to the discharge of mine and industrial waters into the river system, and also with human agricultural activity. Figures 4.3.8-4.3.19 show the dynamics of changes in the concentration of the main components for each river of Donetsk Oblast. Figure 4.3.20 contains a map of the ecological assessment of surface water quality in Donetsk Oblast. The map displays the qualitative and quantitative characteristics of water, with 22 indicators arranged in three groups: salt composition indicators, ecological-sanitary indicators and specific indicators of toxic action. River water quality is assessed on the basis of the water quality index I_e for the worst indicators according to procedures and methods of environmental assessment of water quality by corresponding category. Comparison of the current state of water body pollution with the minimum observed value of the background level by the particular indicator over the last 50 years is based on the water pollution risk assessment by this indicator.

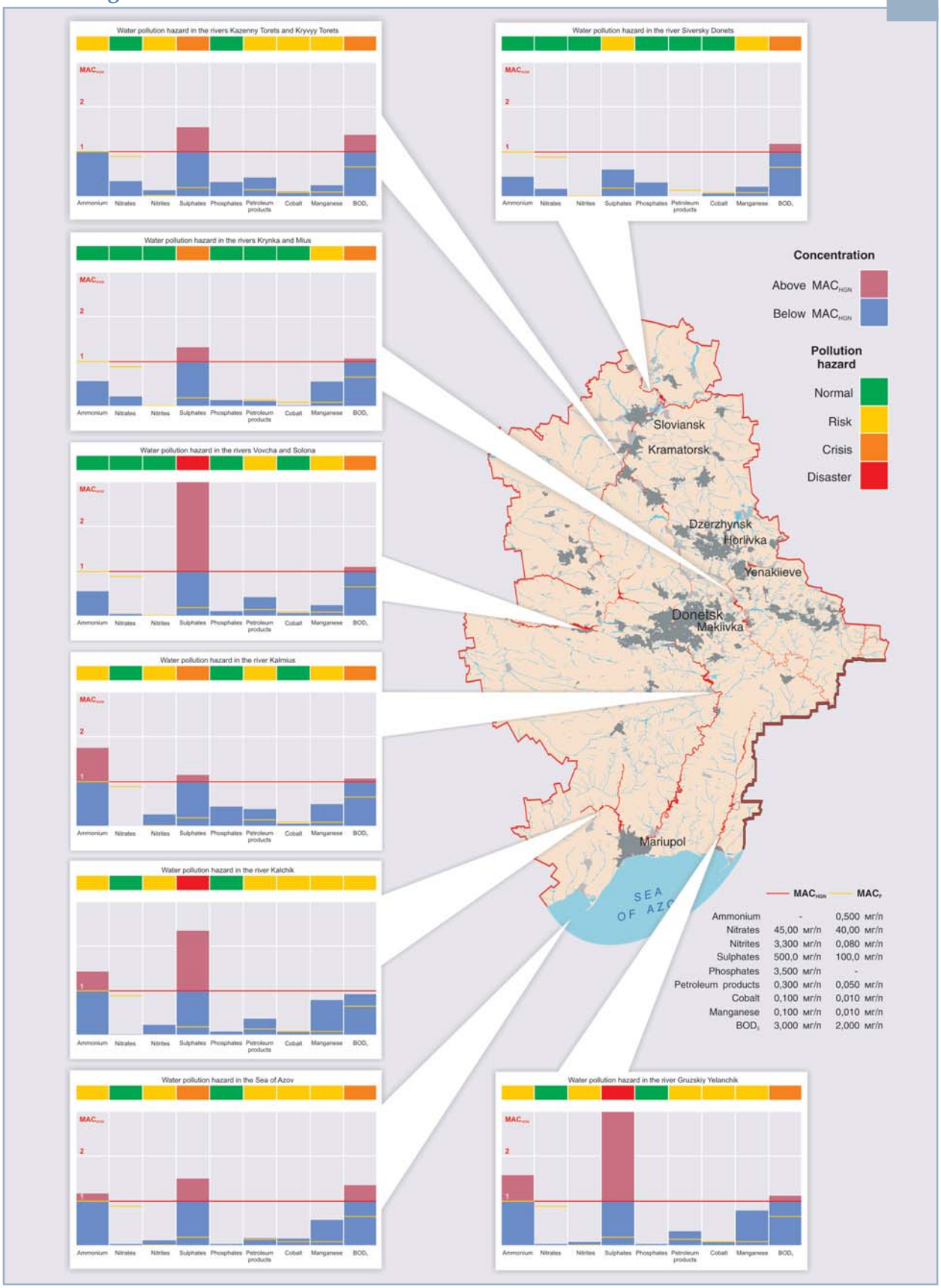
Sea of Azov

Its current name the sea received form the town, which was conquered by the Polovtsi (Cumans) in 1067. They gave it the name of Azak, which subsequently became Azov.

The Sea of Azov covers an area of 38,000 km2, with an average depth of 8 m, a maximum depth of 14 m, and a water volume of 320 km3.

The sea has been a major thoroughfare since the dawn of history. By the end of the 19th century more than 2,660 ships, with a total loading capacity of 362,000 tonnes, sailed into its harbours every year. At the time the Russian merchant fleet on the Sea of Azov numbered 1,210 vessels. To this day it remains a major transport route.

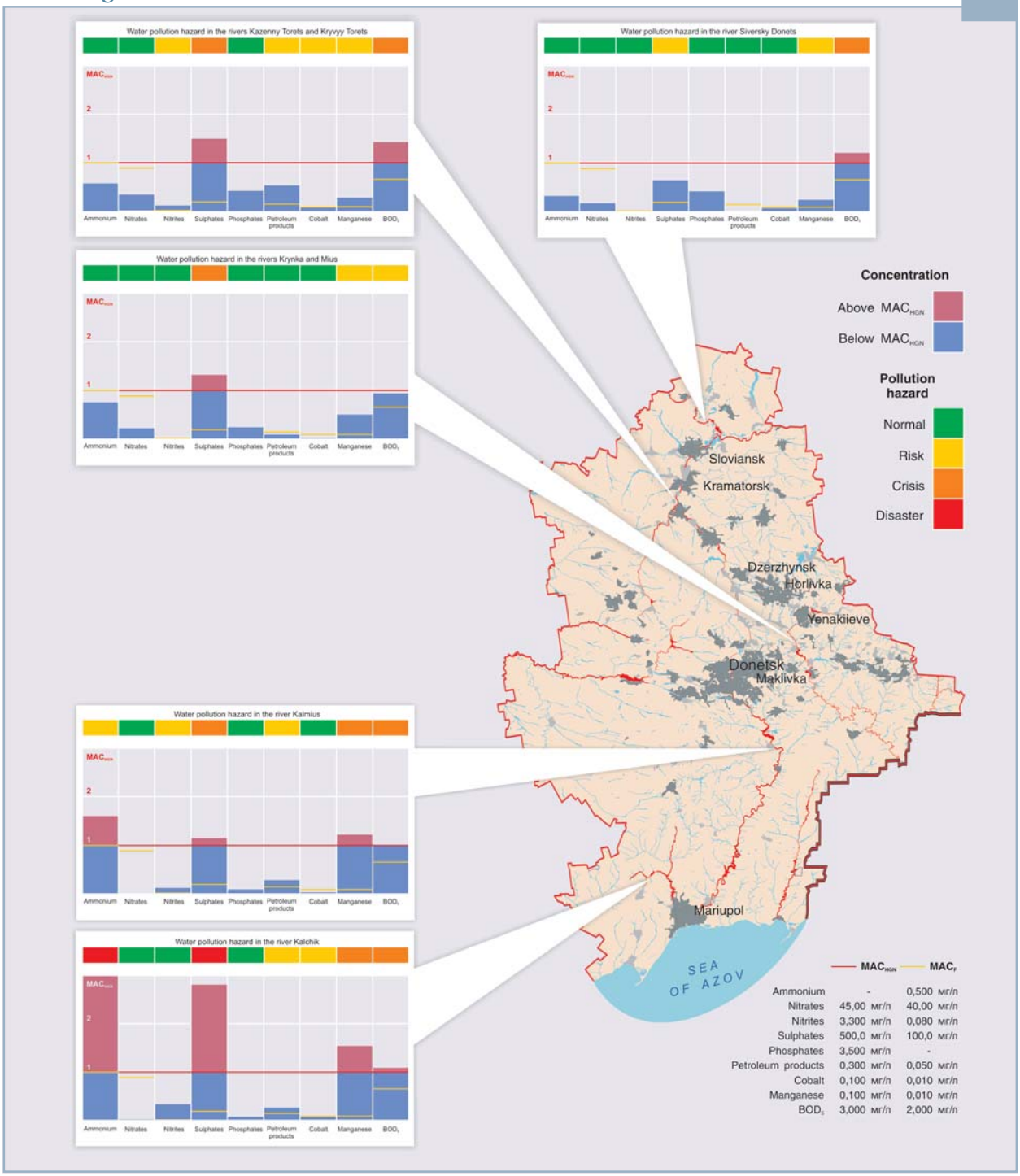
Fig. 4.3.6. Environmental assessment of the state of water in 2008



* MAC_{HGN} - maximum allowable concentrations (Environmental Hygiene), MACf - maximum allowable concentrations (fishery standards)

Source: the State Administration of Environmental Protection in Donetsk Oblast, 2009

Fig. 4.3.7. Environmental assessment of the state of water in 2009



* MAC_{HGN} - maximum allowable concentrations (Environmental Hygiene), MACf - maximum allowable concentrations (fishery standards)

Source: the State Administration of Environmental Protection in Donetsk Oblast, 2009

Analysis of polluting substances in Donetsk Oblast surface waters shows that their average state is mainly brackish, slightly polluted and relatively pure. However, almost all the monitoring sections register situations in which their state deteriorates to being severely polluted, with very poor quality water. There is a considerable difference between worst-case and average values. Such hazardous situations at particular periods and seasons seriously damage the state of hydro-ecosystems.

The results of analysis reveal the following trends characterizing pollution of the re-

gion's surface and ground water in 2000-9.

Natural conditions in Donetsk Oblast determine the spread of brackish sodium sulphate types of water in the region, which have limited use in the public water supply, agriculture and the food industry, and processing industries. The amount of such water is steadily increasing.

The main pollutants of the surface waters of the region are sulphates and biogenic substances (nitrogen and phosphor compounds) and other organic substances. The concentration of specific toxic substances (heavy metals, petroleum products, phenols, synthetic surface- active substances) is not critical in the surface and ground waters of the majority of water bodies.

Among the main river basins of the region the Pryazovia and Dnipro rivers have the worst water quality because of the high level of pollution of their waters by various salt components and biogenic substances.

The lowest level of pollution in the surface waters of most of the river basins was observed in 1994-95, coinciding with the slump in the region's industrial production. The peak of surface water pollution occurred during a period of intense industrial activity in 1985-88.

At present surface water pollution in the region is higher than the background level in 1994-95, but lower, than the background level in 1985-88.

Over the last 10 years a trend towards increasing saline pollution of surface waters, especially by sulphate concentration, has been observed in the rivers Kazennyi Torets, Vovchia, Kalchyk, Kalmius and Gruzkyi Yelanchyk.

Over the same period the maximum increase in the level of ecological-sanitary indicators has been registered in the upper reaches of the rivers Kryvyi Torets and Kazeny Torets and in the lower reaches of the rivers Kalmius, Gruzkyi Yelanchyk and Kalchyk. Nitrates and sulphates are the main polluting substances in these water bodies.

Biochemical oxygen demand (BOD_5) in the river Siverskiy Donets at the border

Priorities for improving the quality of natural water in Donetsk Oblast

1. Decrease the level of surface water pollution by sulphates and biogenic substances in the region.
2. Improve the ecological state of the rivers Kalmius, Kazennyi Torets and Kalchyk. Implement strict measures to control waste water discharge by industrial enterprises into the river system.
3. Control mine water discharge into the rivers Kazennyi Torets, Vovchia and Kalmius.
4. Re-activate hydrochemical monitoring sites on the rivers of the region, closed in 1995-2000.
5. Implement organizational measures to reduce discharge of polluted waste waters by industrial enterprises of the region.
6. Decrease municipal and agricultural runoff into water bodies.
7. Develop automated systems and networks to monitor surface and ground water bodies of the region.

Environmental disasters

On 11 November 2007 four vessels – the dry-cargo ships Volnogorsk, Nakhichevan, Kovel and Hadji-Izmail – sank in the Kerch Strait near the Russian port Caucasus due to a severe storm. Six vessels broke adrift and went aground, two tankers – Volgoneft-139 and Volgoneft-123 – suffered damage. About 1,300 tonnes of fuel oil and 6,800 tonnes of sulphur spilled into the Sea of Azov.

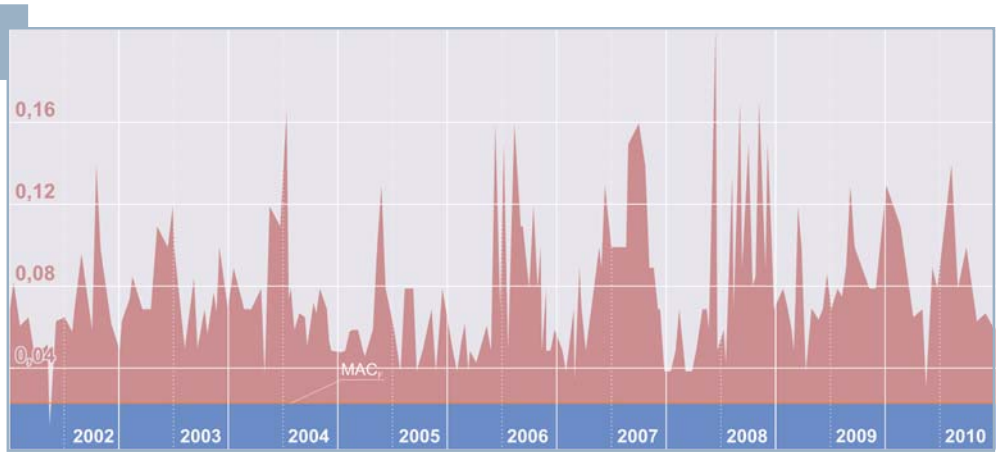


Fig. 4.3.8. Dynamics of nitrite concentration in the river Siversky Donets, Rayhorodok, 2001-9, mg/l

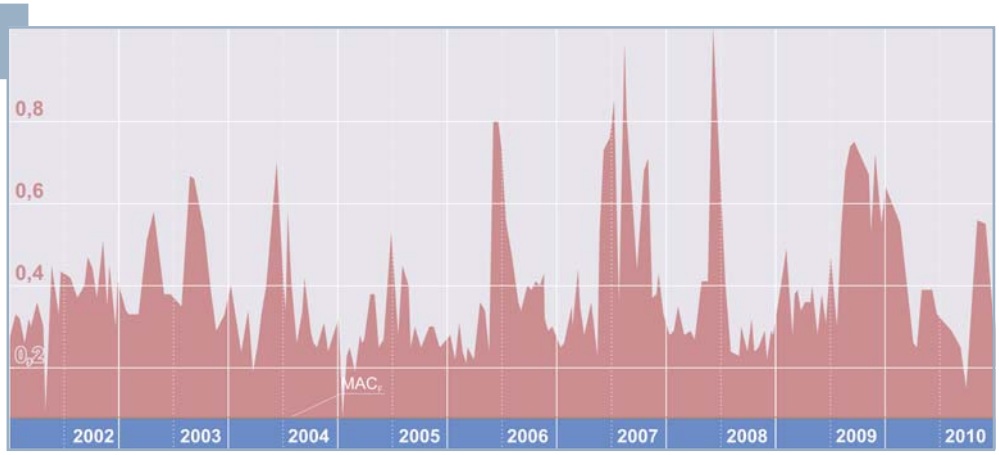


Fig. 4.3.9. Dynamics of nitrite concentration in the river Kazenny Torets, Rayhorodok, 2001-9, mg/l

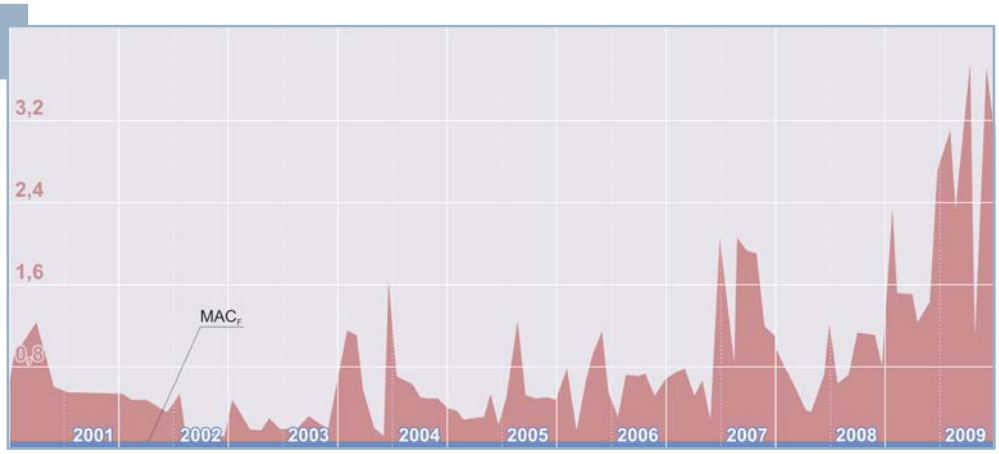


Fig. 4.3.10. Dynamics of nitrite concentration in the river Kalmius, Donetsk, 2000-8, mg/l

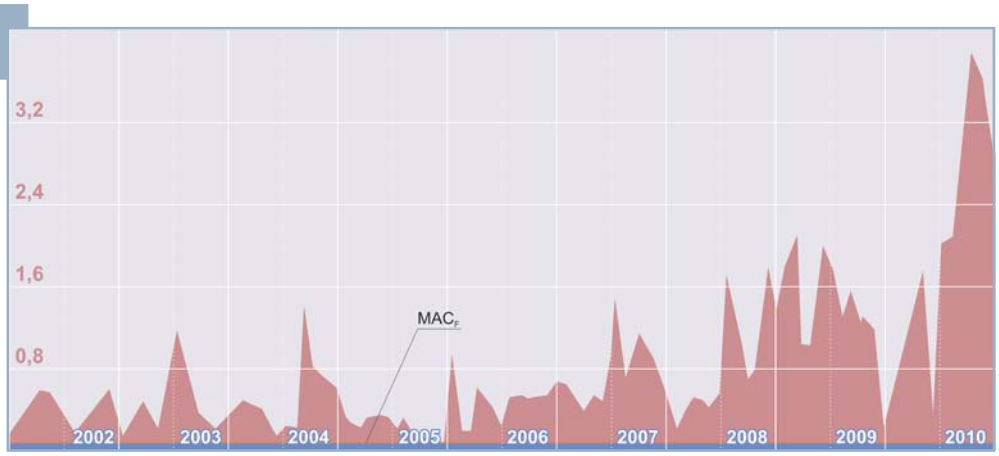


Fig. 4.3.11. Dynamics of nitrite concentration in the river Kalchik, Mariupol, 2001-9, mg/l

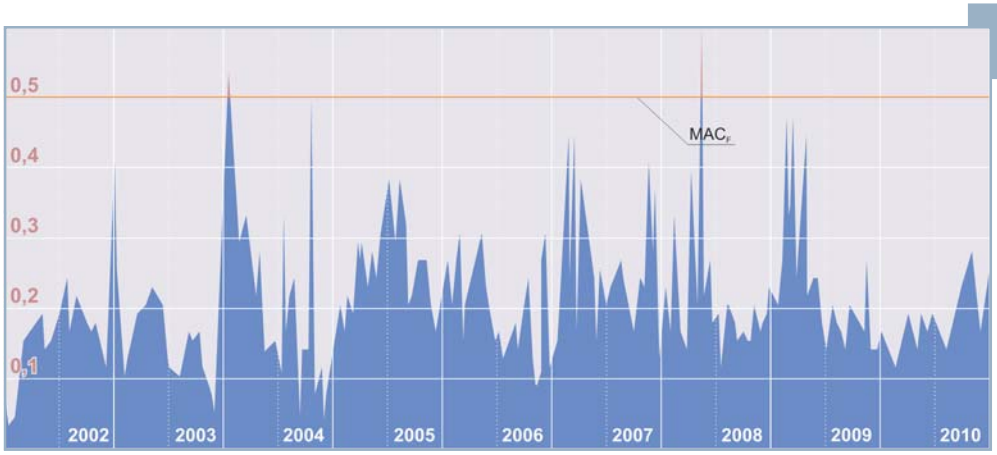


Fig. 4.3.12. Dynamics of ammonium concentration in the river Siversky Donets, Rayhorodok, 2001-9, mg/l

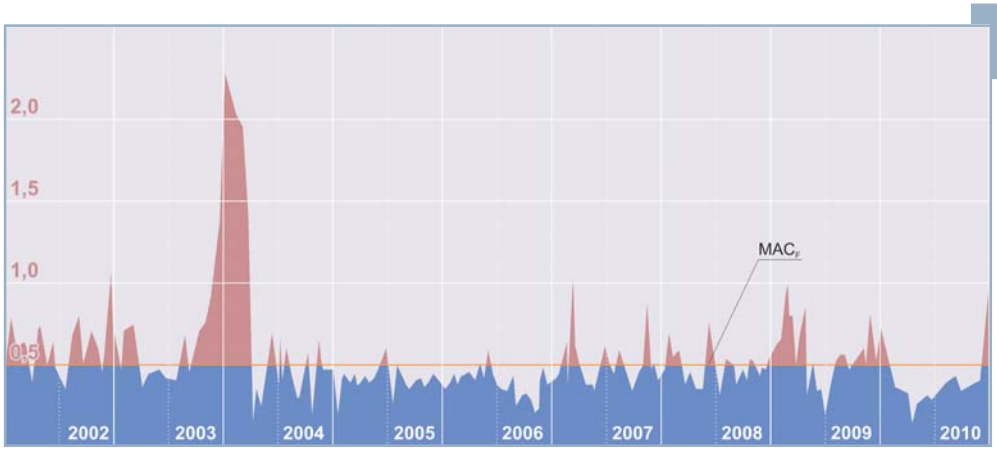


Fig. 4.3.13. Dynamics of ammonium concentration in the river Kazenny Torets, Rayhorodok, 2001-9, mg/l

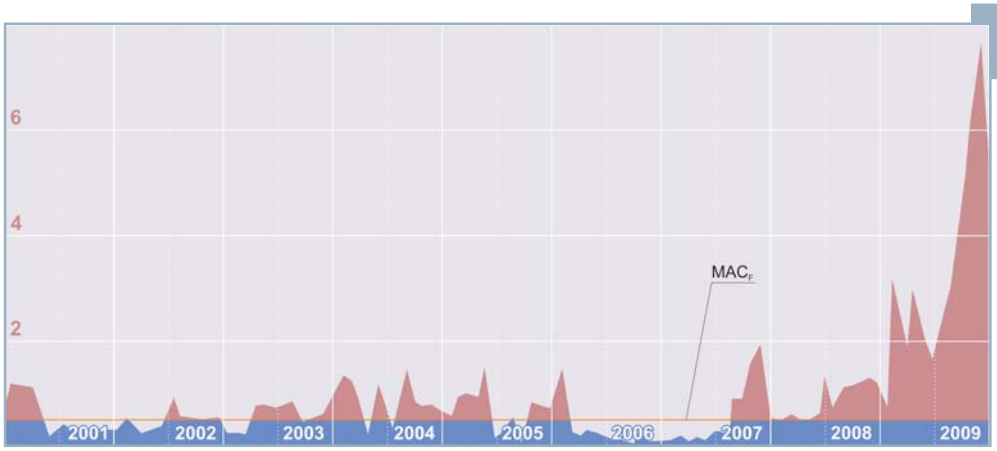


Fig. 4.3.14. Dynamics of ammonium concentration in the river Kalmius, Donetsk, 2000-8, mg/l

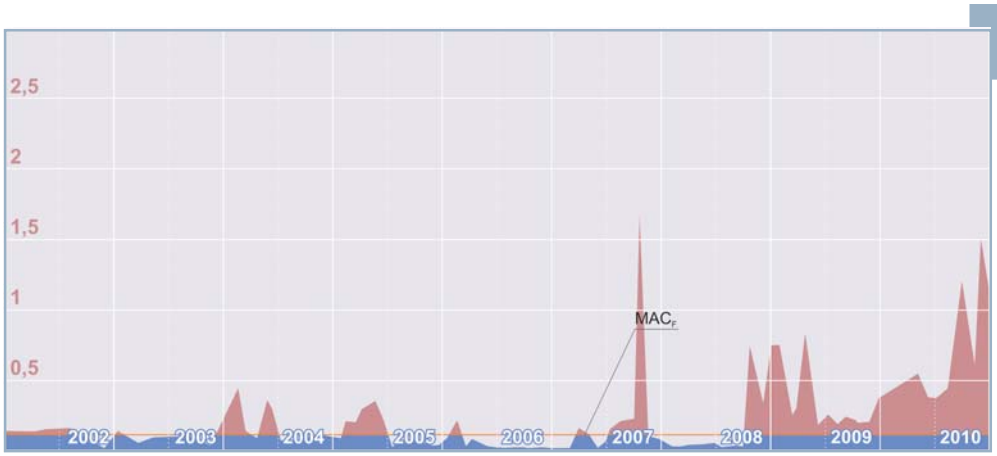


Fig. 4.3.15. Dynamics of ammonium concentration in the river Kalchik, Mariupol, 2001-9, mg/l

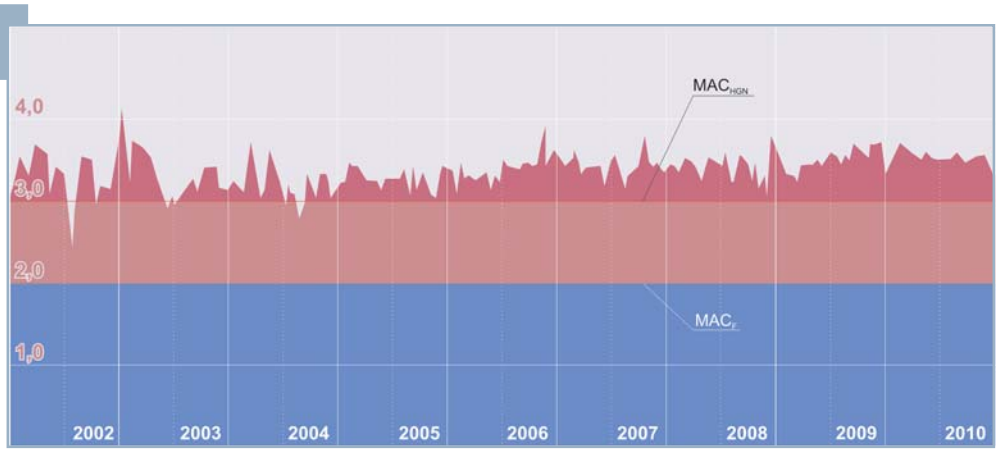


Fig. 4.3.16. Dynamics of changes in BOD_5 in the river Siversky Donets, Rayhorodok, 2001-9, mg/l

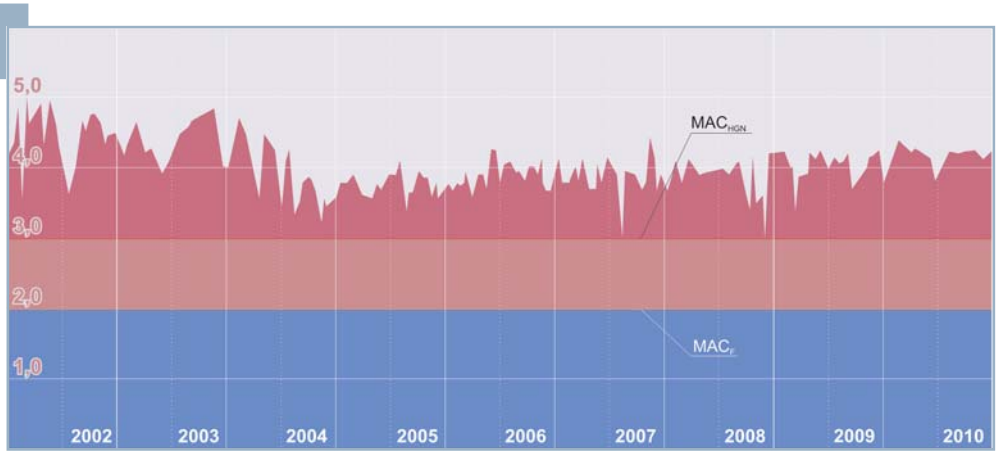


Fig. 4.3.17. Dynamics of changes in BOD_5 in the river Kazenny Torets, Rayhorodok, 2001-9, mg/l

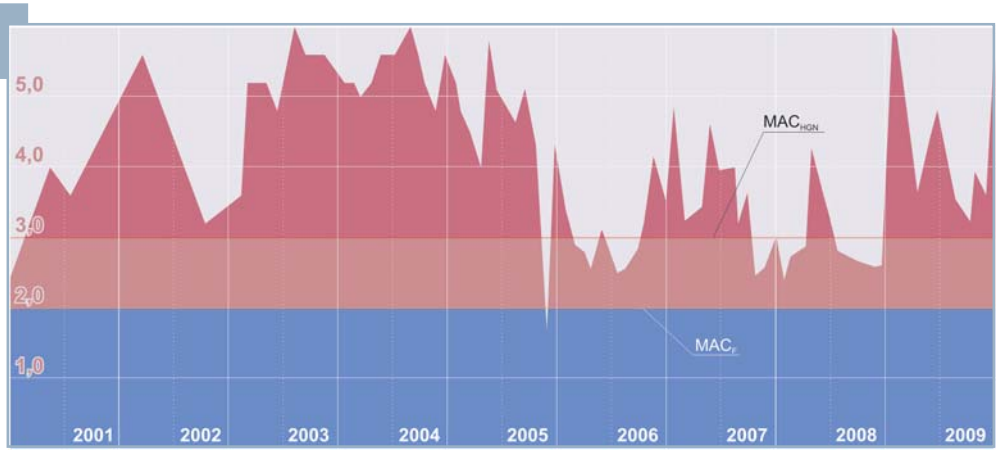


Fig. 4.3.18. Dynamics of changes in BOD_5 in the river Kalmius, Donetsk, 2000-8, mg/l

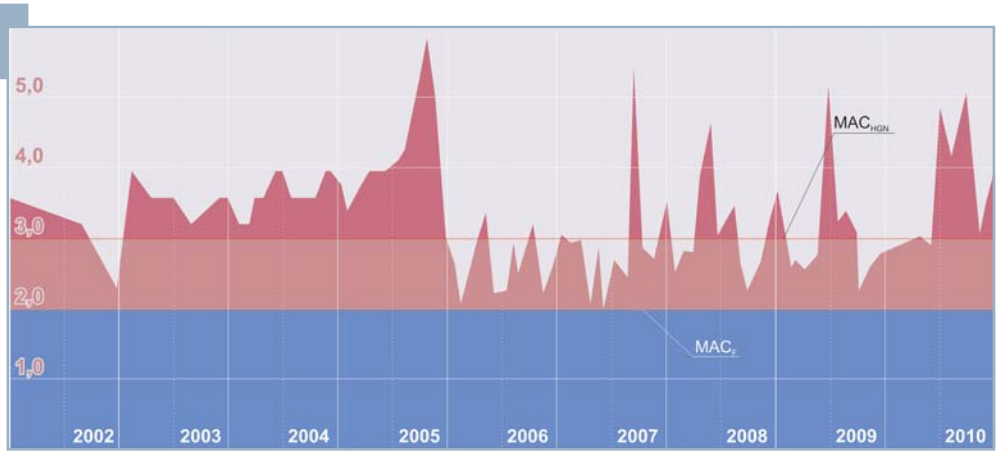
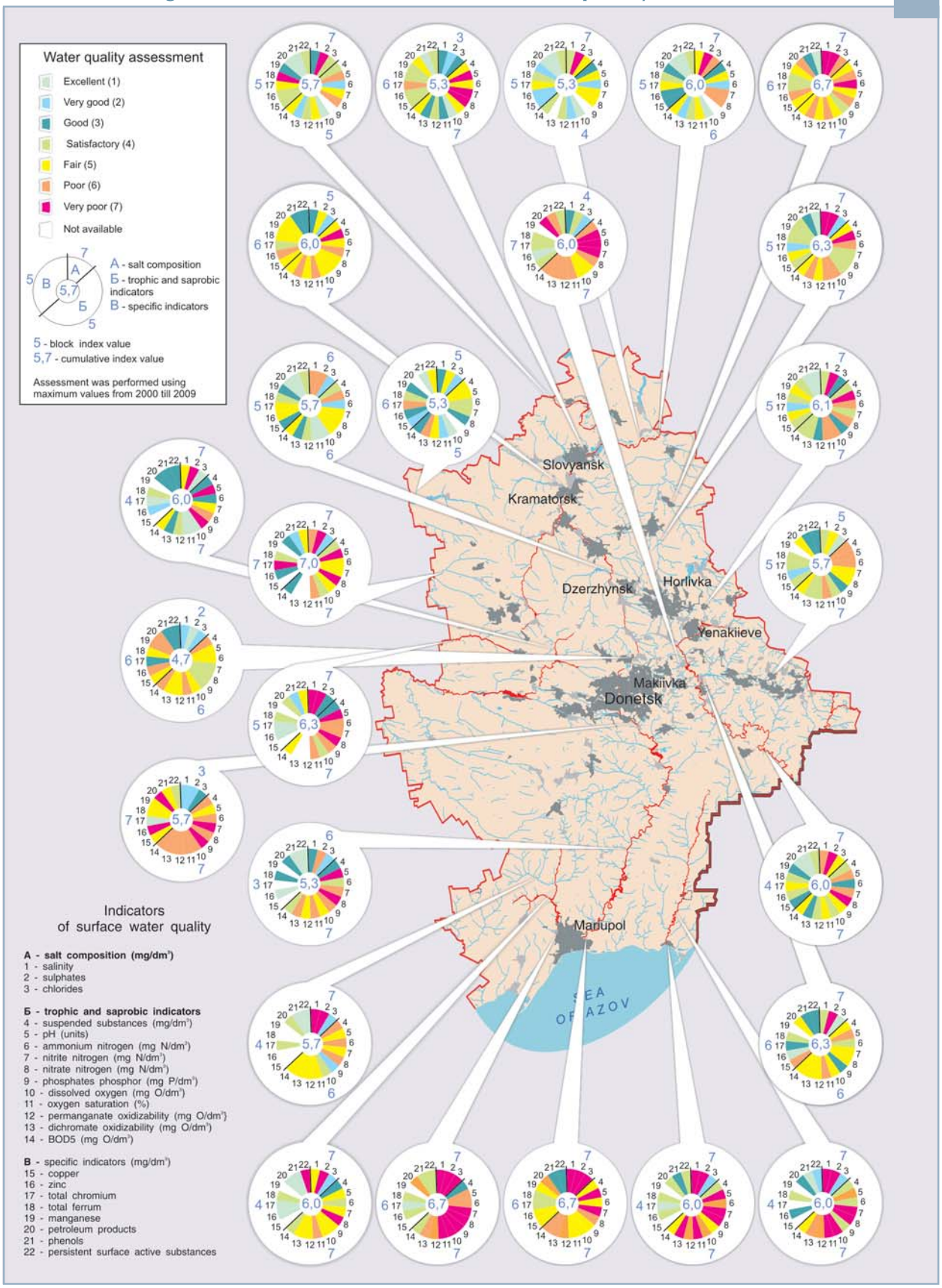


Fig. 4.3.19. Dynamics of changes in BOD_5 in the river Kalchik, Mariupol, 2001-9, mg/l

Fig. 4.3.20. Chart of surface water quality in Donetsk Oblast



Source: State Environmental Protection Administration in Donetsk Oblast, 2009

Flashback

The data for 2008 obtained from the environmental monitoring agencies indicate that the most polluted rivers were the Kalmius (Donetsk, Mariupol), Bakhmut (Artemivsk) and Kalchyk (Kremenivka, Mariupol).

River pollution varies significantly over time, depending on the average annual run-off and the intensity of industrial activity. The table contains an assessment of pollution affecting the rivers cited above at different periods over the last 60 years.

Indicator	1947-1949	1994-1996	2008
Kalmius			
Salinity, mg/dm³	3,160	3,750	2,181
Ammonium nitrogen, mg/dm³	19.8	0.24	1.12
Nitrate nitrogen, mg/dm³	36.0	2.2	1.34
Nitrite nitrogen, mg/dm³	20	0.10	0.81
Phosphates, mg/dm³	-	0.32	1.54
BOD_5	-	2.4	3.2
Bakhmut			
Salinity, mg/dm³	1,595	1,319	2,865
Ammonium nitrogen, mg/dm³	0.025	0.58	0.3
Nitrate nitrogen, mg/dm³	0.136	5.5	16.1
Nitrite nitrogen, mg/dm³	0.992	0.48	0.27
Phosphates, mg/dm³	-	-	0.92
BOD_5	-	4.6	4.1
Kalchyk			
Salinity, mg/dm³	1,423	2,020	3,063
Ammonium nitrogen, mg/dm³	-	0.2	0.93
Nitrate nitrogen, mg/dm³	-	2.5	1.5
Nitrite nitrogen, mg/dm³	-	0.03	0.8
Phosphates, mg/dm³	0.076	0.21	0.34
BOD_5	-	2.5	2.8

As can be seen from the data in this table, salinity and water pollution by biogenic substances in the rivers Bakhmut and Kalchyk has increased over the last 60 years. After the second world war biogenic pollution of the Kalmius was very severe, and related to the demolition of the municipal sewage plants.

Source: State Environmental Protection Administration in Donetsk Oblast, 2009

of Kharkiv Oblast increased substantially over the last 10 years; this indicates an unstable environmental situation in the river basin outside Donetsk Oblast.

A trend towards a considerable increase in the concentration of specific substances (petroleum products, phenols, synthetic surface- active substances, ferrum, manganese and zinc) has been registered in the river Kalmius. In recent years there has been no reduction in the number of enterprises discharging untreated or insufficiently treated waters. This is due to the inefficient purification plants used by various enterprises in the region.

In 2007-8 the concentration of ammonium increased in the rivers Kalmius, Kazennyi Torets, Kryvyi Torets, Kalchyk, Gruzkyi Yelanchyk and in the Sea of Azov; this is due to increased use of ammonia fertilizer, insufficient sewage purification and also discharge of insufficiently treated waters by coking by-product and chemical enterprises.

Analysis of data from long-term monitoring shows, that on the whole the ecological situation regarding pollution of water bodies in Donetsk Oblast is complex. A package of measures needs to be developed and deployed to improve the ecological state of the region's rivers and water bodies.

4.4. Land resources and soil

The current ecological state of land and soil cover in Donetsk Oblast is the result of town-planning and the region's industrial development, but also of agricultural activity. For many years the proportion of the region's territory occupied by towns, industrial zones and farmland, increased, and the area of natural land cover gradually decreased.

The structure of land use in the region started to stabilize in the early 1990s. According to data from the Regional Department of Land Resources, the region occupied a total area of 2,651,700 hectares at the beginning of 2009. The structure of the land is shown in Fig. 4.4.1 and 4.4.2.

Farmland accounts for the largest share, with 79% of the total area (2,096,000 ha) under cultivation (see fig. 4.4.3).

Intensive farming, coupled with natural and climatic conditions, have caused considerable soil erosion. Donetsk Oblast leads Ukraine in the level of erosion by air and water. A high degree of erosion is observed in the Artemivsk, Telmanove, Starobesheve, Pershotravnevyi, Volodarske, Sloviansk, Shakhtarsk and Marinka administrative districts.

One of the main reasons for the degradation of agricultural land is the high level of development and tillage of the territory. Tillage of the territory averages 60% throughout Ukraine, rising to 64% throughout Donetsk Oblast.

Apart from erosion the main adverse effects on land resources and soil relate to salinization and waterlogging of land, disturbance of the natural landscape, loss of organic substances and a decrease in soil biodiversity.

Fig. 4.4.1 The structure of the land in Donetsk Oblast by basic land type

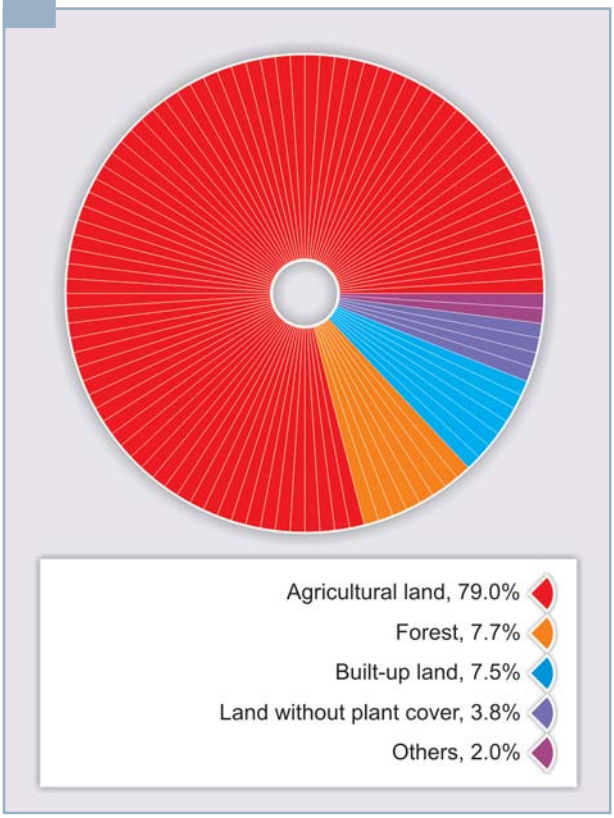
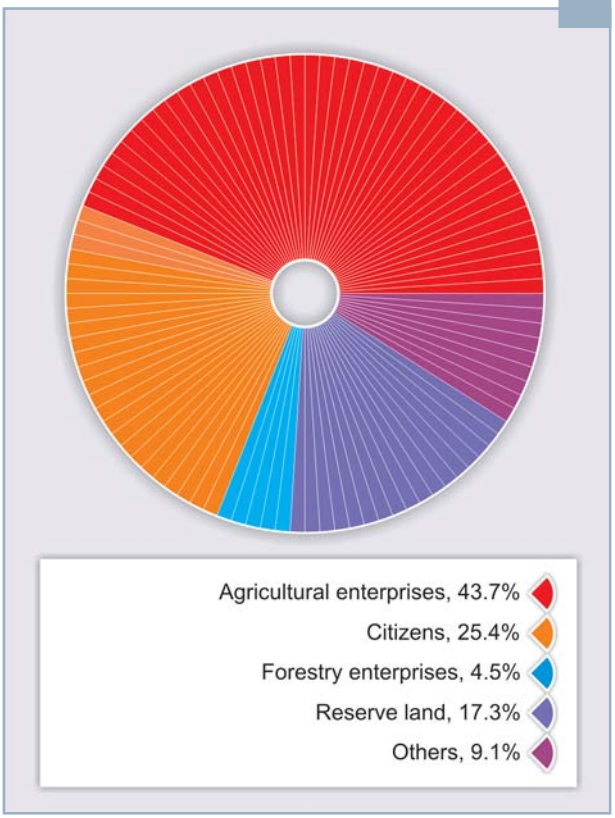
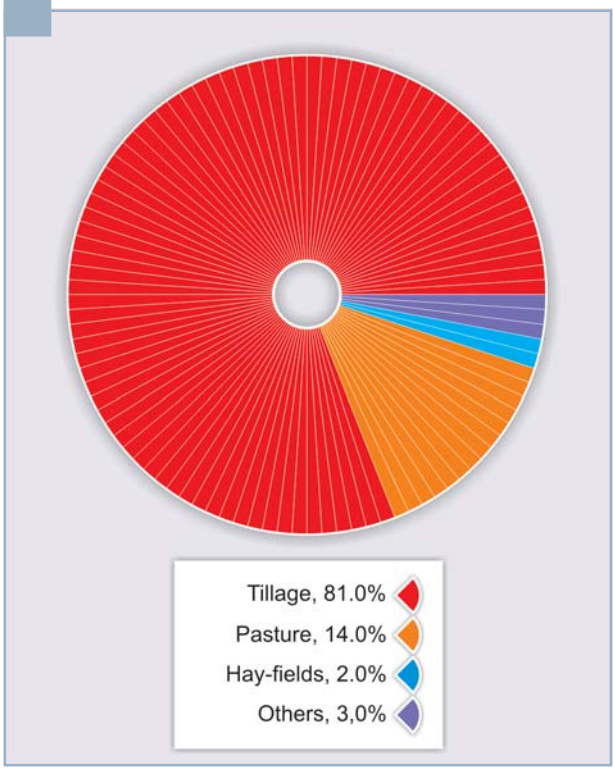


Fig. 4.4.2 Distribution of agricultural land by user



Source: Main Department of Land Resources in Donetsk Oblast, 2009

Fig. 4.4.3 Structure of agricultural land in Donetsk Oblast



Source: Main Department of Land Resources in Donetsk Oblast, 2009

Recent years have seen a tendency to increase the amount of mineral fertilizer used on the region's farms. In 2008 38,600 tonnes of fertilizer were applied, 2.3 times more than in 2000 and just 0.5% less than in 2007. The share of fertilized area increased from 27% in 2000 to 71% in 2008.

In 2008 only 1% of total crop area was fertilized using organic manure. Organic manuring decreased by a factor of 15 between 1990 and 2008.

At the end of 2008 25,000 ha of agricultural land in the region were disturbed by the production activities of enterprises.

In 2008 526 ha of land were disturbed, 652 ha of disturbed lands were exhausted, 2.7 times more than in 2007, and 155 ha were reclaimed. Data on the annual increase in agricultural land disturbed by economic agents and the intensity of reclamation activities in the region are shown in Fig. 4.4.4. It is apparent from the figure that the area of disturbed land is increasing, which suggests reclamation activities are insufficient.

Soil has considerable hygienic value, with multiple effects. It is the main component of the biosphere, in which chemical substances migrate and exchange. In Donetsk Oblast almost all the soil (more than 95%) is classified as technogenically transformed, following intense industrial and agricultural activity. The map of soil pollution is shown in Fig. 4.4.5. As can be seen the soil of Donbas cities is much more polluted than soil in rural areas. The soil of the region's cities is characterized by local pollution with heavy metals and petroleum products, by disorder in the acid-base balance and physical-mechanical properties (decreased soil moisture, increased soil compaction, stoniness), occurrence of fragments of construction and household waste, low concentration of nutrients in soil, which is connected to the intensive technogenic impact. All this leads

Indicators for assessment

1. Indicators of intensity of use of land resources.

1.1. Amount of land resources, thousand hectares: by main type of land, by agricultural land, by type of owner and land-user, by disturbed and eroded soil, etc.

1.2. Amount of applied mineral and organic fertilizers: total amount (Ktonnes), specific quantity of applied fertilizers per unit area of agricultural land (kg/ha).

1.3. Amount of applied pesticides (Ktonnes), specific quantity of applied pesticides per unit area of agricultural land (kg/ha).

1.4. Data on dynamics of indicators over the last 10 years (according to paragraph 1.1-1.3).

2. Soil quality indicators.

2.1. Share of samples, which do not comply with the standards for maximum soil pollution, as a total number of samples, %: by indicator of chemical and bacterial pollution.

2.2. The level of soil pollution by chemical substances, rg/kg: cobalt, manganese, copper, nitrates, sulphates, mercury, lead, phosphor, chromium, zinc, pesticides etc (19 indicators in all).

2.3. Soil pollution index (hazard index).

2.1. Data on dynamics of indicators over the last 35 years (according to paragraph 2.1-2.3).

to a deterioration in the sanitary-hygienic, ecological and biospheric functions of urban landscape.

For example, the number of soil samples exceeding hygiene standards, out of the total number of samples analyzed for heavy-metal content, is higher in the cities (50%) than in rural areas (31%). A similar indicator characterizing soil pollution by pesticide residue is approximately equal in the cities and rural areas, at about 6-8%.

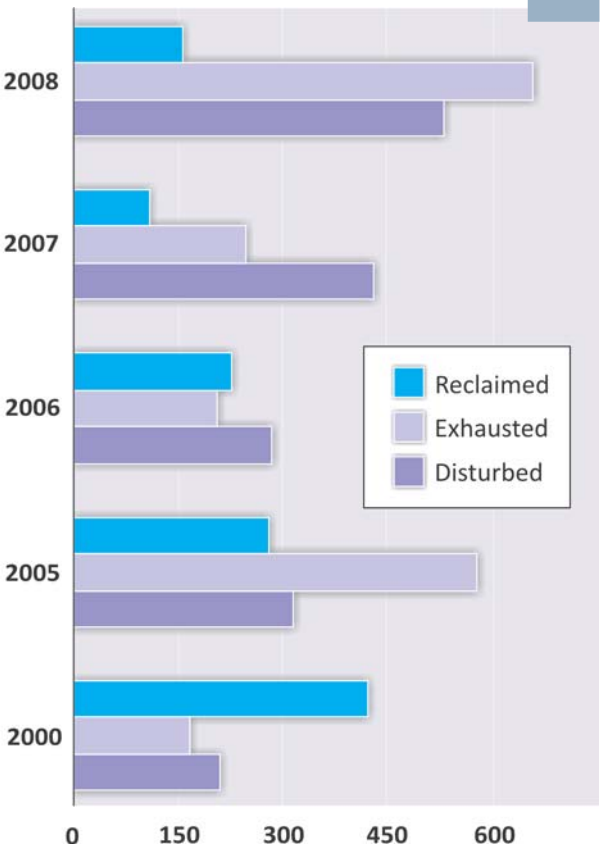
The highest level of soil pollution by pesticides is registered in Artemivsk, Khartsyzk, Makiivka, Horlivka and Druzhkivka, and also in the Marinka and Yasynuvata districts.

A high level of soil pollution by mercury is observed in Horlivka (5.7 mg/kg), Dzerzhynsk (3.2 mg/kg), Mariupol, Yenakiieve and Kostiantynivka (2.6-2.8 mg/kg).

Lead, which is the second most toxic substance after mercury, is fairly common in the soil of all districts of Donetsk Oblast. This is due to widespread occurrence of lead sources in the cities: automobile transport, metallurgy and coking by-product output, coal boiler plants, etc. In rural areas the lead concentration in soils is connected with industrial dust fallout and use of pesticides and herbicides containing lead. The average lead concentration in urban soil (96.8 mg/kg) is almost three times higher than in rural areas (35.4 mg/kg). However there are some pockets of soil pollution with a very high concentration of the metal. Instances include the cities of Kostiantynivka (453.1 mg/kg), Druzhkivka (242.5 mg/kg) and Mariupol (145.4 mg/kg). In all the region's cities the lead concentration in the soil exceeds hygiene standards (see Attachment I).

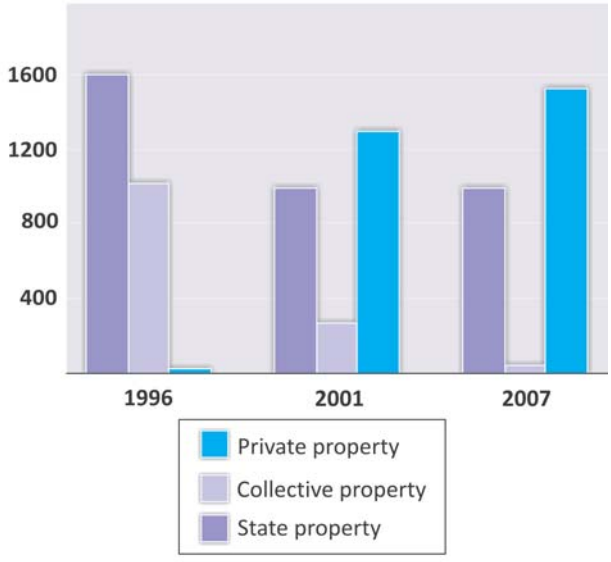
Zinc is common in anthropogenically

Fig. 4.4.4. Extent of disturbance and reclamation of lands in Donetsk Oblast in 2008



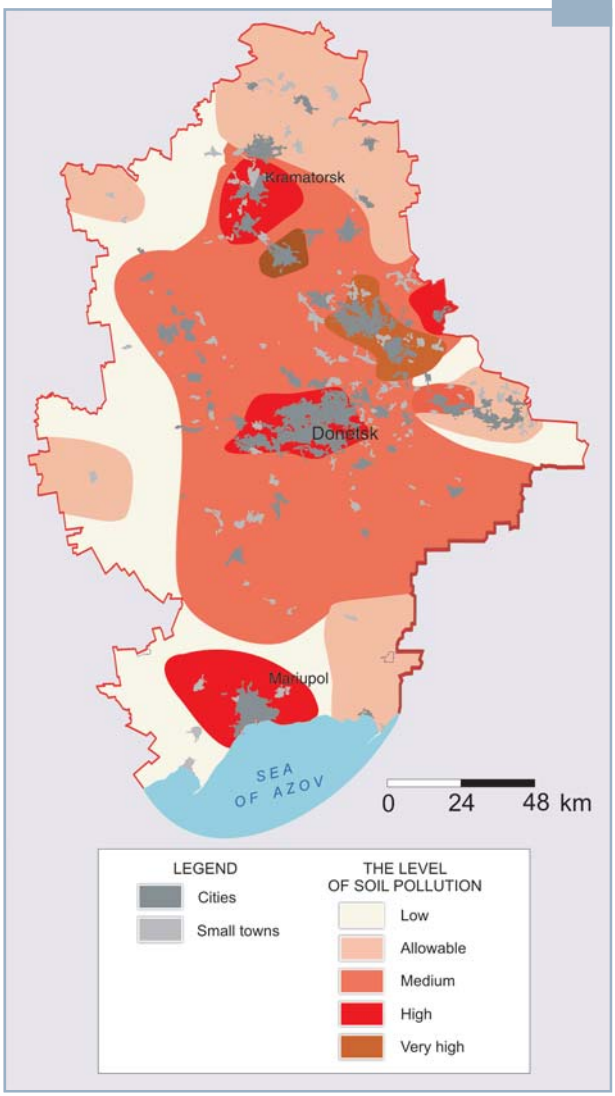
Land reform

Land reform in Ukraine focuses on property. It has been underway in Ukraine for 17 years and has proved tough going so far, with work ranging from land inventory and redistribution, to reforming land relations and eliminating the state monopoly of land ownership. The system of land relations that now exists guarantees equal property rights to citizens, legal entities, territorial communities and the state.



Source: Main Department of Land Resources in Donetsk Oblast, 2009

Рис. 4.4.5. Map of soil pollution in Donetsk Oblast



Source: Donetsk State Medical University, the State Environmental Protection Administration in Donetsk Oblast, 2009

transformed soils of Donbas. At the same time, its concentration in the chernozems of protected areas of the region is very low and does not exceed the corresponding abundance ratio in the lithosphere. The average concentration of zinc in urban soil (228.1 mg/kg) is more than three times higher than in rural areas (60.8 mg/kg). The highest levels of zinc soil-pollution are registered in the cities of Kostiantynivka (850.0 mg/kg), Sloviansk (450.0 mg/kg) and Artemivsk (352.1 mg/kg).

The concentration of manganese in the soil of the region's cities (2,296 mg/kg) is twice as high as in rural areas (1,274 mg/kg), where the manganese content does not exceed current hygiene standards in Ukraine (Attachment I). However, in the cities of Druzhkivka (12,560 mg/kg), Mariupol (5,438 mg/kg) and Yenakiieve (3,672 mg/kg) there are areas with a high manganese concentration.

Chromium, which is one of the most dangerous carcinogens, is common in the region's chernozem soil. The background concentration of chromium (96.0 mg/kg) is relatively high (more than 16 MAC, Attachment I), as well as the corresponding abundance ratio. The main technogenic causes of chromium entering the environment are enterprises producing ferrochrome, metallurgy, cement and coke by-product plants, thermal power stations and coal boiler plants. Chromium pollution in the region is relatively uniform, with an average soil concentration in cities (226.0 mg/kg) 1.3 times higher than in rural areas (198.5 mg/kg), though high chromium concentrations do occur in the cities of Mariupol (1,012 mg/kg), Sloviansk (651 mg/kg) and Yenakiieve (408 mg/kg).

Data from 35 years of soil monitoring in 19 cities and 14 rural districts in the region confirms the high environmental pollution.

Priorities for improving the quality of Donetsk Oblast land resources and soil

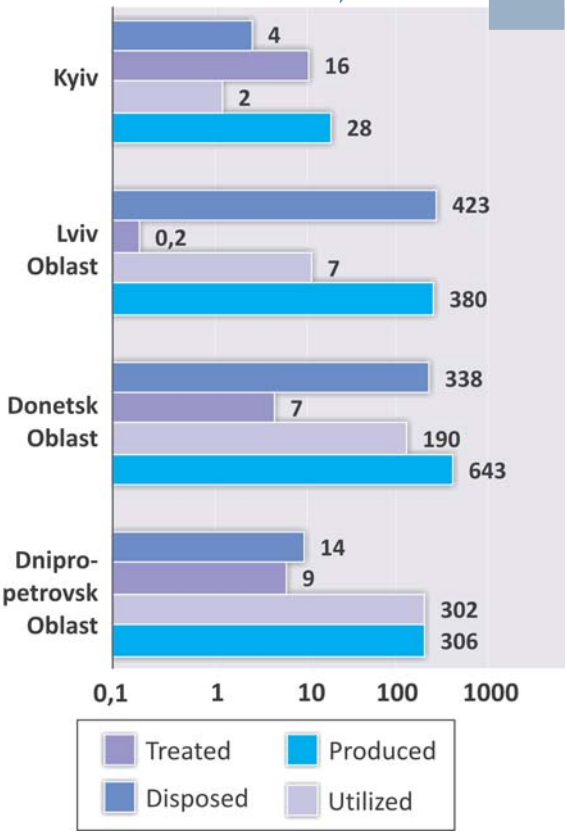
1. Extend of area of reclaimed land and maintain a downward trend in the area of disturbed land from 2020.
2. Significantly increase the number of agricultural measures to protect soil against erosion and drought, and also measures to enhance soil fertility.
3. Withdraw 100,000 ha of degraded arable land from active crop rotation and seed it with perennial herbs.
4. Plant forest on the region's degraded agricultural land.
5. Fully reclaim land exhausted by industry by 2025, including land exhausted before 1970.
6. Implement the soil quality management system in the region.

4.5. Waste

The accumulation of waste is one of the most serious factors in environmental pollution, with an adverse impact on all its components. Infiltration of buried waste, dust formation during disposal, erosion by air and water, and migration of toxic substances pollute ground and surface water, atmospheric air and land resources.

Donetsk Oblast accounts for 31% of industrial and toxic waste in Ukraine and 28% of annual output (see Fig. 4.5.1-4.5.2). At the same time there are no facilities for processing or disposing of hazardous waste in the region, and no landfills for waste storage, equipped in compliance with modern environmental safety standards. The need to solve various environmental problems has grown more acute over a long period of time in Ukraine due to the lack of a coordinated legal and regulatory framework for the long-term control of waste management.

Fig. 4.5.1. Formation and management of class I to III hazardous waste, ktonnes



Source: State Statistics Committee of Ukraine, 2009

Indicators for assessment

1. Amount of accumulated waste, Mtonnes: total amount, by type (industrial, hazardous and solid waste) and composition, by branch of industry, by city in the region, by place of storage and landfill.
2. Amount of waste generated, ktonnes/year: total amount, by type (industrial, hazardous and solid waste), branch of industry, city, etc.
3. Amount of usable (recyclable) waste, ktonnes/year: total amount, by type (industrial, hazardous and solid waste), branch of industry, city, etc.
4. Amount of treated hazardous waste, ktonnes/year.
5. Specific quantity of generated waste: per GRP (Gross Regional Product) unit, per capita.
6. Land area filled with industrial and solid domestic waste, hectares.
7. Dynamics of indicators specified in paragraph 1 to 6 over the last 10 years.

Ukraine only adopted a law on waste in March 1998. This document constituted the first organizational and economic basis for business activity in waste management, while setting standards to guard against adverse impacts on the environment and public health. Ukraine thus laid the foundations of a modern system of waste management. Over a period of 10 years the Cabinet of Ministers issued a series of important decrees on waste management.

Recently there has been a trend towards a reduction in waste output in the region (as much as 10% of the 2002 level). On average, 36 million tonnes of waste are generated a year, but hazardous waste accounts for a relatively small share of the total. Non-hazardous mining waste makes up the largest share of total waste.

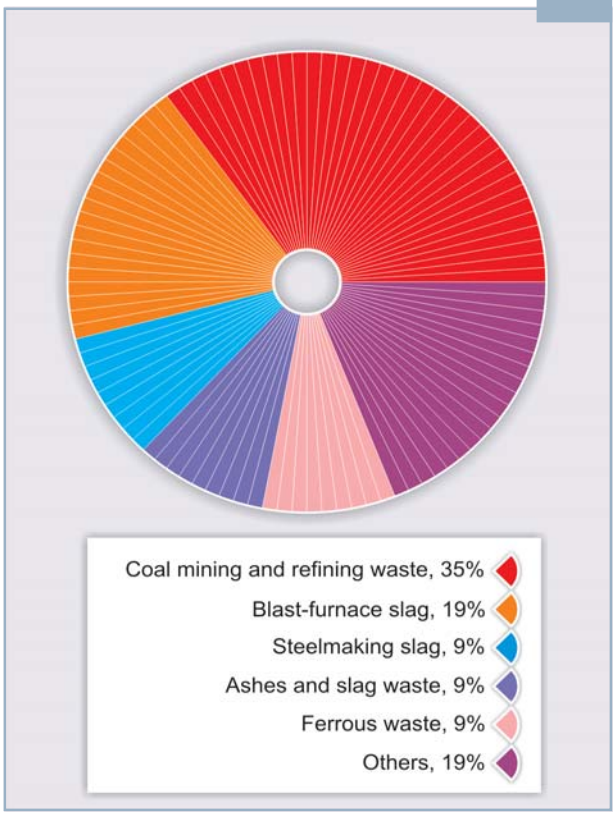
As well as the tendency to reduce the total amount of waste, the output of haz-

ardous waste, and its share in the total, is steadily increasing.

Annual output of class I to III hazardous industrial waste is shown in Fig. 4.5.3. The structure of industrial waste output is represented in Fig. 4.5.4.

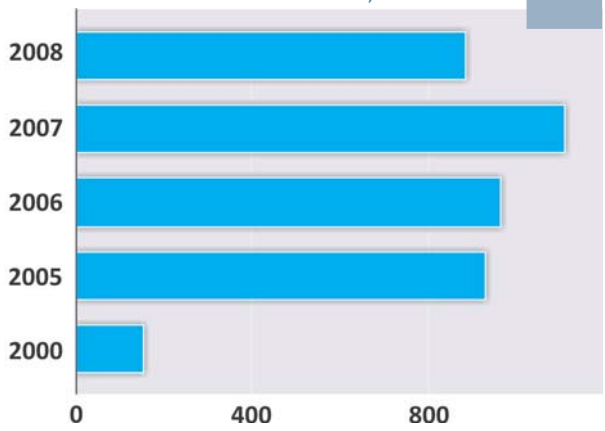
Waste produced by the chemical industry (the best known enterprise generating hazardous waste is the Horlivka chemical plant) represents a separate group of toxic waste. Chemical enterprises produce more than 12,000 tonnes of hazardous waste a year. This is mainly inorganic waste and hazardous substances, in particular chemical agents for crop protection (according to various estimates, about 1,000 tonnes of such substances are produced a year). Waste in this group is generally characterized by highly heterogeneous composition and physicochemical properties. Hazardous chemical substances can potentially have severe adverse effects on public health and the environment in the region.

Fig. 4.5.2. Structure of accumulated waste, %



Source: State Environmental Protection Administration in Donetsk Oblast, 2009

Fig. 4.5.3. Formation of class I to III hazardous waste, Mtonnes



Source: State Environmental Protection Administration in Donetsk Oblast, 2009

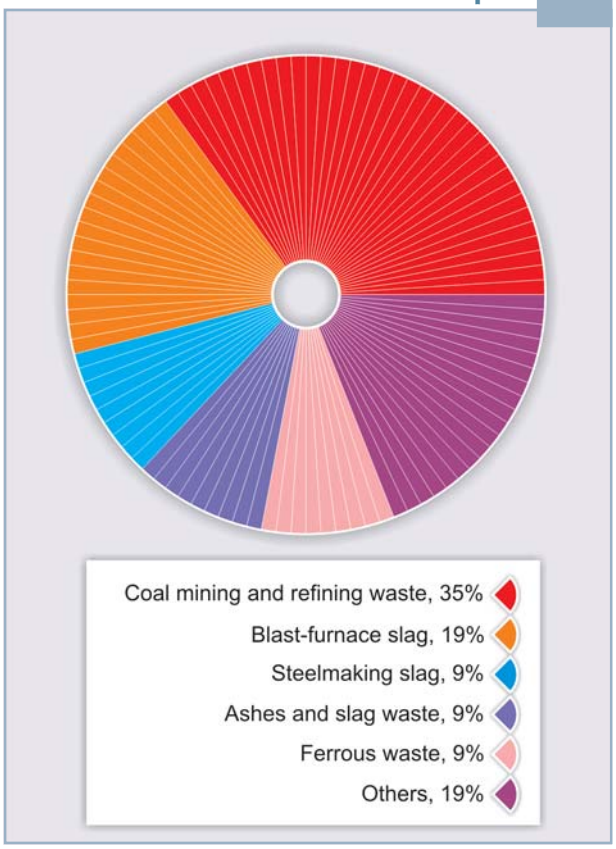
The main sources of industrial waste in Donetsk Oblast are coal, mining and metallurgical industries as well as the power industry. The structure of industrial waste generation by economic sector, shown in Fig. 4.5.5, is practically stable.

The large share of waste produced by the coal industry is directly related to the conventional coal mining technology with which rock is stored at the surface of mines. In metallurgy waste output is largely due to the predominant role played by primary processes and the of blast-furnace steelmaking processes.

Industrial and structural analysis of waste stream shows that by decreasing the standard ash content of rock mass and also a transition to backfilling technology could halve the stream of large-capacity mining waste. In turn slag could be reduced through recycling, a switch to new production technologies and the use of higher grade ore. Recently the amount of accumulated ferrous waste dropped substantially – the backlog accumulated from the past is such that recycling now actually exceeds annual output. Apart from metallurgical waste, the resource value of other large-capacity waste is insignificant.

The distribution and extent of devel-

Fig. 4.5.4. Structure of industrial waste output



Source: State Environmental Protection Administration in Donetsk Oblast, 2009

opment of mineral deposits in Donetsk Oblast are extremely uneven. Very little use is made of large-capacity waste transport in the region. Black coal deposits are concentrated along an imaginary line passing through the Krasnoarmiysk, Donetsk-Makiivka and Shakhtarsk industrial districts; the main sites for storage of coal mining and refining waste are also located here.

Metallurgical waste is disposed of in the cities where metallurgical plants are operating (Mariupol, Donetsk, Yenakiieve etc.). Ash and slag waste are disposed of near thermal power stations. Waste from mining and quarrying of non-metallic minerals is spread over almost the whole of the region (as are enterprises engaged in mining and quarrying such minerals).

Under the accepted classification in Ukraine, large-capacity waste refers to class IV hazardous waste. As a rule, this type of waste has a very high volume and generally causes landscape degradation.

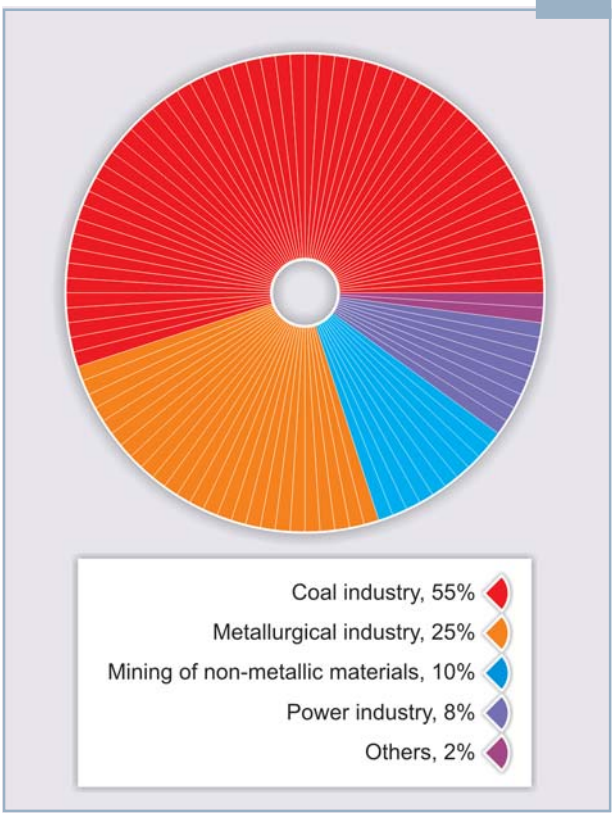
Class III hazardous waste represents an immediate danger, its accumulated volume have reached 6,515,200 tonnes at the end of 2008.

Overall waste occupies about 2% of the region's territory. In Donetsk Oblast there are some 600 rock dumps alone and the area (5,000 ha) they occupy represents 0.2% of the total land area. The region also has numerous sludge reservoirs from coal mining and refining, chemical and coke by-product plants, ash dumps at thermal power stations and overflow dumps. The industrial sites of various enterprises, which are closing down (or have already closed), are industrial waste dumps.

Disposal of industrial and solid domestic waste in the region and future storage sites are shown in Fig. 4.5.6.

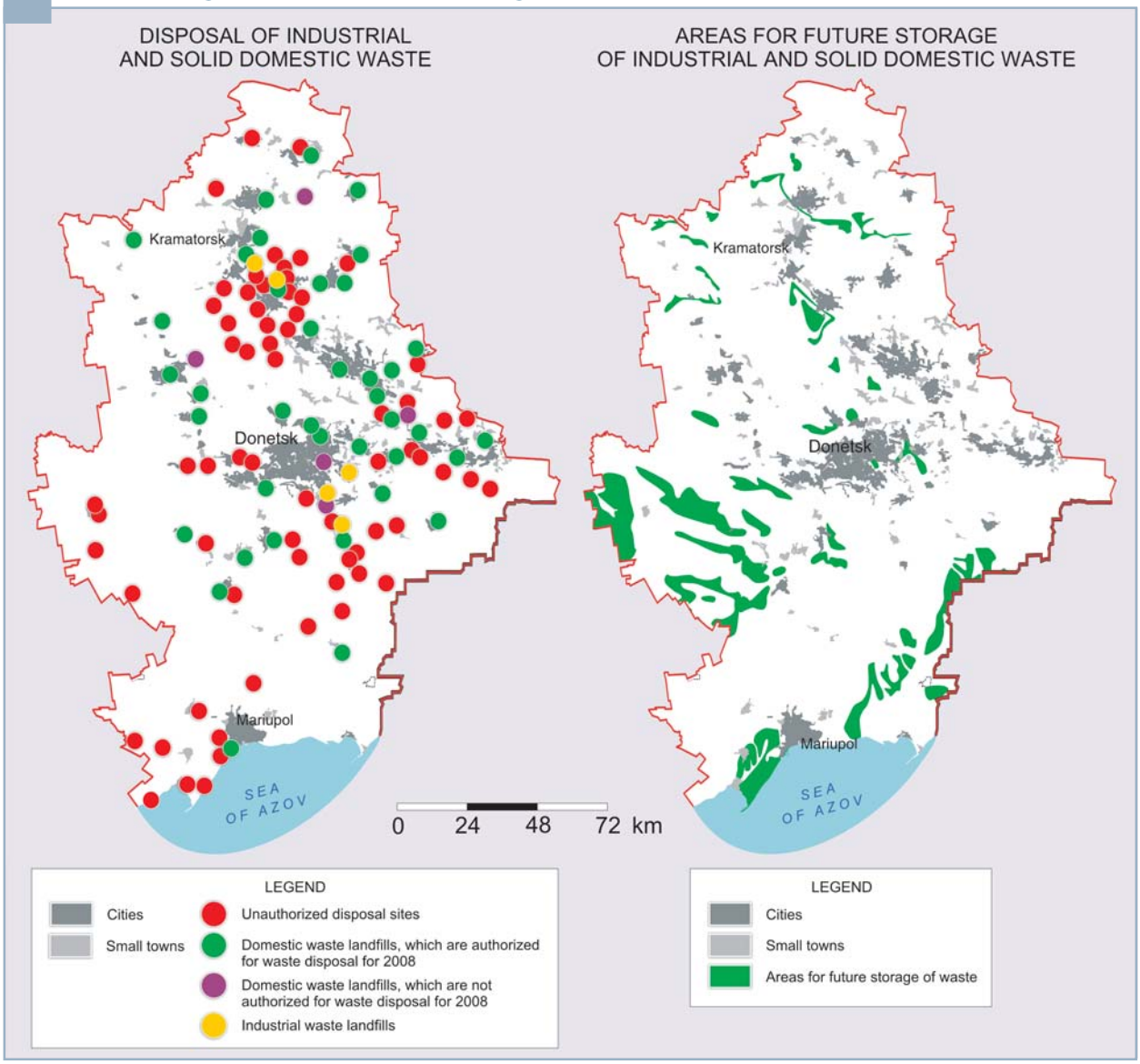
The region contains 240 warehouses,

Fig. 4.5.5. Structure of industrial waste output by economic sector



Source: State Environmental Protection Administration in Donetsk Oblast, 2009

Рис. 4.5.6. Disposal of industrial and solid domestic waste in the region and future storage sites



Source: State Environmental Protection Administration in Donetsk Oblast, 2009

housing 507.6 tonnes of unusable and forbidden pesticides and agrochemicals. Storing such large amounts of pesticides under unfavourable conditions impacts adversely on the state of environment and public health near the storage location, with a potential threat of emergency situations. In 2008 pesticides were packaged, loaded and transported to temporary storage locations.

The top environmental objective for Donetsk Oblast is to decrease the amount of accumulated waste. This can be achieved by reducing output and increasing the degree of use. The present level of use for the main types of wastes is shown in Fig. 4.5.7-4.5.11. It is clear from the figures that only ferrous waste is used in large amounts (over 100% through recycling of accumulated reserves), metallurgical slag is notably less used. The level of use of ash and slag waste, coal mining and refining waste is extremely low (e.g. filling the dams of sludge reservoirs). In recent years there has been an increasing trend towards re-use of paper and carton waste.

Fig. 4.5.7. Volume of generation and use of ash and slag waste, Mtonnes

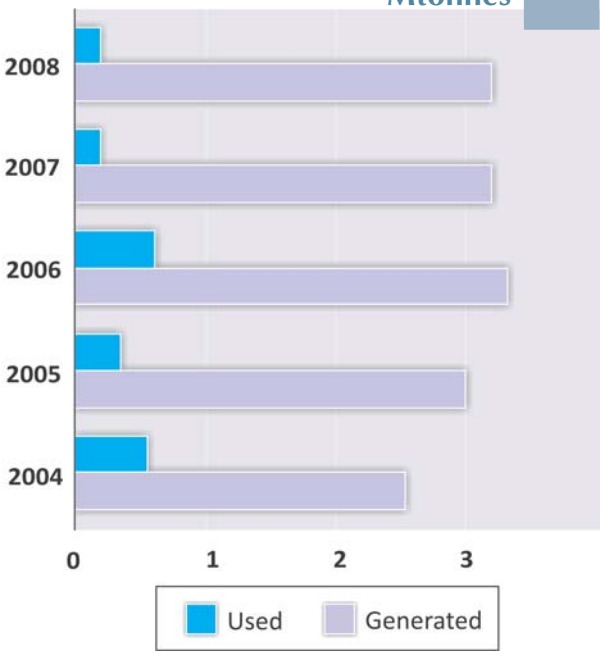
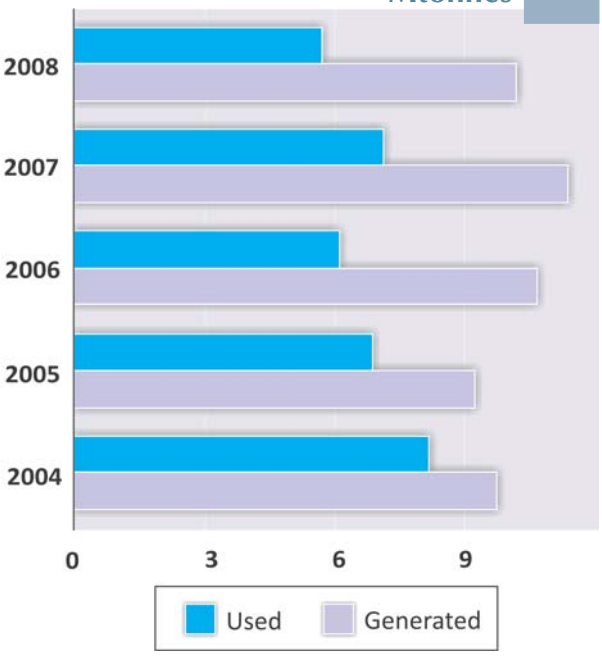


Fig. 4.5.8. Volume of generation and use of metallurgical slag, Mtonnes



Source: State Statistics Committee of Ukraine

The current situation regarding waste management in Donetsk Oblast is environmentally unfavourable. Existing waste recycling resources are nearly completely exhausted, the technologies in use are increasingly out of date. The dynamics of statistical indicators clearly shows that serious legislative, normative, and organizational measures are needed to change the situation, with targeted investment programmes.

The main problem for waste management in Donetsk Oblast is the shortage of recycling and safe storage facilities for all the waste that has accumulated or is still being produced. The prime objective for waste management here is therefore to build the facilities needed to recycle and process hazardous industrial waste, as well as systems for its environmentally safe disposal. In fact, what is at issue is a new branch of business activity in the region. Another long-term goal is to redirect industry towards less material-intensive manufacturing processes with a massive cut in waste output.

For some few years a reduction in the volume of industrial waste output has been expected, related to a drop in metal production and coal mining during the global financial crisis. The level of use of large-capacity waste will change slightly and remain at the level of 20-25% of its generation volume.

The region faces several major problems regarding solid waste management. According to the data shown in the statistical reporting form 14-MTP, in 2008 297,400 tonnes of solid domestic waste (SDW) was produced, with an accumulated volume of 5,998,800 tonnes. The situation is aggravated by the shortage of facilities for weighing disposed of waste in the SDW disposal system. Recently built SDW dumps and landfills are not equipped with weighing facilities. Accounting of waste collected and disposed of in landfill is often carried out by volume with the help of calculation or direct tallying. The significant recent increase in the amount of domestic waste is primarily due to changes in consumption patterns. Data analysis shows that food waste and bottom ash (in-

Fig. 4.5.9. Volume of generation and use of coal mining and refining waste, Mtonnes

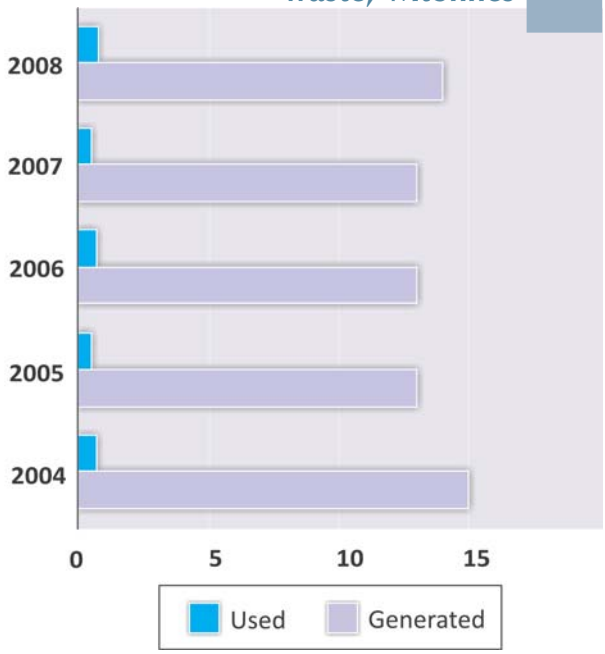
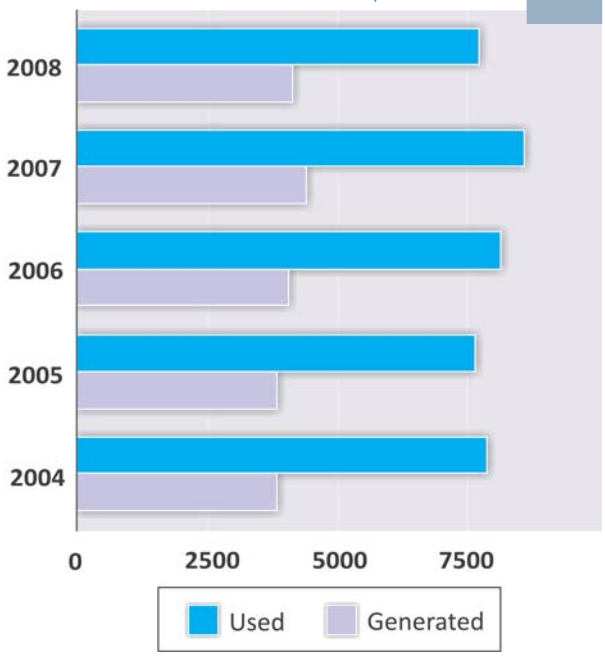


Fig. 4.5.10. Volume of generation and use of scrap and iron-and-steel waste, Ktonnes



Source: State Statistics Committee of Ukraine

cluding heating stove ash), and also plastic, glass and paper make up the largest share of SDW output. The moisture content of food waste ranges from 60-70% in spring to 80-85% in summer and autumn.

City waste consists of 30-50% combustible materials and 20-40% non-combustible constituents: metal, glass and ceramics. With time solid domestic waste contains an increasingly high concentration of environmentally hazardous components. These are waste electrochemical cells, containers of household chemicals, pesticide residues, paint residues, fluorescent lamps and others.

A large number of people and the centres of dynamic business activity are concentrated in a limited amount of space in Donetsk Oblast. As cities and small towns have developed sanitation has become one of the most urgent environmental problems for municipal departments.

Construction of regional landfills in the cities of Kramatorsk and Mariupol has started. In Debaltseve funds have been directed to building a landfill. In Yasynuvata

Priorities for domestic and industrial waste management

1. Decrease volume of waste produced by economic entities and promote further recycling and processing.
2. Recycle accumulated highly toxic chemical and coke by-product waste in the cities of Makiivka, Авдеевка, Mariupol, Yenakieve and Horlivka.
3. Develop and deploy galvanic waste recycling technology in the cities of Donetsk, Khartsyzk, Torez, Druzhkivka, etc.
4. Build environmentally safe storage for unusable pesticides accumulated in the region and continue processing.
5. Build facilities to recycle and process hazardous waste, including use of existing industrial facilities.
6. Improve current regional landfills for solid domestic waste and build new ones, build waste recycling plants and eliminate unauthorized dumps and accumulated litter.
7. Deploy coal mining processes without rock winding to the surface, take preventive measures against spontaneous combustion, and stop rock dumps at mines and coal-cleaning plants.

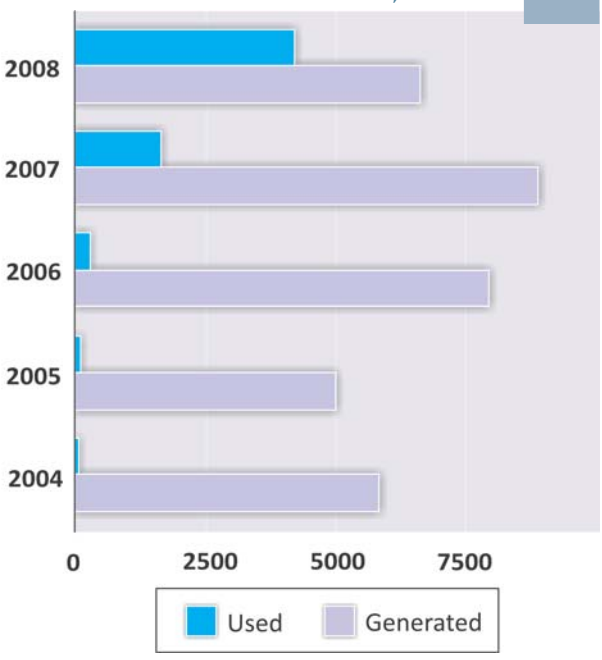
district the landfill is already in operation. A plant for sorting solid domestic waste, which started operating in Kramatorsk in 2006, receives SDW from neighbouring cities in the region. In Khartsyzk a transfer station for solid domestic waste with sorting and compaction functions is in operation. The operation of this station has substantially improved the SDW-management situation in Makiivka and Khartsyzk. By sorting incoming SDW, which involves useful fractionation (paper, cardboard, polymers, glass cullet, metal, wood) and recycling of extracted recyclables, and also further waste briquetting, the service life of the landfill can be considerably extended. Using this technology allows separation of up to 20% of recoverable resources from the initial mass of SDW.

An international TACIS project, on Development of the sphere of solid domestic waste management in Donetsk Oblast, has been running in Donetsk for three years. The project has drawn up the Regional strategic plan of SDW management in Donetsk Oblast for 2005-9. This is the first document in the region to define a strategy for SDW management at a regional level taking into account state policy on waste management. The drafting process took into account European experience implementing the TACIS project on Development of the system of solid domestic waste management in Donetsk Oblast.

Since 2006 an experiment has been underway in Donetsk Oblast for separate collection of plastic packages and bottles in some districts of the cities of Donetsk and Makiivka. More than 600 special containers were also placed alongside common waste containers. It is now planned to expand the area where plastic bottles are collected. A plastic bottle recycling plant in Sloviansk and a tyre recycling plant in Donetsk are under construction in the region.

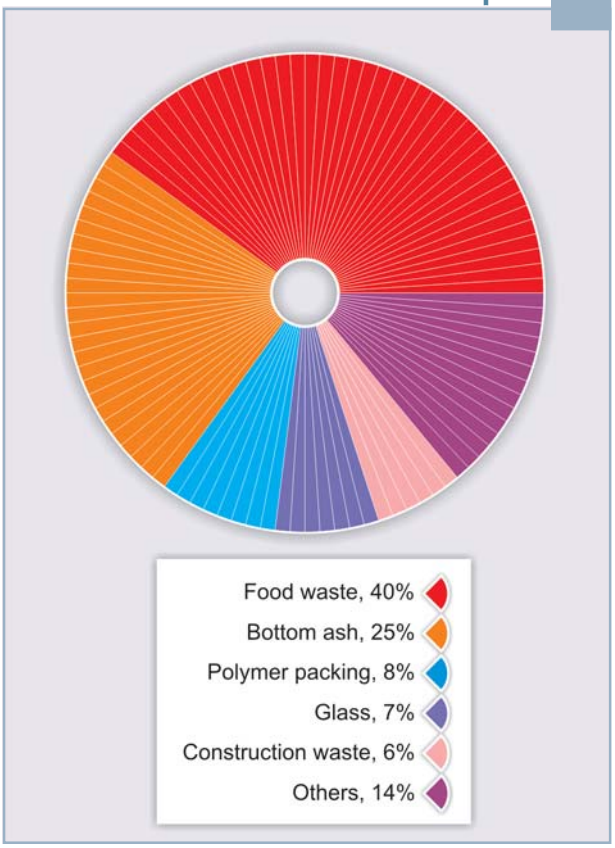
Currently, to improve the waste management situation, various environmental problems still need to be solved.

Fig. 4.5.11. Volume of generation and use of paper and cardboard waste, tonnes



Source: State Statistics Committee of Ukraine

Fig. 4.5.12. Structure of solid domestic waste output



Source: State Environmental Protection Administration in Donetsk Oblast, 2009

4.6. Ecological network and biodiversity

As the new millennium starts mankind faces the threat of a global environmental crisis. The cause of the crisis lies in the level of development of natural resources, which has reached the limit of reducing ability of the natural environment.

The need to preserve no less than 30% of land in its natural state is considered to be a conceptual framework for maintaining the ecological balance of the planet. That is why the main trend of the Pan-European Strategy of Biological and Landscape Diversity is to create the European Ecological Network. This is specified by the decision of the Fifth International Conference of European Environment Ministers.

The concept of the Ecological Network is wider than the concept of the network of nature reserve areas generally accepted in Ukraine. It is a united territorial system, which includes areas of natural landscape subject to special protection, territories and objects covered by the nature reserve fund, resort, recreational, water and field-protective areas and objects, which are part of elements of the Ecological Network – natural core areas, ecological corridors and buffer zones. The interrelated nature of these elements creates the conditions for the development of ecological balance and enables biota to resist technogenic impacts. The idea of the European Ecological Network is reflected in the formation of national ecological networks in every country of the continent which together must create a global continental ecological network.

Despite the concentration of industry and high level of urbanization, Donetsk Oblast is one of the leading areas in Ukraine

Indicators for assessment

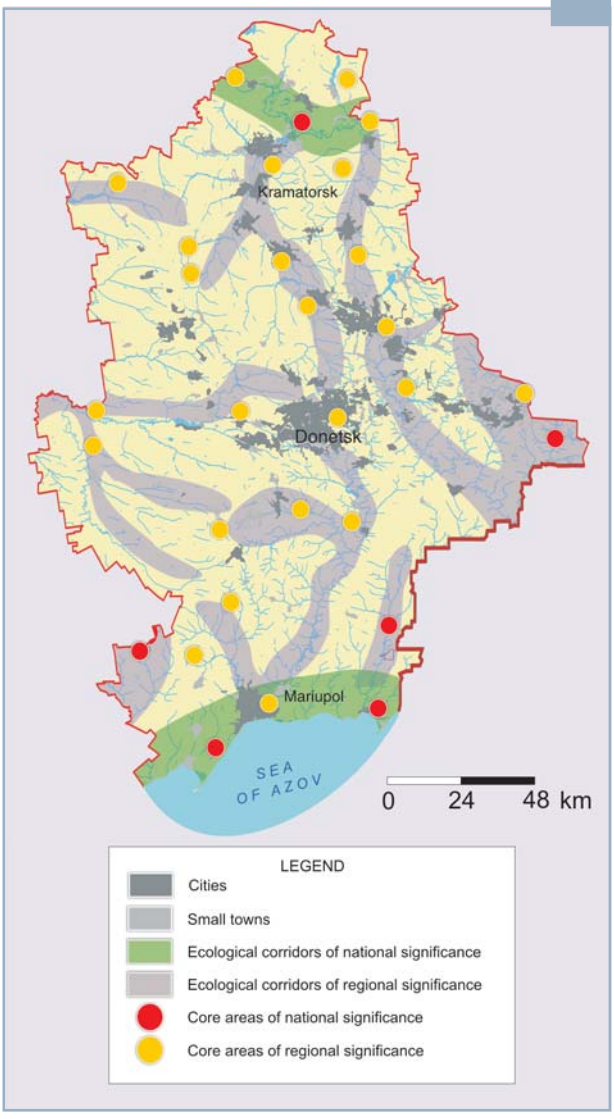
1. Area and percentage of land covered by the nature reserve fund: total area, area by category of nature reserve (km^2), area of nature reserves as a share of the total area of the region (%).

2. Area and percentage of forest and timberland: total area, area by category of forest utilization (km^2), share of forests by category of use and area of forest as a share of the total territory of the region (%).

3. Number of indicator species of regional biodiversity and threatened and protected species (units).

4. Dynamics of changes for indicators over the last 50 years (according to paragraph 1-3) and trends in species richness.

Fig. 4.6.1. Model scheme of development of regional ecological network



Source: State Environmental Protection Administration in Donetsk Oblast, 2009

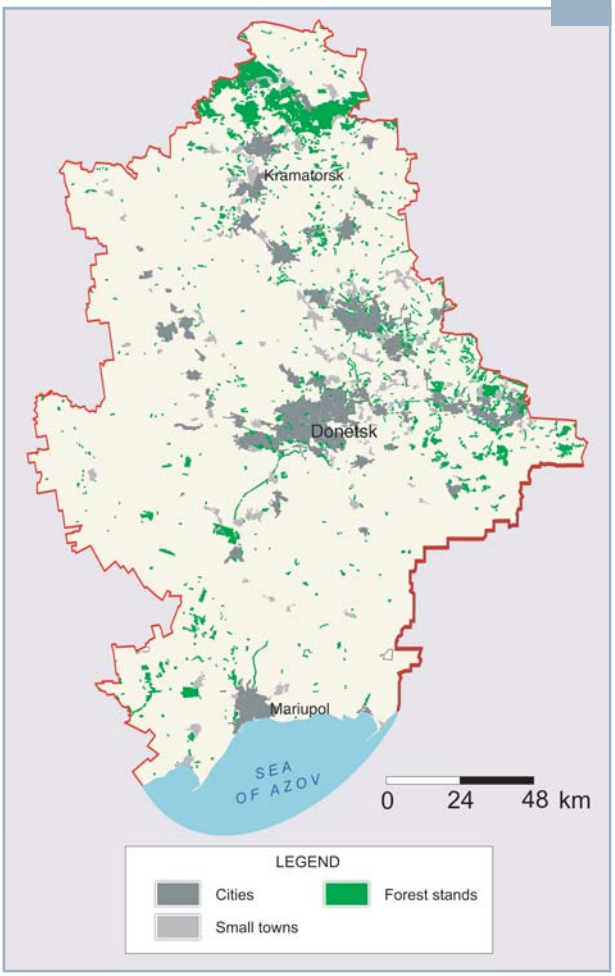
for the quantity and diversity of the objects covered by the nature reserve fund, leading the country's eastern regions for these indicators. By 2008 the total number of nature reserves reached 107 units with a total area of 84,882 ha, which represents 3.2% of the region's territory. Similarly the average percentage of conservation areas amounts to 4.2% in Ukraine and 8.3% in the Ukrainian Carpathians. The area of conservation areas in Donetsk Oblast is constantly increasing, but by 2015 it will not have reached the recommended level – 6% of the territory of the region. The structure of the region's nature reserve fund network is shown in Fig. 2.2.2.

The area of about 70% of nature reserve fund objects is less than 100 ha, well below the desired minimum area for protected areas (500-600 ha), which is why the most important trend for improving nature-conservation activity in the region is creating a regional ecological network. A project to develop a regional ecological network has started recently in Donetsk Oblast, involving the State Environmental Protection Administration, the Association of Land Surveyors and the Donetsk Botanical Garden. This pilot scheme is shown in Fig. 4.6.1.

The structure of the ecological network, which is being created, makes provision for using territories with a higher percentage of natural and semi-natural landscape as core areas, and valleys and beds of minor and medium rivers of the region as ecological corridors. In this connection the whole region was theoretically divided into four sectors.

The first sector is the Donets ridge, the central sector of the region and its main drainage divide. The main elements of the core areas of this sector are the natural and semi-natural territories of the Donets ridge and drainage basins of the rivers Krynka and Mius. The main core area is the regional landscape park Donetskyi Kriazh (Donets ridge), a future national nature park of the same name, which is a constituent part of Russian-Ukrainian biosphere reserve.

Fig. 4.6.2. Forest map of Donetsk Oblast



Source: State Environmental Protection Administration in Donetsk Oblast, 2009

The second sector is the Siverskyi Donets drainage basin. The main territories are the valley of the river Siverskyi Donets and southern parts of valleys of its tributaries. The main core area is the national nature park Sviati Hory and the State nature reserve Melova Flora.

The third sector is the Azov drainage basin including all drainage basins of minor rivers flowing into the Sea of Azov and the coast of the Sea of Azov. The main core areas are State nature reserves Khomutivskyi Step and Kamiani Mogyly, regional landscape parks Meotida (future national nature park) and Polovetskyi Step.

The fourth sector is the Dnieper drain-

age basin represented by drainage basins of rivers belonging to the basin of the Dnieper – the Samara and the Vovcha. The main territories are the valleys of these rivers. There are no large core areas. A complex of small reserves (zakazniks) and protected natural landmarks (urochisches) in the basin of the river Samara, which will be combined in a specially protected natural area with a buffer zone, can be taken as their basis.

On the whole, the proposed model scheme can be treated as the basis for the future regional ecological network in Donetsk which will enable natural diversity in the region to be preserved. Work setting up the ecological network in Donetsk Oblast, as specified under international agreements, is scheduled for completion by 2015.

Thus objects covered by the region's nature reserve fund form the basis of the regional ecological network. Nine independent institutions of the nature reserve fund of national and local significance including the Ukrainian Steppe Nature Reserve, national nature park Sviati Hory, Donetsk Botanical Garden, the Meotida, Kleban Byk, Donetskyi Kriazh, Kramatorskyi, Zuievskyi and Slovianskyi Kurort regional landscape parks have been set and are operating in Donetsk Oblast.

To preserve and recreate the typical, unique steppe ecosystems of left-bank Ukraine, which are of scientific and aesthetic importance, and essential to nature conservation, the territory of the Ukrainian Steppe Nature Reserve was expanded by 579.6 ha at the expense of state land within the territory of Starolaspa and Michurine selsovets (rural councils) of Telmanove district. There are plans to establish a new branch of the Kalmiuske nature reserve within this territory.

Following a decision by the Donetsk regional council the territory of the Donetskyi Kriazh regional landscape park was expanded by including lands from the

History of the Sviati Hory national nature park

As long ago as the beginning of the last century, the famous botanist V.I.Taliyev drew attention to the need to protect the habitat of the relict cretaceous pine, and in 1978 professor R.I.Burda prepared a complete substantiation of the need to create a national park on the river Siverskyi Donets.

The Sviati Hory national nature park was created by edict of the President of Ukraine on the basis of the Hory Artema and Sviatogirskyi landscape reserves (zakazniks) of national significance, becoming the first national nature park on the left bank of Ukraine.

Vegetation cover of the territory of the national park is rich and varied. Typical broad-leaved forests, aged 90-110 years, consisting predominantly of oak and ash, cover a considerable part of the territory. Hazel and Tatarian maple prevail in the undergrowth. Greater Stitchwort dominates in herbage almost everywhere.

Cretaceous pine forests formed by cretaceous pine, a tertiary relict species included in the Red Book of Ukraine, have the highest botanical value. According to the data of various scientists, in the 18th century the right bank of the river Siverskyi Donets was covered with cretaceous pine forests from the Sviatohirsk monastery to the village of Maiaky, and only small islets of oak forests occurred. At the end of the 19th century the areas of cretaceous pine forests decreased drastically. Now all that remains are separate areas in the middle of oak forests.

Inside the territory of the park there are 130 archaeological and more than 70 historic sites. Among them the Sviatohirsk Monastery of the Holy Dormition is of special interest for visitors to the park. The real gem of the natural reserve is the cave temples with the Church of St Nicholas, built on a chalk cliff in the 17th century. This unique brick building with its limestone chancel, reproduces traditional folk architecture in stone and is a vivid evocation of Ukrainian art from that period.

Establishing the Velyko-Anadol forest reserve

The Velyko-Anadol forest reserve is situated within the territory of Volnovakha district. It is a real wonder of Donetsk steppe and a key monument to forestry science.

In the spring of 1843 Viktor Yegorovich Graff, a graduate of the St. Petersburg Forest and Survey Institute, was asked by the Ministry of State Property to choose a place for a forest in southern Russia. Graff chose Velyko-Anadol a state-owned, rentable property with an area of 2,570 dessiatines, where the first steppe forest ranger station was established. Seedlings of Norway maple, Tatarian maple, common maple, elm, smooth-leaved elm, lime and apple were planted in holes in fully ploughed soil.

After 1867 Graff's work was continued by his former assistant L.G.Bark who tried to simplify and to reduce the cost of afforestation. To reduce the number of tilths – 14,000 seedlings per dessiatine – dense stands were created. Single-species plantations of ash, elm, smooth-leaved elm and maple (low-persistent species) were generally used. Even then Bark reached the conclusion that oak must be the main species on the steppe.

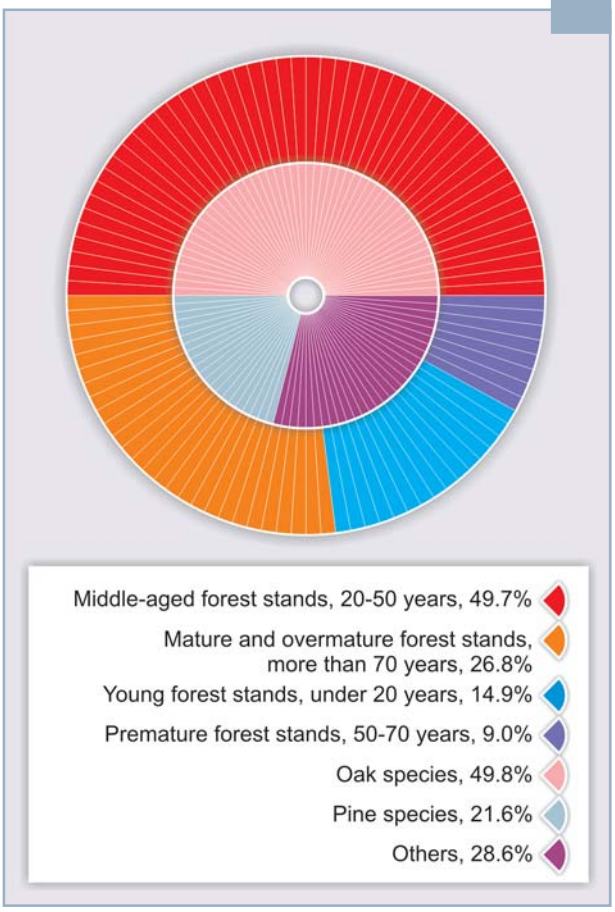
G.N.Vysotskiy has confirmed this in his work. Together with N.Y.Dakno he developed a new system of planting, in which the dominant position was taken by oak, which is drought-resistant and has a strong root system. Forest stands created according to these types proved to be the most persistent, with plantations surviving to the present day and still looking good.

The science of our country owes a debt of gratitude to pioneers of steppe forestation, and to Graff in particular. In 1909 the St Petersburg Forest Company announced a fund-raising campaign to build a monument to the first Russian professor of forestry. It was decided to place the monument in the forest created by the professor's will and labour. On 30 September 1910 the opening ceremony of monument to Graff was held, subsequently visited by leading graduate foresters of Russia. Now in the main path of a picturesque part of the Velyko-Anadol forest reserve in front of the first school of foresters stands a monument to Graff sculpted out of Finnish granite.

Amvrosiivka and Shakhtarsk districts with a total area of 3,511.32 ha. A gradual increase in the area of the regional landscape park is a preparatory phase on the way to creation of a biosphere reserve, provided by the State programme of formation of the national ecological network of Ukraine for 2000-2015. The programme provides creation of the national nature park Meotida on the basis of the regional landscape park Meotida.

Biodiversity of the region is closely connected with its timber resources: 204,000 ha of forest grow within the territory of Donetsk Oblast, 150,000 ha (70%) of which are forests of artificial origin (Fig. 4.6.2). This amounts to 7.69% of the territory of the region, which is half the average in Ukraine and 1.6 times lower than the optimum level (12%). The forests of the

Fig. 4.6.3. Description of Donetsk Oblast forests



Source: State Environmental Protection Administration in Donetsk Oblast, 2009

Fig. 4.6.4. Dynamics of change of area of forest stands in Donetsk Oblast, thousand ha

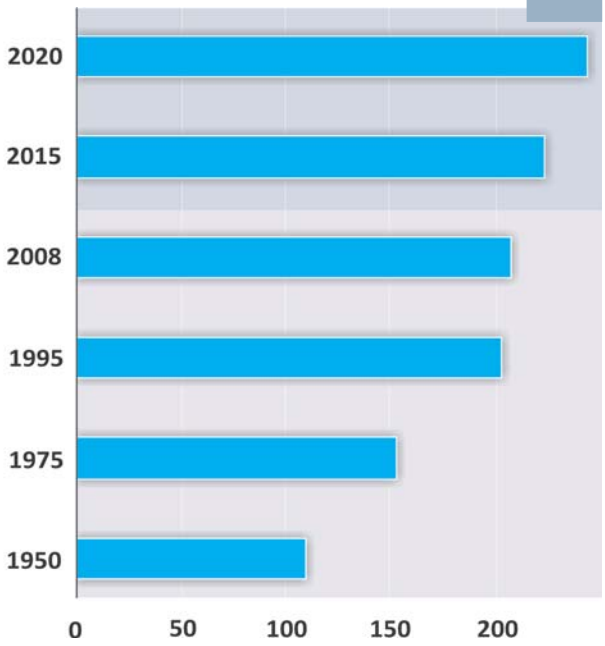
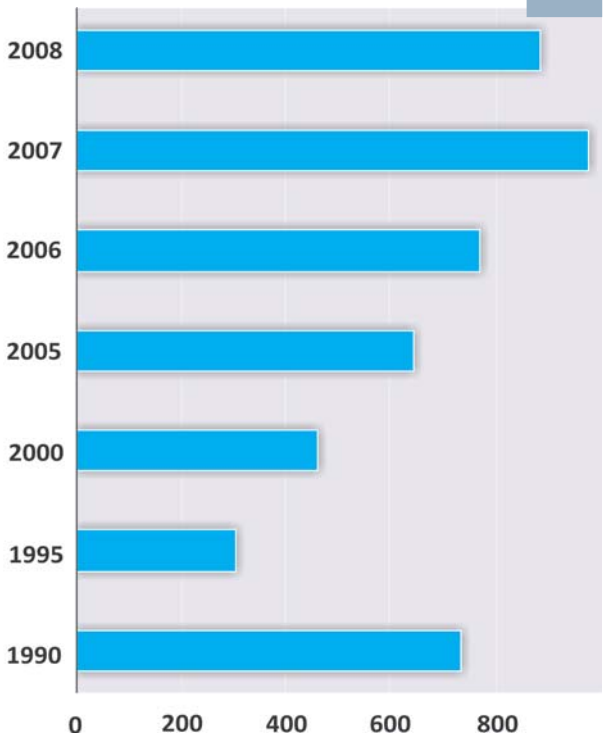


Fig. 4.6.5. Dynamics of change of renewable forests area in Donetsk Oblast, ha



Source: State Statistics Committee of Ukraine, the State Environmental Protection Administration in Donetsk Oblast, 2009

region have no commercial value, but fulfil a nature-conservation function. They are consequently subject to special protection. The distribution of forests within the territory of the region is irregular – the main woodlands are situated in the north of the region, but there are practically no forests in south-eastern and western areas. Planted forests are mainly situated on land exposed to wind and water erosion, and also beside rivers and reservoirs. A description of the region's forests and their distribution among users are shown in Fig. 4.6.3 and 2.2.4.

The average age of trees in the region's forests is 57 years, the average stand of timber per hectare is 158 m^3, the mean annual increment 3.0 m^3/ha, the total amount of timber in the forests of Donetsk Oblast 23,700,000.m^3, and the intensity of forest use 18%. Young forest stands account for 14.9% of trees, middle-aged forest stands 49.7%, premature forest stands 9.0%, mature and overmature forest stands 26.4%.

The dynamics of change in forest area in Donetsk Oblast is shown in Fig. 4.6.4 and 4.6.5. The represented data shows that the rate of forest renovation in the region is very high; however, the recommended percentage of forest area (12%) will not have been reached by 2020.

Major problems in the protection and exploitation of forest resources are related to the need to increase funding for forestry, the cross-departmental nature of the forest management system, the unsatisfactory species structure of forests, poor sanitary state of 40% of forest stands, observed overall ageing of forests, etc. Fire and pests cause considerable damage to woodlands (Fig. 4.6.6 and 4.6.7).

Historically the forests of Donetsk Oblast have an unfavourable age structure. On the whole, middle-aged, premature and mature forest stands predominate, their share amounting to 70%. In particular more than 40% of low oak stands, more than 50%

of ash stands and about 85% of acacia stands belong to this category of forest.

Since 2007 the State Environmental Protection Administration in Donetsk Oblast has been implementing a work programme to radically improve the state of the region's forests. The regional Forests of Donechchyna programme, for 2007-15, was approved by regional council and accepted for execution. Execution of the programme by 2015 will result in an extension of the forest area by 14,900 ha, making a total of 228,300 ha. The percentage of forest area will increase to 8,6% (Fig. 4.6.4). Provision is made for improving the qualitative composition of forests, their capability and also the sanitary state of forest stands. The state of the natural environment of the region will be significantly improved due to an improvement in the water-regulating, soil-protective and other useful properties of forests. The amount of harmful emissions and dust removed from the atmosphere and also the deposition of carbon dioxide will increase by a factor of 1.1-1.2, the state of the hydrographic network will improve and the number of forests and green zones in settlements will increase. On the land, where new forests will be created, wind and water erosion will stop and further degradation of agricultural land will decrease. The forest and agricultural landscape will continue to form, the ameliorative impact of forest stands will be expanded to cover 150,000 ha of agricultural land, with a 10-15% increase in crop yield. On the whole, implementation of the programme will increase the bioclimatic potential of the territory and will result in rehabilitation of the natural environment.

Analysing the changes in the region's biodiversity is a complex task involving assessment of various indices and indicators on a geographical scale. It should be noted that there are considerable gaps in the biodiversity monitoring data, but in

2004-8 specialists carried out a preliminary scope of surveys.

Fig. 4.6.6. Dynamics of the area of forest land damaged by fire, ha

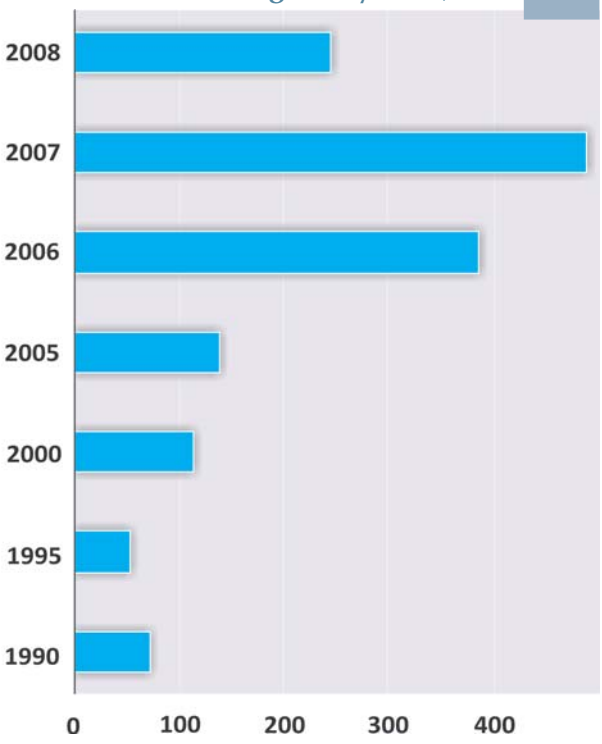
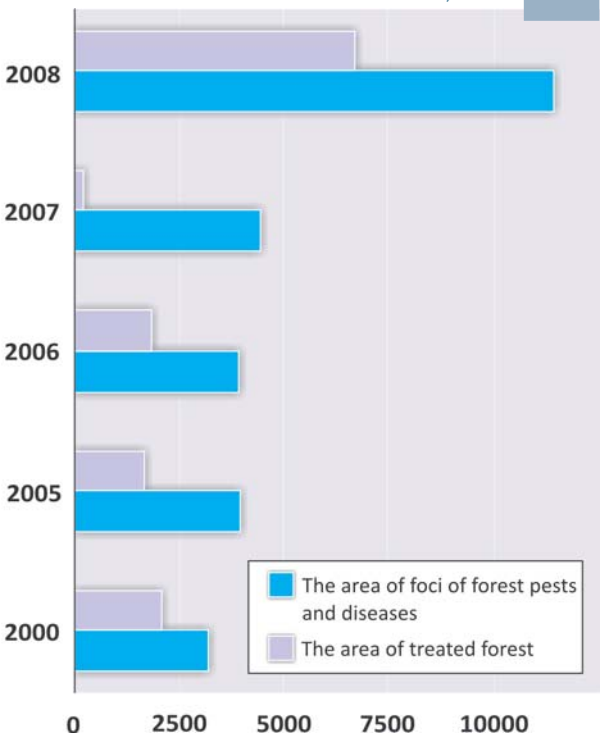


Fig. 4.6.7. Dynamics of the area of forest land damaged by pests and disease, ha



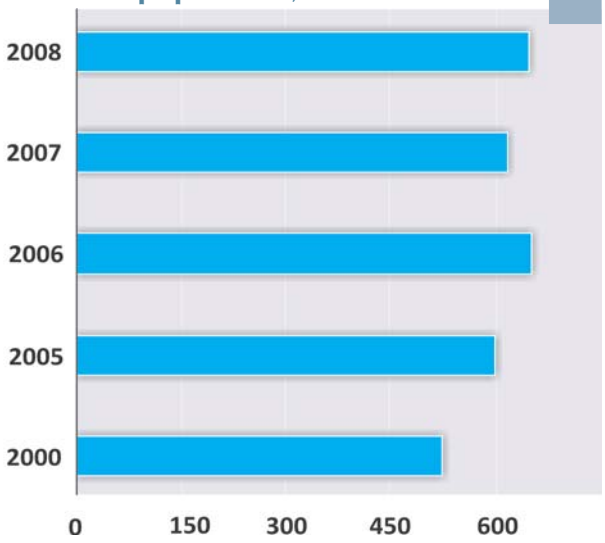
Source: State Environmental Protection Administration in Donetsk Oblast, 2009

The plant world of Donetsk Oblast is distinguished by large species diversity, however only 16% (289 species) of plants are widespread all over the territory. These are weeds, adventitious and feral species, which occupy pockets of landscape, disturbed by human productive activity: 422 species (22.5%) are distributed here and there, 290 species (16%) occur rarely, the number of their habitats does not exceed 10, 238 species (13%) grow singly, the number of their habitats not exceeding three. Some 80 species were found only growing in one place. It also emerged that every fourth species of flora requires special protection, which is why the regional council has taken into account the recommendations of the Donetsk Botanical Garden of NAS of Ukraine, and has approved the list of species of plants, which are not included in the Red book of Ukraine, but which are rare or endangered within the territory of the region.

Species diversity of the animal world in the region numbers 25,000 species of various systematic groups, among which more than 24,000 species are represented by invertebrates (molluscs, insects, myriapods, spiders, crustaceans, worms etc). Vertebrates are represented by fish and cyclostomes (38 species), amphibians (9 species) and reptiles (12 species). Within the territory of the region more than 300 species of birds and about 50 species of mammals are constantly present and observed during passage, wintering and migration. Among the animals included in the Red book of Ukraine there are 134 species, including 58 species of insect, 44 species of bird, 15 species of mammal, 7 species of fish and cyclostome, 4 species of reptile, 3 species of crustacean, 2 species of worm and 1 species of arachnid. And there are also more than 140 species of animals which are rare for the region.

On the whole, the number of hoofed animals (deer, wild boars, roe deer etc) has increased within the territory of the region. The number of fur-bearing animals (15 commercial species were estimated) has increased too, however the number of coypu, beavers and foxes had decreased by 2008 compared to 2000. The number of birds increased by a factor of 1.5 (9 species were estimated) over the last 10 years.

Fig. 4.6.8. Dynamics of wildfowl population, thousand head



Source: State Environmental Protection Administration in Donetsk Oblast, 2009

By the end of 2008 the area of hunting land in the region amounted to 2,018,000 ha, set aside for use by hunting and fishing farms and state-owned enterprises of the Donetsk regional administration of forestry and hunting. In the 2004-6 period projects to organize and develop hunting farms in the region were drawn up by the Kharkiv expedition of the Kharkivdivproagropolis and Kharkivlisproekt.

In line with a decision by the Donetsk Regional Council, the hunting land of Donetsk Oblast is reserved for 36 users, including 23 hunting and fishing farms belonging to the Ukrainian hunting and fishing association, four state-owned enterprises of the Donetsk regional administration of forestry and hunting and nine other organizations. The total number of registered hunters in Donetsk Oblast is 43,900 people.

Individual and collective hunting for field (pheasants, partridges, quails and doves) wildfowl and wetland (ducks, geese and sandpipers) wildfowl, individual and collective hunting for fur-bearing animals (hares, foxes and raccoon dogs) and collective and battue hunting for wild cloven-hoofed animals (since 1998 only wild boars) and wolves is traditional in Donetsk Oblast. Spring hunting for migrant wildfowl is not allowed in the region. Hunting for valuable species of fur-bearing animals and other species of animals is not allowed either.

Thanks to improved hunting management and tighter control over the activity of hunting land users, the population of hoofed animals has stabilized. The wild boar population (from 1,137 in 2005 to 1,771 in 2008) and roe deer (for which the population has increased by 222 animals

Fig. 4.6.9. Dynamics of population of hoofed animals, head

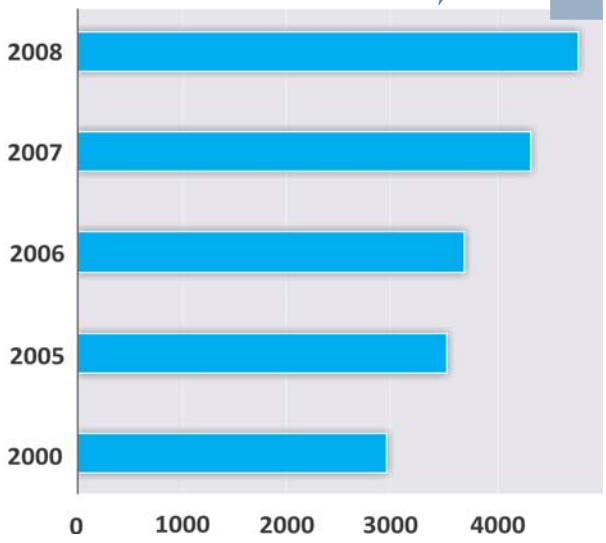
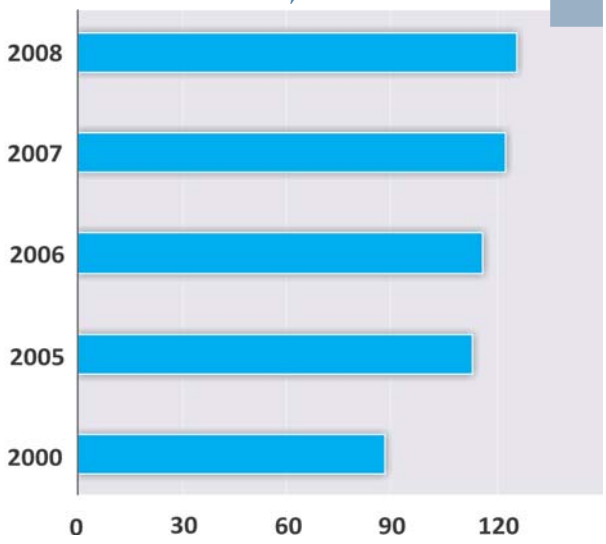


Fig. 4.6.10. Dynamics of population of fur-bearing animals, thousand head



Source: State Environmental Protection Administration in Donetsk Oblast, 2009

Flora of the region

Donetsk Oblast occupies a unique territory at the boundary of two zones – forest-steppe and steppe. This predetermines the great wealth of its flora. There are 1,835 species of plant in Donetsk Oblast (1,714 species in Dnipropetrovsk Oblast, 1,532 species in Zaporizhia Oblast and 1,120 species in the flat part of Crimea). The considerable preponderance of herbal plants (89.3%) over trees and bushes is a specific feature of the regional flora. Perennial species prevail chiefly among herbal plants. The level of endemism (percentage of species confined to a particular location) reaches 15%. The total number of such species amounts to 250. The number of steppe species of plant amounts to 630, and 20 of them are included in the Red book of Ukraine. The number of species growing in rock crevices and rock exposures amounts to 420, and 42 of them are included in the Red book of Ukraine. Grassland vegetation numbers 200 species (1 species is protected), forest vegetation numbers 300 species (13 species are protected), bog vegetation is represented by 180 species, etc.

For two centuries botanists have been studying the flora of the south-east of Ukraine and only by 1940 the academic publications Flora of the USSR and Flora of the Ukrainian SSR generalizing findings of the investigation were published. In 1978 the first edition of the Red book of Ukraine was published. A list was drawn up of 233 species, including rare plants which are becoming extinct or being destroyed within the territory of Donbas. The contemporary composition of rare flora of the region numbers 381 species (20%). The list of plants which have become extinct within the territory of the region over the last 70 years is represented by 33 species. Among rare species there are 91 plants included in the Red book of Ukraine, 40 species which can be included in its new edition and 39 species included in the World Red List.

compared to 2007) in the region continues to grow. However, the population of moose remains very low as before (24 animals in 2008). The total number of animals and birds has been increasing in hunting farms since 2000. The dynamics of the bird, hoofed and fur-bearing animal population is shown in Fig. 4.6.8-4.6.10.

In the inland water bodies of Donetsk Oblast 85 users of special commercial fishing farms implement fishery management; about 1,000 ponds with water volume up to 1,000,000 m^3 are leased for fish farming. The rate of stocking with fish in 2008 amounted to 4,900,000 units and the catch reached 698,6 tonnes. Average fish capacity amounted to 63 kg/ha.

According to information from the Central Statistical Office in Donetsk Oblast, in 2008 enterprises caught 11,000 tonnes of fish, 2,000 tonnes in inland water bodies and 9,000 tonnes in the sea fishing zone of Ukraine. The main target species of the commercial fishery in the region's freshwater bodies are white and spotted silver carp, and in smaller amounts, common carp, bream and crucian carp; in the sea fishing zone, haarder, kilka, Azov goby and pike perch.

Recent investigations show that biodiversity in Donetsk Oblast is decreasing at a higher rate than on average in Ukraine, so there is much to be done to preserve biodiversity and qualitatively change the negative trends.

Priorities for conservation of biodiversity in Donetsk Oblast

1. Create a regional ecological network by 2015 in line with the developed model scheme.
2. Increase the region's natural reserve fund area by 2015 up to 6% of the overall territory.
3. Implement the main activities of the regional Forests of Donechchyna programme in 2007-15 and increase the forest area by 2020 up to 12% of the overall territory.
4. Create a biodiversity monitoring system in the region, select bio indicators, identify areas of high biodiversity, assess abundance of harmful dominant species, etc.
5. Develop a regional strategy for educating the general public and raising social awareness of biodiversity.

SECTION 5

TECHNOGENIC AND SOCIAL RISKS

The concept of human development that has taken shape in the world over the last quarter of a century considers human development to be the main goal and criterion of social progress. Major objectives fall into three categories: to live a long life maintaining a good state of health, to get an education and achieve a decent standard of living. Obviously, if these provisions are not fulfilled, then most other objectives remain unattainable.

Another important trend in assessing development in countries and regions relates to the application of environmental indicators characterizing trends in social and economic human activity and impacts on the natural environment. The list of key environmental indicators was worked out after the Fifth International Conference of European Environment Ministers, held in 2003 in Kyiv, and is used now to analyse the development of countries.

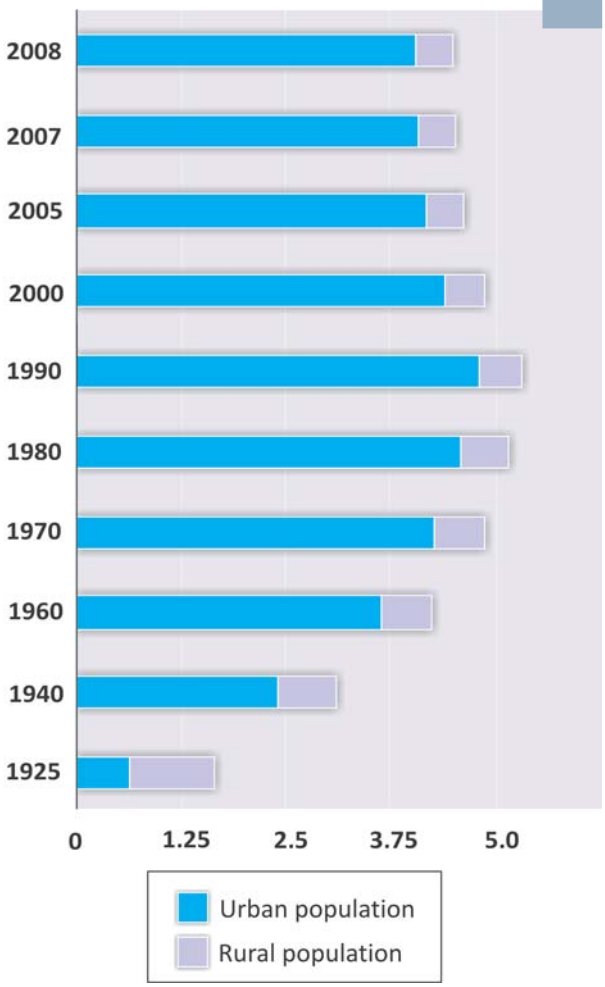
Analysis of social and demographic indicators and the impact of environmental pollution on public health in the region was carried out applying the concept of sustainable human development as well as the recommendations of the UNECE Working Group on Environmental Monitoring and Assessment. A comparative assessment of key environmental indicators in Donetsk Oblast, in relation to other regions of Ukraine, was carried out. The results of this study are presented in this section.

5.1. Social and demographic indicators

Demographic indicators and public health are sensitive features which reflect changes in the quality of the natural environment. Numerous facts testify that an increase in the mortality rate and population morbidity is registered in environmentally hazardous regions, there being a clear connection with the region's environmental peculiarities.

The extremely high anthropogenic stress, typical of the territory of Donetsk Oblast, significantly impairs the quality of life and health of the population. The demographic situation in Donetsk Oblast is characterized by negative natural increase.

Fig. 5.1.1. Population dynamics in Donetsk Oblast



Source: State Statistics Committee of Ukraine, 2009

Table 5.1.1. Birth and mortality rates

	Death rate (per 1,000 people)	Birth rate (per 1,000 people)
Donetsk	**15.0**	**9.2**
Horlivka	**20.1**	**9.9**
Dzerzhynsk	**21.1**	**9.2**
Yenakiieve	**21.4**	**9.7**
Kramatorsk	**17.7**	**10.1**
Makiivka	**19.0**	**9.8**
Mariupol	**15.7**	**8.9**
Sloviansk	**17.7**	**10.0**
Dnipropetrovsk	17.7	11.0
Zaporizhia	16.5	10.3
Kyiv	10.9	11.6
Lviv	13.7	11.3
Odesa	15.9	12.0
Kharkiv	16.2	9.8

Source: State Statistics Committee of Ukraine, 2009

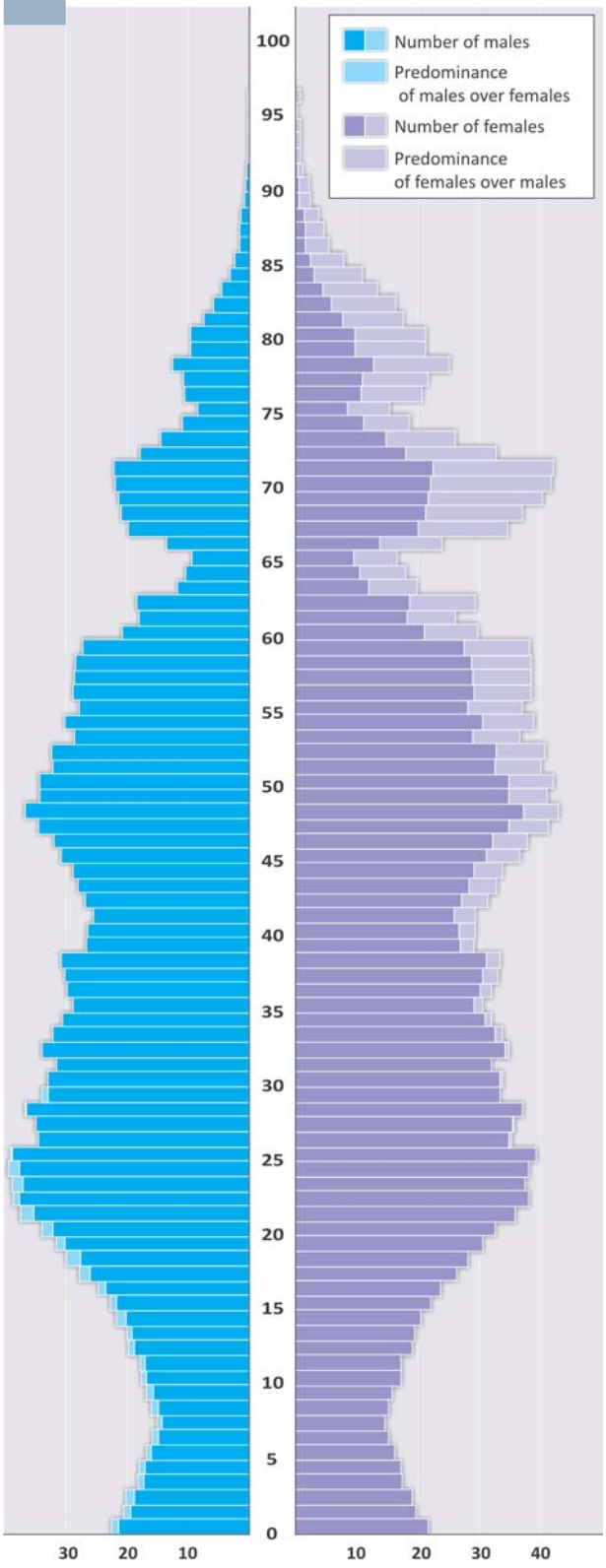
Analysis of the region's demographic indicators shows that the population has been declining for several years, totalling 4,500,500 on 1 January 2009. Fig. 5.1.1 shows the dynamics of regional demographic indicators by major population group.

The main reason for the decline in population is the rising mortality rate coupled with a decreasing birth rate. At present the cities of Donetsk Oblast register the highest mortality rate, overall and for children, among the largest cities in Ukraine. For comparison, the mortality rate observed in the cities of Ukraine is shown in Table 5.1.1.

For the population of Donetsk Oblast, average life expectancy at birth is 66.47 years – 72.98 years for females and 60.35 years for males. In 1991 these indicators were 74.13 and 63.87 respectively. The structure and dynamics of natural variation in the population of Donetsk Oblast are shown in Fig. 5.1.2 and 5.1.3.

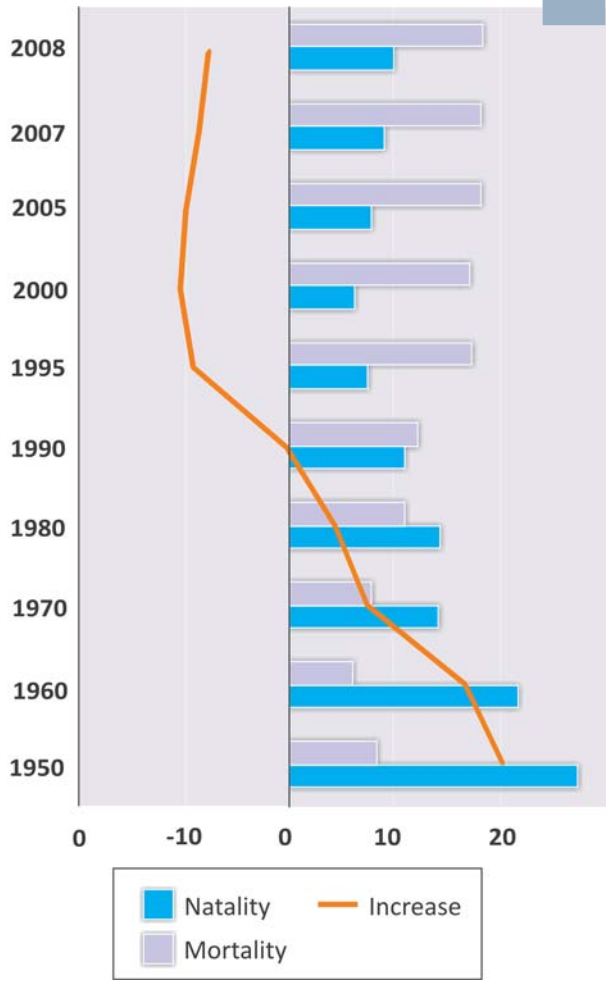
Changes in the age structure of the population, a fall in the quality and dura-

Fig. 5.1.2. Population by sex and age group, thousand people



Source: State Statistics Committee of Ukraine, 2009

Fig. 5.1.3. Natural population variation in Donetsk Oblast, per 1,000 people



Source: State Statistics Committee of Ukraine, 2009

tion of life are due to various economic, social and environmental factors, among which pollution of the natural environment is far from negligible.

In the mid-1990s the Russian Cross concept appeared to characterize the switch to a trend by which mortality exceeds the birth rate. Many researchers represent it with figures consisting of two polygonal chains (birth and death rates), which converge at the end of the 1980s, intersecting to form a cross. Over the last 15 years the population of Ukraine has dropped by more than 5,000,000. Pessimistic estimates suggest that by 2050 the population of Ukraine will have fallen to 36-37,000,000.

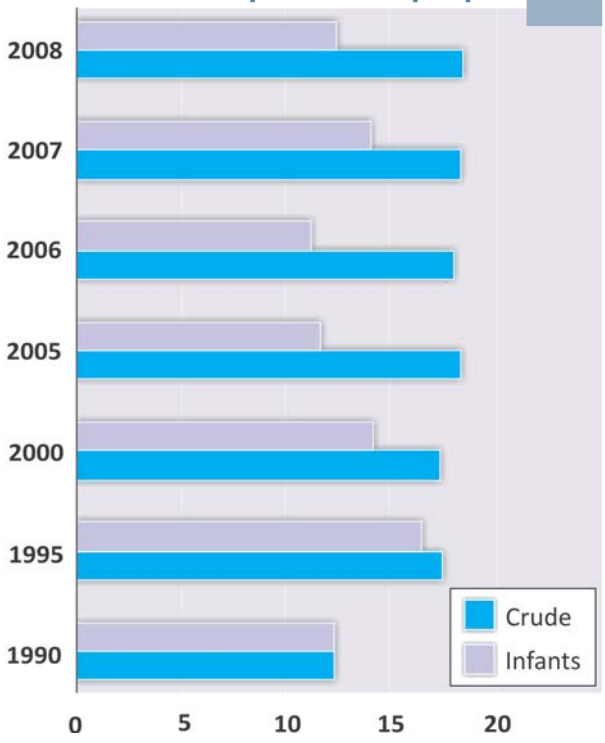
Although the birth rate has bucked this trend in recent years, the overall situation has not fundamentally changed. Many analysts have investigated the causes of the depopulation process which has lead to this protracted demographic crisis. But there is still no answer to the question of how to reverse the negative demographic trend. It is quite possible that social but also by economic factors have contributed to demographic trends in the Donetsk region.

5.2. Public health

The dangerous level of air pollution is one of the main factors in rising mortality and morbidity risks in cities with a high or very high level of air pollution. It is assumed that the average death rate in such cities is 5-10% higher than in cities with a relatively clean atmosphere. In addition, insufficiently clean drinking-water and changes in the quality of nutrition and diet lead to an increase in the number of diseases of the genito-urinary and digestive systems.

Data on mortality due to the main causes are shown in Fig. 5.2.1, with the level of morbidity risk for the adult population of Donetsk Oblast shown in table 5.2.1. Over the past decade the risk of hypertension, ischemia and chronic bronchitis has increased, along with the number of neoplasms and diseases of the circulatory system. A slight reduction in morbidity and mortality due to infectious diseases has been observed. But since 1990 the risk of tuberculosis has increased by a factor of 2.8. Morbidity and mortality rates in the population of Donetsk Oblast are significantly (7-10%) higher than national indices.

Fig. 5.2.1. Dynamics of mortality due to main causes, cases per 1,000 people



Source: Information and analysis centre for medical statistics, 2009

Analysis of morbidity in adult population shows that the risk of respiratory diseases is decreasing, but in cities the risk of chronic bronchitis is still high, with a 25% increase in bronchial asthma over the last 15 years.

Changes in the structure of morbidity highlight the trends in environmental pollution. In the structure of primary morbidity the major portion is accounted for diseases of the respiratory, circulatory, genito-urinary and digestive systems. Since 1995 the percentage of diseases of the respiratory system has decreased by one third, but the percentage of circulatory system diseases has increased by a factor of 1.5. The number of diseases of the genito-urinary and digestive systems and the diseases of blood and blood-forming organs has increased too. Although the level of air pollution has decreased over the last 15-20 years, the quality of water from surface sources, including the drinking water supply, has deteriorated.

One of the main indicators of the re-

Table 5.2.1. Risk of morbidity in adult population of Donetsk Oblast*

Degree of risk	Risk of morbidity by year				Source and cause of risk
	1995	2000	2007	2008	
III	$1.23 \cdot 10^{-3}$	$2.51 \cdot 10^{-3}$	$2.62 \cdot 10^{-3}$	$2.77 \cdot 10^{-3}$	Diseases of the blood and blood-forming organs and certain immune-system disorders
	$4.54 \cdot 10^{-3}$	$4.41 \cdot 10^{-3}$	$4.32 \cdot 10^{-3}$	$4.44 \cdot 10^{-3}$	Mental and behavioural disorders
	$4.60 \cdot 10^{-3}$	$7.70 \cdot 10^{-3}$	$9.12 \cdot 10^{-3}$	$9.04 \cdot 10^{-3}$	Endocrine, nutritional, and metabolic diseases
	$7.06 \cdot 10^{-3}$	$8.26 \cdot 10^{-3}$	$8.77 \cdot 10^{-3}$	$8.53 \cdot 10^{-3}$	Neoplasms
II	$2.12 \cdot 10^{-2}$	$2.46 \cdot 10^{-2}$	$2.52 \cdot 10^{-2}$	$2.49 \cdot 10^{-2}$	Diseases of the digestive organs
	$3.09 \cdot 10^{-2}$	$4.65 \cdot 10^{-2}$	$5.67 \cdot 10^{-2}$	$5.69 \cdot 10^{-2}$	Diseases of the circulatory system
	$3.12 \cdot 10^{-2}$	$4.06 \cdot 10^{-2}$	$4.04 \cdot 10^{-2}$	$3.97 \cdot 10^{-2}$	Genito-urinary diseases
	$3.16 \cdot 10^{-2}$	$3.58 \cdot 10^{-2}$	$3.16 \cdot 10^{-2}$	$3.15 \cdot 10^{-2}$	Diseases of the musculo-skeletal system and connective tissue
	$3.46 \cdot 10^{-2}$	$3.50 \cdot 10^{-2}$	$3.15 \cdot 10^{-2}$	$3.17 \cdot 10^{-2}$	Certain infectious and parasitic diseases
	$4.35 \cdot 10^{-2}$	$3.77 \cdot 10^{-2}$	$3.46 \cdot 10^{-2}$	$3.52 \cdot 10^{-2}$	Skin diseases
	$6.35 \cdot 10^{-2}$	$7.98 \cdot 10^{-2}$	$1.00 \cdot 10^{-2}$	$1.00 \cdot 10^{-2}$	Diseases of the nervous system
I	$3.13 \cdot 10^{-1}$	$3.13 \cdot 10^{-1}$	$2.48 \cdot 10^{-1}$	$2.41 \cdot 10^{-1}$	Diseases of the respiratory system
	$6.68 \cdot 10^{-1}$	$7.12 \cdot 10^{-1}$	$6.33 \cdot 10^{-1}$	$6.23 \cdot 10^{-1}$	All diseases

gion's social and environmental situation is children's state of health. Compared with 1990, children fall sick more frequently: the number of children suffering from diseases of the blood and blood-forming organs has increased almost fourfold, the number of diseases of genitourinary and circulatory systems more than threefold, the number of neoplasms and congenital abnormalities has increased by a factor of 2.6 and 2.3 respectively. The level of infant mortality from the main causes is shown in table 5.2.2.

Analysis of the structure and risk of dis-

Table 5.2.2. Infant mortality rate in Donetsk Oblast*

Degree of risk	Risk of morbidity by year				Source and cause of risk
	2005	2006	2007	2008	
V	$1.10 \cdot 10^{-4}$	$8.00 \cdot 10^{-5}$	$7.00 \cdot 10^{-5}$	$2.00 \cdot 10^{-5}$	Diseases of the digestive organs
IV	$2.50 \cdot 10^{-4}$	$3.60 \cdot 10^{-4}$	$4.80 \cdot 10^{-4}$	$3.30 \cdot 10^{-4}$	Diseases of the nervous system
	$8.40 \cdot 10^{-4}$	$7.70 \cdot 10^{-4}$	$6.80 \cdot 10^{-4}$	$6.30 \cdot 10^{-4}$	Certain infectious and parasitic diseases
	$5.00 \cdot 10^{-4}$	$5.60 \cdot 10^{-4}$	$6.50 \cdot 10^{-4}$	$1.80 \cdot 10^{-4}$	Diseases of the respiratory system
	$1.06 \cdot 10^{-3}$	$8.00 \cdot 10^{-4}$	$4.70 \cdot 10^{-4}$	$7.50 \cdot 10^{-4}$	External causes of death
III	$2.54 \cdot 10^{-3}$	$2.09 \cdot 10^{-3}$	$2.26 \cdot 10^{-3}$	$1.83 \cdot 10^{-3}$	Congenital malformations, deformations, and chromosomal abnormalities
	$5.27 \cdot 10^{-3}$	$5.67 \cdot 10^{-3}$	$7.95 \cdot 10^{-3}$	$7.58 \cdot 10^{-3}$	Certain conditions originating in the perinatal period
II	$1.15 \cdot 10^{-2}$	$1.10 \cdot 10^{-2}$	$1.38 \cdot 10^{-2}$	$1.22 \cdot 10^{-2}$	All causes of death

* Risk is defined as the ratio between the number of cases and the population as a whole

Source: Information and analysis centre for medical statistics, 2009

ease in children in Donetsk Oblast indicates a high level of respiratory-system diseases. The rate of incidence of diseases of the respiratory system, bronchial asthma and chronic bronchitis has remained almost constant in recent years. The number of neoplasms and the incidence of diseases of the digestive system among children has increased.

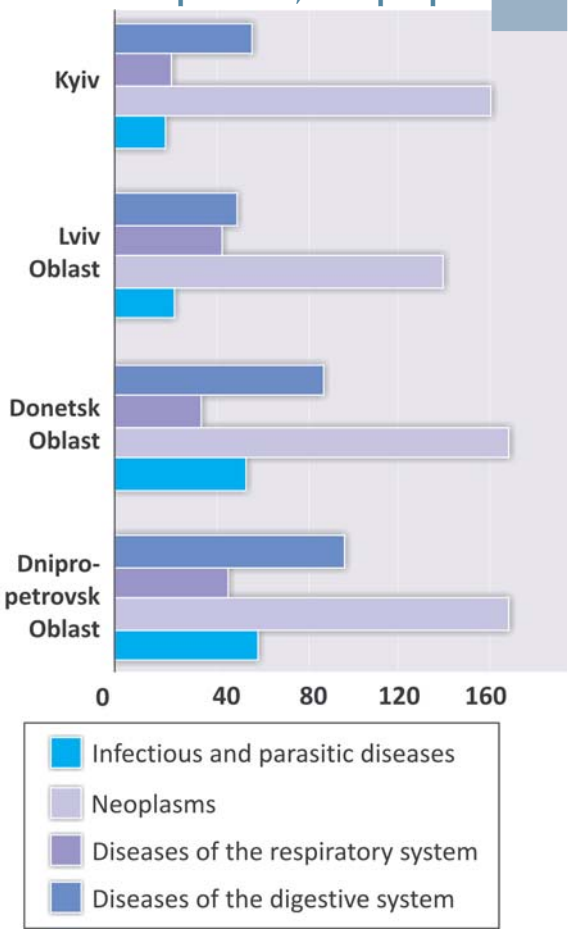
In the course of analysis of morbidity in adults and children stands out increase in the incidence of diseases which first of all testify increase in pathologies in the population. It is a consequence of the high level of technogenic stress and environmental pollution, which in turn results in a breakdown of the body's detoxification system. High levels of primary morbidity are observed in the cities of Donetsk, Yenakiieve, Kramatorsk, Mariupol, Khartsyzk, Shakhtarsk, and also in Starobesheve district.

The structure of primary morbidity in the region's population almost coincides with the average for Ukraine, but with a higher percentage of traumas and intoxication, diseases of the respiratory and musculoskeletal systems and of connective tissue. Fig. 5.2.2 compares death rates due to the main causes in Ukraine.

Compared with 1995, the percentage of almost all main types of diseases has increased except for infectious and parasitic diseases, diseases of the respiratory system, traumas and intoxication.

Furthermore the incidence of diseases of the endocrine, circulatory, digestive and genito-urinary systems and diseases of blood and blood-forming organs has increased. Analysis shows that the incidence of diseases in the region, directly or indirectly related to environmental pollution, has been high for a long time, and there is no sign of any decrease among sensitive population groups.

Fig. 5.2.2. Comparison of death rates due to the main causes, per 100,000 people



Source: State Statistics Committee of Ukraine, 2009

5.3. Comparative assessment of environmental indicators

It is generally accepted that environmental indicators are an important instrument in environmental assessment and analysis of the trends governing the development of environmental processes, as well as the level of exposure and the consequences of environmental pollution. Analysis of the dynamics of change in environmental indicators helps to characterize the effectiveness of implementing environmental measures and management decision-making, and accordingly to choose priority areas for environmental policy.

A comparative assessment of environmental indicators of Donetsk Oblast has been carried out by correlating key indicators recommended by the UNECE Working Group on Environmental Monitoring and Assessment with similar indicators from other regions of Ukraine. Some assessments and correlations of different indicators of Donetsk Oblast are presented in Appendix II.

The analysis carried out shows that Donetsk Oblast ranks highly among the regions of Ukraine with regard to a series of social and economic indicators and indicators of human economic activities. But the region performs poorly on public health, quality of air, biodiversity, etc., all of which characterize environmental impacts.

Today it is generally accepted that economic and social development as well as environmental protection are interrelated and complementary components of sustained development of any region. Starting in the 1990s the UN has published its Human Development Report every year containing data on the level of prosperity of different countries. Its assessment of the human development index serves as a basis for comparative analysis. The procedure for its calculation is proposed by the UNDP (United Nations Development Programme) and it takes into account the life expectancy index, achieved level of education and Gross Domestic Product per capita. An assessment of some regions of Ukraine by the human development index on the basis of available literature data is represented in table 5.3.1.

From the represented data it is clear that Donetsk Oblast has one of the lowest ranks among regions of Ukraine for its life expectancy index, which is why the region's resources must be primarily directed towards improving social and economic indicators showing adverse trends.

The Gross Regional Product per capi-

Table 5.3.1. Ranking of regions of Ukraine by human development index

Regions of Ukraine (oblasts)	Rank by life expectancy index	Rank by level of education	Rank by Gross Regional Product index	Overall rank by human development index
Kyiv	1	1	1	1
Polatava Oblast	14	7	4	4
Kharkiv Oblast	15	2	6	3
Dnipropetrovsk Oblast	22	9	3	7
Lviv Oblast	4	5	13	2
Odesa Oblast	21	4	8	8
Zaporizhia Oblast	20	20	5	11
Ivano-Frankivsk Oblast	5	10	20	13
Vinnytsia Oblast	9	12	16	14
Sumy Oblast	18	15	9	10
Donetsk Oblast	**23**	**18**	**2**	**9**
Kyiv Oblast	17	25	7	6
Sevastopol	7	8	26	15
Mykolaiv Oblast	25	21	11	18
AR of Crimea	12	22	21	21
Kherson Oblast	27	13	18	22
Kirovohrad Oblast	24	14	22	23
Luhansk Oblast	26	24	12	20

Source: State Environmental Protection Administration in Donetsk Oblast, 2009

ta in Donetsk Oblast is forecast to increases by a factor of 2.5 to 3 by 2020. Greenhouse gas emissions will increase proportionately by a factor of 1.5 to 1.7, with a significant rise in the number of vehicles and energy consumption. The quality of air can partially deteriorate in industrial cities. In turn the population of the region will decline slightly; household expenditure will increase significantly, the level of unemployment will decrease; indicators of the public health as well as biodiversity characteristics will improve a little. All of this will allow Donetsk Oblast after having overcome the crisis to improve the human development index and to gain a better standing in the records of human development.

SECTION 6

ENVIRONMENTAL POLICY AND PROJECTS

Environmental policy is defined as organizational and control activities carried out by the state and society to protect and rehabilitate the natural environment, effectively combine environmental management and conservation activities, and secure normal life support and the environmental safety of citizens.

Within a particular region effective environmental policy presupposes a comprehensive environmental feasibility study of each economic project, continuous environmental monitoring, independent and qualified expert environmental services, and the protection of particular natural objects. It is also important to control rational use of natural resources, implement the necessary environmental projects and develop environmental education and training.

The main objectives of Donetsk Oblast in the sphere of ecology and environmental protection are to create environmentally acceptable living conditions for citizens, stimulate economic development without damage to the environment, conserve the landscape and biological diversity, and achieve widespread compliance with global and particularly European environmental requirements.

6.1. Environmental policy

Environmental policy in Donetsk Oblast is implemented by the State Environmental Protection Administration, which began its activity as a state environmental agency in 1988. The State Administration currently includes 12 departments for natural resources management and core activities in which 111 environmental professionals are employed. The Administration has a corresponding material and technical basis and is located in a modern building called Dom Prirody.

To promote rational use of natural resources and reduce environmental pollution the State Administration annually issues several thousand permits for the emission of harmful substances into the atmosphere, special water use and waste disposal, and land allocation approvals.

Analysis of rates of emission of harmful substances into the atmosphere shows that the number of permits for the emission of harmful substances has stabilized as a result of principled policy implemented by the Administration in the course of their issue. Furthermore, emissions from stationary sources are steadily decreasing and the total level of emissions has remained constant due to an increase in emissions of harmful substances from mobile sources.

Research shows that 75% of enterprises hold all the permits and approvals required by primary water users in the region. But progress in obtaining permits for special water use in agricultural districts is unsatisfactory. Claims for unauthorized water use and instructions immediately to obtain permits for special water use have been issued to these enterprises.

The region's environmental situation is complicated by the large accumulation of waste, especially toxic waste. The Executive Board of the Administration has therefore paid more attention to the waste management problem in recent years. At the initiative of the State Administration the Regional Strategic Plan for Solid Domestic Waste Management was worked out. In the near future solid domestic waste landfills are due to be built in the cities of Druzhkivka, Sloviansk, Kramatorsk, Donetsk, Makiivka, Yasynuvata, Avdiivka, Novoazovsk, Mariupol and Yalta.

The area of the nature reserve fund in Donetsk Oblast has been significantly increased thanks to the efforts of State Administration specialists. Compared to 1995 the area of nature reserves has increased by a factor of 4.5, reaching 3% of the territory of the region. The Ukrainian Steppe Nature Reserve, Sviati Hory national nature park, Donetsk Botanical Garden, and the Meotida, Kleban Byk, Donetskyi Kriazh, Zuievskyi and Kramatorskyi regional landscape parks have been set up and are now operating in Donetsk Oblast.

Special attention is being given to rebuilding old industrial facilities and building new ones. The State Administration carries out the state environmental expertise of projects to build or rebuild facilities, checking compliance with the requirements of existing legislation.

State Administration specialists carry out educational activities in higher educational establishments of Donetsk, and students of higher educational establishments do practical training and internships in subdivisions of the State Administration. In association with the Donetsk branch of the State Ecological Academy of Post-Graduate Education and Management a system of technical training has been organized and is now operational, holding educational seminars and courses for employees of the State Administration and representatives of industrial enterprises.

A system of projects, which extends environmental education at all levels, with active provision of information to the public using all available means of information

distribution, is being developed by the State Administration.

The only popular ecological newspaper in Donetsk Oblast, Nash Krai, regularly informs the region's inhabitants about environmental problems in Donbas. It is published with the assistance of the regional environmental fund and the State Administration.

On the basis of the provisions of the Aarhus Convention ratified by Ukraine in 2003, monthly meetings of the community council have been held at Dom Prirody since 2006, addressing questions of cooperation by the community and the State Administration to solve the region's environmental problems. The Aarhus Centre has been set up and is operational.

6.2. Environmental monitoring

Today in Ukraine, much as elsewhere, considerable attention is focussing on the development of automated monitoring systems. The relevance of this trend is clear: such systems not only to collect, store and present primary data on the state of the

Fig. 6.2.1. Organization chart of the automated environmental monitoring system in Donetsk Oblast

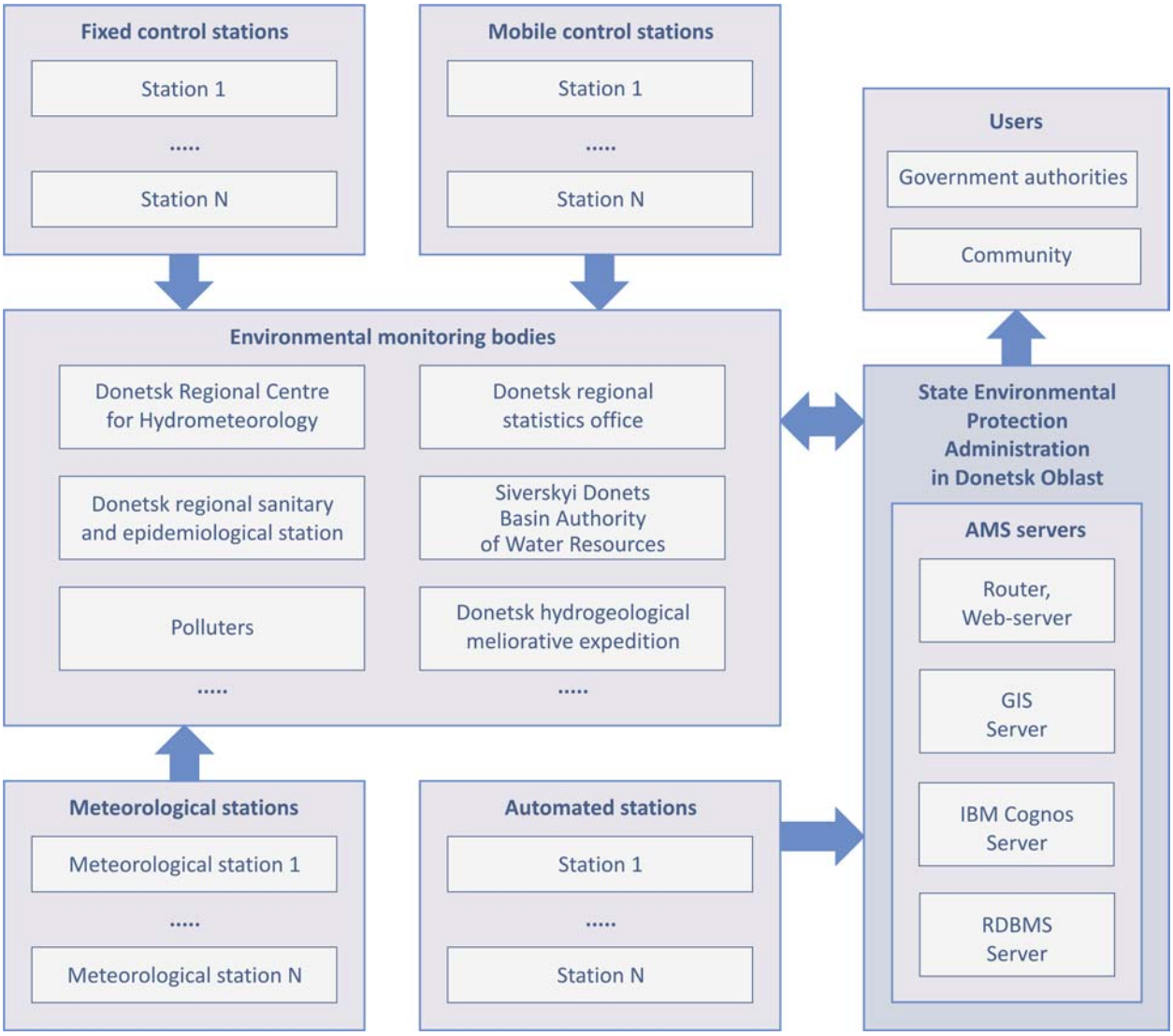
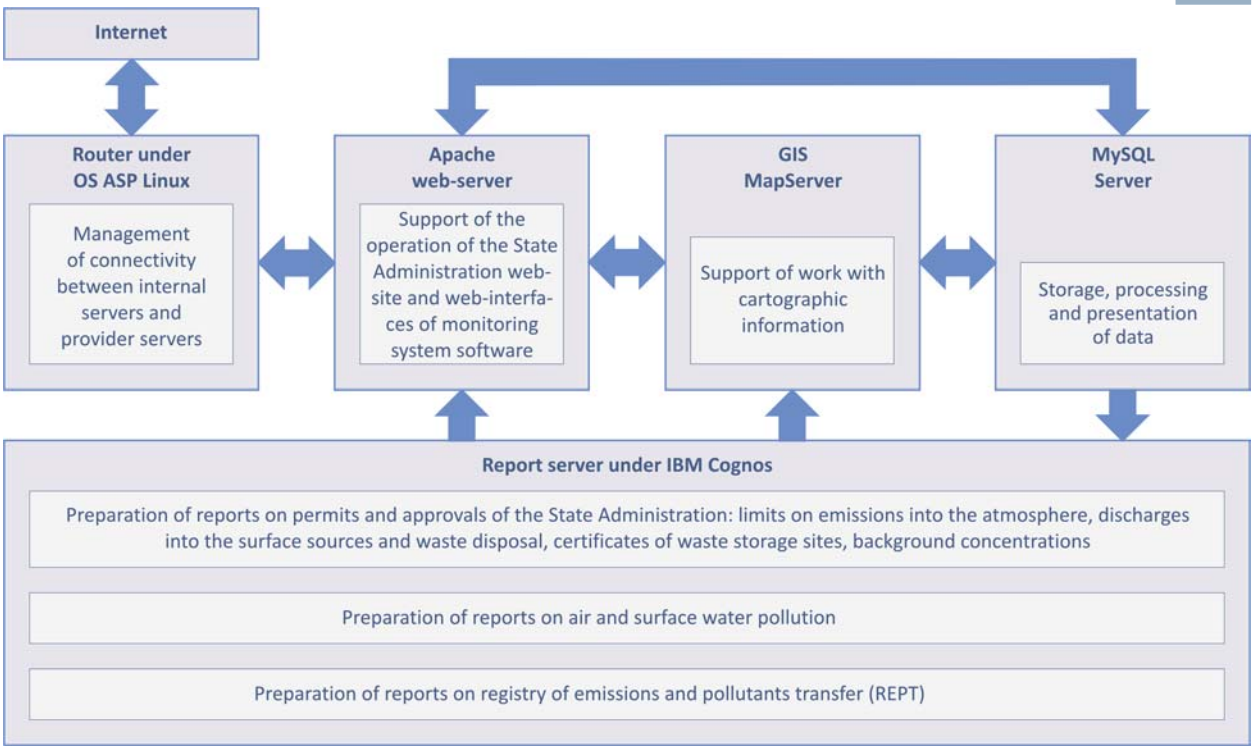


Fig. 6.2.2. Structure of the soft and hard-ware of the automated monitoring system



natural environment, but also identify trends, provide forecasts and recommend management decisions.

Work to set up an automated monitoring system in Donetsk Oblast started in 2006. The hard and soft-ware system solves the problems of regional monitoring. The system's overall design and main data streams are shown in Fig. 6.2.1. As may be seen from the figure, data from monitoring bodies and automated control stations are transferred to the central servers, located in the State Administration. With the help of application software (Fig. 6.2.2) users of the automated monitoring system receive the necessary information directly via the internet. This reduces the number of specialized workstations, simplifies the process of software updates and reduces system costs.

The automated monitoring system in Donetsk Oblast currently processes air and surface water data, manages the flow of documents for permits and approvals issued by the State Administration, and the registry of emissions and pollutants transfer. The data management structure keeps track of logical of actual concentrations of pollutants on the basis of the volume of their emissions into natural environments, estimates the level of limits on emissions, discharges and waste disposal, introduces partly automated issue of permits and approvals, and forecasts changes in various indicators. The design of the user-interface for the internet-enabled geographic information system facilitates access to data and will in the future enable spatial assessments and forecasts to be made.

At the present time in Ukraine a national monitoring system is being created which, much as the software used by the majority of monitoring bodies in Donetsk Oblast, uses specific formats to store and present data. When designing the regional system, special attention was consequently paid to the compatibility of formats used to present data. The system developed in Donetsk Oblast can import data in specialized formats used by monitoring

Development priorities for the Donetsk Oblast monitoring system

1. Assist structural reorganization of departmental networks and regional monitoring bodies' surveillance services;
2. Build an automatic system to monitor major sources of environmental pollution, independent of users of natural resources;
3. Set up automatic environmental monitoring systems;
4. Improve the regulations, organization, methodology, technical data and programming on which the monitoring system is based;
5. Prevent and forecast hazardous situations, implement preventive, administrative and technical measures on the basis of monitoring data;
6. Involve the community in developing environmental programmes on the basis of environmental monitoring data.

bodies, verify and export data to the national monitoring system, and transfer data from automated control stations to the relational database management system for storage. The system is being built with a modular design, allowing for its upgrade and extension. In the near future it is planned to develop modules for monitoring land, forest and ground water.

Currently, data from the automated monitoring system in Donetsk Oblast are used by the State Administration to develop environmental projects as part of the Donetsk socio-economic development programme, and prepare current reports for governmental authorities, local government and community forecasting the state of natural environments and carrying out scientific research.

The Donetsk Oblast automated monitoring system is the first product of its kind to be deployed in Ukraine. However there are still many regional monitoring problems to be solved. First, the elaboration of algorithms defining pollutants of air and water bodies, the spatial calculation and assessment of pollutant transfers, and the elaboration of decision-making algorithms to support the expert system.

6.3. Environmental projects

On the basis of monitoring data the State Environmental Protection Administration annually develops and checks the status of implementation of environmental projects under the Protection of the Natural Environment section of the Programme of economic and social development of Donetsk Oblast.

The Environmental Programme is developed in line with the resource-territory principle. In this case special attention is paid to the most important projects with a significant environmental impact. In 2007 and 2008 the Programme of economic and social development of Donetsk Oblast backed 247 and 221 environmental projects respectively.

In 2008 to reduce air pollution the Programme deployed 44 measures, on which it is planned to spend 326.6 mln. hrn. Now 21 projects are underway and one project has been completed. Since the start of the financial year 286.2 mln. hrn. has been used, 87.6% of total planned expenditure.

In 2008 in Donetsk 2.1 mln. hrn. was spent on developing the project to modernize the steel industry and decommission the open-hearth furnaces of ZAO Donetskstal. The Zasyadko mine continued, at its own expense, its investment project to start an industrial complex for mining gas (methane) recovery. Construction of a cogeneration gas-fired power plant continued. As a result of the implemented projects the mine recovered 38.2 mln. m^3 of methane gas and produced 131.9 mln. kW of electric energy in 2008.

An aspiration system has been fitted to the casthouse of blast furnace №3 at OAO ENMZ in Yenakiievo. At ZAO Svinets

in Kostiantynivka a blast-furnace foundation has been built and non-standard equipment has been produced in line with the project to build a heat-treatment furnace with improved power technology characteristics. At OAO KCP Pushka in Kramatorsk work has resumed on the project to complete work on rebuilding the dedusting system for drying granulated slag. At OAO YASK in Makiivka the coke-oven gas desulphurization system has been converted to an MEA-process (Sulphiban-process), and at ZAO Makeyevkoks work is underway on construction of a desulphurization unit.

In 2008 it was planned to implement 45 projects for water resource conservation at an overall cost of 134.7 mln. hrn. of which only 26.4 mln. hrn. was spent. Twenty-seven projects are underway.

In 2008 purification plants were rebuilt at Yenakiieve, Makiivka and the village of Volodymirovka in Volnovakha district. To protect the village of Volodarske from flooding and waterlogging the river Kalets has been dredged, and dredging of the Osykova river bed in Marinka district is still underway. A facility for mechanical dewatering of sewage treatment sludge has been built in Donetsk and construction of a sewage collector has started in Druzhkivka. Work on the feasibility study and construction of purification plants at the sludge reservoir started at OAO Azovstal in Mariupol. OAO Ilyich ISW continued dredging of the bed of the river Kalchik.

In 2008 the Protection and rational use of land section implemented 19 projects with a total value of 31.2 mln. hrn. In 2008 21.7 mln. hrn. was spent and 12 projects were started.

At OAO Chasivoiarskyi vohnetryvkyi kombinat (Chasiv Yar refractory plant) the mineshaft was replanted. In Dobropillia district OOO Donkerampromsyrovyna replanted 14.15 ha of degraded land, and the state enterprise Mekeyevugol continued rock filling in the mined-out space.

To conserve and expand the nature reserve fund, it was planned to implement seven projects worth a total of 29.7 mln. hrn. Four projects are now in progress and 11.9 mln. hrn. has been spent. Funding of the Meotida, Donetskyi Kriazh, Kleban Byk, Kramatorskyi, Zuievskyi and Slovianskyi Kurort regional landscape parks has continued.

In 2008 to protect environment from hazardous waste pollution it was planned to implement 12 projects for an overall amount of 58.9 mln. hrn., four projects are underway and 31.7 mln hrn. has been spent.

In 2008 in Kramatorsk, Mariupol and Yasynuvata the Regional Strategic Plan of Solid Domestic Waste Management in Donetsk Oblast for 2004-9 was implemented, including construction of regional SDW landfills.

Taking into account analysis of financial standing of execution of regional programme projects in cities and districts of the region in 2007-8 it should be noted that almost all regional environmental projects are being implemented at a slow rate, the major part of the planned funds not having been spent by the end of 2008.

State environmental programmes controlled by the State Administration

1. National Programme for the Protection and Rehabilitation of the Azov-Black Sea Environment;
2. National Programme for the Environmental Rehabilitation of the Dnipro Basin and Improvements in Drinking Water Quality;
3. Programme of protection of rural settlements and agricultural land against adverse effect of water;
4. National Toxic Waste Management Programme;
5. National Forests of Ukraine Programme.
6. Regional strategic plan of solid domestic waste management in Donetsk Oblast;
7. Complex of additional projects for environmental protection and provision of environmental safety in Donetsk Oblast for 2005-2007.

6.4. Public participation and international cooperation

Provision of full information to the public is one of priorities of our state's environmental policy, which is why the priority areas of activity are environmental education and provision of public information on regional environmental problems and the corresponding state strategy. The State Administration has established constructive cooperation with local and regional printed publications.

The only popular ecological newspaper in Donetsk Oblast called Nash Krai is issued with the assistance of the regional environmental fund and the State Administration. Another publication, The Land of Our Concern, based on material from the national report on the state of the natural environment in Donetsk Oblast in 2006, has been published annually since 1998 by the State Administration. In 2007 it was published in partnership with the UN Environment Programme Geo-cities project. In October 2007 the publication was presented at the 6th Conference of European Environment Ministers, Environment for Europe, in Belgrade (Serbia). In line with the regulations of the Aarhus Convention ratified by Ukraine, the State Administration endeavours to contribute to encouraging a civil ecology movement involving large sections of the region's population in environmental activity.

In 2007-8 various public environmental actions and competitions were held with assistance from the State Administration, which facilitated environmental education of citizens, encouraged environmental awareness among youth and fostered ecological thinking among the population of the region. Initial actions include Save firtrees and Epiphany bathing, the Back to clear springs regional competition, the Save Primula competition, a photographic exhibition featuring winners of the Young Photographer and Naturalists Crocus contest, and the Green lungs of Donbas environmental action.

Establishing good relations with foreign colleagues and organizations working at an international level Is one of the priority tasks of the State Administration.

In 2007 the State Administration in association with western European and Ukrainian experts continued implementing a project under the Tacis Programme, Development of the sphere of solid domestic waste management in Donetsk Oblast. In October 2007 the Head of the State Administration made a presentation at the 6th Conference of European Environment Ministers in Belgrade.

In February 2008 a seminar-presenta-

Community Council sessions

The Community Council attached to the State Administration has brought together the most active public environmental organizations and is taking part in a review of important environmental problems, implementing environmental projects and raising environmental awareness among the citizens of Donetsk Oblast.

In 2007-8 monthly meetings of the Council were held at Dom Prirody to address questions of cooperation between the community and the State Administration to solve the region's environmental problems.

tion of the publication of the UN Economic Commission for Europe, The second survey of the effectiveness of environmental activity in Ukraine, and a report by the international Environment and Security Initiative (ENVSEC) for Eastern Europe was held at Dom Prirody. On 16 June 2008 the Norwegian company NORSK ENERGI held an information seminar on Identifying, developing and financing projects to reduce greenhouse gas emissions. Development of an automated pollutant emissions register and an inventory of environmental risk sources in the mining industry started in 2008 in partnership with ENVSEC. On 7 to 10 October 2008 the State Administration in association with UNEP held a seminar on strategic planning and consideration of environmental aspects when opening and closing mines. It also staged a media-tour and a master class on environmental journalism for mass media organizations in Ukraine, Moldova and Belarus interested in environment and security issues.

In 2007-8 the State Administration was visited by representatives of various international organizations and companies, including in particular representatives of the international environment organization UNEP/GRID Arendal, the Swedish Environment Protection Agency (SEPA), the European Investment Bank and experts from a consortium formed by Sogreah, GKW Consult and Ademe.

Appendix I
Safe levels of environmental pollution by chemical substances regulated in Ukraine

When estimating the pollution level of the atmospheric air, surface water and soil by harmful substances the concentration of the initial substance is compared with the maximum allowable concentration (MAC). The hazard of a harmful substance is also characterized by the class of hazard.

The class of hazard is the indicator assessing the degree of personal hazard of the substance polluting the air, water and soils. Substances are divided into the following classes:

Class 1 – extremely hazardous;
Class 2 – highly hazardous;
Class 3 - hazardous;
Class 4 – moderately hazardous.

Atmospheric air

Two types of MAC are used for the effects of inhaling harmful substances:

1. Maximum one-off maximum allowable concentration of a chemical substance in the air of settlements (MAC_{MOT}), mg/m^3. This concentration of a substance must not cause reflex phenomena in a human organism by inhalation within 20-30 minutes.

2. Maximum allowable average daily concentration of a chemical substance in the air of settlements (MAC_{AD}), mg/m^3. This concentration of a substance must not cause direct or indirect adverse effects for human health by prolonged inhalation (over several years).

The MAC_{MOT} and MAC_{AD} values for the main polluting substances controlled at stationary sites in Donetsk Oblast are shown in table 1.

Surface water sources

Standards of composition and quality of water in water bodies are established with respect to certain categories of water use. Usetilization of a water body as a source of domestic water supply relates to the first category; use of a water body for the population's cultural and household

Table 1. Characteristics of hazard from main harmful air-polluting substances

№	Harmful substance	Class of hazard	MAC_{MOT}, mg/m^3	MAC_{AD}, mg/m^3
1.	Carbon monoxide	4	5	3
2.	Nitrogen dioxide	2	0.085	0.04
3.	Nitrogen monoxide	3	0.4	0.06
4.	Sulphur dioxide	3	0.5	0.05
5.	Ammonia	4	0.2	0.04
6.	Hydrogen sulphide	2	0.008	-
7.	Formaldehyde	2	0.035	0.003
8.	Phenol	2	0.01	0.003
9.	Dust	3	0.5	0.15
10.	Benz(a)pyrene	1	-	0.000001
11.	Benzol	2	1.5	0.1

needs,of the population and for recreation and also utilization of water bodies located within urban areas refer to the second category. Sanitary requirements for surface waters protection by exploitation of objects of water use are represented in tables 2 and 3.

Soils of different land-use patterns

Hygienic standards for maximum allowable concentrations of chemical substances in soil for different patterns of land-use apply to settlements, agricultural land, sanitary protection zones of water supply sources, areas of resort zones and certain establishments.

Maximum allowable concentrations (MAC) of chemical substances in soil are shown in table 4.

Risks

Population health risk by environmental pollution is characterized by a probability of adverse health consequences in individuals or groups exposed to certain effects of a chemical substance.

Quantitative risk assessment aims to determine the probability and degree of adverse effects conditioned by the environmental exposure of the population.

According to the requirements of the World Health Organization the level of risk when estimating the effects of environmental pollution amount to:

- minimum: less than 10^{-6};
- low: from 10^{-6} to 10^{-4};
- medium: from 10^{-4} to 10^{-3};
- high: more than 10^{-3}.

Qualitative risk assessment can also

Table 2. Hygienic requirements for composition and quality of water in water bodies at points of domestic, cultural and household water use

№	Indicators of water composition and properties	Characteristics of indicators
1.	Suspended substances	Increasing by no more than 0.75 mg/dm^3
2.	pH	Within the limits of 6.5-8.5 units
3.	BOD	No more than 6.0 mg O_2/dm^3
4.	Dry particles	No more than 1,000 mg/dm^3

Table 3. Maximum allowable concentrations of chemical substances in water

№	Substance	Class of hazard	MAC, mg/l
1.	Ammonia	3	2.0
2.	Ferrum	3	0.3
3.	Calcium	4	180.0
4.	Cobalt	2	0.1
5.	Magnesium	4	40.0
6.	Manganese	3	0.1
7.	Copper	3	1.0
8.	Petroleum products	4	0.3
9.	Nitrates	3	45.0
10.	Nitrites	2	3.3
11.	Lead	2	0.03
12.	Sulphates	4	500.0
13.	Phenol	4	0.05
14.	Chlorides	4	350.0
15.	Chrome	3	0.5

Table 4. Maximum allowable concentrations of chemical substances in soil

№	Substance	MAC, mg/kg	Indicator of harmfulness
1.	Cobalt	5.0	General sanitary
2.	Manganese	1500.0	General sanitary
3.	Copper	3.0	General sanitary
4.	Nitrates	130.0	Water migration
5.	Sulphates	160.0	Water migration
6.	Lead	32.0	General sanitary
7.	Sulphur	160.0	General sanitary
8.	Hydrogen sulphide	0.4	Air migration
9.	Phosphor	200.0	General sanitary
10.	Chrome	6.0	General sanitary
11.	Zinc	23.0	Translocation

be carried out by evaluating the complex contamination factor Q:

$$Q = \sum_{i=1}^{n} C_i / MAC_{AD,\,i},$$

where n – is the amount of harmful substances in the environment; C_i – the concentration of a harmful substance; $MAC_{AD,\,i}$ – the maximum allowable concentration of i harmful substance(s).

Appendix II
Comparative assessment of indicators in Donetsk Oblast in 2008

Indicators for assessment	Ukraine	**Donetsk Oblast**	Dnipropetrovsk Oblast	Luhansk Oblast	Kharkiv Oblast	Odesa Oblast	Lviv Oblast
Social and economic indicators							
Territory, thousand sq. km	603.5	**26.5**	31.9	26.7	31.4	33.3	21.8
Density of population, persons per sq. km	76	**170**	106	87	89	72	117
Output of products, billion hrn.	1,565	**211.9**	158.4	80.0	90.8	67.1	58.9
Gross regional product, billion hrn.	720.7	**92.1**	71.1	32.3	43.9	33.1	28.0
Gross regional product, thousand hrn. per capita	15.5	**20.2**	20.9	13.6	15.6	13.8	10.9
Export of goods, billion USD	67.0	**14.4**	13.2	6.4	1.6	2.3	1.0
Import of goods, billion USD	85.5	**5.0**	8.7	1.8	2.5	4.8	2.6
Export of services, billion USD	11.7	**0.45**	0.46	0.05	0.2	1.6	0.13
Import of services, billion USD	6.5	**0.40**	0.50	0.08	0.43	0.24	0.11
Investments as of the end of 2008, billion USD	35.7	**1.5**	2.7	0.3	1.6	1.0	0.9
Unemployment rate,%	6.4	**5.7**	5.1	6.6	5.3	4.5	7.6
Natural increase, per thousand people	-5.3	**-8.3**	-6.7	-8.5	-6.4	-3.9	-2.4
Balance of migration, per thousand people	0.3	**-0.2**	-0.5	-1.5	1.6	2.8	-0.3
Indicators of the population health							
Number of births, per thousand people	11.0	**9.8**	11.0	9.5	9.8	12.0	11.3
Number of deaths, per thousand people	16.3	**18.1**	17.7	18.0	16.2	15.9	13.7
Child mortality, number of cases per 1,000 live births	10.0	**12.2**	10.8	13.9	9.4	9.9	8.8
Mortality rate from infectious and parasitic diseases, per 100,000 people	35.9	**57.2**	62.2	36.2	24.4	69.0	25.6
Mortality rate from neoplasms, per 100,000 people	159.1	**170.9**	169.8	149.3	143.6	172.3	142.4
Mortality rate from diseases of the blood system, per 100,000 people	781.4	**789.2**	847.9	827.7	852.4	807.7	708.8
Mortality rate from diseases of the respiratory system, per 100,000 people	41.4	**37.0**	48.5	56.8	25.4	34.6	46.0
Mortality rate from diseases of the digestive system, per 100,000 people	69.2	**90.0**	99.5	99.6	56.6	77.7	52.6
Mortality rate from external causes, per 100,000 people	124.0	**143.6**	138.0	133.2	113.5	141.8	90.0

Indicators for assessment	Ukraine	**Donetsk Oblast**	Dnipropet-rivsk Oblast	Luhansk Oblast	Kharkiv Oblast	Odesa Oblast	Lviv Oblast
Indicators of environmental pollution							
Emissions from stationary pollution sources, ktonnes	4,524	**1,533**	952	566	173	34	126
Emissions from road transport, ktonnes	2,420	**206**	191	87	119	136	134
Emissions per capita, kg	155.9	**391.0**	344.0	282.7	111.3	80.3	104.4
Emissions per sq. km, tonnes	11.9	**66.7**	36.5	24.8	9.9	5.8	12.2
Generation of Class I-III hazard waste, ktonnes	2301	**643**	306	28	83	8	1
Existing Class I-III hazard waste, million tonnes	21,017	**6,515**	932	921	103	1	238
Energy and industry							
Use of electric energy, billion kW/h	106.2	**19.6**	23.5	9.2	4.6	2.8	2.7
Use of heat energy, thousand Gcal	96,339	**17,157**	11,006	9,593	4,084	3,035	2,759
Use of boiler and furnace fuels, million tonnes of fuel equivalent	114.7	**32.6**	19.9	11.1	6.1	2.6	2.7
Use of black coal, ktonnes	70,351	**30,020**	11,275	8,460	3,260	122	1,266
Use of natural gas, million m3	63,459	**9,980**	6,696	4,607	4,224	2,771	2,774
Use of motor petrol, ktonnes	5,061	**368**	394	181	251	298	262
Use of diesel fuel, ktonnes	6,195	**461**	553	198	287	396	327
Use of fuel oil, ktonnes	1,206	**177**	55	728	17	45	3
Agricultural industry							
Production of grain crops, ktonnes	53,290	**2,332**	3,694	1,639	3,797	3,681	837
Production of sugar beet, ktonnes	13,437	**25**	43	5	824	25	584
Production of sunflower seeds, ktonnes	6,526	**747**	851	459	586	313	0
Production of potatoes, ktonnes	19,545	**623**	570	534	854	201	1,371
Production of vegetables, ktonnes	7,965	**413**	541	310	509	486	422
Production of fruit and berries, ktonnes	1,504	**96**	157	23	48	68	88
Production of cattle and poultry meat, ktonnes	2,723	**142**	235	60	115	73	154
Production of milk, ktonnes	11,761	**371**	381	319	489	416	731
Production of eggs, million eggs	14,956	**1,476**	904	742	951	504	548
Production of wool, tonnes	3,755	**135**	53	60	56	1398	12
Cattle stock, thousand units	5,079	**160**	149	123	199	187	300
Pig stock, thousand units	6,526	**363**	88	116	211	105	178