

SOIL

Republic of Macedonia

## 2. The general context

The Republic of Macedonia is a land locked country, situated in the central part of the Southern Balkan Peninsula. The country is among the smallest in Europe, bordering four states. Topography of the country is characterized by big and high mountain massifs. Its territory is mountainous, crossed through with river valleys. The average height is 850 meters above the sea level. The River of Vardar cuts through the entire country. Most of its total length is in Macedonia, and the rest in Greece. The country has three big tectonic lakes, 15 artificial lakes and 25 glacial lakes.

Macedonia has been continuously populated since ancient times, with mild increase of the population before the Second World War and more intensive population growth afterwards.

During the last 15 years, Macedonia has been passing through transitional period, which has resulted in economic recession, increased unemployment and declined standard of living.

Macedonia is abundant in diverse flora and fauna, dominated by high number of relict and endemic species.

Although small in size, Macedonia is characterized by high number of soil types, i.e. more than 30, thus representing a natural museum of almost all soils found in Europe.

## 2.1 Facts and figures

Population	2.022.547 inhabitants
Population density	78.8 inhabitants/km <sup>2</sup>
Area	25.713 km <sup>2</sup>
GDP per capita	
Administration	Republic, with 84 Municipalities
Borders	Serbia, Bulgaria, Greece and Albania
Climate	<p>There are eight climate, vegetation and soil areas:</p> <p>Sub-Mediterranean area, with an average annual temperature of 14.2°C; Continental-Sub-Mediterranean area, with an average annual temperature of 12.7°C, and average precipitation of 500 mm; Warm continental area, with an average annual temperature of 10.9°C and average precipitation of 700 mm; Cold continental area, with an average annual temperature of 9°C and average precipitation of 850 mm; Sub-hilly continental-mountainous area, with an average annual temperature of 8°C and average precipitation of 900 mm; Hilly continental-mountainous area, with an average annual temperature of 6.4°C and average precipitation of 1044-1103 mm; Sub-Alpine mountainous area, with an average annual temperature of 4.8°C and average precipitation of 1000 mm; Alpine mountainous area, with an average annual temperature of -0.4°C and average precipitation of 800 mm.</p>
Dominant type of land cover	Forest and semi natural areas 60%; Agricultural areas 37%; Artificial areas 1%; Water bodies 2%. Source: Corine Land Cover 2000.
Height	Highest peak Golem Korab 2764 m; 30% of the territory is at height of more than 1000 meters above the sea level.
Soil geology and resources	Only 36% of the land in Macedonia is located in valleys. Half of Macedonia's territory (50.8%) is used for agriculture, almost equally divided into arable land and pastures. Only 7% of arable land is highly fertile. Although small in size, the Republic of Macedonia is abundant in soil types, i.e. more than 30, among which there are Automorphous, Hidromorphic, Halomorphic, Subaquatic.
Hydrology	Rivers in Macedonia belong to three major watershed areas: Aegean Sea, Adriatic Sea and small portion to Black Sea. Vardar is the biggest river, with its springs in Macedonia and two thirds of its length running through the country, and only one third through Greece before its entry into the Aegean Sea. There are three natural tectonic lakes in Macedonia, which are

	transboundary and shared with neighbouring countries, 20 major artificial water accumulations, as well as a number of glacial lakes. As many as 4.414 springs with a capacity of 6.63 billion m <sup>3</sup> /year have been registered.
Sea	Land locked country.
Water resources	Water intended for drinking is mostly of good quality and most of the springs used for drinking water supply are mountainous-karstic (62%), surface water resources (22%) and ground water resources (16%). Western mountainous part of Macedonia is the richest in water.
Natural resources	<p>Natural resources in the Republic of Macedonia are characterized by diversity rather than quantity. This, together with diversity of climate and hydrological conditions, enables high potential for agricultural land and pastures. Among mineral deposits, the most prominent are lead and zinc ores, as well as nickel, copper, silica and chromium, intended mainly for export. Non-metal ores are represented in high quantities and high degree of purity, thus establishing a solid grounds for the enterprises which process and export cement, plaster products, marble, fireproof materials, ceramic products, building materials, etc.</p> <p>Coal reserves in Macedonia, which mainly in the form of lignite is the main energy source (80% of electricity used from thermal power plants using lignite, and 18% originates from hydro-power plants, i.e. utilization of the water potential of Macedonia).</p>
Natural risks	<p>Owing to its geomorphology and climate, the Republic of Macedonia is liable to floods. Due to the uneven precipitation during the year, as well as short but intensive falls in some periods and dry and hot periods, intensive erosion and local floods appear, capable of destructing the infrastructure and cause earth slide. Major floods have been recorded in central and southern parts of the country.</p> <p>The Republic of Macedonia is situated within an area of high seismic activity. In the period between 1970-1990, around 30 earthquakes of above 5 degrees by Merkali were recorded.</p>
Protected areas	Three National Parks, covering an area of 108.338 ha, Four Strict Natural Reserves with an area of 12.855 ha; Three Landscapes of Outstanding Natural Features with 2.338 ha; 14 Individual Flora and Fauna Species over 2.648 ha and 53 Monuments of Nature over 61.978 ha.
Organic production	Out of the total agricultural land spreading over 1.229.150 ha, organic production is practiced on 1.566 ha or 0.127%, while 0.027% are in conversion.

## Threats against soils

### Diffuse contamination

Potential pollution of our soils with acid rains may be of different origin, such as from thermal power plants in our country, as well as in neighbouring countries, like Greece, Bulgaria and Serbia, but also from the whole Europe. Most of our soils have neutral to base reaction and good purifying capacity by which they are able to resist the antropogene acidification for long time.

Contamination is the strongest and most frequent with lead, cadmium and zinc, in the vicinity of mines in north-eastern parts of Macedonia (Zletovo, Toranica, Sasa), as well as in the central part of the country (smeltery in Veles), and it is rarer and weaker with copper, chromium, nickel, arsenic, mercury, iron and manganese.

Soil pollution alongside highways in Macedonia is higher than in other unpolluted soils, but lower than in Skopje. This refers primarily to zinc and lead. In surface layers (0-20 cm), there is stronger accumulation of lead and zinc and descendent movement of these elements is weak.

According to data in scientific publications, the total quantity of lead in the vicinity of Veles (central part of Macedonia) in the layer of 0-20 cm is above the recommended maximum permissible concentration. Gardens around the Smeltery in Veles contain 3.1 times higher, while at 200 meters before the Smeltery - 67.2 times higher. Accumulation of total lead is very intensive, especially in the 0-20 cm layer. Contamination becomes weaker with the distance from the Smeltery. The average content of mobile lead is much lower than the one of total lead, representing 1.1-5.4% of the total lead. Mobile lead in soil also decreases with the increase of distance from the Smeltery. Zinc accumulation is weaker than the lead accumulation, but it is also found in quantities above the recommended maximum permissible concentration (1.7-5.8). Zinc accumulation is also the strongest at the surface and declines in soil depth. Cadmium quantity is above the recommended maximum permissible concentration (1.4 to 5.5 times higher in the soil around the Smeltery). Based on the above, it may be concluded that the Veles Smeltery pollutes with lead, zinc and cadmium.

## Hydro-geological risks

Soils may be polluted by contaminated surface and ground waters in case it comes into contact with them in any way. Due to the developed drainage, i.e. protection against flood of an area of close to 70.000 ha, contaminated river waters can not come into contact with soil through floods. Exceptions from this include several hot-spots, i.e. soils along rivers carrying polluted wastewater from mines in the eastern part of Macedonia. Areas of soils around the rivers Zletovo, Kamenica and Toranica are not protected against floods.

In Macedonia, 106 land reclamation systems and around 20 major accumulations have been constructed. Irrigation network of 140.000 ha has been developed, with an optimum irrigation capacity for 126.000 ha, but in reality, different land areas of 80.000 ha are irrigated. Most of the land areas irrigated from artificial accumulations are located in upper course of the rivers, above the sources of pollution, except accumulations of Tikves and Kalimanci. The most polluted (especially with heavy metals) are the waters used in mines (Zletovo, Sasa, Toranica), in flotation processes. Soils irrigated with river waters enriched with effluents, are polluted with heavy metals, especially lead and zinc.

## Reduction of organic matters

It is maintained that 95% of Macedonia's territory was under forest, and only small portion under natural grass vegetation before the commencement of antropogene destruction and degradation of natural vegetation and conversion of natural soils into agricultural land. Slightly above 1/3 of natural forests have been preserved. Half of destructed forests have been converted into pastures, and half into arable land areas, and bare areas have expanded as well (337.000 ha). A significant component of the above soil degradation is the reduction of plant residues, humus and biogenic elements and decrease in natural soil fertility.

The contents of humus and biogenic elements declines much slower in soils that used to be under grass vegetation compared to soils that used to be under forest communities. Reduction of humus by meadow and swamp vegetation tilling in Pelagonia, one of the largest ravines in Macedonia used for cultivation of different agricultural crops, is as follows: contents of humus in meadow soil prior to tilling 3.98%, after tilling - 3.43%, while in swamp soils - 6.32% and 5.29%, respectively. This indicates that around 15% of the total quantity of humus have been lost during a period of 20 years. In Pelagonia, 0.75% of the total quantity of humus is lost every year, which means that biological degradation is low, i.e. below 1%. The average content of humus in Macedonian soils, by specific soil types, is as follows: rendzinas in mountainous areas 11.3%; vertisols 4.17-4.68%, brown forest soils 4.6%, alluvial soils 2.9 - 3.9.

## Erosion

Land erosion is a process of soil degradation and its replacement in lower areas of the watershed. In our country, water erosion is dominant type of erosion, especially the one caused by rain falls and running waters. Aeolian erosion is present in higher mountainous areas, but damages resulting from it are minor compared to the ones caused by water erosion. Such is also the case with the abrasive erosion caused by lake waves in the country.

Macedonia is one of the most endangered territories on the Balkans, in terms of erosion. This is due to the following reasons:

Long lasting destructive impacts from man (destruction of natural vegetation, absence of measures for agricultural land conservation, improper cultivation leading to deterioration of physical properties of soils)

Relief in which mountains and valley alternate, involving sloppy and long inclinations

Liability to erosion in certain sediments, rocks and soils

Climate conditions, such as torrent nature of rain falls, climate aridity resulting in weaker coverage of soil by vegetation, and renewal of destructed vegetation is more difficult.

There are around 1700 torrent currents in our country, covering an area of 18.229 km<sup>2</sup> (71% of the whole territory). These torrents are divided into five categories of torrential strength, where the first category has the highest coefficient of torrential strength. These categories include the following areas: I - 8.6%; II-13.2%; III - 30.5%; IV - 29.0% and V - 18.7% of the area of torrential courses (watershed areas). The first three categories (excessive, strong and medium-strong erosion) require undertaking of protective measures. These categories make up to 52.3% of the total recorded torrential area or 37% of the territory of the Republic of Macedonia.

## Threats against soils

### Contamination from local sources

One of the methods of exploitation of coal, copper and nickel ores in Macedonia, is by open pit excavations. Major damages appear during the exploitation of coal for energy production, because it is found in our ravines below fertile soils and below deep layers of loose sediments. These open pits destroy soils and lead to creation of large quantities of thrown sterile earth (geological layers above the coal layer). Such is the case of coal mines Suvodol in the area of Bitola and Oslomej in the area of Kicevo.

The solid waste from mines with excavations of Fe, Zn, Pb, Cu, Ni, Cr and Sb (Zletovo, Sasa, Toranica, Bucim, Radusa and Lojane) contains heavy metals and it is processed by flotation. Flotation material in Zletovo, Sasa and Toranica is rich in Zn, Pb and Cd. Tailings disposal site at Bucim covers an area of 30 ha. Flotation material in the mine of Lojane, apart from chromium and antimony, contains significant quantities of highly toxic arsenic.

Metallurgical waste in the Republic of Macedonia is generated in smelting plants producing iron, steel and alloys (Steelworks - Skopje), lead and zinc (Zletovo-Veles) ferronickel (Fenimak - Kavadarci) and ferro-chromium, ferrosilicon and silicon metal (Jugohrom - Jegunovce). This waste, with its mass, covers certain area of productive land, thus reducing the land resources. This area is not known, but it could not be large, as the waste mass is relatively low, compared to mining. Major damage to soils and to the environment in general is posed by heavy metals contained in this waste and causing contamination. Huge quantity of heavy metals is a result of the applied technology with low ore utilization rates. It contaminates the environment not only by heavy metals, but with other substances as well (e.g. organic pollutants).

There is limited data on soil contamination with industrial waste in the country. This waste contains mainly persistent organic pollutants, chlorinated hydrocarbons, polycyclic aromatic hydrocarbons, phenols, cyanides, aromatic hydrocarbons, pesticides, etc. The main polluters in industry include OHIS-Skopje, Oil Refinery OKTA, Cement Factory, Tannery and Slaughter House - Skopje, celluloses and paper producing factory - Kocani, metal processing factory Zastava - Ohrid, "Tane Calevski" - Kicevo, plants for fertilizers production "Zletovo" - Veles.

Our thermal power plants generate huge quantities of waste in a form of ashes and slag, because they use lignite of low caloric value and high content of ashes. The ashes spread around with the wind contain heavy metals, but also traces of uranium and thorium. The depot with ashes in the site of REK Bitola (thermal power plant) on fertile soil covers 10 ha.

Municipal waste is of heterogeneous composition and results from human activity. It is disposed of on certain landfills, but also on illegal dumping sites in rural areas throughout the country. Apart from municipal waste, other types of waste, such as construction, industrial, hospital waste etc., is disposed on these landfills. In selecting the landfilling sites, no account was taken of relief, hydrographic, geological and soil conditions to be met in relation to the minimization of impacts on the environment. Landfills in the

country cover an area of 200 ha, and soil burial leads to decline in productive land resources, but also there are damages in terms of soil contamination.

#### Land use change

Productive land resources in Macedonia have decreased through land use change, for example areas used for water accumulation, for development of new settlements and industrial facilities and construction of different infrastructure facilities, like highways, railways, etc. Migration from rural to urban areas in Macedonia have been present in Macedonia, leading to rapid urbanization, expansion of some settlements, without control being conducted over the type of land intended for development of certain facilities. In addition, many week-end settlements and tourist facilities have been developed. There is no accurate data on newly developed areas and land use change in Macedonia.

According to data of CORINE LandCover 1990, around 1% of the area of our country is covered by continuous and discontinuous urban land, green urban areas, sport facilities, industrial and commercial facilities, roads, railways and airports, mines and landfills. Land use change has also impacts in terms of habitats fragmentation and disconnection of migration corridors of wild animal species.

Demand for new buildings and for better transportation structure continues to grow in the Republic of Macedonia.

### 2.3 Society

Around 62% of the population lives in urban areas, mostly in the five biggest cities of Macedonia, i.e. Skopje as capital, Bitola, Prilep, Kumanovo and Tetovo. There has been a trend of migration of the population to urban centres. Cities cope with the problem of adequate solid waste management, increase in local traffic and increased air pollution from industrial complexes.

The average life expectancy in 2001 in the Republic of Macedonia was 74.0 years. The natural birth rate was 4.8‰ in 2002, noting a permanent trend.

The rate of literacy in the country, in 1999, was 94%. Around 38% of working able population in the Republic of Macedonia is unemployed.

Since Macedonia's independence and up to 1996, the growth of economy was negative, and noted slight increase since then, except in 2001.

Since 1993, when privatization was initiated, up to 1999, the number of privatized companies was 1488 out of 1720. Private sector contributes more than 50% to the BDP.

The average annual expenditure per household member is 1244 Euro, with highest expenditures being for food and non-alcoholic beverages, then housing and electricity and fuels, clothes and footwear, while the lowest expenditure goes for education, only 27 Euro. The average annual consumption of products per inhabitant in Macedonia is as follows: bread 71.6 kg, fresh and processed vegetable 134,6 kg, fruit 76.5 kg, meat 41.4 kg, milk and dairy products 79.5 kg. Consumption of electricity per inhabitant amounts to 1732.5 KWh per inhabitant.

The average size of dwellings is 70.71 m<sup>2</sup>, and the average housing area per inhabitant amounts 21.09 m<sup>2</sup>.

## 2.4 Policy

Soil protection in the Republic of Macedonia is regulated by several laws, including those covering the matters of nature protection, the Law on Environment, the Law on Agricultural Land, etc.

According to Article 2 of the Law on Environment (Official Gazette of the Republic of Macedonia No. 53/05 and amendments Official Gazette of the Republic of Macedonia No. 81/05), the scope of the law includes protection and improvement of the quality and the state of environmental media, including the soil. The same Law, in its Article 9, stipulates the implementation of the polluter pays principle, and Article 13 provides for the precautionary principle, that would help to avoid local contamination of soil in future. Article 36 stipulates internal monitoring for legal and natural persons possessing sources of emissions and by their activities make impacts on one or more media and areas of the environment.

The Law on Nature Protection (Official Gazette of the Republic of Macedonia No. 67/04), Article 11, restricts the change in land use, and Article 12 prohibits nature use in a manner that leads to soil degradation and loss of its fertility.

The Law on Agricultural Land (Official Gazette of the Republic of Macedonia No. 25/98), in its Article 31, provides for the protection of agricultural land against pollution and infection, for the purposes of safe food production, human health protection, protection of flora and fauna and uninterrupted use and protection of the environment. The same Article stipulates that the Ministry of Agriculture, Forestry and Water Economy specifies matters that are harmful to agricultural land, determines their maximum permissible concentration in soil and measures to be undertaken on agricultural land of higher concentration of harmful matters in order to reduce them below the permissible levels. However, this has not been achieved yet. Article 32 of the same law specifies the measures and the activities undertaken for the purposes of protection against and prevention of erosion of agricultural land, presence of contaminating matters and potential adverse effects on human health or on the environment.

The Law on Spatial and Urban Planning of 1996 determines several types of spatial plans: General urban plan (setting the overall organization of cities, including zoning and land use aspects), Detailed urban plan (spatial arrangement of land plots up to 30 ha, containing details of land use) and Urban documentation (plan for rural settlements).

## 2.5 Environment

The environment of the Republic of Macedonia is characterized with presence of old (historical and non-operational) municipal landfills and illegal waste dumping sites and industrial hot spots that have not been reclaimed or rehabilitated. We face the necessity of remedying the current municipal landfills and construction of new landfills to comply with the legislation, as well as remedial of industrial hot spots (16 identified).

A project on solid waste management in southwestern part of Macedonia is in progress, envisaging construction of one regional landfill, three large and 7 minor municipal landfills. It also envisages procurement of vehicles for waste collection and transport, as well as recycling facilities.

There has been an initiative related to organic waste selection and composting in the households in five municipalities in Macedonia, in order to reduce its quantity on landfills. The produced compost is of good quality and used as fertilizer in soil.

There is a national programme for elimination of ozone depleting substances. More than 90% of ozone depleting substances consumption has been eliminated in the Republic of Macedonia. The programme includes projects for full elimination of chlorofluorohydrocarbons which have highest ozone depleting potential, as well as halones and substances used in cooling devices production and servicing.

Substitution of methylbromide in agriculture used in the production of tobacco nursery plants. Tobacco is one of the main agricultural crops in Macedonia, with annual production of 25000 50 30000 tons. Alternative methods with substitution of methylbromide are used, such as bio-fumigation in combination with solarization in intensive early vegetables production. Selected alternatives show excellent results both in the production of tobacco nursery plants and in early vegetables production (enriched structure of soil, higher and better quality yield). In Macedonia, methylbromide is not imported, and it is expected that the consumption of this chemical will be eliminated by the end of 2005.

On organic agricultural production?

Green house gas emissions in the period 1990-1999 noted decline in industrial processes by 35%, and in agriculture by 22, while forestry oscillated, and waste was rather stable. The only growth was recorded in energy, followed by agriculture, waste, and contribution of forestry was below 2%.

## Hot spots and sensitive areas

In the Republic of Macedonia, 16 hot-spots have been identified. Based on certain criteria, they were ranked by contamination and risk they pose to environment and human and animal health.

1. Organic chemical industry OHIS - Skopje, pollutes with heavy metals, halogen hydrocarbonates, polycyclic hydrocarbonates, pesticides, etc.
2. Iron alloys plant Jegunovce (Silmak), producing iron alloys. Soil and ground water in the vicinity of Jegunovce are polluted with chromium and chromium sols.
3. Lead and zinc smeltery Veles (MHK Zletovo), pollution by huge quantities of sulfur dioxide, lead, zinc and cadmium.
4. Chromium and antimony mine Lojane, near Kumanovo - Flotation waste containing arsenic, antimony and other hazardous substances.
5. Lead and zinc mine Toranica, north-eastern part of Macedonia - waste from flotation processes for lead concentration contains zinc, lead, cadmium and cyanide.
6. Lead and zinc mine Zletovo, north-eastern part of Macedonia - waste from flotation processes for lead concentration contains zinc, lead, cadmium and cyanide.
7. Lead and zinc mine Sasa, north-eastern part of Macedonia - waste from flotation processes for lead concentration contains zinc, lead, cadmium and cyanide.
8. Copper mine in Radovis-Bucim - Solid waste contains heavy metals, as well as waste water with high quantity of copper.
9. Thermal power plant Bitola (REK Bitola) + Lignite mine - dust with content of heavy metals and uranium compounds are released from the landfill at the thermal power plant and mine.
10. Thermal power plant Kicevo (REK Oslomej) + Lignite mine - dust with content of heavy metals and uranium compounds are released from the landfill at the thermal power plant and mine.
11. Metallurgical combine Makstil in Skopje, where during iron melting, dust with content of heavy metals and organic compounds is released.
12. Oil Refinery OKTA in the vicinity of Skopje, polluting with heavy metals and highly toxic organic compounds.
13. Metal processing factory "Tane Caleski" in Kicevo, waste water of which contains high quantities of inorganic mineral acids and oil ingredients.
14. Fertilizers producing factory in Veles (MHK Zletovo), releasing nitrogen, phosphorus, heavy metals, residual gypsum and water with high acidity.
15. Metallurgical combine Feni, in the vicinity of Kavadarci, polluting with heavy metals like nickel, cobalt, etc.

16. Tanning industry GODEL Skopje, polluting with organic compounds, and chromium.

## 1. Main impacts from soil degradation in Macedonia

Soil degradation leads to degradation of other components of the environment, such as water, air, biodiversity, etc. Contamination of these components may be direct or indirect. Direct contamination is carried out by matters related to the very nature of the soil, while indirect is the one resulting from matters put in the soil by man.

- Air contamination from the soil in Macedonia is low. Owing to the weak wind erosion, the smallest particles of dust are raised in the air. They are harmful for the health of people and live stock. Together with those particles, matters carried in by man can be released in the air. An example is the air contamination with sols in Ovce Pole area, ravine in the north-eastern part of Macedonia. Namely, during the dry period of the year sols crystallize on the surface in the sulfate segments in a form of dust, which is then spread around by the strong wind blowing in this area. Through vitalization, gases produced by microbiological processes are released into the air.
- Degradation of surface and ground water is much higher. Erosion processes in Macedonia are very intensive. As a result from water erosion, lakes and artificial accumulations are polluted by carried and suspended deposits. Together with those particles, matters taken in the soil by man in different manners (pesticides, unsolvable nutrients, extremely heavy metals) are transferred. Erosive surface waters also carry on soluble matters in the soil (sols, nutrients, nitrates, less phosphates, soluble pesticides and heavy metals). Impacts from the above include: deteriorated quality of drinking, recreation and irrigation waters, causing further impact on human health. In Macedonia, around 17 million cubic meters of eroded deposits are produced every year. Part of the deposits settle in valleys, and fertile segments of soil are carried out of the country with the waters of Vardar River, while other part of the deposit produced in river basins around artificial accumulations enters those accumulations and natural rivers. Unfortunately, there is no data available in Macedonia on the quantity of soluble matters entering river waters from pedosphere. With regard to ground waters, it should be mentioned that soluble matters resulting from different natural processes, as well as those entering the soil through man's activity, but are not fixed in the soil, are washed out in ground water resources and contaminate the latter. This may lead to unsafety of these waters for use for drinking and irrigation. This type of contamination has been explored in Macedonia to a very limited extent.
- Changes in land use due to the urbanization is an increasing process in the Republic of Macedonia and in combination with the transportation network extension, it leads to fragmentation of natural habitats. This, from its side, makes impact on biological diversity.

## 2. Investigated cases

Contamination of ground waters resulting from three major polluters has been investigated:

- Oil Refinery in the vicinity of Skopje, where excessive quantity of naphtha and oils has been found in wells, as a consequence from their inappropriate keeping in tanks that are probably permeable and founded in water permeable sands.
- OHIS- organic chemical industry in Skopje, built on permeable alluvial sediments, is major polluter of ground waters in Skopje Valley with zinc, mercury, halogen hydrocarbons, polychlorinated bipheniles, organochlorine insecticides and vinyl monomers.
- Metallurgical plant Silmak in Jegunovce, north-western part of Macedonia, producing ferro-alloys, and soils and ground waters in its surrounding are contaminated with chromium and chromium compounds. This is due to the improper handling of chromium sols containing materials and solid waste dumping on the landfill close to the river of Vardar, as it contains chromium.

## Outlook

There has been an increasingly recognized need to adopt appropriate law in the Republic of Macedonia, to regulate soil from several points of view, as environmental medium.

It is necessary to establish the maximum permissible concentrations in soils for different purposes, with regard to heavy metals, certain substances as pesticides, polycyclic aromatic hydrocarbons, halogen hydrocarbons, etc.

According to the current legislation, as well as to the forthcoming new legislation, there is an evident need for establishment of permanent monitoring of the soil, with an accent on areas with highest contamination of the soil.

The presence of industrial and commercial sites with certain degrees of soil degradation in Macedonia, as well as tailings disposal sites as part of the operations of the mines in the past, pose the necessity to undertake measures and activities for remediation and reclamation of the soil, i.e. restoration of soil and environment as a whole into their original state, a state that would not pose risks for biodiversity and for human health.

## Policy instruments (including market-based instruments) for soil protection

### a) Main legislation in force

Soil protection in the Republic of Macedonia is regulated by several laws, including those treating the environment and the nature protection, such as the Law on Environment, the Law on Agricultural Land, etc. The Law on Environment (Official Gazette of RM no. 53/05, 81/05) applies the polluter pays principle and precaution principle, in order to avoid local soil contamination in future. This Law stipulates internal monitoring to be performed by legal and natural persons that have sources of emissions and the activities of which make impact on one or more media and areas of the environment. The Law on Nature Protection (Official Gazette of RM no. 67/04) stipulates restrictions in land use change, and prohibits nature use in a manner causing land degradation and its fertility

loss. The Law on Agricultural Land (Official Gazette of RM no.25/98) provides for agricultural land protection against pollution and infection, for the purpose of safe food production, human health protection and protection of flora and fauna, as well as uninterrupted use and protection of the environment. The same Law envisages the measures and the activities to be undertaken in the context of protection against and prevention of erosion of agricultural land.

b) Specific policy targets

With reference to specific targets of the legislation, it may be stated that there are no specific targets set in the legislation, nor there are targeted priorities apart from the above mentioned ones. Legal framework and institutional set up should be developed in order to cope with historical pollution.

c) Market-based instruments for soil protection

As far as instruments for soil protection are concerned, it should be underlined that there are no specific funds, charges or other allowances to be used specifically to cover the costs related to soil and land protection. Options in this context include resources from the Central Budget, capital grants and long-term loans intended for environment protection, financing on bilateral bases and capital investments from the European Union Instrument for Structural Policies Pre Accession.

d) International cooperation in the field of soil and land degradation and soil protection

In the domain of international cooperation in the area of soil degradation and protection, we should mention the Project National Waste Management Plan and Feasibility Study, financed by the European Union and implemented through European Agency for Reconstruction. In the framework of this project, a Case Study was developed on Industrial Contaminated Hot-spots, where based on certain parameters, examinations and application of algorithm, hot-spots have been ranked by the risk they pose to environment and human health, including measures for remediation that should be undertaken with cost estimates.

The second ongoing project carried out with the donation provided by the Japan Agency for International Cooperation (JICA) is the Study on capacity building in the management of pollution related to mining in the Republic of Macedonia. This Project has planned detailed analyses of soil with regard to the presence of heavy metals as pollutants produced by mining in the eastern part of Macedonia, as well as capacity building in mining related pollution management.

Documentation available on the state of the implementation of national policies relevant to soil protection

Remediation programme is in progress in the Copper Mine "Bucim" in Radovis, financed by EU. The efforts aimed at reducing the pollution and the quantity of dust include trees planting and polymer application on an area of four ha.

The complex for iron alloys Silmak in Jegunovce carries out a remediation programme financed by the European Agency for Reconstruction.

In the vicinity of the waste depot at the site of the thermal power plant Bitola, 100.000 black locust trees have been planted in order to reduce the dust emission.

## 5. Environment management, monitoring and access to environmental information

Permanent monitoring, i.e. systematized measurement, monitoring and control of the state, quality and changes in the soil as environmental media in the Republic of Macedonia does not exist. The only monitoring of the state of the soil concerning certain heavy metals, such as lead, zinc, and cadmium was carried out in the area of Veles in the course of 2004 and 2005, as one of the most endangered and most contaminated areas in the country, due to the long operation of the Lead and Zinc Smeltery. Such monitoring was conducted by the Institute for Health Protection in Veles.

There has been no comprehensive strategy and national policy for contaminated sites management or specific legislation to regulate contaminated sites investigation and cleaning up. The strategy and the national policy for contaminated sites management to be observed in the Republic of Macedonia, in order to overcome environmental impacts on areas with identified environmental degradation and to minimize potential threats to environment, should include: polluters identification, preliminary investigation of potentially contaminated sites, comprehensive examinations to determine accurate contamination and contaminated area, to be followed by remediation plan, including specific investigations in remediation and undertaking of measures to reduce negative impacts on human health or environment.

Macedonian Environmental Information Centre within the Ministry of Environment and Physical Planning is responsible for collection of data and information related to any way of soil degradation and contamination, land use change, erosion, salination, etc. Such data is processed and annual reports are published, different indicators are developed and public is informed on the state of the soil as environmental medium. Data and information of the Macedonian Environmental Information Centre originate from certain published papers, mainly as scientific works and books of individual authors or group of authors, as well as established environmental statistics.

### Conclusions

In the domain of soils management in the Republic of Macedonia, the main priorities include the upgrading of legislation on soil as environmental medium; overcoming of pollution from local industrial and commercial sources and municipal landfills, as well as transboundary air pollution; prevention of uncontrolled land use change in urban areas. Great attention needs to be devoted to land erosion control in the Republic of Macedonia, which is one of the most endangered countries in the Balkan Region in this regard, as well as to identification of funding sources for reclamation of historical soil contaminations due to the operation of mines in eastern parts of Macedonia and industrial facilities.

## 2.2. Economy

### Agriculture

Arable agricultural land (around 48% of the total territory) in Macedonia, in terms of ownership, is 27% state and minor private farmers possess 73% of the total area. There is significant fragmentation of land in numerous small size and irrational parcels, with an average size between 0.4 and 07 ha. Pastures are mainly socially owned (73%), and many farmers have access to summer pastures in hills. The total area under forest in the Republic of Macedonia is 947.653 ha (around 38% of the total territory), most of which in state ownership (845.874 ha) and 101.779 ha in private ownership.

Within the process of denationalization, reforms in land ownership included return of state owned land nationalized after the Second World War to original owners and state owned land privatization. After the independence, agricultural production was more sustainable compared to other economic branches, with 15-20% share in GDP.

### Transport

The transport plays an important role in the economy of the Republic of Macedonia, enabling access to goods, services and people. The main transportation corridors include Corridors 10 and 8, as integral parts of the Pan-European network. Corridor 10 connects Western Europe and Hungary with Aegean Sea, while Corridor 8 connects Adriatic with the Black Sea.

Road network covers 13.124 km roads and 925 km railroads. There are two international airports (Skopje and Ohrid), eight permanent polygons for navigation services to agriculture and forestry, five recreation airports with grass covered runways. In the period between 1990 and 1998, the transport sector consumed 21% of the total energy consumed in the country. The transportation sector contributes to many environmental problems, during both construction and operation periods. Such problems include damages to flora, fauna, endangered species and sensitive habitats, erosion, sedimentation, etc.

Freight transport and passengers transport through roads and railroads has noted a declining trend since 1990s, which is still present.

### Tourism

Tourism as economic branch has been noting a continuous decline since 1980s on, in terms of number of tourists and acquired overnight stays. The most frequently visited resorts by domestic and foreign tourists are the natural lakes, followed by the City of Skopje, and mountains and spas.

### Energy generation

The main energy infrastructure includes: coal mines, crude oil refinery, gas network from Ukraine through Burgas to Skopje, as well as oil pipeline from Thessalonica to Skopje and Burgas to Albania through Macedonia, thermal and hydro-power plants, electricity transmission and distribution networks, central heating systems and fuel wood.

The period of transition as of 1991 has been accompanied by privatization process. In this context, state ownership has been maintained only in coal mines and hydro and thermal power plants, while the rest has been privatized. High proportion of energy reserves in

Macedonia, except water, will near their end by 2020, indicating that solutions need to be found, e.g. reconstruction and revitalization.

The total amount of consumed electricity in 2000 in Macedonia was 6.619.6 GWh, out of which 78% produced in thermal power plants, 18% in hydro-power plants, and 4% imported. The country is highly dependent on one state owned thermal power plant using lignite as a fuel, REK Bitola, which produces more than 65% of the total electricity. Lignite is a dominant energy resource in Macedonia, and there are no local reserves of gas or oil. It should be noted that hydro potentials in the country are used with only 20%.

### Industry

Most of industrial facilities were constructed during 1960s and 1970s. In the period of transition after 1991, the process of privatization has been carried out in this sector. Industrial production declined significantly, with a drop of 50% in the period from 1989 to 1997. At present, industrial sector operates at 50% of the total capacity. More than 80% of the equipment in the sector is obsolete. Apart from the low productivity level, industry remains the biggest polluter. The old and unproductive production technology, inadequate equipment for waste control, weak enforcement of environmental protection requirements are the main causes of industrial pollution. In 1993, chemical industry and fertilizer production, the refinery, tanning industry and paper producing industry discharged 420 million m<sup>3</sup> waste water, out of which only 6% underwent treatment, thus resulting in discharge of huge quantities of organic matters and heavy metals into water bodies. Waste water treatment in industry is mechanical, using old and inadequate equipment. This sector is still dominant one in economy, contributing 20.7% to the GDP.

Environmental aspects integration in industrial activities is partial, although improvements are notable. In the past, in the period before the transition, environment protection measures were not incorporated in the legislation regulating the industry.

The main polluters in industrial sector are: Lead and Zinc Smeltery in Veles, which has not been in operation in the last two years, steelworks in Skopje, which has been partially privatized and does not operate under full capacity, metallurgical complexes in Jegunovce and Kavadarci, which have been privatized and operate. Then, chemical industry OHIS in Skopje, which operates with slightly above half of its capacity, using old equipment and technology, fertilizers factory in Veles and oil refinery in Skopje, fully privatized.

### Other sectors (mining)

In Macedonia, there are mineral deposits necessary for production of copper, iron, lead, precious metals and zinc. Industrial minerals like bentonite, feldspar, gypsum, sand, gravel and stone, as well as cement and other building materials are excavated and intended mainly for export. Coal mines include Suvodol near Bitola, Oslomej-Kicevo, Brik and Priskupstina. Most of them are operational and state owned. The most significant mineral deposits in Macedonia are lead and zinc, and the biggest mines are Zletovo, Sasa and Toranica, all located in north-eastern part of Macedonia. Their privatization is underway. These three mines, as most of other mines in Macedonia, have been closed as a result of financial shortages, lack of product placement, old technology and plants and insufficient maintenance over the years.

