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Management of Contaminated Sites and Land in Central and Eastern Europe

Ad Hoc International Working Group on Contaminated Land

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Foreword

The enormous increase of waste volumes and the widespread use of chemicals during the past four decades have resulted in a variety of soil problems in most of the world. The contamination pattern differs, depending on the individual countries' industrial history, geographic and geological conditions and many other factors.

Yet, one common feature seems to be the impact on the environment. The magnitude of the problems is, however, far from exhaustively described.

The European Environment Agency concluded in 1998 that over 300,000 potentially contaminated sites have been identified in Western Europe alone, and the estimated total number in Europe is much larger.

This report is the first systematic survey of problems with contaminated soil in 21 Eastern and Central European countries. The report describes the contamination problems in a common form, enabling comparison of and access to information about the individual countries.

Most Eastern European countries face problems similar to those in the West, particularly in areas with a long tradition of heavy industry or with abandoned military bases.

Regulatory and financial frameworks for dealing with contaminated sites are not developed in many of the Central and Eastern European countries, but will be important tools for ensuring a sustainable development. Without regulatory and financial frameworks for management of contaminated soil and resulting uncertainty of liability, private investors will - for fear of having to pay for soil remediation – locate new industries on greenfields in stead of using the already existing industrial areas.

In Denmark we provide international environmental assistance to CEE countries as well as to developing countries. Till now soil and groundwater protection has only been included in a limited number of projects. This was a reasonable prioritisation, since, at short sight, other environmental problems have been more urgent.

I would like to thank the governmental experts in the 21 Central and Eastern Europeans countries for their contribution to the report. Without their support the report could not have been written. Also the European Environment Agency Topic Centre for Soil has contributed valuable information.

I am sure that within a few years, soil contamination projects will play a more central role. We hope that our assistance can help avoid the mistakes we made ourselves during our development of soil management systems. Therefore, I hope that the report may support the future work.

Steen Gade
Director General, Danish Environmental Protection Agency

Content

Introduction

The present report has been elaborated as part of the preparatory work for the 4th meeting of the Ad Hoc International Working Group on Contaminated Land. The meeting was held in Copenhagen in June 1999 organised in co-operation between Denmark and Switzerland. The aim of the present report is to provide a set of summary data sheets, describing management of contaminated sites and land in a number of Eastern European and former Soviet Union countries. The report includes data on the countries shown in the table below.

The Baltic States	Central- and Eastern Europe	Balkan	CIS countries
Estonia	Bulgaria	Albania	Russia
Latvia	Poland	Bosnia-Herzegovina	Armenia
Lithuania	Romania	Croatia	Azerbaijan
	Slovakia	Macedonia	Belarus
	The Czech Rep.	Slovenia	Georgia
	Hungary		Moldavia
			Ukraine

During the meeting of the Ad Hoc International Working Group on Contaminated Land held in Amsterdam, the group expressed a wish also to include countries from Central and Eastern Europe into the group activities. Aiming at this, Switzerland with support from Denmark invited some 20 CEE countries to an informal working group meeting, which was held in Warsaw on September 17-18, 1998. Among others, the aim of the Warsaw meeting was to gather information on the contaminated land situation in the respective countries.

The initial work on the present report was based partly on the information resulting from the Warsaw meeting and collected by Switzerland in a meeting report /1/. This information supplemented by data collected from various other sources formed the basis for elaboration of a set of preliminary data sheets.

Each of the preliminary data sheets was distributed to the Ad Hoc Group contact persons in the countries in question for commenting and supply of additional data. The comments and additional data collected also by dialogue with the contact persons - among others at the Ad Hoc Group meeting in Copenhagen - were then used to revise the data sheets thus forming the data of the present final report.

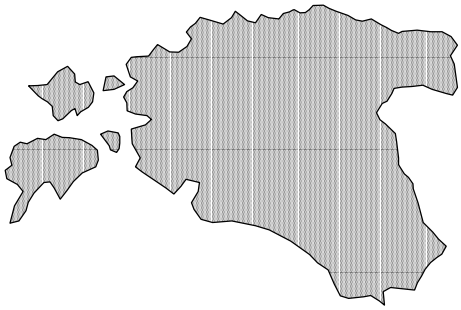
The Danish EPA has funded the work on the editing of the data sheet information, which has been performed by RAMBØLL. Also, the EEA and the ETC/S, which have provided for assistance on the data collection performed by the Austrian EPA, have supported the work.

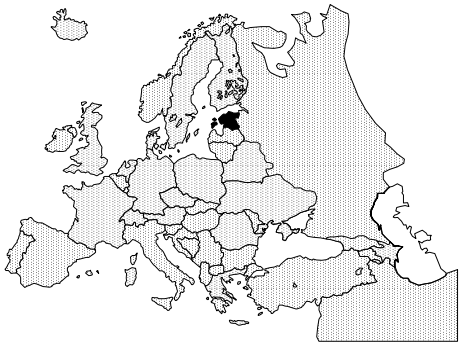
Reference

/1/ Ad Hoc International Working Group on Contaminated Land (1998). *Ad Hoc CEE Forum on Contaminated Land. Report of the Warsaw Meeting, September 18, 1998*. Report from the Swiss Agency for the Environment, Forests and Landscape.

Estonia

Country Characterisation





Background

Estonia regained its political independence in 1991. The major towns of Estonia are Tartu (109 100), Narva (80 300), Kohtla-Järve (70 800), and Pärnu (52 000). The administrative divisions are counties (15), which are divided further into local government areas (parish).

Privatisation of enterprises is mainly completed in Estonia. Only large infrastructure enterprises have not been privatised: Estonian Railways, Estonian Energy, and oil shale mines.

In general terms, the most hazardous consequence of soil contamination in Estonia is the contamination of groundwater. About 65 % of the drinking water come from groundwater abstraction. Maximum effort must be devoted to the preservation of the water quality of aquifers for the sustainable utilisation of the groundwater resources.

The most contaminated areas are located in the north-east Estonia industrial region and several contamination sources are located in the Tallinn-Paldiski area. Here, the upper aquifers are contaminated, and groundwater is not abstracted from these any more.

Since the middle of the 1990'ies, investigations of soil and groundwater contamination as well as remedial activities have been performed in Estonia. Furthermore, many remediation projects are to be carried out in the nearest future. Main problems today are the prioritising and cost-benefit assessments of the remediation projects.

Total area	Agricultural areas		Wooded areas		Nationally protected areas		Other areas	
km²	*km²*	*%*	*km²*	*%*	*km²*	*%*	*km²*	*%*
45227	19918	44,0	11344	25,1			8844	19,6

Figure on total area from UN/ECE, 1998.

Population	Population density	Annual pop. growth 1990 – 1995	Life expectancy at birth	
			Male	Female
1000	*per km²*	*%*	*years*	*years*
1458	32	-0,58	65	76

Figures from UN/ECE, 1998, and POPIN, 1999.

Legal and Administrative Basis

Definition of Contaminated Sites and Land

There is no specific definition for contaminated sites and land. Also, there is no official definition for contaminated military sites. According to a survey carried out by UBA in 1997 any site that has been used by the Soviet army.

Legislation

There are no complete legislation regulating investigations and clean-up of past-contaminated properties. Harmonising of the legislation is under way at the present time. Main attention is paid to contamination prevention measures.

The constitution of Estonia declares, that everyone must preserve the living and natural environment and compensate any damage, caused to the environment. The law must prescribe the order of compensation. In 1997 a new environmental liability legislation was in preparation.

Requirements of soil protection are included in several legislative acts. It is aimed to follow the "polluter pays principle", but the laws and lower legislative acts in force so far are not systematic regarding this:

- The Water Law prescribes measures of groundwater protection and indirectly also soil protection. E.g. wastewater can be discharged to soil only according to regulations set by the Government.
- The Administrative Law prescribes the fine for breaching land and soil protection requirements in the amount of 50 to 200 wages. Soil protection requirements are not regulated in detail within this law. Fines are small and do not correspond to the extent of soil contamination.
- The Waste Law regulates the question of liquidating environmental contamination caused by waste disposal. The polluter is obliged to liquidate the contamination. In case the polluter can not be identified, the owner of the site must arrange for the remediation and cover the expense.

The only act directly dealing with this item is the Preliminary Environmental Quality Objectives for Contaminants in Soil and Groundwater approved by regulation No. 174 in April 1995. This document sets guiding values for the evaluation of soil and groundwater contamination, and leaves the decision-making on remedial activities etc. to be made by local environmental authorities.

Furthermore, by March 1998 the Ministry of Environment has approved a norm on Application of Environmental Norms for Establishments Connected with Oil Products.

In the future, the soil protection legislation will be more precisely regulated by means of the Water Law, which is subject to changes at present. Among others, the following will be incorporated: Prescription of contamination preventive measures, specification of responsibility for already existing contamination, obligation of establishment of a contaminated sites database, and subsidy for owners of contaminated sites performing clean-up activities. Also, an Environmental Monitoring Law and an Environmental Impact Assessment and Auditing Law has bee drafted. The latter will require enterprises posing high environmental risk to perform environmental audits at least every three years.

The topic of remediation of past-contamination is considered in the Estonian Environmental Strategy and National Environmental Action Plan. Concerning past-contaminated sites the plan includes the following topics:

- Establishment of an inventory and environmental risk assessment of abandoned military sites and contamination from industry and landfills.
- Localisation of past-contaminated areas posing a direct risk to groundwater and human health.
- Remediation of land disturbed due to mining activities.
- Abolishment of the spread of contaminants from active industrial waste depositories into the ground, surface waters and groundwater and remediation of abandoned industrial waste depositories.

Implementation of Limit Values

Guiding values for the evaluation of soil and groundwater contamination stated by the Preliminary Environmental Quality Objectives for Contaminants in Soil and Groundwater (approved by regulation No. 174 in April 1995) are shown in the table below.

No.	Chemical	Objectives for soil, mg/kg			Objectives for groundwater, µg/l	
		Target values	Guidance values living zones	Guidance values industrial zones	Target values	Guidance values
I	**Heavy Metals**					
1.	Mercury (Hg)	0.5	2	10	0.4	2
2.	Cadmium (Cd)	1	5	20	1	10
3.	Lead (Pb)	50	300	600	10	200
4.	Zinc (Zn)	200	500	1500	50	5000
5.	Arsenic (As)	20	30	50	5	100
6.	Nickel (Ni)	50	150	500	10	200
7.	Chromium (Cr)	100	300	800	10	200
8.	Copper (Cu)	100	150	500	15	1000
9.	Cobalt (Co)	20	50	300	5	300
10.	Molybdenum (Mo)	10	20	200	5	70
11.	Tin (Sn)	10	50	300	3	150
12.	Barium (Ba)	500	750	2000	50	700
II	**Other Inorganic Compounds**					
13.	Fluorides (as F^--ion, total)	450	1200	2000	1500	4000
14.	Cyanides (as CN^- -ion, free)	1	10	100	5	100
15.	Cyanides (as CN^--ion, total)	5	50	500	100	200
III	**Aromatic Hydrocarbons**					
16.	Benzene	0.05	0.5	5	0.2	5
17.	Ethylbenzene	0.1	5	50	0.5	60
18.	Toluene	0.1	3	30	0.5	50
19.	Xylene	0.1	5	50	0.5	60
20.	Phenols (individual compounds)	0.1	1	10	0.5	50
21.	Chlorophenols (individual compounds)	0.05	0.5	5		
22.	Aromatic hydrocarbons (total)	0.5	10	70	1	100
23.	Oil products	100	500	5000	20	600
IV	**Polycyclic Aromatic Hydrocarbons (PAH)**					
24.	Benzo[a]pyrene	0.1	1	10	0.01	1
25.	PAH (total)	5	20	200	0.2	10
V	**Halogenated Hydrocarbons**					
26.	Aliphatic chlorinated and aromatic hydrocarbons (individual compounds)	0.1	5	50	1	70
27.	Polychlorinated biphenyls (PCB, total)	0.1	5	10	0.1	1
VI	**Amines**					
28.	Aromatic amines (aniline, xylidines) (total)	5	10	50	0.1	5
29.	Aliphatic amines (total)	50	300	700	1	20
VII	**Pesticides**					
30.	Organochlorine pesticides (individual compounds)	0.1	0.5	5	0.05	1
31.	Organochlorine pesticides (total)	0.2	1	10	0.1	2
32.	Pesticides (total)	0.5	5	20	0.3	5

The objectives in the list are either target or guidance values. The **target value** for a pollutant in the environment indicates the concentration which is considered harmless for human health and ecosystems and which is set as a goal of consistent and systematic efforts of the society. The **guidance value** indicates the concentration which, when exceeded, would cause unacceptable health or environmental risk at the specific location. In order to take decisions concerning the possibility of further use or the necessary treatment method, investigations should be carried out at the risky site and/or region. Values for the **groups of substances** (e.g. cyanides and phenols) should be considered as maximum values in the given group, unless indicated otherwise. In the case of necessity, more strict requirements for individual compounds in the group may be established, depending on their risk. If the guidance value is exceeded in an industrial zone, the establishment of new enterprises and the expansion of existing enterprises should be avoided at the specific site. In practise, the guidance values are used to make land use restrictions and not to implement clean-up measures (due to the limited resources).

Responsible Public Authorities

Management of contaminated sites and land is performed by:

- The Ministry of Environment.
- Local environmental authorities.

Concerning the 1565 military sites of the former Soviet army located in Estonia, the Estonian Ministry of Defence was responsible for these before the breakdown of the Soviet Union. After the break down of the Soviet Union the sites are currently under the following responsibilities:

Responsible party	No. sites	Current use
Ministry of Defence	40	Military purposes (Estonian army)
Ministry of Economy	3	Fuel stocks
Private companies	2	Fuel stocks
Communities	~ 1500	After an environmental audit, the sites can be privatised. Usually, buildings are sold and the land is leased

Recently, a working group with the title "Commission to assess environmental damage at former Soviet bases" has been set-up, consisting of representatives from:

- The Ministry of the Environment,
- The Central Environment Laboratory,
- The Academy of Science,
- The State Financial Control Authority.

Registration

Except for military sites, there are no inventories on contaminated sites.

Characterisation of Soil and Groundwater Contamination

Sources of Soil and Groundwater Contamination

Large chemical industry enterprises are located in the north-eastern Estonia, the main enterprises being the following: Kiviter chemical works (processing oil shale), AS Silmet (producing rare metals), AS Nitrofert (producing mineral fertilisers), and Velsicul Eesti AS (producing preserving agents). The most serious environmental problems are related to oil shale processing and rare metals production. Both enterprises were founded as large industries of the Soviet time, ignoring the environmental requirements. Industrial waste from the enterprises is dumped into waste tips, piled directly on the soil, and contaminated industrial wastewater is not treated properly. E.g. the waste tip at Kiviter chemical works near the city of Kohtla-Järve covers 250 ha elevated up to 100 m above ground. The groundwater in the area is contaminated with high concentrations of phenols, PAHs etc. along with sulphur compounds and metals.

Production and use of shale oil causes a range of environmental problems specific for Estonia. Shale oil is environmentally more hazardous than regular heating oil due to the composition of the shale oil. On average, the shale oil contains 25% water soluble phenols, alongside aromatic and polyaromatic compounds. Furthermore, the specific weight of shale oil is close to the specific weight of water having an impact on the spreading of the oil and also complicating the separation of the oil from water. Careless handling and storing of shale oil has caused serious contamination cases in the entire Estonia in the surroundings of fuel storage and asphalt production plants.

Also, Sillamäe Rare Metals Production Plant present serious environmental problems due to radioactive and industrial waste storage. It is old waste storage, which should be closed as the new storage will be designed and constructed. Contaminants are mainly discharged into the Finnish Gulf, since the waste storage is located on clay layers. Large amounts of nitrogen compounds, used in the production process, are discharged from the waste storage into the sea.

Oil shale mining is carried out by the state-owned monopoly Eesti Põlevkivi. The mines are only operating at 50% of their exploitation capacity due to reduced energy demands. The groundwater table in the oil shale mining areas is lowered. The groundwater lowering has an impact on the upper aquifers water quality. Furthermore, the present mining technologies have waste yields of about 40% of the output weight. E.g. in 1994 some 5,5 million tonnes of mining waste was produced of which 1,8 million tonnes were disposed of. Totally, about 135 million tonnes of accumulated mining residues cover an area of about 336 ha. Several mining tips have self-ignited. The waste tips also contaminate soil and groundwater with toxic organic compounds. Mines are closed without performance of all necessary environmental measures, and so far it is not decided, who will responsible for old mining areas (both underground mines and open-pit quarries) if the state monopoly is privatised.

Phosphoric mining at Maardu on the border of Tallinn was closed some years ago. The phosphoric plant is re-profiled, but the old phosphoric mines do not have any possessor today. Mined deposits contain dictyonema shale with a high content of organic compounds and heavy metals (incl. moderate content of uranium), which causes self-ignition of mining tailings. Burning and oxidation of dictyonema shale produces large amounts of sulphur compounds and heavy metals. The upper aquifer in this area is contaminated with sulphate and heavy metals.

The electric power production causes generation of ash waste. It is estimated that ash fields contain 200 million tonnes of ash. The ash is highly alkaline and has high concentrations of metals. Contaminants are washed out from the ash and contaminated surface and groundwater. The impact of the contamination in the surrounding of the power plants is somewhat decreased, as the power plants are located away form densely populated areas. The first priority environmental problem of power plants is air contamination.

The condition of liquid fuel facilities vary from ideal or minor environmental problems at recently constructed fuel terminals and service stations, to extremely bad shape and hazardous facilities dated from the Soviet time. At old facilities, the condition of storage and loading places is not corresponding to elementary environmental requirements. The most drastic case is a heavy contamination with fuel caused by mismanagement and poor condition of loading facilities and covering an area of approximately 6 ha around the Paldiski Central Boiler house. Similar problems are encountered at many civil oil storage facilities e.g. at district boiler houses, railway stations and various facilities with underground fuel storage tanks among others due to the fact that pipelines are usually in poor conditions. Furthermore, the securing of liquid fuel transportation safety poses a problem and several hazardous fuel transportation accidents have happened.

At railway stations, the main reason of extensive soil and groundwater contamination is extremely low level of fuel management, distribution and recycling. Underground fuel reservoirs are frequently used, the condition of which cannot be controlled. Big share of fuel reservoirs is amortised and environmental protection devices are outdated or missing at all. The pipelines are usually in poor condition, and waste oil commonly discharged directly on the railway. Accidents were common and keep happening up to now, caused by poor state of technical appliances of the railways and the rolling stock. The most seriously contaminated areas of the Estonian Railway are at Tallinn, Tapa, Tartu and Valga railway stations.

In the earlier years, the Soviet Army used two component liquid rocket fuel including an acidic component and an organic component. The organic component contained toxic compounds (xylidine $(CH_3)_2C_6H_3NH_2$ and triethylamine $(C_2H_5)_3N$). Contamination with rocket fuel has been more thoroughly studied at the Keila-Joa missile base where the contamination is spread at a 25 ha area. Contamination has been found at several other former rocket bases.

So far, landfills in Estonia have been located without proper preceding site investigations. Also, no complementary protective liner has been established before the beginning of waste dumping at the individual landfills. It has, however, been sought to minimise negative impacts by locating the landfills in areas with better natural protection of groundwater from surface contamination. Landfills with household waste have caused groundwater contamination, but these problems seem to be easier to handle than the oil products and industrial waste contamination problems. Formerly, waste oil has also been disposed at several landfills. At several landfills such liquid waste disposals have been made separately using old quarries or basins.

Contamination with heavy metals have been detected at dumping sites of used accumulators at former military bases, near galvanisation industries, and old paint production plants. At present, the extent of such contaminating activities is not known. Finally it is noted, that large amounts of agricultural pesticides have been left in the storage facilities at former collective farms from the Soviet times.

Concerning military sites, the sites of greatest environmental concern are:

- Harbours with sunken ships and the resulting sediment contamination.
- Airbases with heavy fuel contamination (kerosene). E.g. the river Parnu flows along one major airbase, and in the past there has been a fire incident due to free phase fuel contamination floating on the river.
- Subsoil fuel stocks.
- Shooting ranges with unexploded mines.
- Sites where hazardous substances have been stored.

Ecologically the most harmful military sites are the airfields (especially fuel leaks here). The military accepted norm for losses of jet fuel was up to 0.1%, but recently it was estimated that losses can be several per cent. Military airfields used large amounts of aircraft fuel (each over 10 000 tons annually).

The fuel losses were caused by leaking fuel tanks and by careless fuel loading. Large leaks due to pipeline damages and discharges into surface water bodies are known at Pärnu, Tartu and Ämari. In Tartu and Sillaotsa military airfields serious accidents, where thousands of tons of jet fuel leaked were released into the environment, have taken place in period 1968 - 1991.

Groundwater contamination with nitrate was a serious problem in Estonia. In the end of 1980-s the content of nitrate in dug wells and shallow drilled wells exceeded the permitted limit concentration (45 mg NO3 -/l): Southern Estonia 40-70%; Põltsamaa region 30-60%; Pandivere Upland 20-40%; Lahemaa region and Muhu Island less than 10% of wells. In the limestone outcrop area was studied the connections between the fertilisation of fields, yield of crops and nitrate content in the aquifer, closest to the surface. The quality of the groundwater is determined by the amount of nitrogen not used by the crops and the volume of infiltrating water.

The most thorough monitoring of the content of nitrogen compounds in the groundwater was carried out in Järvamaa region. Groundwater quality monitoring in Järvamaa region is a direct continuation of water protection schemes for the agricultural enterprises of the region, compiled in the end of 1980-s and beginning of 1990-s, during which water samples were collected from 70% of the wells of the county. Selection of the monitoring observation points was made by the water protection schemes. These observations are the only ones in Estonia, which make it possible to follow the dynamics of the formation of groundwater quality during the year. Groundwater contamination with nitrate will be a local problem. The problem still exists at intensive agricultural areas near Tartu and Adavere, where contents of nitrate are over 45 mg/l in dug and drilled wells.

Number of Registered Contaminated Sites / Contaminated Land Areas

Sites are assessed according to a three-phase assessment procedure with the objective to assign sites to risk classes (in total five).

Concerning military sites, the status of the site assessment is shown in the table below.

			Assessment phase		
Category	Description	Sites	I	II	III
1	Sites with no risk potential; i.e. accommodation facilities, specific stocks, light houses.	820	●		
2	Sites with a low potential of contamination; i.e. low frequented air hangers, minor shooting ranges.	290	●		
3	Sites with small or minor contaminated areas; i.e. telecommunication facilities or facilities of the boarder troops.	300	●		
4	Sites with large contaminated areas and sites contaminated with hazardous substances; i.e. sites where chemical weapons have been stored or handled, fuel stocks, rocket bases, military harbours and other.	135	●	●	
5	Sites with heavily contaminated areas, such as airbases, specific areas of rocket bases, and large fuel stocks.	20	●	●	●
	Total	**1565**			

The former Soviet Army (and later the Russian Army) exploited a total of 1565 sites and objects in Estonia, their area totalling over 81 000 hectares (approximately 1.8% of the country's territory). In Tallinn only, the Soviet Army used 872 ha at 185 locations.

By the end of 1994, an inventory completed of environmental pollution and the damage to nature at the military sites of the former USSR army in Estonia. Oil pollution is by far the greatest problem affecting surface and groundwater and soil over large areas and to considerable depth. During their occupation and use, many spills and accidents have occurred, but these were practically inaccessible for Estonian environmental inspection. After withdrawal of the military forces, it appeared that there is extensive oil and chemical pollution.

Investigation Methods

Identification of Potentially Contaminated Sites and Areas

The assessment methods used for the above-mentioned three-phase assessment procedure for classification of sites is the following:

- Phase I On-site visit, first assessment based on visual expert judgement (1565 military sites).
- Phase II Includes a detailed investigation to define further action (155 military sites).
- Phase III Includes a detailed risk assessment (groundwater and soil samples) (for military sites: 20 airbases, missile bases, and major fuel stocks).

Along the on-sites visits during phase I, inventories of hazardous substances are made. Identified hazardous substances are classified according to the Estonian Waste Directive. A land use specific list of relevant substances does not exist.

All military sites have been preliminarily assessed (phase I) based on on-site visits and expert judgement and been assigned to the five priority classes (see the table above).

Investigation of Contaminated Sites and Areas

Phase II includes the following data collection:

- Name and registration ID of the site.
- Site specific contamination or substances.
- Estimation of the amount of waste produced at the site (t).

- Size of the site (km²).
- Duration of polluting activities.
- Description of the potential risks connected to substances or wastes that have been detected at the site.
- Description of the possible environmental impacts.

The phase II assessments usually includes soil and groundwater sampling and analysis but not compulsory.

The total risk potential of a site is defined according to the following criteria:

- Potential risk to human health.
- Potential risk to ecosystems.
- In the case of groundwater resources: Potential impacts to drinking water resources.

Concerning phase III, a standard procedure or standard criteria have not been defined yet.

The material base of the Estonian consulting companies and laboratories provide for the proper execution of the majority of soil and groundwater investigation works. There are, however, problems with precise detection of some specific organic compounds, but the laboratory base is developing. At present, there are no internationally accredited laboratories in Estonia.

The actual problem of the investigation and assessment works is a lack of unified instructions e.g. accepted minimum requirements. Thus the comparison and general use of results obtained by different investigations and assessments is rather complicated.

A complicated item also, is the priority setting of the remediation activities. No standard methodology for this has been developed in Estonia. The primary basis of priority setting is individual expert evaluations on risks posed to human health and groundwater resources. However, it is noted that profound risk assessments are costly.

Facilities for Contaminated Soil

Handling and Treatment of Excavated Contaminated Soil

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Measures Used by Remediation of Soil and Groundwater Contamination

Experience has been gained by use of e.g. the following measures for remediation of soil and groundwater contamination:

- Selective abstraction (by skimming) of free phase oil contamination e.g. an airfield.
- Remedial pumping of groundwater contaminated with dissolved oil compounds and on-site water treatment by striping.
- Bioremediation of soil contaminated with oil products.

Remediation activities have been undertaken at the areas, where contaminated soil and groundwater pose danger to human health. The most extensive activities focus on the remediation of oil contamination. Localisation of jet fuel contamination has been carried out at the Tapa airfield in co-operation between Estonian and Danish experts since 1993. Remediation of groundwater contamination is based on the selective abstraction (skimming) of the free phase oil layer, and on the subsequent separation with concurrent pumping, venting and discharging of groundwater contaminated with dissolved oil products to the infiltration fields.

The liquidation of samine contamination in soil and groundwater is being carried out at Keila-Joa, based on German know-how. At the same site, the bioremediation method of cleaning contaminated soil from oil products is tested in co-operation with the Finnish Water and Environment Board. The localisation of samine contamination by pumping and treating of contaminated groundwater was started in 1995.

Large chemical industry enterprises, Kiviter Chemical Works and Silmet Rare Metals Production Plant have started contamination localisation activities. The elaboration of Silmet Rare Metals Plant waste storage closing project is financed by PHARE. Decreasing of Kiviter Chemical Works phenol emissions has been started with construction of industrial wastewater settlement basins, followed by conducting wastewater into the treatment facility.

Liquidation of waste oil disposals (oil pools) has been started, but these works will last for several years.

The new owners have remediated some gasoline stations and have started the clean-up works of some oil terminals. Clean-up works are more extensive in Tallinn, where the price of land is quite high.

Financing and Liability

Investigation and Remediation Activities

Concerning military sites of the former Soviet army, Estonia has identified all these sites at total costs of approximately 1.5 million US dollar. About two thirds have been financed by Estonia and the other third by Finland, Germany and Denmark. This first assessment is supposed to be the basis for further financial negotiations with the Russian authorities. The small returns from selling metal scrap from former Soviet military sites are used to finance very urgent measures.

Legal Requirements re. Polluters and Site Owners

The responsibilities of the Government and the private owners of past-contaminated properties are not exactly defined by the present legislation. The fact, that the privatisation of land and enterprises fall under different civil jurisdictions, may have a negative impact on both economic development and environmental protection.

Site owners but also leasing partners are usually held liable for contamination. Private organisations are usually called on taking care of clean-up measures.

Foreign purchasers usually require an environmental audit, before sealing contracts. Typically, the purchaser pays the audits. Local investors usually try to confine any possible later pretensions by ordering investigations of soil contamination. Environmental auditing of enterprises under privatisation is not a standard procedure. The Ministry of Environment has proposed to include environmental audits as obligatory in the privatisation process, but the proposal has not yet been fully supported. According to the State Privatisation Programme there is a demand to carry out relevant environmental studies including environmentally hazardous objects.

Scope of the Problem

Scale of the Problem and Handling Costs

Based on the phase I assessments of all military sites, total costs to restore major environmental damages caused at the former Soviet military bases are estimated to be about 5 billion US dollars.

Priority in Relation to Other Societal Problems

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Illustrative Cases

In 1996, groundwater monitoring has been performed at the following military areas as a follow up on monitoring performed in 1995 and previous years:

- Tapa airfield: 58 water samples were collected from 15 locations four times a year. During the recent years, the content of oil components has decreased in the monitoring wells. From 1994 to 1996 e.g. the mean concentration fell from 133 µg/l to 62 µg/l. During this period, part of the free-phase fuel

contamination was removed by remedial pumping, whereby the average thickness of the free-phase floating at the groundwater table was reduced by 12 cm. It is noted that during the period, oil components have not been detected in the wells for drinking water supply for a neighbouring city.

- Ämari airfield: 31 water samples were collected from 10 locations four times a year. Compared to the monitoring performed in 1995, the content of oil components in private wells located in a neighbouring city has decreased considerably. However, the content of oil components in the groundwater near one of the contaminant sources (a fuel pumping station) has not decreased considerably, reaching seasonally 2050 µg/l.
- Haapsalu airfield: 8 water samples were collected from 4 wells twice a year. The content of oil components in a well located in a fuel storage area was below 600 µg/l. In other monitoring wells, the content of oil components has also generally decreased.
- Rakvere helicopter airfield: 8 water samples were collected from 4 wells twice a year. The content of oil components in monitoring wells located in a fuel storage area has decreased, although the decrease was not continuous a quite large variations have been observed. Levels ranging from 11800 µg/l down to 175 µg/l have been observed.
- Keila-Joa rocket base: 23 samples were collected from 5 wells five times a year. The aim of the monitoring was to determine the concentration of rocket fuel components (xylidene(s) and triethylamine) in the groundwater. Also, content of other components was measured. Comparing the data from 1995 and 1996 show that the content of xylidene(s) and triethylamine has been decreasing. Other contaminants have also been identified. Contaminants have been found in groundwater at a distance of 200 m, from the centre of the contaminant sources.
- Paldiski marine base: At the former Soviet marine base an abandoned submarine training centre and a torpedo factory have been identified as two of a number of major sources of severe contamination. A variety of different wastes and wrecked ships have been detected in the harbour basin, and there are high levels of radioactive contamination in the sediments. The harbour area is highly polluted by different types of stockpiled materials, particularly fuels, chemicals and torpedoes. The submarine training centre, which includes two nuclear reactors, a boiler house and a wastewater treatment plant, poses the particular problem of nuclear contamination. The cost of ad hoc measures to remove only the nuclear reactors has been estimated to lie between 55 million and 90 million Euro.

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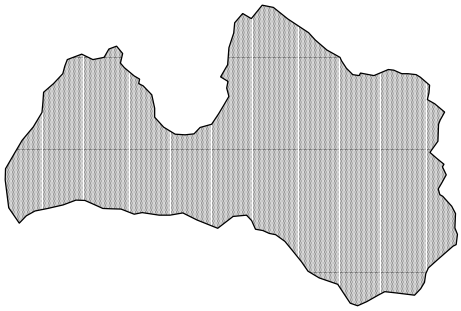
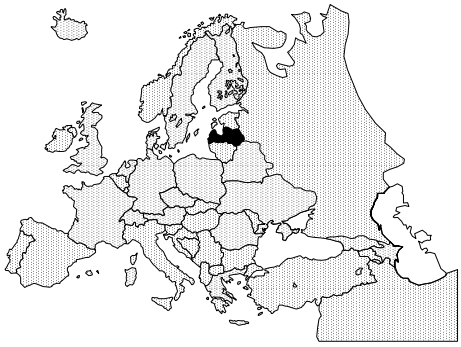
Latvia

Country Characterisation





Background

In 19991 Latvia regained its political independence. The headquarter of the Northwest forces of the former Soviet army was located in Latvia. Latvia has in total 850 abandoned Soviet military sites, which cover approximately 1000 km², corresponding to approximately 1,6 to 2% of the total country.

By August 1994 all Soviet forces had left the country. Only very few of the ex-Soviet military sites are currently used by the National Army of Latvia.

It is noted that about 70 % of the drinking water come from groundwater abstraction. Maximum effort is devoted to the preservation of the water quality of aquifers for the sustainable utilisation of the groundwater resources.

Total area	Agricultural areas		Wooded areas		Nationally protected areas		Other areas	
km²	*km²*	*%*	*km²*	*%*	*km²*	*%*	*km²*	*%*
64589								

Figure on total area from UN/ECE, 1998.

Population	Population density	Annual pop. growth 1990 – 1995	Life expectancy at birth	
			Male	Female
1000	*per km²*	*%*	*years*	*years*
2470	38	-0,87	64	76

Figures from UN/ECE, 1998, and POPIN, 1999.

Legal and Administrative Basis

Definition of Contaminated Sites and Land

There is no specific definition for contaminated sites and land.

Legislation

The "polluter pays principle" is emphasised in the environmental strategies implemented in the environmental legislation. Besides this, there is no specific legislation that refers to contaminated sites.

The Law "On municipal wastes" contains a provision that producers and holders of municipal waste shall cover costs for the management of waste. Costs for the management of municipal waste shall include costs for the closure of landfill, aftercare of the landfill, and monitoring of the environmental conditions. Landfill manager shall cover all the costs of the closure and aftercare of the landfill. The aftercare period of the closed landfill shall be at least 30 years. It should be stressed that existing legislation have not regulated the closure and aftercare of existing dumpsites.

In accordance with the Law "On municipal waste" regional environmental boards are responsible for the issuing of permits for the disposal of waste and control of the environmental conditions at the landfills and dumpsites.

Implementation of Limit Values

Concerning groundwater and abstraction of groundwater for drinking water purposes, attention is being paid to the EU Drinking Water Directive during the transposition of EU directives into national legislation. At present, however, the former Soviet drinking water standards are still applied in Latvia.

Up to 1997, threshold values had been defined neither for soil nor for groundwater. The Dutch list was most frequently used as reference. The development of target values (clean-up targets) is underway.

Responsible Public Authorities

The first site assessments made after the withdrawing of the Soviet Forces were carried out under the supervision and responsibility of 9 regional committees of the Ministry of the Environment and the Regions.

Registration

In co-operation with the Environment Ministry of Baden-Württemberg (Germany), first attempts towards establishing an inventory of potentially contaminated sites have been made.

In 1996 a pilot project was carried out in the region of Daugavpils, including the city of Daugavpils and the rural areas of Demens and Visku. Objective of the project was to identify all potentially contaminated sites within the test area by carrying out a regional survey and to familiarise the Latvian staff with this methodology. Within the pilot study, 111 sites have been identified as potentially contaminated, being about 13% waste sites, 51% industrial sites, 3% military sites, and 7% diffuse contamination.

Characterisation of Soil and Groundwater Contamination

Sources of Soil and Groundwater Contamination

Although detailed information is limited, it is broadly known that severe environmental impacts occur at former military training areas and shooting ranges. Typical contamination patterns are unexploded mines, bomb residues, hydrocarbons, heavy metals, and residues deriving from waste incineration. Other typical contamination patterns are fuel contamination at missile bases and sediment contamination at marine bases.

In some areas, the quality of the shallow groundwater or well water is contaminated due to various point sources including livestock farms, fertiliser storage sites, landfills, fuel storage sites, and leaching from

intensively cultivated land (mineral fertilisers and manure). E.g. in some areas shallow groundwater can no longer be used as source of drinking water due to high levels of contamination with oil products.

Number of Registered Contaminated Sites / Contaminated Land Areas

Preliminary assessment: Immediately after the withdrawing of the Soviet Forces, all abandoned sites (850) have been pre-assessed. The first results of this exercise estimated that 300 sites are potentially contaminated, covering an area of approximately 95,920 ha, and hence 96% of the total area used for military purposes.

The 300 military sites have been the basis for preliminary investigations. After a first assessment procedure, the number of affected bases was reduced to 53, covering approximately 58,200 ha. Detailed investigations have been carried out at a few selected sites only, most of which were supported by international joint ventures (see also financing). Up to now only very few military sites have been investigated in detail:

- A bombed area in Zvarde.
- A fuel stock in Spilve.
- A training area in Suzi.
- The missile bases in Tashi and Barta.
- The military airport in Lielvarde.
- The marine harbour of Liepaja.
- The air force base of Rumbula, Riga.
- Former Soviet military bases in general.

Investigation Methods

Identification of Potentially Contaminated Sites and Areas

Procedures for site identification and investigation are not standardised and have usually been carried out on a site-specific base. First attempts towards development of a standard procedure have been made along a joint venture project between Norway and Latvia (see also financing).

Though the preliminary survey is not based on a standard procedure, the following activities are usually included:

- On-site visits with the objective to find out whether chemicals or hazardous wastes has been handled on the site.
- If necessary investigations concerning the site history.
- Assessment of available documents and maps.
- Assessment of satellite maps.

Investigation of Contaminated Sites and Areas

In 1998, the Ministry of Environmental Protection and Regional Development accepted a methodology for investigation of groundwater contamination elaborated by the State Geological Survey of Latvia.

Previously, Drinking Water Standards or Surface Water Standards were used to evaluate groundwater quality. Major mistakes were made when natural hydrogeochemical anomalies were identified as cases of contamination. On the other hand, actually occurring groundwater contamination was not defined as such due to high Permissible Value valid for specific parameters.

Therefore, a new system for evaluation of groundwater contamination categories has been developed. This system is based on following principles / assumptions:

1. Background chemistry of shallow groundwater and upper confined aquifers is defined.
2. Sensitivity of most popular methods of chemical analyses is used in definition of the different contaminant categories.
3. Correlation between different contaminants present within major types of contaminant plumes is utilised.

In order to define the typical background chemistry, thousands of chemical analyses of groundwater samples, collected during hydrogeological mapping of Latvia and during groundwater monitoring, were evaluated.

On this basis, it is recommended to use three border concentrations / values for evaluation of the degree of groundwater contamination (see the table below.):

- Corresponding to the natural background (A-values).
- Corresponding to the maximum natural concentration or to detection level for micropollutants (B-values).
- Corresponding to the lower limit of strong contamination (C-values).

	Parameters		A	B	C
Major ions and contamination characterising parameters	TDS	mg/l	500	900*	3 000
	Na^+	-	40	70*	1 000
	K^+	-	7	12*	30
	Ca^{2+}	-	100	180*	600
	Mg^{2+}	-	40	80*	200
	Cl^-	-	50	100*	1 000
	SO_4^{2-}	-	60	140*	1 000
	$N\text{-}NH_4^+$	-	0.5	3*	20
	$N\text{-}NO_2^-$	-	0.03	0.4	1
	$N\text{-}NO_3^-$	-	1	4	20
	$N_{tot.}$	-	3	10*	50
	$P\text{-}PO_4^{3-}$	-	0.2	0.5*	2
	COD-Cr	mg O_2/l	40	100*	300
	BOD_5	-	3	10*	20
Heavy metals	Zn	µg/l	100	200	800
	Cu	-	10	50	200
	As	-	10	50	100
	Cr	-	10	50	200
	Ni	-	10	50	200
	Pb	-	2	30	100
	Cd	-	0.3	3	10
	Hg	-	0.01	0.5	2
Oil products	Total mineral oil	µg/l	-	1 000	5 000
	Benzene	-	-	Det. limit	30
	Toluene	-	-	-	200
	Xylenes	-	-	-	100
Other contaminants	SSAS	µg/l	-	20	200
	Phenols	-	2	10*	50
	Chlorinated hydrocarbons	-	-	Det. limit	70
	Pesticides total	-	-	-	5

* For areas characterised by hydrogeochemical anomalies, the maximum natural concentrations of the marked parameters should be used (see table below).

Remark: The A, B and C values are valid only for aquifers depth not exceeding 100 m.

Category	Water quality class	Actions			
		Additional investigation	Monitoring	Sanctions	Remediation and localisation
< A	Not contaminated, good natural quality	Not needed			
A - B	Slightly contaminated or poor natural quality	Reason of poor quality should be determined	Not needed	Justified [1)]	Not needed
B - C	Contaminated	Contaminant	Needed [2)]	Justified [3)]	Needed [2)]
> C	Strongly contaminated	distribution and spectrum should be investigated	Needed	Justified	Needed

[1)] Only after identification of contamination source and determination of background chemistry.
[2)] If contaminant plume is threatening water intakes and ecologically important objects.
[3)] After determination of background chemistry.

Based on the border concentrations A, B and C as defined above, classification of the degree of groundwater contamination is proposed. Actions needed for confinement of contamination, depending on contamination degree and its impact on nearest ecologically important objects are recommended. The type of action recommended in each case could be additional investigations, monitoring, sanctions or remediation.

Various anomalies of the natural groundwater quality are caused by salt water intrusion, mineral water intrusion and also dissolution of gypsum and decomposition of peat and marine silt. Information characterising typical, natural hydrogeochemical anomalies in Latvia is summarised in the table below.

Origin	Parameters		Maximum concentration (B value)
Salt water intrusion	TDS	mg/l	10 000
	Na^+	-	3 000
	Mg^{2+}	-	200
	Cl^-	-	6 000
	and other marine origin compounds proportional of dilution degree		
Mineral water intrusion in tectonic fault zones	TDS	mg/l	2 200
	Na^+	-	300
	K^+	-	23
	Ca^{2+}	-	280
	Mg^{2+}	-	130
	Cl^-	-	900
	SO_4^{2-}	-	500
Dissolution of gypsum	TDS	mg/l	3 000
	Ca^{2+}	-	700
	SO_4^{2-}	-	1 800
Decomposition of peat or marine silt	$N_{tot.}$	mg/l	15
	$N\text{-}NH_4^+$	-	10
	$P\text{-}PO_4^{3-}$	-	3
	Phenols	-	0.03
	COD–Cr	mg O_2/l	150
	BOD_5	-	20

The practical aspects regarding the recommendations for investigations of groundwater contamination are as follows:

- Collection of existing data and inspection of the object.
- Design of the monitoring network and installation of wells.
- Groundwater sampling.
- Spectrum of parameters analysed.
- Specific methods of investigation of groundwater contamination such as surface and well geophysics, tracers, techniques, etc.
- Basic requirements for reporting.
- Calculation of the volume of contaminated groundwater and contaminants mass.
- Field investigation including design of wells, drilling and completion of wells and well sampling depends on type of leachate, source of contamination, hydrogeological conditions and phase of investigation.

Type of leachate

Two major types of leachate are considered: Leachate containing mineral and other compounds characterised by density >1,0 kg/l and leachate with oil products with density <1,0 kg/l. Depending on the type of leachate different depth of filter installation and different sampling methodologies are recommended.

Source of contamination

There are different types of point sources. Small landfills with homogenous type of waste, gasoline stations and other sources with narrow range of contaminants belong to one group, while large factories with different productions and waste generation belong to another group. Different requirements will be valid for design of monitoring network for the two types of point sources.

Hydrogeological set-up
The degree of homogeneity within the geological profile, presence of low-permeable layers, type of aquifer (porous or fractured), thickness of the upper aquifer and permeability distribution within the geological profile are important factors, which have to be taken into account during the selection of investigation procedures, design of network, completion of the individual wells and selection of sampling procedures.

Phase of investigation
Four phases of investigation of groundwater pollution are identified: Preparatory, provisional, detailed and specific. It is important to differentiate between scientific investigations and investigations necessary for the design of remedial actions. Different methodologies may be appropriate during different phases of investigations. The investigations should be performed in such a way that wells and / or other hardware utilised in the investigation phase can be used in the future monitoring network.

Proposed standards
Standards for groundwater sampling procedures as well as documentation forms have been proposed. Three major cases are given as examples: Deep well with high specific yield, shallow well with medium specific yield and shallow well with small specific yield.

A part of a document prepared for the ministry is devoted to discussions of principles for selection of a reasonable spectrum of parameters for analysis depending on the source of pollution. This question is very important: The spectrum of parameters has to be sufficient for reliable determination of the contamination plume, and from the other side, the number of parameters should be limited in order to reduce the investigation costs. Among others, general parameters and specific compounds characteristic for typical sources of contamination are discussed in the document.

Facilities for Contaminated Soil

Handling and Treatment of Excavated Contaminated Soil

Up till now, no facilities exist for treatment or proper depositing of contaminated soil.

Measures Used by Remediation of Soil and Groundwater Contamination

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Financing and Liability

Investigation and Remediation Activities

Concerning military sites, identification and investigation of military sites was funded by the national budget up to 1997. For clean-up measures no resources were available from the government. Detailed investigations have been carried out at a few selected sites only, most of which were supported by international joint ventures, among them are:

- A bombed area in Zvarde. Funded by the UK know-how fund. Constancy to the local farmers on cultivation of the border zones of the former Soviet bombing test area.
- A fuel stock in Spilve. Supported by an US-Latvian Joint company. The project included the first remediation of a military site in Latvia.
- A training area in Suzi.
- The missile bases in Tashi and Barta. Co-operation of the Canadian Ministry of the Environment and the University of Riga. Major objective: Training of local staff.
- The military airport in Lielvarde. Supported by the German Environment Ministry. Major objective: Detailed risk assessment.
- The marine harbour of Liepaja, contaminated sediments. Supported by the European Union's PHARE programme. Major objective: Environmental impact study to assess environmental problems involved in the planned harbour enlargement.
- The airforce base of Rumbula, Riga. Co-operation of Danish and Latvian engineering companies, and the Latvian Environment Ministry. Objective: Remediation of soil and groundwater.

- Former Soviet military bases in general: Joint venture of Norwegian and Latvian Organisations (Ministries, Geological Surveys). Objective: Assessment of former Soviet bases.

Legal Requirements re. Polluters and Site Owners

Legal requirements regarding owners of landfill are set by the Law "On municipal waste" and Regulations of the Cabinet of Ministers "On the siting, construction and management of landfills". The Law "On municipal waste" requires owners and managers of the landfills to:

1) Receive permit for disposal of municipal and comparable waste.
2) Carry out management of the landfill in accordance with requirements set in the permit, in this Law and other legal acts.
3) Register amount (volume), origin and mode of transportation of municipal waste disposed of at the landfill.
4) Provide state and municipal institutions with required information on the management of the landfill site.
5) Organise closure of the disposal site in accordance with this law and other legal acts.
6) Cover the costs for closure of landfill if that is stated in the agreement.

The regulations of the Cabinet of Ministers "On the siting, construction and management of landfills" sets requirements for the siting, construction and management of the landfill, including preparation of feasibility study, requirements for the construction of the different elements of the landfill (leachate collection system, insulation layers, drainage system). The regulations require the manager of the landfill to prepare technical passport and operation manual for the landfill. The operation of the landfill shall be in accordance with the permit issued by the regional environmental board. Included in the permit are descriptions of the types of waste, which shall be accepted at the landfill. The managers of the landfill shall prepare a yearly report on the management of the landfill and submit it to the regional environmental board and to the municipality, where the landfill is located. The Landfill manager is responsible for the organisation of the closure procedure.

Regarding the pollution there is set a tax on the use of natural resources (including landfilling of waste). Tax is paid for the landfilled waste.

The legislation does not contain special provisions for the enforcement, but sufficient provisions are made in the Administrative Violations Code and Criminal law. The Administrative Violations Code regulates three kinds of violations:

1) Land or water pollution with industrial or municipal wastes.
2) Violation of regulations on waste transportation, disposal or liquidation of wastes.
3) Violation of operation regulations for the industrial, municipal or other waste landfills that have polluted or might pollute the environment.

Also, the Criminal Law contains several articles regarding waste management:

1) For violation of collection, sorting, disposal, transportation, utilisation, deposition or liquidation of hazardous waste regulations if the violation is repeated second time in a period of one year or if violation has caused significant damage to the environment, human health, property or business interests.
2) For violation of regulations on hazardous waste import in Latvia or for hazardous waste transit through Latvia.
3) For pollution of land and water with waste.

Scope of the Problem

Scale of the Problem and Handling Costs

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Priority in Relation to Other Societal Problems

-

Illustrative Cases

In Latvia, there are many cases of contamination of the shallow Quaternary aquifer but only few cases of major contamination of the Devonian aquifer. Until the 1990-ties, many local networks were established for monitoring of point pollution and hundreds samples were taken every year and collected in State Geological Archives. In addition to groundwater sampling, other methods were used to control the extension of the contaminant plumes, and the most popular investigation type was the geoelectrical profiling and sounding. However, some locations, as for example military facilities, were never investigated during Soviet time – which was very unsatisfactory.

The present situation is unsatisfactory as well. In spite of the fact that the local Environmental Protection Boards have the authority to order an investigation and monitoring of groundwater contamination cases, very little is done. It is caused by a combination of absence of necessary equipment, poor financing, insufficient of the local personnel and lack of experience and insufficient guidance and support from the central authorities. But most of all, the legislation within this field is only being made and no clear guidance can be provided.

Several private firms conduct investigation of groundwater contamination around facilities providing transport, storage and handling of oil products (terminals, gasoline filling stations, etc.) on request of the owners of these facilities. In such cases the requirements of Environmental Protection Boards can be meet. However, that kind of investigation can not be regarded as monitoring due to lack of unified investigation procedure, as well as procedures for data treatment, storage and publication. At the same time, no monitoring of old dumpsites established by factories, which do not exist any longer, is made.

At present, several groundwater pollution spots have been identified where the groundwater quality differs radically from the natural state. The main areas of groundwater pollution are solid waste disposal sites (*Getlini* in Riga, *Kudra* in Jurmala, *Deimena* in Daugavpils), liquid toxic waste ponds (Olaine, Incukalns, Jelgava), agrochemical warehouses (Iecava, Ventspils, Jelgava), oil storage sites (Jaunmilgravis, Tukums), and former Soviet military bases (Rumbula, Barta, Spilve, Factory No 177 in Riga).

Serious artesian groundwater pollution is found around the Incukalns disposal site for sulphuric acid tar, the Jurmala municipal waste disposal site, *Kudra*, the Riga waste disposal site, *Getlini*, and the Tukums oil storage site.

Only the three most hazardous cases of local contamination are covered by the state monitoring programme. There are two sulphuric tar waste pools in the vicinity of Incukalns, the waste pool containing chemical-pharmaceutical waste in Olaine, and the landfill of city Riga in Getlini. Local monitoring at these sites is carried out by the State Geological Survey of Latvia. These three worst cases of groundwater contamination in Latvia are characterised in the table below.

Source of contamination			Characteristic of groundwater contamination				
Location	Source of waste	Type of waste	Parameters	Maximum value in mg/l	Contami-nated aquifers	Volume of contaminated groundwater in 1000 m^3 and depth of contaminant percolation in m	Number of monitoring wells
Incukalns Riga District	Former lubricants factory in the Riga City	Sulfuric acid tar, 2 waste pools	TDS SO_4^{2-} PO_4^{3-} SSAS COD-Cr V Phenol pH	17 000 8 000 310 75 1 200 5,7 0,9 1,5	Q + D_3gj	800 & 1 000 90	30 & 30
Olaine Riga District	Chemical-pharmaceu-tical factory in the Olaine	Liquid chemical waste	TDS Cl NH_4^+ COD-Cr Pyridine Buthanol	29 000 15 000 4 000 22 000 5 000 3 000	Q	700 15	50
South of Riga	"Getlini" landfill	Domestic waste	TDS Cl^- $N_{tot.}$ NH_4^+ Cr COD-Cr	11 000 4 400 980 340 1 1 400	Q + D_3pl	3 000 30	40

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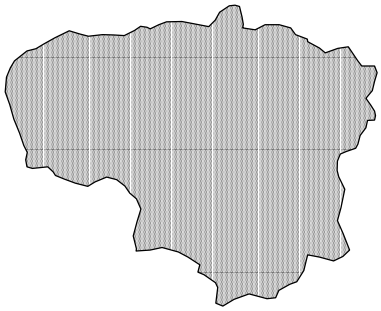
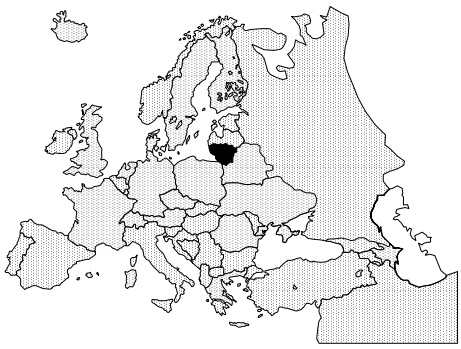
Lithuania

Country Characterisation





Background

Lithuania regained its independence in 1991. The withdrawing of the Soviet forces was completed in August 1993.

The military sites of the former Soviet army cover an area of approximately 677 km² corresponding to about 1% of the total area. In total have 275 sites been identified. Most of the military sites belong now to the municipalities. The national army uses a few, and some have been privatised and sold to private companies.

The centralised water supply system in Lithuania depends almost entirely on groundwater abstraction. In rural settlements traditional wells are still widely used. Maximum effort is devoted to the preservation of the water quality of aquifers for the sustainable utilisation of the groundwater resources.

Total area	Agricultural areas		Wooded areas		Nationally protected areas		Other areas	
km²	*km²*	*%*	*km²*	*%*	*km²*	*%*	*km²*	*%*
65300	39215	60	18879	30	7584	12	5346	8

Figure on total area from UN/ECE, 1998.

Figures on Agricultural areas, Nationally protected areas, and other areas are derived from the Statistical yearbook of Lithuania, 1998. Dept. of Statistics to the Government of the Rep. of Lithuania. ISSN 1392-026X. As of 1998.01.01.

Figure on Wooded areas is derived from the Lithuanian Forests Statistics, Dept. of Forestry and Nature Conservation, as of 1998.01.01.

Population	Population density	Annual pop. growth 1990 – 1995	Life expectancy at birth	
			Male	Female
1000	*per km²*	*%*	*years*	*years*
3705	57	-0,06	65	76

Figures from UN/ECE, 1998, and POPIN, 1999.

Legal and Administrative Basis

Definition of Contaminated Sites and Land

There is no specific definition for contaminated sites and land.

Legislation

The "polluter pays principle" is emphasised in the environmental strategies implemented in the environmental legislation.

In 1991 an environmental law was issued.

In 1994 a joint programme of the Ministry of the Environment and the Ministry of Defence was launched with the objective to improve the state of the environment at the abandoned military sites. The responsible parties for this programme are the national army and the Ministry of the Environment and its 8 regional units. Long term goals of the programme were:

- To remove 2000 spots of heavy contamination between the year 1995 and 2000.
- To prevent future contamination.
- To carry out detailed investigations and set up clean-up plans for the most contaminated sites.

A national decree requires the clean-up of the 10 most heavily polluted sites.

Implementation of Limit Values

Concerning groundwater and abstraction of groundwater for drinking water purposes, attention is being paid to the EU Drinking Water Directive during the transposition of EU directives into national legislation.

Up to 1997, Lithuania used the former Soviet standards (GOST) for contaminated soil and groundwater. However, new draft drinking water standards and standards for contaminated soil and groundwater have been elaborated and now need to be adopted by the Government. The new draft standards are harmonised with the EU standards. Also, the new values are streamlined with the Dutch values in relation to land use and sensitive environments.

Responsible Public Authorities

The Ministry of the Environment and its 8 regional units are the responsible authorities for investigations and clean-up activities at contaminated sites. Furthermore, the National Army in co-operation with the above-mentioned is responsible for investigations and clean-up activities at military sites.

Registration

In the period of May 1992 to September 1993 a pilot project with the objective to register sites with chemical waste was carried out. The Danish EPA and the Lithuanian EPA funded the project. The applied registration system of chemical waste sites is a modification of the Danish registration system. Major registration features were:

- Sites where industrial waste is most likely deposited.
- Areas of industrial plants using or producing various kind of chemicals.
- Pesticides, fertiliser, and oil products.

In total, 636 sites were registered of which 291 sites were classified as sites with chemical wastes. Of the identified 636 sites

- 82% were identified as landfills.
- 14% industrial sites.
- 4% sites with sludge from waste water plants.

The identified sites were prioritised according to the following:

- The degree of hazard of the disposed material.
- The ground water vulnerability (priority 1).
- The land use sensitivity (priority2).
- The surface water vulnerability (equal to land use / priority 2).

For the identified waste sites (82%), the land use has been identified to be a minor problem. Most of the waste sites are situated in areas of low population density, and few land use conflicts. Many groundwater aquifers have been identified as contaminated downstream of larger sites. Many sites are surrounded by surface waters i.e. drainage channels, river streams etc. In some cases, river pollution due to waste sites has been identified (i.e. Dane River, Kalotes landfill, North of Klaipeda). The number of identified industrial sites appears to be unrealistically low. However, due to the planned economy fewer but larger industrial sites can be expected compared to the Western European countries.

Characterisation of Soil and Groundwater Contamination

Sources of Soil and Groundwater Contamination

In some areas, the quality of the shallow groundwater or well water is contaminated due to various point sources including livestock farms, fertiliser storage sites, landfills, fuel storage sites, and leaching from intensively cultivated land (mineral fertilisers and manure). E.g. in some areas shallow groundwater can no longer be used as source of drinking water due to high levels of contamination with oil products.

Concerning military sites, contamination with mineral oil products and missile fuels has been identified as the most problematic sources of contamination.

Number of Registered Contaminated Sites / Contaminated Land Areas

By the beginning of 1996, 787 municipal landfills had been registered. Furthermore, there are several known, but not legally proven, industrial landfills e.g. with deposits of heavy metals containing waste, residues from fur and leather industry etc.

Also, about 900 fertilisers and pesticides storage sites are suspected. Furthermore, several military sites left after withdrawal of the former Soviet army are registered.

All military sites have been pre-assessed. In total, 2743 contaminated areas have been identified at the military sites and assigned to the categories listed in the table below.

Source of contamination	No. of contaminated areas
Mineral oil products	566
Bacteria	137
Chemicals	56
Mechanical soil damage	778
Forest damage	249
Landscape damage	438
Radioactivity	9
Missile fuels	20
Explosives	12
Wastes	478
Total	**2743**

Investigation Methods

Identification of Potentially Contaminated Sites and Areas

All military sites have been pre-assessed, including on-site visits, and limited soil surface sampling at areas with a high probability of contamination. The pre-assessment included a questionnaire with the following main topics:

- Existence of chemicals and wastes at the investigated sites and their quantities and toxicity.
- Possible contamination and possible impacts to the environment.
- Local condition of the environment; i.e. possible pathways of contamination spreading and major goods to be protected.

Investigation of Contaminated Sites and Areas

Based on the results of the pre-assessment, 20 military sites have been selected for detailed investigations. The methodologies applied did not follow any standard procedures but followed sites-specific rules. A limited number of soil and groundwater samples were taken at these sites.

Furthermore, a simplified risk assessment was carried out for these sites based on the results of the questionnaire and the detailed investigations. The results have been considered in relation to human health, ground water, surface water, soil, flora, fauna, and landscape. As a result, 10 priority sites have been identified with an urgent need for clean-up measures.

Facilities for Contaminated Soil

Handling and Treatment of Excavated Contaminated Soil

The largest facility for the cleaning of soil and water contaminated with oil products was constructed near Klaipeda in 1995. The capacity of the facility is 20000 m^3 of polluted soil per year. Soil washing and biological methods are used for the cleaning of soil and water, using special bacteria. This object is under the responsibility of the Ecological Centre “Soil Cleaning Technologies”.

The companies “Biocentras” and “Ðulinys” are working in the field of ex-situ soil bio-remediation as well.

Measures Used by Remediation of Soil and Groundwater Contamination

The Baltic Consulting Group and the hydrogeological company “Grota” perform in-situ soil and groundwater remediation using methods like free phase oil / groundwater pumping and soil flushing.

Financing and Liability

Investigation and Remediation Activities

Most of the military sites now belong to the municipalities. Only a few sites are currently used by the National Army, and a few sites have been privatised and sold to private investors.

Some funding from the European Union's PHARE programme has been made available.

To some extent, clean-up activities are funded by the national environment funds.

The private owners have funded clean-up activities at sites that have been privatised.

Legal Requirements re. Polluters and Site Owners

The site owner is responsible for the clean-up.

Scope of the Problem

Scale of the Problem and Handling Costs

Total costs for remediation of contaminated sites have previously been estimated to about 1,1 billion USD. This covers remediation of sites contaminated with oil products, bacteriological/organic waste, chemical substances, rockets fuel components, waste/garbage, and explosives.

By the pre-assessment of all former Soviet military sites a cost calculation concerning the repair of the environmental damage at these sites has been made. The estimated restoration costs amounted to approximately 733 million USD.

The cost calculations are based on a damage inventory and standard costs for specific clean-up activities.

Priority in Relation to Other Societal Problems

Remediation of contaminated land is not the first priority environmental problem if compared with wastewater treatment and waste management.

Illustrative Cases

The airbase of Siauli is one of the major cases in Lithuania. The site has multiple contamination patterns:

- About 1213 ha are contaminated by hydrocarbons.
  - Approximately 2,5 million m³ soil are estimated to be contaminated.
  - Groundwater pollution due to kerosene has been identified. About 20,000 tonnes of kerosene are estimated to exist as free phase contamination floating on the groundwater.
  - Contamination of nearby surface waters has also been identified.
- A smaller area of about 200 m² is contaminated with heavy metals and radionuclides.
- Approximately 30 ha are contaminated due to inadequate disposal of various wastes and chemicals.

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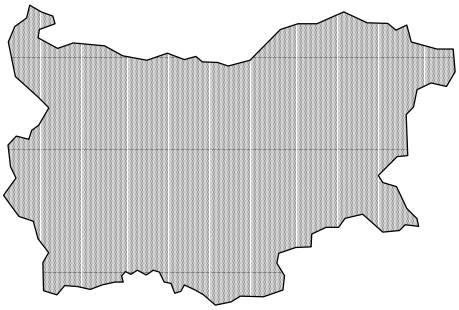
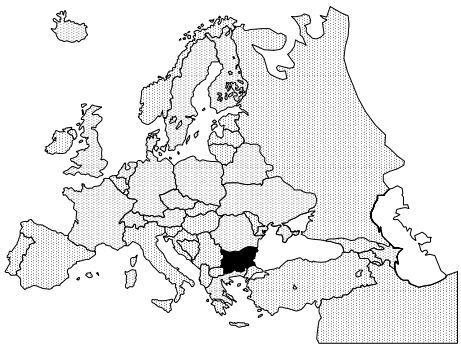
Bulgaria

Country Characterisation





Background

The Republic of Bulgaria covers a territory of about 111 000 km^2 on the Balkan peninsula. Land use in Bulgaria resembles that in OECD Europe, with agricultural areas covering about half of the country (shared between arable and permanent crop land, and permanent grassland), and forests and wooded areas more than one third.

The main causes for the soil anthropogenic contamination are atmospheric deposition and application of industrial wastes, sewage sludge, slurry, farm manure, and fertilisers. The most significant for Bulgaria is industrial pollution. Industrialisation of Bulgaria started in 1955-1965, i.e. rather later than most of European countries. Nevertheless, soil pollution with heavy metals, arsenic, oils, nuclides etc. was not avoided. At that period were constructed the main plants for ferrous and non-ferrous metallurgy, lignite coal power production, crude oil processing, large-scale chemical processing, metal processing and cement production.

The heavy metal excess in Bulgarian soils is comparatively well studied. Lead, zinc, copper, arsenic and cadmium are considered to be the major pollutants, deposited on soil mainly as aerosols. About 1% of the cultivated land in Bulgaria (43660 ha) is contaminated by heavy metals above the admissible standards, of which 80% is situated in regions of operating metallurgical, machine manufacturing and energy generating plants. The concern does not arise from the percentage of contaminated land, although some of it is situated in regions of intensive agriculture and near by the biggest towns, but from the fact that it is permanently contaminated, as well as the long period needed for its regeneration and the considerable investment required for the application of remedial methods.

Total area	Agricultural areas		Wooded areas		Nationally protected areas *		Other areas	
km^2	*km^2*	*%*	*km^2*	*%*	*km^2*	*%*	*km^2*	*%*
110994	63440	57	37410	34	4790	4	10110	9

Figure on total area from UN/ECE, 1998.

* National parks			Reserves			Natural landmarks			Protected areas		
N	*th ha*	*%*	*N*	*th ha*	*%*	*N*	*th ha*	*%*	*N*	*th ha*	*%*
12	352	3,17	90	81	0,72	2241	23	0,21	123	23	0,21

Population	Population density	Annual pop. growth 1990 – 1995	Life expectancy at birth	
			Male	Female
1000	*per km^2*	*%*	*years*	*years*
8341	75	-0,50	67	75

Figures from UN/ECE, 1998, and POPIN, 1999.

In Bulgaria, the ecological legislation is based on the polluter pays principle (the owner is liable for current contamination) – from one side, and from the other, that at times of restitution and privatisation of property, the new owners "shall not be liable for ecological damage caused by past actions or lack of actions". These two principles lay in the basis of the Environmental Protection Law (EPL) (publ. in the Official Gazette, n. 86/1991; amend. n.90/1991; add. and correc., n.100/1992; n.31, 63/1995; n.13/1997; n.85, 86/1997) and also in other regulations.

Since the end of World War II, up to 1989, Bulgaria's economy was wholly state-controlled. Priority was given to industrial development. The share of the heavy industry was 64.8 per cent of the industrial production. The radical change in the Bulgarian economy started with the implementation of an ambitious, wide-ranging, supported by European and international institutions, stabilisation programme in 1990-1991, which includes reforms to restructure the Bulgarian economy. In this programme, the Law on Transformation and Privatisation of State-owned and Municipal-owned Enterprises is very important (LTPSOMOE) (publ. in the Official Gazette, n. 38/1992; amend. and add. n.51/1994, n.45, 57, 109/1995; n.42, 45, 68, 85/1996; amend. n.86/1996; n.55, 61, 89, 98,122/1997; n.39, 70, 412/1998; n.12/1999) together with the creation of the Privatisation Agency, in 1992. The industry development, the extensive agriculture and urbanisation process, led to environmental contamination, including the groundwater, soil and land pollution.

Abstraction of groundwater is providing more than 70 per cent of the drinking water in the country. This determines the exceptional importance of the groundwater quality and quantity control and protection. The main groundwater contamination sources in Bulgaria are the industrial plants and mines, the urban areas, the agriculture, the stockbreeding, the waste (landfills) and others. The groundwater state in the country is controlled by the National monitoring network covered by the Regional Environmental and Water Inspectorates (REWI). The monitoring parameters of groundwater quality are: temperature, pH, alkalinity, COD (Mn), conductivity, redoxpotential, total hardness, total solids, total dissolved solids, suspended solids, main ions, ammonium, nitrite, nitrate, orthophosphate, iron, manganese and heavy metals (in some monitoring sites). In the last two years, an investigation was carried out on pesticide contents in the groundwater in the areas with intensive treating with vegetable protection substances.

Legal and Administrative Basis

Definition of Contaminated Sites and Land

Bulgarian State Standard 17.4.1.03-88: Entry into the soil as a result of human activities of substances and living organisms, that have negative effect on the fruitfulness, productivity, and self purging of the soil, reduce the technological, alimentary, and the hygiene and sanitary value of the crops, and the quality of other natural objects.

Legislation

Soil protection strategy and policy in Bulgaria has not been elaborated as a separate document. Elements of soil protection strategy have been built into numerous documents of parliamentary level, government and self-government programmes, for example for the polluted areas.

The following basic kinds of laws concerning the environment are promulgated in the Republic of Bulgaria: Statutes (laws) passed by the Parliament and signed by the President; regulations of the Council of Ministers, and guidelines issued by ministers. Apart from the above-mentioned normative acts, there are also rules regulating matters not settled by law. Resolutions of the Parliament on the main trends of state policy are examples of such documents.

Environmental policy in the agricultural (soil protection) sector is based on legal instruments (Laws, Regulations and Acts) related to the soil protection as described in the following.

According to the New Constitution of Republic of Bulgaria (State Gazette, N: 56/1991, Art. 21) "the land is a basic national wealth, that is under a special protection of the State and the Society. Arable land shall be used only for agricultural purposes. Land use changing shall be permitted only as an exclusion when such a need is proved by the rules defined in the law".

These constitutional ideas are developed more widely in the special laws approved by the Parliament and signed by the President and many Decrees, Regulations and Decisions of the Council of Ministers, and Regulations and Instructions of individual Ministers.

The background principles of the Bulgarian Environmental Policy is proclaimed in the Environmental Protection Law (EPL) promulgated in 86/1991 last amendment, 85, 86/1997:

- State Control of the Environment, considering "the control" as a monitoring of the quality of the environmental components, registration of the changes and their causes.
- Rights of everybody to be informed about the status of the Environment.
- Reduction of the risk for Environment and human health.
- The polluters must pay preventing and remediation activities.

The amendments of the EPL provide a new foundation for Bulgaria's environmental policy, in compliance with the European legislation. In part 4 of the Law the objectives are specified, subject to Environmental Impact Assessment (EIA). The order and provision for EIA are determined by Regulation N-4 for Environmental Impact Assessment (publ. in the Official Gazette, n. 84/1998). By definition "EIA is a process for determination, analysing, assessment and taking decision about possible consequences from programmes, projects, objectives and activities and their practical alternatives, with respect to human health risk, and to environmental protection, in accordance with the operative ecological enforcement needs and regulations in the country". Subject of EIA are also the existing (working) objectives (periodically assessed, or the objectives, which are assessed because of systematic violation of the environmental needs and regulations), as well as the objectives which will be subject to privatisation or restitution in the case of supposition of ecological damages caused by previous actions, till the moment of privatisation or restitution, by the competent national body.

The physical or legal entities concerned can suggest (propose) preparing of EIA's to the competent authorities. Regulation N-4 describes the procedures for EIA preparing about different objectives, the necessary documentation, the way of mandatory public hearing of the results, and the competent national bodies, which take decisions and control its implementation. In the appendixes to Regulation N-4 are enumerated in particular the common requirements for the scope and contents of the EIA's reports about different objectives. Also, the required information for the EIA's is stated. Included here are data on hydrological and hydrogeological conditions, quantitative and qualitative characteristics of the water resources - groundwater and surface water have to be considered. A review is required of contamination sources, sewage (waste) water and waste; a local monitoring plan, including the groundwater monitoring plan in the scope enterprise's site; with scheme of monitoring sites; sampling frequency and the analysed parameters; the procedure for information delivering to REWI. The EIA's report includes also an approved financial providing programme (from the owner) which describes the steps for adjusting enterprise's activity in compliance with the environmental regulations and needs; it requires work-schedule to attain the emission standards. "The polluter pays principle" is used. An important characterisation of the new ecological legislation is the assuming of the liability of the government (state) for proved previous pollution damages, i.e. the new owners "shall not be liable for ecological damage caused by past actions or lack of actions".

In accordance with the political decisions and orientation of the Republic of Bulgaria towards the EU and international agreements, transposition of EU requirements (directives) and harmonisation of Bulgarian legislation has started. Environmental policy in the agricultural (soil protection) sector is based on the following Laws and Regulations:

- Law on Environment conservation (1991, 92, 95).
- Law on Nature protection (1967, 77, 78, 82, 88, 91).
- Law on Water and Soil protection (1963, 68, 69, 75, 77, 78, 88, 91, 92).
- Law on Agricultural land protection (1996).
- Law on Agricultural land and Pastures protection (1973, 81, 87, 89).
- Law on the Ownership and the Use of Agricultural land (1991, 92, 93, 94, 95, 96, 97).
- Law on the Forests (1997).
- Law on the Waters (1969, 77, 79, 84, 86, 87, 97).
- Law on Cleanliness of the Air (1996, 97).

- The Regulation on application of the Law on Environment conservation.
- The Regulation on application of the Law on Nature protection (1969, 78).
- The Regulation on application of the Law on Water and Soil protection (1964, 78).
- The Regulation on application of the Law on Agricultural land protection (1996, 97).
- The Regulation on application of the Law on Agricultural land and Pastures protection (1973, 75, 76, 78, 85, 87, 94).
- The Regulation on application of the Law on the Ownership and the Use of Agricultural land (1991, 92, 93, 94, 95, 97).
- The Regulation on application of the Law on the Forests (1975, 79, 80, 82, 83, 91, 94, 97).
- The Act on application of the Law on the Ownership and the Use of Agricultural land (1993).
- The Act on Environmental Impact Assessment (1993).

In addition to this are international legal instruments. Currently Bulgaria is a party (1) or signatory (2) of the following conventions related to soil protection:

(1) like a party:
- The 1971 Ramsar Convention on Wetlands, since 1976.
- The 1979 Convention on the Conservation of European Wild Fauna and Flora and Natural Habitats, ratified 1991.
- The 1992 Rio Convention on Biological Diversity, ratified 1996.
- The 1979 Geneva Convention on long-range Trans-boundary Air Pollution, ratified 1981.
- The 1984 Geneva Protocol to 1979 Geneva Convention on long-term Financing of the co-operative Programme for Monitoring and Evaluation of the long-range Transmission of Air Pollutants in Europe, ratified 1986.
- The Helsinki Protocol to the 1979 Geneva Convention Concerning Reduction of Emission of Sulphur or their Trans-boundary Fluxes, ratified 1987.
- The 1988 Sofia Protocol to the 1979 Geneva Convention Concerning the Control of Emissions of Nitrogen Oxides or their Trans-boundary Fluxes, ratified 1989.
- The 1991 Sofia Protocol to the 1979 Geneva Convention Concerning the Control of Emissions of volatile organic compounds or their Trans-boundary Fluxes, ratified 1989.
- The 1985 Vienna Convention for the Protection of the Ozone Layer, ratified 1989.
- The 1987 Montreal Protocol for the destruction Ozone Layer compounds.
- The 1992 UN Framework Convention on Climate Change, ratified 1995.
- The 1989 Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and Their Disposal, ratified 1995.
- The 1992 Helsinki Convention on the Trans-boundary Effects of Industrial Accidents, ratified 1995.
- The 1991 Espoo Convention on Environmental Impact Assessment in a Trans-boundary Context, ratified 1995.

(2) like a signatory:
- Convention for damages on the Trans-boundary Pollution of Environment.
- Law for Protected Areas.
- Law for Ungrounded Natural Wealth.

Concerning other instruments, it is worth mentioning some government strategies and programs in force or being developed:
- National Programme “Environment”.
- Strategy and Programme.
- National Programme of Environmental Monitoring.
- Programme for Development of Mountain and Mountains Regions.
- National Programme “Ecology and Health”, Plan of Actions.
- National Programme for gradually finishing the production and the use of a leaded fuel.
- National Programme for reducing the use of compounds destroying the Ozone Layer.
- National Plan of Action about the Climate Change.
- National Strategy on Biodiversity.

The waste management legislation was elaborated in the recent two years and is harmonised with the European standards. All waste disposal sites are potential polluters of the environment. At present, the National Centre of Environment and Sustainable Development (NCESD) monitors the municipal (household waste) landfills. In September 1997, the Law for Restriction of the Harmful Impact of Waste on the Environment was adopted. In 1998, ten regulations have been adopted whose provisions concern the polluted areas. The municipal administrations are responsible for the condition of the waste disposal sites. The municipalities and the Regional Inspectorates for Environment (RIs) control the sites.

Implementation of Limit Values

There is no separate law in the Bulgarian legislation dealing with soil, but there is a number of legislative acts and other procedure instruments concerning the management of polluted areas. Regulation No. 3 defines the norms of Admissible Contents of Hazardous Substances in the soil (SG, 36/1979, last Amendment, 54/1997). The max admissible levels for heavy metals in soil are shown in the table below.

	pH	Max admissible levels in mg/ kg							
No.	(H_2O)	Cr	Ni	Cd	Hg	Pb	Cu	Zn	As
1	2	3	4	5	6	7	8	9	10
1.	3.5					< 20	< 15	< 20	< 25
2.	4.0	150	25	0.04	1	< 25	< 20	< 30	< 25
3.	4.5					< 30	< 25	< 40	< 25
4.	5.0	170	35	0.08	1	< 40	< 40	< 60	< 25
5	5.5	180	50	1.0	1	< 50	< 60	< 90	< 25
6.	5.7					< 60	< 80	< 110	< 25
7.	6.0	190	60	1.5	1	< 70	< 120	< 200	< 25
8.	6.2					< 75	< 230	< 300	< 25
9.	6.5					< 80	< 250	< 320	< 25
10.	7.0	200	70	3.0	1	< 80	< 260	< 340	< 25
11.	7.5					< 80	< 270	< 360	< 25
12.	8.0					< 80	< 280	< 370	< 25

The regulation has been implemented. In this moment, the Ministry of Environmental is preparing admissible levels for persistent organic pollutants (POPs) and Precautionary Values for heavy metals.

Responsible Public Authorities

The responsible governmental bodies are the Ministry of Environment and Water (National Centre of Environment and Sustainable Development), 15 Regional Inspectorates, the Ministry of Agriculture, Forestry and Agrarian Reform, and the Ministry of Health.

Registration

The Ministry of Environment and The Ministry of Agriculture funded a large-scale survey of all hot spots and of most of the arable land areas. As a result, soil maps of heavy metals, arsenic, and radionuclide pollution in scale 1:5.000 as well as maps of saline soils in the same scale have been made.

As a result of investigations made for all territory of the country, polluted areas have been defined by type and degree of pollution. The areas are under control. The data are available in the National Centre of Environment and Sustainable Development. Also, a list of polluted areas as a result of industrial activities is available (The Regulation of The Council of Ministers N: 50/10.03.93 pub. in Gov. p. number 24/1993).

Concerning waste disposal sites, in the NCESD there exists and is maintained a register of the disposal sites and the old pollution. The register is updated each year. Until 1998 there were included 307 sites.

Characterisation of Soil and Groundwater Contamination

Sources of Soil and Groundwater Contamination

The main causes for the soil anthropogenic contamination are atmospheric deposition and application of industrial wastes, sewage sludge, slurry, farm manure, and fertilisers. The most significant for Bulgaria is industrial pollution. In some regions of the country, soils were chemically polluted as a result of trace elements and As in the soil surface layers. There are four souses of pollution as follows:

- Atmospheric pollution of soils near industrial plants.
- Pollution caused by agricultural activity (chemicals for plant protection, contain heavy metals).
- Irrigation with polluted water.
- Transported pollution.

Oil contaminated soils are found around plants, oil stations and along an oil pipelines. A list of polluted areas as a result of industrial activities is available (The Regulation of the Council of Ministers N: 50/10.03.93 pub. in Gov. p. number 24/1993). It refers to heavy metals and As contaminated soils, oil contaminated soils, radionuclide pollution and degraded lands. It includes the hot spots, type and degree and source of pollution.

In the area of household waste, a specialised monitoring programme of the Ministry of Environment and Water covers 250 cities and villages. In 1997, the National Centre for Environment and Sustainable Development (NCESD) collected data for 275 waste disposal sites. These sites occupy an area of 7400 ha and service 6,35 million inhabitants, which is 76% of the total population of the country. Disposed at these landfills are different kinds of waste, including hazardous waste. At present, the monitoring of the landfills covers only territorial and construction characteristics as well as the quantity of the disposed of waste. Laboratory control on the components polluting the environmental is not made. The waste disposal sites are one of the potential sources of pollution of the environment. At present in Bulgaria, investigations of the infiltrated water and gas production at these sites are not carried out for the impact of these sites, and there are no data about the pollution, which they cause.

Number of Registered Contaminated Sites / Contaminated Land Areas

The contaminated areas register has all the information collected during all the management stages on the potential, suspected and contaminated areas. The register includes an information file and a database (Geographical Information System).

	Agricultural lands - Polluted due to industrial activities (ha)				
	1 - 2 ACL	2 - 3 ACL	3 - 5 ACL	> 5 ACL	Total
Heavy and toxic elements	18437.8	9117.0	7941.3	8164.5	43660.5
Radionuclides	541.5	344.0	92.3	71.1	1048.9
Oil pollution	62.9	74.4	-	-	137.3
Salinisation	71.3	90.4	90.9	-	252.6
Total	19049.9	9553.7	8074.3	8235.6	44913.5

Investigation Methods

Identification of Potentially Contaminated Sites and Areas

The main sources of the information are based on the following:

- Investigation and Mapping (region by region/ scale 1:25 000 and 1:5 000).
- National networks of the stations for observance and control of the components. The locations of these are defined on basis of preliminary investigation and mapping of soil pollution in the region, according to the national and European standards and having the function to estimate the background state of the components and their changes as a result of human or natural impact. Systematic monitoring has been carried out since 1992. 15 Regional Inspectorates accomplish its fulfilment on the territory of Bulgaria, supplied with modern equipment. The NCESD is in charge of their activities.

For waste disposal sites, a review of the disposal sites and the old pollution as well as analytical control of the infiltrated water and gas from them is expected.

Investigation of Contaminated Sites and Areas

The determination of previous ecological damages is made according to methods approved by the Minister of Environment and waters, and Methodological Instructions published in 1998 about the scope and content of reports on determination of the damages of previous contamination dated before privatisation. The process of making such reports involves a two-stage procedure:

- The first step is preparing a preliminary report, filling up questionnaires and forms for identifying the contamination concerning the groundwater, the surface water, the soils and the air - by assessment on the basis of a point system. Useful are the help work-schemes with lists containing criteria for probability of the groundwater contamination, soil contamination etc., and criteria for selection of primary objectives of impact concerning groundwater, surface water, soils, and air.
- The number of the points determines whether the second step will be applied (only for groundwater and soils). Based on the careful study of the available information about the groundwater and soil, a work-plan is set-up ("Plan about additional investigations of the enterprise's site") on the basis of the Methods of ecological risk assessment, Dutch target and intervention values for soil and groundwater, and the experience of other countries (e.g. the Czech Republic) on these problems. The aim of the additional investigations is to be able to evaluate the soil and groundwater conditions and impact factors (polluters), in order to determine the extent of soil and groundwater contamination. The additional researches supply information necessary for these evaluations.
- The competent national body - the Supreme Environmental Experts Council evaluate the report and make decision to finish the determination of damages from previous contamination until the moment of privatisation. In the case when as a result from the two stages of determination, previous damages are proved, a Plan-programme is proposed with remedial measures and a groundwater monitoring plan also. The prepared report, by determination, concerns only the past damages in the scope of the plant site, which have been caused directly by the enterprise.
- If a local monitoring network is available, it must be updated. Otherwise, a new monitoring network must be established. It shall provide information on the current state and development of the contamination and the effect of remediation measures upon the groundwater and will be useful for corrections and management of remedial actions and warning in emergency or risk situations.
- The Ministry of Environment and Waters approves the remedial measures, but their value is accepted by the Privatisation agency. It reduces the cash-prise of the enterprise. The ecological legislation requires from the new owner to implement the remediation programme, which is financed from domestic or foreign sources. The implementation control is made by the REWI's. The Government may secure the development of technologies for treatment of contaminated soils and groundwater.

Sampling during investigations is made according to ISO standard. The analysis are made according to ISO standard as follows:

- pH - ISO 10390/1994.
- Heavy metals - ISO 11047.
- PAH (NAP, ACE, ACY, FLU, PHE, ANT, FLA, PYR, BaA, CHR, BbF, BcF, BeP, BaP, IND, DbahA, BghiP), PCB (PCB28, PCB52, PCB101, PCB118, PCB153, PCB138, PCB180), and pesticides - ISO/CD 10382.2.

The order and provisions by which the Government is going to take the liability about consequences for proved previous damages will be accepted by a regulation, which is still to be developed by the following national bodies: The Ministry of Environment and Waters, the Financial Ministry, the Ministry of agriculture and agrarian reform and the Privatisation agency.

Facilities for Contaminated Soil

Handling and Treatment of Excavated Contaminated Soil

For soil contamination by heavy metals and other toxic substances, some experimental projects are under way, but no economically feasible measures for remediation exist.

Measures Used by Remediation of Soil and Groundwater Contamination

Since 1991, polluted surface soil has been replaced with cleaner soil at some sites. Complete remediation of contaminated sites would require very high expenditures over a very long period.

During the last years, the activities have been focused on remediation of some of these areas (16 ha - heavy metals and 13 ha - oil products), by an original Bulgarian remediation technology.

Through the NEPF and external donors, the construction of modern waste disposal sites is financed. Construction of installations for processing of waste from old pollution is made jointly between Bulgarian and foreign companies (Kremikovtsi waste piles).

Financing and Liability

Investigation and Remediation Activities

Restitution of agricultural land to private owners has begun, raising difficult questions in relation to soil contamination. State-owned land is to be returned to its former owners, and the Government is being held liable for soil contamination caused by human activities. The Government is expected as a result to deal with: i) clean-up of soil contamination, ii) prevention of health effects from polluted crops, and iii) compensation for damage to crops caused by soil pollution.

A 1993 regulation regarding restitution of agricultural land requires the Government to certify the condition of the land regarding pollution and make a recommendation as to land use when a property is returned to the former owner. An assessment system recently developed for this certification will integrate information about soil characteristics and pollution conditions. The recommendation on land use includes guidance on which crops can be grown without problems. It is recommended that the most heavily polluted land be used only for non-food crops, such as cotton. The Government does not plan to apply this system nation-wide because the necessary data and funds are lacking. As some land is contaminated due to natural sources, the Government is seeking a way to distinguish between this contamination and pollution from human activities.

The next point deals with privatisation of industrial plants, where a preliminary assessment of pollution problems is required, with the condition and the cost of restoration to be reflected in the price. As major plants have not yet been privatised, however, this assessment procedure is not well established.

Legal Requirements re. Polluters and Site Owners

Bulgaria has addressed the issue of environmental liability for past contamination problems in the 1991 environmental protection Law. The law states that, at the time of restitution and privatisation of property, the new owners “shall not be liable for ecological damage caused by past actions or lack of actions”. Procedures under this principle are still to be developed, including environmental audits to determine the extent of damage, and criteria for actions on contamination problems identified by audits. Any property to be privatised must also be evaluated for ongoing pollution and compliance with environmental requirements. The results must be provided to potential purchasers. A financing mechanism for such actions is also necessary. Whatever mechanism is developed, resources will be scarce, and attention should be focused on identifying and managing the sites that pose the most serious risk to human health.

Scope of the Problem

Scale of the Problem and Handling Costs

A list of contaminated areas as a result of industrial activities is published in ”The Regulation of The Council of Ministers N: 50/10.03.93” (pub. in Gov. p. number 24/1993) referring to the Land Ownership and Agricultural Land use Law:

- About 43 thousand hectares of the country’s arable land is polluted by heavy metals.
- The radionuclide contamination of soil is connected mainly with the uranium mining. A special survey shows that about 2 thousand hectares are affected of this type of pollution and 1.4 thousand hectares of them are arable land.
- Oil pollution is found only as small hot spots. It was estimated to cover about 0.137 thousand hectares.

The problem is that contaminated and degraded lands do not cover very large areas, but on the other hand cover the most fertile and flat lands in the country. Due to the economic conditions, arable land treated with lime is not significant. Consequently in fact, an increase of acid soil areas has started. Availability of saline land spots is a sure indicator for potential danger of their spreading and salinisation of new areas.

The assessment of the pollution from waste disposal sites and the old pollution from these sites is still to be done. There were allocated funds through international co-operation amounting to 500,000 DEM. The waste management is a priority for the Ministry of Environment and Water in the environmental protection.

Priority in Relation to Other Societal Problems

Although the most heavily contaminated land is not supposed to be used for food production, some contaminated soil is farmed. Studies suggest that soil and food contamination with heavy metals (especially lead) is a significant public health concern. Surveys have estimated that between 1986 and 1989, children in Bulgaria received daily lead intakes well in excess of the Food and Agriculture Organisation recommendations. The extent to which this was due to soil contamination is debated, as total exposure to toxic substances and the contribution of soil contamination have not been sufficiently studied. Heavy metals can also affect crop and livestock production. The Government expresses greater concern about the damage to crop production from acidification, however, since a larger area is affected by this problem.

Given the gap between the magnitude of the problem and the resources available to solve it, Bulgaria should put priority on cost-effective measures to reduce major risks to public health, the environment and crop production. Identification of significant risk should be the first step; other possible measures include reduction of industrial emissions, proper management of hazardous waste and changes in land use, including a ban on food production in heavily polluted areas. Individuals who receive contaminated land under the restitution programme are allowed to request a piece of uncontaminated land instead; this option is rarely used but could be developed. Close co-operation of environmental, health and agricultural agencies is essential to developing cost-effective policies to respond to soil contamination.

Illustrative Cases

The most considerable environmental problems, connected with the soil pollution with the heavy metals, are concentrated in specific regions, near industrial enterprises.

For example, in the region of Pirdop there are some typical representatives of pollution sources connected to the non-ferrous metallurgy industry (e.g. the copper works) that cause direct and secondary pollution (through polluted waters). As a result of their activities, about 19247 ha are affected with heavy metals in levels exceeding the ACL. The main pollutants in that region are Cu, As, Cd, and Pb.

Another pollution source from the ferrous metallurgy industry is Kremikovtzi Ltd. About 5057 ha soil in the region of Sofia is polluted at different extend mainly with Pb, Cd, Zn, and As.

Region	Source and elements	Agricultural lands - Industrially polluted by heavy and toxic elements (ha) 1 - 2 ACL	2 - 3 ACL	3 - 5 ACL	> 5 ACL	Total
Pirdop	Non-ferrous metallurgy Cu, As, Cd, and Pb	4284	5231	5197	6582	21294
Sofia	Ferrous metallurgy Pb, Cd, Zn, and As	2978	1257	822	-	5057
Plovdiv	Non-ferrous metallurgy Pb, Cd, and Zn	5933	958	813	9	7713
Kurdgali	Non-ferrous metallurgy Pb, Zn, and Cd	1809	260	154	107	2330
Eliseina	Non-ferrous metallurgy As, Cd, Cu, Pb, and Zn	453	229	310	645	1636

The waste disposal site at Dolni Bogrov was opened without any design and preliminary preparation of the terrain. At this site, household, industrial and hazardous wastes were disposed. The water of the rivers Lesnovska and Iskar and the adjacent agricultural lands is polluted. Since 1997, the disposal of wastes site at this site was stopped. A project for the clean-up and recultivation of the site has been prepared.

The waste rock piles at Kremikovtsi for the slag from processing occupy very large areas of fertile lands. There were piled large quantities of slag with high contents of Fe. A project for utilisation of the slag has been prepared.

There was prepared a project for a disposal site for hazardous waste in the municipality of Dolni Dubnik for the disposal of pesticides, soil contaminated by oil products, and other hazardous wastes.

The procedure for determination of contamination from previous activities (determination of previous ecological damages mentioned under the section on “Investigation of Contaminated Sites and Areas”) is illustrated by an example concerning the Lead and Zinc Smelter near the city of Kurdzhali. In the examined area, the ecological damages for groundwater and soils have been investigated, and a remediation Plan-programme and a local groundwater monitoring plan have been accepted. The Supreme Environmental Experts Council approved the report on determination of damages from previous contamination. The remediation Plan-Programme includes remediation of highly contaminated and dangerous soils, constructing a drain around landfills with lead slag and zinc depositions, scrapping up contaminated soil from the plant site and storing it in existing temporary landfills, liquidation of useless buildings and equipment, making harmless 60 000t of plastic waste from lead acid batteries, and processing of accumulated until this moment a quantity of lead slag, zinc sediments and sediments from a wastewater treatment plant. The groundwater monitoring plan includes monitoring of the following parameters: pH, Pb, Cu, Zn, Cd, As, Ba, Cr, Co, Ni, Hg and Mo in 19 piezometric wells, with a sampling frequency of four times per year for 4.5 years.

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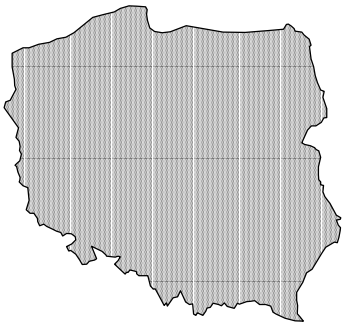
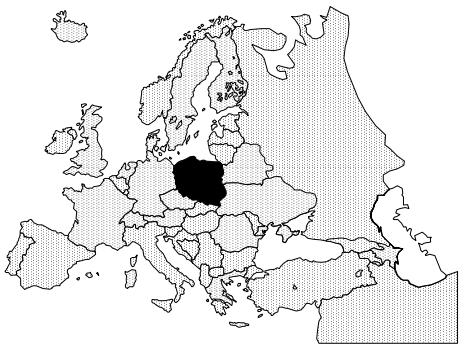
Poland

Country Characterisation





Background

In Poland, contaminated land is not related only to industrial activity but is also the legacy of the former communist regime. The former regime supported inefficient technologies as well as inefficient production systems consuming energy and natural resources. The priority of industrial production over human needs and environmental requirements resulted in uncontrolled emissions and environmental pollution. The collapse of the communist system and the transition of the economy revealed a critical need for technology innovation as well as environmental clean-up programmes. The legacy of the past left a great number of contaminated sites encompassing large areas. Many of these contaminated sites are former military bases.

Up to the year 1993 the Soviet army occupied 59 sites, covering an area of approximately 70000 hectares. Most sites are situated in the North and in the Northwest of the country. The systematic assessment of former Soviet military sites started in 1991 and major work was carried out between 1992 and 1993. In May 1992, an agreement concerning the withdrawal of the Soviet forces was signed. After this date, sites were assessed by committees with both Polish and Russian representatives. The resulting protocols concerning the state of the environment were later used as official documents when the sites were handed over to the Polish authorities. The major goals of this project were to identify contaminated areas, the need for clean-up, and the potential clean-up costs. With respect to the Polish National Army sites investigations have been limited to a few sites, being fuel and chemical storage facilities and air bases.

Total area	Agricultural areas		Wooded areas		Nationally protected areas		Other areas	
km²	*km²*	*%*	*km²*	*%*	*km²*	*%*	*km²*	*%*
312685	187000	60	88000	28	97000	31		

Figure on total area from UN/ECE, 1998, [1], Institute of Environmental Protection [2].

Land Use in Poland: Plough Land - 45.5%, Orchards - 1.0%, Grassland - 13.1%, Forests - 28.1%, Water - 2.7%, Communication - 3.1%, Urban areas - 3.2%, Wastelands - 1.6%, Other - 1.7%.

Figures from Polish Central Statistical Office, 1998 [3].

Population	Population density	Annual pop. growth 1990 – 1995	Life expectancy at birth	
			Male	Female
1000	*per km²*	*%*	*years*	*years*
38660	124	0,14	68	77

Figures from UN/ECE, 1998 [1], POPIN, 1999 [4], Polish Central Statistical Office, 1998 [3].

Legal and Administrative Basis

Definition of Contaminated Sites and Land

Land contamination is regarded in Poland as the presence in the environment of a substance or other agent, which might cause harm, or as one of the land degradation forms e.g. erosion, changes in geology and hydrology, and depletion of soil resources [5]. Land contamination per se does not always pose a threat to the environment, and the importance of the contamination can only be determined following detailed investigation and site specific evaluation of risks.

Legislation

The present Polish legal system does not offer any binding regulations neither for risk assessment nor for land recovery procedures or standards. The Act on Environmental Protection and Management from January 1980 classifies areas with chemically degraded soils as lands subject to special protection. The category embraces areas degraded due to industrial, agricultural or any other activities. The protection of degraded areas involves, in particular, counteracting negative impacts of polluting objects and pollutants, and restoration of ecological and productive values of the land.

The Mining and Geological Law from February 1994 states that restoration of damaged agricultural or forest land shall proceed in conformity with the Law on the Protection of Agricultural and Forest Land (as of February 1995). The latter contains only very general provisions concerning reclamation of degraded land.

This gap in legal system has been partially filled in by the Guidelines for classifying contaminated land and risk assessment in grounds and groundwater contaminated by petroleum derivatives and other chemical substances, issued by the State Inspectorate for Environmental Protection in 1995 [6].

Other important legal documents relevant for the management of contaminated sites are:

- The Water Act of 1974, which regulates the use of water resources and also water protection.
- The Act on Regional Development of 1995, which regulates specific land uses.

It is noted that waste management was regulated by a separate Waste Act adopted in June 1997. Major elements of the Polish law on waste management are:

- Permits for waste generators.
- Permits for hazardous waste recipients.
- Waste classification (including hazardous waste).
- Waste (quantity and quality) records.
- Action hierarchy: waste prevention and minimisation, utilisation (recycling), disposal.
- Regulations for responsibilities of landfill managers.
- Ban on hazardous waste import.

The environmental policy and consequently the environmental acts are broadly based on the use of environmental impact assessment (EIA) as method for assessing new investments, which are regarded as harmful or potentially harmful of the environment. Public consultations are also required in the permitting process for building of installations.

Implementation of Limit Values

The Polish standards for environmental protection are based on fixed regulatory limits. However, the regulations do not include threshold (permissible) values for soil contamination i.e. there are no specific generic values or regulations establishing admissible contaminant concentrations in soil nor any binding classifications of contaminated land.

Soil is regulated with respect to regulations concerning “raw sewage sludge for agricultural purposes” given in a decree on agricultural use of sludge and manure mixture issued by the Ministry of Environmental Protection, Natural Resources and Forestry (decree of 1986).

Suggested standard values (or advisory standards) have been published by soil specialists in a bulletin sponsored by the State Inspectorate for Environmental Protection. At present, there are no official criteria for classifying contaminated sites, and therefore there is no impetus for corrective action.

The above-mentioned guidelines for risk assessment for soil and groundwater contaminated by petroleum derivatives and other chemical substances have a status of advisory reference standards. The guidelines are based on other European regulations including the Dutch list of standards updated in 1993, the Berlin list and the 80/68/EEC Directive of 1979 concerning the protection of groundwater. The guidelines provide a useful tool for unification of procedures for land remediation on a countrywide scale.

A decree on drinking water criteria was amended in 1994. The defined values from the decree are used as reference values for ground water quality criteria. Furthermore, groundwater quality criteria are defined within the groundwater monitoring of the State Inspectorate for Environmental Protection.

Though the Ministry of Environmental Protection, Natural Resources and Forestry, has identified a list of the 80 "worst" polluters in Poland, there is no sufficient level of enforcement for environmental audits. In some cases, contaminated sites posing extremely high risk to human health and the environment have started to be regarded as policy priorities (e.g. the Tarnowskie Góry site, a former chemical plant).

An important barrier for the implementation of clean-up strategies is the lack of regulation of the state liability for environmental damages / old pollution caused by the state owned enterprises. This makes the implementation of the "polluter pays principle" rather doubtful.

Risk assessment has not been incorporated into Polish regulations. However, full-scale risk assessments have been performed for two clean-up demonstration projects performed by US department of Energy (DoE) at the Czechowice refinery and by US DoE / Us EPA at a phytoremediation project in Piekary. Both projects were made in co-operation with the Institute for Ecology of Industrial Areas in Katowice [7].

Responsible Public Authorities

Management of contaminated sites and land is the responsibility of:

- The State Inspectorate for Environmental Protection. The State Inspectorate for Environmental Protection carries out the control of environmental quality criteria.
- The 16 Polish provinces (voivodships). Most environmental issues are under the responsibility of the provinces (voivodships). They are also the responsible authorities for the abandoned Soviet military sites.
- An Inter-Ministry Working Group for remedial measures at former Soviet military sites. The group supervises investigations and remediation at former Soviet military sites.

It is noted that no national clean-up strategies or programmes for contaminated sites and land have been implemented. The only exception is a program outlined for the former military bases.

Some regional action plans have considered the issue; e.g. clean-up of contaminated land is stressed in the 2020 action plan for Katowice voivodship and hazardous waste management plan elaborated under the PHARE program.

Registration

As no appropriate legislation exists, there is no basis for performance of a national survey of contaminated land.

The State Inspectorate for Environmental Protection has made a preliminary identification of contaminated sites on former military bases transferred into civil use.

In 1995, the US Department of Energy (DoE) sponsored a survey of the Polish market for contaminated site characterisation and here listed several dozens of contaminated sites in need for characterisation.

Data on industrial waste producers, amount of waste generated, re-use, dumping places, and applicable technologies are collected by the Waste Management Institute in Katowice.

According to the Polish Central Statistical Office, in 1997, the amounts of industrial wastes were the following:

- Produced: 124,469,500 tonne
- Utilised: 80,126,100 tonne
- Neutralised: 299,600 tonne
- Deposited: 44,043,800 tonne

The total industrial waste landfill area was 11,172 ha.

The major regions of waste generation and dumping are Katowice, Legnica, Walbrzych, Szczecin, Tarnobrzeg and Krakow. In 1997, there were 956 municipal waste landfills (area: 3,141 ha) and about 350 so-called pesticides tombs.

Characterisation of Soil and Groundwater Contamination

Sources of Soil and Groundwater Contamination

The present state of the soil contamination is mainly caused by negative impact of past economic activity – mostly industrial activity, transportation, and public utilities. Currently, since appropriate changes in production technology and protective facilities have been applied, emission of industrial and traffic pollution (affected state of soil contamination) has radically improved. Finally, impact of various waste disposal sites on soil and water environment remains the most serious problem in the field of land protection. The issue of waste management arrangement is a priority in Poland.

Generally, most significant recognised environmental hazards related to soil contamination arise from the presence of chemical substances, but other hazards such as flammable gases, combustible and radioactive materials, and pathogenic organisms may locally be very important e.g. on former military sites. Best-recognised problems under the conditions prevailing in Poland are the presence in soil of chemical substances such as heavy metals, sulphur, oil products and pesticides [8-10].

Agricultural use is, to a large extend, responsible for land quality. Loss of organic substances and acidification are two of main problems. Acidification is regarded as a major factor responsible for chemical degradation of soils in Poland enhancing the solubility of mineral and organic soil constituents. It has been estimated that use of NPK fertilisers combined with acid deposition from man-made sources has resulted in the acidification of sandy soils, which are the dominating soil types in Poland.

In some regions, heavy metal soil contamination poses a local problem. Soil contamination by heavy metals implies that the concentration of these elements is higher than it would occur naturally. According to a study performed in industrialised and clean regions of Poland, increased soil levels of cadmium, lead, copper and zinc can be found primarily in the Katowice and Cracow regions and in the Legnica-Głogow copper mining and smelting region. Other contaminated areas are encountered in most of the larger towns such as Warsaw, Łodz, Rzeszow, Opole, Wrocław, Wałbrzych and Lublin. Contamination by heavy metals in agricultural topsoil (0-20 cm) has been thoroughly investigated during a recent countrywide agrochemical soil study performed in 1991-95. The results of the study indicate that more than 80% of the soil has natural contents of heavy metals and should be classified as non-contaminated. About 17% of the agricultural soil have slightly elevated levels of Cd, Cu, Ni, Pb and Zn. Only about 2,6% of the soils were classified into higher contamination classes. The highest average contents of heavy metals in agricultural soils were found only in close vicinity of metalliferous ore smelters.

In total, 21 abandoned Soviet military sites have been subject to the first investigations performed at military sites in Poland. The results of the detailed investigations revealed soil contamination at approximately 1% of the investigated areas and groundwater contamination corresponding to approximately 10% of the investigated areas:

- Soil contamination deriving from mineral oil products was identified at all 21 sites. Uncontrolled waste disposal of hazardous wastes was detected at 19 sites. Furthermore, in many cases soil contamination with heavy metals and contamination due to phenols, PAH and chlorinated hydrocarbons were detected.
- Groundwater and surface water contamination was detected in 20 cases, mainly due to hydrocarbons and heavy metals.
- Vegetation damage was detected especially at the test ranges. The total vegetation damage of the soil surface was assessed with 25%.

Number of Registered Contaminated Sites / Contaminated Land Areas

According to data provided by the Polish Central Statistical Office (GUS) [3], areas taken by settlements and communication lines occupy now less than 5% of the country surface while wastelands and other uses take together some 3.3%. The majority of these areas is regarded as heavily and/or moderately degraded. According to recent estimation, their total surface amounts to about 850,000 ha. These include waste dumping sites, landfills, and industrially degraded or derelict grounds where reclamation is urgently needed [11]. According to recent assessments made by the State Inspectorate for Environmental Protection (PIOS), chemically contaminated lands constitute together about 2.7% of the total surface [12].

A detailed inventory on the state of soil contamination in industrial plants and municipal plants is currently carried out mainly for privatisation purposes.

Regarding the former Soviet military sites, the sites were assigned to priority groups according to the results of the pre-assessment and the first investigation of the sites.

Category	Description	No. sites
Group 1	Sites where clean-up measures are urgently needed. All those sites were included in this category where major quantities of mineral oil products have been stored and which are situated close to drinking water wells.	6
Group 2	Sites which pose a high risk to the groundwater. In practise sites where mineral oil contamination in the soil needs to be removed in order to avoid groundwater contamination in the future.	3
Group 3	Sites which pose a risk to the groundwater.	10
Group 4	Sites which pose a minor risk to the groundwater.	21

Investigation Methods

Identification of Potentially Contaminated Sites and Areas

It is estimated that the area of land devastated and degraded by mining industry (and raw materials extraction) is about 49,000 ha, by power industry about 1,000 ha, and by metals production industry 256 ha.

Territorial chemical-agricultural stations and institutes of agricultural and environmental protection have carried out investigations of agricultural soil contamination for many years in Poland.

Currently, in the framework of the State Environmental Monitoring, monitoring of soil contamination by heavy metals is carried out in stationary control points on the whole area of the country. Comprehensive analytic materials in this field, which enabled elaboration of maps showing the contaminated areas, are prepared.

Regarding the abandoned Soviet military sites, all the 59 sites were pre-assessed between 1991 and 1993. Of these, 35 sites were classified as potentially contaminated. Of the 35 sites, 21 sites were selected for further investigations. The selected 21 sites cover an area of approximately 60000 hectare, which corresponds to 86% of the total area of all the former Soviet military sites. The selected sites included the following:

- All airbases with major fuel stocks.
- All major fuel stocks.
- All test ranges.
- All ammunition stocks.

- All marine harbours.
- Selected garrisons.

Investigation of Contaminated Sites and Areas

Investigation methods of soil contamination used in Poland deal with determination of total content of the pollutants regardless of their existence in the form available for plants (by roots) – thus in form, which determines their contamination state, or their existence in other forms.

Guidelines for risk assessment for soil and groundwater contaminated by petroleum derivatives and other chemical substances exists.

Site assessments and investigations are carried out according to the guidance document [6], which defines three major steps:

- The pre-assessment of sites has the objective to identify actually contaminated spots or areas, and includes the following activities:
  - The collection of relevant information concerning land use, geology and hydrogeology, and general environment conditions of a site.
  - An on-site visit.
  - The evaluation of aerial photos (usually scale 1:10 000)
- The first investigation includes limited sampling at the identified contaminated areas and spots:
  - Limited number of soil, groundwater, surface water and wastewater sampling.
  - Systematic screening for subsoil storage tanks.
  - Geophysical analysis with screening for metal objects in the subsoil.
- The detailed investigation is carried out to further specify the need for remedial measures. This step includes:
  - Additional sampling for specific investigation.
  - Detailed hydro-geological investigations.
  - Modelling of potential contamination migration pathways.
  - Risk assessment.

For the assessment of risks Poland partly applied and tested the methodology of the US EPA on hazard ranking called *HRS Hazard Ranking System*. For the assessment of risks at sites contaminated with mineral oil products, the State Inspectorate for Environmental Protection recommends the methodology elaborated by the American Kerosene Institute, the "*Exposure and Risk Assessment Decision Support System, DSS*".

At the former Soviet military sites, the technical investigations usually included the following activities:

- Drillings and sampling at the identified most likely contaminated areas.
- Physical and chemical analysis of the collected samples.
- Soil gas analysis.
- Groundwater monitoring.
- Measurements for radioactivity.

Facilities for Contaminated Soil

Handling and Treatment of Excavated Contaminated Soil

Chemical contamination of land within the immediate impact of chemical industry and in urbanised areas has been identified and inventoried. There are numerous cases where appropriate remediation technologies and programmes were developed but not implemented due to lacking legal and structural regulation [11].

Treatment methods for contaminated soil in Poland depend on the kind and state of contamination, occurrence depth of the contamination, geological conditions, and predicted economic use method of the soil, and other economic and technical factors.

Contaminated soil is excavated in order to treatment or disposal in (protected) landfill sites exclusively in particularly reasonable cases.

Various Polish and foreign companies carry out soil treatment (including treatment of oil contamination). The most frequently applied remediation technologies include washing pollutants away from the soil and biological treatment in-situ. In some particularly difficult cases, other, more complicated chemical and physical-chemical technologies are applied with use of various stationary and mobile facilities.

Measures Used by Remediation of Soil and Groundwater Contamination

Most clean-up technologies on the Polish market are offered by western companies (joint ventures and representatives) or Polish companies acting on licence or contractual basis. The market for services is not yet developed. This is due to the lack of a legal framework, e.g. defining risk assessment, and the lack of demands in respect to the problem holders. The real market competition has only occurred for the remediation of former military bases. The majority of the remediation projects performed in Poland have focused on the remediation of oil spills.

One of the remediation technologies successfully applied on a technical scale in Poland is remediation of heavy metal contaminated soils by use of zeolite. Zeolite has been added to the soil on selected contaminated agricultural sites within the industrial regions of Katowice and Cracow and in the vicinity of the Głogow copper mining and smelting region. The minerals have been applied as granulates enabling the later removal of these again with adsorbed heavy metals. Efficiency of the soil clean-up was assessed after one and two year intervals and was shown to be dependent on the actual soil type. On average levels, the soil contents of Cd, Pb, Zn, Cu and Hg dropped by 17-18% relative to initial levels within one year, and decrease in heavy metals content reached 40% for some soil types the second year after the zeolite application. Other tests with zeolite application for cleaning heavily metal contaminated soil have also been performed [13, 14].

Remediation of sites contaminated by petroleum, petroleum derivatives and other organic compounds is still in a preliminary stage in Poland. However, technologies have been developed and applied on a technical scale for decontamination of soil and groundwater. E.g. in one case, the soil and groundwater contamination was assessed, hazards identified and remediation performed at a 50 ha site owned by the Polish railways in Wrocław and used for oil storage. Methods for remediation included in-situ ventilation and bioventing of contaminated soil and aeration of groundwater as well as ex-situ treatment of excavated soil by biodegradation. By the remediation, the contents of hydrocarbons in soil and groundwater were reduced to levels below the advisory standards recommended by the State Inspectorate for Environmental Protection [15].

Another case of successful bioremediation of an oil contaminated ground within the Kielce Railway Station was reported by the Warsaw University of Technology jointly with the Exbud-22 Hydrogeotechnika Enterprise from Kielce. Microorganisms were applied in-situ and the clean-up effect was almost 100% reduction of oil derivatives in two months following the onset of the trial [16].

Similar problems of land decontamination are to be tackled among others in a part of sites occupied by the former Soviet army. Major hazards in those areas are linked to oil spills, illegal waste dumping and storage of toxic chemicals. It was estimated that ground contamination by petroleum and hazardous toxic chemicals is to be found on more than 500 ha. The most urgent recovery activities include removal of oils and toxic chemicals and skimming of free phase oil floating on the groundwater. A few remedial measures have been implemented at the former Soviet military sites. All measures were dedicated to avert the risks of the most urgent cases. The measures applied were usually:

- Removal of free oil phase from polluted groundwater and re-infiltration of the treated groundwater into the soil.
- Extraction of soil gas and treatment of contaminants in the extracted soil gas by filtration or incineration.

Apart from petroleum products and toxic chemical contamination, sulphur mining and processing is another source of environmental hazards and a hot spot on the land recovery map of Poland. According to recent

reports, about 500 ha of grounds heavily contaminated by sulphur in the Tarnobrzeg Sulphur Mining Region have been recovered using postflotation lime and sewage sludge for soil remediation [5].

The review of methods and underlying practical and theoretical knowledge concerning biodegradation of various hydrocarbons in soils and wastes in Poland shows that there is already some domestic expertise in this field [17].

Financing and Liability

Investigation and Remediation Activities

The major financial resources for investigation and remediation activities are resources of the landowners as well as soft loans and grants from local, regional and national environmental funds (created from fees and fines). Generating funds for clean-up within the privatisation process is still unclear.

Contaminated land management is also a priority of the EcoFund created as a debt to grant swap money. The fund is dedicated to environmental measures and also the measures at heavily contaminated sites where polluters can not be held liable.

At the former Soviet military sites, the application of the polluter pays principle is hardly possible. The government finances the most urgent clean-up measures at the most contaminated sites. In the case of privatisation, the new owner has to accept the environmental liability.

In 1995, the Polish Council of Ministers approved the national clean-up programme for the abandoned Soviet military sites, which defined:

- To fund the most urgent cases with resources from the National Environment Fund.
- To oblige new owners to take care of the appropriate clean-up measures.

Legal Requirements re. Polluters and Site Owners

In the case of privatisation the new owners are in general held liable for site investigations and clean-up measures. In some cases, the new owner can be exempted from the clean-up liability. This is the case if the contamination was not evident at the time of the property transfer.

Scope of the Problem

Scale of the Problem and Handling Costs

Concerning the acidification of soils, it has been estimated that about 60% of the agricultural soils in Poland have pH in the range of 4.5-5.5 while the remaining 40% have pH above 5.6. Acidification is observed especially in the South-western and the central parts of Poland. Acidification of topsoil is regarded as the most widespread form of degradation of soil properties in Poland, and the extent is growing due to increasing N- and S-acid precipitation. As a basic remediation practise for counteracting the acidification of arable soils, liming have been widely used.

According to recent assessments, chemically contaminated land constitutes all in all about 2,7% (8,400 km^2) of the total land area of Poland. Other areas subject to various degradation factors and areas potentially subject to degradation including motorway side zones and other diffusely contaminated areas are all in all estimated at about 17% (53,000 km^2) of the total land area of Poland.

In December 1992, the first cost calculations were carried out for the remediation of the abandoned Soviet military sites. The calculations included the definition of standard clean-up costs according to the type of contamination and the type of technology applied. Ad-hoc measures to avert the highest risks at the abandoned Soviet military sites were calculated to amount to 104 million USD. The restoration of the environmental damage at all bases was calculated to amount to 2.4 billion USD.

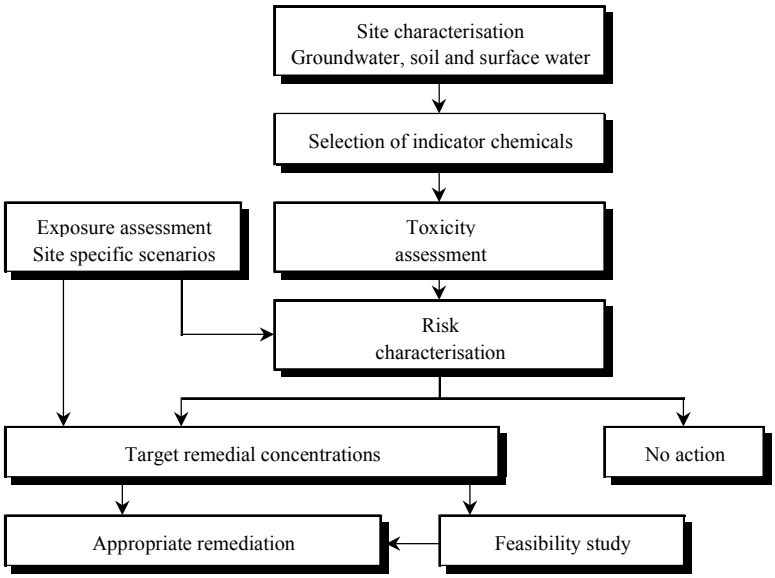
Priority in Relation to Other Societal Problems

Results of the investigations enabled undertaking the most urgent activities aimed at prevention of impact of the soil-water environment contamination on life conditions and human health. In particularly contaminated industrialised area (Upper Silesia), a common pure water supply system (from distant not-contaminated water intakes) has been organised, and organisational activities aimed at elimination of food and fodder made of plants particularly susceptible on heavy metals accumulation have been undertaken. Environmental protection issues are significant during preparation of spatial management plans and, as a consequence, during siting of health protection objects, educational objects, recreational objects, residential building objects, etc.

Illustrative Cases

The Czechowice Oil Refinery is situated in the southern part of the Katowice Province about 45 km from the city of Katowice. The refinery is located in a small town, where land uses include residential, recreational, agricultural, and industrial areas. The refinery has been in operation for about 100 years. Catalytic cracking processes are used to refine crude oil, and waste from acid refinery processes has been disposed off in lagoons. The waste product is a viscous semi-liquid hydrocarbon mixture, which is not completely characterised.

The Czechowice Oil Refinery was selected as a demonstration site for a risk assessment project conducted by the Institute for Ecology of Industrial Areas in Katowice in co-operation with US Department of Energy (DOE) and others. The risk assessment process used for remediation purposes includes site characterisation, selection of chemical indicators, toxicity assessments, site-specific human exposure assessments, risk characterisation, and development of remedial goals. A general flow-chart representing this is shown below.



The first step – site characterisation – has been completed. During the site characterisation, historical information and data on geology, hydrology, ecology, and local land use were collected. Mainly, the characterisation focused on soil and groundwater affected by refinery activities in the vicinity of the waste lagoons. Resulting from this, the extent of contaminants was determined.

The second step is the selection of chemical indicators, which are representative of the toxicity and environmental behaviour of the contaminants at the site. For the Czechowice Oil Refinery site, the BTEX, 6 PAH, and 9 heavy metals were selected as chemical indicators. For these chemicals, information on environmental occurrence, physical/chemical properties, and fate and transport in the environment were gathered.

By the next step – toxicity assessments – toxicological characteristics on each of the chemicals of concern were identified.

An important step of the risk assessment process is the exposure assessments. For the Czechowice Oil Refinery site, the exposure assessments have included determination of exposure scenarios, determination of factors associated with each scenario and collection of data to support each factor.

The next step is the risk characterisation, which combines the toxicity assessments with the exposure assessments in order to quantify the risks posed by a contaminated site under a given set of conditions. The risk characterisation is considered separately for carcinogenic and non-carcinogenic effects and includes the accompanying uncertainties.

If action is deemed needed as a result of the risk characterisation, site specific remedial goals (i.e. target concentration limits, TCLs) will be developed for selected environmental media. The remedial goals combined with results of feasibility studies will help to select the specific remedial technologies to be implemented at the site.

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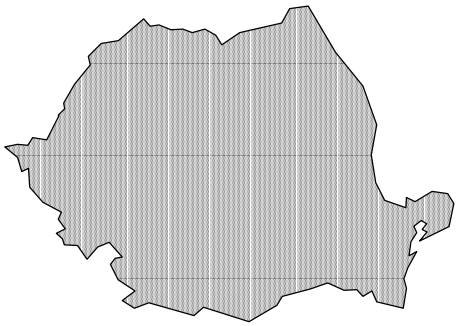
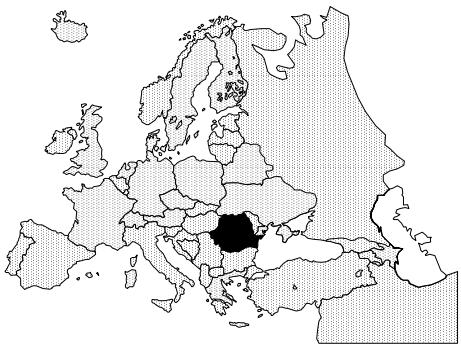
Romania

Country Characterisation





Background

Total area	Agricultural areas		Wooded areas		Nationally protected areas		Other areas	
km²	*km²*	*%*	*km²*	*%*	*km²*	*%*	*km²*	*%*
238391	148000	62	67000	28				

Figure on total area from UN/ECE, 1998.

Population	Population density	Annual pop. growth 1990 – 1995	Life expectancy at birth	
			Male	Female
1000	*per km²*	*%*	*years*	*years*
22570	95	-0,32	65	73

Figures from UN/ECE, 1998, and POPIN, 1999.

Legal and Administrative Basis

Definition of Contaminated Sites and Land

There is no specific definition for contaminated sites and land.

Legislation

The following documents are important legislation in respect to contaminated land:

- Law on Environmental Protection (Law no. 137/1995).
- Law on Waters: Comprise provisions on contaminated sites and land.

The Ministerial Orders and Government Decisions related to the Law on Waters contain some provisions regarding land contamination.

Furthermore, a Law on Waste is under discussion in the Parliament.

Implementation of Limit Values

The Ministerial Order (from the Ministry of Water, Forests and Environmental Protection) no. 756 was published in the Official monitor in November 1997. This Ministerial Order comprises the regulations on evaluation of pollution of the environment (water, soil and air). An annex of the regulations comprises the reference and maximum values of pollutant concentrations (alarming and intervention thresholds) in soil.

The Romanian standard no. 4706-88 gives the pollutant concentration limits for surface water quality classifications. The standard no. 1342-88 gives the limit values for drinking water quality.

Responsible Public Authorities

Mainly, the mayoralty, the EPAs, and the Ministry of Water, Forests and Environmental Protection are responsible for monitoring and inspection of contaminated land.

Registration

The project named “Landcover (CORINE Program)” comprises an inventory of contaminated sites.

Characterisation of Soil and Groundwater Contamination

Sources of Soil and Groundwater Contamination

The supervision of the groundwater quality of the main aquifers has been carried out by analysis of water samples collected from some 2000 observation wells, which are included in the national hydrogeological supervision network. To this can be added about 12000 further observation points mainly consisting of:

- Wells for monitoring of contamination located within the radius of potential pollution sources.
- Groundwater abstraction wells for water supply.
- Water wells mainly located within the rural localities.

Mainly due to a reduction, during the latest years, of certain intensely polluting industrial activities and also to a decrease of the quantities of agricultural use of chemical and organic fertilisers, a tendency towards improved groundwater quality has been observed.

In some areas, the aquifers are highly polluted with nitrate (NO_3^-) having concentrations above 45 mg/l, which is the maximum permissible concentration for drinking water in Romania. The causes of the nitrate contamination are complex. An important source is the continuos atmospheric precipitation of various nitrogen oxides (NO_x), which has been emitted to the atmospheric air. Another important source is water infiltrating from surface waters (rivers, lakes etc.) to which high loads of nitrates have been discharged. Also, the use of chemical fertilisers on certain types arable land is a source of nitrate contamination. In these areas,

nitrate concentrations of more than 100 mg/l are often observed.

Groundwater contamination with oil products has been found in areas near oilfields due to accidents along pipelines and lack of proper monitoring of produced and distributed amounts oil, as well as in areas near petrochemical plants and sites with storage of processed oil products.

Already in 1975, the National Integrated System for monitoring of soil quality was set up. A new monitoring system harmonised with other European systems was set up in 1992. The monitoring system includes 940 representative locations, of which 670 are in agricultural areas and 270 in areas used for forestry purposes. The locations are within 16x16 km^2 areas. The soil quality monitoring is organised at three levels: Identification of soil quality conditions, identification of causes of soil contamination, and identification of possible rehabilitation solutions.

Soil pollution in a broad sense is caused by several factors. All in all, for more than 12 million ha of agricultural land soils are subject to the influence of one or several polluters such as erosion, marshing, increasing salt contents, compaction, acidification, and contamination by chemical substances (pesticides, heavy metals, fluorides, oil among others.

Number of Registered Contaminated Sites / Contaminated Land Areas

The number of registered contaminates sites and land areas has been estimated to the following:

- Estimated number of contaminated sites: 1634.
- Estimated land area: 164000 ha.

It is noted that the data are provisional.

Investigation Methods

Identification of Potentially Contaminated Sites and Areas

The contaminated sites and areas are identified with the opportunity of an authorisation process of the activities of various titleholders.

Investigation of Contaminated Sites and Areas

The investigation of contaminated sites and areas is achieved by:

- The certified legal or physical persons who are used to prepare EIAs or Environmental Audits for their activities.
- The EPAs inspectorates.
- The RAAR (Regia Autonoma Apele Romane) inspectors.
- Mayoralties inspectors.
- By the site owners (self-monitoring).

The RAAR is an autonomous national company under the co-ordination of the Ministry of Water, Forests and Environmental Protection.

Facilities for Contaminated Soil

Handling and Treatment of Excavated Contaminated Soil

Up till now, no facilities exist for treatment or proper depositing of contaminated soil.

Measures Used by Remediation of Soil and Groundwater Contamination

Not applicable.

Financing and Liability

Investigation and Remediation Activities

No available data.

Legal Requirements re. Polluters and Site Owners

According to article 14 in the Law on Environmental Protection (Law no. 137/1995) polluters and site owners are required to recover the contaminated land.

Scope of the Problem

Scale of the Problem and Handling Costs

No available data. More studies are needed.

Priority in Relation to Other Societal Problems

Biological reconstruction of contaminated land is included as a priority issue in the Romanian strategy on environmental protection. There are some projects concerning contaminated sites and land provided in the Environmental Action Program on short term.

Illustrative Cases

An on-going project includes biological reconstruction of the Copsa Mica contaminated land.

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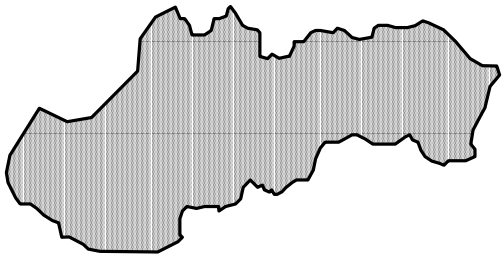
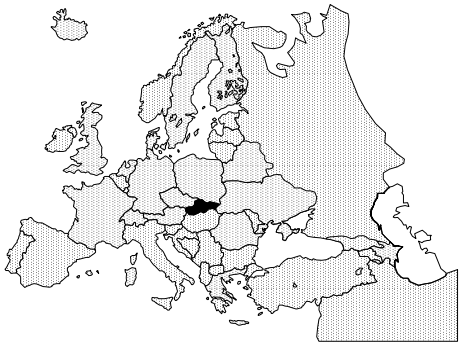
Slovakia

Country Characterisation





Background

The Slovak Republic was established on January 1st 1993 after a peaceful split of the former Czechoslovakia into two independent sovereign countries.

The Slovakian landscape, belonging entirely to the Carpathian mountain system, changes from the lowest point at 94 m above sea level at the Bodrog river near the state border to Hungary up to the highest peak at the Gerlachovský peak 2644 m above sea level. From a hydrological point of view, Slovakia is situated on the main European watershed; the water resources are among the poorest in Europe.

In general terms, Slovakia has a very complicated pattern of soil types due to a complex topography and geology. Soil contamination is partially caused by natural (geochemical) factors but in particular by man caused changes. Soil under natural conditions may contain some metals at phytotoxic levels. Such elevated concentrations of some heavy metals in Slovakian soils correspond to geochemically anomalous zones representing some parent rocks (basic and ultrabasic), hydrothermally altered mineralised rocks and secondary dispersion halos. On the other hand, however, there is predominant contamination around the mining and ore processing sites as well as in some industrial and urban centres. Though heavy metals have been accumulated in the soil around some mining areas for centuries, accelerated accumulation occurred during the rising industrialisation (the development of heavy industry after World War II and implementation of non-proper technologies). The composition, concentration and speciation of the risk substances in "hot spot" regions vary widely and may influence their behaviour in the soil.

Soil contamination as an environmental issue emerged in Slovakia at the end of the seventies when the first limits for some heavy metals (Pb, Zn, Cu and Hg) were accepted. The concern on soil contamination has grown gradually and at present results of several regional projects related to soil contamination are available. It is noted, that karst-groundwater is the main source for drinking water.

Total area	Agricultural areas		Wooded areas		Nationally protected areas		Other areas	
km²	*km²*	*%*	*km²*	*%*	*km²*	*%*	*km²*	*%*
49036	24400	50	19900	41	8216	20	4736	10

Figure on total area from UN/ECE, 1998.

Population	Population density	Annual pop. growth 1990 – 1995	Life expectancy at birth	
			Male	Female
1000	*per km²*	*%*	*years*	*years*
5381	110	0,37	68	76

Figures from UN/ECE, 1998, and POPIN, 1999.

Legal and Administrative Basis

Definition of Contaminated Sites and Land

There is no specific definition for contaminated sites and land.

Legislation

Given the aim that soil shall retain a multifunctional potential for use, an environmental policy plan has been developed. The Slovak environmental policy is not clustered in themes (acidification, eutrophication etc.) but rather in target groups (agriculture, transport, industry etc.) and environmental constituent groups (air, water, soil, food chain). This clustering has caused some competence problems. E.g. the Ministry of Agriculture is responsible for soil protection, while the Ministry of Environment guides other environmental constituent groups (air and water).

The most important laws and regulations concerned with soil in Slovakia are the following:

- Act No. 307 from 1992: Soil Protection Law.
- Act No. 309 from 1992: Air Protection Law.
- Act No. 238 from 1993: Water Law.
- Act No. 287 from 1994: Environment Protection Law.
- Act No. 127 from 1994: Environment Impact Assessment Law.

Clean-up measures are decided based on the Water Act of 1973 or the Act on Soil Quality Criteria in Agriculture of 1992.

Furthermore, after January 1993 a National Act on Waste management was issued, defining measures for waste reduction, waste recycling, safe waste disposal and remediation of unsafe waste sites.

Based on these and other laws, the program document National Environmental Policy and National Environmental Action Program was developed in 1995 by the Ministry of Environment. Soil, however, was not integrated into this program, so in fact no integrated environmental policy plan exists.

The “polluter pay principle” is part of the national environmental policy.

Implementation of Limit Values

Within the law on soil protection, target values or permissible levels for risk elements in soil were introduced. For this purpose, the former Dutch ABC-list was adapted in 1994. The defined values are supposed to support the decision making process of the local authorities.

The B values are usually applied as remediation targets. In groundwater protection areas, however, A values should be applied as remediation targets. With regard to soil gas, the C values of the Dutch list are used as intervention values.

Quality criteria for surface waters are defined in the decree 242/93, which are to be used as target values for abstracted groundwater.

At present, new limit values are elaborated related to application of sewage sludge and sediments from water dams.

Policies on soil clean-up are more linked to land reclamation and only loosely coupled to preventive environmental policies.

Responsible Public Authorities

At a general level, the Ministry of Agriculture is responsible for soil protection, and the Ministry of Environment guides other environmental constituent groups (air and water).

The Ministry of the Environment is responsible for:

- Compliance to environmental law.
- Definition of fines for environmental misdemeanours.
- Environmental inspection.
- Consultancy to the Ministry of Defence concerning clean-up of Soviet military sites

The general policy of the Environment Ministry with regard to soil protection is oriented to agricultural land use and specifies that the quality of soil must not be impaired compared to the background values. Impairment of soil quality and soil erosion must be prevented.

Furthermore, Environmental Departments exist both at the regional level and at the district level.

The Ministry of Defence is responsible for the clean-up of military sites of the former Soviet army, of the former Czechoslovakian Army, and of the current Slovakian National Army.

Registration

Up to now there are no inventories on contaminated sites except for sites of the former Soviet Army.

However, several projects have been initiated, among others in relation to mapping of soil:

- Geochemical mapping of soil in Slovakia started in 1991. Within this project, agricultural and forest soils were sampled all over the Slovakian territory with a grid of 1 sample per 10 km^2. The samples are analysed for the content of 36 metals and inorganic elements. The project is finished and about to be published. The mapping has been conducted within the frame of a major national program "Geochemical Atlas of Slovakia", which includes the following media: Stream sediments, soils, radioactivity, forest biomass and rock types geochemistry. This provides the sound basis for the rational evaluation of the main environmental problems within the country.
- Soil monitoring has started some years ago. Within the frame of this project, contamination problems have been addressed. The content of some chemical elements, PAHs and mineral oil has been monitored.
- Agrochemical soil testing which is already made for agricultural soil aiming primarily at investigating available nutrients (N, P and K), pH and carbonate status. Later the testing has been extended to include also some extractable forms of heavy metals (Cr, Cd, Hg and Pb).
- Regional geochemical mapping of surface soils showing the distribution of chemical elements in some industrial regions.

Characterisation of Soil and Groundwater Contamination

Sources of Soil and Groundwater Contamination

The potentially worst contaminated areas are located around the industrial centres comprised of middle Spis region (Krompachy and Rudnany), Ziar and Hronom region, Jelsava-Lubenik, Hacava-Hnusta, and lower Orava region. The regions of upper Nitra, Ruzomberok, Kosice, Strazske-Humenne-Vranov, and Vojany are considered far less contaminated.

Middle Spis is a common name for the immission areas of the metal works in Krompachy town and iron ore mines at Rudnany. These immission areas overlap each other. In 1986, the metal works in Krompachy emitted some 20000 tonnes of SO_2, 1400 tonnes of dust, and 90 tonne of arsenic (As). Other heavy metals (Cu, Hg, Ni, Cd, Pb and Zn) are also present in the emitted dust. The situation has radically changed after substantial improvement of production technology leading to about 50% decrease in the emissions. The contaminated land area is estimated to about 11000 ha. At Rudnany, the worst problem was the mercury (Hg) production. Due to this, mercury was spread in the surroundings and is present in the soils, watercourses etc. The contaminated land area is not known but may be several thousands ha.

The aluminium works at Ziar and Hronom are sources of contamination with fluorine together with Hg and As. It is estimated, that the fluorine content exceed the limit (10 mg/kg) for about 3700 ha of land. In 1995, a new technology was introduced. Following this, substantial improvements regarding the contaminant emissions are expected.

Soil in the areas of two other regions (Jelsava-Lubenik and Hacava-Hnusta) is contaminated by Mg and some heavy metals from magnesit works. The contamination was caused by emissions of large amounts of dust sedimenting on the soil in the surroundings. All in all, it is estimated that in these two regions about 21000 ha of land is contaminated.

The lower Orava region is known for ferro-alloys factories (Istebné) in which about 13 different alloys were produced. At present new technologies are applied, but it is estimated that in the past emissions of primarily Cr and Mn caused the contamination of about 13000 ha of land.

In the region of upper Nitra, As and Hg are the main contaminants in areas surrounding the chemical factories and the local electric power station. At Kosice, soil is contaminated by some heavy metals due to emission of dust from iron works.

For all of the above-mentioned areas, SO_2 is also an important contaminant. At Ruzomberok, SO_2 is actually considered the main problem as the soils are only slightly contaminated by heavy metals. In all the regions also non-point sources for contamination exist.

Based on the present data, it is estimated that soil of about 180000 ha of land in Slovakia is contaminated on various levels. New recommendations for the use of such areas are elaborated at present. Regarding metals, the following elements are considered as risk elements: As, Ba, Cd, Co, Cr, Cu, Hg, Ni, Pb, Sb, Se and Zn.

Within the soil monitoring program, mostly PAHs have been detected. Other organic contaminants have been indicated sporadically (so called point by point local contamination).

Based on available data it is generally estimated that about 70% of Slovakian land are not contaminated. About 28% of the land is to be classified as risky as the content of one or more of the risk elements in the soil is above the A-values but lower than the B-values. Land where the content of risk elements in the soil is above the B-values is estimated about 1,4%, and land with soil contents above the C-values is estimated about 0,4%. As far as agricultural land is concerned it is estimated, that not more than 30000 ha is contaminated meaning that in general more forest soils are contaminated.

Concerning the former Soviet military sites, the most frequently occurring problems are usually kerosene, diesel and fuel contamination due to handling losses and leaking subsoil tanks, spills deriving from car maintenance facilities, and fuel stocks of garrisons.

Number of Registered Contaminated Sites / Contaminated Land Areas

There is no inventory of contaminated sites or land areas. However, the registration of contaminated sites of the former Soviet Army was made available.

A registration of landfills has been made. By 1996, 6370 waste landfills were registered, about 500 of these are still being in operation.

Investigation Methods

Identification of Potentially Contaminated Sites and Areas

Two programmes for a systematic identification of potentially contaminated sites have been established referring to:

- Potentially contaminated sites of the former Fuel Monopoly Benzinol.
- Potentially contaminated sites at former Soviet military sites.

In both cases, the obtained data were not joined to central information systems.

For the former Soviet military sites, the first pre-assessment activities started with the withdrawing of the Soviet Union forces under the supervision of a Czechoslovakian Commission between July and September 1991. The results of the pre-assessments were:

- 87 potentially contaminated areas were identified at 18 military sites.
- 13 out of the 18 military sites were further investigated.
- Based on the first results the remediation action (soil remediation, groundwater treatment, and hazardous waste disposal) has been undertaken.

The first pre-assessment of the former Soviet military sites included on-site visits to assess the different military land uses and the condition of the buildings. Based on the obtained findings, answers to the beneath aspects were deducted and integrated to a final report to the Ministry of Environment:

- Identification of potentially contaminated sites.
- Estimation of the contaminated soil volume.
- Identification of the source of contamination.
- Type of contamination.
- Concentration of contaminants.
- Definition of appropriate remediation technologies.
- Definition of target values for remediation.

Concerning the Slovakian military sites, the Dutch Ministry of Defence in 1990 - 93 supported a programme to identify potentially contaminated sites at military sites of the former Czechoslovakian Army. In total, 57 military sites were pre-assessed, and 2 sites were investigated in more detail. The pre-assessment included a standard questionnaire, and the collection of historical data.

Investigation of Contaminated Sites and Areas

At the former Soviet military sites, 87 potentially contaminated areas at 18 sites were selected for detailed investigations. Samples were collected from soil, groundwater, surface waters, and disposed wastes.

Soil samples were collected from the soil surface and from drillings made for the set-up of groundwater monitoring wells. Groundwater samples were collected from existing wells at the sites or in the vicinity. In specific cases new groundwater wells were set-up for continuos monitoring. The most frequently applied chemical parameter for the sample analysis was the content of total hydrocarbons followed by phenols, cyanides, aromatic hydrocarbons and chlorinated hydrocarbons. For the investigation of hygienic conditions microbiological methods were frequently applied, especially examination for faeces bacteria.

For the Slovakian military sites, it is previewed to investigate the sites on a step by step basis:

Step 1: Detailed investigations and risk assessment.
Step 2: Remediation activities if necessary.

Facilities for Contaminated Soil

Handling and Treatment of Excavated Contaminated Soil

For the treatment of contaminated soil, several technologies have been applied (bioremediation and disposal).

Measures Used by Remediation of Soil and Groundwater Contamination

For the former Soviet military sites, the pre-assessment reports included recommendations for clean-up measures. The general procedure is to remove the source of contamination, usually removal of tanks, fixing of leaking pipelines, and removal of unsafe waste disposals.

The most frequently applied remediation technologies for soil contamination are:

- Excavation and disposal of excavated soil.

- On-site microbiological treatment of excavated soil.
- Off-site microbiological treatment of excavated soil.

The most frequently applied technologies for groundwater contamination are:

- Groundwater draining.
- Groundwater extraction and separation of free oil phase.
- Groundwater extraction and stripping of VOCs.
- Set-up of groundwater barriers (after extraction of contaminated groundwater).

Financing and Liability

Investigation and Remediation Activities

The Slovakian Ministry of Defence is liable for the contamination at all military sites.

With respect to the former Soviet military sites a special national fund was established. Regarding the military sites of the former Czechoslovakian Army and those of the current Slovakian National Army clean-up measures have to be covered by the budget of the Ministry of Defence.

Legal Requirements re. Polluters and Site Owners

Several legal acts have been adopted in order to help new property owners – but in practice legal basis is not sufficient. Most of the historically polluted sites are in the ownership of the state (e.g. former Czechoslovakian military sites are now occupied by the Slovak Army).

Scope of the Problem

Scale of the Problem and Handling Costs

Total clean-up costs concerning the environmental damage at the former Soviet military sites was estimated to amount to 44 million USD up to the year 2005. More than half of this amount (26 million USD) is exclusively dedicated to the clean-up of Sliac-Vlkanová site.

The annual public budget for the former Soviet military sites amounts only to 5 million USD per year.

Priority in Relation to Other Societal Problems

At present Slovakia faces the common problems for all countries in transition: The decreasing of industrial activities, increasing of unemployment and worsening of soil management and farming. This is mostly due to restructuring of the industry and cancelling of some industrial programmes (steal industry, weapon industry) and due to lowering of the state subsidy to the farmers.

Illustrative Cases

The Sliac-Vlkanová site is one of the largest former Soviet military sites with the heaviest contamination. The identified contamination represents more than half of the total contamination of all former Soviet Union military sites in Slovakia. The site is situated in an important groundwater protection area and is located next to an important spring for mineral water. The site was used as airbase. It has been investigated in detail:

In total, 14 heavily contaminated spots have been identified, amounting approximately 130,000 m² and ~ 200,000 m³ soil. Soil samples contained hydrocarbons with peak values of up to 16 g/kg. Apart from aliphatic hydrocarbons, contamination with chlorinated hydrocarbons was also found in the groundwater.

The first clean-up measures already started in 1981, being remedial pumping of groundwater and oil separation. After the withdrawing of the Soviet forces, remediation measures were improved.

Up to 1995 the total amount of kerosene separated from the groundwater amounted to 550,000 l.

Soil contaminated with hydrocarbons is excavated and biologically treated on site. After achievement of the remediation targets, the soil is usually refilled.

Groundwater extraction is carried out at 25 to 30 wells. The extracted groundwater is cleaned via oil separators, and filters with activated carbon. The treated groundwater is usually re-infiltrated at the site.

Clean-up measures are planned to continue to the year 2000.

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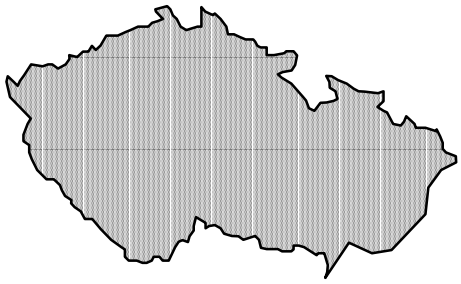
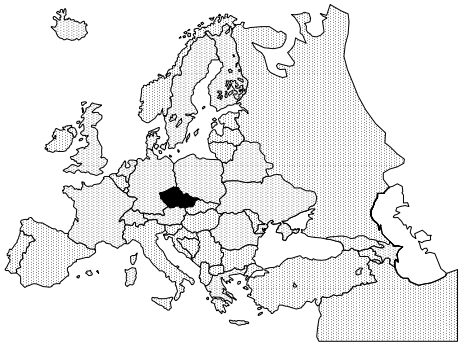
The Czech Republic

Country Characterisation





Background

The independent Czech Republic was founded in January 1993, when the former Czechoslovakia was split in two parts - the Czech Republic and Slovakia.

As a consequence of industrial and agricultural activities the geological environment and groundwater are contaminated at a number of locations. Significant contamination has been caused particularly by the chemical, petrochemical, metallurgical industries as well as by coke producing and brown coal and uranium mining and milling industries. Contamination of smaller extent due to improper handling of petroleum products and deposition of waste are evident at numerous enterprises.

The strategy for tackling environmental burdens from the past is based on the principles of the environmental policy. One of the basic principles consists in finding a socially acceptable level of environmental and health risk. This approach is based on the fact that the attaining of "zero risk" (e.g. absolute elimination of the contamination) is not always necessary from the standpoint of the environment and is usually associated with disproportionate costs. The actual degree of risk following from an environmental burden can be determined only on the basis of detailed analysis. A second important principle underlying the entire process is evaluating and remediation of burdens in relation to the expected use of the territory (as clean as reasonable for use).

It is noted, that groundwater is the main source for drinking water. Landfilling is the most common manner of waste disposal.

Total area	Agricultural areas		Wooded areas		Nationally protected areas		Other areas	
km²	*km²*	*%*	*km²*	*%*	*km²*	*%*	*km²*	*%*
78866	43000	55	26000	33				

Figure on total area from UN/ECE, 1998.

Population	Population density	Annual pop. growth 1990 – 1995	Life expectancy at birth	
			Male	Female
1000	*per km²*	*%*	*years*	*years*
10304	131	-0,02	70	77

Figures from UN/ECE, 1998, and POPIN, 1999.

Legal and Administrative Basis

Definition of Contaminated Sites and Land

Contamination is a stage of nature when different parts of the environment (soil, groundwater, geological environment etc.) contain the pollution of an anthropogenic origin as chemicals strange to the given environment with their composition, concentration or volume.

Contamination is defined by different legal regulations and decrees both for contaminated sites and land. Generally speaking, contaminated sites are localities where the content of pollutants exceeds the regulatory limits given by the law or similar legal tools.

Legislation

The new Czech Constitution was established on 16 December 1992. The Act on the Environment (Act No. 17/1992) was adopted from the Federal law, as it was done for many other legal provisions. A new environmental policy was adopted in August 1995.

In the Czech Republic there is no independent law dealing with contaminated sites. At present, contaminated sites are covered primarily by the following legal documents:

- Act No. 138/1973 Coll.: The Water Management Act.
- Act No. 125/1997 Coll.: The Waste Management Act (replacing the former federal Waste Act No. 238/1991 Coll.).
- Act No. 92/1992 Coll.: The Privatisation Act.
- A New Water Quality Decree of 1992.
- A New Environment Policy of 1995.

Protection of agricultural land fund (ALF) is provided by the Act No. 334/1992 Coll., and by the Decree of the Ministry of the Environment No. 13/1994 Coll.

The privatisation of public properties initiated the requirement to conduct environmental audits (Eco-Audits) at the properties of interest. This requirement is laid down in the Privatisation Act of 1992. The act includes several Decrees specifying the systematic approach of Eco-Audits, liability and remediation criteria.

As this situation is not completely satisfactory, the Ministry of the Environment is preparing an independent law on soil protection.

Implementation of Limit Values

Aiming at the implementation of the requirement for environmental audits for privatised companies given in Act No. 92/1991 S.B., a joint methodical decree has been issued by the Ministry for the Administration of National Property and Its Privatisation and the Ministry of the Environment. The Decree (No. 393/94) defines the Czech ABC values for soil, soil air, and groundwater corresponding to background values, intervention values and urgent intervention values. The decree has two parts:

- Requirements on ecological audit focused on assessment of contamination (Eco-Audits).
- Standards re. pollution of soil and groundwater (guideline limit values for soil, soil gas, and groundwater).

Responsible Public Authorities

The highest environmental authority in the Czech Republic is the Ministry of Environment. It is responsible for identification, assessment and clean-up of contaminated sites. Especially, the Ministry is responsible for the federal environmental policy, legislative tools and guidelines for the entire process.

The Regional Departments of the Ministry have an authority and responsibility for the administrative tasks related to the environment of their regions.

The Section of Technical Protection of the Environment and its subordinated Divisions i.e. the

Environmental Damage Division, the Division of Environmental Impact Assessment (EIA) and The Division of Waste Management are dealing with the management of technical protection of the environment, designing and supervising the remediation programmes and control the clean-up activities at the contaminated sites.

The Ministry of Defence controls the clean-up activities at military sites.

The Czech Inspection of the Environment (CIZP), in total 42 offices, enforces the environmental laws.

An Environmental Damage Assessment Committee co-ordinates site investigations at former Soviet military sites and consists of representatives from:

- The Ministry of the Environment.
- The Ministry of Finance.
- The Ministry of Agriculture.
- The Ministry of Industry and Trade.
- The Ministry of Defence.
- Experts from relevant engineering companies.

The National Property Fund is responsible for:

- Privatisation.
- Together with the Regional Authorities environmental audits are carried out and the needs for clean-up measures are assessed. The tendering of companies dealing with the remediation projects is carried out.

Registration

Up to now, there is no complex inventory for all contaminated sites. However, the Ministry of Defence registers contaminated sites of the Czech Army. Registration of waste dumps and landfills has been started by one of the District Offices in 1995 by use of questionnaires. Registration of contaminated sites including waste dumps and landfills has been organised by the Ministry of Environment as a research project. Ten districts have been selected and involved in the first phase of this project.

The National Property Fund (NFP) has its own registration of those contaminated sites, where remediation is financed by NFP and covering sites that were privatised according to Act No. 92/1991.

The GEOFOND Czech Republic is responsible for the information system covering the national parks, nature protected areas, old mining sites, inventory of minerals and their evaluation regarding reserves and use, protected areas of mineral resources, etc.

Characterisation of Soil and Groundwater Contamination

Sources of Soil and Groundwater Contamination

The following types of contaminated sites can be distinguished:

- Sites where contaminant concentrations exceed the Dutch C limits or the Czech drinking water standards.
- Former Soviet Army bases left after the departure of the army in 1991.
- Contaminated sites and areas affected by mining and milling of minerals (North Bohemian brown coal basins, North Moravian pit coal basin, areas affected by uranium mining and milling, waste dumps, tailing impoundments, etc.)
- Other contaminated sites when contaminant concentrations in soil, rocks, groundwater, waste, soil gas and buildings pose a risk as assessed by the Czech Inspection of the Environment.

Experiences show that the following substances are considered to be most important:
Petroleum hydrocarbons, chlorinated hydrocarbons, PCBs, pesticides, heavy metals, radionuclides and other toxic substances.

Number of Registered Contaminated Sites / Contaminated Land Areas

-

Investigation Methods

Identification and investigation as basis for risk assessment

Experiences show that the most prevailing problem is insufficient quality of environmental audits and risk analysis, i.e. the provision of proper data for qualified decision making on remedial measures. Aiming to eliminate these inadequacies, the Ministry of the Environment has developed the following guidelines so far:

- Environmental audit. The guideline provides detailed requirements on the content and form of the audit including guidelines for investigation methods and methods for evaluation of results. The audits have two stages. In stage I, data are collected by studies of available information e.g. from the enterprise in question, the federal authorities, archives, and scientific institutions. Stage II focuses on obtaining lacking data. Stage II includes investigation e.g. of contaminated soil and groundwater. Obtained data are used for completion of risk analysis.
- Risk analysis of contaminated land. The concept for risk analysis was firstly incorporated in the Government Decree No. 393/94, however, without specification of detailed requirements. The purpose of the guideline is to establish requirements on the content and form of completion of risk analysis. The guideline has two basic principles. By the first principle, the assessment is made in accordance with the actual or expected use of the land (suitable for use). By the second principle, the assessment is made in relation to multifunctional use of the land. The guideline establishes a procedure for risk assessment carried out in four following main steps (identification of hazards, assessment of exposure, establishing dose-response relationships, and risk characterisation). For each of the steps, the essential volume of data and requirements on data quality is prescribed.
- Criteria for decontamination of contaminated soil and ground water. The purpose of the guideline is both to define the means of the criteria application and the delimitation of the criteria considering increasing scientific knowledge and specific natural conditions. The following criteria are defined:
  - **A**: Correspond approximately to the natural contents of the substance in question in natural soil.
  - **B**: The contamination can have a negative impact on the health of humans and the environment. Criteria B levels are given as intervention levels.
  - **C**: Correspond to urgent intervention levels. Further investigation and risk analysis should be performed as serious risk for the health of humans and the environment exists.
- Supervision.

Furthermore, elaboration of the following guidelines has begun:

- Assessment stage. Guideline dealing with cost-benefit analysis, feasibility studies, sampling, and geophysical surveys.
- Clean-up stage. Guideline dealing with planing and implementation of clean-up activities, up-dated risk analysis, and monitoring.

Facilities for Contaminated Soil

Handling and Treatment of Excavated Contaminated Soil

Controlled disposal of contaminated soil in landfills has been used. Furthermore, several on-site or *ex-situ* treatment methods have been used (see below).

Measures Used by Remediation of Soil and Groundwater Contamination

It is expected that by the year 2000 remediation will be accomplished at most of the 60 contaminated Soviet Army bases. The clean-up of the largest of these – Mladá-Milovice and Ralsko Hradèany – is expected to last until 2006 – 2008.

The eight largest contaminated Czech military sites being returned to civilian use are expected to be remediated by 2000 – 2005. Five other large contaminated Czech military sites that will still be used by the army are also expected to be remediated by 2000 – 2005.

Experience has been gained by use of numerous remedial technologies, e.g.:

- On-site or ex-site treatment by bioreclamation of soil contaminated with hydrocarbons.
- On-site or ex-site treatment by soil washing of soil contaminated with heavy metals.
- On-site or ex-site treatment by incineration of soil contaminated with hydrocarbons.
- On-site or ex-site venting of soil contaminated with hydrocarbons and chlorinated hydrocarbons.
- On-site or ex-site stabilisation/solidification of soil contaminated with hydrocarbons.
- *In-situ* soil vapour extraction for soil contaminated with hydrocarbons and chlorinated hydrocarbons.
- *In-situ* encapsulation of soil contaminated with various contaminants.
- Pump and treat methods for groundwater contaminated with various contaminants.
- *In-situ* airsparging of groundwater contaminated with hydrocarbons and chlorinated hydrocarbons.
- Auxiliary *in-situ* methods: Air and hydraulic fracturing, will blasting, soil hearing, and surfactant flushing.

The most frequently applied method for soil remediation is excavation of soil, and soil treatment on the site. The most frequently applied methods for groundwater remediation are groundwater extraction and VOC stripping in the case of VOC contamination, and oil separation in the case of hydrocarbon contamination.

Factors influencing the choice of remedial methods include hydrogeological and physical soil properties, chemical/physical properties of contaminants, target concentrations for the clean-up, amount of contaminated soil, buildings and roads etc. at the contaminated site, remedial time, and costs.

The most cost-effective and reliable method for cleaning of soil contaminated with hydrocarbons is estimated to be on-site or ex-site bioreclamation. For sites contaminated with both hydrocarbons and chlorinated hydrocarbons, the most effective method is estimated to by soil vapour extraction. Pump and treat methods are reliable and versatile, but their cost-effectiveness decreases with time due to the decrease of contaminants concentrations. On-site or ex-site incineration of contaminated soil is expensive, and until now has only been used for very harmful substances.

The Ministry of Environment provides grants for topics of environmental assessment and remediation methods for research, development and demonstration projects.

Financing and Liability

Investigation and Remediation Activities

The Government Decrees No. 455/92 Coll., No. 123/93 Coll., No. 393/94 Coll. and No.810/97 Coll. give a systematic approach to deal with the responsibility and financing of assessment and clean-up of old cases of contamination.

There are three sources of public financing for environmental projects in the Czech Republic:

- the State Budget
- the State Environmental Fund (mainly based on pollution levies, e.g. for emissions and waste disposal)
- the National Property Fund (based on means from privatisation)
- clean-up activities at military sites of the former Czechoslovakian army are funded by the Ministry of Defence.

Environmental Burdens from the Past

The above-mentioned Law No. 92/192 Coll. on the conditions for the transfer of state property to private persons constitutes a significant step towards dealing with environmental burdens of the past. §6a of this act requires the preparation of an environmental audit as part of the privatisation project. If the environmental audit reveals the existence of serious burdens, the new owner of the privatised property, to which the burden

is bound, may request the conclusion of an environmental agreement on funding for remediation. The Department of Environmental Damages of the Ministry of Environment (hereinafter DED) evaluates the substantiation of the request from the standpoint of whether the existence of the burden is adequately demonstrated and whether the burden constitutes a significant risk for human beings and the environment. Fulfilling of these criteria is a condition for issuing a favourable standpoint. A favourable standpoint of DED on the environmental audit is thus a necessary condition for NPF to recommend the concluding of an agreement to the Government. Along with the recommendation from NPF, the fulfilling of further conditions is also evaluated, such as the condition that the request for concluding of an agreement be submitted prior to making a decision on privatisation, and others. If the Government agrees with the concluding of an agreement, NPF or Land Fund (LF) concludes an environmental agreement with the new owner.

In order to ensure a uniform method for the evaluation of the obligations of enterprises from the standpoint of the environment, the Ministry of Environment and the Ministry for Administration of National Property and Privatisation (MANPP) jointly issued a methodical instruction in 1992. Part of this instruction also consists in the standpoint of the Ministry of Environment on indices and standards for contaminated soil and underground water; this was amended in 1996 (Bulletin of ME, 1996, Volume 3).

In the agreement NPF pledges that it will pay the new owner purposefully expended costs for compliance with environmental obligations. For these purposes, environmental obligations are understood to consist in obligations following from an administrative decision imposed pursuant to the special regulations by the pertinent state administrative body. In this case, this consists in measures for remedy imposed pursuant to § 27 of Law No. 138/1973 Coll., on waters, in the wording of later regulations. Measures for remedy are imposed by the pertinent District Inspectorate of the Czech Environmental Inspection.

Scope of the Problem

Environmental Burdens from the Past

According to Law No. 92/192 Coll. concerning the privatisation of properties, some 5500 environmental audits and 200 risk analyses have been completed. As a result a significant burden in about 10% of privatised companies has been identified. Damages exceeding 500 mil. CZK (13 mill EUR) have been estimated in about 50 cases and damages of some 1 bill. CZK (26 mill EUR) in 10 cases. Up to now, a total of 270 agreements has been concluded on payments for environmental obligations between NPF or LF and new owners. At the present time about 70 decontamination projects are being carried out and a number of others are in preparation. The estimated costs for decontamination are about 35 bill. CZK. (920 mill EUR) In 1997, the expenditures of NPF for resolving environmental obligations corresponded to the sum of 3 bill. CZK (79 mill EUR), and of 2 bill. CZK (53 mill EUR) in 1998. This states one of the largest investments for improvement of the environment in the Czech Republic.

Chemical Mining of Uranium

As a consequence of the chemical mining of uranium, a total of 260 mil. m^3 of groundwater was contaminated. The total weight of waste with PCB content greater than 50 ppm is estimated at 15.000 t and the weight of used oil containing PCBs up to 50 ppm is estimated at about 50.000 t.

Illustrative Cases

Uranium mining and milling

According to international statistics, the Czech Republic belongs to the areas with the strongest impact of extraction of minerals both at European as well as at worldwide scale. Due to extensive and in many places haphazard exploitation of minerals, high population density and extensive industrial activities in the last 50 years the ecological stability in many regions of the Czech Republic has been completely destructed.

One of the negative impacts of past and recent mining of minerals, among many other environmental issues, is uranium in-situ leaching in Stráž pod Ralskem. This mine is situated in Cretaceous sandstone, which build up a platform over northern Bohemia and represents a reservoir of drinking water for the Czech Republic.

The quantity of about 4 mil. tons of acids and other chemicals were injected into the leaching fields of Stráž pod Ralskem deposit in the past 25 years, which affected a total of 188 mil. m^3 of ground water in the area of 28 square km. Technological solutions from in-situ leaching fields dispersed horizontally and vertically not only within the cenomanian horizon, where the uranium minerals are present, but also along the not properly sealed extraction boreholes and tectonic lines up to the turonian aquifer of drinking water.

The following Government Decrees have been issued regarding this problem:

- No.366/1992 - Complex evaluation of chemical mining in North Bohemian area. A program for closing ISL and remediation of uranium mines.
- No.429/1993 - Concept of the recession program of underground mine Hamr and its "dry" conservation.
- No. 244/1995 - Realisation of restriction of uranium mining and milling in the Czech Republic.
- No. 170/1996 - issued to the Final Report about the remediation of the chemical extraction of uranium in Stráž pod Ralskem. It announced the end of chemical uranium extraction started from 1 April 1996 and the duty for the Ministries involved to submit each following year the progress report about the remediation program.

The financing of restoration program was covered by the state budget with support from international sources (EC, PHARE, Dutch Government, Danish Government, and IAEA). The analysed problem is unique all over Europe in its size and timescale.

The remediation programme, which has started in Straz pod Ralskem in 1992, represents an excellent example of the co-operation between the uranium producer DIAMO s.p. and state administrative bodies. This co-operation is even more valuable knowing that the problem of uranium ISL and the necessity of its remediation was recognised as a very serious environmental problem at European scale. The help of EU and IAEA experts during the preparation of the analysis of the problems was also highly appreciated.

Military sites

The presence of the Soviet Army on the territory of the Czech Republic led over the past 50 years to significant environmental damages. Payment for these cases comes entirely from the state budget without any contribution from the countries of the former Soviet Union. In 1991, the directing of this activity was entrusted to the Office for Dealing with the Consequences of the Presence of the Soviet Army on the Territory of CSFR and, following the division of Czechoslovakia, this jurisdiction passed to the Ministry of the Environment of the Czech Republic. Thermal treatment is carried out within the sector of the Ministry of Defence.

A total of 73 locations, formerly occupied by the Soviet Army, have been delimited in the Czech Republic. In the first stage, the extent of damage at these locations was investigated. Only 12 locations were found to be free of damage. Further studies were concerned particularly with locations with danger of emergencies (danger to groundwater, spreading of contamination). A number of cases have been identified of serious contamination of the geological environment and underground waters, especially by petroleum hydrocarbons (primarily automotive fuels - gasoline, diesel fuel, aircraft kerosene), chlorinated hydrocarbons and ammunition. The most serious contamination was found in the areas around airports, oil management centres, unsecured dumps and dry cleaning plants.

So far, a total of almost 900 million CZK (24 mill EUR) has been devoted to liquidation of environmental damage and it is expected that completion of decontamination will require further 500 million CZK. At the present time, the annual budget for decontamination of locations formerly occupied by the Soviet Army corresponds to a sum of 90 - 100 mil. CZK (2,4 – 2,6 mill. EUR) p.a. This amount does not cover the full requirements for decontamination and permits only decontamination of the most high-risk burdens. At the present time, decontamination is proceeding at 14 locations.

One of the most highly affected areas is the Ralsko area in Northern Bohemia, especially the locality of the former Hradčany airport, where decontamination will continue to the year 2008. The special sensitivity of this area is a result of the fact that it lies in the North Bohemian Cretaceous Protected Natural Water Accumulation Area.

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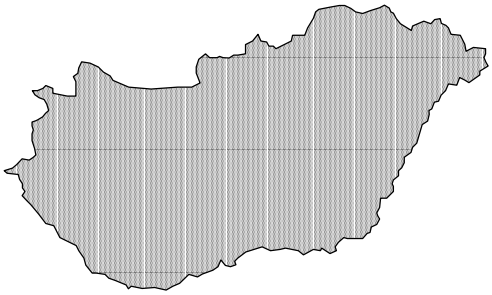
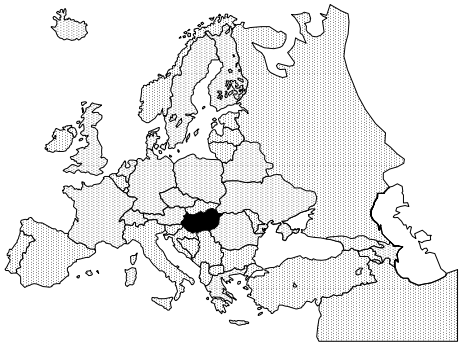
Hungary

Country Characterisation





Background

Economic growth, especially vigorous industrial development took place in Hungary without the constraints of strong environmental protection regulation up to the end of the seventies and the beginning of the eighties. Due to economical difficulties of this time, only insufficient means could be spent on environmental protection measures causing among others a gradual accumulation of non-degradable and of slowly degradable contaminants in soil and groundwater at many industrial sites. In Hungary, the environmental problems were recognised about ten years ago. Hard preparation work preceded the start of a remediation programme.

Contamination of soil and groundwater is obviously less perceptible than smoke-emitting factory chimneys, petrochemical city-smog, or dead fish in oil polluted river. But human health can be threatened by consumption of contaminated drinking water, garden grown vegetables etc. This long-term environmental damage constitutes one of the factors of environmental pollution that has an unfavourable effect on public health and, ultimately, life expectancy.

The first experience in Hungary in remediating environmental damage was directed at former Soviet military bases. In 1991, the Government made a short and medium term action plan identifying the tasks of surveying, assessing, and eliminating accumulated contamination present at abandoned Soviet barracks, training grounds and other military sites. The plan can be considered as the starting point for the remediation programme. The investigation of the abandoned sites showed that immediate clean-up measures were needed at 20 of the 171 sites. Now, the remediation of the most contaminated former Soviet military sites is expected to be complete within several years.

Total area	Agricultural areas		Wooded areas		Nationally protected areas		Other areas	
km²	*km²*	*%*	*km²*	*%*	*km²*	*%*	*km²*	*%*
93030	53957	59	15815	18	7443	8	13955	15

Figure on total area from UN/ECE, 1998.

Population	Population density	Annual pop. growth 1990 – 1995	Life expectancy at birth	
			Male	Female
1000	*per km²*	*%*	*years*	*years*
10153	109	-0,49	66	75

Figures from UN/ECE, 1998, and POPIN, 1999.

Legal and Administrative Basis

Definition of Contaminated Sites and Land

Soil and groundwater is contaminated if the concentration of the harmful substances exceed the threshold (B) limit values.

Legislation

A soil and groundwater act is in preparation and will be passed by the end of this year. The policy documents as specified beneath are currently the most relevant for the management of contaminant soil and groundwater.

- The Environment Act LIII on the General Rules of Environmental Protection was in force in 1995. The Act can be seen as a key policy document, which stipulated a variety of decrees on specific environmental issues. The Act defines the administrative system of the execution of environmental law and defines measures to prevent pollution in the future. One of the key issues of the Act is the establishment of a license system based on the idea that the "use" of the environment needs appropriate control. Activities having significant impact on the environment require the completion of an Environmental Impact Assessment and to issue an Environmental License.
- The Privatisation Act of 1992. Before privatisation of public property, environmental damage and costs of necessary remediation activities need to be defined and liability issues to be clarified.
- The Remediation Act of 1991, which lays down the need for clean-up of 20 former Soviet military sites and the public funding of this.
- The National Environmental Programme of 1997, which was stipulated by the Environment Act, includes a National Remediation Programme.

The National Remediation Programme started in 1996 with the objective to assess contaminated areas, to identify and to eliminate environmental damage that falls within the scope of the Governments responsibility. The programme is implemented i three phases, which are:

- The short term phase (1996 - 1997).
- The medium term phase (1998 - 2002).
- The long term phase (2003 - about 20 years).

Included in the programme are only contaminated sites, for which the Hungarian state is responsible for the remediation. The main environmental elements to be investigated within this programme are soil and groundwater. In Hungary, promoting and safeguarding the quality of groundwater is extremely important as more than 90% of Hungary's drinking water is based on groundwater abstraction.

The National Environmental Programme serves as uniform structure of different actions. Within this frame, the National Environmental Remediation Programme is connected to other environmental programmes:

- The Wellfield Protection Programme: The programme was adopted by the Government in 1995 and is aimed at securing both operating and prospective wellfields located in vulnerable environments. As part of the programme, protection zones for wellfields are determined. Within the protection zones, pollution sources are listed and monitoring zones are established. Decisions on measures aiming at securing the wellfield areas are made in consideration also of cost/benefit analysis of the relevant alternatives. The measures can include lean up of existing contamination in soil or groundwater as well as elimination of the cause of pollution.
- The National Environmental Health Action Plan (NEHAP): Within the frame of the action plan, a database on contaminated areas has been established aiming at evaluating environmental hygiene risks and considering local characteristics and possibilities. Results obtained from survey areas provide a fairly good basis for comprehensive prioritising along the National Remediation Programme.
- The Clean-up programme of the Hungarian Railway Company (MÁV Rt.): The clean-up programme was initiated in 1997. All registered contaminated sites of the railway company (railway stations, workshops etc.) are incorporated in the KÁRINFO database of the National Remediation Programme.
- The Mining Structure Conversion Programme (SZÉSZEK): The programme was started early on basis of a Government decision of 1991. About 1000 sites have been registered within this programme and

the most critical sites have already been remediated. The registered sites of this programme are incorporated in the KÁRINFO database of the National Remediation Programme.

- The Industrial Park Programme: The programme was initiated in 1997 aiming at the reclamation of former industrial zones. It is noted that new industrial parks have also been created by reclamation of old mining properties within the above-mentioned mining programme. Available data from the Industrial Park Programme on old, contaminated industrial sites will be incorporated in the KÁRINFO database of the National Remediation Programme.
- The Military Sites Clean-up Programme: The programme is based on the work performed during the preparation of the framework of the National Environmental Remediation Programme. Since 1998, the Military Sites Clean-up Programme has been financed by the budget of the Ministry of Defence.
- The Governmental Property Privatisation Agency (ÁPV Rt.): Recently, the programme of the privatisation agency has been developed in different fields covering the rest of the former Soviet military properties.

Implementation of Limit Values

The Hungarian environmental regulations have to be adjusted gradually to the EU standards. Recently, the Ministry for Environment has prepared a legislation draft, which contains the provision of the groundwater directive (80/68/EEC). Among others, it deals indirectly with discharge of contaminants into the groundwater, and in this respect, it also gives some provision about soil protection. It is a demand in Hungary to regulate the standards for proper groundwater quality.

The proposed Hungarian legislation includes the set up of a system of limit values for soil and groundwater:

- A: Background values.
- B: Threshold values of contamination.
- C: Threshold values of measures.
- D: Target values.

The complete system of limit values was proposed by an expert group considering the values found in the Dutch and German lists as well as Canadian values and guidelines issued by the US EPA. It is noted that the threshold values and the target values differ depending on the vulnerability of the aquifers.

Previously, for the most urgent clean-up measures the National Standards for agricultural soils were applied, which are, however, inherently conservative. The ABC values of the Dutch Standards have partly been applied for other clean-up activities. In many cases, the A values of the Dutch Standards were not applicable due to the high clean-up costs involved. Until the new legislation comes into force the Regional Environmental Inspectorates define clean-up criteria on a case-by-case basis.

Responsible Public Authorities

The Ministry for Environment is responsible for the National Remediation Programme. It involves into the work of the Regional Environmental Inspectorates and the National Inspectorate for Environment and Nature Protection, which is a nation wide second stage authority.

The National Environmental Remediation Programme is co-ordinated by the Remediation Programme Office created in 1996 at the Institute for Environmental Management. The activities of the Remediation Programme Office are supervised by the Ministry for Environment.

Hungary has 12 regional environmental inspectorates, with about 1,200 employees. Each inspectorate is responsible for the enforcement of environmental law in its region. The regions of the inspectorates are defined according to catchment boundaries of the rivers and do not correspond to administrative regions. The tasks and functions of the environmental Inspectorates are laid down in the decree 211/1997 (XI. 26.). The regional environmental inspectorates are co-ordinated in their enforcement activities by the National Inspectorate for Environment and Nature Protection.

According to Act LIII on the General Rules of Environmental Protection, the Hungarian municipalities have a high degree of autonomy with regard to environmental issues. Their decisions are supervised by Offices for

Public Administration.

The Hungarian Privatisation Agency and Public Holding (APV Rt.) is the responsible organisation for privatisation of public properties.

The Hungarian Finance and Property Agency has since 1995 been the public owner of the Soviet military sites. The agency operates in close co-operation with APV Rt. in the case of privatisation.

The main national task is the nation-wide registration of pollution sources and contaminated sites. A National Priority List of clean-up will be calculated yearly using the database.

Furthermore, regional environmental inspectorates are involved in the management of contaminated sites and land.

Registration

Among others, the National Environmental Remediation Programme deals with the nation-wide inventory of pollution sources and contaminated sites. Its database is the KÁRINFO database. The aim is to create a homogenous database of sites for remediation, and on this basis set up a national priority list of contaminated sites covering all kinds of responsibilities.

The KÁRINFO database is a comprehensive national database on contaminated sites. It was set-up with the objective to integrate results from different national programmes and is now in the developing phase.

Characterisation of Soil and Groundwater Contamination

Sources of Soil and Groundwater Contamination

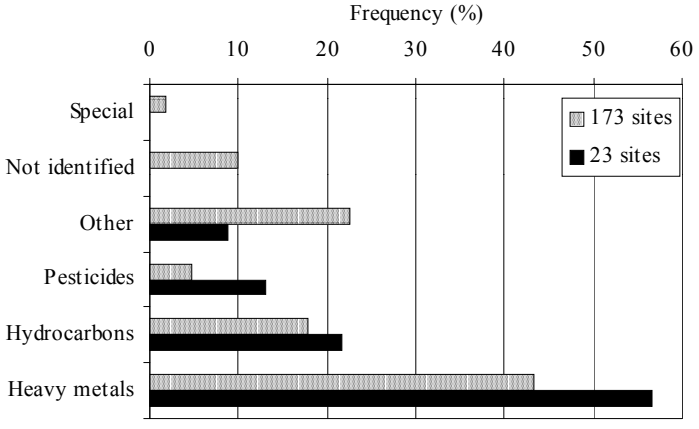
Industry, agriculture, military activity, and urban human activity are the sources of soil and groundwater contamination.

Also, each Hungarian municipality has at least one municipal waste disposal site. Most of these sites are not equipped with any protection measures.

Industry and traffic pollute the soil and groundwater mostly with hydrocarbons and heavy metals.

Number of Registered Contaminated Sites / Contaminated Land Areas

The process of establishing a nation-wide inventory of pollution sources and contaminated sites has been initiated. The regional environmental inspectorates have filled in questionnaires distributed by the Remediation Programme Office. In the framework of the National Environmental Remediation Programme a preliminary database has been set up containing 173 contaminated sites. Investigations of soil and groundwater have been made at 23 of these. The expected distribution of types of contaminants at the 173 sites and the distribution of the same at the 23 sites are shown below.



The number of contaminated sites collected by the above mentioned sub-programmes and registered so far are about 600. At the same time, other 25,000 pollution sources and potentially contaminated sites have been identified and registered in the KÁRINFO database. These data are not sufficient for priority calculations. In the short term phase of the National Remediation Programme, different clean-up measures were carried out:

I. Site assessments and feasibility studies: In 1996 - 97 the 26 sites with the highest priority were selected for investigation.
II/A. Emergency measures: In 1996 - 97 13 sites required performance of emergency measures.
II. Rehabilitation of soil and groundwater until specified target values are reached.
III. Development and operation of monitoring systems for controlling the efficiency clean-up process. The regional environmental inspectorates will operate the monitoring systems.

The remediation of contaminated sites was initiated with the abandoned military sites of the Soviet Army, which left 171 military sites, 340 settlements, and 6000 large buildings. Apart from the Soviet military sites there are a variety of military sites, which were run by the National Hungarian Army. After the withdrawing of the Soviet forces the number of these sites was significantly reduced. An enormous process of conversion was initiated. 75 shooting and test ranges were converted to civil land use, and 4 former Soviet military sites were declared national park.

The contamination at the 20 most contaminated Soviet military sites were investigated in detail. The former land use of the sites was 7 airfields, 1 helicopter base, 3 major fuel stocks, and 9 garrisons.

The identified contaminant types are listed in the order of importance and frequency of occurring:

1. Mineral oils, mainly at airfields, fuel stocks, and car repair shops. Kerosene, diesel and gas were most frequently identified. The total amount of soil and groundwater contaminated with hydrocarbons was estimated to amount to 2.7 - 3 million m³ soil, and 1 - 1.2 million m³ groundwater. The free hydrocarbon phase on the groundwater was estimated to amount to 5,500 - 6,000 m³.
2. Heavy metals, especially at shooting ranges. Among the most frequently occurring heavy metals were copper, lead, cadmium, chromium, and arsenic.
3. Uncontrolled waste disposal, leaking wastewater pits, and direct infiltration of wastewater into soil.

Among the 20 most contaminated Soviet military sites 8 was completely cleaned-up by the year 1996.

The contamination profiles identified at military sites of the National Hungarian Army are similar to those of the Soviet Army.

Investigation Methods

Identification of Potentially Contaminated Sites and Areas

The National Environmental Remediation Programme started in 1996. The major objective of the programme is the nation-wide registration of polluted areas and pollution sources.

- A homogenous national database is in the developing phase (KÁRINFO).
- The programme defines methodologies for soil and groundwater investigation. Proposed technologies for mapping, analytical methods and modelling of contaminants are aiming at the implementation of best available technologies (GPS, landset, GIS, geophysics, geochemistry, transport models etc.). Risk assessment is required for the determination of contamination priorities and hence the necessity of clean-up measures.

The identification of contaminated sites is connected to the various programmes as described in the section “Legislation”.

- Facilities / premises of the Hungarian railway: Clean-up Programme of the Hungarian Railway Company).
- Facilities in sensible groundwater areas: Wellfield Programme.
- Military sites: Military Sites clean-up programme and Programme of the Privatisation Agency.
- Industrial sites: Programme of the Privatisation Agency and Industrial Park Programme.

A pre-assessment of the former Soviet military sites was carried out during 1990 - 91 in parallel with the withdrawing of the Soviet forces. The sites were classified as follows:

- Immediate clean-up measures necessary: 20 sites
- Immediate safety measures necessary: 62 bases
- Long-term measures necessary: 77 bases

The pre-assessment included:

- On-site visits.
- Assessment of available historical documents.
- If possible interviews with staff.
- Evaluation of aerial photographs.
- Geophysical methods to identify metal objects in the subsoil.
- Collection of groundwater samples.
- Limited soil sampling.

After the pre-assessment more detailed investigations were carried out and the number of sites of concern was reduced to 61 sites. Before 1995 detailed risk assessment had already been carried out at 18 sites.

The identification process was different for the military sites of the National Hungarian Army. In 1992 the Dutch Ministry of Defence supported a project concerning the identification of potentially contaminated sites at the properties of the National Hungarian Army. Along this project, 100 military sites were pre-assessed and for 2 exemplary risk-assessments were carried out.

In 1996, the Ministry for Environment started to set up a GIS supported land register for military sites at national parks. Each site was assessed and classified with a code. The code reflected the balance of the sensitivity of receiving environments (groundwater, surface water, air, and nature protection) versus environment measures at the site.

Investigation of Contaminated Sites and Areas

The usual investigation methods are drilling bore-holes, taking soil and groundwater samples, and testing the samples in laboratory. On the basis of the data of the contamination, proposals are given for the clean-up measures.

The National Environmental Clean-up Program was started in 1996. The strategy of the program is determined. It consists of a nation-wide registration of polluted areas and pollution sources. A homogeneous database is developed.

The methodology of investigation is prescribed for soil and groundwater contamination. Mapping, measuring and modelling (3M) concepts are used. The aim is to use the best available techniques (GPS, landset, GIS, geophysics, geochemistry, transport models etc.). For determining the priority of the remediation process, environmental risk assessment is calculated.

Facilities for Contaminated Soil

Handling and Treatment of Excavated Contaminated Soil

Excavated soil contaminated with hydrocarbons is cleaned up mostly by on-site or ex-situ bioremediation methods, or rarely with thermal desorption based processes. Other methods, like soil washing or solidification have not been used so far.

Measures Used by Remediation of Soil and Groundwater Contamination

For the treatment of soil contaminated with hydrocarbons, biological technologies are usually applied. Either in situ soil venting or soil excavation and on-site treatment is used. The most widely used clean-up measures for groundwater and soil contaminated by hydrocarbons are:

- Groundwater:
  - Dual-phase extraction of free phase oil and contaminated groundwater.
  - Separate extraction of free phase contamination by use of skimmer systems.
  - Air stripping used for cleaning contaminated groundwater.
  - Activated carbon filtration of contaminated groundwater.
  - Installation of slurry walls.
- Soil:
  - In-situ bioremediation.
  - Extraction of soil vapour by venting.
  - Land farming.
  - Ex situ bioremediation.

For heavy metals contamination, excavation of contaminated soil is widely used.

Financing and Liability

Investigation and Remediation Activities

In general, the polluter pays principle is applied. In the case of public property, the current landowner is liable for environmental damage at his property.

Investigation and remediation of contaminated sites by the National Environmental Remediation Programme is intended only for cases, when no person or firm can be held responsible. The new environmental law stipulates that, if no person can be made responsible, the Government will be responsible for eliminating the consequences of significant environmental damage. This is the case, when the polluter is unknown, or the presumed polluter can not be proved to be responsible.

For cases, where an enterprise has been terminated without a legal successor, or the liquidation is ongoing and the assets are insufficient for cleaning up the environmental damages, clean-up measures must be made within the framework of the National Environmental Remediation Programme.

With respect to the Soviet military sites, all sites were handed over to the State of Hungary. A variety of sites were privatised and hence the liability was transferred to the new owner. In some cases owners were exempted from the liability. In 1995 all the remaining properties were handed over to the Hungarian Finance and Property Administration. A private company was assigned to take care of remediation and investigation activities at these sites.

The National Remediation Programme initiated by the Governmental Decision 2205/1996 (VII. 24) deals with the remediation of contaminated sites of state responsibility. Among others, the Decision states that the financing of the program will be determined yearly. Ordered by the central budget law, the yearly budget of the National Remediation Programme, co-ordinated directly by the Ministry for Environment, is separated from the income made by privatisation. In the period of 1996 – 98, yearly 1 billion HUF (about 4 million USD), and in the year 1999, 1.5 billion HUF, was allocated for the program. For the so called “sub-programmes” – financing remediation activities of other ministries – in total value, more than 50 million USD is separated in 1999.

Legal Requirements re. Polluters and Site Owners

Under certain conditions, the law stipulates a joint responsibility of the polluter and the owner of the area in which the activity causing the pollution is or was pursued. This provision will, in the long run, increase the chance of having the responsible persons, and thereby not the Government, pay for eliminating environmental damage.

Concerning the privatisation of former Soviet military sites, there are two possibilities to deal with environmental liability. In both cases the decision needs the approval of the Ministry of Finance.

- The new investor can be totally exempted from the environmental liability concerning historic contamination.
- The price of a property can be reduced in the case of contamination. In this case, the costs of the necessary remedial activities are estimated and deducted from the market value of the property.

The costs for the necessary remediation activities and the time frame are specified on a case by case basis and are under the supervision of the regional environment inspectorates.

Scope of the Problem

Scale of the Problem and Handling Costs

About 20% of the known contaminated sites are located within protection zones of waterworks in operation. Remediation of these has the highest priority. All in all, costs for remediation of contaminated sites located in protection zones of operating waterworks amounts to about 100 billion HUF (about 500 million US$).

Along the National Environmental Programme total clean-up costs for all contaminated sites of concern have been estimated to exceed 1 billion US$. In the first 2 years of the remediation programme, the annual budgets were about 7 million US$, partly retrieved from privatisation revenues.

For 82 Soviet bases, ad hoc measures have been estimated to amount to 20 million US$. Long term measures were estimated to need another 130 million US$. Up to the year 1996 about 8 million US$ were spent on clean-up measures.

Priority in Relation to Other Societal Problems

Economic interests are very important. Pollution prevention is usually less expensive than clean-up measures.

Contaminated sites are usually impairment to regional development because they are difficult to sell. The reclamation of former industrial areas has stimulating effects on the economy and the employment of the affected region.

Illustrative Cases

Due to heavy metals contamination of soil in areas surrounding the Metallochemia factory located in the southern part of Budapest, the local health authority closed down the factory in May 1990. This was the first time in Hungary that enterprise activities were stopped because of the pollution caused by the activities.

Activities at the Metallochemia plant started in 1910. At the beginning, recovery of lead containing materials was performed. Later copper electrolysis and melting were carried out. The key activities at the plant were production of lead articles and copper alloys and recovery of battery wastes.

In 1992, the regional environmental inspectorate ordered a site assessment and remediation of the site. The Metallochemia site is of the owner's responsibility and therefore does not belong to the National Remediation Programme.

Shortly after the closure of the plant activities, investigations of soil contamination were made covering:

- The Metallochemia plant area covering about 11,5 ha.
- A dumpsite at the Metallochemia area covering about 9,0 ha and containing approximately 220000 m^3 of slag and other waste materials.
- The surroundings of Metallochemia within a radius of about 1500 m corresponding to an area of a little more than 7 km^2.

By the investigations it was found that the slag in the waste material at the dumpsite had high contents of lead, zinc and copper. Penetration of the heavy metals contamination in the original soils below the waste

material was found in the upper 1 m of the original soils. Contamination was also found in the groundwater, but this was limited to the Metallochemia area.

At the Metallochemia plant area backfill of sand, debris, slag and cinder was found with a thickness up to about 2 m. Generally, the backfill is covered by concrete preventing direct contact and also rainwater infiltration through the backfill. It is estimated that the penetration of the heavy metals contamination in the original soils below the plant area is rather limited.

Lead was found to be the most critical contaminant in the soil in the areas surrounding the Metallochemia factory. The centre of the contamination in these areas was located between 250 to 600 m east to south-east of the Metallochemia factory in the prevailing direction of wind. On average, a 150 mgPb/kg d.m. contour line is estimated to be situated somewhere between 1250 and 1400 m south east of the Metallochemia factory. For lead and other metals, a distinct decrease of content with depth has been found for approximately the upper 0,6 m soil. It was estimated that about 108000 m^3 soil is contaminated with lead in concentration of more than 600 mgPb/kg d.m., about 255000 m^3 soil contain 250 - 600 mgPb/kg d.m., and about 130000 m^3 soil contain 150 - 250 mgPb/kg d.m.

Based on the investigation results, restoring of the multifunctionality of the soil in the areas must be ignored as a practical solution. For the Metallochemia area, isolation has been considered as the best rehabilitation method possibly consisting of establishment of an impermeable cover layer, cut-off walls fencing the horizontal groundwater flow, and remedial pumping of groundwater within the isolated area.

In the surroundings of the Metallochemia factory, removal of the contaminated soil seems to be the best solution. Removed soil from these areas can be stored on the surface of the plant dumpsite.

Preceding the remediation, a number of interim measures can be taken aiming at reducing the existing risk for public health posed by the present contamination e.g.:

- Within the zone surrounding the Metallochemia factory where lead concentrations exceed 150 mgPb/kg d.m. privately grown crops should not be eaten.
- Groundwater in the area should not be used for drinking water purposes.
- In the areas west of the Metallochemia factory crops grown on commercial basis should be monitored in order to detect any unacceptable contamination.

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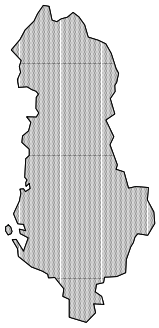
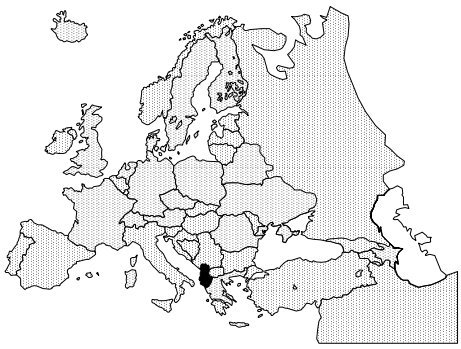
Albania

Country Characterisation





Background

Emerging from 45 years of an isolated and a strict central planning regime, Albania has embarked on a comprehensive program of policy reforms in all major sectors of society. One of the key elements of reform policy has been a privatisation programme in all sectors of the economy. In this context, laws have been introduced by the parliament in 1995 to allow private unrestricted ownership of land. Since then, the privatisation of the land has been completed.

The transition period has shown to be difficult for Albania accompanied by many social and economic problems, and during the first month of 1997 the situation was critical with strong pressure on political and social equilibrium of the country.

The population density of Albania is relatively high. Approximately 60% of the population live in rural area (the highest percentage in Europe).

During the former regime, Albania has suffered from social and economic problems including among others environmental degradation and poor natural resource management. The transition period left a vacuum with respect to the management of the environment and in this period environmental problems became fully visible. However, shortage of institutional and managerial as well as financial capacity has limited the effectiveness in addressing these problems.

The first environmental strategy study was prepared during 1992-93 in co-operation with the World Bank. It formed the basis for the National Environmental Action Plan (N.E.A.P.) which was approved by the Government in January 1994. The N.E.A.P. includes an action programme for short, medium and long term action as well as a series of priority projects related to sewage treatment, urban waste, deforestation and measures against erosion.

Total area	Agricultural areas		Wooded areas		Grass areas		Other areas	
km²	*km²*	*%*	*km²*	*%*	*km²*	*%*	*km²*	*%*
28748	7000	24,3	16000	55,7	4000	13,9	1748	6,1

Figure on total area from UN/ECE, 1998.
National protected areas are included in the wooded areas and the grass areas.

Population	Population density	Annual pop. growth 1990 – 1995	Life expectancy at birth	
			Male	Female
1000	*per km²*	*%*	*years*	*years*
3324	116	> 0,9	69	74

Figures from UN/ECE, 1998, and POPIN, 1999.

In January 1993, the Albanian parliament endorsed the basic law for environmental protection and some other laws related in particular to environmental items. Recently it was also approved to establish a national environmental agency as an independent body. Before, the Committee for Environmental Protection was attached to the Ministry of Health. As most administrative structures are new, capacity building and institutional development are key components in a move towards better management of environmental policies and investments.

A number of programmes have been initiated or developed during the transition period as for instance: PHARE, Environmental Programme for Albania (since 1993), National Water Strategy, National Waste Management Plan, Lake Ohrid Conservation Project, Forestry Project, and Environmental Centre for Administration and Technology (since 1995).

Legal and Administrative Basis

Definition of Contaminated Sites and Land

There is no specific definition for contaminated sites and land.

Legislation

A basic law for environmental protection was approved by the Albanian parliament in 1993. Two other lows related to soil protection have been endorsed in 1996:

- The law for forestry.
- The law for the management of urban wastes.

The problem of contaminated sites and land raises a number of legal and administrative issues. It is important to elaborate a comprehensive legislation with respect to systematic recording and monitoring of contaminated sites, preventive measures, suitable land use, and clean-up procedures.

Implementation of Limit Values

Also existing are two old regulations providing standards for concentrations of pollutants in drinking water hence in industrial wastewater discharges. Within the N.E.A.P. programme it is planned to prepare specific legislation and implement regulations and standards in the areas of forestry, use of agrochemicals, and solid and hazardous waste management.

Several specific studies related to soil protection have been planned within the N.E.A.P activities. Included are activities such as developing a strategy for reduction of soil erosion, evaluate use and application of agrochemicals, develop and implement a strategy for the safe disposal of unused agrochemicals, develop a master plan for safe disposal of industrial and hazardous wastes, evaluate waste disposal practices of industry and mining prevent negative impacts on soil, establish priorities and develop guidelines for minimising damage to soil environment etc.

Until now it is noted that many of the planned activities have not been implemented. This is caused by several factors including lack of co-ordination between various ministries and governmental institutions, insufficient financial resources etc.

Responsible Public Authorities

Management of contaminated sites and land is performed by three state institutions:

- The Ministry of Agriculture and Food.
- The Ministry of Construction.
- The National Environmental Agency.

It is noted that the National Environmental Agency is in the process of reviewing and updating of the N.E.A.P.

Registration

Up to now there are no inventories on contaminated sites.

Characterisation of Soil and Groundwater Contamination

Sources of Soil and Groundwater Contamination

The environmental strategy study made in co-operation with the World Bank (1992-93) and other surveys made recently show that the most important environmental problems concerning land in Albania are:

- Soil erosion. Agricultural policies of the past have let to strong erosion of soils. In addition to some natural factors as high rainfall in short periods of the year and the pedological composition of the soil, other factors have had a significant impact such as deforestation, poor maintenance of hillside terraces, overgrazing of pastures etc.
- Contamination of soil is some rural areas due to misapplication of fertilisers, pesticides and other agrochemicals. A relative high use of fertilisers and other chemicals was due to the effort to maximise the productivity of the arable land. More than 70 different pesticides were produced and used (roughly about 3 – 30 kg/ha per year), some of which are highly toxic and have been banned from use in most countries. The high use of fertilisers and pesticides seems to have caused contamination not only of arable land but also of water in rivers, lakes, sea and probably groundwater. Besides this, accidental spills and pesticide manufacture present problems. At the end of 1996 there were about 700-800 ton banned or non-usable pesticides. Until now, no regulations exist on the use of fertilisers and pesticides.
- Contamination of soil caused by discharges of industrial waste, mainly from oil, mining and chemical industry. It is difficult to evaluate the scale of the problems, as appropriate data are not available. Former activities have often resulted in soil contamination at these sites. Many of the large industrial enterprises responsible for severe contamination have been closed during the transition period. It seems, however, that soil contamination at the sites continue to have negative impact on the health of neighbouring inhabitants, and on flora and fauna for a relatively long period.
- Urbanisation of agricultural areas. Among others, the transition period has been characterised by migration of population from less developed areas towards more developed areas especially near the major cities (Tirana, Durres, Vlora, Shkodra etc.). The political and economic changes created favourable conditions for illegal building leading to rapid urbanisation of agricultural areas. The urbanisation is leading to an array of negative phenomena among others environmental problems in these areas including groundwater contamination.

Pollution from oil fields is mainly due to oil spills and leakage from pumps, and deficiency of adequate equipment for treatment and safe disposal of liquid and solid wastes. After simple separation of e.g. water and lubricants by decantation, the wastewater is discharged into rivers. Substantial quantities of solid waste containing various toxic components are deposited in dumps without any preliminary treatment. Large parts of former oil field areas are used for agriculture but ought to be remediated.

Mining and industrial processing of copper, chromium and iron-nickel have produced substantial amounts of liquid and solid wastes, which often have high contents of toxic substances. During the two years of 1995-96 the amount of solid waste generated from chromium and copper industries was 1,1 million tonne. Often, the waste was discharged directly into rivers or elsewhere in nearby disposal areas. Now, only a few mines and industrial processing plants are in operation thus decreasing the pollution rates. For years, however, large amounts of solid wastes were accumulated in open dumps without any precaution causing serious problems for inhabitants in nearby areas. The amount of mine wastes accumulated in dumps is estimated to approximately 12,5 million tonne.

Since 1991 nearly all chemical plants have stopped working. Some derelict industrial sites are contaminated due to production and waste disposal and need to be remediated.

The improper disposal of waste and sludge is an environmental problem of great concern in Albania. The amount of municipal solid waste during 1995-96 was about 700000 tonne. In 1996, the parliament approved a law on the management of urban waste, but no changes have been observed following this. No landfills exist for the municipal solid waste. The waste is disposed in open dumps without any treatment and precaution. In most cases the domestic waste is collected together with industrial waste and no separate disposal is used.

An environmental problem, that is special for Albania, is the 700000 bunkers built throughout the country during the former regime. The previous proposals on the demolition of these have all been costly and further studies must be made to reach an optimal solution.

It is important to note also, that the natural content of manganese, chromium, cobalt, nickel, copper and zinc is relatively high in Albanian soil. Previously, contents e.g. of chromium and nickel of 3865 mg/kg respectively 3597 mg/kg have been found in soil from the Prenjas area, and of copper and zinc of 1107 mg/kg respectively 2495 mg/kg have been found in soil from the Rubik area.

Number of Registered Contaminated Sites / Contaminated Land Areas

There is no estimate on the number of contaminated sites.

Examples of acute cases that pose major risks at local levels are:

- Heavy contamination with mercury in an area at the beach of Vlora caused by an obsolete PVC-plant.
- An area near Durres contaminated with chromate, pesticide residues, and aluminium sulphate waste caused by a chemical plant.
- An area surrounding the large metallurgical and chemical production complex in Elbasan.

Investigation Methods

Identification of Potentially Contaminated Sites and Areas

Two categories of contaminated land may be investigated:

- Large areas (including agricultural land) contaminated from distance or non-point sources.
- Discrete areas of industrial or other obvious contaminating activities.

The data collection must comprise the location of each site or area, its size, present and former use, and main contaminants present. Also important is the risk posed by the site or area on the groundwater, the surface water and the people living nearby. Costs will be a major consideration in the planing of any site surveys.

Investigation of Contaminated Sites and Areas

Information on the contamination state of soils is fundamental to future policy development. Also important in this context is development of standards for the sampling and analysis of soil.

Facilities for Contaminated Soil

Handling and Treatment of Excavated Contaminated Soil

Up till now, no facilities exist for treatment or proper depositing of contaminated soil.

Measures Used by Remediation of Soil and Groundwater Contamination

In Albania up to 1990, improving measures have been used only for soils with high content of magnesium, salt soils and acid soils. Magnesium soils (about 12000 ha) stretch mainly on the north-eastern of the country. Generally, they also contain other metals (Ni, Cr, Fe, etc.). The used improving measures are drainage and liming. Salt soils (about 12000 ha) stretch mainly on the western part. As improving measures are used drainage, natural and artificial rinsing and gipsing. Acid soils (about 85 000 ha) are in the form of spots in the whole country. The used improving measures are drainage and liming.

At present, for the remediation of contaminated soils at the oilfield in Patos-Marinza, clean-up of the contaminated soils is made to enable the land to be brought back into beneficial use.

During 1998, in a territory contaminated by pesticides residues near Durres, work has been made for the movement of the pesticides to secure places, away from the populated areas.

So far, no measures have been used for the remediation of soil contaminated from discharges of industry (mining and chemical industry).

Financing and Liability

Investigation and Remediation Activities

Different parts of the country are studied regarding contamination of soils and waters. Involved projects are for example:

- "Soil and water contamination in the most sensitive environmental areas of the country" (financed by the National Environmental Agency of Albania).
- "Diagnosing and identifying of contaminated soils and plants from heavy metals in serpentine and industrial zones" (realised by the Agricultural University of Tirana and the Soil Science Institute in Albania and INPL Nancy in France).
- "Soil Contamination by mercury in an area in the beach of Vlora (financed by the National Environmental Agency of Albania and realised by the Chemical Institute of Tirana).
- "The Rehabilitation of the Patos-Marinza oilfield, Albania" (financed by the PHARE program and realised by Oawok (English company) and Albpetroleum of Albania).

The last mentioned project was finished in 1996. The objectives of the soil survey were to assess the lateral and vertical extent of ground contamination by petroleum hydrocarbons within the Patos-Marinza oilfield. The soil survey comprised the sampling and analysis of soil samples taken in the vicinity of selected oil wells, group stations and treatment stations. A review of the field data and chemical analysis results has been undertaken along with an assessment of the risk posed by the contamination to the local population and the environment. Recommendations have been made on the requirements for remedial measures to reduce contamination concentrations to acceptable levels along with budget costs and priorities for implementation.

Soon the second phase of the project "The Rehabilitation of irrigation and drainage systems" starts in Albania financed by Word Bank. The environmental evaluation of 9 basins is accomplished. The waters of irrigation and drainage systems have been analysed and their quality evaluated according to FAO guidelines (1983). The results of this study will be taken into consideration during the rehabilitation of the irrigation and drainage systems of each basin. This project includes also the monitoring of water quality and fertility of soils in these areas.

There are many problems concerning the contamination of soils and waters, but the possibilities for their remediation are very small. In Albania, remediation activities for soils and waters are almost missing. So far, the most of the realised projects have consisted of identifying the environmental situation.

Legal Requirements re. Polluters and Site Owners

As an example is mentioned a company operating in Albania named Anglo-Albpetroleum company, and dealing with oil extraction at the Patos-Marinza oilfield. There is a contract with respective obligations signed between this company and the landowners, where it operates. The company is obliged to improve the land damaged or to reimburse the owners for the damage caused. In the latter case, the farmer is obliged to himself accomplish these improving measures.

The disagreements between the parties need to be sent to the courts. However, there have been no problems of that nature, so far.

Scope of the Problem

Scale of the Problem and Handling Costs

So far no special strategy and national policy for contaminated land has been developed. Soil protection requires an integrated approach within the larger context of environmental protection and sustainable development.

Priority in Relation to Other Societal Problems

In 1995, with a decision of the Albanian Government some institutions have to monitor the quality of soils and waters. So far this decision has not been executed because the government has not granted the money for organising of the activity.

There are many problems in the areas of contaminated soils. Low economic level of farmers and the financial impossibility of the state to support them, has led to the abandoning and degrading of most contaminated soils. The difficult conditions of the farmers in these areas have caused the migration of the population on the west of country, especially in the cities Tirana, Durres, Vlora or abroad.

Erosion is one of the important factors of soil degradation in Albania. The effect of some objective factors (climate-soils conditions) and subjective factors (absence of investments to soil protection, cutting of trees, etc.) has caused the increase of erosion in all the country.

Illustrative Cases

Contaminated soils at the Patos-Marinza oilfield

Soil contamination by crude oil is widespread around the oilfield installations as oil wells, group stations and treatment stations throughout the Patos-Marinza Oilfield. The oilfield equipment is generally in poor condition due to the effects of corrosion and lack of preventative maintenance, and leakage of oil to the ground are therefore common at all stages of production.

Typical penetration of oil contamination within the soil profile was found to be on average 0.53 m in the vicinity of the oil wells and between 0.80 and 0.90 m at the group and treatment stations investigated.

The volume of contaminated soil at each of the oilfield installations investigated has been calculated. It is estimated that on average a volume of 150 m^3 of oil contaminated soil is present at each oil well and that 1600 m^3 and 14900 m^3 of contaminated soil is present at each group station and treatment station respectively. Approximately 67.4 ha of contaminated ground exist throughout the oilfield. The actual total area of contaminated ground within the oilfield is therefore considered to be significantly higher than estimated above.

Land contaminated by petroleum hydrocarbons can present a potential hazard to a number of different receptors providing that plausible pollutant linkage exist. Consequently a brief qualitative risk assessment has been undertaken which has identified a number of risks associated with the soil contamination present the Patos-Marinza Oilfield.

Surface water pollution of drainage ditches, streams and rivers is considered to be a major problem within and beyond the oilfield, as evidenced by the frequently observed free oil floating on the top of the water courses, and the common observations of black oil staining on banks of ditches, rivers and streams. The remedial measures are required in order to reduce the risks posed to the human and environmental receptors to an acceptable level.

For the potential risks, particularly those to human health, animals, plants, water pollution and amenity, it is concluded that remedial measures are required in order to reduce the risks posed to the human and environmental receptors to an acceptable level.

Contaminated soil due to mining activities

There are some data concerning contaminated soil in areas with mining activities. The data are shown in the table below.

		Values in mg/kg						
No.	Area	Cd	Co	Cr	Cu	Ni	Pb	Zn
1	Gjegjan	4	289	574	27	1104	87	49
2	Pogradec	5	259	635	8	2442	98	63
3	Prrenjas	14	476	3865	36	3579	172	93
4	Rubik	9	338	256	1107	66	135	2495

Also, some plants were observed in the studied areas. In the table below there are some data for the content of heavy metals found in the plants in these areas.

		Values in mg/kg						
No.	Area	Cd	Co	Cr	Cu	Ni	Pb	Zn
1	Gjegjan *Markgrafii* (leaves)	4	23	19	56	12625	31	291
2	Pogradec *Alyssum murale*	3	86	12	23	8463	23	108
3	Prrenjas *Alyssum murale*	5	5	6	1508	12	31	
4	Rubik *Dittrichia graveolens*	9	34	69	1110	94	28	849

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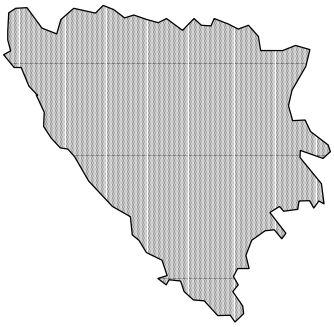
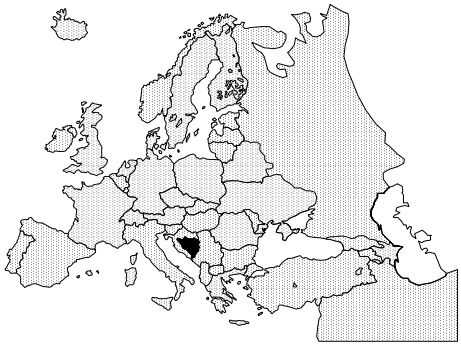
Bosnia-Herzegovina

Country Characterisation





Background

Bosnia-Herzegovina generally belongs to a mountainous region (700 m and above).

Due to irrational utilisation of soil, particularly within agriculture and forestry, there is a continuous damage of soil surfaces. Land devastation is caused by contamination, degradation and destruction.

According to approximate data 3000 km^2 of land is contaminated, and 10000 km^2 is in the process of degradation. Physical destruction of land covers about 500 km^2. The annual loss of land is about 30 km^2 primarily due to expansion of settlements and sites with excavation of raw materials. During the four years of war approximately 60 km^2 of land have been damaged, and following the war 12000 km^2 have to be considered as mine fields.

Total area	Agricultural areas		Wooded areas		Nationally protected areas		Mountain terrain	
km^2	*km^2*	*%*	*km^2*	*%*	*km^2*	*%*	*km^2*	*%*
51197	25250	49	23310	46			2570	5

Figure on total area from UN/ECE, 1998.

Population	Population density	Annual pop. growth 1990 – 1995	Life expectancy at birth	
			Male	Female
1000	*per km^2*	*%*	*years*	*years*
3738	73	-4,37	-	-

Figures from UN/ECE, 1998, and POPIN, 1999.

Legal and Administrative Basis

Definition of Contaminated Sites and Land

There is no specific definition for contaminated sites and land.

Legislation

Generally, soil and groundwater issues are regulated by the following laws:

- The physical planning law.
- The environmental protection law (in preparation).
- The agricultural land law.
- The law on waters.
- The law on forests.
- The geological law.
- The nature protection law.

Implementation of Limit Values

The implementation of limit values is very small.

Responsible Public Authorities

Institutions responsible for management of soil and groundwater contamination are:

- The Federal Ministry of Physical Planning and Environment.
- The Federal Ministry of Agriculture, Water Management and Forestry.
- The Institute of Agropedology.
- The University of Sarajevo (Faculty of Forestry and Faculty of Agriculture).

Registration

Maps have been prepared for areas in the vicinity of industrial zones showing areas with contaminated soil. However, it is necessary to continue investigation work that was performed before the war.

Also maps showing erosion areas must be improved, as some of the consequences of the war are accelerated soil erosion. It is urgent to establish remediation programmes for these areas as the pose a major risk for residents and land.

Furthermore, it is necessary to establish programmes for the rehabilitation of devastated areas (mine fields, industrial waste depots, military installations etc.).

Characterisation of Soil and Groundwater Contamination

Sources of Soil and Groundwater Contamination

Soil has been contaminated in areas of some industrial and urban regions (e.g. Zenica, Tuzla, Kakanj, Sarajevo etc.). Here, the soil is contaminated with heavy metals e.g. Pb, Zn, Mn, Co, Cu, Mb and Cd. High contents of sulphur have been found especially in areas of power plants (Kakanj and Lukavac).

A particular problem in Bosnia-Herzegovina is dumpsites for ash and slag from power plants as well as waste (red mud) form aluminium industry. The ash causes great ecological problems.

Besides the above-mentioned, the agriculture and forestry also cause soil contamination. However, the use of fertiliser in Bosnia-Herzegovina is rather small in average about 55 kg/ha.

Generally, soil contamination is caused by heavy metals, sulphur compounds, organic pollutants, acid rain, fertiliser, pesticides, ash depots and red mud.

Besides contamination there is also a physical destruction of land. The causes of land destruction are divided into two groups (temporary and permanent), and considered through 3 periods:

- Pre-war period up to 1992.
- War period 1992 – 1995.
- Post-war period from 1995.

Temporary physical destruction of land in the pre-war period was caused by surface mines, gravel pits, clay pits, industrial waste depots, and erosion. As land damage causes was considered as residential areas, industry, roads, and airports. The estimated land loss was about 3000 ha per year.

Besides the suffering of citizens and the destruction of economy during the four years or war, specific land damages also occurred. Causes of land destruction during the war were damages from explosion of mines and shells, trenches and embankments, concrete fortifications, temporary roads, temporary settlements, mine fields, accelerated erosion, moving of military troops across agricultural areas and poison gases. Approximate land losses during the war was about 6000 ha, with the major par characterised as temporary damages. Particular heavy losses were on areas where trees were cut down. The consequence of this is acceleration of soil erosion.

Causes of land damages in the post-war period are the same as in the pre-war period supplemented by accelerated building of settlements, felling of trees and soil erosion as well as remaining mine fields. Also, use of land on hillsides has been intensified providing for accelerated soil erosion. De-mining activities are performed slowly. Existing mines present a major danger for citizens, and also limit the use of the areas in agricultural production.

Number of Registered Contaminated Sites / Contaminated Land Areas

So far, the number of registered contaminated sites is 6.

Investigation Methods

Identification of Potentially Contaminated Sites and Areas

Identification of potentially contaminated sites and areas is based mainly on areas near highways. These investigations are carried out in the community of Sarajevo.

Also, identification is carried out in the urban zones, and included here are the urban zones of Sarajevo and Tuzla. Furthermore, identification is carried out in the industrial zones, and included here are Tuzla and Zenica.

Investigation of Contaminated Sites and Areas

Investigations of soil contamination have been performed in areas of some industrial zones as well as some urban zones (Sarajevo).

Also, investigation activities have included soil sampling at various sites depending on land use as arable land, meadows and pastures. Mainly, samples have been collected from two depths as surface and subsurface layers.

Facilities for Contaminated Soil

Handling and Treatment of Excavated Contaminated Soil

Up till now, no facilities exist for treatment of proper depositing of contaminated soil.

Measures Used by Remediation of Soil and Groundwater Contamination

Up till now, no measures have been used for remediation of contaminated soil or groundwater.

Otherwise, remediation is based on given recommendations as e.g. the use of lime for acid soils, and choice of proper cultures for that can grow on contaminated sites.

Financing and Liability

Investigation and Remediation Activities

-

Legal Requirements re. Polluters and Site Owners

Legal requirements demand that polluters pay for remediation of damages caused to the soil. This provided for special laws and decisions. However, up till now there is no significant application of these requirements.

Scope of the Problem

Scale of the Problem and Handling Costs

The highest costs refer to the recultivation of damaged soils.

Priority in Relation to Other Societal Problems

Up to date, revitalisation of devastated areas has been very limited. For this reason, only small area have been reclaimed (about 10% of the total devastated area).

Illustrative Cases

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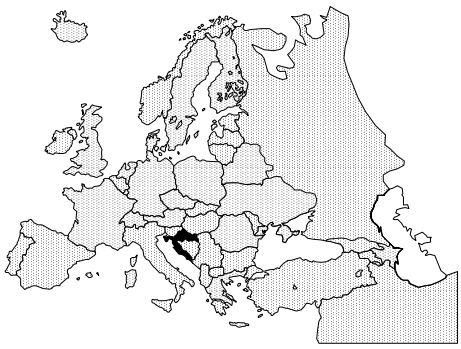
Croatia

Country Characterisation



Background

Total area	Agricultural areas		Wooded areas		Nationally protected areas		Other areas	
km²	*km²*	*%*	*km²*	*%*	*km²*	*%*	*km²*	*%*
56538								

Figure on total area from UN/ECE, 1998.

Population	Population density	Annual pop. growth 1990 – 1995	Life expectancy at birth	
			Male	Female
1000	*per km²*	*%*	*years*	*years*
4572	81	-0,10	69	77

Figures from UN/ECE, 1998, and POPIN, 1999.

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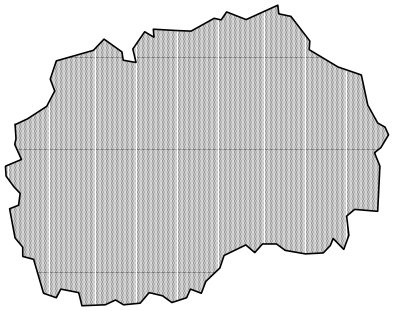
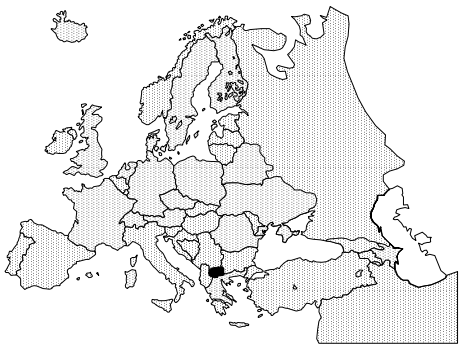
F.Y.R of Macedonia

Country Characterisation



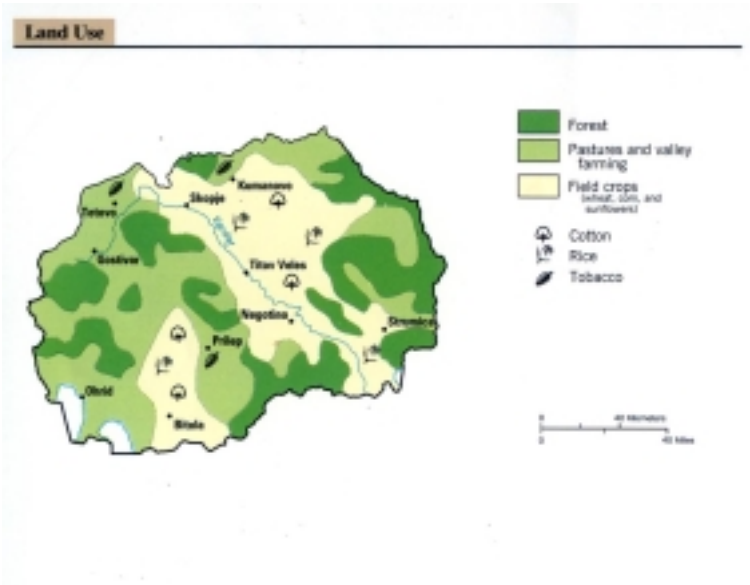


Background

In the F.Y. Republic of Macedonia, contaminated land is only partially detected and, therefore, there is a lack of research on this topic.

The legislation concerning contaminated land is in a preparatory phase, and hopefully will be adopted by the end of 1999.

General land use in the F.Y. Republic of Macedonia is illustrated on the map below.



Total area	Agricultural areas		Wooded areas		Pastures		Barren land		Lakes		Urban areas	
km²	*km²*	*%*	*km²*	*%*	*km²*	*%*	*km²*	*%*	*km²*	*%*	*km²*	*%*
25713	6428	25	9514	37	6428	25	2057	8	514	2	514	2

Figure on total area from UN/ECE, 1998.

Population	Population density	Annual pop. growth 1990 – 1995	Life expectancy at birth	
			Male	Female
1000	*per km²*	*%*	*years*	*years*
1983	77	1,11	70	74

Figures from UN/ECE, 1998, and POPIN, 1999.

Legal and Administrative Basis

Definition of Contaminated Sites and Land

As contaminated sites and land are regarded those areas in which one or more harmful matters exceed MPC (maximum permissible concentrations), as scientifically identified and legally accepted.

Legislation

As far as the legislation on land contaminated with harmful matters is concerned, in the Republic of Macedonia, there is no individual definition of MPC for harmful matters by means of legal act. The science uses international information available on MPC, which are not harmonised at the level of Europe and wider.

Implementation of Limit Values

The implementation of limit values for land contaminated with harmful matters in the Republic of Macedonia, for inspection and control purposes, is not carried out, for reasons mentioned under the above item. On the basis of scientific research projects and works, conducted for scientific purposes, we have achieved original results with reference to certain contaminated sites and contaminants, and we compare our results with international scientific results.

Responsible Public Authorities

Responsible public authorities for the subject matter are the competent Ministries that deal with issues of this kind (Ministry of Agriculture, Forestry and Water Economy, Ministry of Environment, and Scientific Institutions: Faculty of Agriculture and relevant Institutes).

Registration

According to our knowledge, registration of the listed institutions, responsible for the subject matter, is not carried out yet.

Characterisation of Soil and Groundwater Contamination

Sources of Soil and Groundwater Contamination

The soil and ground waters can be disposed to contamination by harmful matters from various sources, most significant among which in Macedonia are the following:

a) Agrochemicals (mineral fertilisers and pesticides) if used uncontrolled.
b) Untreated industrial wastewater from dirty industry, used for irrigation of agricultural crops.
c) Unprotected mining facilities, especially disposal sites with hazardous toxic material and industrial waste disposal sites.
d) Live stock breeding farms lacking developed supplementary facilities (solid waste storage and wastewater collecting facilities).
e) Thermal power plants using coal or similar type of fuel.
f) Air pollution from industry and erosion from waste disposal sites.

Number of Registered Contaminated Sites / Contaminated Land Areas

According to the scientific researches conducted in the Republic of Macedonia so far, which have not covered the whole territory of the country, the number of contaminated sites is between 4 and 6. Theoretically we assume that there are about 10 such sites.

Investigation Methods

Identification of Potentially Contaminated Sites and Areas

According to the scientific researches conducted in the Republic of Macedonia so far, there are contaminated

sites in the following areas: Veles, Kriva Palanka, Probistip, as well as along the flow of some rivers: Bregalnica, Zletovska, Kumanovska, Vardar at certain sites, live stock breeding farms.

Investigation of Contaminated Sites and Areas

At the above-mentioned sites, some harmful matters have been investigated, including mainly heavy metals and certain organic pollutants. Investigation methods are based on the modern world investigations, for the purpose of which appropriate methodology is used, such as: atomic adsorption spectophotometry and chromatography.

Facilities for Contaminated Soil

Handling and Treatment of Excavated Contaminated Soil

There are no treatment measures undertaken with regard to contaminated soils for various reasons, the most significant being financial constraints and undefined range of the total contaminated area, due to the lack of relevant studies.

Measures Used by Remediation of Soil and Groundwater Contamination

So far, there have been no organised applied measures aimed at remediation of soil and groundwater at the level of entire site. Probation recultivation on small parcels were carried out, by investigation through grass seeding and sols rinsing from the soil with fresh water, and several other small investigations.

Financing and Liability

Investigation and Remediation Activities

In the course of the last 20 to 30 years, 12 to 15 researches have been working on scientific, scientific and professional and professional researches regarding soil contamination with harmful matters in the Republic of Macedonia. The majority of those researches have been published in magazines and collections. There have been a small number of remediation activities (2-3).

Legal Requirements re. Polluters and Site Owners

In my knowledge, there has been one court dispute for soil contamination in the vicinity of Kriva Palanka, where several site owners requested legal protection against contamination of the soil caused by the disposal site of the Toranica mine as polluter. The dispute won the applicants requesting compensation for the suffered damage.

Scope of the Problem

Scale of the Problem and Handling Costs

The scale of the problem connected with the soil contamination should be identified for all sites. For that purpose, the Faculty of Agriculture in Skopje, Division for Agrochemistry has developed a proposal project for investigation, including ten sites in the Republic of Macedonia. The Project is titled “Agrochemical, Physiological and Health Aspects of the Soil, Irrigation Water and Plant Products Contamination with Harmful Matters and Measures for Production of Health Safe Food”. The implementing institution of this Project is the Faculty of Agriculture - Skopje, while participants are the Republican Institute for Health Protection and Faculty of Science and Mathematics. This project was positively assessed by the reviewers from the Ministry of Science, but because of the improper approved financial resources; the project is not implemented yet.

Priority in Relation to Other Societal Problems

The above mentioned proposal project should be given top priority, because there has already been a case of displacement of a population from one site as a result of long lasting soil contamination. It is the case of the site in the vicinity of Kriva Palanka.

Illustrative Cases

A typical case is mentioned under the paragraph "Priority in Relation to Other Societal Problems". Similar cases can occur in other areas, such as Veles, Probistip etc.

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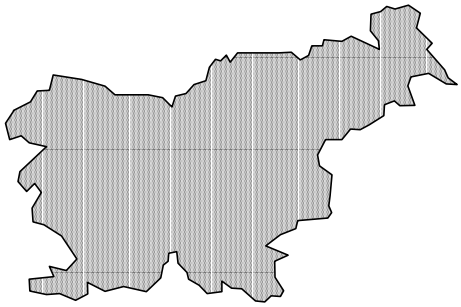
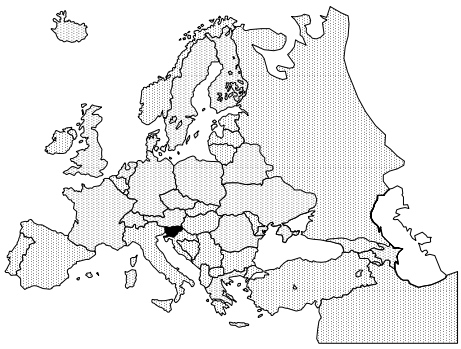
Slovenia

Country Characterisation





Background

When considering the natural characteristics of Slovenia, the following must be emphasised:

- High relief - only 10% of Slovenia is lowlands, and together with valleys and basins only 18%. In these areas, rivers, arable land, main urban areas, and economy and traffic infrastructure are concentrated, and represent the heaviest burdens and highest pressures on nature. Most of the landscape is hilly and mountainous; there are even areas with high mountains.
- Slovenia is a mosaic of at least 50 different kinds of rock types, and several hundreds soil types. This, in combination with different climatic belts, caused the development of various ecosystems and biotops.
- 44% of Slovenian territory is karstic with an underground system of caves and rivers.
- Slovenia is rich in water sources, mainly groundwater and springs, which are an important source of drinking water.

Concerning land use, forest account for 53% of the country's surface, 42.6% of land is agricultural, but only 14.6% are arable land. Other uses account for 4.4%. Slovenia has relatively few protected areas and only one national park. They cover about 8% of the territory (approx. 122.000 ha).

There is only 1246 m^2 of arable land per inhabitant, which is not enough for self-reliance, especially at the present state of technology. The message is clear: we must preserve every piece of arable land, because lost fertile soil cannot be replaced through amelioration of soils with less favourable properties. Changing nature requires great risks and large investments; intensification should be redirected towards biotechnological findings, which would enable the production of enough of healthy food to meet basic needs. The socio-economic strategy of the preservation and improvement of agriculture and the countryside is important. Science should help determine land use, and develop new technologies for food production. We all share the responsibility to make sure that their processes are environmentally friendly.

Total area	Agricultural areas		Wooded areas		Nationally protected areas		Other areas	
km^2	*km^2*	*%*	*km^2*	*%*	*km^2*	*%*	*km^2*	*%*
20256	8629	42,6	10736	53	1620	8	891	4,4

Figure on total area from UN/ECE, 1998.

Population	Population density	Annual pop. growth 1990 – 1995	Life expectancy at birth	
			Male	Female
1000	*per km^2*	*%*	*years*	*years*
1987	98	0,29	70	78

Figures from UN/ECE, 1998, and POPIN, 1999.

Soil pollution by heavy metals, such as Cd, Pb, Cr, Cu, Zn, Hg and pesticides and other organic contaminants, nitrates and in some cases phosphorus is a problem of concern. Although heavy metals are present naturally in soils, contamination comes from local sources, mostly industry, power plants, iron and steel and chemical industry, zinc smelters, use of irrigation water, sewage sludge, road traffic etc. Also agriculture contributes to the eutrofication process and to pollution with toxic substances (pesticides), which both affect ecosystems.

Some landfills in Slovenia are still in use and some belong to the past. For old industrial landfills not used anymore it has been decided to carry out rehabilitation measures of the affected areas. Studies on sanitation and rehabilitation have been made for a range of identified industrial landfills. However, rehabilitation activities are slow due to the lack of financial means and also unsolved land ownership issues.

Legal and Administrative Basis

Definition of Contaminated Sites and Land

There is no specific definition for contaminates sites and land.

Legislation

Changes in the political and economic system and the independence of the Republic of Slovenia, the decision for Slovenia to move towards the European Union and replacing the complete legal order with the legal order of a Western Democracy, governed the decision for legislative reform also in the area of protection of the environment. On a new constitutional basis, Parliament passed the Act on the Protection of the Environment in June 1993 (Official Journal of the Republic of Slovenia, No. 32/93). The Act contains general provisions and basic methods of protecting the environment and exploiting natural resources. On the basis of the Environmental Protection Act, new legislation regarding soil protection has been adopted in Slovenia recently.

1. In purpose to set up maximum allowed values of dangerous substances in soil the ***Decree on the Limit, Warning and Critical Concentration Values of Dangerous Substances in Soil*** was adopted in 1996 (Official Journal of the Republic of Slovenia, No. 68/96).
   The decree defines the soil as a surface part of the lithosphere, which consists of mineral and organic substances, water, air and organisms.
   Concentrations of seven classes of pollutants were determined: heavy metals, inorganic pollutants, aromatic compounds, polyaromatic hydrocarbons, chlorinated organic, pesticides and others. This is particularly important in those soils, used to produce foodstuffs.
   Values below the maximum allowed represents the uncontaminated soils and values over critical concentrations means that a clean-up is necessary. Values over warning allowed values indicate that further investigation is required.
2. A ***Decree on Input of Dangerous Substances and Plant Nutrients into the Soil*** (Official Journal of the Republic of Slovenia, No. 68/96) was also adopted in November 1996 in order to regulate the input of fertilisers (both mineral and organic: manure or slurry) and heavy metals into soil. The decree defines limit values for amounts of heavy metals which may be added annually to soils, and limit values for amounts of plant nutrients, which may be added annually to soils with manure or slurry (inorganic fertilisers not included).
   In areas with shallow groundwater, used for water supply the decree is trying to narrow the imbalance between fertilisers input and crop uptake with following measures:
   – limit input values for nutrients (fertilisers) regarding crop uptake,
   – application of fertilisers at the proper time (in the growing season),
   – sowing winter crops to minimising leaching losses, etc.
   Increased nitrate concentrations in groundwater, which have exceeded the limit value, have been detected. The increased nitrate contents were ascribed to the intensive agricultural activity, so the measures are important to prevent the pollution of drinking water.
   The decree also controls the use of sewage sludge from treatment plants, compost and slurry in agriculture by setting limit values for concentrations of heavy metals. The use of sewage sludge, compost or slurry is controlled by permission given by the ministry of environment.

3. ***Regulation on the Operation Monitoring of the Input of Dangerous Substances and Plant Nutrients into the Soil*** (Official Journal RS, 55/97) defines the types of parameter for soil, sludge from treatment plants, compost and slurry which are the subject of operation monitoring of the input of dangerous substances and plant nutrients deposited in the soil with sludge from treatment plants, compost and slurry from riverbeds and lakes (hereinafter: operation monitoring), the methodology of sampling and measuring the parameters, and the contents of the report on operation monitoring. This Regulation defines the conditions required from the person who conducts the operation monitoring.

Furthermore, the assurance of groundwater quality is laid down in the ***Law on Drinking Water*** (Decree of July, 1997).

Also it is noted that concerning waste management there exists an ***Integrated Waste Management Strategy*** from 1992.

Implementation of Limit Values

Soil monitoring system in Slovenia
The assessment of soil and vegetation pollution is based on 8 X 8, 4 X 4, 2 X 2, or 1 X 1 km grids. Foreign and domestic experience has shown that a systematic survey of soil pollution requires that denser network be established, taking into consideration various factors that influence the level of soil and vegetation pollution including, among others: urbanisation, industrialisation, air pollution, type and properties of the soil, lithological base, soil utilisation, and precipitation.
At the moment, we only have soil pollution data for around 8% of the territory.

Soil pollution by heavy metals
The results of upper soil samples showed that Cd, Pb and Zn exceed the limit values in the city of Celje and its vicinity. Celje County lies in the middle of Slovenia in a topographic basin surrounded by hills and mountains, characterised by frequent temperature inversions, especially in the winter months. This is the main reason why stack emissions from local smelting industries are widely spread over the basin.
In Ljubljana the main problem regarding contaminated soils is lead from road traffic. Higher zinc and copper contents in the soil occur only occasionally.
In Jesenice, where the iron industry is located, higher Cd, Zn, Fe and As contents were found.

Soil pollution by pesticides and other organic contaminants
Of 21 potential harmful substances only triazine herbicides and DDT derivatives were detected locally in samples from the agricultural land, but did not show any substantial concentrations in soils. These substances are, or were in the past, used in plant production. The low levels at which these substances were found are not considered to be hazardous to human health.
Pesticide represent a problem in the areas with an intensive agricultural land use because of their leaching in the ground water. The quality of Slovenia's ground water is deteriorating, mostly because of increased pesticide and nitrate concentrations, which come from intensive agricultural activity.

Other problems
Among other problems regarding soil degradation there are some data about soil acidification, especially in forests. Soil acidification is a natural process, but it has been enhanced by human activity through the emission of sulphur and nitrogen compounds from the combustion of fossil fuels and from industry emissions.
Another problem might be a salinisation in the NE part of Slovenia (because of semi-arid climate), caused by irrigation with improper drainage.

Groundwater
For groundwater, general monitoring of the quality based on analysis of selected parameters was started a few years ago. Generally, the groundwater quality is good although there is a trend of declining quality for some parameters. Based on the results of the monitoring, it was decided to monitor drinking water by samples collected at end points of the water supply systems. In 1995, it was decided to include some carcinogenic substances such as Pb, As and $CHCl_3$ in the monitoring, and in 1996 pesticides such as atrazine and alachlor and metabolites of these were also included.

For the parameters measured constantly and periodically in groundwater by the monitoring programmes, limit values has been determined. The parameters and the limit values are prescribed by the official gazette no. 46/97.

Due to contamination e.g. by pesticides, the groundwater quality is declining although at present the contents of the individual substances almost everywhere are below the prescribed maximum permissible levels.

Responsible Public Authorities

The Ministry of Environment and Physical Planning is responsible for the legal basis for the management of contaminated sites and land. Recently, the ministry has decided to expand its activities from the strictly legislative to more practical areas. Also, The Ministry of Environment and Physical Planning is responsible to ensure state monitoring of soil pollution according to the Environmental Protection Act.

The Ministry of the Environment and Physical Planning employs approximately 1000 people and is responsible for environmental issues, nuclear safety, regional planning, meteorology, and the monitoring of air and groundwater.

Directly under the authority of the Ministry of Health is the Institute of Public Health. It consists of 9 regional institutes (dividing Slovenia into 9 regions), of which the institute in Ljubljana is the core one. Its key responsibility lies in the analysis of food and drinking water.

The systematic monitoring of groundwater and drinking water is carried out more than 70 years, but since 1994 includes also monitoring of some carcinogenic substances in drinking water and continuos analysis of drinking water resources (wells and springs) and the analysis at the consumer level (from the tab).

Also, in 1997 an environmental inspection body began operating in Slovenia. The duties of this include the monitoring and registering of all events and activities connected with environmental pollution.

Registration

All the data regarding soil pollution in Slovenia are available at the Ministry of Environment - Nature Protection Authority. A Soil Information System in the Republic of Slovenia unites the soil databases: data on soil mapping in the scale 1:25000 and data on monitoring of soil pollution (five selected regions in Slovenia) into a logical whole.

SIS data will become the integral part of geo-oriented databases gathered at the Geoinformation Centre of Slovenia - still in the process of establishing and furnishing.

Characterisation of Soil and Groundwater Contamination

Sources of Soil and Groundwater Contamination

Because of the past human activities, some of the Slovenian regions are now polluted with heavy metals, pesticides, PCB etc. The pollution of soil can be a result of an intensive application of agricultural chemicals, traffic emissions, emissions from metal industry, waste disposal, and the incineration of fossil fuels (especially) rich in metals.

The source of pollution is often identifiable (specific production technology), but the incidence of multiple pollution in a single area is growing. Also, there are many “hidden”, usually undetected polluted areas, which can only be defined with a very systematic and co-ordinated approach.

Soil pollution by heavy metals in Slovenia is a problem of concern. Contamination comes mainly from local sources (industry) and road traffic. Also agriculture (use of mineral fertilisers, manure, sewage sludge and pesticides) can contribute to soil contamination.

Monitoring of drinking water quality has been performed for many years. The monitoring has shown that the levels of certain parameters have significantly changed during the recent years. Thus, increasing contamination of groundwater resources have been seen in the last few years. Primarily, carcinogenic substances and pesticides are contaminating drinking water resources. The latter are caused by the intensive use of pesticides in agriculture. Other sources of contamination both with carcinogenic substances and pesticides may be the dumping of chemical waste at illegal dumps in the natural environment as well as various spills due to accidents or negligence.

Generally, groundwater quality is considered to be good. However, major problems are posed by diffuse contamination from agriculture, mainly pesticides. Especially older pesticides with arsenic compounds pose a pressure on groundwater. This problem is expected to be solved in the near future due to the abandonment of arsenic pesticides.

Military sites

The former Yugoslav army did in total run approximately 30 facilities with some 20,000 people. Slovenian military sites were not equipped with heavy weapons (such as missiles, chemical weapons etc.).

Along with the withdrawing of the Yugoslav army, a committee, consisting of various representatives from Ministries and Research Centres checked the contamination at some of the abandoned sites. This was done by on-site visits and by taking soil samples at the premises.

Contamination was identified at 2 sites only, in both cases hydrocarbon contamination (one site was the former military airport).

Waste Management

The total waste generation per annum is estimated to amount to approximately 800,000 tons.

Slovenia has 53 licensed landfills, of which 75% have already reached the limit of their capacity. It is estimated that the full limit will be reached within the next ten years. The licensed waste sites are in general equipped with a leaching control but only partly with surface sealing.

Apart from the licensed sites it is estimated that approximately 500 illegal landfills exist all over Slovenia. These sites are not equipped with any safety devices. Of major concern are pits in the carstic areas of Slovenia, which are used for waste dumping without any leachate protection. In carstic areas, groundwater has no or only a very low potential of regeneration (self-cleaning).

In 1992, the Ministry of Environment and Physical Planning published an integrated waste management strategy. For the future it is foreseen to build only a few (9 – 12), but very large waste sites which comply with the EU standards.

Slovenia has no waste incineration for domestic waste. There are 2 smaller incinerators, which belong to industrial facilities. One is the factory Lek in the Northeast of Slovenia, which produces pharmaceutical products the other is a pesticide factory, which incinerates returned packaging material.

Radioactive waste: Slovenia has one power plant, which is jointly operated together with Croatia. Low radioactive waste is currently kept at the premises and will soon reach the limit of storage capacity. There are plans to export the waste to Australia.

Hazardous waste: only waste contaminated with PCBs is transferred to France and incinerated there.

Industrial Structure

Today's Slovenia has a mixed pattern of all industrial sectors. Decline and abandonment of heavy industry is not significant in Slovenia. In the former Yugoslavia, 40% of the exports were produced in Slovenia.

Two coal mines have been reduced in staff over the recent years and will probably be closed within the next decade (due to the minor caloric value of the coal and the high content of sulphur).

The car manufacturing plants have been abandoned.

One very large facility of the electronic industry, which employed up to 30,000 employees in the former Yugoslavia was restructured and reduced in size.

Number of Registered Contaminated Sites / Contaminated Land Areas

There is no estimate on the number of contaminated sites / land areas. However, it has been estimated that about 3500 – 4000 factories, plants and workshops in operation produce industrial wastewater.

Investigation Methods

Identification of Potentially Contaminated Sites and Areas

The main source for identification of the potentially contaminated sites is the annual state report on the environmental protection, containing all the data on water, air, soil etc. pollution. A very good source of the information regarding contaminated sites is also some research projects and the reports from the Inspectorate for environment.

Investigation of Contaminated Sites and Areas

Methods for the investigation of soil pollution are covered by the above-mentioned Regulation on the Operation Monitoring of the Input of Dangerous Substances and Plant Nutrients into the Soil.

Facilities for Contaminated Soil

Handling and Treatment of Excavated Contaminated Soil

Up till now, no facilities exist for treatment of contaminated soil and there are any measure used. Slovenia has no experience in this field.

Measures Used by Remediation of Soil and Groundwater Contamination

Slovenia has no experience with the remediation of contaminated sites. Only one remediation is known, which included the excavation of hydrocarbon contaminated soil.

Financing and Liability

Investigation and Remediation Activities

Up till now no remediation activities are going on in Slovenia.

The Slovenian Government in December 1998 adopted a ***National Environmental Action Plan (NEAP)***. In the field of soil protection, the main goals are to prevent further chemical and physical contamination and to perform remedial actions where necessary and feasible. To realise these goals, a detailed action plan for the next five years is established including the estimation of the costs and possible sources of funding.

Legal Requirements re. Polluters and Site Owners

The transfer of property to a new site owner also includes the liability for environmental impairments. The new owner is hence liable for the clean-up.

If a contaminated real estate is sold, the buyer gets a cheaper price but has to guarantee the clean-up. Control is carried out via an ecological inspection of the Ministry of Environment and Physical Planning. Up to now, this system exists only in theory since no experience has been gathered.

The Republic of Slovenia has declared a commitment to take care of the clean-up of those sites, which are "commercially unattractive", such as abandoned mining facilities.

Slovenia has an ecological fund, which retrieves money from environmental taxes on air and water emissions. The ecological fund provides low interest loans for environmental protection measures. In the case of remediation activities support from the ecological fund is feasible.

Scope of the Problem

Scale of the Problem and Handling Costs

Up till now, no data are available.

Priority in Relation to Other Societal Problems

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Illustrative Cases

For several industrial landfills, studies on sanitation and rehabilitation have been performed. The following description is made on this basis.

Soil Pollution in Celje County

Pollution monitoring of soil samples was first carried out in 1989 in the area of Celje County. The results of upper soil samples showed that Cd, Pb and Zn exceed the allowed values in the city of Celje and its vicinity. On some locations slightly higher concentrations of arsenic and nickel were found. 35 out of 119 examined soil samples contain more lead than allowed. Most of the 35 were from locations around the city and its industrial area. The highest Cd concentrations were also found in the centre of the city and the nearest surroundings. Maximum allowed Zn content in the soil of was exceeded in 36 soil samples. Higher arsenic and nickel contents in the soil occur only occasionally. Se, Hg, Ti, Cu and Cr concentrations were within legislative limits in all examined samples.

Since heavy metals can migrate from the soil to the plants or to the ground water when they are rinsed, it is of utmost importance to determine their mobility within the soil profile. Metal migration (Pb, Zn, Cd, As, and Ni) to deeper layers of soil (5-20 cm and 20-30 cm) was determined on selected points. In the majority of cases zinc, lead, and cadmium content in the soil decreases with depth in heavily polluted areas however, the concentration of these three elements is still above the allowed value in the depth of 5-20 cm, in some examples up to 30 cm.

Celje County lies in the middle of Slovenia in a topographic basin surrounded by hills and mountains, characterised by frequent temperature inversions, especially in the winter months. This is the main reason why stack emissions from local smelting industries are widely spread over the basin.

Landfill for uranium ore tailings from the mill in Žirovski Vrh

Uranium mining started in the area of Žirovski Vrh in 1982. However, due to high production costs and low prices, the Parliament passed the law on the permanent closure of mine in 1992. In 1995, an environmental impact report was presented together with the application for decommission permit in 1995.

One of the mill tailing disposal sites contain 620000 tonnes of tailings and 80000 tonnes of mine waste. The waste is situated on a potential earth slide, and since the drainage of the disposal sites has been stopped, the tailing and waste site slide has to be stabilised. This, however, require 7 million tonnes of material for stabilising the situation.

Industrial landfill for waste from organic acid production plant

The organic acid production plant (Tovarna Organskih Kislin (TOK)) producing mainly citric acid is one of the bankrupt companies in the Ilirska Bistrica region. The region lies in a karst region and sources of contamination threaten the groundwater. The Globovnik landfill near Ilirska Bistrica was used by TOK and presents a danger to the groundwater in the area. The landfill was used for disposal of residues from the production of organic acids at TOK as well as other solid and liquid waste mixed with household solid waste.

The most critical substances in the landfill are sodium hexacyanate, cyanides, $CaSO_4$, other hazardous waste, and all kinds of household solid waste. The landfill covers approximately 9 ha and is up to 10 m thick. The

landfill has not been managed properly e.g. it is not sealed properly. An assessment of the environmental impact of the landfill has been prepared and a feasibility study for remediation is in preparation. It is expected that a programme for remedial activities will be completed and all necessary permits obtained by the end of 1999.

Industrial landfill for tar from the oil refinery in Maribor

In 1966, a landfill (Pesniška jama) was established for acidic tar from the oil refinery in Maribor. The landfill was used until 1983, when it was closed due to environmental problems. The landfill represents a typical tar cave divided into three layers. The upper layer consists of acid oil, the middle layer of acid water, and the bottom layer contains compact and partially hardened tar material.

Investigation results show that the liquid material in the landfill has a high acid content, mainly due to the presence of sulphuric acid and high contents of heavy metals such as Pb and As. Under the landfill, the soil is contaminated in an approximately 3 m thick zone. The groundwater in the area is contaminated in a narrow zone. A range of remedial measures has been proposed and evaluated by a feasibility study e.g. removal of acid water and treatment in a waster water treatment plant, incineration of tar and contaminated soil etc.

Industrial landfill for waste from a pesticides production plant (Pinus)

Waste form the pesticides production plant (Pinus) has been dumped at a landfill or cave named Kozoderčeva jama. Analysis of drinking water from the area has indicated that the water contains pesticides. Further studies have shown that the source of the pesticide contamination is the industrial landfill Kozoderčeva jama. A feasibility study on rehabilitation has been concluded. It has been suggested to remove contaminated soil from the site. One third of the contaminated soil can be disposed of in a landfill for urban waste and the remaining soil must be specially treated.

Industrial landfill for foundry by-products

Waste from a foundry has been dumped in a funnel shaped cavity in a limestone karst. Occasionally, a black sludge can be found in groundwater in the area due to the dumped foundry waste. The main components of the waste are foundry sand and phenolformaldehyde resin. Investigations have shown that the sludge does not affect the quality of the groundwater but, however, presents a danger for a very rare animal species. Remedial measures for the site has been proposed e.g. building of a concrete barrier around the landfill in the depth of 70-100 meter to prevent the leaking of water and spreading of waste material into the groundwater.

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Russia

Country Characterisation

Background

In Russia, the state institutions in relation to the nature protection were organised just after the international programs nature protection had been adopted e.g. the program of UNESCO from 1968 (Paris) and the program of OON from 1972 (Stockholm).

In 1972 in the former USSR, the decisions of the Government about the foundation of a state national system of the monitoring of environment and control of environmental pollution was accepted. In 1978, the National Committee of the Environment Protection was organised.

A considerable part of the arable land is subject to degradation under the influence of wind and water erosion, dehumidification, loss of nutrition, desertification, and contamination. Erosion is the main factor leading to degradation of soil on large territories.

Contamination is playing an active role in smaller areas, but the ecological consequences of this type of soil degradation are more dangerous. The control of the main groups of contaminants in soil is performed according to the program of the soil monitoring. The results of the soil monitoring are presented in the annual national reports “the land status utilisation in Russia”, which have been published regularly since 1993.

For military purposes approximately 12.8 million ha land are used by the Russian Ministry of Defence of which 5.1 million ha are forests. At approximately 7 million ha, military land use has been stopped because of the environmental impacts involved. Many military sites are located in heavy industrialised areas, i.e. the Ural region, the region of Moscow, the central Volga basin, and the Kama basin. For security reasons activities of the Soviet army at military sites were kept in secret. In general, military sites were not required to follow any specific environmental regulations up to the middle of the 1980ies.

Total area	Agricultural areas		Wooded areas		Nationally protected areas		Other areas	
km²	*km²*	*%*	*km²*	*%*	*km²*	*%*	*km²*	*%*
17075400	3400000	20	9600000	56				

Figure on total area from UN/ECE, 1998.

Population	Population density	Annual pop. growth 1990 – 1995	Life expectancy at birth	
			Male	Female
1000	*per km²*	*%*	*years*	*years*
147140	9	-0,12	60	73

Figures from UN/ECE, 1998, and POPIN, 1999.

Legal and Administrative Basis

Definition of Contaminated Sites and Land

Official publications refer to contaminated sites as spots or areas which pose a risk to the environment and which are not necessarily of the same size as the property.

In a decree of the Russian Federation, from December 1993, military sites and natural resources, which are used by the Ministry of Defence, are considered as "Natural Resources of the Russian Federation". Military research centres without shooting ranges and armament and production plants are considered as civil sites. The Ministry of Internal Affairs runs a variety of sites, which are very similar to military sites, i.e. sites with armed forces. These sites are not considered as military sites.

Legislation

The protection of nature is a national problem in Russia according to the Constitution of the Russian Federation. The following acts form the legal basis for the management of contaminated sites and land:

- The law "about the protection of atmospheric air" from 1982.
- "The earth code" from 1991.
- The law "about the ecological expert evaluation" from 1995.
- The law "about soil melioration" from 1996.

Also important are the decisions of the Government of Russia and the working decisions of the Government of the former USSR:

- About soil monitoring from 1982.
- About standards for pollutants emitted to the atmosphere from 1981.
- About standards for pollutants emitted to the environment from 1992.
- About contaminated soil from 1992.
- About the monitoring of the environment from 1994.

There are a number of normative methodological instructions, which regulate different types of this activity. The National Committee of the Environment Protection has worked these out.

In 1993, a requirement to carry Environmental Audits at military sites on an annual basis was laid down per law in decree N406-1993.

Implementation of Limit Values

Critical levels of e.g. heavy metals in soil are estimated on basis of a sanitary-hygiene approach. The aim of the approach is the protection of humans from the impact of contaminants. However, now it is clear, that the major aim of the estimation of critical contaminant levels in the environment (including soil) should be the protection of the ecosystems in general including humans as part of this.

The Ministry of the Environment and its corresponding regional departments are responsible for remediation targets. Clean-up criteria are in general defined according to the previewed land use.

Responsible Public Authorities

The National Committee of the Environment Protection heads the protection of nature in Russia. Also involved in decisions on environmental and ecological problems, and realisation and control of environmental legislation are:

- The Council of the Russian Federation.
- The government of the Russian Federation.
- The Ministry of the Environment of the Russian Federation.
- The Land Resources National Committee.
- The National Committee on Hydrometeorology.
- The Ministry of Agriculture.

- The Ministry of Health Service.
- The Federal Service on Forestry.
- The Russian Committee for internal affairs.
- The Russian Committee for fishery.
- The Russian Committee for cartography.
- The Russian Committee for forestry.
- The Russian Committee for meteorology.

During the identification of potentially contaminated sites the tasks of the Environment Authorities are:

- Detailed definition of the location of the potentially contaminated sites and estimation of the quantity of contamination and assessment of the risks involved.
- Definition of fines for environmental misdemeanours, issue a requirement to the polluter.
- Control of the remediation of the environmental damage and supervision of the remediation activities.
- To issue an environmental certificate after remediation.
- To implement measures for the protection of the environment.

The environmental authorities can force the polluter per law to comply with the clean-up requirements. It is noted that this also applies to the military.

The Environment Department of the Ministry of Defence is responsible for environmental issues at military sites. In general, only military staff deals with environmental issues at military sites. However, the Russian Ministry of Defence and the Russian Ministry of the Environment and their regional agencies deal with the management of contaminated sites at military sites. Remediation activities at military sites have to be carried out by external parties, which can be civil as well as military. The environmental authorities can support remediation measures at military sites with financial or technical support.

The scientific institutes of the academies of science and the academies of the agricultural science at the universities of Russia take an active part in working out strategies of nature protection and in preparing instructive documents dealing with soil protection.

The soil status in the industrial centres is monitored on local and regional levels. An overall ecological monitoring is also performed in Russia. The aim of the overall monitoring is the control of areas, which are far from local sources of pollution, and therefore receive pollution by long-distance transport (including transboundary pollution).

Registration

Up to now there are no inventories on contaminated sites.

However, the Ministry of Defence has made an inventory of military sites situated in sensitive environments. In total, 470 military sites have been included in the inventory.

Area	Sites	Area	Sites	Area	Sites
Moscow MD	36	Siberia MD	10	Marine Bases of the Baltic Sea	7
Leningrad MD	23	Trans Baical MD	43	Missile Forces	15
North Caucasus MD	32	Far-East MD	39	Air Defence	63
Volga MD	18	North Marine Forces	12	Air Force	70
Ural MD	18	Pacific Marine Forces	8	Other	76

MD = military district

Characterisation of Soil and Groundwater Contamination

Sources of Soil and Groundwater Contamination

The arable land is contaminated at the highest degree in areas surrounding the industrial centres. As a rule, the soil is contaminated in 5-km zones around these centres. The main sources of contamination are the enterprises dealing with energy production, metallurgy and transportation.

The soil is greatly affected by aerosols, and solid and liquid waste. In Russia, about 20% of the areas surrounding the industrial cities with a population of more than 1 million are contaminated.

Within the soil monitoring program, the selective control of 1997 showed that 3% of the total area of the arable land is contaminated by heavy metals. Due to reduced plant production in Russia, this area has not increased during the last years. However, at the same time the area of contaminated land did not decrease. Here, contaminated soil is defined as soil with contents of Pb, Cd, Cr or Sn exceeding the background levels 10 – 40 times. Furthermore in the industrial regions, the arable soil is contaminated by dioxins. Commercial fertilisers have been suspected as source of heavy metals in the arable soils, but no evidence of this has been found.

The soil of almost 3% of the arable land is also contaminated with pesticides. It is estimated that high levels of DDT, metaphos and trephlan are present in the soil in these areas.

The problem of soil contamination caused by the oil industry is very important for Russia. Due to the numerous accidents, this type of contamination is rather widespread within the oil production sector. E.g. the number of oil spill accidents in West Siberia during 1995-97 amounts to some thousands.

Concerning military sites, most of these were built in the 1950ies and 1960ies, very poorly maintained and far from today's standards. Many environmental damages were caused along routine operations as described beneath:

- Total dust emissions deriving from military sites was about 700,000 tons, of which only 100,000 were filtered.
- The total amount of wastewater from military sites was about 500 million m³ in 1994, of which about 100 million m³ were not treated.
- The total annual waste volume deriving from military sites amounts to about 10 million tons of domestic waste and 850,000 tons industrial waste. About 90% of the domestic wastes are disposed, in many cases on unsafe waste sites.
- The total annual consumption of mineral fuels is about 10 million tons. It is estimated that about 0.2% of this amount is lost due to handling losses or leaking tanks. It is estimated that about half of the mineral oil stocks are in a very bad condition. As a result, soil, surface, and groundwater contamination with mineral oil products is increasing from year to year.
- Wastewater and solid wastes deriving from marine bases are usually dumped directly to the sea.

Areas at military sites where the potential for contamination is very high are described beneath:

- Car parks, stocks for equipment, maintenance facilities, car wash facilities, and petrol stations:
  Contamination with hydrocarbons, solvents, acids, and heavy metals.
  Hydrocarbons are the most frequently occurring contaminants (in 50% of the investigated cases). It is estimated that approximately 3,100 ha of land are contamination with hydrocarbons and that several hundred thousand tons of hydrocarbons have been lost.
  Between 1992 and 1993 contamination profiles of 9 military sites were carried out: Chkalowski, Kresty, Solzy, Tver, Emgels, Mosdok, Jeisk, Kamensk-Uralski, and Yelizovo-5. At all military sites soil, groundwater, and surface water contamination was identified. In all cases, free oil phase of kerosene was found on top of the groundwater.
- Waste disposals. Interim or final disposal and waste treatment facilities:
  Contamination by various, chemicals, PCBs, dioxins, and heavy metals.
  The total annual waste volume deriving from military sites amounts to about 10 million tons of domestic waste and 850,000 tons industrial waste. About 90% of the domestic wastes are disposed, in

many cases on unsafe waste sites.

- Missile launching sites / Space Technology:
  Contamination with 1,1-dimethylhydrazine and metal scrap.
  A special problem of contamination exists at missile launching sites, i.e. Plesetsk and Kapustin Jar. Affected are not only the launching sites themselves but also areas where discarded missile elements crash to the ground. The affected areas are estimated to have a total surface of 5 to 9 million hectare. It is estimated that about 10,000 metal residues are distributed all over the country. After the missile launching, carrier missiles are discarded and crash to the ground. Carrier missiles contain considerable amounts of unburned fuels especially 1,1-dimethylhydrazine, a highly toxic substance.
- Nuclear waste disposal / Radioactive Wastes:
  The operation of nuclear powered submarines and marine ships produces nuclear wastes. Besides that, nuclear wastes were generated at military sites, where nuclear weapons were stocked. The annual amount of liquid radioactive waste ranges between 18,000 m³ and 20,000 m³. In 1994 the amount of radioactive solid waste amounted to 3,500 tons. Radioactive wastes are collected, treated, and disposed. Most of the nuclear waste sites have already reached the limit of their capacity. In addition, nuclear wastes are dumped into the sea.
- Sewage systems:
  Hygienic problems due to untreated wastewater or leaking sewage systems.
- Shooting and test ranges:
  Contamination by explosives, chemicals, hydrocarbons, and heavy metals.

Number of Registered Contaminated Sites / Contaminated Land Areas

There is no estimate on the number of contaminated sites.

Investigation Methods

Identification of Potentially Contaminated Sites and Areas

The Russian Federation has a standard procedure regarding environmental certification of the state of potentially contaminated soils. They concern the different types of soil resources: arable lands, pasture, forest lands and so on. The arable lands are investigated more detailed. There are some dozen of documents, which regulate the investigation methods of the identification of potentially contaminated soils. The list includes more than 50 normative acts of the Russian Federation, more than 40 documents of the State Committee of the Environmental Protection and Hydrometheorology, and the same number of documents of some other Ministries (Health service, Agricultural service, Transport, Statistics and so on), near 50 State Standard documents, and more than 500 Instructions, which conclude the description of the methods of soil samples selection and their laboratory analyses.

It is planned to determine the different types of the contaminants: heavy metals, pesticides, oil and oil-products, and radionuclides. The different demands are made to the soils of the different types of utilisation. Pesticides are controlled in the arable soils, and the points of soil sampling are usually distributed evenly. Heavy metals are determined in soils predominantly around the industrial sources of contamination and according to the distance from these. The analytical methods are standardised. The certification is made on the base of the critical standard levels of each type or pollutants.

Concerning military sites, identification of potentially contaminated sites and areas have been made by environmental audits carried out at a variety of military sites. The audits have been made since 1992, when the Ministry of Defence established the Environment Division and one-year later the Environment Centre. Objective of the environmental audits is to create a database for environmental information at military sites and to establish a standard procedure for the assessment of identified contamination. Environmental Audits are supposed to be carried out on an annual basis.

In 1994, environmental compliance controls for military sites started. Since then, pre-assessments have been carried out at 1,868 military sites and environmental inspections at 4 marine bases. Results revealed that most of the sites were contaminated and did not comply with the legal requirements. In view of the enormous number of sites, estimates on the extent of contamination were not possible. The Russian Federation has a

standard procedure regarding environmental certification of industrial facilities (Union Standard 17.0.0.04-90). The procedure is valid for civil as well as military facilities. A first attempt to establish a standard procedure for the identification of contaminated areas at military sites has been made:

- The Russian Ministry of the Environment has drafted a guidance document "Guidance for the Assessment of Environmental Conditions at Military Sites". The procedure as described in the document has been tested along a variety of Environmental Audits.
- Framework guidance has been issued for the assessment of groundwater contamination. The guidance is based on a 2-tier procedure:
  - Tier 1 describes the classification of military sites according to their environmental compliance.
  - Tier2 involves geo-hydrological investigations and the carrying out of an Environmental Audit. Based on the obtained results, hot spots of contamination and the distribution of contaminants are assessed, and a remediation plan and cost calculation are set up.

Although a standard procedure for the investigation of military sites has not been established yet, the procedure as described below was more or less applied for most of the investigated military sites.

Preliminary Assessment: Collection of information concerning the general environmental condition of a site; i.e. storage of hazardous substances, existence of subsoil tanks, and vulnerability of ground and surface water resources. The activities of the preliminary assessment include:

- The collection of archive data.
- Visual inspections of the site (on-site visit).
- Qualitative and quantitative assessment of the vegetation.
- Identification of potential contamination sources.
- Geo-referencing (mapping) of potentially contaminated sites and potentially contaminated environments (soil, groundwater, vegetation, surface waters).
- Set-up of a sampling plan, with specification of the sampling depth.
- Mapping of already existing dwellings and groundwater wells.
- Investigation of hydro-geological conditions and assessment of the groundwater quality.
- In some cases application of remote investigation technologies such as radio spectrometry, radar and laser monitoring.

The preliminary assessment is completed with a report including the assessment of the contamination and the feasibility of conversion to agricultural land use, and furthermore a concept for a feasibility study on conversion to agricultural land use and detailed investigations.

Preliminary Classification: The site is subdivided in smaller areas, which are classified in different risk categories according to identified substances and the vulnerability of the environment.

Investigation of Contaminated Sites and Areas

Areas for detailed investigations are selected. Afterwards, specification of the distribution of contaminants, risk assessment, and drafting of remediation plan is made.

There is no standard procedure for the detailed investigation of contaminated sites.

Most frequently applied are quick methods for the identification of hydrocarbons, such as geophysical methods and drillings.

Facilities for Contaminated Soil

Handling and Treatment of Excavated Contaminated Soil

The differentiation of the technology methods of contaminated soil facilities depends on the type of pollutants, the type of polluted landscapes, and the size of the polluted area. They include mechanical, chemical, physical, biological, agrochemical, and agrotechnical methods.

Mechanical methods consist of the moving away of the contaminated soils and keeping it in special storehouses. The last are disposed in the types of landscape, in which this is safe from an ecological point of view. They include also the putting of the clean soil layers on top of the polluted soils, which protect the surrounding media from the pollution. The methods of burring of polluted soil and the mixing of polluted material with underlying layers concern the mechanical methods too. These methods are used as a rule to improve the lands polluted with the inorganic contaminants.

As far as the organic pollutants such as pesticides, oil and oil-products, the methods of microbiological destruction and thermal decomposition of pollutants are used. These methods are not very wide spread. Among the physical and chemical methods different sorbents such as zeolites, activated carbon, and some resins are used.

Agrochemical methods are the most widespread. They consist of the carrying in the polluted soils lime, organic and mineral fertilisers. Their action is based on the ability of the fertilisers to increase the stability of plants to contamination and to increase the rate of decomposition of organic pollutants.

Measures Used by Remediation of Soil and Groundwater Contamination

Special attention has been paid to the development of 1,1-dimethylhydrazine (DMH) decontamination methodologies (see also space technologies). However, a variety of specific clean-up technologies have been developed:

- A special adsorbent has been developed for DMH contaminated soil and microbiological technologies for the treatment of DMH contaminated wastewater.
- Furthermore, technologies for the decontamination of liquid radioactive waste.
- In the case of hydrocarbon contamination, conventional technologies are usually applied. Hydrocarbon contaminated soil is usually excavated and biologically treated on-site. For hydrocarbon contaminated groundwater, pump and treat technologies are usually applied.

Financing and Liability

Investigation and Remediation Activities

The Environment Authorities (Ministry and regional agencies) retrieve some funding from fines for environmental misdemeanours. This money is partly used for remediation measures at military sites.

Remediation activities can also be covered from the normal budgets of military sites or from their research budgets. The Ministry of Defence has also the possibility to carry out investigations at contaminated military sites on its own.

Some states of the Russian Federation support the remediation of contaminated military sites; i.e. Astrachan, Archangelsk, and the Republic Nordossetien.

Furthermore, the interstate environmental council of the community of independent states (CIS) has established an interstate foundation for environmental protection measures.

Legal Requirements re. Polluters and Site Owners

The polluter pays principle is applied. Therefore, e.g. the Ministry of Defence is liable for remediation measures at military sites. However, it is noted that the Ministry of Defence has no separate budget for the remediation of contaminated sites.

The polluter has the possibility to pay compensation instead of taking care of the remediation himself. The liability is hence transferred to the recipient of the compensation.

Scope of the Problem

Scale of the Problem and Handling Costs

During the last 10 years, the ecological state in Russia has not improved. The recession in the industry has more than twice provided a sufficient decrease of the pollution of the atmosphere and natural waters. For example, the level of oil pollution has decreased 4 times, and the level of different metals from 2 to 4 times. But at the same time, the soil pollution has practically remained at the same level. As far as Pb pollution, it has increased in the soils around the industrial centres due to the fact that the number of cars has increased almost twice at the same time.

During the last 10 years, the costs of the nature protection have changed. The relative quota of these resources has increased twice and become equal to 0,1 part of the total internal product. At the same time the absolute level of these expenses has decreased three times. The affairs of the Russian Federation to provide the environmental protection will be successful only when the investment in this business will increase may be from international resources too.

Some estimates on cost related to investigation and remedial activities at military sites have been made. In 1995, the annual costs to finance activities at priority cases and hence the most urgent safety measures were estimated to 39 million USD, corresponding to 0.26% of the budget of the Ministry of Defence.

Furthermore, a variety of regional departments of the Ministry of the Environment have calculated the costs for clean-up measures at some specific military sites.

Region	Number of affected military sites	Affected area in hectare	Estimated costs in million USD
Kaluga	50	407	0.4
Nowgorod	78	500	3.0
Wladimir	27	-	0.6
Mari El	57	603	2.8

Priority in Relation to Other Societal Problems

The main directions of the modern soil protection actions in Russia are the following:

1) The total stopping of the developing of new lands (now there are in Russia many nature reserves and some dozen national parks where any types of housekeeping are prohibited. They occupy almost 2,5% of the territory of Russia).
2) The recultivation of the polluted soils. This problem includes the working out of the methods of identification of the polluted soils, the modern express and correct methods of contaminated matter's determination, and the perfection of the critical levels of the different pollutants in soils.

Illustrative Cases

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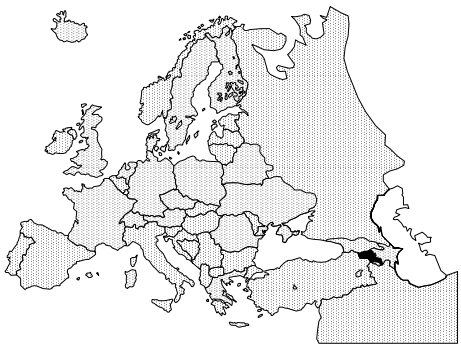
Armenia

Country Characterisation



Background

The land contamination issue is one of the main land management problems in Armenia. The problem is almost as serious as soil erosion or land degradation. However, the problem is not yet so serious as the problems with treatment and disposal of industrial and municipal wastes or depletion of biological resources.

The importance of the problem is now increasing, taking into account the different sources of land contamination.

Although the overall environmental pollution situation in Armenia has improved during the recent years, this is primarily related to the drop in industrial production due to the earthquake in 1988, the collapse the USSR, and the numerous socio-economic problems. Now the economy begins to recover and therefore pollution problems are very likely to become more evident again.

Total area	Agricultural areas		Wooded areas		Nationally protected areas		Other areas	
km²	*km²*	*%*	*km²*	*%*	*km²*	*%*	*km²*	*%*
29800	14000	47	3341	11	3055	10		

Figure on total area from UN/ECE, 1998.

Population	Population density	Annual pop. growth 1990 – 1995	Life expectancy at birth	
			Male	Female
1000	*per km²*	*%*	*years*	*years*
3787	127	1,42	69	76

Figures from UN/ECE, 1998, and POPIN, 1999.

Legal and Administrative Basis

Definition of Contaminated Sites and Land

There is no specific definition for contaminated sites and land.

Legislation

For the ecologically safe and economically effective management of the environmental pollution the following laws and regulations have been adopted:

- Principles of Nature Protection Legislation (1991).
- Law on Environmental Impacts (1995).
- Law on Air Protection (1994).
- Water Code (1992).
- Land Code (1991).
- Governmental Decision No. 448 (1998). Introducing taxes and fees on air and water pollution and industrial disposals in landfills, as well as on the use of surface waters, groundwater and mineral water, and on discharges of industrial wastewater. Taxes and fees are to be paid by the operational industrial and transport companies, regardless of ownership.
- Governmental Decision No. 97 (08.12.1995). The order of adjustment of hazardous wastes import, export and transit over the territory of Armenia. The Decision regulates all the issues, concerning transboundary movement of hazardous wastes. This document is prepared on the base of the Basel Convention. The Parliament of Armenia have adopted the Basel Convention "On the control of transboundary movement of hazardous wastes and their disposal" on March 26, 1999.

Implementation of Limit Values

Aiming at characterising contaminants levels in water, air and soil, the values of MPC (maximum permissible concentration) and RC (residual concentration) are implemented.

Responsible Public Authorities

Within the Ministry of Nature Protection, the Division of Land Protection and a recently organised Division of Hazardous Substances are responsible for the management of contaminated sites.

Registration

Staff at the Centre for Ecological and Neosphere Studies of the National Academy of Sciences has developed and implemented a method for the mapping of sites contaminated by heavy metals. This will contribute to the communication of results to the citizens.

Characterisation of Soil and Groundwater Contamination

Sources of Soil and Groundwater Contamination

The following types of contaminated sites and land are of major importance in Armenia:

- Industrial sites. In Armenia principal sources of industrial pollution are mining, metallurgical, chemical, and construction industry. The emissions from these contain a complex of heavy metals (arsenic, lead, cadmium, nickel etc.), fluorine and chlorine compounds (including dioxins), cyanic and nitrogen compounds, and other substances, that cause soil and groundwater contamination.
- Landfills. A principal factor of land contamination is industrial and household wastes. During the years 1985 – 1990 about 36,7 million tonne of industrial wastes were generated, and 20,0 thousand tonne of this was toxic waste. Now, it is difficult to estimate the current amount of industrial waste generation in the country.

- Contamination of agricultural land. The problems mentioned above for industrial sites also have an impact on agricultural land in areas near the sites. Furthermore, agricultural land, especially in the region of Ararat valley, is contaminated with pesticides and fertilisers. Though the use of the most harmful chlororganic pesticides (DDT, DDE and heptachlor) was prohibited in the 1970ties, investigation performed in 1995-96 revealed high residual concentrations of these pesticides in some soils. Besides, after the privatisation of the agricultural land in 1992 and the breakdown of the former centralised pesticide supply system the present use of pesticides can not be controlled.
- Mining sites. Today, there is no clear data on land contamination caused by mining activities. Deposits of mine tails, dumps and slag contain high concentrations of pollutants that might also spread to surrounding areas.
- Sites contaminated with lead. Due to the economic conditions, some people in Yerevan use plots of land that are contaminated with high concentrations of lead. The sources of this contamination are industrial emissions and use of leaded petrol.

It is noted that there are no facilities for treatment or recovery of recyclable industrial and household waste. In addition, a significant part of the industrial waste is dumped in the landfills for municipal waste without any preceding treatment.

There are 45 urban and 429 rural landfills for municipal solid waste in Armenia, and the total landfill areas occupy about 1500 ha. The landfills have been constructed without special planning permission or environmental impact assessments. Usually landfills are not covered with soil. High concentrations of heavy metals have been found in landfills leading also to contamination of soil and groundwater.

Number of Registered Contaminated Sites / Contaminated Land Areas

There is no estimate on the number of contaminated sites.

Examples of likely contaminated sites are:

- A copper and molybdenum factory in Kadjaran. In some zones of the factory area, contamination of soil with copper and molybdenum is considerable high.
- A gold extracting plant in Ararat. It is estimated that an area of about 20 km^2 surrounding the factory is contaminated by heavy metals. The concentration of arsenic exceeds the maximum permissible concentrations (MPC) several hundred times.
- Chemical plants in Vanadzor and Yerevan.

Investigation Methods

Identification of Potentially Contaminated Sites and Areas

There are no sources of respective data.

Investigation of Contaminated Sites and Areas

To detect heavy metals contamination in soils, atomic-adsorptive and spectrographic methods are used and implemented into practice.

Facilities for Contaminated Soil

Handling and Treatment of Excavated Contaminated Soil

Up till now, no facilities exist for contaminated soil, though Armenian researchers develop some clean-up technologies for contaminated soils.

Measures Used by Remediation of Soil and Groundwater Contamination

Staff at the Centre for Ecological and Neospheric Investigations at the National Academy of Science is working on development of a technology for cleaning sites contaminated with heavy metals, cyanic and nitrogen compounds, and pesticides. The use of the technology will provide for the cleaning of different contaminated sites e.g. the above-mentioned area surrounding the gold extracting plant in Ararat.

Financing and Liability

Investigation and Remediation Activities

Given the economic situation in Armenia, practically no governmental funding is available for investigations or remedial actions on contaminated sites and land. It is estimated that the problems with contaminated land in Armenia are common for all the countries of the former USSR and the CEE. Thus, co-operation between these countries is of great importance in identifying proper and sufficient solutions for the ecological problems.

Legal Requirements re. Polluters and Site Owners

Legal requirements are included in the Law of the Republic of Armenia on Nature Protection and Environmental Management fees and charges (28.12.1998) and in the corresponding Governmental Decisions adopted recently (31.12.1998).

Scope of the Problem

Scale of the Problem and Handling Costs

No investigation has been made on the total number of contaminated sites due to lack of appropriate financing.

Priority in Relation to Other Societal Problems

Contamination of agricultural land is related to the food problem.

Illustrative Cases

See the paragraph “Number of Registered Contaminated Sites”.

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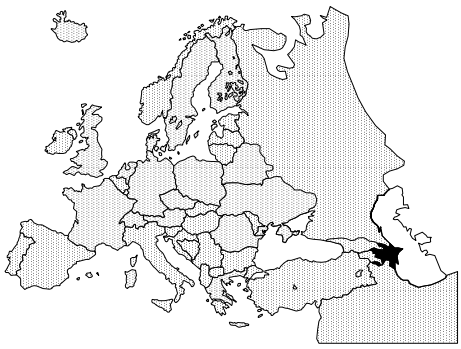
Azerbaijan

Country Characterisation



Background

Unit	Total area	Agricultural areas	Perennial plants	Pasture areas	Woodland areas	Swamp soils	Flooded soils	State reserves	Protected areas
In %	-	51,4	2,4	27,8	11	0,3	3,9	2,2	1,0
In km²	86415	44469	2073	24023	9486	227	3338	1912	887

Figure on total area from UN/ECE, 1998.

Population	Population density	Annual pop. growth 1990 – 1995	Life expectancy at birth	
			Male	Female
1000	*per km²*	*%*	*years*	*years*
7632	88	1,20	67	75

Figures from UN/ECE, 1998, and POPIN, 1999.

Legal and Administrative Basis

Definition of Contaminated Sites and Land

There is no specific definition for contaminated sites and land.

Legislation

The Government and the Parliament of Azerbaijan have adopted a number of laws and standards during the past few years. In 1998 the Government approved a national environmental action plan which primarily is aimed at the restoration of land contaminated by oil products. The plan was elaborated by the State Committee of Economy together with the World Bank and with participation of various ministries and departments as well as relevant specialists.

A second project carried out in 1998 deals with the management of toxic and hazardous waste. This was also made in co-operation with the World Bank.

Besides this, the republic has also joined the UN convention on struggle against desertification. One point of this convention is also dealing with the chemical degradation of land. A national programme for the republic on the struggle against desertification will be made in the near future.

Implementation of Limit Values

-

Responsible Public Authorities

The main institutions responsible for control on soil conditions are:

- The State Committee on Ecology and Nature.
- The State Land Resources Committee.

Registration

Up to now there are no inventories on contaminated sites.

Characterisation of Soil and Groundwater Contamination

Sources of Soil and Groundwater Contamination

The problem of land contamination by pesticides and mineral fertilisers is very important for the republic. During the past, more than 300000 tonne of mineral fertilisers and 40 – 60000 tonnes of pesticides (about 100 different kinds) were used within the agro-industrial complex. The mean loading of pesticides in the cotton growing regions was 25 – 30 kg/ha per year, and for vineyards was 150 180 kg/ha per year. The pesticide use has been reduced. However, the quality of these has been lowered. Formerly, the republic received pesticides from centralised USSR departments. Now the individual farms get the pesticides from small companies e.g. selling low quality products.

Besides this the, the main sources of soil contamination are oil products, oil processing, chemicals in general, mining, and metallurgy.

Contamination with heavy metals represents a problem. The main sources of heavy metal accumulation in the soil are industry emissions, waste and traffic emissions. In general, the contents found for heavy metals exceed the index for average lithosphere about 8 times for lead, 2 times for nickel, 50-60 times for zinc, and 10 times for copper. The high contents may among others be explained by the use of copper vitriol and zinc against pests. Long term monitoring have shown that the crop capacity of fields decrease about 20% due to traffic emissions in a distance of 1 m from a road.

Mining activities are also among the factors that cause soil and land contamination. In the republic, there are more than 300 mineral deposits being exploited. About 200 of these are mined by the open pit method, which is cheaper an more effective compared to underground methods, but also causes more environmental problems.

Furthermore, areas contaminated by oil products represent a special problem in Azerbaijan. It is estimated that areas contaminated with oil products equal approximately 11000 ha. Until today, none of these have been restored. Furthermore, there is a considerable loss of land connected to the construction of pipelines (4 ha per 1 km).

Number of Registered Contaminated Sites / Contaminated Land Areas

There is no estimate on the number of contaminated sites.

The following estimates have been made on contaminated areas, saline soil areas etc.

Unit	Total area	Saline soils	Erosion soils	Oil contaminated areas	Other contaminated areas
In %	-	13,8	42,8	0,16	0,18
In km²	86415	11954	36957	140	160

Investigation Methods

Identification of Potentially Contaminated Sites and Areas

-

Investigation of Contaminated Sites and Areas

-

Facilities for Contaminated Soil

Handling and Treatment of Excavated Contaminated Soil

Up till now, no facilities exist for treatment or proper depositing of contaminated soil.

Measures Used by Remediation of Soil and Groundwater Contamination

Up till now, no remediation of contaminated soil and groundwater has been performed.

Financing and Liability

Investigation and Remediation Activities

-

Legal Requirements re. Polluters and Site Owners

-

Scope of the Problem

Scale of the Problem and Handling Costs

-

Priority in Relation to Other Societal Problems

-

Illustrative Cases

-

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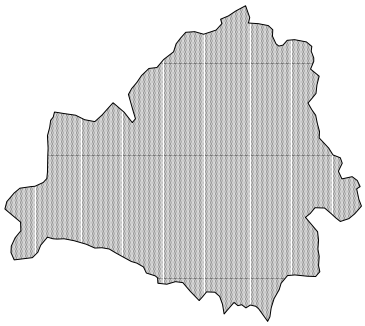
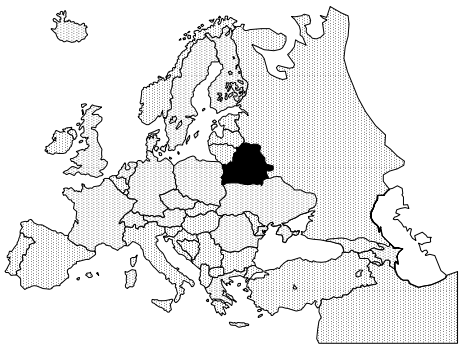
Belarus

Country Characterisation





Background

Belarus' terrain is chiefly plain. It rises 160 metres on an average above the sea level. Over one-third of the territory is forest-covered. The biggest rivers, with more than 500 km in length, are the Dnieper, the Neman, the Zapadnaya Dvina and the Western Boog, whereas all in all there are about 20,000 big and small rivers in Belarus. A big number of lakes (more than 11000 covering the territory of almost 2,000 km^2) is a characteristic feature of the country: most of the lakes are scattered in the north and southern provinces. There are places where 10 percent of the surface is under lakes - Ushachi and Braslav districts of Vitebsk region.

The ecosystems of Belarus are of great environmental significance to Eastern and Western Europe. The Belarussian lake district is part of the larger Baltic lake area, stretching from Germany, through Poland, Lithuania, Belarus and Latvia, to Russia. Large areas in Poland and Belarus form a common forest belt encompassing Knyszynska Pushcha, the Belarussian and Polish parts of Belovezhskaya Pushcha, as well as Ruzhanskaya and Nalibikskaya Pushchas in Belarus. The Belarussian Polessye district is part of a strip of European marshlands and forest that extends from Poland to Ukraine. Under the international agreement "The Green Lungs of Europe", signed in 1993, the entire territory of Belarus, along with Lithuania, Latvia, Estonia, the Eastern part of Poland, and the Western part of Russia, requires special efforts directed towards preserving natural ecosystems and implementing friendly modes of economic activities.

Administratively, Belarus is divided into six provinces - the Brest, Vitebsk, Gomel, Grodno, Mogilev and Minsk oblasts, and 118 districts. There are 102 towns, 111 town-type settlements and over 24000 large and small villages in the country.

According to the 1996 census, the country's population was about 10,3 million people, out of whom 7,1 million lived in town and 3,2 in the country. The annual rate of population growth was 0.6% from 1975 to 1985. In the years following it decreased to 0.35%.

Total area	Agricultural areas		Wooded areas		Nationally protected areas		Other areas	
km^2	*km^2*	*%*	*km^2*	*%*	*km^2*	*%*	*km^2*	*%*
207600	103221	50	68353	32	5837	3	30189	15

Figure on total area from UN/ECE, 1998.

Population	Population density	Annual pop. growth 1990 – 1995	Life expectancy at birth	
			Male	Female
1000	*per km^2*	*%*	*years*	*years*
10215	49	-0,14	63	74

Figures from UN/ECE, 1998, and POPIN, 1999.

Despite efforts to strengthen environmental protection in nearly all spheres of economic activities, and the enactment of numerous laws regulating environmental pollution, the state of environment in the big cities and industrial centres is still a cause for concern. And in 1986 almost one quarter (23%) of Belarus' territory was contaminated by radioactive fall-out from the Chernobyl NPP accident.

Two regional capitals head the list of cities with substantial environmental problems, Gomel and Mogilev, situated in the Chernobyl affected territory and containing environmentally hazardous industries. The level of overall pollution on the 1/3 of the territory of Minsk, the capital of Belarus, is described as extremely unfavourable. Inspections of soil in the urban areas have revealed that the main pollutants are lead, zinc and copper.

Obviously, every city, industrial plant, agricultural or military activities influence natural complexes: contaminate air, soil, subsurface, and groundwater. The main concern are: bacteriological pollution due to improper sanitary practices, nitrate contamination due to the draining of lands, inappropriate application of fertilisers and livestock manure practices, pollution from storage and application of pesticides, and contamination at toxic waste sites.

The Chernobyl NPP accident had suddenly transformed the living conditions of more than 2 million people into hostile surroundings. 3668 towns and villages were polluted with caesium-137 over 37 kBq/m^2. The highest rates of caesium-137 contamination, except for the area of resettlement, were registered in the villages Shepetilovichi of Checherski district 2272 kBq/ m^2, Vylevo of Dobrush district 2220 kBq/ m^2 (Gomel oblast) and village of Chudyany of Cherikov district (Mogilev oblast) 5402 kBq/ m^2.

As a result of the Chernobyl disaster, the area of arable land contaminated with radioactive caesium-137 with the density over 37 kBq/ m^2 amounts to 1.6 million hectares, out of which 260 000 hectares have been taken out of agricultural use, 1 685 000 hectares of forests are radioactively polluted. A considerable amount of radionuclides accumulated in upper layer of soil, creating unfavourable conditions for farming and forestry activities for decades to come.

Another environmental problem is the re-cultivating of more than 4.6 million hectares of land left after the withdrawal of former Soviet military troops, which were:

- The troop training areas.
- Garrisons.
- Explosive firing test-sites.
- Airbases.
- Maintaining facilities.
- Missiles bases.
- The accompanying social infrastructure, i.e. housing, public utilities, depots, storage and other facilities.

The most frequent and problematic types of contamination are jet fuel, petroleum, diesel oil, used lubricated oil, TCE and other chemicals. The former depots and storage facilities for petrol and mineral oil products caused the worst environmental damage.

Legal and Administrative Basis

Definition of Contaminated Sites and Land

The Radioactively contaminated territory of Belarus is divided into specially defined zones depending upon soil contamination and average annual, effective radiation dose.

Zoning of the Republic of Belarus according to the contamination level			
	Contamination density, Ci/km^2		
Name of zone	Cs-137	Sr-90	Pu-238, 239, 240
Residence zone with periodic radiation control	1-5	-	-
Zone with the right for resettlement	5-15	0.5-2	0.01-0.05
Zone of subsequent resettlement	15-40	2-3	0.05-0.1
Zone of immediate resettlement	> 40	> 3	> 0,1
Evacuation zone	The territory around the Chernobyl NPP from where people were evacuated in 1986 (30-km zone and the area from where people were additionally settled out owing to the strontium-90 contamination over 3 Ci/km2 and the plutonium contamination – 0.1 Ci/km2)		

Legislation

All environmental legislation is based upon the Constitution of Belarus, namely articles 34, 46, and 55. The concept of state policy of the Republic of Belarus in the field of environmental protection was adopted by the Supreme Soviet on September 6, 1995. The basic Law "On Protection of the Environment" of November 1992 states that contaminated sites need to be assessed and remediated.

A special Law "On legal treatment of the territories contaminated as a result of the Chernobyl NPP catastrophe" was put into force.

Concerning military sites, the following regulatory documents were adopted: "The Procedures of Conducting Sanitary, Hygienic and Radio-ecological Monitoring of the Former Military Sites and Adjoining Territories" (January 1994) and "The Programme and Methods of Ecological Monitoring of Released Military Sites and Adjoining Territory". According to the Programme, the ecological inspection and detailed studies are to be performed for received data to be the basis for the sites' remediation and rehabilitation.

Implementation of Limit Values

Standards of the former Soviet Union define values for soil in terms of "maximum allowable concentrations", which are usually more conservative than the A-values of the Dutch list.

Groundwater values are usually derived from drinking water standards.

Examples for "Maximum Admissible Concentrations of Contaminants in Soil" (Belarus) are:

- Cadmium 1 mg/kg.
- Zinc 70 mg/kg.
- Lead 30 mg/kg.
- Copper 45 mg/kg.
- Nickel 57 mg/kg.
- Mercury 2,1 mg/kg.
- Benzapyrene 0,02 mg/kg.
- Sulphates 160 mg/kg.
- Nitrate 130 mg/kg.
- Soluble fluorine 10 mg/kg.

Responsible Public Authorities

Ministry of Nature Resources and Environmental Protection, Main tasks:

- Development and carrying out of the state policy in the field of environmental protection and rational utilisation of natural resources.
- Complex management of nature protection in the country, co-ordination of the activities of all republican institutions.
- Conducting of state control in the field of environmental protection and nature resources utilisation.
- Information provision of the population on the concerned issues, etc.

Into the structure of the Ministry are included 6 oblast and Minsk city committees and 123 inspections of nature resources and environmental protection, as well as scientific and research institutions, science and technical centres (including ECOMIR), and others.

State Committee on Land Resources, Geodesy and Cartography, Main tasks:

- Inventory of land.
- Conducting of state land cadastre.
- Control of use and protection of land.

Ministry of Health, Main tasks:

- Conduct sanitary control, quality of drinking water and food as well as sanitary state of urban territories, etc.

Ministry for Emergencies, Main tasks:

- Co-ordinates all the activities on the radioactively contaminated territories, as well as in other damaged areas as a result of natural and man-made disasters.
- Possess some former military sites, conducts environmental monitoring and rehabilitation of them for converting them into civil use.

Ministry of Forestry, Main tasks:

- Conduct state control, use and reproduction of forests, etc.

State Committee of Hydrometeorology, Main tasks:

- Monitor the condition of air, surface waters, land, radioactively contaminated territories, etc.

Scientific and Research Institutes of the National Academy of Science, Ministry of Food and Agriculture, Ministry for Emergencies, Ministry of Health

Registration

There is a National System of Environmental Monitoring for conducting the precise monitoring of the state of air, soil and ground water. The Ministry of Nature Resources and Environmental Protection conducts the co-ordination of all activities. The chief executor of all the tasks is the State Committee of Hydrometeorology.

The database on the state of lands and water resources is created with special attention to radioactive and chemical contamination. There is a special cadastre of ground waters (annually up-dated).

Annual National Reports of the different responsible authorities are published. There are maps of radioactively contaminated territories and territories polluted with the heavy metals.

Characterisation of Soil and Groundwater Contamination

Sources of Soil and Groundwater Contamination

The main sources of contamination are the Chernobyl NPP fall-out of radionuclides, agricultural activities due to the use of chemicals, and military activities.

Concerning the former Soviet military sites, the contamination profiles identified were mostly:

- Mineral oil products, especially fuels.
- Heavy metals.
- Explosives.
- Toxic chemicals.
- Various wastes, among which hazardous wastes, radioactive wastes, and building material.
- Radioactive contamination.
- Blinds.

Number of Registered Contaminated Sites / Contaminated Land Areas

As a result of the Chernobyl NPP accident, the caesium-137 contamination amounted to 23% of the territory of Belarus (46.45 thousand km^2). The strontium-90 contamination is of a more local nature, and it was revealed on the area of 21 000 km^2 (that is 10% of the country's territory). Soils contaminated with plutonium-238, 239, 240 cover about 4 000 km^2 that is almost 2% of Belarus' territory.

The total area of released military sites is 4.6 million ha.

Investigation Methods

Identification of Potentially Contaminated Sites and Areas

Belarus has no systematic pre-assessment of potentially contaminated sites and areas. The first pre-assessments and site assessments were carried out according to the US *Threat Reduction Programme* of 1992. Major objectives of the programme were to support Belarus in the disarmament of missile bases and to set-up environmental programmes of the following features:

- Assessment of the environment.
- Set-up of remediation plans.
- Training of staff.

In 1995 the Ministry of Resources and the Environment and the Ministry of Defence issued a guidance document concerning the assessment of the environment at military sites. The document is in principal based on the experience of the US and of Germany concerning the assessment of military sites of the former GDR. The following time frames are usually expected:

- Up to 3 months for the pre-assessment.
- Up to 6 months for the detailed investigation and risk assessment.

The pre-assessment includes the following key steps:

- Investigation and assessment of historical information from archives.
- Evaluation of aerial photos.
- On-site visits.
- Geo-referencing (mapping) of contaminated areas.
- First assessment of geological and hydro-geological data.
- First collection of samples from contaminated areas including chemical and radioactivity analysis of soil, soil air, plants, surface waters, and groundwater.

Special emphasis is put on on-site analysis with mobile equipment and remote sensing; i.e. infra-red spectrometry and ultrahigh frequency analysis to assess soil humidity for the assessment of groundwater levels, hydrocarbons contamination, and underground fuel storage tanks.

Investigation of Contaminated Sites and Areas

Preliminary site investigations include:

- The assessment of hygienic conditions.
- The sampling of soil, soil air, water and plants.
- Chemical and radioactivity analysis.
- Toxicity assessment of identified contaminants.
- Mapping of contaminated areas.

For the Chernobyl contaminated territories the following investigation methods were applied:

- Preliminary assessment.
- Measurements at sites.
- Sampling.
- Analysis of samples at the laboratories.
- Received data analysis.
- Mapping of contaminated sites.

In some specific military sites, identified hot spot areas have been investigated in more detail. These investigations were based on joint decisions of the Ministry of Resources and the Environment and the Ministry of Defence and included:

- The definition of the extent of contamination.
- The selection of appropriate remediation technologies.
- Recommendation for the future land use.
- Cost estimates.

Facilities for Contaminated Soil

Handling and Treatment of Excavated Contaminated Soil

See below.

Measures Used by Remediation of Soil and Groundwater Contamination

The radio-ecological situation after the Chernobyl NPP accident demands the large-scale decontamination works to be fulfilled with the primary goal to reduce the external exposure dose of the population. The major works were done in 1986 - 1989.

At that time outside the 30-km zone of NPP about 500 settlements were decontaminated (60% of them were under decontamination 2 - 3 times). Those activities included removal of contaminated soil and re-filling with clean soil; dismantling of objects not subjected to clean-up; asphalting of streets, roads and sidewalks; and replacement of roofs; disposal of accruing wastes. 13.3 million m^3 of soil was cut off and buried, and 2.8 million m^3 of clean soil was brought in.

The removed contaminated soil and parts of demolished buildings were stored at temporary disposal sites for wastes resulting from decontamination. After the Chernobyl disaster 69 disposal sites for decontamination waste were set up in Gomel region.

From 1989, decontamination activities were narrowed down. At present, decontamination activities are limited. In the first instance there are such socially important objects under decontamination as children's pre-school institutions, schools, medical and rehabilitation institutions as well as local spots of abnormally high contamination in settlements.

To dispose of the waste resulting from decontamination of open areas and demolition of constructions, there is 3 operating Decontamination Waste Disposal Sites (DWDS) in the Gomel region and 4 sites in the Mogilev region. The first line of DWDS near the village of Koshara (Stolin district, Brest region) was put

into operation by the end of 1995. Prior to that in the Brest region, the waste was stored on temporary grounds.

One of the tasks is the safety maintenance of DWDSs, in particular, to prevent radionuclides from getting into ground waters. Therefore, to ensure the control over DWDSs there is a monitoring network deployed. The aim is to monitor the migration into the 'soil-surface waters' system. There is a system of control holes at 11 characteristic DWDSs drilled in Bragin, Khoiniki, Vetka and Chechersk districts. The results obtained show no increase in radionuclides' content in ground waters, which is confirmed by the IAEA experts' conclusion.

Decontamination of soil of the former military sites, polluted mainly with jet fuel, petroleum, diesel oil, used lubricated oil and other chemicals (with concentration 28 - 60000 mg/kg), includes removal of contaminated soil, its storage and replacement by clean soil.

Financing and Liability

Investigation and Remediation Activities

For the military sites of Belarus, the Ministry of Defence is supposed to cover necessary remedial measures. However, the Ministry of Defence has no specific budget for such measures.

With regard to former Soviet military sites, Russia is supposed to cover the necessary remediation activities. The first activities at the former Soviet missile bases Postavy and Ruzhany have been financed by the Ministry of Resources and the Environment with the objective to calculate the costs of the environmental damage in order to obtain compensation from Russia.

Legal Requirements re. Polluters and Site Owners

In accordance with the laws, the special taxes and other payments are envisaged for the use of nature resources, including emission of pollutants and wastes into environmental surroundings. Compensations for any damage to the environment are envisaged too.

The amount of taxes, penalties and compensations depends upon the character and scale of damage caused.

Scope of the Problem

Scale of the Problem and Handling Costs

The state budget for the Programme on overcoming the Chernobyl catastrophe is the largest among other shares of it.

The scrapping of weapons in order to comply with the disarmament agreements is estimated to amount to 12 billion USD.

Investigations at all military sites are estimated to need a budget of approximately 12 - 20 billion USD.

Priority in Relation to Other Societal Problems

The Chernobyl contamination is priority number one.

Illustrative Cases

The Chernobyl Catastrophe

The Chernobyl tragedy is the greatest radiation catastrophe that has ever occurred on the earth. The contamination caused by the radioactive releases from the wrecked reactor is spread throughout large areas of Belarus territory. The maximum levels were found within the 30-km zone (the "alienation zone"). Here, the levels exceed the pre-accident levels by more than 20000 times. Beyond this zone there are also areas

with high levels of contamination e.g. levels exceeding the pre-accident levels by more than 1500-3500 times. At the same time, significant variations of the contamination levels (x1000) were revealed in relative small areas. The high gradients make it difficult to assess the contamination situation in specific residential areas. In the rest of the Belarus territory, the levels are also higher than the pre-accident levels.

According to the law on social status of territories affected by radioactive contamination as a result of the Chernobyl NPP catastrophe the territory of the Republic of Belarus is divided into zones according to the level of radioactive contamination and the following average annual effective human dose.

The use of forest, mineral and other resources has been reduced considerably. About 132 mineral and raw materials deposits including industrial sources of building materials (chalk, sand, clay etc.) are located in the contaminated areas. Several of these have been taken out of use. Also, a large oil and gas deposit site has been withdrawn from the plans of geological investigation. 2640 km^2 of agricultural land have been taken out of use, including closure of farms and food processing plants.

The scale of the catastrophe demanded urgent countermeasures. At the initial stage of the post- accident period, 24700 people were evacuated. Up to now, more than 135000 people have been relocated from the contaminated areas. Afterwards, it has been decided to abandon a mass relocation of people, and instead to carry out rehabilitation measures that can provide for renewal and development of the economic potential of the contaminated territory and the social activity to restore to normal living conditions.

Following this, regional programmes for rehabilitation of the most affected regions have been developed. The programmes are characterised by a complex approach to rehabilitation of industrial and social objects in each region taking into account radiation-hygienic, socio-economic, demographic and psychological aspects. All the programmes aim on rehabilitation of the environment and decreasing the dose rates on the population. The programmes are related to territories inhabited by more than 1,6 million people.

Rehabilitation measures are planned to be conducted both in public and private sectors taking into consideration the flows of radionuclides e.g. by foodstuff. Special attention is paid to the production of milk, as consumption of radioactively contaminated milk form up to 80% of the average individual internal exposure. The 1998 programme aims at reduction of the content of radionuclides in agricultural products and increase in the productivity of natural tillage. A range of specific activities has been planned within the framework of this programme such as liming of acid soils, application of additional phosphorus-potassium fertilisers, and laying out pastures.

Provision of relayed pastures and hayfields in the affected areas is one of the most effective measures to reduce the transfer of some radionuclides to milk. Also, application of combined fodder with ferrocyanides is planned, as this will allow for significant reductions of the content of radionuclides in ruminant milk and meat.

From 1986 to 1989, engineering and civil defence troops decontaminated settlements in contaminated areas on a large scale. Just outside the 30-km zone, about 500 settlements were decontaminated. The work included removal of contaminated soil and refilling by clean soil, dismantling of contaminated installations, asphalting of streets, roads and sidewalks, replacement of roofs, and disposal of waste. 7.3 million m^3 soil were excavated and buried, and 1.6 million m^3 of clean soil were brought in. The needs greatly exceeded the opportunities, and full-scale decontamination of settlements, agricultural and industrial installation to foster normal living conditions turned out to be unrealistic. Since 1989, the decontamination work has been cut down and resettlement has been a major protective measure.

Military sites

A military site close to the city Zaslonova in the region of Vitebsk was the first investigated military site. The site is among the largest with a total surface of approximately 5 km^2. The site was used as missile base and also had a medical station. Major contamination is due to hydrocarbons, furthermore lead, benzopyrene, sulphate, and soluble fluorides.

Later on the strategic missile bases of Postavy and Ruzhany were investigated. Hot spots of contamination were mainly identified near the following facilities:

- Parking facilities for cars and tanks.
- Stocks and filling stations for fuels and lubricants.
- Sewage treatment plants.
- Shooting and test ranges.

Major contamination profiles identified were: Hydrocarbons, heavy metals, industrial and domestic waste, metal scrap, organic solvents, paints and varnishes, building material, missile fuels, and explosives and ammunition.

Research and Development projects include:

- Treatment of heavy metals contaminated wastewater with means of magnetic sorption materials.
- Synthesis of fertilisers from missile fuels.
- Removal of radionuclides in soil by use of microorganisms and highly concentrated saline solutions.

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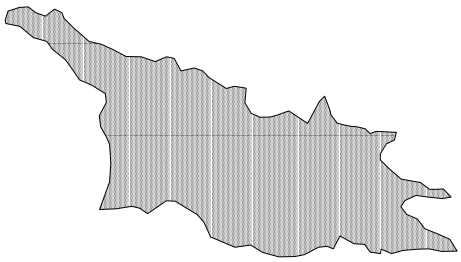
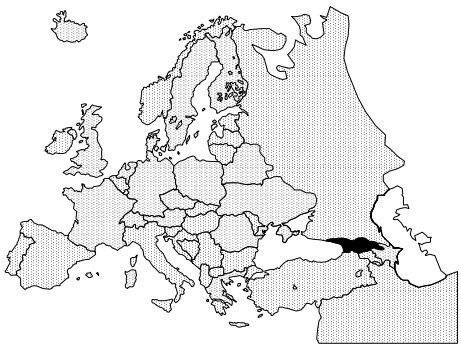
Georgia

Country Characterisation





Background

The existing information on managing of contaminated sites and land in Georgia is limited. However, it is estimated that more than 27 ha territory of Georgia is contaminated by different forms of pollutants.

Total area	Agricultural areas		Wooded areas		Nationally protected areas		Other areas	
km²	*km²*	*%*	*km²*	*%*	*km²*	*%*	*km²*	*%*
69700	29886	43	30031	43	2779	4	9552	14

Figure on total area from UN/ECE, 1998.

Population	Population density	Annual pop. growth 1990 – 1995	Life expectancy at birth	
			Male	Female
1000	*per km²*	*%*	*years*	*years*
5427	78	0,14	69	76

Figures from UN/ECE, 1998, and POPIN, 1999.

Legal and Administrative Basis

Definition of Contaminated Sites and Land

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Legislation

Georgia has adopted following laws in the field of the environment.

Year	Law	Function
1960	Criminal Code	Specifies penalties for violating environmental laws
1978	Forest Code	Specifies forest policy
1981	Law on the Protection of Atmospheric Air	Protects air quality
1984	Administrative Violation Code	Enforcement law
1994	Law on Soil Protection	Regulates the use of fertilisers
1994	Law on Plant Protection	Regulates the harvesting of wild plants
1994	Law on Basic Taxation.	Tax law
1995	Law on Transit and Import of Waste	Prohibits the import or transit of hazardous waste
1995	Law on Tourism	Encourages tourism
1995	Constitution of Georgia	Defines basic rights
1996	Law on Protected Area System	Provides for seven national parks
1996	Law on Mining	Introduces a taxation system for the use of subsurface natural resources
1996	Law on State Ecological Examination	Requires Environmental Impact Assessments (EIAs) to be carried out for certain classes of development. EIAs must be conducted and financed by the proposing party. NGOs may conduct independent EIAs with full access to information
1996	Law on Environmental Permission	Requires releases to the environment to be kept within specified limits. Companies must submit details of their planned emissions, releases and utilisation of resources
1996	Law on Environmental Protection	Framework Law
1997	Law on the Animal Kingdom	Provides a basis for protecting the diversity of fauna
1997	Law on Water Resources	Defines water as a non-renewable resource and introduces fees for its use

Implementation of Limit Values

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Responsible Public Authorities

The responsible public authorities are as follows:

- The Ministry of Environment of Georgia.
- The Ministry of Health of Georgia.
- Other governmental organisations.

Registration

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Characterisation of Soil and Groundwater Contamination

Sources of Soil and Groundwater Contamination

As contaminated sites could be considered the Black Sea Coastal Zone and Terminals located in this area and also those resorts where the technologies and proper treatment facilities are not functioning.

There are many sources of soil and ground water contamination. One of them is landfill. There are 46 registered landfills. These do not meet the requirements, even basic. There are also illegal landfills, and they are considered as the significant sources of contamination.

Number of Registered Contaminated Sites / Contaminated Land Areas

It is estimated that more than 27 ha territory of Georgia is contaminated by different forms of pollutants.

Areas contaminated by oil and oil products are estimated to amount more then 10 ha, and more than 17 ha are estimated to be contaminated with different kind of wastes. There are no specific landfills for toxic or hazardous waste.

In most cases, industrial waste (accumulated or generated) on the companies sites are toxic. According to the data of 1988, the total amount of waste is 64,5 mt from which 70% comes from mining activities. There is 1,3 mt of hazardous waste, among them are:

- 658 t hydrological waste;
- 15,8 thousand tons wall (fence) mud;
- 4,8 t cobalt containing dust;
- 1829 t arsenic waste;
- 726 t chromic waste;
- 293 t dust from reactive cleaning;
- 1404 t paintings and their solutions;
- 50000 t acid tar;
- 3000 t pesticide.

Poor agricultural technologies, not environmentally sound disposal of fertilisers and chemicals, their improper usage, transportation and utilisation remains as considerable problems.

1990s data indicates that nautrical fusion in soil exceeds the limit 20 - 80 times. For pesticides, limits are exceeded 30 - 50 times in rivers and underground water.

Investigation Methods

Identification of Potentially Contaminated Sites and Areas

At present, analyses are not carried out for determining the contamination level and the concentration of the specific substances in water, soil and air (due to the poor capacity).

Investigation of Contaminated Sites and Areas

See above.

Facilities for Contaminated Soil

Handling and Treatment of Excavated Contaminated Soil

Handling and treatment of excavated contaminated soil is not often carried out, but sometimes this is done for a technical and biological, recultivation point of view.

Measures Used by Remediation of Soil and Groundwater Contamination

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Financing and Liability

Investigation and Remediation Activities

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Legal Requirements re. Polluters and Site Owners

According to the law, the site owner is obliged to protect the soil from the degradation and contamination.

The polluter pays for the pollution and caused damage to the owner and environment.

Polluters must compensate to owner damage and restore the soil that was contaminated. At one location, a contaminated site covers more than 27 ha, and it is estimated that costs for clean-up activities is around 120.000 GEL (Georgian Currency).

Scope of the Problem

Scale of the Problem and Handling Costs

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Priority in Relation to Other Societal Problems

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Illustrative Cases

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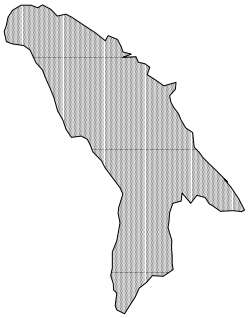
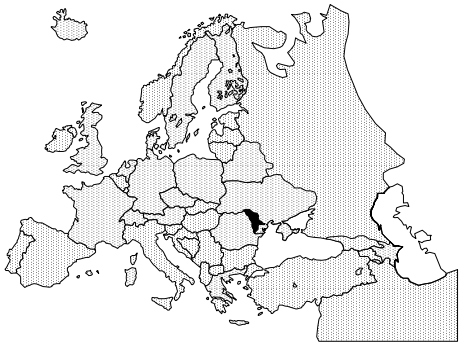
Moldova

Country Characterisation





Background

As an independent State, the Republic of Mo1dova was created resulting from the collapse of the former Soviet Union. Moldova is situated in the south-east part of the European continent. Moldova is bounded on the west by Romania, and on the north, east and south by the Ukraine. The Republic area is 33.8 thousand square km. The country population is approximately 4.35 million inhabitants with an average density of the population of about 129 people per square km.

The territory of the Republic of Moldova includes three natural zones: forests, forests steppe and steppe. It represents a component part of the Eastern European plain.

Total area	Agricultural areas		Wooded areas		Nationally protected areas		Other areas	
km²	*km²*	*%*	*km²*	*%*	*km²*	*%*	*km²*	*%*
33851	25557	75,5	4229	12,5	664,5	2,0	3450	10,0

Figure on total area from UN/ECE, 1998.

Population	Population density	Annual pop. growth 1990 – 1995	Life expectancy at birth	
			Male	Female
1000	*per km²*	*%*	*years*	*years*
4310	127	0,32	63	70

Figures from UN/ECE, 1998, and POPIN, 1999.

Legal and Administrative Basis

Definition of Contaminated Sites and Land

There is no specific definition for contaminated sites and land.

Legislation

-

Implementation of Limit Values

-

Responsible Public Authorities

For the implementation of Convention provisions was created the Government Commission. Where practically, it involves the representatives from the below mentioned supervision State institutions. The leading role is given to the Ministry for Environment Protection of Moldova.

- Republican Centre of Hygiene and Epidemiology observance of sanitarily normative.
- State Civil Defence Board public security, response to industrial accidents and natural disaster, licensing and inspections of transport of hazardous substances.
- Ministry of Affairs - supervision of respecting antifire normatives, removal of fire accidents.
- Ministry of Public Works and Exploitation of Housing Fund - supervision of quality of water supply, efficient use of wastewater treatment plants, and sanitary situations in the localities.
- AGEOM - geological and hydrological investigations.
- Moldhydrometeorological Service - supervision of the ambient media quality.
- Moldsilva - exploitation of forests fund.
- Concern ACVA - exploitation of water surface resources.
- The Ministry of Agriculture and provision rational agricultural land pesticide uses.
- Customs services - prohibition of illegal import of hazardous chemical substances and industrial wastes.
- Moldovastandard - supervision of established standards and technological security.
- Centre of Veterinary diagnostic - observance of respecting the sanitary normatives in the animal world.

Registration

Up to now there are no inventories on contaminated sites.

Characterisation of Soil and Groundwater Contamination

Sources of Soil and Groundwater Contamination

The main sources of soil and groundwater contamination are:

1. Intensive use of pesticides. At the moment, Moldova is importing (based on issued licenses) 10 thousands of pesticides and mineral fertilisers. Illegally it is importing still 6 thousands of pesticides. Recently, however, the use of pesticides has decreased as illustrated below:
   1990: 14.5 thousand ton of active substances.
   1994: 4.8 thousand ton of active substances.
   1996: 3.168 thousand ton of active substances.
   1997: 3.014 thousand ton of active substances.

   Per 1 ha of agricultural field, the pesticide use has developed respectively:
   1991: 5.6 kg of active substances.
   1994: 2.1 kg of active substances.
   1996: 1.69 kg of active substances.
   1997: 2.03 kg of active substances.

At the same time, an increase in the quantity of storage keeping of outdated and also of prohibited pesticides has occurred:
1994: 1247.7 ton.
1996: 1150 ton.
1997: 2626.97 ton.

2. Municipal wastes which has polluted 636 ha of arable fields.
3. Waste from animal farms.
Each year breeding farms produce about 8.5 mln. ton of waste. Actually it is not well estimated in full consideration the impact to soil resources.
4. Petroleum products:
   - Marculesti, Floresti District: Sources of pollution are at an airbase of the former Soviet Union.
   - Blijnii Hutor: In the period of the former Soviet Union, sources of pollution were at a military airbase.
   - Iargara, Leova District: Storage of oil products.
   - Budesti, Chisinau Municipal area: Source of pollution at an oil filling station. Local inhabitants have lost the supply of clean drinking water.
5. Waste from excavation and treatment of raw materials.
Wastes from such kind of production are compiling 25-45% from extracted raw material. Actually, it has accumulated around 2.0 mln. ton of mineral wastes from which a large quantity is stored on agricultural areas. At the moment, 875,43 ha of former careers require recultivation.
6. Erosions and land slides.
Actually, 1.205 thousand ha of agricultural fields are in the threats of soil erosions, which are located in versatile area:
Eroded soils: concern 800 thousand ha (30%).
50 thousand ha of soil are destroyed from landfills.
On average, 20.3 ton of fertile soils are washed from slopes each year.
7. Due to contamination, the quality of groundwater resources does not meet the standards for drinking water at about 52 % of the country territory.

Soils: Resources, Pollution and Degradation Levels in Moldova

Being a component part of the Soviet Union, Moldova was imposed some models of national economic branch development that bears an absolutely environmental damaging character. Very often, Moldova was used for experiment with all-fated consequences for the environment. Moldova was the country where the spreading megalomania implied the following activities: concentration of agricultural production, intensive chemisation and irrigation, livestock's industrial development, etc. And it is clear that the development of mentioned directions was made without taking into account the natural potential of the territory and the impact of human activity upon environment.

Soils are the main natural wealth of the Republic of Moldova.

The soil covers of the country are formed by chernozems (80%), brown soils, forest grey soils (11.4%) and meadow soils (8.6%). During the 1960 – 1980, the state of soils with whole profiles has reduced in the agricultural surfaces in the north of Moldova from 70 to 65 %, in the centre from 65-70 to 50 %, in the south from 65-70 %. The surface of eroded soils has increased in the north from 30 % to 35 %, while in the south and centre from 30-35 to 35-50 %.

Soil erosion is one of the main factors that have affected soil fertility in the Republic of Moldova. The eroded areas constitute 1.205 thousand ha or 80 % of the arable land, while the area of moderately and strongly eroded soil is 780 thousand ha, the area increasing every year by 0.86 %. The eroded soil's fertility is 40-60 % lower than that of the un-eroded ones. Along with fertility decrease, the degradation of cumuli soils from meadows takes place as a result of their calmatation with weakly humified material, with environmental pollution, leading to major economic and ecological damage.

The soil pollution with toxic compounds, production wastes, the soils settling and degradation through use of heavy agricultural technique, irrigation and draining, desertification, the soil deterioration during extraction, building works, etc., are sources of enormous ecological and social economic damage.

During 1978-1989, more than 4 mln. tons of mineral fertilisers and more than 0.4 mln. tons of pesticides were used. Expenditures in this regard were doubled. Their irrational utilisation caused environmental pollution and affected the health of population. The process of soil phosphorisation, fluoride pollution, micro elements' disbalance and other negative processes caused similar damages.

According to the results of a special survey made in 1989, from 1/3 to 2/3 agricultural lands in Moldova (reports avoid being more precise in many cases) contain pesticides more than the Maximal Permissible Concentration (MPC) (137). The use of pesticides and fertilisers gradually decreased by 26% and 30% respectively from 1986 until 1989. In 1986, the average use of pesticides in Moldova was 15.4 kg/ha, and in 1990 it was 5.7 kg/ha. In 1989, pesticides were traced in 30.2% of soil and in 8.8 % of vegetation samples from Moldova, and in 11.7% and 6.9% respectively they exceeded the MPCs.

One of the most important factors that caused the environmental degradation in the republic was the process of livestock industrialisation.

Animal concentration led to a massive offal concentration, much larger than the bulk of animal production. For example, at the swine complexes with a capacity of 54 thousand heads, the annual meat production was, more than 6.3 thousand tons, whereas the bulk of offal constituted 464.3 thousand tons. The figures connected to cattle complexes were 4.9 thousand tons and 341 thousand tons respectively. Annually, offal production constituted over 40 mln. tons. By their capacity of impurification, this amount of complexes is tantamount to 20 mln. of urban population.

The animal complexes impact upon environment was enormous. Here we can mention the ammoniacal air pollution and soil contamination as a result or irrigation with used waters of these complexes. First of all we underline the negative effect upon water resources. 20 mln. m^3 of utilised waters were accumulated and, as usual, practically unpurified (after decantation in accumulators), protruded into hydrographic systems. More negative was the impact upon groundwater: around each complex it contained over limited quantities of nitrates, bacteriological pollution was registered. Hundreds of hectares were alienated for solid offal depositing.

There are very few indicators, which may as genuinely be used to demonstrate the level of welfare of community, as the availability of a pure and clean environment for the people. The environment pollution, however, is not only a social welfare indicator. It is also one of the most important interdisciplinary problems endangering our health. These risks must be studied to include all health effects, both acute and chronic, immediate or delayed genetic injuries with due care to the probable synergism between several pollutants.

At present, more than 50 chemical compounds, which are divided in 10 classes, are known. Pollution with chemicals in compliance with ecosocial stress is on cruel realities, which compose a main factor of risk to human health in Moldova. In conformity with scientific investigation data it is presupposed that the development of malign effects is a result of some somatic mutations, actions of one latent oncogenic virus or of some modification of mechanisms for control of hemeostazi, for example as hormonal disturbances immunology supervision etc.

One of significant influence on ecological indexes in Republic of Moldova it has the hiring of rural population in activities of agriculture chemisation.

Industrial waste

The problem of industrial waste utilisation is still current; however the annual volume of their production has decreased in comparison with preceding years. The volume of the accumulated ones is growing all the time. The following amounts of waste have been accumulated: 13 million tons of combustion cinders at power plants and boiler stations, 5,2 million tons of mud at the residual domestic and industrial water purification plants, 11 million tons of building and demolition waste, 11 million tons of industrial waste, and 9 million tons of agricultural waste, including 7.9 million tons of animal waste. Among the industrial residuals, 915

tons of rubber residuals, 45 tons of leather, 45 tons of used metals, and 18.5 thousand toxic residuals (1994) have been registered.

Among toxic residuals with diverse compounds and origin the following should be listed:
1000 tons of hydroxides.
Heavy metals: 60 tons of used solvents, 1100 tons of forbidden and unusable pesticides, 150 thousand items of Berlin blue, 1000 tons of used luminescent tubes, oil products residuals.

Only in Chisinau, about 40 tons of lead residuals have accumulated, 200 tons of paints and enamels, 100 tons of used emulsions, 40 tons of ferrous cyanides, about 70 thousand used luminescent tubes.

The majority of the industrial units in the country do not observe the rules of residuals' storage, including the storage of toxic waste. The lack of primary evidence and the lack of the staff responsibility have led to unauthorised storage of residuals, which provide for their spreading and environmental pollution. Some enterprises dump their residuals in domestic waste disposal places because they lack specially arranged facilities for residuals' storage or neutralisation or destruction technologies for the special type of waste. There is no polygon for burying toxic residuals in the country; the producers have means to solve their problem on their own.

For the situation, amelioration amendments and modifications were proposed to the respective articles of the Code on Administrative Contravention concerning the responsibility of consumers for chemical substances and waste management. Simultaneously, additions were made to the Sanitary Rules on collection, transportation and burial of waste issued by the Ministry of Health. Development and approval is necessary for a Law on toxic substance's utilisation, a Regulation on toxic waste regime; as well as the accounting of any types of waste, according to unified environmental hazards criteria (chemical composition, standards, technical conditions) or waste passports; the implementation of new technologies or existing technologies improvement with the purpose of waste volume minimisation, especially for toxic waste; the setting of some taxes for waste storage in the established 1imits, exceeded limits and for storage regulations violations. The waste reduction should be started from the source and the utilisation of waste should be encouraged.

The achievements of the Moldovian scientists in the 4 spheres of recuperation and utilisation of the residual water precipitates with heavy metal compounds have proved, that depending on the qualitative composition, the precipitate can be used as additive to building materials, roads cover, for solvents preparation and for the sediments' recuperation in residual water purification systems; in other areas and technologies.

The problem of used luminescent tubes is under permanent control. In the nearest future a demercurisation plant will be installed with a capacity of 750 thousand tubes per year. Until then, the tubes will be collected and stored in consumer's warehouses. When the plant will be put into exploitation, a favourable way should be secured for the tubes collection and transportation to the destination.

The wine industry does not have technologies for processing and neutralisation of wine clearing residuals. Enterprises have accumulated: 8 thousand tons of grapes leftovers, 43 tons of dregs, 15 thousand tons of terocyanide; 1000 tons of bentonite, 1000 tons of bentonite with ferrocyanides, 2 tons of tartar. A part of the residuals (dregs and grape leftovers) are utilised, while the rest are accumulated.

Some categories of waste, if they are partially dumped at domestic waste disposal facilities, are recuperated by such enterprises as glass factories, cardboard complex, and plastic processing plants ("Chisinau-plast" and "Uniplast"). The economic agents supply to the used metals enterprises iron, non-ferrous metals, oil products residuals, etc. The private firms have become more active in waste paper and metals export.

Considering the above, we believe that the urgent development of neutralisation and subsequent destruction measures for the non-recuperated toxic residuals is necessary through harmless methods for environment and population health.

The situation with reusable materials from the industrial residuals is somewhat more stable. Although part of them is still dumped, a large amount is utilised at such enterprises as the cardboard, glass factories, plastic processing complexes like "Chisinau-plast" and "Uniplast"; the economic agents supply in a centralised way

the used iron, non-ferrous metals, and oil products residuals.

However, the 91 tons of tyres accumulated at enterprises and transport units have not found any application. Only a part of them is restored or used for other necessities. The types can be supplied for remelting, use as additives for asphalt production, and rubber powder fabrication. The waste of light (textile) industry can be used in different areas of national economy, building waste - for roads building and repair, and houses building.

Paper waste can be used as raw material for paper, cardboard, raw cardboard and bitumen based cardboard fabrication.

Oil products can be regenerated, refined and recuperated, and supplied for processing into other oil products usable for boilers.

The solution of forbidden and unusable pesticides utilisation is still to be found, they being stored in agricultural farms and commercial water houses. The non-observance of storage and accounting rules and the wearing out of packing materials leads to soil pollution with the substances. In Europe, destruction methods are used for such substances through incineration in special ovens. The possibility of destroying these preparations in the country of their export needs to be studied. Their further storage or burial can be hazardous for the environment and health of the population.

Domestic Residuals

The quantity of solid domestic waste produced in the country in 1994 exceeds 1.6 million cubic meters, in Chisinau the figure being 862 thousand cu. m. About 500 thousand cu. m of liquid domestic waste has been registered. Using the average specific weight, the mass of the solid domestic residuals (SDR), produced in the country, is estimated at 800 thousand tons. In Chisinau - 300 thousand tons, or 400 kg for each inhabitant.

Although the SDR volume has considerably decreased in comparison with previous years, the problems connected with its collection and storage are still there.

Out of the 69 residual platforms of the urban localities, 61 % do not satisfy the requirements. Out of 1595 platforms of the rural localities, 73 % do not satisfy the requirements. 36 % of urban localities platforms are unauthorised, as well as 49 % of the rural ones. The total area of the platforms for SDR neutralisation and storage in the country is 1010 ha, and the area of the unauthorised ones is 445 ha.

Environmental pollution is enhanced also by residual storage in unauthorised places, gullies, holes, former quarries, and road edges. Only in Chisinau there are 7 unauthorised waste plots, situated in different parts of the city and having areas of 0.5-2 ha. SDR management is not performed, although there exists very efficient methods for the improvement of the situation.

In order to minimise the waste spreading and to ameliorate the human settlements hygiene, different actions are necessary (legislative, regulatory, organisational, educational, coercion, conviction, etc.) on the part of the authorities of local and central public organisations, non-governmental organisations, educational and cultural institutions in order to create a different attitude, different behaviour, and civic responsibility of the social environment for the way of life, consumption, production, and leisure.

A special role in the task could be played by the national and local programs for waste minimisation and utilisation. Simultaneously, the development of some technical-normative acts is needed, which would ensure a stricter control of the Pb contents in gasoline and S contents in diesel oil, as well as the respective procedures for inspection and control.

Landfills areas in Moldova

Moldova as developing country is still the loser in the race to industrialise, producing only 14 % of manufactured output. Each year in Moldova, around 1.1 min. tons of industrial wastes and approximately 1568.9 thousand tons of domestic wastes are generated.

At present, landfills are the most commonly practised waste disposal method in the majority of localities in Moldova. For domestic waste neutralisation, the Republic has around 43 dumps with a total surface area of 1077.6 ha and stocked volume of 30191.56 thousand m^3.

The major disadvantages of landfill disposal of municipal waste with hazardous wastes have been following

- The potential risks for polluting water resources.
- The potential risks of contaminating the soil.
- The generation of landfill gas i.e. methane and carbon dioxide.
- Potential human exposure to volatile chemicals.
- Smell, vermin and fire.
- Destruction of natural/virgin sites.
- Long term and cost intensive clean-up remediation and monitoring (aftercare, close-up).

Reducing dependence on land disposal through waste generation prevention their minimisation by recycling and reusing represents the first choice in the hierarchy of hazardous waste management options.

Past Industrial accidents with contamination of soil resources

Among the subjective factors of accidents we could name the following causes: the outdated technology, equipment and machinery at the moment of economic collapse, and lack of financial resources for reestablishment and modernisation of unit operations.

One of the largest accidents in the last 10 years was the rupture of a barrage of reservoirs happening in Ukrainian sites, but the water transported through Dniester River and the pollutants to Moldovian territory. It was necessary on huge effort for forecasting of the situation, and respective works have been made to stop further spreading of pollutants in other nearby zones with water catchment installations for drinking water purposes. As a result of this accident, at the bottom of a water reservoir nearby Novodnestrovsk (in the northern part of Moldova) was accumulated more than 1.4 mln. tons of salts with such ingredients like, sulphates and chloride of sodium and potassium with a concentration up to 37 g/l. At a length of one hundred km of the Dniester river basin, practically all flora and fauna perished and major negative performances have been given to the entire water system for long time.

In the majority of cases, the accidents, which have occurred in a region of Moldova Site, might be systemised if following way;

Accidents with extremal pollution of soil and water resources with pesticides and mineral fertilisers in the result of violation of the established rules or in the result of natural calamities like torrential rains with flooding of chemical storage, and solution preparing stations. Such cases occur each year. For example, as a result of hard raining during the summer of 1991, around 350 cu. m of pesticides were washed away by water in the village Vulcanesti polluting severely the soil and water resources. Similar events have been registered in other localities, several chemical storage, had flooded in Orhei District etc.

In the result of long exploitation of fuel stations and oil depositions almost in the entire country, the systems for storage and fuel transportation are in poor conditions thus becoming potential sources of extremal pollution.

Sources of Hazard

Sources of hazard have been the following:

1. Deviations of the process parameters from the specified state (pressure, temperature, mass, flaw, and phases) state, and concentration.
2. Faults in the containment (vessels, storage, tanks, piping and joints (sells)).

For example, on August 1973 at a petroleum store in the village Iargara (district Leova) an accident happened after as a result of which about 628 tons of gasoline flowed out from the deterioration reservoirs (an official registered date) during which a great part of it penetrated the soil reaching the groundwater and severely polluting. In 1995 it was appreciated, that from the oil tank of diesel and furnace oil of an elevator

which were placed 150-300 m South Eastern from the petroleum store and lower it on relief during many years was take place local leakage of mentioned oil products in the result of underground reservoirs' corrosion.

All these lose of more heavily oil fractions (with unknown volume of leakage) also polluted very hard the soil and groundwater under commanding territory. All these accidents turned up to be a really ecological catastrophes for the local habitants, as for as it deprived them from the unique potable water source of individual and common wells. Especially, the situations become irreversible and it aggravated in 1996. After the intensive hard winter snow falls in the spring the slow melting allows the full absorption of the moisture in the soil. All this enhances the level of groundwater, which reached at last the polluted soil layers. As result, in all wells oil products appeared in such concentrations making unfitting the water not only for drinking, but also and for other domestic needs.

Geological and hydrological conditions

The common polluted with oil products' plot has 12-15 hectares in area (or 30-40 acres), and it is situated in the southern part of the village Iargara on the right site of the stream Tighech in the lowest site of relief of the southern exposition with the surface inclination from 1-2 (0.018-0.035) at the elevator territory till 3-4 degrees (0.053-0.070) on the oil deposition territory. Between the elevator and oil deposition it is passed by two track railway roads. In conformity with the available data, the horizon of the groundwater belongs to the alluvial and delluvial stratum, which is covered with clay soil of the upper Sarmation-Macotis stage. The level of the underground water ranges from 5-7 m on the lower site to 11-12 m on the upper site of the territory. The level of the groundwater in conformity with the available data is oscillating from 2 to 4 m.

Referring to the principle of subsidiary, they claim the right to set national emissions limits values for industrial installations according to their own environmental and economic circumstances. Taking into account all above mentioned from my point of view the Directive must be therefore enforced substantial regulations for as of potential hazardous activities, rather than on procedural rules. Which will give us the opportunity in the future to reveal the hazardous activities borders zones.

Number of Registered Contaminated Sites / Contaminated Land Areas

There is no estimate on the number of contaminated sites.

Investigation Methods

Identification of Potentially Contaminated Sites and Areas

-

Investigation of Contaminated Sites and Areas

-

Facilities for Contaminated Soil

Handling and Treatment of Excavated Contaminated Soil

Up till now, no facilities exist for treatment or proper depositing of contaminated soil.

Measures Used by Remediation of Soil and Groundwater Contamination

-

Financing and Liability

Investigation and Remediation Activities

-

Legal Requirements re. Polluters and Site Owners

-

Scope of the Problem

Scale of the Problem and Handling Costs

So far no special strategy or national policy for contaminated land has been developed.

Priority in Relation to Other Societal Problems

-

Illustrative Cases

-

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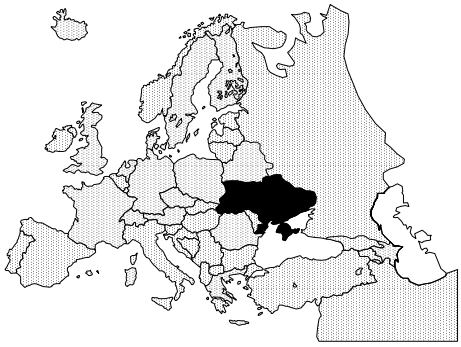
Ukraine

Country Characterisation



Background

The Ukraine regained its independence in 1991. Ukraine is a country with a high level of industrial infrastructure development. In the industrial sector, significant shares belong to chemical, metallurgical and mining manufactures.

Potentially harmful industries comprise about one third of the enterprises in Ukraine. Due to this, the industrial emissions to the environment are quite high. Because of its geographical position, there is located in Ukraine several tens of military airbases, sites with underground nuclear strategic missiles, and affiliated service installation. Furthermore, the Chernobyl disaster has caused an extensive contamination of land by radionuclides. All these factors have caused various kinds of land contamination in Ukraine. However, the land contamination problems only gained attention after Ukraine became independent in 1991.

Upon independence, Ukraine declared itself as being a nuclear weapon free country. Military sites of the so called "Military Defence Complex" are distributed all over the country, some of which are situated in areas with high ecological impacts; i.e. the industrial areas of the Donetsk basin, along the Dnepr River, and industrial areas close to the Black Sea and the Asow Sea.

In general, information concerning operation and the management of military sites were kept secret. The sites were usually operated without any environmental control measures. The exact number of sites, which are run by the "Military Defence Complex", is confidential. When Ukraine regained its independence, the number of sites was remarkably reduced and conversion was considered for many sites. Major conversion aspects are usually:

- The elimination of weapons and ammunition.
- The remediation of the premises and conversion to economical beneficial land uses.

Total area	Agricultural areas		Wooded areas		Nationally protected areas		Other areas	
km²	*km²*	*%*	*km²*	*%*	*km²*	*%*	*km²*	*%*
603700	435000	72						

Figure on total area from UN/ECE, 1998.

Population	Population density	Annual pop. growth 1990 – 1995	Life expectancy at birth	
			Male	Female
1000	*per km²*	*%*	*years*	*years*
50536	84	-0,10	62	73

Figures from UN/ECE, 1998, and POPIN, 1999.

Legal and Administrative Basis

Definition of Contaminated Sites and Land

There is no specific definition for contaminated sites and land.

However, the Ukraine legislation has a definition for contaminated military sites, which are considered as sites of the Military Defence Complex, where concentrations of contaminants in soil, surface waters and groundwater exceed defined limit values. Mainly, military sites consist of garrisons, air and marine bases, test and shooting ranges, strategic points (i.e. repair and maintenance facilities, and stocks for ammunition), stocks in general, and military research centres.

Legislation

The legislative base for the planning and realisation of remedial activities is the Ukrainian Environmental Protection Act and also the Water and Land Codes of Ukraine.

Among others, the Environmental Protection Act defines a fining system for environmental misdemeanours, and environmental criteria for military operations. The management of contaminated sites or remediation is not specified.

In 1996, Ukraine established per law a National Auditing Programme for potentially contaminated facilities. The programme is valid for both civil and military facilities.

The order of the Cabinet of Ministers of Ukraine No. 595-p from august 1994 allows for ensuring the profitability of remedial activities at the expenses of extracted product realisation. This was developed aiming at attracting commercial structures for the remediation work.

It is noted that the legislation does not secure the “polluter pay principle”. Economic mechanisms inducing polluters to liquidate negative consequences of their activities have not been established.

Implementation of Limit Values

In Ukraine, there are practically no specifications on acceptable residual concentrations of contaminants in soil. Maximum allowable concentrations are, however, defined for a variety of compounds for water and air (groundwater and surface water).

A site-specific approach is applied for the assessment of soil contamination, considering general environmental conditions, the type and extent of contamination, and the future land use.

Responsible Public Authorities

Concerning the Chernobyl, the work performed on elimination of the disaster consequences is constantly supervised at government level. The work is co-ordinated by the Ministry of Emergency Situations and Liquidation of the Chernobyl Disaster Consequences. The ministry was founded in 1996. A state “program for Chernobyl disaster consequences minimisation” has been developed, in which the aspects of remediation of contaminated areas are also included.

The Ukraine Military Defence Complex (MDC) consists of several parties. The central military administration of the MDC and the Ministries involved in the MDC are responsible for the management of military sites. The central military administration is part of the government, and has a special division, which is concerned with the environmental management at the sites of the MDC. The Ministries of the MDC have their own environmental divisions, which are responsible for the assessment of contamination at military sites and the implementation of appropriate remediation measures. The Ministries of the MDC operate in accordance with the regional agencies of the Ministry of the Environment Protection and Nuclear Safety.

Important in respect to other types of land contamination is the Ministry of Environmental Protection and Nuclear Safety, and also the State Committee on Geology. A Special Task Force Division of the Ministry of the Environment Protection and Nuclear Safety is responsible for the management and remediation of

contaminated sites.

The Regional Agencies of the Ministry of the Environment Protection and Nuclear Safety are responsible for the identification and registration of military sites and investigations at military sites.

The site-specific management at each military site is responsible for the compliance to current environmental legislation and has to implement measures in the case of violations.

Registration

Up to now there are no general inventories on contaminated sites.

However, along the National Environment Audit Programme, 43 military sites were registered as being potentially contaminated. The programme is valid for both civil and military facilities. A key feature of the programme is to inspect the facilities on an annual basis.

In practise only very few sites have been audited. In total, the 43 sites were audited and registered as potentially contaminated. The largest sites among these were:

- The air base of Uzen, with a total surface area of 5 km².
- A variety of airbases close to the cities Poltava and Lutsk.
- The marine base of Sewastopol.

Characterisation of Soil and Groundwater Contamination

Sources of Soil and Groundwater Contamination

The contamination of soil with pesticides has the most complex character. Here, the most hazardous factor is the presence of persistent chlororganic pesticides. In Ukraine, more than 20% of the soil in the used land contain DDT and products of the degradation of this. 4% are contaminated by hexachloro-cyclohexane.

Due to the Chernobyl disaster, more than 84000 km^2 of agricultural land is contaminated by radionuclides. The greatest degrees of radioactive land contamination are in the Zhytomir (70%) and Kiev (15%) regions. The work performed on elimination for the disaster consequences is constantly supervised at government level.

Also, the contamination from the petrochemical industries and related to the use of mineral oil products is doubtless a problem in Ukraine. The basic sources of contamination are oil refineries (6), airbases and some other Soviet Army objects, network of transit and international oil pipelines (more than 6000 km), and numerous sites of production, storage and transportation of mineral oil products (more than 300 objects).

Today, 133 of 197 large water works in Ukraine are located in zones, which also have potential sources of oil contamination. Contamination has already been detected at more than 150 water works located in the rural territories. It is estimated, that the contaminated land area exceed 30000 ha. Concerning the airbases (43), soil and groundwater on practically all of these is heavily contaminated by light hydrocarbon fractions.

Some of the contaminated sites (e.g. in the towns of Lutsk, Zaporozhye, Stryi and Uzin) need urgent remediation due to the risk the contamination pose to the water supply in the areas.

On basis of the urgent character of the potable water supply problem, a three year scientific and technical program has been developed by joint co-ordinated efforts of the National Academy of Science, the Ministry of Environmental Protection and Nuclear Safety, and the State Committee on Geology. The programme is entitled “realisation of the control, estimation and forecasting of the situation of petrochemical contamination of ground water in Ukraine”. One of the results of this programme will be the development of methodologies for scientifically reasonable and ecologically safe remediation of contaminated land. With the support of the ministry, new technological elements are developed for remedial activities. Here, development has especially

focused on biological technologies for degradation of petroleum contamination. Development of investigation methods has also been included in the programme.

During the Environmental Audits performed at military sites, the following contamination profiles have been identified: Hydrocarbon contamination in soil, surface waters, and groundwater deriving from fuel tanks, stocks for fuels and lubricants, pipelines, and filling stations. Most pipelines and filling stations are in poor condition. They were built in the 1950ies and usually poorly maintained. Limited or lacking emergency planning and implementation of safety technologies, such as oil separators, wastewater treatment and sewage systems, has also caused contamination.

The most frequently occurring contaminants were identified to be hydro carbons, heavy metals, hazardous and domestic wastes, building material, metal scrap, organic solvents, paints and varnishes, various plastic material, chemicals and rubber, radioactive material, and explosives and ammunition.

Major sources of contamination were identified to be:

- Stocks and filling stations for fuels and lubricants.
- Vehicle parks, especially for tanks.
- Service and maintenance facilities, car wash facilities, and paint boxes.
- Sewage systems.
- Shooting and test ranges.
- Permanent and interim waste sites.
- Construction sites.

Besides that, there are a variety of special problems of major environmental concern; e.g.:

- Abandoned sites with nuclear weapons, which are usually also contaminated with 1,1-dimethylhydrazine (DMH), a highly toxic substance.
- The environment around marine bases at the Black Sea. The treatment and collection of wastes on board ships is usually insufficient, and waste ships and oil separators are few and mostly in poor condition. The water at the marine base of Sewastopol contains hydrocarbon concentrations, which are 15 times the maximum allowable concentration. The number of sewage systems along the coast is not sufficient, and liquid wastes are usually dumped into the sea.

Number of Registered Contaminated Sites / Contaminated Land Areas

There is no estimate on the number of contaminated sites.

Investigation Methods

Identification of Potentially Contaminated Sites and Areas

The Environmental Audits are carried out by:

- Authorities which are responsible for environmental protection and nuclear safety.
- Authorities of the health system.
- Authorities which are responsible for nature protection and the use of natural resources.

Key objectives are to identify potentially contaminated areas, and facilities, which have the potential for negative impacts on the environment.

When an audit is completed, an environmental certificate is issued, which defines specific criteria for air emissions, water emissions, and disposal of hazardous wastes.

The key steps of the first Environmental Audit of a site are:

- On-site visit (visual assessment).
- The identification of potentially contaminated areas.
- Analysis of identified contamination (air emissions, wastewater).
- Control of compliance to the requirements of standards, regulations and other.

In some cases, pictures are taken of the identified potentially contaminated areas and samples are collected. After the first audit, it is decided to which extent further sampling and detailed investigation of the potentially contaminated areas or identified contaminated areas will be necessary.

In 1994, the Ministry of Environmental Protection and Nuclear Safety developed a guidance document describing the general objectives of the National Environmental Audit Programme and the general procedure. Major objectives were defined as:

- The identification of potentially contaminated areas.
- The assessment of the extent of contamination.
- The calculation of necessary remediation measures.
- The definition of criteria to avoid emergencies in the future.
- The carrying out of remediation activities at identified contaminated areas.

The general procedure consists of:

- Definition of those sites which need to be audited and in which order.
- Lays down which data and documents that need to be checked.
- Lays down the workers safety measures during the audits.
- Special procedures for those sites, where violations of previous inspections are identified.

During the audit, the following documents shall be checked:

- Ownership documents.
- Documents concerning the sewage system.
- Maps specifying water treatment facilities.
- The environmental certificate of the site.
- Any plan defining measures to minimise negative environmental impacts.
- Licenses for the exploitation of natural resources; i.e. wastewater emissions, and air emissions.
- Documents concerning accident prevention and emergency plans.

Investigation of Contaminated Sites and Areas

If potentially contaminated areas are identified along the pre-assessment or the Environmental Audit, further investigations are carried out. The applied methodologies for sampling and chemical analysis are those of the former Soviet Union.

Risk assessment of contaminated sites and areas is oriented to maximum allowable concentrations in water and air, which exist for a variety of substances. A site-specific approach is applied for the assessment of soil contamination, considering general environmental conditions and the type and extent of contamination.

If remedial activities are carried out, the environment and health authorities evaluate the performance of these, and an environmental certificate is issued, when remediation is completed.

Facilities for Contaminated Soil

Handling and Treatment of Excavated Contaminated Soil

Up till now, no facilities exist for treatment or proper depositing of contaminated soil.

Measures Used by Remediation of Soil and Groundwater Contamination

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Financing and Liability

Investigation and Remediation Activities

In some cases, funding can be made available from the environmental budgets of the regions.

Concerning military sites, the budgets of the individual sites of the Military Defence Complex are partly dedicated to the assessment and remediation of contamination at the sites. However, the available resources are limited and not sufficient to solve the actual problems. In addition, the EU programme *Partnership for Peace* has funded Environmental Audits at military sites.

Legal Requirements re. Polluters and Site Owners

Concerning military sites, the owner, and hence the responsible party of the Military Defence Complex, is liable for clean-up measures. Remedial measures are carried out as official remediation projects and are supervised by the regional authorities.

Scope of the Problem

Scale of the Problem and Handling Costs

For military sites, it has been estimated that remediation activities per site range on average between 1 - 5 million USD.

Priority in Relation to Other Societal Problems

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Illustrative Cases

Kryvey Rig is a large industrial mining region located in the southern part of Ukraine with a population of more than 700000 people in 1995. The region is very rich in iron ore deposits that are several kilometres in thickness and cover a 3500 km^2 area. Iron ore in the are is mined by both open pit mining and underground mining methods. Today, there are 11 open pit mines and 12 underground mines located within a 100 km^2 area.

Today, the region is in a deep slump. The total production volumes of marketable iron ore and of steel in 1996 were only 40-50% compared to the volumes in 1990. Latent unemployment at the end of 1995 was estimated at about 25-30%. A continuous reduction in the iron ore market is forecasted for the next 10 – 15 years.

During almost all of the past century, mining activities have been carried out in the area resulting in excavation of more than 1.3 billion tonnes of iron ore or about 500 million tonnes of iron. This of course has a great impact on the geochemical processes in the region.

In fact, the natural steppe land surface that is characteristic to the region has been transformed into a hilly or foothill landscape with height differences ranging from 300 to 500 meters. The hydrological regimes of both surface and ground water to a depth of 1700 meters have been severely transformed.

In the area, an amount of 300 – 400 million m^3 waste from the mining activities is deposited in waste banks and 80 – 110 million m^3 waste results from the ore enrichment processes. Moreover, 12 – 14 million m^3 of highly mineralised saline mine water with an average salt concentration of 12 g/l is discharged to the ground and the surface waters in the area.

The total area covered by mining waste banks is about 70 km^2, in some cases with heights exceeding 100 meters. As a result of the mining activities, the topography of the region has been significantly changed

transforming it into an unnatural state. Mining activities in the region has resulted in changes to air quality, changes to chemical composition and level of ground water, and creation of numerous artificial reservoirs.

The mine tailing ponds in the area contain about 5 million tonnes of sludge and cover an area of about 80 km^2. The majority of the sludge results from the iron ore enrichment processing enterprises in the Kryvey Rig region. The sludge consists of light sandy soil containing among others 60-70% SiO_2, 5-15% FeO, 3-5% Fe_2O_3 and up to 1% of a range of heavy metals (Cu, Zn, Cd, Pb, Cr and others).

All in all it is evaluated, that the changes of the environment resulting from the many years of mining activities must be characterised as irreversible changes. Returning the various environment parameters in the region to their natural state is practically impossible.

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