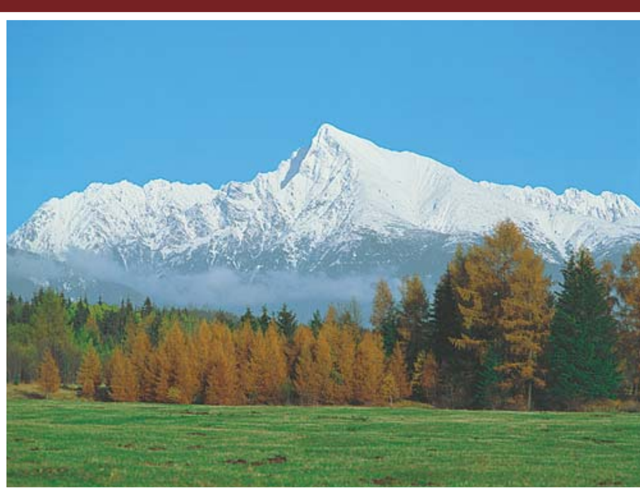
Ministry of the Environment
of the Slovak Republic

STATE OF THE ENVIRONMENT REPORT SLOVAK REPUBLIC 2007



Slovak Environmental Agency

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The terms sustainable exploitation of the arable land and farming the farmland mean exploitation and protection of the properties and functions of the soil by the means and to the extent, which would keep its biological diversity, fertility, restoration ability and potential to perform all functions.

§ 2 letter e/ of the Act on Protection and Use of Farmland No. 220/2004 Coll., including the change of Act on Integrated Pollution Prevention and Control No. 245/2003 Coll., and on change and amendment of some laws

• SOIL

Land use

♦ **Land Use on the basis of the Land Register's data**

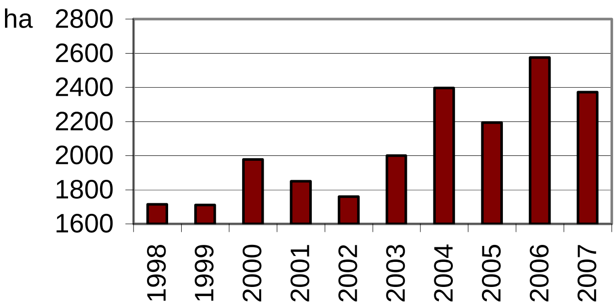
Land Use categories (state to the date 31st December 2007)

Land category	Area (ha)	% of total area
Agricultural land	2 428 899	49.53
Forest land	2 007 142	40.93
Water areas	93 656	1.91
Build-up land	227 931	4.65
Other land	145 945	2.98
Total area	4 903 573	100.00

Source: GCCA SR

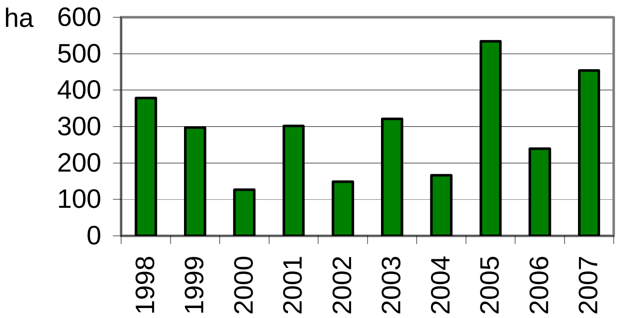
Anthropogenic pressure to use soil for purposes other than its primary production and environmental functions brings about its gradual decrease. In the years 1999-2007, **losses of agricultural soil to construction** grew on the year-year basis, mainly for public, house, and industrial construction purposes (1 398 ha in 2007).

Trend in agricultural soil loss including the losses of arable soil to forestland, non-agricultural and non-forested soil in the SR



Source: GCCA SR

Trend in forestland loss to agricultural soil, non-agricultural and non-forested soil in the SR



Source: GCCA SR

Soil properties

Information on state and trend in agricultural soil properties and their degradation may be obtained from the Partial Monitoring System - Soil (PMS-S) carried out by the Soil Science and Conservation Research Institute (SSCRI) and from the Agrochemical soil testing (AST) carried out by Central Controlling and Testing Institute in Agriculture (CCTIA). Information on state and trend in forest soil properties may be obtained from the Partial Monitoring System – Forests (PMS-F) carried out by the National Forest Centre – Forest Research Institute.

- **Chemical properties of soil**

Soil reaction

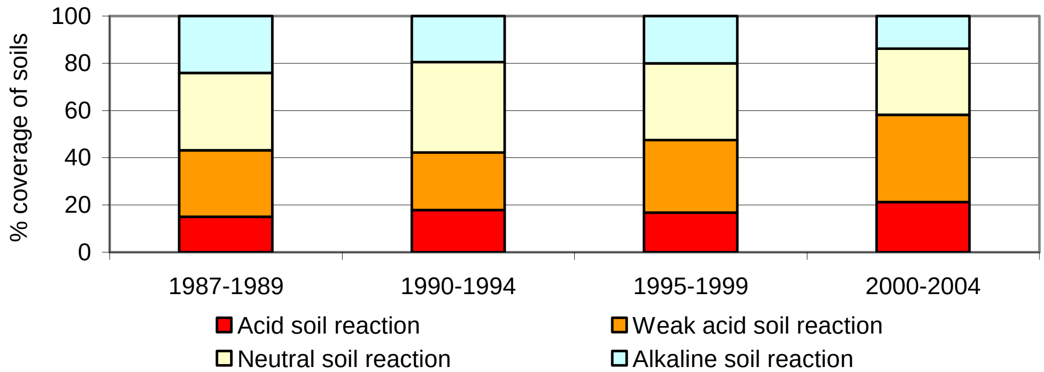
Trend in soil reaction (pH/H_2O) in the A-horizon of agricultural soil in Slovakia, based on the comparison of outcomes from three PMS-S cycles

Main soil unit	1993-1997	1997-2002	2002-2007
Mollic Fluvisols AL	7.29	7.24	7.03
Fluvisols AL	7.13	6.95	6.84
Chernozems AL	7.28	7.31	7.22
Haplic Luvisols AL	6.71	6.85	6.90
Planosols AL	6.66	6.70	6.47
Planosols PG	6.31	6.24	6.13
Rendzic Leptosols AL	7.27	7.25	7.54
Rendzic Leptosols PG	7.17	7.18	6.57
Regosols AL	6.68	6.54	6.95
Cambisols AL	6.56	6.42	6.18
Cambisols PG	5.61	5.56	5.29
Solonchaks and Solonetz PG	8.29	7.88	8.45
Podzols PG	4.21	3.93	3.88

AL – Arable Land, PG – Permanent Grassland Source: SSCRI

Outcomes from agrochemical soil testing for the VIII. (1987-1989) through XI. (2000-2004) cycle show an **increase in the proportion of agricultural soil with acid** (+6.2 %) and **weak acid** (+8.8 %) **soil reaction.** On the other hand, a reduction was seen in the proportion agricultural soil with neutral (-4.7 %) and alkaline (-10.3 %) soil reaction.

Trend in agricultural soil reaction in the SR (in KCI) based on the outcomes from Agrochemical soil testing



Source: CCTIA

Most Slovak forestland is mildly to strongly acidic.

Trend in exchange soil reaction (pH/$CaCl_2$) in forest soil in the SR based on comparison of the PMS-F results

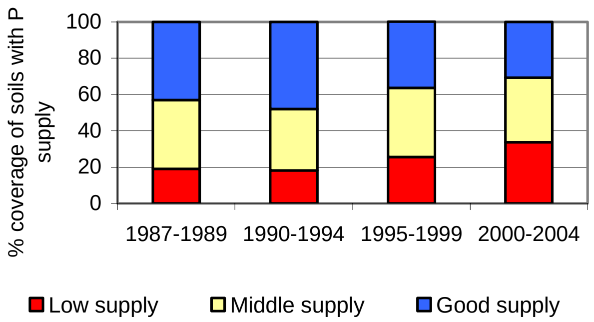
Depth	1988	1993	1998	2006
Upper humic horison	-	4.8	4.7	4.7
0-10 cm	4.2	4.1	4.1	4.1
10-20 cm	-	3.9	4.0	4.0

Source: NFC - FRI

Available nutrients

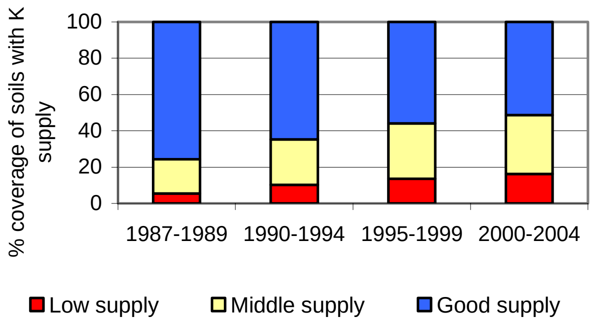
During the period VIII. (1987-1989) through XI. (2000-2004) of Agrochemical soil testing there was an **increase in low supply of all three available nutrients (phosphorus, potassium, and magnesium).** In phosphorus, it was by 14.6 %, by 10.7 % in potassium, and by 5.3 % in magnesium. However; during this period, good supply of all three available nutrients were reduced (by 12.4 % in phosphorus, by 24.2 % in potassium, and by 12 % in magnesium), which, in terms of plant nutrition, is a negative tendency.

Trend in phosphorus content in agricultural soil in the SR based on outcomes of Agrochemical soil testing



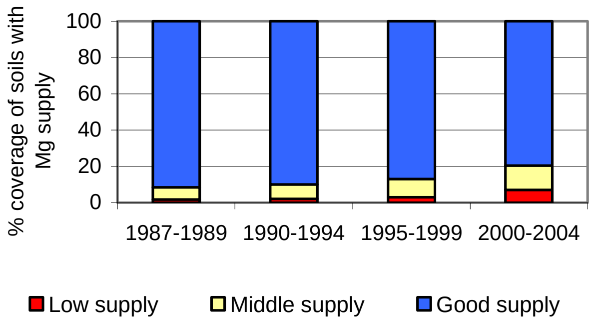
Source: CCTIA

Trend in potassium content in agricultural soil in the SR based on outcomes of Agrochemical soil testing



Source: CCTIA

Trend in magnesium content in agricultural soil in the SR based on outcomes of Agrochemical soil testing



Source: CCTIA

Humus

Trend in humus content in the A-horizon of agricultural soil in the SR, based on the comparison of outcomes from three PMS-S cycles (%)

Main soil unit	1993 - 1997	1997 - 2002	2002 - 2007
Chernozems AL	2.74	2.17	3.12
Mollic Fluvisols AL	3.62	3.10	3.72
Fluvisols AL	2.71	2.24	3.03
Haplic Luvisols AL	2.07	1.72	2.59
Planosols and Luvisols AL	2.05	1.69	2.38
Planosols and Luvisols PG	3.79	3.45	5.12
Cambisols AL	3.05	2.45	3.45
Cambisols PG	5.52	4.14	6.55
Regosols AL	2.07	1.60	2.07
Rendzic Leptosols AL	3.74	2.76	3.14
Rendzic Leptosols PG	5.94	4.32	6.61
Andosols PG	10.91	12.48	16.55
Podzols PG	18.79	20.17	24.79

AL – Arable Land, PG – Permanent Grassland Source: SSCRI

Note: Error in humus setting is app. 10%, i.e. 0.3 % of humus, for this reason, differences lower than 0.3 % may be attributed to analytical setting. In case of permanent grasslands differences between years may be caused by high heterogeneity of humus values between individual sites in the land, especially in case of lands above the upper forest border, and they are not statistically significant.

Changes to values in forest soil humus content in individual extraction cycles are shown in Table.

Trend in humus content in forest soil in the SR based on comparison of the PMS-F results

pth	% of humus		
	1993	1998	2006
Upper humic horizon	51.8	55.3	61.7
0-10 cm	9.55	9.79	8.60
10-20 cm	5.55	6.04	5.27

Source: NFC - FRI

- **Physical properties of soil**

The table shows changes to values of total porosity in the A-horizon of agricultural land during three PMS-S cycles.

Trend in overall porosity in the A-horizon of agricultural soils in the SR, based on the comparison of outcomes from three PMS-S cycles

Main soil unit	Volume %								
	Light soils			Medium heavy soils			Heavy soils		
	1993-97	1997-02	2002-07	1993-97	1997-02	2002-07	1993-97	1997-02	2002-07
Chernozems	-	-	-	51.8	47.3	49.6	45.0	50.7	46.7
Mollic Fluvisols	54.0	46.8	42.3	46.4	49.5	51.4	53.5	48.8	47.3
Fluvisols	45.8	50.3	48.4	47.8	48.4	52.2	47.5	50.8	52.6
Haplic Luvisols	-	-	-	49.8	47.3	48.7	50.5	46.3	51.5
Planosols and Luvisols	-	-	-	46.0	46.8	49.6	50.8	47.6	52.0
Cambisols	32.7	45.5	45.5	40.2	48.3	52.5	51.9	51.6	51.8

Source: SSCRI

Soil degradation

Serious soil degradation includes contamination with heavy metals and organic pollutants, acidification, as well as alkalinization and soil salinization. Recently, soil degradation through desertification grows in significance.

Soil contamination by hazardous substances

Results from the III. cycle of PMS-S with samples extracted in 2002 showed that the contents of the majority of hazardous substances in selected agricultural land of Slovakia are below the limit, especially being the case of arsenic, chromium, copper, nickel, and zinc. In case of cadmium, excessive limit values were recorded only in soils situated in higher altitudes, podzols, andosols, which might relate to remote transfer of emissions (Kobza and coll., 2002).

Hazardous substances ($mg.kg^{-1}$) in A horizon of selected agricultural soil of the SR (the third PMS-S cycle)

Main soil unit	Hazardous substances in 2 $mol.dm^{-3}$ HNO_3						
	As*	Cd	Cr	Cu	Ni	Pb	Zn
Podzols and Rankers	3.55	0.48	2.24	4.52	0.85	63.61	12.94
Andosols	1.42	0.51	3.32	11.00	1.01	49.72	33.44
Regosols	0.65	0.17	3.31	8.38	1.84	5.31	9.34
Solonchaks and Solonetz	1.03	0.20	4.24	5.84	4.33	11.71	9.49
Cambisols	1.89	0.25	3.08	10.20	3.07	18.88	11.92
Rendzic leptosols	0.69	0.38	3.50	9.10	5.15	20.40	21.55
Mollic Fluvisols	1.45	0.22	3.55	13.05	5.95	16.10	15.55
Planosols and Luvisols	1.73	0.18	2.76	6.99	2.76	5.53	9.88
Planosols	1.70	0.22	2.59	5.59	1.67	16.09	9.16
Haplic Luvisols	1.13	0.14	2.94	10.16	4.8	11.55	9.73
Chernozems	1.11	0.15	2.49	11.49	7.11	11.86	8.92
Fluvisols and Gleyic Fluvisols	3.51	0.25	3.88	15.87	7.47	17.16	20.23
Fluvisols, Gleyic Fluvisols and Gley	2.42	0.63	5.76	16.27	6.35	57.45	41.7

*in 2M HCl

Source: SSCRI

Contents of contaminants in soil in selected cadastre areas are monitored under the Spatial Soil Contamination Survey (PPKP). Within the SSCS 2005, 861 soil samples from 71 agricultural companies were analysed for heavy metal contents. The analysed 861 soil samples represent the area of 3 6345.8 ha in the number of 861 hunts. The mentioned control area showed 1 436.0 ha over the limit, which are 42 hunts.

Overview of controlled areas, number of plots, parameters in SSCS 2005 – sampling year 2004

Name of district	Controlled plots		Parameter	Limit exceeding plots		Limit exceeding parameters
	ha	number		ha	number	
Malacky	1429.0	43	Pb, Cd, Cr,Ni, Hg, As	-	-	-
Pezinok	33.0	6	Pb, Cd, Cr,Ni, Hg, As, Zn	-	-	-
Senec	1 634.0	33	Pb, Cd, Cr,Ni, Hg, As	-	-	-
Galanta	1 191.0	13	Pb, Cd, Cr,Ni, Hg, As	-	-	-
Hlohovec	720.0	15	Pb, Cd, Cr,Ni, Hg, As	-	-	-
Piešťany	153.0	11	Pb, Cd, Cr,Ni, Hg, As	-	-	-
Senica	681.0	19	Pb, Cd, Cr,Ni, Hg, As	56.0	2	Cd, Pb
Bánovce nad Bebravou	1 657.0	53	Pb, Cd, Cr,Ni, Hg, As	-	-	-
Ilava	282.0	8	Pb, Cd, Cr,Ni, Hg, As	-	-	-
Nové Mesto nad Váhom	392.0	13	Pb, Cd, Cr,Ni, Hg, As	-	-	-
Prievidza	760.5	20	Pb, Cd, Cr,Ni, Hg, As, Zn	145.0	5	As
Trenčín	202.0	13	Pb, Cd, Cr,Ni, Hg, As	-	-	-
Komárno	808.0	16	Pb, Cd, Cr,Ni, Hg, As	-	-	-
Levice	613.0	15	Pb, Cd, Cr,Ni, Hg, As	-	-	-
Nitra	1 180.0	17	Pb, Cd, Cr,Ni, Hg, As	-	-	-
Nové Zámky	594.0	14	Pb, Cd, Cr,Ni, Hg, As	-	-	-
Zlaté Moravce	1307.0	20	Pb, Cd, Cr,Ni, Hg, As	-	-	-
Čadca	312.0	17	Pb, Cd, Cr,Ni, Hg, As	12.0	1	Cd
Dolný Kubín	206.2	14	Pb, Cd, Cr,Ni, Hg, As	-	-	-
Liptovský Mikuláš	1 244.0	36	Pb, Cd, Cr,Ni, Hg, As	199.0	6	As, Cd, Cr,
Martin	852.0	38	Pb, Cd, Cr,Ni, Hg, As	51.0	2	Cd-
Ružomberok	306.0	17	Pb, Cd, Cr,Ni, Hg, As	47.0	2	Cd, Ni
Tvrdošín	598.0	21	Pb, Cd, Cr,Ni, Hg, As	93.0	5	Cd
Banská Bystrica	43.0	4	Pb, Cd, Cr,Ni, Hg, As	12.0	2	Cd, Pb
Brezno	99.0	5	Pb, Cd, Cr,Ni, Hg, As	-	-	-
Detva	457.0	18	Pb, Cd, Cr,Ni, Hg, As	-	-	-
Krupina	1 026.8	29	Pb, Cd, Cr,Ni, Hg, As	-	-	-
Lučenec	1 572.7	41	Pb, Cd, Cr,Ni, Hg, As	-	-	-
Revúca	101.1	3	Pb, Cd, Cr,Ni, Hg, As	-	-	-
Rimavská Sobota	704.3	18	Pb, Cd, Cr,Ni, Hg, As	-	-	-
Veľký Krtíš	262.2	9	Pb, Cd, Cr,Ni, Hg, As	-	-	-
Zvolen	417.0	19	Pb, Cd, Cr,Ni, Hg, As	-	-	-
Bardejov	541.0	10	Pb, Cd, Cr,Ni, Hg, As	-	-	-
Humenné	138.0	5	Pb, Cd, Cr,Ni, Hg, As	-	-	-
Levoča	597.0	15	Pb, Cd, Cr,Ni, Hg, As	-	-	-
Medzilaborce	448.0	10	Pb, Cd, Cr,Ni, Hg, As	-	-	-
Poprad	134.0	5	Pb, Cd, Cr,Ni, Hg, As	-	-	-
Prešov	1 679.0	36	Pb, Cd, Cr,Ni, Hg, As	-	-	-
Stará Ľubovňa	489.0	7	Pb, Cd, Cr,Ni, Hg, As	255.0	3	Cd
Stropkov	303.0	12	Pb, Cd, Cr,Ni, Hg, As	-	-	-
Svidník	459.0	13	Pb, Cd, Cr,Ni, Hg, As	41.0	1	Cd
Vranov nad Topľou	855.0	14	Pb, Cd, Cr,Ni, Hg, As	-	-	-
Košice-okolie	3 501.0	35	Pb, Cd, Cr,Ni, Hg, As	130.0	1	Hg
Michalovce	1 677.0	24	Pb, Cd, Cr,Ni, Hg, As	-	-	-
Rožňava	717.0	17	Pb, Cd, Cr,Ni, Hg, As	165.0	7	Hg
Sobrance	2 217.0	24	Pb, Cd, Cr,Ni, Hg, As	-	-	-
Spišská Nová Ves	230.0	5	Pb, Cd, Cr,Ni, Hg, As	230.0	5	Hg
Trebišov	523.0	11	Pb, Cd, Cr,Ni, Hg, As	-	-	-
Total	**36 345.8**	**861**		**1 436.0**	**42**	

Source: CCTIA

In case of forest soil, the most significant effect of their anthropogenic contamination involves accumulation of contaminants in upper humic horizon.

Content of risk elements in upper humic horizon of forest soil determined in aqua regia

Risk element		1993	1998	2006
Lead	Mean	61.8	38.4	30.5
	Maximum	300.4	234.8	180.5
Zinc	Mean	131.6	104.2	83.3
	Maximum	401.0	357.2	258.4
Copper	Mean	24.4	20.9	15.3
	Maximum	299.0	240.3	140.7
Cadmium	Mean	1.13	1.01	0.64
	Maximum	2.99	2.51	1.56

Source: NFC - FRI

Average content of polycyclic aromatic hydrocarbons (PAH) in agricultural soils of the SR in the I. monitoring cycle was around 200 $\mu g.kg^{-1}$, which represents **reference values.** Values beyond 1000 $\mu g.kg^{-1}$ were only of local character (Žiar nad Hronom, Strážske, Danube and Morava river flats).

In the III. monitoring cycle covering 274 agricultural hunts with the size of 15 802 ha, **no excessive limit pollutants (PAU, PCB, chlorinated hydrocarbons) were found in the monitored hunts.**

♦ Physical degradation

Erosion and soil compaction belong among the major phenomena of physical degradation in Slovakia.

Soil erosion

Water erosion is prevalent in Slovakia.

Agricultural land endangered by erosion in the SR

Erosion categories	Water erosion		Wind erosion	
	Land area in ha	% from Agricultural Land	Land area in ha	% from Agricultural Land
No erosion or slightly	1 378 697	56.7	2 277 268	93.6
Medium	227 392	9.3	75 422	3.1
Strong	332 519	13.7	48 660	2.0
Extremely strong	494 371	20.3	31 629	1.3
Total	2 432 979	100	2 432 979	100

Source: SSCRI

Soil compaction

Based on the results of the PMS-S for the years 1993-2002, there was an improving tendency in physical soil properties. This also suggests less dramatic compaction of heavy and medium heavy arable soil types. In case of subsoil, greater proportion of compacted sites was found. Heavy soil types show higher rate of compaction over the whole soil profile.

Desertification

Methodologically, recent soil monitoring process has shown the solution in its initial phase. Slightly observable phenomena have so far been recorded mainly in the south of Slovakia, in some monitored sites.

Application of the sewage sludge and bottom sediments into the soil

Aplying the sewage sludge from waste water treatment plant to agricultural soil and forestland follows the provisions of the SR National Council **Act 188/2003 Coll. on application of sewage sludge and river bed sediments to soil**, **and on amendment to Act 223/2001 Coll. on waste and amendments to certain laws as amended.**

In 2006, the overall sludge production in the SR was 55 305 tons of dry matter. Of this volume, 42 315 tons (76.5 %) were used in soil processes, 9 400 tones were temporarily stored (17.0 %), and 3 590 tons (6.5 %) were landfilled. In 2007, there was **no direct application of waste water treatment sludge into agricultural soil**. 37 220 tons of sludge dry matter was used for compost production, while 5 095 tons of sludge dry matter were used for soil processes (reclamation of landfills, areas, etc.).