JRC Scientific and Technical Reports

Soil Country Analyses
Belgium

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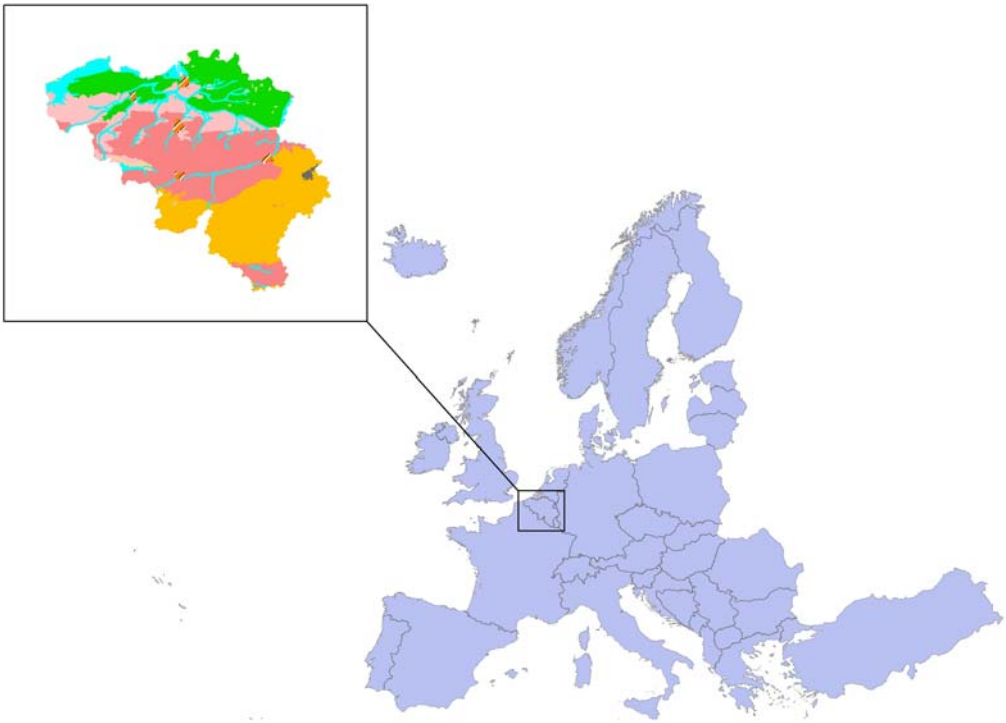

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Soil Country Analyses
Belgium

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Introduction

The state of soil in Europe is influenced by its diversity, distribution and specific vulnerabilities across the region, as well as the diversity of geology, climate, topography and the availability of other natural resources. Soil conditions are also determined by the spatial distribution and intensity of the economic activities, together with the underlying social political, legislative, financial, scientific and institutional frameworks within individual countries. Given the cross-cutting nature of the soil environment and the many users and sectors exploiting soil resources, providing comprehensive assessments on soil in Europe or at the national level is a difficult task.

The DPSIR (Driving forces-Pressures-State-Impacts-Responses) approach has been widely used to carry out integrated environmental assessments. This approach requires the integration of socio-economic information on driving forces and pressures with: media-specific information on state and impacts; information on the impacts of environmental degradation on society and information on responses and their effects.

On the other hand, data on the different aspects of soil at the pan-European scale are scarce and patchy. In particular, the information currently available is not sufficient to cover all the soil threats nominated in the EU Thematic Strategy for Soil Protection[1] and socio-economic aspects are in general not taken into account. This scarcity of the policy-relevant information has prevented so far the production of a comprehensive assessment on soil in Europe.

In order to approach this challenge, in early 2007, the European Environment Agency (EEA) initiated the preparation of soil country analyses in close collaboration with the EIONET.

The EEA started the process by putting together available information on the different soil aspects. This information was loaded into a customised questionnaire for each country. The countries were then asked to review the information and provide additional data where possible.

The so-called "Soil Country Analyses" reports are the final outcome of this process. Each report offers an overview of the status of soil resources at the national level and touches the aspects presented in the Soil Thematic Strategy. These include the main soil threats, the different soil policy instruments (also economic instruments) in force, and the specific soil management programmes and monitoring activities implemented or planned in each country.

Putting together this wide range of information from diverse sources has not been an easy exercise, and the EIONET countries have made considerable efforts over a period of two years.

The completeness and quality of the information which underpins the analyses is variable, reflecting the range of resources and information available at the national level. The positive outcomes of the exercise are many:

- The information provided by the countries filled many of the existing data gaps and provided the basis for preparing the soil country reports;
- For the first time, soil information spanning across the aspects of the EU Soil Thematic Strategy is available from one place, thus facilitating analysis and further use;
- The completed questionnaires plus the country reports are available as input to national activities (e.g. preparation of national State of the Environment Reports);

[1] COM(2006) 231. Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions – Thematic Strategy for Soil Protection. Commission of the European Communities. Brussels, 22.9.2006

- Comprehensive lists of national data sources have been collected and can be used for further processing in European and national projects;
- The Information provided by the countries helped the validation of the data already available and has in some countries led to improvements in data reporting processes, in particular by enhancing the contacts between national institutions;
- Information is now available to support the European State of the Environment Report.

In parallel to this exercise, the European Commission's DG Environment (ENV), DG Joint Research Centre (JRC) and Eurostat, together with the European Environment Agency (EEA) decided at the end of 2005 to establish "Environmental Data Centres" to ensure the provision of robust data and information on the state of the environment for the development of environmental policies at European Union level. In that context, the European Soil Data Centre (ESDAC) was established at the JRC.

In the "EIONET Workshop on Soil" held on 18 September 2007[2] with representatives from DG ENV, the EEA and the JRC, together with representatives from the EIONET 'National Reference Centres for Soil' and members of the Steering Committee of the 'European Soil Bureau Network', the EEA and the JRC jointly decided that all soil data management activities carried out by the EEA in collaboration with EIONET were to be transferred to the JRC.

Following that decision, in the "EIONET workshop on Soil" organized by the JRC IES on the 4-5 of March, 2009[3], the representatives of the EIONET National Reference Centres for Soil agreed on the joint JRC-EEA publication of the Soil Country Analyses under the "Scientific and Technical Reports" series of the JRC. The final edition of the reports and the inclusion, where relevant, of additional soil information available at the SOIL Action was the contribution of the JRC to the publication of the Soil Country Analyses. They are also made available online at the European Soil Portal (http://eusoils.jrc.ec.europa.eu/).

[2] All the material from the workshop can be found at http://eusoils.jrc.ec.europa.eu/library/data/eionet/Workshop2007.htm
[3] All the material of the workshop can be found at http://eusoils.jrc.ec.europa.eu/library/data/eionet/Workshop2009.htm

Organization of the report

Section 1 presents a brief description of the general situation in the country. It is aimed at capturing the main context features which have an influence on the environment, with specific reference to the status of soil resources.

Section 2 contains a summary of the status of soil resources, including priorities, challenges, problems, and success stories. It presents information on the following specific issues:

- the eight threats identified in the Soil Thematic Strategy (compaction, contamination, erosion, depletion of soil organic matter, loss of soil biodiversity, salinisation, floods and landslides, and soil sealing)
- cross-cutting and complex issues such as desertification (where relevant)
- impacts of sectors of activity that are relevant in the country
- case studies/success stories. Specific documentation that is related to issues of particular interest or that describes an emergent or underestimated issue that is worth telling (e.g. surface mining in Germany)

Section 3 provides a brief overview on legislation, market-based and in general economic instruments to protect soils (e.g. remediation funds, subsidies, etc.), as well as international activities.

Section 4 contains information on management and monitoring programmes with particular reference to programmes aimed at soil resources (e.g. the water basin management programmes, national inventories of contaminated sites) and major factors that hinder the access to relevant information (e.g. confidentiality issues).

Section 5 presents information on the status of the main environmental issues in the country, including priorities, challenges, problems, success stories.

Section 6 presents brief overviews and relevant statistics of main sectors of activity and main industries and a snapshot of the social features, including characteristics of the population such as lifestyles and consumption patterns. The sectors that are likely to be relevant to soil are agriculture, energy production, transport, tourism, households, chemical industry, etc. It includes information on industrial development and economic evolution (historical).

Section 7 presents information on land use changes.

The report has four appendices. The first one details information on local soil contamination, since a reporting process has been going on in the EEA since 2000 and more detailed information is available. The second appendix provides a detailed factsheet on the different Market Based Instruments presented in section 3, when this information is available. Finally, the third and fourth appendices offer some comments provided by the country experts on different datasets available at European level: on soil threats in appendix 3 and on socio-economic information in appendix 4.

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This report was prepared by Anna Rita Gentile, European Environment Agency, on the basis of the information available in December 2006. Comments and additional and recent information were provided by Belgium through an ad-hoc questionnaire.

Sara Barceló-Cordón and Marc Van Liedekerke, Joint Research Centre, completed and revised the report for its publication.

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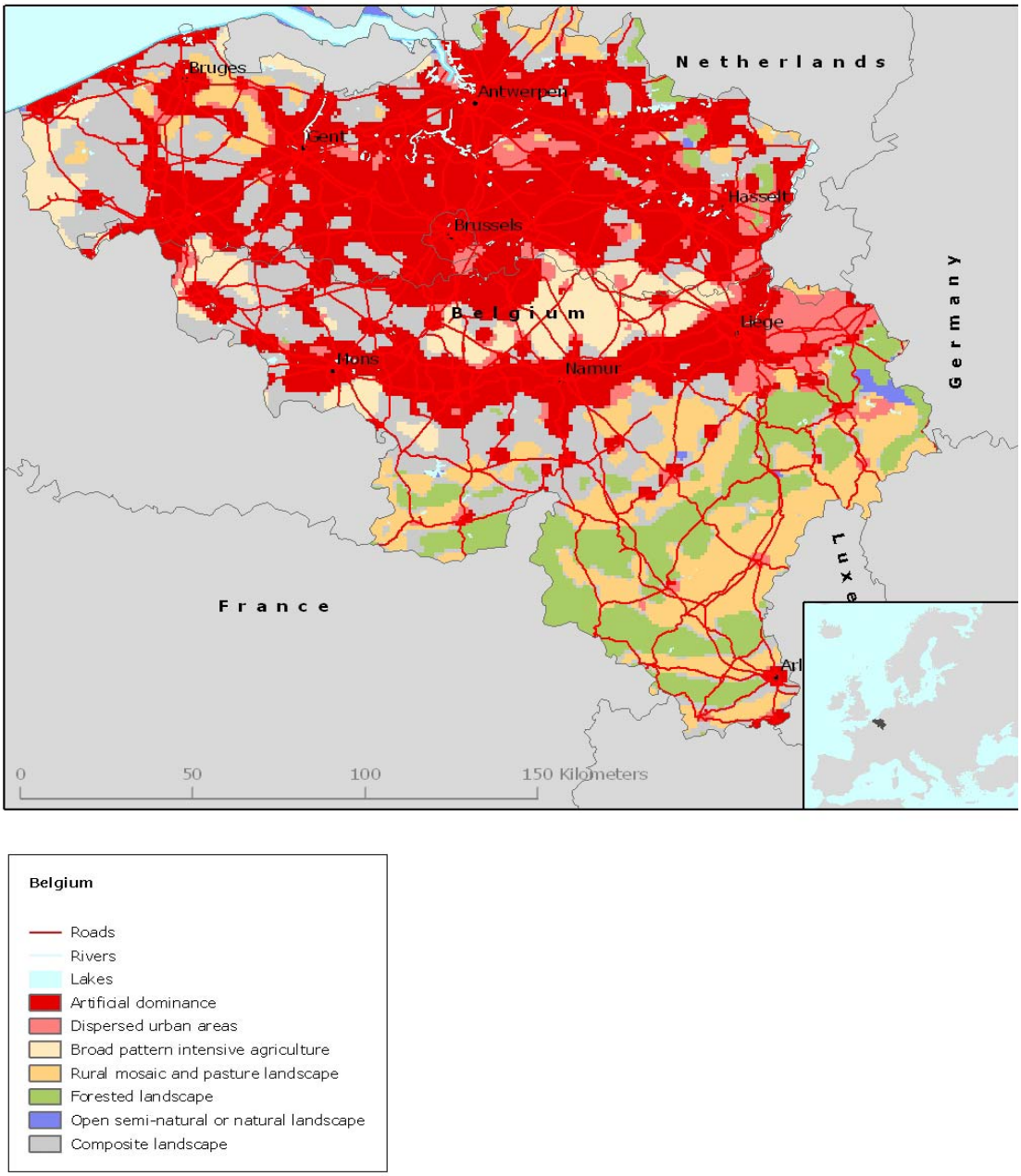
Other experts: Hendrik Neven (ALBON); Els Gommeren, Victor Dries, Geert Van Soom, Patriek Casier and Sam Fonteyne (OVAM).

Note from the editors

Belgium is a federation of three regions: Flanders, Wallonia and the Brussels-Capital Region (comprising the capital and its metropolitan area). Environmental policy is devolved to the regions and therefore, in this report, most of the information is presented separately for each region. The differences in the content and approach of the information regarding the regions are therefore a result of the different interests and organization of the regional administrations. In those cases where the Brussels-Capital Region is not mentioned it should be assumed that the situation is equivalent to that of Flanders (in which this small region is geographically embedded) or that the Brussels region has not developed a policy for the discussed issue.

1. THE GENERAL CONTEXT

Belgium is located on the southeast bank of the North Sea. Almost the entire country lies in the basins of the two main rivers, the Scheldt and the Meuse, which enter it at the French border and then flow northeast to the Dutch border. The country is almost flat, with its highest point at nearly 700 meters above sea level. However, due to the great variation in topography, geology and soil types, it has a large variety of landscapes. Geographically, three main regions can be distinguished. The northern lowland plains (up to 50 m of altitude), or *Lower Belgium*, stretches from the flat and fertile polders in the west to the poor sandy soils in the



Map 1. Dominant Landscape types of Belgium. *Source: EEA (Year: 2007).*

east. This region is mainly characterised by sands and sandy loams, with slopes that rarely exceed 2 %, and a mixed land use. Agricultural areas are predominant in the west, while forests are mainly found in the east; the extent of urban areas is also relevant. The central plateau, or *Central Belgium* (50-200 m), includes densely urbanised areas, as well as farmlands in the west and the east. This region is characterised by a hilly landscape, created by south-north running rivers, with slopes in general steeper than 5 % that can reach 15-25 % in some areas. Loess-derived Luvisols are the main soil types and agriculture is the main land use (dominant crops: winter wheat, maize, sugar beet and potatoes). Located further to the south, *Upper Belgium* (200-700 m) is the most sparsely populated and densely forested region in Belgium. It comprises the Ardennes and many limestone caves. Cambisols are the main soil types, while pastures and forests are the main land uses. Cropland is almost negligible. The slopes can be very steep (over 30 % in some areas).

Belgium has a moderate maritime climate with generally mild temperatures, predominantly westerly winds and regular rainfall (OECD, 1998; Boardman J. and Poesen J. (eds.), 2006). The intensity of water use is relatively high due to the high population density.

1.1. Soil description[4]

This region is exposed to the cooler and wetter conditions associated with the North Sea. The dominant soil processes are essentially weathering, leaching, illuviation and podzolisation. Among the different factors that influence the evolution of the soil of this region are geology, geomorphology (landforms) and past and present climatic conditions.

Soil from sandy materials exhibit leaching and podzolisation processes leading to the development of different kinds of Podzols. Sandy regions are extensive in Belgium (sandy Flanders and Campine), leading to the development of Gleyic and Carbic Podzols. Soil from loamy-loessic deposits and old alluvium is favourable to a rapid differentiation by clay illuviation. However, a number of soil types were initially calcareous and have previously undergone decarbonation, giving rise to progressive desaturation by leaching thus creating optimum conditions for eluviation. This process is the basis for the differentiation of Luvic Cambisols and then Haplic Luvisols that appear extensively in Belgium. The resulting variation in drainage conditions and the associated acidification then allows conditions for soil degradation with appearance of Haplic Albeluvisols. This loamy soil, as a whole, appears notably in the so called Belgium loess belt, covering nearly 30 % of the total area of the country.

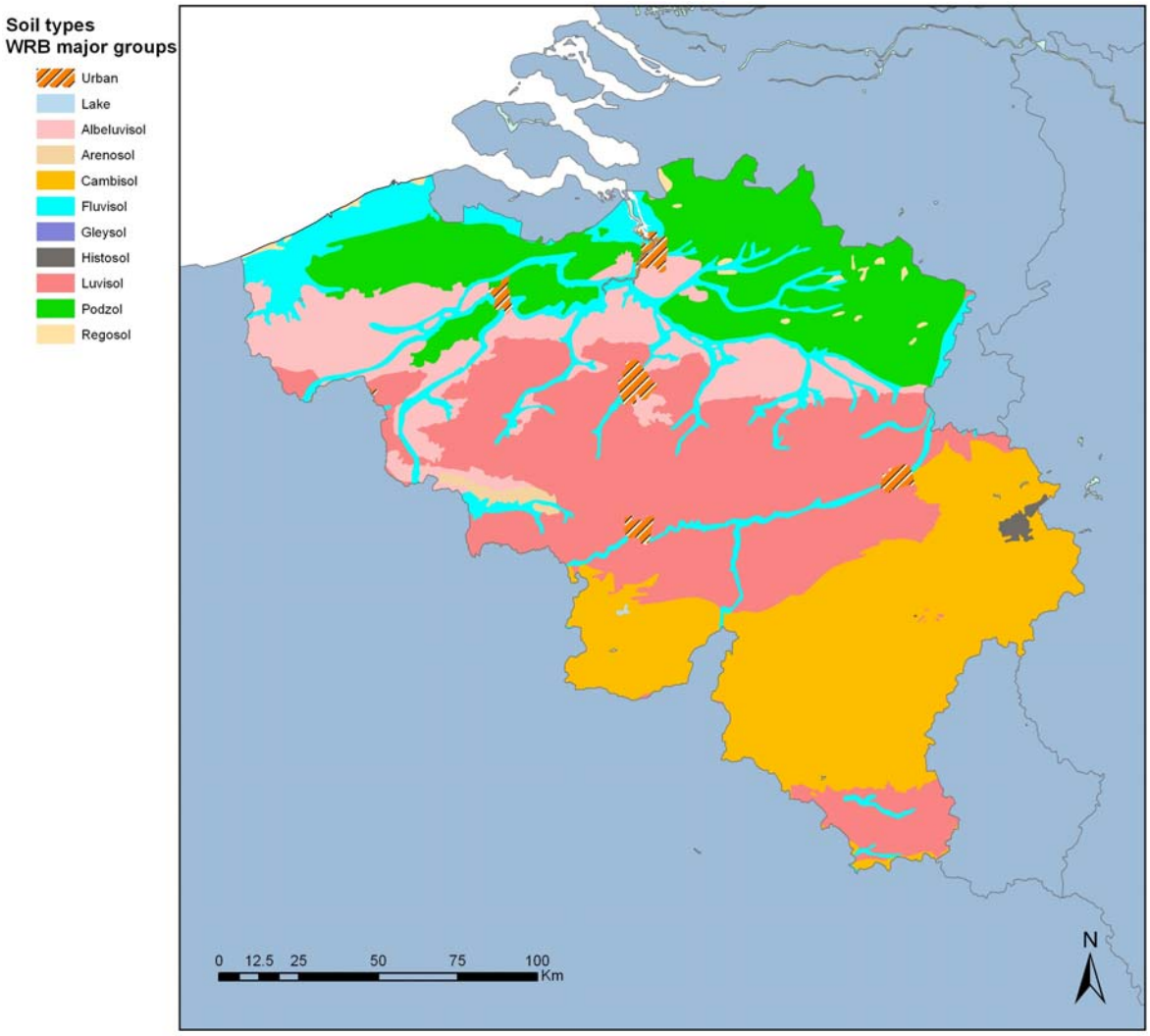
Soil from the moderate weathering of different kind of parent materials are relatively weakly differentiated, without important geochemistry processes, may be saturated or slightly acid,

[4] Extracted from Soil Atlas of Europe (2005).

and mostly dystric in nature. The south-eastern part of Belgium (Condroz, Famenne and Ardennes) is dominantly a Dystric Cambisol.

Other soil types are typical of more specific pedogenetic processes. The extent of recent marine formations is very important in Belgium (mostly Calcaric and Eutri-Gleyic Fluvisols).

The coverage of the main soil types in the country is reported in Table 1.



Map 2. Soil Map of Belgium. *Source: elaborated from European Soil Database (v.2).*

Table 1. Facts and figures

Item	Data and information			Sources
Population (inh)			10 584 534	*2*
Population density (inh/km2)[5] [1]			345.5	*2*
GDP (Million EUR) [2]			275 580.7	*2*
GDP (EUR per capita) [3]			26 100	*2*
Administration	Federal parliamentary democracy under a constitutional monarchy. As a result of the 1993 constitutional revision that furthered devolution into a federal state, there are now three levels of government (federal, regional, and three linguistic communities) with a complex division of responsibilities.			*3*
Geography	Crossroads of Western Europe; majority of West European capitals within 1 000 km of Brussels, the seat of both the European Union and NATO			*3*
Borders	*Land:*	Total: 1 385 km; border countries: France 620 km, Germany 167 km, Luxembourg 148 km, Netherlands 450 km		*3*
	Coastline:	66.5 km		*3*
Climate	Temperate; mild winters, cool summers; rainy, humid, cloudy			*3*
Land use	*Land use type*	*Km²*	*Reference year*	*2*
	Total agricultural land	17 361	2000	
	Arable land	8 635	2000	
	Total land under forest and other wooded land	6 791	2000	
	Built-up and related land	5 640	2000	
	Land used for transport and communication	1 942	2000	
	Wet open lands	232	2000	
	Total dry open lands	304	2000	
	Waters	200	2000	
	Land area	30 328	2000	
	Total area	30 528	2000	
Dominant landscape types [4]	*Landscape type*		*% of total area*	*1*
	A1 - Urban dense areas		39	
	A2 - Dispersed urban areas		6	
	B1 - Broad pattern intensive agriculture		7	
	B2 - Rural mosaic and pasture landscape		14	
	C1 – Forested landscape		11	
	C2 - Open semi-natural or natural landscape		0	
	D1 - Composite landscape		22	
Elevation	Flat coastal plains in northwest, central rolling hills, rugged mountains of Ardennes Forest in southeast; lowest point: North Sea 0 m; highest point: Signal de Botrange 694 m			*3*
Elevation Breakdown (%total area)	*Elevation class*		*% total area*	*1*
	1 - Low coast		7	
	2 - High coast		0	

[5] See Table 2 for more information on population density at the regional level.

Table 1. Facts and figures

Item	Data and information		Sources
[5]	*3 - Inlands*	61	
	4 - Uplands	32	
	5 - Mountains	0	
Soil resources [6]	*Major soil type or ground cover type*	*% total area*	*4*
	Luvisol	30	
	Cambisol	27	
	Podzol	11	
	Fluvisol	11	
	Albeluvisol	8	
	Arenosol	4	
	Other soil and ground cover types [7]	9	
Hydrology			
Seas			
Water resources			
Natural resources	Construction materials, silica sand, carbonates		*3*
Natural risks	Flooding is a threat along rivers and in areas reclaimed from the sea using concrete dykes. Some areas are also subject to collapsing terrain (karstic areas), rockslides of rock walls, landslides, and the presence of radon in high concentrations sometimes.		*3, EIONET*
Protected areas			
Products	*Agriculture:*	Sugar beets, fresh vegetables, fruits, grain, tobacco; beef, veal, pork, milk	*3*
Products	*Industry:*	Engineering and metal products, motor vehicle assembly, transportation equipment, scientific instruments, processed food and beverages, chemicals, basic metals, textiles, glass, petroleum	*3*

Notes	[1] See also Section 6 Society and Appendix 4 Socio-economic indicators [2] Source: ESTAT data. Latest reference year available. Population data refer to 2007; density of population refers to 2005. [3] At 1995 prices and exchange rates. Source: ESTAT; Reference year: 2006 [4] EEA Major landscape types (EEA, 2006ab) [5] EEA Elevation classes (EEA, 2006ab) [6] Soil classification based on the reference soil groups of the World Reference Base for Soil Resources-WRB (FAO AGL, 2003). EEA elaboration based on European Soil Database v. 2. Only soil and ground cover types covering at least 2% of total area are explicitly included. [7] % area less than or equal to 2 %. Leptosols cover about 1.7 %

Sources:

1 EEA
2 ESTAT
3 CIA world factbook web updated 7 September 2006
4 European Soil Database (v. 2)

2. THE STATUS OF SOIL RESOURCES

2.1. A snapshot of the status of soil in the country

Flanders

Flanders presents a flat to gently sloping relief from sea level (and under sea level for some areas in the Polders) to 130 m above sea level and quaternary soil types (heavy clay, light clay, loam, heavy sandy loam, light sandy loam, loamy sand, sand; sand, sandy loam and loam are predominant). The majority of the soil types present in Flanders have an æolian origin (Würm glacial period), while a small percentage is represented by polder soils (of marine or alluvial origin). The more ancient tertiary soils emerge on eroded hill tops in the loamy or sandy loam areas.

The overall climate is a moderate sea climate with a year rain average of 800 mm.

Erosion is considered to be the main threat to soil in agricultural areas. The more hilly southern part of Flanders, with loamy and sandy loam soil textures, is sensitive to erosion with varying intensities (one third of the agricultural surface of Flanders is inside an erosion risk area). The flat northern part of Flanders with sandy and/or clay soil texture has no erosion problems.

Erosion is a consequence of the steady growing surface of arable land parcels and the growing extent of erosion-prone summer crops, which gives rise to higher soil erodibility in springtime.

The loss of multi-functionality of soil by sealing in built-up areas is also considered to be a serious problem. This is a direct consequence of the high population density and the high level of socio-economic activities.

The decline in soil organic matter is considered to be another major soil threat. Soil analysis for agricultural and manuring purposes has shown some steady decline of soil organic matter in percent terms in the two last decades. However, this may not correspond to a decrease of the total mass of organic matter in the soil (SOM)[6]. The observed percent decline may be caused by the increase of plough depth, or the substitution of permanent grassland by temporary grassland. Concerns about soil organic matter and erosion have been integrated in cross-compliance actions and in rural development plans.

Diffuse contamination is generally limited to small regions. Due to intensive animal husbandry, phosphorous is commonly spread in the soil, but phosphorous saturated soils are only found in

[6] Comment from Hendrik Neven: The total mass of SOM is more stable than the carbon content of the top layer, expressed in percent terms. Research studies, targeted at the total mass of organic matter in the entire soil profile and extending over several years, indicate a more constant content with time.

some sandy areas. Heavy metals such as cadmium or copper (generally originated by rock phosphorous or feed supplements) are not considered to be a problem, except in the sandy Campine area, a region near the Dutch border, where there is a legacy of contamination by non-ferrous industries. Although it is only indirectly monitored through the monitoring of surface and ground waters, soil contamination by pesticides is estimated to be widespread in agricultural land.

Soil compaction has always been considered as an individual problem for the farmer and has rarely been monitored. The relative soil weight is known from several soil bound research projects. A growing awareness about soil compaction is a consequence of the increased awareness about soil organic matter and soil erodibility.

Salinisation is a minor problem, confined in the areas close to the North Sea.

The loss of soil biodiversity is not yet monitored, besides a few pilot studies carried out in the framework of soil quality related research projects (rainworms, etc.).

Wallonia

In the south of the country, the Walloon territory is hillier, with an elevation ranging from 25 to 694 m above sea level (Signal of Botrange: the highest point in Belgium). The underground is composed of a very wide diversity of geological formations stretching from the Cambrian (limestones, phyllites, quartzite, shales, sandstones, etc.) to the Quaternary (loess). The diversity of landscapes and bedrocks has given rise to many different soil types (deep silty soils north of the Sambre-Meuse furrow, acid pebbly-silty soils in the Ardenne, sandy and clay soils in the Belgian Lorraine, etc.). There are thirteen major soil associations in Wallonia with marked differences in terms of chemical, physical, and biological properties.

On the basis of available information, action should be directed primarily towards the restoration of soil organic matter content, the prevention of the risks of water erosion, the control of diffuse contamination, and the remediation of contaminated sites. In relation to soil compaction and soil biodiversity decline, information is still too sparse to allow a complete assessment.

The decreasing amount of soil organic matter (OM) in arable land is a cause for concern, especially in field crop areas, where most of the soil is depleted (OM content below 2 %). On the other hand, OM has risen in forests and permanent grassland over the past forty years.

According to the results of a model, in agricultural land soil losses due to water erosion increased on average from 1.7 to 2.6 tonnes/ha/yr in the period 1971-2000. This trend can be connected to more abundant and erosive rainfall and decreasing plant cover in arable land (root crops) during the most critical periods.

It is currently difficult to evaluate the extent of diffuse contamination in the region, given the absence of regular soil monitoring. Model estimates seem nevertheless indicate a decrease in the

nitrate concentration in the root zone in certain catchment areas, due to reduced fertiliser inputs and better effluent management. In addition, in general, soil seems not to suffer from (or show the signs of) major metallic trace element contamination (of airborne or agricultural origin).

The large number of industries that contributed to economic development in Wallonia is estimated to have left a heavy heritage of contaminated sites, the exact number of which is not yet known. Whereas the remediation of polluted soils is considered a priority by the regional government and large sums have been allocated for the clean-up, some structural elements for an effective contaminated site management are still lacking. The main problems include ineffective regulations, lack of a centralised inventory, distribution of competences and lack of communication among stakeholders.

A country review of European datasets relevant to the soil threats is provided in Appendix 3.

2.2. The threats to soil

2.2.1. Contamination

2.2.1.1. Diffuse contamination

From the end of the 19th century to until the late 1970's, zinc smelters located in the Campine area, stretching across Flanders and the Netherlands[7], used thermal processes to extract zinc from zinc ore (see also section 2.5 and box 2). The processes produced emissions containing heavy metals such as cadmium, lead and zinc, which caused the diffuse contamination of a vast area, estimated to cover 350 km^2, of which 200 km^2 in Flanders and 150 km^2 in the Netherlands. In addition, the residues of the smelting processes, the so called 'zinc ashes', were used for road stabilisation. This practise resulted in the pollution by heavy metals of the soil and the groundwater around and below the ash-roads. The ashes were used in a region of about 2,600 km^2, nearly half of which in Flanders. This area, corresponding to 4 % of the total land area of Belgium has been contaminated through the deposition of airborne pollutants, dumping in water channels and the re-use of zinc-ashes. In many places, the concentration of heavy metals in soil and groundwater still exceeds environmental quality standards.

In the south of the country, the soils located in the industrial basins of Liège and Charleroi often present metal trace element concentrations above the natural pedological and geochemical background levels. In these districts, diffuse contamination results primarily from the fall-out of airborne pollutants from the non-ferrous metallurgy, an industrial activity which has been widely practised there since the start of the Industrial Revolution.

The deposition of airborne pollutants from the industrial areas of Antwerp and the Ruhr is contributing to the effects of soil contamination in acid sandy soils. According to the latest report

[7] One smelter in Budel.

on the State of Environment in Flanders (MIRA-T, 2007), in 2004, critical loads for eutrophying nitrogen were exceeded in 95 % of the total area of terrestrial ecosystems (forests, semi-natural vegetation, etc.) in Flanders. On the other hand, the critical loads for acidifying compounds (nitrogen, sulphur) were exceeded in an area corresponding to 59 % of the Flemish terrestrial ecosystems.

In 2004, almost the entire territory of Wallonia (99 %) received acidifying inputs of nitrogen and sulphur below the critical load for forest ecosystems, whereas exceedances were observed in 1990 in over 70 % of the forested area[8]. This improvement is explained mainly by the drop in the emissions of acidifying compounds, especially sulphur compounds. However, in 2004, more than 75 % of the forested areas (mainly located below the Sambre and Meuse River Valleys) and almost the totality of other semi-natural ecosystems were still affected by exceedances of the critical load for eutrophying nitrogen. This brings the risks of nitrate leaching into the aquifers, nutrient imbalances and the loss of biodiversity.

Other causes of contamination include the improper use of pesticides and emissions from incomplete incineration processes. These latest processes may generate emissions to air containing polycyclic aromatic hydrocarbons (PAHs), which can be deposited in vast areas. High concentrations of these pollutants have been found in old residential areas and along main roads.

In residential areas, high concentrations of PAHs are also found in garden paths paved with materials containing industrial ashes. For several decades, from the 1950's to the 1970's, the use of residues from industrial processes as paving materials, including residues from asbestos converting companies, was a common practice by local authorities and private households in the areas surrounding industrial plants. These materials, which were appreciated for their high mechanical stability and good drainage capability, often included contaminants, thus causing soil contamination and serious human health problems due to the inhalation of asbestos fibres. The remediation of the contaminated soils is currently underway by government action.

Agricultural areas are regularly monitored. Due to the heavy use of fertilisers in the past, especially manure produced by intensive animal husbandry, most of the cultivated areas have fairly high contents of phosphates. Some localised sandy areas are over-fertilised (phosphate saturated zones are officially identified in the Flemish region, while work to identify the soils that are saturated in phosphorus in the Walloon Region is currently under way). Continuous measures are taken in the context of the Flemish manure law to prevent further excesses of phosphates. The manure law, implementing the Nitrate Directive (Directive 91/676/EEC), includes limits for the application of both nitrogen and phosphorus. As a rule, phosphorus application with chemical fertilisers is prohibited unless soil analysis is performed and a permit is issued by the competent authority. In groundwater, high concentrations of phosphates are only present in the polders,

[8] Blin & Brahy (2007).

probably due to the specific soil conditions, such as the high concentration of organic matter. In Wallonia, the aquifers are not contaminated by phosphates.

Measures are also taken to control copper content in animal feed, as copper contamination was detected in the past. Recent monitoring of groundwater shows that diffuse contamination due to chrome, copper and mercury is almost absent, as it is the case for phosphates[9]. Cadmium, lead, arsenic, zinc and especially nickel are present in higher concentrations (nickel concentrations are higher than the drinking water limits in 30 % of the monitored sites in Flanders but less than 0.5 % of the monitored sites in Wallonia). Some groundwater bodies can be considered to be in a bad status due to the presence of contaminants such as phosphates and zinc.

Contamination by pesticides is only monitored in groundwater, sediments in riverbeds and through bio-indicators (e.g. eels). Pesticides were found in 58 % of the 500 groundwater measuring points in Flanders, while 36 % of the 360 measuring points are affected by the presence of pesticides in Wallonia. Desethylatrazine, atrazine, bentazon and AMPA[10] are the main pesticides found in groundwater[11]. In 15 % of the monitoring sites in Flanders, the limits of individual products are exceeded, while the global limits are exceeded in 9 % of the cases. In Wallonia, the limits of individual pesticides are exceeded in 8 % of the monitoring sites and the global limits in only 2 % of the investigated water intakes.

2.2.1.2. Contamination from local sources[12]

In Flanders and Brussels, soil contamination requiring clean up is estimated at present at 12 400 sites. Potentially polluting activities are estimated to have occurred at nearly 83 000 sites (including the 12 400 sites already mentioned) and investigation is needed to establish whether remediation is required. Just above 600 sites have been cleaned up since 1995.

There is no centralised inventory of contaminated sites in Wallonia. Several inventories have been carried out by different subjects for several purposes. These inventories also include sites where

[9] Comment from Vincent Brahy: Soil contamination by phosphates has not affected groundwater quality (except in the Polders Region).This is mainly due to the fact that phosphates are specifically fixed at the surface of iron and aluminium oxy-hydroxides present in the soils. For this reason, they cannot be easily lixiviated to groundwater bodies (when the phosphorus fixation capacity of the (sub) soils is not exceeded of course).
As far as heavy metals are concerned, soil contamination ahs not affected groundwater quality in the case of Cr, Cu and Hg but not necessary in the case of Cd, As, Pb, Zn and Ni. Some of these elements are "naturally" present in certain aquifers (dissolution of rocks containing sulphur-bearing minerals for example) but it is still difficult to know if these trace elements are coming from natural or anthropogenic sources.
[10] Aminomethylphosphonic acid
[11] The monitoring done on most of the groundwater extraction points in the Walloon Region also reveals the appearance of new molecules, such as 2,6-dichlorobenzamide (the main metabolite of dichlobenil), in high concentrations.
[12] Unless otherwise specified, numbers in this section refer to the regions of Flanders and Brussels (source: Eionet data flow on contaminated sites 2006). In Flanders, soil contamination requiring clean up is estimated at present at 11 200 sites. Potentially polluting activities are estimated to have occurred at nearly 76 200 sites (including the 11 200 sites already mentioned) and investigation is needed to establish whether remediation is required. Just above 600 sites have been cleaned up since 1995.

the soil is little or not contaminated. The inventories list 3 550 brownfield sites (SAED[13]), 2 500 old landfills, and 1 500 service stations (Maes et al., 2007). However, it is estimated that the number of the sites potentially contaminated is much higher, as many sites have not yet been registered[14].

A wide range of pollution sources have been identified. Industrial production and commercial services, oil extraction and production, industrial waste disposal and treatment, and power plants are reported to be the most important sources. In Wallonia, pollution sources also include the old coal industries (coking plants, gas factories, etc.), and the metallurgical industry and steel mills which ensured a booming economic growth in the region until the early 20th century.

Heavy metals, polycyclic aromatic hydrocarbons (PAH), mineral oil and aromatic hydrocarbons (BTEX) are the most frequent soil contaminants at investigated sites.

Information on expenditures for the management of contaminated sites in Belgium is limited. In Flanders, a quarter of the remediation expenditure comes from public budgets. In Wallonia, the costs for the remediation of 50 priority sites have been estimated to be 800 million EUR[15]. Although considerable efforts have been made already, it will take decades to clean up a legacy of contamination. A detailed assessment is reported in Appendix 1.

[13] SAED = *Sites d'activités économiques désaffectés* (abandoned economic activity)

[14] Note from Vincent Brahy: The specialised state-funded company, SPAQuE S.A., in charge of orphan sites and sites that require urgent action due to the presence of relevant health or environmental risks, established a classification of priority sites, namely based on the estimation of theoretical risks (Auditsol software). The results of this classification carried out only for the existing SAED inventory (not yet complete) are included below:

	Type of risk	**Number of sites**
A	High risk	253
B	Moderate risk	853
C	Low risk	1 817
D	Not determined or no risk	603

[15] Note from Vincent Brahy: It is difficult to provide more information on funding because there are many budgets, each of them being dedicated to a specific class of sites. Moreover, a specific company has been created by the regional authority (SOWAFINAL S.A) for contracting loans and boosting soil remediation. A rough overview of the situation is provided in the table below :

Type of sites	**Number of sites**	**Corporation**	**Funding (EUR)**
SAR (Sites à réhabiliter) non pollués à assainir prioritairement	79 sites (2005) 70 sites (2006)	SOWAFINAL SOWAFINAL	34 500 000 64 000 000
SRPE (Sites de Réhabilitation Paysagère et Environnementale)	77 sites (2006)		22 700 000
SAR pollués	50 sites (2006)	SPAQuE + FEDER	800 000 000
Contaminated sites in general	1207 sites		Rough estimation: 2.1~3.9 billion EUR over 30 years

More information is available in the analytical report on the state of the Walloon environment (chapter SOLS05). (Available at: http://environnement.wallonie.be/eew/rapportProblematique.aspx?id=SOLS_05)

Legislative and budgetary measures were taken in Wallonia in 2005 to accelerate the remediation of polluted soils. However, the decree on soil remediation has not yet gone into effect. In Brussels, new legislation has been in force since 2004[16].

2.2.2. Salinisation

Salinisation is rather a minor concern in Belgium, since this soil threat is present only along the coastline of the North-Sea. The problem in general originates from or is increased by the exploitation of groundwater in the coastal areas with the consequent subsoil intrusion of marine water.

The presence of salts in the topsoil is confined to a small natural area (some 15 ha) in the dune zone, and some 5 ha of agricultural land in the nearby polders. In the dune zone and the northern part of the polders, the groundwater sometimes shows a high salt content and therefore it is no longer suitable for irrigation or animal drinking purposes.

The intrusion of seawater is expected to increase due to the predicted sea level rise consequent to global warming. Under present climatic conditions, there is no problem of salinisation caused by irrigation, although quantitative information on salt accumulation in topsoil is not available. On the other hand, salinisation is known to cause problems in greenhouses with soil cultivation.

2.2.3. Erosion

The localisation, causes and magnitude of soil erosion problems in Belgium reflect the distribution of the landscapes in the three main geographical regions. Main erosion processes include erosion due to water, tillage and crop harvesting, while wind erosion affects a small area. In the central part of the country, characterised by a hilly topography, loess-derived luvisols and a high share of arable land, soil erosion caused by water and tillage is dominant. In many agricultural catchments, total water erosion soil loss rates vary between a few to more than 10 tonnes/ha/year. The average within-field tillage soil redistribution rates are of the same order of magnitude. According to estimates made using a risk model combining water and tillage erosion[17], the percentage of

[16] Information for Brussels can also be found on the web page of the Brussels Institute for the Management of the Environment, INTERNET: http://www.ibgebim.be. Information for Wallonia can be found on the web site of the "State of the environment in Wallonia". INTERNET: http://environnement.wallonie.be/eew

[17] Soil loss by water erosion in Belgium is predicted using the RUSLE equation. Hence, this is a risk indicator, based on modelling without using measured data. However the model was calibrated under Walloon and Flemish conditions. In the Flemish Region, the soil erodibility factor is estimated from the soil texture data provided by the digitalized Belgian Soil Map (1:20 000). The topographic factors are derived from a digital elevation model with a resolution of 5 m, originated by laser-supported topographical technology. The accuracy of this DEM is high. The crop management factor is simplified by assuming that no erosion takes place on grassland, and by taking an average C value of 0.37 for all field parcels in arable use. The agricultural field parcel map results from a yearly inventory of the agricultural land use.
The results of the degree of yearly erosion/ha combine water erosion and tillage erosion. The net downwards soil flux due to tillage translocation on a hill slope is proportional to the local slope gradient multiplied with the transport coefficient (500 kg/m/year, assuming that each field parcel is tilled once with a chisel plough and once with a cultivator per year).
The model used in Wallonia to estimate soil losses (EPICgrid model) differs somewhat from the model used in the Flemish Region (Watem/Sedem model). The results obtained with these two models are, however,

agricultural land under risk of erosion varies from about 19 % in Wallonia to nearly 14 % in Flanders (Table 2).

Table 2. Erosion risk class in agricultural land

Region	Low	Moderate	High	All risk classes
Flanders	6.5	7	0.4	13.9
Wallonia	16	3	0.3	19.3

Notes:
Unit: % of agricultural land under risk of water and tillage erosion
Erosion classes: OECD classification

The effects of erosion are mainly concentrated on site in the field parcels (loss of soil from the fields and accumulation downslope[18]). Soil erosion by water is also causing the sedimentation of water bodies and other environmental problems such as muddy floods. Especially after intense storm events, soil erosion and sediment export rates can reach several tens of tonnes/ha in a single catchment. Off-farm delivery of eroded soil into the main watercourses is considered to be the main sediment input, estimated to reach 0.4 million tons per year in Flanders and 0.67 million tons per year in Wallonia. This estimated erosion sediment corresponds to an erosion rate of 1 to 2 tonnes/ha of arable land in the whole country.

In regions where water and tillage erosion are less important (e.g. in the northern part of Flanders and the southern part of Wallonia, Famenne-Ardennes), soil erosion caused by crop harvesting is probably the most important soil degradation process. Mean values of soil losses have been estimated at 1.4 tonnes/ha/year, while mean values for individual crops (e.g. potatoes, chicory, carrots, sugar beet) can range from 2 to 16 tonnes/ha per harvest.

In the northern part of Belgium, wind erosion is also observed in many fields, although not many measurements of its intensity are currently available.

Finally, within two smaller areas – in the Flemish Ardennes, south of Ghent, and in the eastern part of the country, near Liege and Andenne – several tens of landslides have been identified. These have an average affected area per landslide of about 5-6 ha. Many of the landslides are still active and cause damage to private and public infrastructure (Boardman and Poesen, 2006).

Erosion prevention is a major soil policy issue and several anti-erosion actions are being taken, such as subsidies for small scale anti-erosion works by local authorities, cross-compliance, agri-environment measures and legislation related to soil protection.

consistent with each other. The EPIC grid model and parameters used in Wallonia are described in detail in Dautrebande & Sohier (2006).
[18] This phenomenon is known as colluviation.

2.2.4. Decline in soil organic matter

Soil organic carbon data from the agricultural advice system on soil fertility provided by the Belgian Soil Service (BDB vzw) show that the actual carbon content of arable land parcels in Flanders can be considered fairly good. An average of 70 % of the (randomly) analysed arable land parcels have a sufficient carbon content (from normal to very high), as shown in Table 3, which provides the frequency distribution of carbon content in arable land (all soil types), for four time periods, as percentages of soil samples.

Table 3. Soil carbon content in arable land in Flanders (%of soil samples)[19]

Classes[20]/Periods	1982-1985	1989-1991	1992-1994	1996-1999
Very low	2.0	2.3	1.9	3.3
Low	6.8	6.3	6.0	9.1
Moderate low	13.9	12.3	12.6	17.7
Normal	52.0	50.7	51.7	50.1
Moderate high	22.9	25.8	25.7	18.0
High	2.3	2.4	2.0	1.7
Very high (peaty)	0.1	0.2	0.1	0.1

Note: measured at a soil depth of 23 cm
Source: Belgian Soil Service (BDB)

In Wallonia, a more recent analysis of the total organic carbon (TOC) contents in arable land (at a depth of 0-25 cm) and grasslands (at a depth of 0-15 cm), carried out in the period 1998-2002, shows that 84 % of the samples taken from cropland had organic carbon concentrations above the cut-off value, whereas all the samples taken from meadows contained sufficient amounts of organic carbon (Colinet *et al*., 2005).

The data in Table 3 indicate that, in the past two decades, the status of the carbon content in most of the arable land parcels has been sufficient. However, the percentage of parcels with carbon content below normal has increased in recent years. This trend has been observed since the beginning of the 1990s in all soil texture classes. For example, the organic status trend in the arable land (0-30 cm) in Wallonia reveals an overall 10 % decline in the TOC for the region as a

[19] The figures in Table 3, although referring to percentages of soil samples taken in arable land, give a rough indication on the carbon content in the arable land parcels (several thousands of soil samples are taken randomly every year).
[20] The Belgian soil fertility advice system uses the evaluation classes below for soil organic carbon content for arable land:

Evaluation classes of the carbon content related to the main soil type/texture classes for arable land

Classification / Soil type	Sand	Loam and Sandy-Loam	Clay
	% C	% C	% C
Very low	< 1.2	< 0.8	< 1.0
Low	1.2 – 1.4	0.8 – 0.9	1.0 – 1.2
Moderate low	1.5 – 1.7	1.0 – 1.1	1.3 – 1.5
Normal	1.8 – 2.8	1.2 – 1.6	1.6 - -2.6
Moderate high	2.5 – 4.5	1.7 – 3.0	2.7 – 4.5
High	4.6 – 10.0	3.1 – 7.0	4.6 – 10.0
Peaty	> 10.0	> 7.0	> 10.0

Source: BDB

whole between 1947 and 2004. This drop concerns above all the Ardennes, Upper Ardennes and the Jurassic Region.

Although general conclusions should be made with care due to the abrupt nature of the changes observed, these may be explained by the changing patterns of crop rotations, the historical conversion of grassland into arable land (especially that under forage crops), changes in agricultural and horticultural practices (such as deep tilling or the preferential use of inorganic fertilisers) and the decreasing use of animal manure.

On the other hand, research studies targeted at the total mass of organic carbon in the entire soil profile (0-90 cm) indicate that carbon content is more constant with time. Regional differences exist, however. For example, in Wallonia, the total mass of the soil organic matter (to a depth of 1 metre) rose from 137 million tons in 1960 to 163 in 2000. This was mainly due to the rise in the carbon contents in forest soils. A large proportion of forests are still fairly young and productive, meaning that the sources of soil organic matter (leaf litter and roots) are rising apace with biomass production. Another explanation lies in the extensification of forest management, which increases the return of harvest residues. (Cellule Etat de l'environnement Wallon, 2007). A decreasing trend of soil carbon mass is also present in grassland parcels, probably caused by an increased grass renewal.

Due to the importance of a sufficient level of soil organic matter for maintaining soil fertility and in general for ensuring the sustainable use of soil and combating erosion, compaction, loss of soil fertility, priority is given to actions for maintaining or increasing soil organic carbon where needed, up to a reasonable optimal level, depending on the specific circumstances. Actions include agri-environmental measures, organic farming, and the utilisation of externally produced organic matter.

Until 2005, green manuring was part of the environmental measures of the regional Plan for Rural Development. This measure is considered to be no longer necessary since green manuring is becoming a more common practice.

2.2.5. Sealing

The relatively high proportion of sealed soil in Belgium is related to the limited availability of space, as it is shown by the high population densities. With an average density of over three times the average density in the EU27, Belgium is one of the most densely populated countries in Europe after Malta and the Netherlands. Over 97 % of the total population live in urban areas[21]. The "Flemish Diamond", the central region situated between Antwerp, Leuven, Brussels and Gent, is the most densely populated area (see Table 4).

[21] In the Wallonia, 56 % of the population living in rural areas and 44 % in urban nuclei (Liège, Charleroi, Mons, Namur, etc.). In Flanders, the rural areas with smaller communities ('village') type cover 60 % of the total surface, while the main communities ('city' type) cover about 40 % of the total surface.

Table 4. Population density			
Region	**% population (2006)**	**% total area (2005)**	**population density (inh/km^2; 2005)**
Be Belgium	100.0	100.0	345.5
Be1 Région de Bruxelles-Capitale/Brussels Hoofdstedelijk Gewest	9.7	0.5	6 290.5
Be2 Vlaams Gewest	57.8	44.3	453.5
Be3 Région Wallonne	32.5	55.2	202.6

Source: ESTAT, regional statistics

The extent of built-up areas is increasing. This growth is relatively more important in rural areas. In January 2005, the total built-up area (residences, economic and recreational activities, public facilities, and transport infrastructure) amounted to 17 % in Flanders and about 14 % in Wallonia. In rural areas of Flanders, a proportion ranging from 10 to 20 % of the total surface is built-up. In urban areas, the built-up surface may amount up to 70 %, as in Antwerp and Gent. The increase in built-up area has recently slowed down (Table 5).

Information on the percentage of the sealed surface is limited. It has been estimated that in Wallonia, the sealed area amounts to about 2.6 % of the territory (preliminary estimates).

Transport infrastructures contribute significantly to the problem. In Flanders, the road infrastructure is considered to cover about 2 % of the total surface[22]. The yearly increase is slowing down. In the Walloon Region, transport infrastructure covers over 5 % of the total surface[23].

Table 5. Soil sealing			
Region	**Belgium**	**Vlaams Gewest**	**Région Wallonne**
Total area (km^2)	30 528	13 522	16 844
Built-up areas (ha)		233 676	232 000
Built-up area (% of total)		17	13.7
Sealed areas (ha)			44 250
Sealed areas (% of total area)			2.6
Average yearly increase in built-up areas 1986-1997 (ha)		4 000	2 000
Average yearly increase in built-up areas in 2005 (ha)		2 150	1 200

2.2.6. Hydro-geological risks

In Belgium, and in Flanders in particular, the occurrence of mass movements is confined to a small area, which is located in the south of Flanders, at the border with Wallonia ('the Flemish

[22] Flanders: total paved road infrastructure in 2005: 69 783 km; in 2000: 67 984 km. More information on soil sealing in Flanders: http://aps.vlaanderen.be/statistiek/publicaties/stat_Publicaties_vrind2006.htm (VRIND 2006, chapter 10)

[23] Wallonia: the area covered by transport infrastructure rose from 83 000 ha in 1986 to 87 000 ha in 2004, for an increase of 4.3 %.

Ardennes'). This region is particularly vulnerable to land sliding, due to its hilly topography and the presence of alternating clay (smectites) and sandy layers below a quarternary loam cover (loess).

The risk area covers an extension of about 71 000 ha comprising 17 Flemish communities, corresponding to 5 % of the total area of the region (over 2 % of Belgium)[24]. In Wallonia, a study is being carried out by the University of Liège. The study is aimed at predicting the actual risk of land sliding inside the potential risk area by means of a statistical model. A recent inventory (2005), carried out in a test area of 20 000 ha, resulted in the mapping of 147 landslides covering a total of 490 ha or 2.5 % of the investigated area. In most cases, the landslides are old and not active. They may also be reactivated, sometimes partially, by human activities such as road construction, building activities and construction of ponds. In these cases, landslides may cause damage to private and public infrastructure without risk for human lives. The movement is always slow and rather invisible. Damage is mainly limited to cracks in houses, roads, sewage systems and water pipes.

Since 1997, karst has been recognised as a natural risk in Wallonia together with floods, landslides, rockslides from rocky cliffs, mining collapses, and seismic risks. Consequently, the Walloon Parliament changed its legislation on town planning, parcelling and environment permits in order to manage this stress and a map inventory of the areas of karstic constraints was drawn up. The latest inventory has identified 5 700 karst sites and phenomena in Wallonia (Atlas du karst wallon: http://www.cwepss.org/atlasKarst.htm).

In addition, after intense precipitations mainly in spring and early summer, central Belgium is affected by "muddy floods", generating from areas which are intensely cultivated and scarcely covered by vegetation, presenting high soil erosion risks. In general these events do not bring 'risks' for lives, but they rather pose economic burdens due to damage to properties and public infrastructures (Boardman and Poesen, 2006).

In Belgium floods mainly originate from rivers, although floods originating from the sea can also happen (the Scheldt is a tidal river). Floods are not considered to be an item for soil policy, but for water policy.

2.3. Cross-cutting issues

2.3.1. Brownfields

There are no reliable quantitative data available on brownfields in Belgium. However, inventories have been established in Wallonia to cover sites that formerly hosted economic or other activities (except residences). Registered sites include sites that are suspected to be contaminated and sites that have little or no contamination but need to be rehabilitated (Maes et al., 2007).

[24] Outside this area, landslides are not expected to occur in Flanders.

The presence of contaminated sites close to densely populated areas does not only pose a potential risk to public health, but it may also influence urban development and growth. Because of their location, for instance inside urban agglomerations and city centres, or along water and railways, these sites have a large potential for redevelopment and reuse. There is a growing consensus in the country on the opinion that former industrial sites can play an important role in the revitalization of derelict areas. The development of abandoned contaminated sites or sites with suspected contamination (brownfields)[25], is considered necessary, especially in densely populated regions where the demand for land for development is bigger than the supply.

Incentives for the productive reuse of brownfields may also lead to the protection of the scarce green and open spaces. However, the redevelopment of a site requires a close collaboration between all parties involved: local authorities, administrations, land owners, neighbours, local action groups, project developers, remediation professionals, financing agencies, investors, insurers and other subjects. In this context, the key question is whether a site can be remediated sufficiently and cost-efficiently to guarantee a safe and economic reuse, with a clear definition of all responsibilities and liable parties. The length of the process and the lack of information and expertise in brownfield development are the major factors that hinder the realisation of brownfield projects, for which there is a large potential in Belgium. More information on brownfield management and public incentives in this area can be found in section 4.1.

2.4. Soil services

In Belgium soil is mostly valued for supporting food production, for groundwater protection and for providing a physical platform to human activities.

Belgium is among the nine European countries with the highest water exploitation index (about 32 % in 2005)[26,27]. However, it should be taken into account that the high water abstraction is for non-consumptive uses (energy cooling water) (EEA, 2009). More than two thirds of the drinking water supply comes from groundwater (source ESTAT). According to the criteria and targets established in the context of the Water Framework Directive, the groundwater bodies at risk of not achieving a good quantitative status by 2015 or intensively exploited are about 45 % of the total in Flanders and over 27 % in Wallonia, where more than half are also at risk in terms of not reaching

[25] In Belgium a brownfield is a group of derelict or underused sites that have been affected in such a way that they require structural intervention to bring them back to beneficial use. The sites are geographically adjacent or situated in an area with a similar degree of dereliction or under use.

[26] WEI= Annual total water abstraction per year as percentage of available long-term freshwater resources around 1990 and latest year available. The warning threshold of WEI indicating water stress is around 20 %. Severe water stress is occurring where the WEI exceeds 40 %.

[27] http://dataservice.eea.europa.eu/atlas/viewdata/viewpub.asp?id=3381 ; http://ims.eionet.europa.eu/IMS/ISpecs/ISpecification20041007131848/IAssessment1197887395187/view_content

a good chemical status[28]. These figures give an indication of the relevance of soil for the protection of water resources and the priority given to the clean-up of contaminated sites.

In relation to the economical consequences of soil degradation, a detailed and accurate assessment of all the costs associated with soil erosion in Belgium is too difficult to carry out[29]. However, using the estimated range of cost for crop damages, muddy floods and sediment dredging in the watercourses in Flanders, it is possible to provide a rough estimate of the minimum annual costs associated with soil erosion in Flanders. These range from 60 to 90 million EUR. Crop damage consists of burying or washing away seedlings, growth disturbance of young plants, and a decrease of soil fertility on the long run. Muddy floods are damaging infrastructure and properties; the washing away of mud is a burden for the landlord and a costly action for the local authorities. Dredging in the navigable and non-navigable watercourses amounts to several tens of millions EUR a year.

2.5. Hot spots

2.5.1. Heavy metal contamination in the north of Flanders

From the mid-19th century to the mid 1970s, zinc and lead were being refined in the Campine (Kempen) region (north-east region of Flanders) by heating up ores and coal extracted from the area. For the refining of zinc and lead, ores and coal were heated to 1400° C inside tubular muffles. Metal vapours were condensed inside a condenser, collected and transferred into casting moulds. The residues (ashes, slag and muffles) from this pyro-metallurgic process were used in the hardening of roads and industrial terrains. Volatile metals not captured inside the condenser, condensed on dust particles and subsequently were expelled through the smoke stacks. As a result of these emissions, a widespread area became polluted through the deposit of dust contaminated by lead, zinc, arsenic and cadmium. The use of ash material for road stabilisation also resulted in the spread of heavy metals.

[28] In the context of the Water Framework Directive, member states have the obligation to report the different water bodies under pressure. Flanders reported 4 sites as being a potential pressure to the water bodies.
In 2006, the permits for water groundwater extraction in the Flanders region mounted up to 426 millions m³ per year. The yearly groundwater replenishment is considered amounting up to 222.2 mm in average, which corresponds to 2.57 billion m³/year. Out of the 42 Flemish groundwater bodies, 19 are in risk of not obtaining the good quantitative status in 2015.
In 2004, about 400 million m³ of water was extracted from aquifers in Wallonia. This was about 70 % of the volume renewed naturally by precipitation (which is estimated to amount to a total of 550 million m³ on average). At the current stage of analysis, only one of the thirty-three bodies of groundwater in Wallonia, the Calcaire du Tournaisis, runs the risk of not achieving a good state in terms of quantity by 2015, while doubts persist for eight bodies of groundwater, most of which are intensively utilised. As for the quality of groundwater in Wallonia, more than half of the bodies of groundwater –eighteen to be specific – run the risk of not reaching a good state of chemical quality by 2015.
[29] This is for several reasons: (1) not all the different types of consequences and the related costs are known; (2) if they are known, they are often difficult to quantify; (3) even if they are known, it is difficult to do this for the total area affected as the data are not centralised.

The discharge of the waste water from this industrial operation into the surface water has led to the contamination of groundwater. The leaching of solid soil particles and ashes into the groundwater is expected to last for centuries.

Calculations have been made towards the transport and trends of groundwater contamination. However, the seepage towards rivers and brooklets is negligible compared to the contaminant load from upstream.

A sediment catch has already been constructed upstream, to reduce incoming contaminants as much as possible.

Groundwater quality and the paths to receptors are closely monitored. The impact on terrestrial and aquatic ecosystems is currently being studied.

Different actions are undertaken to tackle the problem of soil contamination with cadmium in the Campine region. These include an agreement with the industry, cross-border collaboration with the Netherlands and an action plan for cadmium. These are described in sections 3.3 and 4.1.

2.6. Outlooks

2.6.1. Integrated management of contaminated land and urban redevelopment

In the coming years, investigations and remediation of sites with historical soil contamination are expected to continue to increase following a linear trend. More soil remediation projects will be started, due to the establishment of more *ad hoc* sectoral soil management organisations. Because of the need for the integration of soil remediation activities in a broader social context, more focus is expected on alternative financing and integrated approaches in case of complex contamination problems, brownfields, residential areas and sediments, including more common partnership agreements between the public and private sectors. Because of the changing legislative approaches, investigation obligations will become more flexible. This will initially create a less marked increase of soil investigations activities, until the effects and implementation of the new legislation are clarified.

The development of a wider range of soil management approaches is expected. More operational tools will be developed to manage remedied soils with residual contamination and soils where remediation is not considered to be a solution.

A more simplified legislation on excavated soil will help to avoid new soil contamination. Remediation and investigations carried out by the government will continue, also in partnership with the private sector in order to improve cost-efficiency. The actual trends will depend on available resources.

3. POLICY INSTRUMENTS AND INTERNATIONAL COOPERATION

3.1. Environmental policy

In Belgium, environmental policy is tackled at the regional level, while only a few issues, such as radio- nuclides and product safety, are dealt with at the national level.

In Flanders, environmental legislation consists of two main instruments:

- Regulation concerning prevention and management of waste (VLAREA, Decree of 2 July 1981;
- Regulation concerning environmental permission, including general provisions on environmental policy (VLAREM I, Decree of 5 April 1995).

In Wallonia, most of the legislation concerning the environment has been grouped in the Environment Code (*Décret du 27 mai 2004 relatif au Livre Ier du Code de l'Environnement*, M.B. 09/07/2004, see http://environnement.wallonie.be/aerw/dgrne/index.htm). Book II of the Environment Code concerns the Water Code.

3.2. Soil policy instruments

3.2.1. Soil legislation

In the Belgian legislation, the term "soil" includes both the solid phase and the groundwater.

3.2.1.1. Contaminated sites

To date, only Flanders and the Brussels Region have adopted a full legislative framework concerning contaminated sites. In Wallonia, the management of contaminated sites is regulated through the waste legislation. Specific legislation on contaminated sites was published in 2004, but it still not come into force.

Flanders

In Flanders, the "Soil Remediation Decree" was ratified by the Flemish Government on 22 February 1995 and came into force on 29 October 1995. The practical implementations were regulated in the "Flemish Regulation on Soil Remediation" (VLAREBO), which entered into force in October 1996.

The Decree on Soil Remediation introduced new approaches, which include some new key elements:

- the register of polluted soils and the possibility to request a soil certificate, an extract of this register;
- the differentiation between historical and new soil pollution;
- the differentiation between obligation and liability for remediation.

The evaluation of the Decree on Soil remediation led to a proposal for a new Decree concerning Soil remediation and Soil protection. This Decree was adopted on the 11 October 2006 by the Flemish Parliament and by the Flemish Government on 27 October 2006. It creates a legal framework to further elaborate on soil protection measures.

The Decree has created the possibility to establish sectoral soil management organisations. This was an important first step in the establishing of a fund for example the dry cleaning sector to make remediation affordable in this sector. This decree also imposes an obligation to draw up soil prevention and management plans for certain activities, thus creating a duty to identify and make use of specific "best practices" for soil protection in a sector with high risks for pollution.

Brussels Region

An ordinance on the management of potentially polluted sites entered into force in 2004. This establishes a list of activities entailing a risk of soil pollution and sets up an inventory of polluted or potentially polluted sites. A government decree identified 79 risk activities. More than 6,300 sites have been identified to date. The ordinance provides for the obligation of carrying out a study of the state of the soil (a “reconnaissance study”) in certain situations such as the start of a risk activity, the cessation of a risk activity, the sale of land on which a risk activity took place, etc. The need for remediation is established either by reference to a system of standards or as a result of a risk assessment.

Wallonia

Pending the entry into force of new specific legislation, potentially polluted land in Wallonia is managed in line with the legislation on waste (especially *décret relatif aux déchets du 27/06/1996* (decree on waste) and *décret relatif au permis d'environnement du 11/03/1999* (decree on the environment permit) and the legislation governing service stations (*Arrêté du Gouvernement wallon du 04/03/1999*).

A decree concerning the remediation of polluted land and economic activity sites to be rehabilitated was published in 2004 but it is not yet in effect. This legislation can be applied to land that is likely to have been polluted by a risk activity or in response to a voluntary request, and it is based on risk management and the concept of “fitness for use” for soil and land quality. The soil quality is assessed in two stages: an “orientation study” aimed at confirming the existence of

absence of pollution, followed, when pollution is ascertained, by a “characterisation study” aimed at specifying the vertical and horizontal dimension of the pollution. Soil quality is assessed through a system of standards that depend on landuse (natural, agricultural, residential, recreational/commercial, and industrial) and are calculated on the basis of the risks for human health, the ecosystems and groundwater. In addition, a distinction is made between new pollution and historical pollution, but only on the basis of the outcome of the risk assessment that is done in the case of historical pollution. The list of at-risk activities is currently being drawn up. This decree provides for the creation of a database/contaminated site inventory on the state of the soil that will include the findings of the soil studies and decisions concerning the needs for remediation or for safety and monitoring measures. The databank will centralise the information already available in different inventories. The creation of the new register is foreseen at the end of 2008.

3.2.1.2. Excavated soil

During the execution of road works, construction projects and the construction or reconstruction of utility cables and similar operations, often a volume of soil is being excavated or stripped away from the surface. Sometimes this excavated soil is used again as filler on the excavation site. In most cases, however, the excavated soil will be reused at some other location, for instance, for raising the profile of a terrain, filling wells, incorporation into the body of a dyke, in the construction of a roadway, or in a sub-foundation. If such soil works take place in a contaminated site, there is a great risk that the contaminants in the soil will be dispersed. In order to prevent the diffusion of contaminants and to offer sufficient legal security to the different actors involved in the use of excavated soil, the Flemish government issued directives related to the use of excavated soil. The regulation on the use of excavated soil is established in chapter 10 of the VLAREBO (Flemish regulations on soil remediation) and came into force on 1 January 2004. In relation to the threat of soil contamination, this regulation is constantly re-evaluated[30] because of specific problems. A regulation for the transport and traceability of the soil was proposed and approved but it is still being evaluated. A revised regulation is expected in 2008, together with the implementation of the new Decree on Soil remediation and Soil protection.

The use of excavated soil in Wallonia is regulated by the decree of 14/06/2001, which specifies the quality criteria that the various types of waste must meet for recycling and re-utilisation.

3.2.1.3. Brownfields (Soil remediation in residential areas)

Flanders

The problem of remediation in residential areas is complex, as in general several private stakeholders –often including "non-liable owners"– are involved. In order to speed up the complex and costly procedure of examination and remediation of soil contamination in residential areas,

[30] This legislation is continuously re-evaluated in the light of new knowledge concerning limit values such as leaching criteria. Furthermore, standard procedures and protocols for good practice are re-adjusted to the newly assessed bottlenecks (i.e. problems).

the Soil Remediation Decree was amended in 2001 by adding of the so-called "Site Decree". In the context of this definition of "site", a "residential area" can be described as a group of land parcels where the current residential use is affected by previous soil polluting activities. This approach aims at providing benefits to all involved parties, because of the larger scale of the operation. This is in terms of costing, exploratory and remediation strategy, analysis and reporting, and the implementation period within which an end result can be achieved. This approach can be applied, for example, in the case of a residential district developed on the site of an old landfill, a cluster of potentially polluted and populated locations in a city centre, a residential district located in a potentially contaminated area with an industrial history, and so on. On the basis of this legislation, the Public Agency for Waste of Flanders, OVAM, in cooperation with the local authorities, is enabled to tackle pollution problems in residential areas as one single process. By means of specific selection criteria, OVAM has started a number of test projects in close cooperation with the involved cities and municipalities. At the moment, a total of 11 residential areas have been considered eligible for this approach. This activity is slowly developing, due to the time needed for negotiating with the stakeholders.

Similar programmes have not been established yet in Wallonia. No information is available to the EEA on brownfield management in the Brussels Region.

3.2.1.4. Soil sealing

In Belgium, sealing is not yet recognised as a soil problem. The issue is dealt with in the context of land management and the protection of open spaces. Sealing as such is also tackled in the context of water management (prevention of rainwater runoff and flooding).

In Wallonia, the flood prevention and control plan PLUIES (*Plan de Prévention et de LUtte contre les Inondations et leurs Effets sur les Sinistrés*) proposes, amongst many other measures, to reduce soil impermeabilisation by encouraging the use of discontinuous and/or permeable pavements[31].

3.2.1.5. Soil erosion

Information on soil erosion measures in Belgium is provided in section 3.2.3 marked-based instruments for soil protection.

3.2.2. Soil policy targets

Flanders

An Environmental Policy Plan (MINA-plan) is prepared every 5 years, in execution of the Decree on Overall Provisions concerning Environmental Policy (1995). The MINA-plan defines indicators and goals for different environmental policy themes, including ‘soil contamination and damage to

31 http://environnement.wallonie.be/de/dcenn/plan_pluies

the soil'. More information on soil targets in Flanders is included in Box 1. The targets for soil contamination are currently being met.

Specific soil policy targets are also addressed in the Policy Note from the Flemish Minister competent for Environmental issues at the start of his period of legislative power. This is followed by a yearly Environmental Policy letter.

Wallonia

Soil targets are established in the regional Environment Plan for Sustainable Development (Plan d'Environnement pour le développement durable or PEDD), established in 1995[32]. The main focus is to preserve and maintain all soil functions in a sustainable way. Soil is considered as a substrate for balanced ecosystems, for agricultural and silvicultural operations, for landscape features, for the infrastructures necessary for residential, industrial, and transport activities, and as a medium for the replenishment of the water table. The main aims are:

i. preserving and improving soil quality, notably by increasing preventive measures in certain sectors (agriculture and forestry, waste, industrial activities, infrastructure, and transport) and implementing remediation measures (monitoring soil depletion processes, raising the soil organic content, etc.);
ii. rehabilitating contaminated soils and derelict land (the aims and methods of remediation must take into account of all the elements at play); and
iii. improving knowledge and monitoring of soil quality.

The PEDD does not, however, set deadlines for meeting these objectives.

The Walloon government has taken measures through the decree on the economic recovery and administrative simplification programme of 3 February 2005 and programme decree of 23 February 2006 concerning priority actions for the future of the region (the so-called "Plan Marshall") to speed up the rehabilitation of potentially polluted sites. Considerable additional sums have been made available via a loan taken out by a semi-regional body created for this purpose, the public corporation S.A. Sowafinal. The government is committed to fully remediate 50 polluted sites presenting health and environmental risks. This work is entrusted to SPAQuE, which has been asked to rank the polluted sites by priority of intervention and to carry out their remediation. According to SPAQuE, the rehabilitation of the 50 priority sites will amount to some 800 million EUR.

[32] http://environnement.wallonie.be/pedd/C0e_tm.htm

Box 1. Soil targets included in the current MINA plan in Flanders

The third MINA-plan, covering the period 2003-2007, is currently in force. Due to some adaptations of the Decree on Overall Provisions concerning Environmental Policy, the period covered in future MINA-plans will correspond with the period of legislative power of the minister. The current MINA-plan will therefore be prolonged until the end of 2010. Currently, policy goals are reconsidered due to this prolongation.

The targets for 'soil contamination' include:

- Long term targets:
  - The investigation of soils with urgent historical pollution has to be finished before or at least started by 2016;
  - The remediation of soils with urgent historical pollution is started before 2021;
  - All the soils with historical pollution, with serious danger to man and the environment, will be remediated before 2036.
- Plan targets:
  - At the end of 2007, 30% of the sites with potentially soil polluting or activities are investigated;
  - At the end of 2007 the remediation of 23% of the sites with historical soil contamination is started.

The targets for erosion include:

- Long term targets:
  - The maintenance of the multi-functionality of the soils which are still multifunctional at this moment
  - Before the end of 2015, at least 75 % of the actual erosion bottlenecks(*) are solved. At least for 20 % of the potential erosion bottlenecks the situation on the field is consolidated
- Plan targets:
  - At the end of 2007 for at least 90 % of the municipalities with erosion bottlenecks an erosion control management plan has been made.

(*) Erosion bottlenecks are locations with severe local erosion problem, i.e. small to very small catchment areas with high erosion risk (water and mud floods).

3.2.3. Market based instruments for soil protection

3.2.3.1. Erosion control

In Flanders, subsidies are provided to municipalities affected by soil erosion to establish erosion control management plans[33]. The implementation of measures indicated in the management plan is subsidised up to 75 %. Eligible measures include mostly small-scale technical control measures (e.g. the construction of small dams and pools or grass buffer strips). Since 2005, other specific

soil erosion control measures (e.g. grassed waterways, grass buffer strips, sediment retention dams and pools, conservation tillage and no till) are subsidised as agro-environmental measures through the Flemish Plan for Rural Development.

In Wallonia, several agro-environmental measures are currently applied to control soil erosion. Protection against water erosion is taken into account in the CAP-related subsidies (regional decree, *Arrêté du Gouvernement Wallon du 22 juin 2006*). Specific standards apply to agricultural plots where there is a high risk of erosion (that is when more than 50% of the plot has a slope greater than or equal to 10 %). At the catchment scale, Actions to limit soil erosion and run-off are at the catchment scale are also foreseen in the flood control plan: PLUIES (*Plan de Prévention et de Lutte contre les Inondations et leurs Effets sur les Sinistrés*; see above for more details). In addition, a preliminary draft decree (*arrêté*) establishing subsidies for anti-erosion schemes in farmland and for the control of floods and mudslides due to run-off was adopted in early 2007. Amongst other things, the decree provides for regional funds to help local authorities (municipalities, provinces, etc.) carry out engineering and construction works aimed at limiting soil erosion and retaining run-off in order to maintain the land's agricultural value and to limit damage to downstream or downslope properties. Regional funds amount to 60 % of the total costs and may be increased by at most another 20% under certain conditions.

A list of marked-based instruments relevant to soil in Belgium is reported in Table 6. More details on specific instruments are provided in Appendix 2.

[33] The subsidies are regulated by a regional decree concerning 'subsidy of small-scale erosion control measures to be taken by local authorities', issued in December 2001.

Table 6. MBI overview

Marked-based Instrument (MBI)				Soil threats covered by the MBI									Type of instrument [2]	References [3]	Sources [4]	Detailed information available [5]
Country/Region	Country code	ID	Name of instrument	Short description	1. General	2. Erosion and Hydro-geological risk	3. Decline in organic matter	4. Contamination	5. Sealing [1]	6. Compaction	7. Decline in soil biodiversity [1]	8. Salinisation [1]				
Belgium	BE	1	Agri-environmental measures	Implementation of voluntary conservation and environmental quality improvement actions		X	X			X			4	EEA_EIONET		**N**
Belgium	BE	2	Conditionality	Subordinate the direct aid paid to farmers to compliance with environmental requirements		X	X	X (diffuse)					5	EEA_EIONET		N
Belgium	BE	3	Organic farming	Specific aids (premiums or rebates) to support the expansion of organic farming		X	X	X		X	X		2	EEA_EIONET		N
Belgium	BE	4	BOFAS (Fund for the remediation of service stations)	BOFAS npo is a fund for the remediation of contaminated (former) service stations, which is financed by the revenues of a fuel tax.				x					1		6	Y
Belgium (Flanders)	BE	5	Soil protection fund	Fund for the clean-up of contaminated sites' or 'fund for ex-officio remediation'. The management of orphan sites is included (they				x					5	EEA-EIONET	1	Y

Table 6. MBI overview																
Marked-based Instrument (MBI)				Soil threats covered by the MBI									Type of instrument [2]	References [3]	Sources [4]	Detailed information available [5]
Country/Region	Country code	ID	Name of instrument	Short description	1. General	2. Erosion and Hydro-geological risk	3. Decline in organic matter	4. Contamination	5. Sealing [1]	6. Compaction	7. Decline in soil biodiversity [1]	8. Salinisation [1]				
				represent only a very small part of the sites managed with this fund.												
Belgium (Flanders)	BE	6	Subsidy for soil remediation organisations	Soil remediation organisations can provide support for research & development ,for soil remediation and for corporate management vis-à-vis soil related issues for vulnerable sectors, appointed by the Flemish government				x					2			Y
Belgium (Flanders)	BE	7	Subsidies for erosion control	Subsidies to municipalities (“Erosion Decree”)		X							2	EEA-EIONET Verstraeten et al (2003) p. 95-103.; Olmeda-Hodge et al. (2004)	1	Y
Belgium (Flanders)	BE	8	Erosion management agreements	Subsidies to farmers (“Flemish Plan for Rural Development”)		X							2	EEA-EIONET; Verstraeten et al (2003) p. 95-103.; Olmeda-Hodge et al. (2004)	1	Y

Table 6. MBI overview

Marked-based Instrument (MBI)				Soil threats covered by the MBI									Type of instrument [2]	References [3]	Sources [4]	Detailed information available [5]
Country/Region	Country code	ID	Name of instrument	Short description	1. General	2. Erosion and Hydro-geological risk	3. Decline in organic matter	4. Contamination	5. Sealing [1]	6. Compaction	7. Decline in soil biodiversity [1]	8. Salinisation [1]				
Belgium (Wallonia)	BE	9	Taxes on waste deposits and abandoned sites	A landfill owner must pay a tax of €25/m³/yr up to a maximum of €248 000/yr. As for abandoned sites, the tax is set at €560.27/are of built-up land and €71.31/are of non built-up land.				X					1	Rapport analytique sur l'état de l'environnement wallon 2006-2007	4	N
Belgium (Wallonia)	BE	10	Subsidies for establishing schemes to protect farmland from soil erosion and to control flooding and mudslides	Subsidies for local authorities (municipalities & provinces)		X							2	Rapport analytique sur l'état de l'environnement wallon 2006-2007	5	N
Belgium (Wallonia)	BE	11	Soft" timber forwarding and forest thinning methods	Subsidy for private owners of woodlands who use horses for forwarding timber and thinning their stands						X			2	Arrêté du Gouvernement wallon du 4 novembre 2001	7	N

NOTES

[1] No information available

[2] Type of instrument:

1 Taxes and charges
2 Subsidies
3 Tradable permits
4 Voluntary agreements
5 Other

[3] Relevant literature referring to the specific instrument

[4] Sources of the information contained in this table:

1 DGENV, 2005
2 EEA-OECD, 2006
3 EC, 2006
4 http://environnement.wallonie.be/eew/rapportproblematique.aspx?id=SOLS_05
5 http://environnement.wallonie.be/eew/rapportproblematique.aspx?id=SOLS_03
6 http://www.bofas.be/
7 http://environnement.wallonie.be/eew/rapportproblematique.aspx?id=SOLS_06

[5] Y/N. If yes a detailed table is available for the specific instrument

3.3. International co-operation

Belgium participates in international initiatives and projects covering in particular the management of contaminated land. The public agencies dealing with contaminated sites in Flanders and Wallonia, OVAM and SPAQuE, are contributing to the Common Forum on Contaminated Land in the European Union[34]. Partnerships have also been established for collaborating on specific tasks or for exchanging knowledge across the border and overseas (see Box 2 and Box 3).

Box 2. BeNeKempen: a cross-border partnership to remediate contaminated land

The Flemish-Dutch partnership in BeNeKempen

The remediation of the Campine region (Kempen) has received a lot of attention in the past decades. The region stretches across the Dutch-Belgian border.

In Belgium, four sites, owned by Umicore NV, are contaminated by heavy metals (Hoboken, Olen, Balen/Lommel, Overpelt). The company and its predecessors have already been involved in the production of non-ferrous metals for more than a century. Throughout the years, the production led to soil and groundwater pollution at the sites and in neighbouring land (see section 2.4 for more details).

In the Netherlands, since 1998, the project agency 'Actief Bodembeheer de Kempen' (ABdK or Campine Active Soil Management) has been involved in the development of a socially responsible management program of soils polluted with heavy metals in the Dutch part of the region. In Belgium, a covenant was signed in 1997 between the Flemish government, Umicore NV and OVAM to implement remedial measures in operating and former Umicore sites in the next 15 years. In 2004, the covenant was extended to remedial measures across a broader area. In parallel, a partnership agreement was reached in 2002 with the Netherlands in order to find common solutions to the problem. The agreement led at the end of 2004 to the start of a joint project for the remediation and the management of the region, the BeNeKempen project, financed by the INTERREG programme.

The first stage of BeNeKempen involves the consolidation of existing data, as a great deal of information was gathered by several authorities in both countries in the past 25 years. The existing knowledge will be used to develop feasible and widely-supported solutions. The various project activities have been distributed among several study groups, composed by representatives from the administrations (regional, provincial and municipal), relevant knowledge centres and other stakeholders. A strategy for the remediation and the management of the region is expected in early 2008.

The cross-border discussion platform is expected to continue after the conclusion of the project in order to support future choices on the development of the region.

[34] The Common Forum on Contaminated Land (CF) is an informal group from national government and environmental agencies in the EU Member States involved with contaminated land and groundwater issues. This initiative started in 1994. Its general objectives are to share knowledge and develop strategies for the management and treatment of contaminated sites and for land recycling with respect to ‘sustainable resource protection” for contaminated land and groundwater.

Box 3. The Wallonia-Quebec Collaboration Project

In 2004, the Walloon and the Brussels-Capital Regions, and the Province of Quebec launched a two-year collaboration project to support the exchange of knowledge and information on sustainable remediation amongst the main stakeholders, namely, public administrators, policy makers, risk assessment experts and consultants, universities, industry, contaminated soil treatment centres, and remediation companies. The aim was to share experiences on policies, management strategies, techniques and practices implemented in the three regions. The exchanges were supported by an Internet site and through meetings held in Belgium and Quebec (http://www.assainissementsoutenablespaque.be/projet.html).

The project revealed that remediation strategies were sustainable if all the parties involved subscribed to their objectives and helped to achieve them in a spirit of co-operation and partnership. To be successful, the interests of the various parties involved must converge towards a common end. An overall vision of the environmental and socio-economic aspects involved, coupled with legal and financial instruments, transparent legislation, good communication, and a stakeholders' sense of responsibility were identified as the main factors for the successful implementation of sustainable remediation strategies.

4. SOIL MANAGEMENT, MONITORING AND ACCESS TO ENVIRONMENTAL INFORMATION

4.1. Soil management

4.1.1. Contaminated sites

In Belgium, specific programmes for the management of contaminated land exist in all the regions. Details on programmes and procedures in the three regions are described below. Case studies are presented in Appendix 5.

4.1.1.1. Flanders

In Flanders, exploratory soil investigations should be carried out:

- on the initiative and at the charge of the transferor, when there is a transfer of land where a facility or an activity included in the 'list of potentially contaminating activities/facilities' is currently located or was located in the past (these activities are called 'risk-activities';
- on the initiative and at the charge of the operator, before the closure of a facility or the cessation of an activity included in the list mentioned above;
- periodically, on the initiative of the operator for some categories of activities or facilities that are included in the list mentioned above.

Most of the exploratory soil investigations occur due to land property transfers.

In the event that the exploratory soil examination indicates that more investigations are needed (a descriptive soil examination), the legal authority (OVAM) will inform the transferor.

If the descriptive soil examination shows the need for remediation, the transfer may only take place on condition that the transferor:

- has drawn up a soil remediation project that is complete and admissible;
- has committed himself vis-à-vis the OVAM to carry out soil remediation works;
- has secured financial resources.

All of the above-mentioned obligations may likewise be assumed by the buyer of the land or by another party with legal title to proceed to the execution of transfer.

In case the parties involved are unable or refuse to remediate, OVAM has the right to intervene in order to prevent impacts on human health and the environment.

The main objective of OVAM activities is to restore, remediate and manage environmental damage.

This involves remediation of sites listed in an official ‘soil remediation list’, updated yearly by the Flemish government. In addition, OVAM takes safety measures in case soil pollution will cause immediate danger for man or environment and the owner fails to solve the problem.

The Flemish law makes a distinction about historical and new contamination. "Historical" soil pollution is pollution originated before the Decree came into force (29 October 1995). “New" soil pollution originates after the Decree came into force.

The clean-up of new pollution is, according to the Decree, required as soon as the soil clean-up values are exceeded. With respect to historical pollution, the decision to clean-up will depend on the actual danger to humans and the environment (qualitative general criteria) and a risk-assessment approach is followed in the descriptive soil investigation.

Brownfield management. In Flanders, a strategic-oriented project on "Brownfield Development" is being carried out by the Flemish ministry of environment with the support of the ministry of economics and urban planning. Several governmental institutions cooperate in the project, which has the aim to investigate how policy can contribute to the development of brownfields in Flanders and which structural measures need be taken to stimulate their development.

Action plan Cadmium. In February 2006, the Flemish ministry of environment set out an action plan on cadmium. The plan has the aim to provide an overview of the issues concerning cadmium in Flanders, the location of hot-spots of cadmium contamination, and the measures taken to resolve these issues.

4.1.1.2. Wallonia

The principles of the decree concerning the remediation of polluted soils that has been published in the Belgian official gazette but has not yet come into force were presented above. This decree institutes the obligations to check the state of the soil and remediate:

- abandoned sites that the government has designated for rehabilitation;
- sites hosting activities likely to pollute the soil on the government-established list of at-risk activities upon any cessation of said activity and possibly within a set deadline or at fixed intervals; and
- any other site upon a voluntary request or following a decision by the authorities in the event of serious indications of a risk of soil pollution.

A soil data bank must be created to record and centralise study findings and decisions taken in relation to remediation, safety measures, and follow-up. This data bank will be consulted each time a plot of land is sold.

Pending this legislation’s enforcement, potentially polluted sites are managed on the basis of the legislation governing waste management (waste deposits) and service stations. Under this legislation, administrative data banks are kept. They keep track of some 1 100 waste deposits and

1 500 service stations. There is also a data bank on abandoned sites that previously hosted economic activities in which a total of 3 500 sites are registered. However, the proportion of contaminated sites is not known. The data in these databases are as a rule insufficient for site environmental management. They are not directly accessible to the public.

In Wallonia, three state players are involved in rehabilitating potentially polluted sites:

- the administration that is responsible for regional planning and development, DGATLP, is in charge of unpolluted or slightly polluted brownfield sites (http://mrw.wallonie.be/dgatlp/);
- the administration that is responsible for waste management, OWD, is in charge of the sites that come under the legislation regarding waste and service stations (http://environnement.wallonie.be/owd/); and
- a specialised state-funded company, SPAQuE S.A., is in charge of “orphan” polluted sites” and those that require urgent action because of health or environmental risks (www.spaque.be).

The soils are studied by approved engineering firms and remediated by specialised undertakings.

4.1.1.3. Brussels Region

The principles of the legislation that applies in the Brussels-Capital Region have been described above. An inventory of potentially polluted sites was conducted in 2002. The data may be consulted on request to the relevant administration (www.ibgebim.be).

4.2. Soil monitoring

In Flanders, the soil remediation decree established an obligation to undertake soil investigations on a periodical basis or upon closure where "activities posing risk" took place or still take place at the moment of the property transfer. A list of activities implying a high risk of soil contamination was established. A preliminary regional inventory of land properties and related database, including present and past risk activities, was established, based on data from permits provided by the provinces and the communities. The inventory is not complete and currently contains 27 000 parcels.

The preliminary site investigation consists of a study on the present and past potentially soil contaminating activities taking place on the site and the results of some soil samples.

At the moment, preliminary site investigations have been carried out on about 25 000 sites.

If these investigations indicate the presence of soil pollutants, the parcel where the activity took or takes place is included in the register of contaminated sites.

This register can be seen as an inventory of contaminated sites.

At the end of 2006 the OVAM registered circa 47 000 parcels in its register of contaminated land. For a terrain included in the register there are 2 possibilities: if the preliminary investigation indicates the presence of pollutants, the need for further soil investigation depends on comparison with soil cleanup values. If no measurements are necessary, the investigation stops. If further measurements are necessary, a descriptive soil investigation has to be carried out in order to characterise the pollution in detail and to define the risk for humans and the ecosystem. The aim of this examination is to give a description of the nature, quantity, concentration and origin of the contaminating substances, the possibility that these might spread, and the danger that human beings, plants and animals, as well as surface and groundwater, might be exposed to it.

4.2.1. Wallonia

Currently, soil monitoring in Wallonia is not complete. Monitoring concerns mainly local contamination and the quality of forest soils, whereas agricultural land is only partially covered. In 2003, a multi-institutional partnership (called "ARVA") bringing together representatives of the universities in the region, soil laboratories, research centres, and the farmers, prepared a technical proposal for the establishment of a data collection scheme for agricultural soils. The scheme includes the spatial distribution of soil types, properties, and changes in soil quality over time.

An inventory of the existing monitoring programmes shows that soil data in Wallonia are diverse and complementary. The parameters analysed and the operating methods are numerous and varied (see Appendix 5). Moreover, most of the soil observation programmes concern only a single data acquisition date. Therefore, these programmes cannot all be considered operational monitoring systems. Figure 1 lists the various existing soil quality monitoring programmes conducted in Wallonia[35]. Information on soil services is reported in Appendix 5.

[35] A programme to determine agricultural soil's degree of phosphorus saturation (SATUPHOS) is currently under way in the Walloon Region .

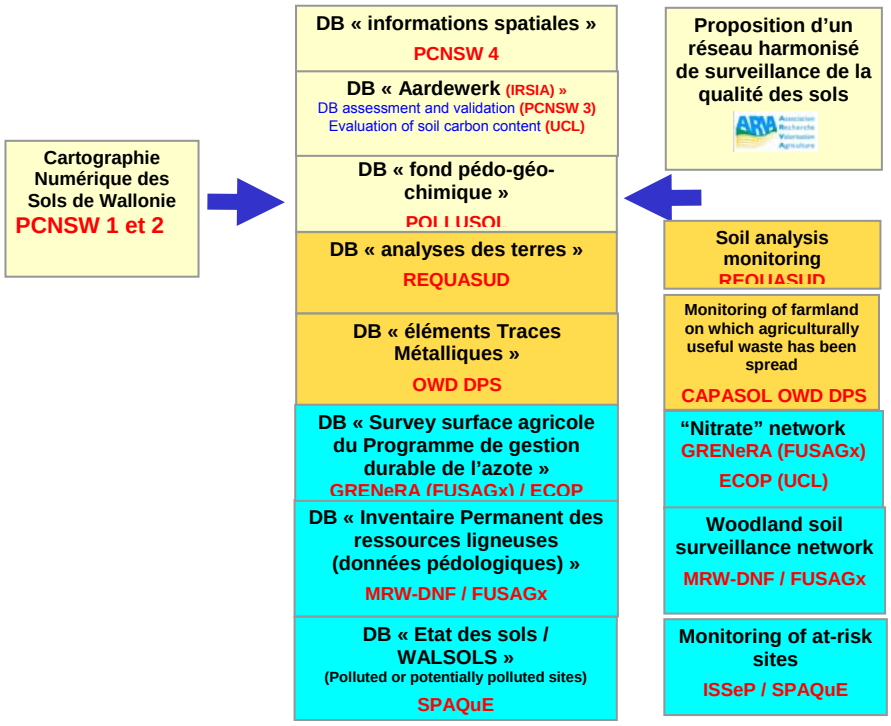


Figure 1. Soil monitoring programmes in Wallonia

4.3. Information, education and data access

In Belgium information on the environment are available through a specific portal at: http://statbel.fgov.be/port/env_fr.asp#A01

4.3.1. Flanders

The Flemish state of environment report is available online at: http://www.milieurapport.be/

Reports prepared by OVAM are available on: http://www.ovam.be/jahia/Jahia/cache/offonce/pid/176?actionReq=actionPubDetail&fileItem=1394

In Flanders, the contaminated land register stores information on land parcels. A site may consist of one or more parcels. The database, managed by OVAM, contains information on 27 000 parcels where potentially polluting activities have taken place. The register has information of about 47 000 parcels which are considered contaminated[36,37]. The register can be consulted by

[36] As of the end of 2006, the OVAM database contained data on the following elements:
a) potentially contaminated land: 27 000 parcels;

the public through an explicit request (soil certificate). The certificate is normally issued in connection to land transfers. If data are available, the certificate includes a summary of the information concerning the contamination of the specific site. Information on the location and status of the investigated sites (exploratory investigation, descriptive investigation or remediation ongoing) is also available on a map accessible through the OVAM website. The map is updated every month.

4.3.2. Wallonia

The main data concerning the state of soil in Wallonia (for the various soil threats identified in the draft EU framework directive on soil protection) are available on line on the web site of the State of the Walloon Environment (see in particular the analytical report on the state of the Walloon Environment 2006-2007, available at http://environnement.wallonie.be/eew/)

A selection of data on the potentially contaminated sites in the region are also accessible through the SPAQuE website (WALSOLS database: http://www.walsols.be/).

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b) register of contaminated land: ca. 47 000 parcels;
c) preliminary investigations: ca. 25 000 sites;
d) descriptive investigations: ca. 6 600 sites;
e) remediation projects on ca. 2 700 sites;
f) remediation works in progress on ca. 1 800 sites;
g) remediation completed in ca. 600 sites.

[37] The correspondence between parcels and number of sites provided in the country response to the 2006 contaminated sites questionnaire is explained below.
In Flanders, a study estimated that risk-activities (potentially contaminating activities/facilities') are currently located or were located in the past on 76 200 sites. A site or a terrain is composed by one or more cadastral parcels. OVAM has inventory data for 27 000 parcels where these risk-activities are supposed to have taken place. These data have to be verified and completed by the local communities. All these sites have to be investigated at least once.
OVAM has preliminary investigation data for 25 213 sites. On 6 481 sites no significant contamination was found. A total of 18 732 sites where put in the register of contaminated land (this corresponds with ca. 47 000 parcels). On 8 837 of these sites, no further actions are necessary. On 9 895 sites a descriptive soil investigation is necessary. OVAM received 6 675 of these investigations. On 3 278 sites a remediation project is necessary. OVAM received 2 694 of these projects. Remediation works already started on 1 843 sites. Remediation has been completed on 618 sites.

5. STATE OF THE ENVIRONMENT

Belgium has a high population density and can be considered as one of the main crossroads of Western Europe. This leads to considerable pressure on the environment and the land in particular. Belgium is performing moderately across most EEA environmental indicators. However, the country presents good results for municipal waste generation and is having some success with tackling freight transport. An area for particular attention is ozone pollution (extract from EEA, 2005a). Details on the Belgian environmental performance are provided in Table 7 (selected EEA core-set indicators, published in EEA, 2005 and revised by national experts for this report).

According to the OECD:

> "In a country as densely populated and as developed as Belgium, the environment is exposed to intense pressures from human activities: about one fourth[38] of the territory consists of built-up areas and very dense networks of roads, railways and navigation canals; industry and very intensive animal breeding and crop cultivation impose further pressures on air, soil, water resources and nature.
>
> Under such conditions the challenge of making development economically, socially and environmentally sustainable is particularly acute.
>
> In the two decades leading up to 1993, Belgium went through a series of institutional reforms which transformed the country into a federal state made up of three regions and three communities. […] Since environmental responsibilities were clearly defined much work has been carried out to create coherent environmental management frameworks and accelerate efforts to reduce the pollution burden. In order to catch up on the backlog, the challenge is to:
>
> i) achieve and maintain a high level of effort to implement new environmental policies and strengthen environmental infrastructure;
> ii) further integrate environmental concerns in economic decisions; and
> iii) meet international environmental commitments." (extract from OECD, 1998)

[38] Source: OECD. Other sources (ESTAT land use statistics and CLC2000) provide a share of built-up areas of about 20%. This may depend on the definition of built-up areas used.

Table 7. Environmental indicators[39]	
Environmental issue	**Description**
Greenhouse gas emissions	Total emissions in 2002 were at the same level as in 1990, but Belgium seems to be on track to reach the Kyoto target (7.5 % below the 1990 level). The regions showed different results for 1990–2002 GHG emissions: 3.1 % increase in Flanders; 7.3 % reduction in Wallonia; and 9.6 % increase in the Brussels-Capital region. In Flanders GHG emission trends in the period 1990–2002 showed a 26 % increase from transport but reductions from industry (-11 %) and agriculture (-10 %). The Brussels-Capital region showed increases from the domestic sector (15 %), the tertiary sector (8.7 %) and the transport sector (3.6 %, with a dramatic increase of 376 % in chlorofluorocarbon –CFC– emissions) and a strong decline from the industry sector. In Wallonia, the greatest drops in GHG emissions between 1990 and 2002 were posted by manufacturing (-11 %), energy transformation (-32 %), and waste (-54 %). The transport sector remains the main concern, given that its GHG emissions rose 24.5 % over the same period. Measures to reduce emissions include voluntary agreements with energy-intensive industries, performance standards for residents, and support for combined heat and power generation. Internal and external measures (investing in the World Bank Community Development Carbon Fund) are being introduced in the Walloon and Brussels-Capital regions.
Energy consumption	Flanders reports improvements in energy intensity due to efforts in the industry and energy sectors since 1998. Wallonia reports an increase in final energy consumption by 7.6 % (1990–2002). Final energy consumption in the Brussels-Capital region increased by 18 % between 1990 and 2003, to 2.16 million tonne oil equivalent in 2003. Flanders aims to reduce household energy use by 7.5 % in 2010 compared with 1999, despite an increase of 37 % from 1990 to 2002, through several measures to promote the rational use of energy. The Walloon 'Plan pour la maîtrise durable de l'énergie' shows that total energy demand could be reduced by 9 % in 2010, compared with 1990, with detailed targets for various sectors. The key sectors in the Brussels-Capital region are housing, tertiary and transport, and the most important energy carriers are natural gas, oil and electricity.
Renewable electricity	There was an almost threefold increase in 2002 but the total share only reached 2 %. The share of renewable energy in electricity production in Flanders is growing (0.75 % in 2003). The use of the organic fraction of household waste will contribute to reaching targets. In Wallonia, the share reached 2.3 % in 2003: hydroelectricity fell in 2003 due to unfavourable climatic conditions, and wind energy is growing rapidly but was less than 2 % of the total in 2002 (windpower accounted for 7 % of the energy electricity generated in Wallonia in 2004). The Brussels-Capital region applies 'green certificates' covering renewable energy production in the two other regions to boost demand.
Emissions of acidifying	Belgium seems to be on track to meet the National Emissions Ceilings Directive targets. Emissions in Flanders fell by 41 % (1990–2003), but

[39] NB: These indicators were published in part C on the report "The European Environment. State and outlook 2005" (EEA, 2005). An update is foreseen for the next edition of the report, to be published in 2010.

Table 7. Environmental indicators[39]	
Environmental issue	**Description**
substances	deposition of acidifying substances is higher than the critical loads in 53 % of the nature area. In Wallonia, emissions of acidifying substances fell 30 % between 1990 and 2003 and the acreages affected by critical load exceedances accounted for about 15 % of the region's land under forests and semi-natural vegetation. New measures for the different industrial sub-sectors and lower emissions from agriculture should enable the targets to be met. Emissions have also fallen in the Brussels-Capital regions.
Emissions of ozone precursors	If no extra measures are taken, Belgium will not reach the target. In Flanders volatile organic compound (VOC) emissions decreased by 43 % during the period 1990–2003, NO_x emissions by 12 %. In Wallonia, VOC emissions fell by 36 % and NO_x emissions by 22 % over the same period. Progress has already been made through the use of catalytic converters and the reduction of solvents in paints. Emissions of VOCs and NO_x fell by 25 % in the Brussels-Capital region (1990–2003).
Freight transport demand	Freight transport demand is still growing. In Flanders it has increased by 30 % (1995–2000), but has stabilised since 2000. The use of waterways is increasing (46 % in 1990–2003). Total transport demand in Wallonia keeps increasing; freight transport by 17 % (1995–2000). Road transport represents up to 85 % of freight transport. Total road traffic in the Brussels-Capital region increased by 15 % (1990–2003) (small reduction in 2003).
Share of organic farming	The area under organic farming stabilised at around 1.7 % of the total agricultural area in 2004. Organic farming in Flanders covered only 0.5 % of the total agricultural area (2004) but new subsidies have recently been endorsed. In Wallonia, 2.7 % utilised agricultural area is under organic farming (2004) and the number of farms converting to organic farming is still increasing. The Brussels-Capital region, although very urbanised, is developing a 'green network' of public spaces, including some nature reserves and parks. Some areas of this 'green network' are managed in a differentiated way, e.g. extensive gardening and protection of threatened species.
Municipal waste	There has been a good progress in slowing the growth of municipal waste. Household waste generation in Flanders is decreasing: stabilisation in 2001, 0.2 % reduction in 2002 and 3.4 % in 2003. Waste generation *per capita* has fallen since 2001. A total of 70 % of household waste is collected separately, most of this is reused, composted or recycled. Wallonia has seen a slow but irregular decline in municipal waste since 1997. The amount of household waste generated fell by 18 % between 1997 and 2003. A large proportion is recovered: in 2003 more than half went to material reclamation plants and less than 20 % to landfill. The amount of municipal waste collected in the Brussels-Capital region was stable between 1999 and 2002. Raw municipal waste fell by 9.4 % (1996–2002). Selective collection of waste for recycling of packaging increased by 42.9 % and of other types of paper and paperboards by 50.1 %.
Use of freshwater resources	Total use of water (excluding cooling-water) in Flanders decreased by 14 % (1991–2002). Industry use decreased by almost 40 % in the period 1996–2000. Water availability in Flanders is low and two-thirds are imported. Among the lowest in Europe, Wallonia uses 105 litres per person per day for domestic needs. This is due mainly to the use of more efficient equipment and increasing use of rainwater. In 2004, the Brussels region

Table 7. Environmental indicators[39]	
Environmental issue	**Description**
	used 113 litres per person per day for domestic needs. A total of 61 % of water in the Brussels-Capital region is used by households, 25 % by the tertiary sector and 11 % by fire control and other public services, including network losses.

6. ECONOMY AND SOCIETY[40]

6.1. A snapshot of the country socio-economic development

A selection of relevant socio-economic indicators is reported in Appendix 4.

6.1.1. Social background

Belgium enjoys a high standard of living and a high income *per capita*. In the yearly UN *Human Development Report,* Belgium is consistently ranked among the countries with the highest Human Development Index that measures quality of life. There are large differences of wealth and poverty in Belgium. However, the country social welfare programs prevent extreme poverty.

The Belgian social welfare system covers family allowance, unemployment insurance, retirement, medical benefits, and a program that provides salary in case of illness. Employers and workers contribute to the system. Many companies also offer supplemental retirement and medical programs. Almost all citizens are covered by medical insurance.

Each region has special councils that provide public assistance and aid to the poor. The Housing Societies provide low-income housing for the poor and immigrants. Policies to eliminate slums and revitalize urban neighbourhoods are also in place.

Belgium's educational system (regional competence) is among the best in Europe. Freedom of education is a constitutional right. Both public and private schools exist, but the regional governments subsidise private schools since the legal system abolished fees in 1958. Children must attend school between the ages of 6 and 18. The country has 7 universities (4 that teach in French and 3 that teach in Flemish). There are also a number of specialised and technical schools.

6.1.2. Historical economic background

For most of its history, Belgium's economy was based on the country manufacturing capabilities. Belgium was the first country in continental Europe to undergo the Industrial Revolution, and through the 19th century it was a major steel producer. Large coal deposits helped fuel the industrialisation. At the same time, agriculture began to decline. This decline was even more pronounced after World War II, and by 2000, agriculture only accounted for a small percentage of the economy. Currently, agriculture is concentrated in West Flanders,

[40] Part of the information on economy in this section was taken from :
http://www.diplomatie.be/en/belgium/belgiumdetail.asp?TEXTID=49019
http://www.nationsencyclopedia.com/economies/Europe/Belgium-OVERVIEW-OF-ECONOMY.html

Liege, and Eastern Namur. In the post-World War II era, heavy manufacturing and mining declined. However, there was significant growth in the service sector, and the country switched from heavy production to light manufacturing and began producing finished products instead of steel, textiles, and raw materials. Belgium imports basic or intermediary goods, adds value to them through advanced manufacturing and then exports the finished products. With the exception of the remaining coal resources, Belgium has no significant natural resources.

Belgium's economic strength is based on its geographic position at the crossroads of Western Europe, its highly skilled and educated workforce, and its participation in the EU. During its industrial period, Belgium developed a highly efficient and capable transportation infrastructure that included roads, ports, canals, and rail links. The multilingual nature of the workforce and its industriousness has made the workforce one of the most productive in the world.

The oil crisis of the 1970s and economic restructuring led to a series of prolonged recessions. The 1980-82 recession was particularly severe and resulted in massive unemployment. Personal and consumer debt soared, as did the nation's deficit. Meanwhile, the main economic activity shifted northward into Flanders. In 1990, the government linked the Belgian franc to the German mark through interest rates. This spurred a period of economic growth. In 1992-93, another recession plagued Belgian history. During this period, the real GDP declined by 1.7 percent. Foreign investments have provided new capital and funds for businesses and have consistently helped maintain the economy. Consequently, the government has consistently implemented programs to encourage foreign investment. Since Brussels is the capital of the EU, many multinational firms have relocated to the city so they can be near the bureaucracy and regional body's government seat.

There are major regional differences in the country economy. In the former industrial and agricultural areas of the countryside, unemployment rates tend to be higher. However, in the newer urban centres (where the service economy is dominant), unemployment rates are lower. For instance, in Wallonia and Brussels, unemployment rates are higher than in Flanders. Nevertheless, overall national unemployment rates continue to be lower than the EU average. In addition, wage levels are among the highest in Europe. In 1993, in an effort to give the regions greater flexibility to deal with economic problems, each region was given broad economic powers to control trade, industrial development, and environmental regulation.

The government has also privatized many companies that were formally owned by the state.

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https://www.cia.gov/library/publications/the-world-factbook/geos/be.html#Econ

As the profitability of many industries declined in the post-World War II era, the government attempted to support them in order to maintain employment. Among the strategies used were subsidising certain industries, mainly steel and textile companies. In addition, the government reduced interest rates and offered tax incentives and bonuses to attract foreign businesses. All of these measures helped maintain the economy by preventing massive unemployment, but they also led to drastic government deficits in the 1970s and 1980s. The government was then forced to borrow funds from international sources in order to maintain their imports and to continue social welfare programs. By the 1990s, successive governments diligently worked to reduce the debt. In fact, they even shifted from foreign to domestic sources in underwriting their debts.

Belgium was one of the founding members of the European Community (later the EU), and has been one of the foremost proponents of regional economic integration. In 2000, 80 % of Belgium's trade was with other EU member states. Membership in the EU was the culmination of longstanding national support for economic cooperation. For instance, in 1921, Belgium joined with Luxembourg to form the Belgian-Luxembourg Economic Union (BLEU). This organization oversaw cross-border trade between the 3 nations. Belgium is also a member of the Organization for Economic Cooperation and Development (OECD), an organization of the world's most highly developed industrialized democracies.

6.1.3. Current economy

Belgium has a well-developed free market economy, based on both industrial and service sectors. It is heavily dependent on international trade and most of its economic sectors are geared toward exporting products. The nation's exports are around 80 % of its GDP. In spite of its small size, Belgium's economy has consistently placed among the richest economies of the world and remains strong.

Belgium has capitalized on its central geographic location, highly developed transport network, and diversified industrial and commercial base. With few natural resources, Belgium must import substantial quantities of raw materials and export a large volume of manufactures, making its economy unusually dependent on the state of world markets. Roughly three-quarters of its trade is with other EU countries. Public debt is 83.5 % (2007) of GDP but declining steadily as the governments succeeded in balancing its budget, and income distribution is relatively equal. Belgium began circulating the euro currency in January 2002.

6.2. Economic statistics by sector

6.2.1. Agriculture

The relationship between agriculture and the environment in Wallonia is rather complex. Several centuries of extensive farming effectively helped to create and maintain a broad range of semi-natural habitats and landscapes hosting plants and animals specific to the area. Starting in the 1960s, however, the intensification and specialisation of agricultural production led to a spectacular rise in yields but at a price: that of a considerable increase in pressures on the environment and natural resources. This development was made possible by technological progress and was promoted for a time by the European Union's Common Agricultural Policy (CAP). The gradual decline in the number of traditional farms (multicropping and animal husbandry) in favour of specialised holdings, simplified planting schemes, a rise in field size, the use of inputs (fertilisers and pesticides) and mechanisation gave rise to problems of soil erosion, compaction and contamination; water and air pollution; the fragmentation of habitats (wildlife); and the disappearance of environments marked by high biodiversity. Only starting in the 1990s, under the impetus of the successive CAP reforms and adoption of several European Directives, were the environmental pressures linked to agricultural production gradually taken into account in parallel with the imperatives of the sustainability and economic profitability of farming. This recent trend has had concrete effects on farmers, who are now being induced to (re-)orient their production practices or even play an active role in management the rural environment, which covers close to half of Wallonia's territory. Moreover, opportunities for diversification in the areas of renewable energy sources and rural tourism, to name the big two, are cropping up alongside food and feed production.

The development to the current agricultural situation and the relationship between agriculture and the environment, is altogether rather similar in Flanders, although there are differences, as it is also the case for the soil types in both regions. The loam belt is present in the Flemish and the Walloon regions, but the soils outside the loam belt are different. The differences in soil types and geographical situations are considered to be some of the main reasons for the differences in the agricultural systems of both regions.

As far as the circumstances of the environmental pressures on soil are concerned, the Flemish agriculture has a higher proportion of horticulture, indoor and outdoor as well, and a more intensive animal husbandry (pigs and poultry). On the contrary, the Walloon agriculture has a higher proportion of arable farming and a more soil bound animal husbandry. The threats to soil are similar in both regions, but diffuse contamination through fertilisers and pesticides may be of a higher intensity in Flanders as a consequence of the intensive husbandry and horticulture.

6.2.2. Transport

Transport equipment is one of the strongest remaining industrial sectors in Belgium. This sector includes the automotive industry, shipbuilding, railway and tram construction, bicycles, and the aeronautical and aerospace industry. Although Belgium does not have its own national automotive manufacturers, it has a large number of international companies. Ford, General Motors, Opel, Audi and Volvo have plants in Belgium. It also produces specialty vehicles including vans, trucks, buses, and minibuses. Of the vehicles manufactured in Belgium, 95 % are exported. The main markets are France, Germany, and the United Kingdom. The automotive industry also produces a variety of specialty parts for cars. The industry specializes in "just in time" (JIT) manufacturing which involves producing products to be used immediately upon receipt. This process eliminates the need to stockpile items in warehouses.

Belgium invests considerable sums in aerospace. The government works with other European nations such as France and Germany on projects such as Airbus jet aircraft and the Ariane rocket.

Belgium has an excellent infrastructure of roads, waterways, ports and airports. A huge amount of goods are transported across Belgium's infrastructure. Brussels is the heart of a dense highway network that extends beyond the borders of the kingdom to major destinations such as Paris, Amsterdam and London (via the tunnel under the English Channel). There is an extensive network of pipelines for crude petroleum products and natural gas pipelines.

Belgium's extensive transportation network and geographic position have enhanced its role as the major point of destination for goods entering Western Europe. The international airport at Brussels has become a (regional) European hub. Antwerp is one of the largest port facilities in Europe and is the centre of the international diamond trade. Also Ghent and Zeebrugge are major seaports. Meanwhile, Brussels and Liege are major river ports.

6.2.3. Energy

The kingdom has few energy sources. Consequently, it must import a substantial amount of fossil fuel. The country has a well-developed nuclear industry that provides more than half of Belgium's power needs. The remaining energy needs are met by a limited number of hydroelectric and coal plants.

6.2.4. Industry

Belgium's traditional industries face a number of challenges. Historically, the main industries were concentrated in the French-speaking areas of Wallonia. However, since the 1970s, the principal areas of industrial growth have been in Flanders. Newer light industries and more sophisticated technologies have replaced the older and labor-intensive manufacturing

systems. Between Antwerp and Brussels, a new corridor of industries emerged. The majority of these were less labor-intensive and required more skilled workers. The principal industries that have fueled this growth have been the petro-chemical and refining sectors. Nonetheless, the remaining industries tend to be highly advanced and technologically sophisticated. Light manufacturing and refining increasingly dominate the industrial sector.

6.2.5. Trade

Belgium's economy is dependent on international trade. From year-to-year, foreign trade accounts for approximately 80 % of the nation's economy. This makes Belgium particularly sensitive to disruptions in global trade. Recessions or other economic problems around the world often cause reciprocal problems in Belgium's economy. Fortunately, the kingdom has a variety of trade partners so that problems in one export market are mitigated by export diversity

The nation's main trade partners are in the EU, Germany, France, The Netherlands and the United Kingdom. The United States is also major trading partner of Belgium.

Since Belgium is home to the headquarters of the EU and over 100 international organizations, it has a unique perspective on world trade and global markets. It also has significant influence on trade. Since it joined the European Community (now EU), Belgium has supported free trade and advocated measures that lower tariffs and reduce other barriers to the free movement of goods and services, labour and capital within Europe.

Besides the national trade agreements, each of the 3 regions has the authority to grant financial incentives and other inducements to attract foreign goods and services.

The service sector is the largest area of the Belgian economy, accounting for around 75 % of GDP. It is well developed and diversified. Because of its geographic position as the gateway to Europe and the government's efforts to attract foreign banking and financial companies, Belgium is one of the largest financial centres in the world.

6.2.6. Tourism

Tourism is one of Belgium’s smaller industries; however the country’s easy accessibility from elsewhere in Europe makes it a popular tourist destination.

The main centres of the Belgian tourist industry are the coastal region and the Ardennes.

The coastline has several resorts and numerous beaches. Most are designed for family-oriented vacations and draw tourists from France, the United Kingdom and the Netherlands. Situated in the southeast of Belgium, the Ardennes forest is one of the few unspoiled natural areas in Western Europe. The area attracts campers and daytrippers. It is known for hiking,

fishing, canoeing and kayaking and mountaineering in the spring and summer months. In the winter, tourists engage in both downhill and cross-country skiing.

6.2.7. Waste

6.2.7.1. Flanders[41]

Collection household waste: Between 1991 and 2000 the household waste mountain grew continually. In 2001 and 2002 the supply appeared to stabilise and in 2003 it even decreased by 115 ktonnes (21 kg/inhabitant). However, in 2004 the supply of household waste increased again by 168 ktonnes (25 kg/inhabitant). The growth of the household waste mountain is entirely on account of the separately collected waste. Especially green waste and wood residue show a remarkable increase. However, the amount of residual waste continues to decrease: in 2004 an average of 159 kg/inhabitant was collected (target 2007: maximum 150 kg/inhabitant).

Processing household waste: Thanks to the success of separate collection an ever growing part of household waste is recycled or composted (65 % in 2003). The rest of the waste is for the most part incinerated (25 % in 2003). The proportion of landfilling has been reduced from 47 % in 1991 to 7 % in 2003. This happened partly by making landfilling more expensive than incineration by means of taxation. Furthermore landfill bans were implemented and deviations from this were painstakingly followed up, and the available capacity at incineration plants was used optimally. Only a small part of the household waste is re-used (3 % in 2003).

Volume industrial waste: 20.5 million tonnes of primary industrial waste were produced in 2003. Processing of that waste by waste processing companies generated 9.6 million tonnes of secondary waste. The quantity of primary industrial waste remains virtually constant since 1996. The volume of primary industrial waste must be lower in 2007 than in 2002 and furthermore it must be decoupled from economic growth. To achieve these targets there are subsidy programmes, the government gives concrete information about avoiding waste and actions are undertaken targeting specific sectors and waste flows via sectoral implementation plans.

Processing industrial waste: In 2003, 38 % of the total industrial waste volume was conditioned, i.e. pre-processed, before it was processed further. 47 % was recycled or used as secondary raw material. The quantity of industrial waste that was incinerated gradually increased. The quantity of industrial waste going to landfills declined drastically between 1992 and 1997 and remained fairly constant thereafter. In 2002 and 2003 the volume of industrial waste going to landfills remained under the target for 2010. Due to the reduced export of waste to Germany and the Walloon provinces in the middle of 2005, about 250 to 300

[41] http://www.milieurapport.be/Default.aspx?PageID=584&Culture=nl

ktonnes of industrial waste, however, turned up again in the Flemish waste figures. Further implementation of landfill bans will have to ensure that landfilling does not increase again.

6.2.7.2. Wallonia

No significant overall drop in the amount of waste generated in Wallonia is currently under way. This situation illustrates well the public authorities' difficulties implementing preventive measures. It is effectively necessary to act upon production and consumption patterns. However, the region does not control all the levers necessary to achieve this. It can act upon production via environment permits and on consumption through awareness raising campaigns and public procurement, but a key element – product policy – is a federal power. Improvements in the region's environmental performances per unit of merchandise produced must nevertheless be underlined. They are due notably to the growth of clean technology, the institution of packaging and product recovery obligations, and the signing of environmental agreements between the Walloon Region and waste generators.

The best results, however, concern the performances of selective waste collection and reclamation or recycling, even though there is room for improvement when it comes to hazardous waste, bulky objects, and the fermentable fraction of household waste. These good results are also explained by the observed advances made in waste disposal and above all in the drop in the reliance on land fills, although their use still remains above target. Standards promoting the use of recycled materials in product manufacturing could help improve these results even more, especially when it comes to building materials. A strict legal framework (for example, take-back obligations and bans on land-filling waste), the creation of appropriate management infrastructure alongside stepped-up enforcement of the "polluter pays" principle, and communication campaigns praising sorting efforts have enabled the Walloon Region to join the ranks of the best pupils when it comes to waste reclamation in Europe, and even in the world.

On another front, technological progress has enabled waste treatment installations, especially incinerators, to cut their emissions into the air considerably. Compliance with legal requirements in this area appears to have been reached. For example, not a single exceedance of the dioxin emission level was registered for household waste incineration plants in the Walloon Region in 2005.

7. LAND USE

7.1. Land use changes

The trends in land cover changes differ between the densely-populated Flemish Region in the north and the more forested Walloon Region in the south. In Flanders, in the period 1990-2000, built-up areas, urban sprawl and fragmentation of urban spaces have increased. On the other hand, in the Walloon Region, traditionally more rural, urban development mainly occurred along transport networks leading to Brussels. In the same period, urban areas also increased in the immediate surroundings of Brussels.

In general, rural areas cover most of southern Belgium. In the northern and in the central parts of the country, agricultural land has to compete with pressures from urban areas. However, central Belgium enjoys good fertile soils and this factor may have influenced urban patterns.

In Flanders, land cultivated with corn has increased by nearly 80 % since 1990 at the expenses of permanent grassland and land cultivated with other cereals. The increase in Wallonia has been only 18 % since 1995. The horticultural and specialised open-air cultivation areas increased by over 30 %. These trends are the result of changes in land use towards more cost-effective production methods for fodder crops and more profitable cultivation (extension or conversion to horticulture). The gross added value of agriculture increased by 26 % between 1990 and 2002 due to increased production and productivity[42]. This trend towards intensification has resulted in increased pressures on the environment in many areas. Despite of some forest creation in north-eastern and southern Belgium, the total area of forested land decreased (EEA, 2006a).

[42] Data source: Eurostat. Gross value added (at basic prices); nace: a_b : Agriculture, hunting, forestry and fishing; units: millions of euro (at 1995 prices and exchange rates); (data file: nama_nace06_k, downloaded 08-05-2008)

Table 8. Relevant statistics 1990-2000 by land cover class in ha						
Corine land cover types	**Land cover flows**					
	Total land cover, 1990 (ha)	Total Consumption of 1990 land cover (ha)	Total Formation of 2000 land cover (ha)	Net Formation of Land Cover (formation-consumption)	Net formation as % of initial year	Total land cover, 2000 (ha)
1 Artificial areas	607 568	4 718	21 583	16 865	2.8	624 433
2A Arable land & permanent crops	683 192	8 357	4 675	-3 682	-0.5	679 510
2B Pastures & mosaics	1 098 661	18 322	4 916	-13 406	-1.2	1 085 255
3A Forested land	627 125	19 747	19 628	-119	0.0	627 006
3B Semi-natural vegetation	18 347	2 044	1 532	-512	-2.8	17 835
3C Open spaces/ bare soils	1 971	20	0	-20	-1.0	1 951
4 Wetlands	10 925	249	266	17	0.2	10 942
5 Water bodies	18 801	167	1 024	857	4.6	19 658
Total (ha)	3 066 590	53 624	53 624	0	0.0	3 066 590

Source: EEA, 2006bc

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APPENDIX 1. Soil contamination from local sources

In Flanders and Brussels, it is estimated that potentially polluting activities have occurred at 82 640[43] sites and investigation is in progress to establish whether remediation is required. Following a European trend, more is being learned on the size of the problem but the speed of the clean-up is still relatively slow. In particular, investigations carried out up to 2006 identified 32 490 potentially contaminated sites. National estimates expect that 35 % (or 12 400 sites) are contaminated and need to be remediated. Most cases of contamination are a legacy from the past. However, current activities may still cause soil contamination. Until recently, the contribution of new contamination was considered not significant. This, however, has proved not to be the case in Flanders. Environmental objectives and targets will have to include this aspect.[44]

These estimates have increased considerably over the past years, due to progress in investigation, monitoring and data collection, and this trend is expected to continue in the future. On the other hand, 618 sites have been cleaned up since 1995.

Nevertheless, progress in the remediation of sites has been observed in recent years. In Flanders, the number of cleaned-up sites has increased by more than 600 % between 2000 and 2005. On the other hand, the total number of sites awaiting remediation has grown by 16 % in the same period, while the estimates on the number of sites where potentially polluting activities have taken place have increased of 30 %. These observations indicate that, in Flanders, the specific remediation targets established for historical contamination could be met, as long as the observed trends continue in the future (see section 3.2.2 Soil policy targets for more details).

There is no centralised inventory of contaminated sites in the Walloon Region. Several inventories have been carried out by different subjects for several purposes. These inventories also include sites where the soil is little or not contaminated. The inventories list 3 550 brownfield sites (SAED[45]), 2 500 old landfills, and 1 500 service stations (Maes et al.,

[43] Unless otherwise specified, numbers in this section refer to the regions of Flanders and Brussels (source: Eionet data flow on contaminated sites).

[44] Information on the extent of the problem is also available in terms of area in Flanders:

- 4 % of the region must be investigated because of the presence of soil contaminating activities, mainly occurring in the past. This corresponds to an area of 570 km².
- 75 % of the already investigated soils are polluted and included the register of contaminated sites. These covers an estimated area is of 416km².
- 52 % from the known contaminated sites need to go through detailed soil investigations (i.e. “descriptive soil examination”).
- Around 50 % of the sites that concluded a descriptive soil contamination needed to be remediated. In 19% of these sites remediation has been completed.

The three most important soil contaminants are heavy metals, PAHs and mineral oil.

[45] SAED = Sites d’activités économiques désaffectés (sites of abandoned economic activity)

2007). However, it is estimated that the number of the sites potentially contaminated is much higher, as many sites have not yet been registered.

Legislative and budgetary measures were taken in the Walloon Region in 2005 to accelerate the remediation of polluted soils. However, the decree on soil remediation has not yet gone into effect. In Brussels, new legislation has been in force since 2004[46].

A wide range of pollution sources have been identified. Industrial production and commercial services, oil extraction and production, industrial waste disposal and treatment and power plants are reported to be the most important sources. In Flanders and Brussels, industrial sources come mainly from the oil, chemical and metal working industries (respectively 24 %, 22 % and 16 % of all sources). In Wallonia, pollution sources also include the old coal-related industries (coking plants, gas factories, etc.), and the metallurgical industry and steel mills which ensured a booming economic growth to the region until the early 20th century.

Heavy metals, polycyclic aromatic hydrocarbons (PAH), mineral oil and aromatic hydrocarbons (BTEX) are the most frequent soil contaminants at investigated sites. These estimates are based on the frequency with which a specific contaminant is reported to be the most important in the investigated sites. Other contaminants include chlorinated hydrocarbons (CHC) and cyanides.

In Flanders, one fourth[47] of the remediation expenditure comes from public budget. The annual expenditure for the management of contaminated sites is about 112 MEUR. This corresponds to an average of 0.4 per mille of the national Gross Domestic Product or 0.6 per mille of the regional GDP. The largest portion of expenditure is employed for remediation measures (67 % of the total expenditures) and site investigations (33 % of total expenditures). In Wallonia, the costs for the remediation of 50 priority brownfield sites were estimated to 800 million EUR.

A national inventory or register of contaminated sites has not been established and registers are kept at the regional level (Brussels and Flemish regions). The regional inventories include both historical and new contamination, potentially polluting activities (abandoned and in operation), potentially contaminated sites, non-contaminated and contaminated sites. Both inventories cover industrial, commercial and waste disposal sites, sites where accidents have occurred and military sites. The Flemish inventory also includes harbours, airports, nuclear operations and mining sites. For each site, the registers provide information on the exact location, site characteristics and local conditions. The Information on environmental impacts (in terms of risks to environmental media) is not included in Flanders, while progress in the

[46] Information for Brussels can also be found on the web page of the Brussels Institute for the Management of the Environment, INTERNET: http://www.ibgebim.be. Information for Wallonia can be found on the web site of the "State of the environment in Wallonia". INTERNET: http://environnement.wallonie.be/eew

[47] Data on remediation expenditure are not available for the other regions.

management of the site is not registered in the Brussels region. In both regions, soil and groundwater are reported to be the only media investigated.

Several techniques are available for the reduction of the risks caused by soil contamination. In Belgium, there is a balance in the application of innovative *in situ* (on-site) and *ex situ* (off-site) techniques[48]. A quarter of the most-frequently-applied techniques can be defined as traditional such as the so-called "dig and dump" techniques and the containment of the contaminated area. This reflects the fact that contaminated soil is frequently treated as waste to be disposed of rather than a valuable resource to be cleaned and reused.

The reduction of the exposure of humans via plants, soil gas and explosions, and the direct uptake of contaminated soil is reported as the most important reason for the application of risk-reduction measures in the Brussels region (this information is not available for Flanders). The protection of ecosystems and the soil *per se* are not reported as priorities for remediation. This is due to the lack of specific regulations covering the soil media.

[48] This information is available for the Brussels region only.

APPENDIX 2. Market Based Instruments (MBI) Fact sheets

Table A2.1 MBI fact sheet: Fund for the remediation of former service stations

Country/Region	Belgium
Country code	BE
ID	4
Name of instrument	BOFAS npo
Short description	BOFAS npo is a fund for the remediation of contaminated (former) service stations, which is financed by the revenues of a fuel tax.
Year of introduction	2004
Date last revision	N/A
Type of instrument [1]	1
Level of application	Federal
Institution(s) responsible for implementation	*De Interregionale Bodemsaneringscommissie* (the inter-regional soil remediation committee), composed by representatives of the three regions (Flemish region, Brussels Capital region, Walloon region).
Website	http://www.bofas.be
References [2]	N/A
Contact -- name	Filip De Naeyer
Contact -- phone / fax	0032 (0)1528440
Contact – email	filip.de.nayer@ovam.be
Contact -- organisation	Public Waste Agency of Flanders – OVAM
Objectives	To stimulate the remediation of contaminated (former) service stations.
Target group / sector addressed	Owners and operators of (former) service stations.
Eligible objects / activities	Contaminated (former) service stations.
Eligible subjects	Beneficiaries include private owners and operators of former and current operators
Conditions	The owner or operator of a contaminated site that is or was used for the exploitation of a service station have to submit an application. After acceptance by BOFAS npo, BOFAS npo will carry out the soil remediation (in the case of a closed service station) or will carry out a repayment for a maximum of 62 000 EUR (in the case of a service station that stays in exploitation).
Yearly revenue (million EUR)	N/A
Reference year [3]	N/A
Source of funding	BOFAS npo is financed by the revenues of a fuel tax
Relationship with other instruments	N/A

Table A2.1 MBI fact sheet: Fund for the remediation of former service stations

Evidence on effectiveness and possible side effects	Between 2004 and 2006, 2 688 applications were accepted by BOFAS npo. A total of 1 033 of them are applications for closed service stations and 1 481 are applications for service stations, which stay in exploitation. Before 2014 (possibly extensible until 2019) BOFAS npo will carry out the soil remediation for the closed service stations and a repayment for the other applications. The clean-up of a large portion of contaminated an unused land will provide opportunities for redevelopment and reuse.
Costs of and possible problems with implementation	N/A
Stakeholders' opinions	NN
Relevant legislation	Agreement of co-operation between the federal state, the Flemish region, the Walloon region and the Brussels Capital region concerning the implementation and financing of the soil remediation of service stations (13/12(2002).
Sources [4]	Belgian Bulletin of Acts, Orders and Decrees (2002-2003)
Detailed description	N/A
Comments	

NOTES

NA Information not available

NN Field not applicable

[1] Type of instrument:

- *1 Taxes and charges*
- *2 Subsidies*
- *3 Tradable permits*
- *4 Voluntary agreements*
- *5 Other*

[2] Relevant literature referring to the specific instrument

[3] Reference year for the revenue

[4] Sources of the information contained in this table (See References, Section 3):

- *1 DGENV, 2005*
- *2 EEA-OECD, 2006.*

Table A2.2 MBI fact sheet: Soil protection fund

Country/Region	Belgium (Flanders)
Country code	BE
ID	5
Name of instrument	*Bodembeschermingsfonds* (Soil Protection Fund)
Short description	Fund for clean-up of contaminated sites' or 'fund for ex-officio remediation'. Public funding for the investigation and remediation of contaminated soils in cases where the parties involved are unable or refuse to cooperate and in cases where the parties involved are not obliged to cooperate. Orphan sites are only a very small part of the sites which are being remediated with this fund.
Year of introduction	1996
Date last revision	2006
Type of instrument [1]	5
Level of application	Regional
Institution(s) responsible for implementation	OVAM – *Openbare Vlaamse Afvalstoffenmaatschappij* (Flemish Public Waste Agency)
Website	http://www.ovam.be
References [2]	N/A
Contact -- name	Eddy Wille
Contact -- phone / fax	0032 (0)15284460
Contact -- email	eddy.wille@ovam.be
Contact -- organisation	OVAM
Objectives	Restore, remediate and/or manage environmental damage caused by soil contamination.
Target group / sector addressed	Land users or owners
Eligible objects / activities	Contaminated sites and their remediation, avoiding new contamination.
Eligible subjects	Land users, private owners, municipalities, private enterprises.
Conditions	Contaminated sites are remedied on a basis of urgency.
Yearly revenue (million EUR)	19
Reference year [3]	2006
Source of funding	Waste law
Relationship with other instruments	Linked to BOFAS, the fund for soil remediation of petrol stations, which uses the revenues of fuel taxes.
Evidence on effectiveness and possible side effects	N/A

Table A2.2 MBI fact sheet: Soil protection fund

Costs of and possible problems with implementation	N/A
Stakeholders' opinions	N/A
Relevant legislation	Decree on soil remediation dd. 22.02.1995
Sources [4]	N/A
Detailed description	NN
Comments	

NOTES

NA Information not available

NN Field not applicable

[1] Type of instrument:

- *1 Taxes and charges*
- *2 Subsidies*
- *3 Tradable permits*
- *4 Voluntary agreements*
- *5 Other*

[2] Relevant literature referring to the specific instrument

[3] Reference year for the revenue

[4] Sources of the information contained in this table (See References, Section 3):

- *1 DGENV, 2005*
- *2 EEA-OECD, 2006.*

Table A2.3 MBI fact sheet: Subsidies for soil remediation organisation

Country/Region	Belgium (Flanders)
Country code	BE
ID	6
Name of instrument	Subsidies for soil remediation organisations
Short description	Soil remediation organisations can provide support for research and development for soil remediation and for corporate management vis-à-vis soil related issues for vulnerable sectors, appointed by the Flemish government. The Flemish government can give subsidies for the soil remediation or part of these tasks.
Year of introduction	2006
Date last revision	N/A
Type of instrument [1]	Subsidy
Level of application	Regional (only Flanders)
Institution(s) responsible for implementation	Overall responsibility lies with the Flemish government. The OVAM – *Openbare Vlaamse Afvalstoffenmaatschappij* (Flemish Public Waste Agency) – gives advise and is the controlling authority.
Website	http://www.ovam.be
References [2]	N/A
Contact -- name	Victor Dries
Contact -- phone / fax	0032 (0)15284460
Contact -- email	victor.dries@ovam.be
Contact -- organisation	OVAM
Objectives	To facilitate soil remediation in sectors vulnerable for bankruptcy due to soil remediation obligations and to facilitate the creation of a cost-effective soil remediation strategy for these sectors.
Target group / sector addressed	Owners and users of contaminated sites practising an activity appointed by the Flemish government.
Eligible objects / activities	Contaminated sites and their remediation.
Eligible subjects	Soil remediation organisations, de facto enterprises of vulnerable sectors.
Conditions	Soil remediation organisations have to be recognised by the Flemish government to which end they have to satisfy several conditions (for further reading cf. Decree and Implementing order). Only these organisations can request to obtain a subsidy for the remediation of the soil contamination related to the main activity (= determined by the Flemish government) of the member companies and/or owners/users of sites contaminated by this activity. Upon approval of the subsidy the organisation will use it to remediate sites according to urgency of remediation (based on own judgement).
Yearly revenue (million EUR)	1.4
Reference year [3]	2006
Source of funding	Public
Relationship with other instruments	none

Table A2.3 MBI fact sheet: Subsidies for soil remediation organisation

Evidence on effectiveness and possible side effects	Several sectors consist mainly if small enterprises (dry cleaning, printing, car service stations…) which are confronted with severe soil contamination problems. Without some form of aid these sectors would be severely struck by bankruptcies due to soil remediation costs. The possibility to create soil remediation organisations (and the possibility to grant subsidies) aims to counter this threat. To start the process which will lead to the creation of these organisations an initiative of a sector is necessary. Up till now, only the dry cleaning sector has taken this initiative.
Costs of and possible problems with implementation	N/A
Stakeholders' opinions	N/A
Relevant legislation	Decree of soil sanitation dd. 22.02.1995 as amended by the decree dd. 16 June 2006); the decision to change the implementing order of the Flemish government dd. 5.03.1996 concerning soil sanitation (VLAREBO).
Sources [4]	N/A
Detailed description	NN
Comments	NN

NOTES

NA Information not available

NN Field not applicable

[1] Type of instrument:

- *1 Taxes and charges*
- *2 Subsidies*
- *3 Tradable permits*
- *4 Voluntary agreements*
- *5 Other*

[2] Relevant literature referring to the specific instrument

[3] Reference year for the revenue

[4] Sources of the information contained in this table (See References, Section 3):

- *1 DGENV, 2005*
- *2 EEA-OECD, 2006.*

Table A2.4 MBI fact sheet: Subsidies for erosion control

Country/Region	Belgium (Flanders)
Country code	BE
ID	7
Name of instrument	Subsidies for erosion control (“Erosion Decree”)
Short description	Subsidies for small-scale erosion control measures to be taken by local authorities. Municipalities in the hilly areas of Flanders receive funds for the compilation of an erosion control management plan (12.5 euro/ha). The plan indicates the measures to be taken. A further 75 % subsidy is granted for the implementation of the approved measures, which include small-scale technical control measures such as the construction of small dams and pools or grass buffer strips.
Year of introduction	2001
Date last revision	2007
Type of instrument [1]	2
Level of application	Local (municipalities)
Institution(s) responsible for implementation	*afdeling Land en Bodembescherming, Ondergrond, Natuurlijke Rijkdommen, van het departement Leefmilieu, Natuur en Energie* (Division Land and Soil protection, Subsoil and Natural Resources, of the Department of Environment, Nature and Energy
Website	http://www.lne.be/themas/bodem/erosie
References [2]	
Contact -- name	Petra Deproost
Contact -- phone / fax	0032 (0)2 553 21 78
Contact -- email	petra.deproost@lne.be
Contact -- organisation	ALBON
Objectives	Progressive elimination of the existing erosion bottlenecks
Target group / sector addressed	Municipalities and agricultural sector (arable land farming)
Eligible objects / activities	Control management plans; small-scale erosion control measures (small dams, erosion pools, buffer strips)
Eligible subjects	Municipalities in erosion sensible areas
Conditions	(erosion-technical) approval of plans and measures
Yearly revenue (million EUR)	1.6
Reference year [3]	2006
Source of funding	Department of Environment, Nature and Energy
Relationship with other instruments	N/A
Evidence on effectiveness and possible side effects	Evidence of effectiveness in the field Growing awareness of the erosion problems in the farmer communities

Table A2.4 MBI fact sheet: Subsidies for erosion control

Costs of and possible problems with implementation	
Stakeholders' opinions	N/A
Relevant legislation	Soil erosion decree
Sources [4]	1
Detailed description	NN
Comments	NN

NOTES

NA Information not available

NN Field not applicable

[1] Type of instrument:

- *1 Taxes and charges*
- *2 Subsidies*
- *3 Tradable permits*
- *4 Voluntary agreements*
- *5 Other*

[2] Relevant literature referring to the specific instrument

[3] Reference year for the revenue

[4] Sources of the information contained in this table (See References, Section 3):

- *1 DGENV, 2005*
- *2 EEA-OECD, 2006.*

Table A2.5 MBI fact sheet: Erosion management agreements

Country/Region	Belgium (Flanders)
Country code	BE
ID	8
Name of instrument	*Beheersovereenkomsten erosiebestriding voor landbouwers* (erosion management agreements for farmers)
Short description	Erosion management agreements, as a part of the agri-environmental measures of the Flemish Plan for Rural Development: specific erosion control practices as grassed waterways, grass buffer strips, sediment retention dams and pools, conservation tillage and no till
Year of introduction	2005
Date last revision	2007
Type of instrument [1]	2
Level of application	Local (farmers)
Institution(s) responsible for implementation	1. VLM (*Vlaamse Landmaatschappij*) (Flemish Land Agency) 2. *afdeling Land en Bodembescherming, Ondergrond, Natuurlijke Rijkdommen, van het departement Leefmilieu, Natuur en Energie* (Division Land and Soil protection, Subsoil and Natural Resources, of the Department of Environment, Nature and Energy)
Website	http://www.lne.be/themas/bodem/erosie/copy_of_beheersovereenkomsten-erosiebestrijding-voor-landbouwers
References [2]	
Contact -- name	Tom Vander Elst
Contact -- phone / fax	0032 (0)2 55321 94
Contact -- email	tom.vanderelst@lne.be
Contact -- organisation	ALBON
Objectives	substantial on-site erosion control practices to reduce erosion to an acceptable level (=sustainable use)
Target group / sector addressed	Farmers/agricultural sector
Eligible objects / activities	Erosion management agreements
Eligible subjects	Farmers with erosion sensitive arable land
Conditions	
Yearly revenue (million EUR)	1.1
Reference year [3]	2005
Source of funding	Flanders region (50 %) and EU (EAFRD, axis 2) (50 %)
Relationship with other instruments	
Evidence on effectiveness and possible side effects	

Table A2.5 MBI fact sheet: Erosion management agreements

Costs of and possible problems with implementation	
Stakeholders' opinions	
Relevant legislation	Flemish Plan for Rural Development
Sources [4]	
Detailed description	
Comments	

NOTES

NA Information not available

NN Field not applicable

[1] Type of instrument:

- *1 Taxes and charges*
- *2 Subsidies*
- *3 Tradable permits*
- *4 Voluntary agreements*
- *5 Other*

[2] Relevant literature referring to the specific instrument

[3] Reference year for the revenue

[4] Sources of the information contained in this table (See References, Section 3):

- *1 DGENV, 2005*
- *2 EEA-OECD, 2006.*

APPENDIX 3. Country review of European datasets for soil erosion, decline in organic matter and hidrogeological risks

At the time of drafting these reports, there are few data at European scale on soil threats. Three European datasets that were identified as significant are: the data of the Pan-European Soil Erosion Risk Assessment (PESERA), the Map of Organic Carbon Content in Topsoils in Europe (OCTOP) and the Emergency Disasters Data Base (EM-DAT). The PESERA and the OCTOP data are both available at the JRC web site (http://eusoils.jrc.ec.europa.eu/ESDB_Archive/pesera/pesera_data.html and http://eusoils.jrc.ec.europa.eu/ESDB_Archive/pesera/pesera_data.html), while data on natural and technological accidents are available at the EM-DAT web site (http://www.em-dat.net/).

For this appendix, the national experts were asked to provide:

1) Comments on the results of PESERA for their country.
2) Reference to national data sources on erosion, if available.
3) Comments on the OCTOP data for their country.
4) Reference to national data sources on topsoil organic carbon, if available.
5) Comments on the quality and coverage of data stored in the EM-DAT for their country.
6) Reference to national data sources on natural and technological accidents, if available.

1) The PESERA erosion map provides a good indication of the erosion level and the location of the erosion vulnerable areas. However, because of the low resolution (1 km x 1 km raster), the data cannot be used to quantify erosion at the local level. In general, erosion rates and extent seem to be underestimated, and the transition between the southern erosion belt and the northern erosion-free sandy areas seems too abrupt; the erosion rates in the areas in between should be higher.

2) In Flanders, detailed soil erosion maps, updated on a yearly base and describing the erosion risk degree (classes: very heavy, heavy, moderate, light, very light, negligible) for all parcels in agricultural use are available on the Internet. The maps concern 'potential' erosion: all parcels are considered to be used as arable land, with a C-factor (plant cover) of 0.37. The data are given by municipality, in pdf format: http://dov.vlaanderen.be/dovweb/html/erosie.html [49]. The data are provided by the municipalities.

Maps depicting the mean soil exports due to water erosion, the risk of water-induced soil erosion, and the sediment yields for the Walloon Region are available on the State of the Walloon Environment site:

http://environnement.wallonie.be/eew/rapportproblematique.aspx?id=SOLS_03

[49] Follow the links to: Gemeentelijke erosiekaarten: Anzegem, erosie 2007; wijzigingen tov 2006 (changes since 2006).

Various projects are currently under way to improve our knowledge of the risks of runoff and soil erosion across the entire territory of Wallonia. These include, for example, the ERUISSOL project (http://cartographie.wallonie.be/NewPortailCarto/PDF/ERRUISSOL.pdf) and the Interreg MESAM (Mesures contre l'Erosion et Sensibilisation des Agriculteurs en faveur du Milieu) project.

3) Information not available.

4) Several research teams working under the METAGE (Estimating greenhouse gas fluxes from Belgian ecosystems under global change scenarios) project, which is funded by the Federal Scientific Policy Department, have estimated and mapped the soil organic carbon concentrations and reserves and biomass in Belgium in 1960, 1990, and 2000. They have also forecast greenhouse gas stores and fluxes according to various climate change and land-use scenarios.

(Consult http://www.geo.ucl.ac.be/metage/index.html for more information in this connection).

Maps of the soil organic matter contents in Wallonia in 2000 and changes therein between 1960 and 2000 are available on line on the Walloon State of the Environment's site:

http://environnement.wallonie.be/eew/rapportproblematique.aspx?id=SOLS_02

5) The given data base looks to be all right, as far as the main risks and floods are concerned, as it should be the case on supra-national level.

6) The data are available at different levels, but there is a general flood map available for the Flemish region, indicating flood risk areas of all types, including the recent flooded areas:

http://geo-vlaanderen.agiv.be/geo-vlaanderen/watertoets

The Walloon Region has set aside a budget of some 5 million EUR to map the areas of flooding across the entire territory of Wallonia between January 2004 and June 2007. Two types of map are placed at the municipalities' disposal, namely, (1) a flood risk map, showing the territories vulnerable to flooding due to watercourses' overflowing their banks; and (2) a map of the risk of damage, expressing the potential damage that the vulnerable elements might sustain. These maps can be consulted via the Walloon Region's map portal:
http://cartographie.wallonie.be/NewPortailCarto/index.jsp?page=subMenuInondations&node=32&snode=321

The areas subject to karstic constraints, for their part, are presented in the Atlas of Walloon Karst: http://www.cwepss.org/atlasKarst.htm)

Additional sources

Landslides inventory:

http://www.lne.be/themas/bodem/grondverschuivingen/Inventarisatiekaart%20van%20grondverschuivingen.pdf

Risks of landsliding:

http://www.lne.be/themas/bodem/grondverschuivingen/Nieuwe%20geklasseerde%20gevoeligheidskaart%20voor%20grondverschuivingen.pdf

Risks of landsliding (new website under development on soil and subsoil):

http://dov.vlaanderen.be/dovweb/html/index.html (‘*geografisch zoeken’*…and further on...).

APPENDIX 4. Socio-economic indicators

Table A4.1 Social indicators

Year	Geo	Variable	Unit	Value	Source	Reference	Notes
2007	Belgium	Total population	Inhabitants	10,584,534	ESTAT	demo_pjan	
1950	Belgium	Total population	Inhabitants	8,639,000	ESTAT	demo_pjan	
2005	Belgium	Population density	inh/km2	345.5	ESTAT	reg_d3dens	
2005	Région de Bruxelles-Capitale/Brussels Hoofdstedelijk Gewest	Population density	inh/km2	6290.5	ESTAT	reg_d3dens	
2003	EU27	Population density	inh/km2	113.4	ESTAT	reg_d3dens	
2003	EU15	Population density	inh/km2	118.7	ESTAT	reg_d3dens	
1966	Belgium	Life expectancy	Years	70.7	ESTAT	demo_mlexpec	Life expectancy less than 1 year
2004	Belgium	Life expectancy		78.9	ESTAT	demo_mlexpec	Life expectancy less than 1 year
2006	Belgium	Life expectancy	Years	79.5	ESTAT	demo_mlexpec	Life expectancy less than 1 year
2004	EU27	Life expectancy	Years	78.4	ESTAT	demo_mlexpec	Life expectancy less than 1 year
1955	Belgium	pc_y65_max	%	11.5	ESTAT	demo_pjanind	Proportion of population aged 65 years and more
1969	Belgium	pc_y65_max	%	12.7	ESTAT	demo_pjanind	Proportion of population aged 65 years and more
2007	Belgium	pc_y65_max	%	17.1	ESTAT	demo_pjanind	Proportion of population aged 65 years and more
2007	EU27	pc_y65_max	%	16.9	ESTAT	demo_pjanind	Proportion of population aged 65 years and more
2005	Belgium	Population ages 65 and above	%of total	17.6	The World Bank	wb_pop_en_v5EEA16309I(1)	
2005	Belgium	Rural population	%of total	2.8	The World Bank	wb_pop_en_v5EEA16309I(1)	
2005	Belgium	Urban population	%of total	97.2	The World Bank	wb_pop_en_v5EEA16309I(1)	
2005	EU27	Population ages 65 and above	%of total	16.7	The World Bank	wb_pop_en_v5EEA16309I(1)	
2005	EU27	Rural population	%of total	26.5	The World Bank	wb_pop_en_v5EEA16309I(1)	
2005	EU27	Urban population	%of total	73.5	The World Bank	wb_pop_en_v5EEA16309I(1)	
2005	EU15	Population ages 65 and above	%of total	17.4	The World Bank	wb_pop_en_v5EEA16309I(1)	
2005	EU15	Rural population	%of total	23.6	The World	wb_pop_en_v5E	

Table A4.1 Social indicators							
Year	**Geo**	**Variable**	**Unit**	**Value**	**Source**	**Reference**	**Notes**
					Bank	EA16309I(1)	
2005	EU15	Urban population	%of total	76.4	The World Bank	wb_pop_en_v5E EA16309I(1)	
1960-2005	Belgium	Change total population 1960-2005	%	15	The World Bank	wb_pop_en_v5E EA16309I(1)	
1960-2005	Belgium	Change urban population 1960-2005	%	21	The World Bank	wb_pop_en_v5E EA16309I(1)	
1960-2005	Belgium	Change rural population 1960-2005	%	-57	The World Bank	wb_pop_en_v5E EA16309I(1)	
1960-2005	Belgium	Change population ages 65 and above 1960-2005	%	69	The World Bank	wb_pop_en_v5E EA16309I(1)	
1960-2005	EU27	Change total population 1960-2005	%	21	The World Bank	wb_pop_en_v5E EA16309I(1)	
1960-2005	EU27	Change urban population 1960-2005	%	47	The World Bank	wb_pop_en_v5E EA16309I(1)	
1960-2005	EU27	Change rural population 1960-2005	%	-19	The World Bank	wb_pop_en_v5E EA16309I(1)	
1960-2005	EU27	Change population ages 65 and above 1960-2005	%	105	The World Bank	wb_pop_en_v5E EA16309I(1)	
1960-2005	EU15	Change total population 1960-2005	%	22	The World Bank	wb_pop_en_v5E EA16309I(1)	
1960-2005	EU15	Change urban population 1960-2005	%	43	The World Bank	wb_pop_en_v5E EA16309I(1)	
1960-2005	EU15	Change rural population 1960-2005	%	-18	The World Bank	wb_pop_en_v5E EA16309I(1)	
1960-2005	EU15	Change population ages 65 and above 1960-2005	%	100	The World Bank	wb_pop_en_v5E EA16309I(1)	

Table A4.2 Economic indicators									
Geo	**Variable**	**Unit**	**All NACE branches (1)**	**Agriculture (2)**	**Total industry (3)**	**Construction (4)**	**Commercial services, tourism and transport (5)**	**Financial services (6)**	**Public administration and social services (7)**
Belgium	GVA 2005	Million EUR	239 582.2	3 045.4	53 753	11 888.9	48 384.4	71 845.9	50 519.3
EU27	GVA 2005	Million EUR	7 874 533	201 623.8	1 775 314	407 198.8	1 768 263	2 088 254	1 626 881
EU15	GVA 2005	Million EUR	7 520 894	178 313.6	1 664 403	389 552.3	1 674 994	2 033 746	1 571 470
Belgium	GVA 2005	% of total	100.0	1.3	22.4	5.0	20.2	30.0	21.1
EU27	GVA 2005	% of total	100.0	2.6	22.5	5.2	22.5	26.5	20.7
EU15	GVA 2005	% of total	100.0	2.4	22.1	5.2	22.3	27.0	20.9
Belgium	Change GVA 1995-2005	%	18.3	2.6	15.5	15.8	11.2	30.3	12.2
EU27	Change GVA 1995-2005	%	20.3	8.6	16.1	8.1	25.2	27.5	14.3
EU15	Change GVA 1995-2005	%	24.6	9.0	17.3	8.5	32.5	37.6	16.1

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table *nama_nace06_k*
National Accounts by 6 branches - aggregates at constant prices
unit *mio_eur_kp95*
Millions of euro (at 1995 prices and exchange rates)
indic_na *b1g*
Gross value added (at basic prices)

NOTES:

1 *All NACE branches - Total*
2 *Agriculture, hunting, forestry and fishing*
3 *Total industry (excluding construction)*
4 *Construction*
5 *Wholesale and retail trade, repair of motor vehicles, motorcycles and personal and household goods; hotels and restaurants; transport, storage and communication*
6 *Financial intermediation; real estate, renting and business activities*
7 *Public administration and defence, compulsory social security; education; health and social work; other community, social and personal service activities; private households with employed persons*

APPENDIX 5. Additional information[50]

Section 2

Soil contamination in Wallonia

Data on diffuse and local soil contamination in the Walloon Region are available on line on the State of the Walloon Environment's site (chapters SOILS 04 and SOILS 05: http://environnement.wallonie.be/eew/rapportproblematique.aspx?id=SOLS_04 and http://environnement.wallonie.be/eew/rapportproblematique.aspx?id=SOLS_05) and the site of the *Société Publique d'Aide à la Qualité de l'Environnement* (Walsols database: http://www.walsols.be/).

Case studies in Wallonia

An integrated approach to soil contamination is illustrated by the case study of the Kessel-Dal residential district, which was developed on a former landfill site. The assessment of the risks to human health of the residents, started with the analysis of the soil quality of the top of the landfill. Soil samples were taken, applying a regular grid with 65 cells, focussing on the top layer. Only 6 samples, spread over the area, exceeded the soil sanitation standard. In addition, the diffusion of the contamination from the waste deposits to the groundwater and the soil air was investigated. The model Vlier-Humaan was used to determine the human-toxicology. The application of the RBCA[51] model assessed off-site migration aspects. The conclusion of the investigation was that the contamination present in the living area did not form a human or eco-toxicological risk if groundwater was not used and remediation was judged not necessary. The residents were advised not to use the groundwater. This was the first case of an integrated approach for contaminated residential areas. This study provided guidelines for the approach to take in similar cases.

In the Walloon Region, the environmental protection firm specialised in soil remediation SPAQuE publishes the list of the most problematic polluted or potentially polluted sites in Wallonia on its Internet site (http://www.spaque.be/). It also presents some case studies, such as the rehabilitation of the Carcoke site (33 hectares) in the municipality of Saint Guislain. The Carcoke site was the largest coke production site in Belgium between 1928 and 1997. This activity generated substantial pollution of the site, which had to be remediated accordingly. This rehabilitation was exceptional given the surface area involved and the symbolic importance of the site. Not only was an important part of Wallonia's industrial past slated for destruction, but its rehabilitation was also a clear sign of the area's renewal. The site contained a large pollution load (cyanide, hydrocarbons, benzene, ammonia compounds, and so on) in its soil and the pollution levels measured in various spots exceeded the reference standards applicable in the Walloon Region. The polluted

[50] This section was developed by Belgium.
[51] RBCA (pronounced "Rebecca") stands for "Risk-Based Corrective-Action. RBCA refers specifically to the standard entitled *Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites* [E-1739-95] that was published by the American Society for Testing and Materials (ASTM) Subcommittee on Storage Tanks. More information on the USEPA web site at: http://www.epa.gov/OUST/rbdm/rbdmfaq6.htm last accessed in May 2007.

earth was confined in a 4 250 m² confinement cell that was 4 m deep with an 11 metre-high dome. A total of 36 000 m² of land was excavated to make this cell, which held about 5 000 m³ of cyanide-contaminated soil and 47 000 m³ of polluted materials from the site's dismantling. (Cost of the characterisation study: 19 000.00 EUR; cost of remediating the cyanide-contaminated areas: 700 000.00 EUR).

Section 4

The management of soil contamination in Flanders

Since the coming into force of the Decree of 22 February 1995 concerning Soil Remediation, a major step was made in the soil remediation policy from the Flemish Region. The purpose of the decree is to remediate polluted land in Flanders and to prevent new pollution. In order to achieve this objective, the following measures are taken:

- Attribution of soil certificates. Ever since October 1, 1996, a soil certificate is needed when transferring a piece of land. If the land is registered as polluted, this is marked on the certificate. If not, the soil certificate is called 'blank'.
- Follow up of preliminary and descriptive soil examinations. A preliminary soil investigation provides indications on the degree of soil pollution.

Remediation depends on the degree of pollution and the time it has been established (recently or long ago). The first step in the process of remediation is a descriptive soil investigation, which tries to find out about the dispersion of the pollution and its future evolution. Moreover, the risks of the pollution are evaluated. If pollution is more established, a soil remediation project is worked out.

Transfer regulations have an important impact on the remediation process.

- Evaluation of soil remedying projects involving verification of the completeness and sustainability of the remedying projects submitted,
- Request of necessary advice and supervision on the publication of the project, draft a certificate of conformity or request changes/additions.
- Follow up and control of remediation works in progress.

If any safety or control measures are needed after finishing the works, OVAM provides a follow up. At the end, OVAM issues a final report, stating the results of the works.

OVAM actively participates in the policy of remediation, financing and development of 'brownfields', e.g. grounds that are polluted as a consequence of toxic industrial activities and which will be given a new destination after remediation. OVAM pro-actively participates in alternative remedying methods as well. In case the parties involved are unable or refuse to remediate, OVAM has the right to intervene in order to prevent worse. The main objective is to restore, remedy and/or manage environmental damage. This initially involves soil remediation sites listed on an official 'soil remediation list', established yearly by the Flemish government. Moreover, OVAM takes safety measures in case soil pollution should cause immediate danger for man or environment and the owner fails to solve the problem.

Since October 1, 1996, a soil certificate is needed when transferring a piece of land. There is an obligation of investigation of soils at the moment of property transfer. This is to protect further owners. If the land is registered as polluted, this is marked on the certificate. If not, the soil certificate is called 'blank'. In the Flemish Decree a clean-up obligation rests on the operator or the owner of the land where the pollution entered the soil. This means also that the obligation does not rest on the owner of the land polluted by migration of pollutants from other property. If new pollution is concerned, the obligation exists automatically. In the case of historical pollution, the obligation only arises after the clean-up order by the government. If from the descriptive soil examination it appears that a soil remediation project needs to be instituted, the transfer may only take place on condition that the transferor:

- has drawn up a soil remediation project that is complete and admissible;
- has committed himself vis-à-vis the OVAM[52] to carry out soil remediation works;
- has posted financial securities.

The Flemish Decree introduced a non-retroactive strict liability rule and channelled the liability for the new pollution to those that caused the pollution. Recourse against other responsible parties is however possible.

With respect to historical pollution, liability is determined by the rules in effect before the decree came into force. The owner or operator of the land where the pollution entered the soil is not obliged to carry out the clean-up if he can prove that he did not cause the pollution himself (by his fault or otherwise) and that when acquiring the property, he was not and should not have been aware of the pollution. In addition the owner for historical pollution is not obliged to carry out the clean-up if he proves that the polluted land was acquired prior to 1993 and was since then exclusively used for a non-professional use although he had prior knowledge of the pollution.

In case the parties involved are unable or refuse to remediate, OVAM has the right to intervene in order to prevent the worsening of the situation. Its main objective is to restore, remediate and/or manage environmental damage. This initially involves soil remediation sites listed on an official 'soil remediation list', established yearly by the Flemish government. Moreover, OVAM takes safety measures in case soil pollution should cause immediate danger for man or environment and the owner fails to solve the problem.

OVAM also actively participates in the policy of remediation, financing and development of 'brownfields', e.g. grounds that are polluted as a consequence of toxic industrial activities and which will be given a new destination after remediation.

Soil contamination can have severe spatial and economical consequences in urban and rural areas. The using opportunities of contaminated soil are limited. If the necessity of remediation is recognised too late, the spatial and economical development of housing, land use, infrastructure and industrial areas will stagnate. A remediation can be necessary because of high risk for man (human health) or risk for plants, animals and ecosystem or risk for spreading. To determine the severity of soil contamination and the necessity for soil remediation (including the urgency), a risk evaluation is been conducted including the determination of the

[52] OVAM is the Flemish agency for waste, which is in charge of contaminated land.

three risks mentioned above. In the risk evaluation the actual risk as well as the potential risk as a consequence of future changes in land use, are quantified.

Description of existing data on soil in Wallonia

Study name	Bibliography	Parameters used	Number and type of observations	Types of data	Sample referencing	Periodicity of monitoring
Soil Database of REQUASUD	Colinet, Toussaint, Laroche, Goffaux et Oger (2005) Laroche et Oger (1999)	Soil Soil Database fertility parameters: pH, C, N, P_{disp}, et échangea.	Georeferencing accuracy problem, but many analyses: ≈100 000 from arable land ≈53 000 from grasslands	Composite samples in the topsoil of the plots studied	Samples referenced by postal code	1st synthesis (1994-1998) 2nd synthesis (1998-2002)
Survey Surface Agricole of PGDA	Vandenberghe, Marcoen 2004 (GRENeRA, ECOP)	NO_3, N, C, pH, CEC, P_{disp} et échangea.	140 plots of arable land and 40 meadows	Composite samples from the surface and deep horizons	Georeferencing of the plots Georeferencing of the elemental samples	yearly
Pollusol Database	Pollusol - Groupe d'Étude APPP, « Application de la pédologie aux problèmes de pollution » 2003 (SPAQuE, UCL, FUSAGx–BEAGx)	ETMs & MPOs norms	112 surveys in agricultural areas Main soil series	Spot samples from the diagnostic horizons taken from core samples	Georeferencing of survey points	no
Pedological monitoring of the permanent inventory of ligneous resources	Colinet et Bock, 2004 Laroche, Weissen et Bock, 2003 Rondeux, Lecomte, Florkin, Thirion 1996	pH, C, N, P_{disp} , échangea., ETMs	88 samples from forest inventory "placettes" (1 "placette" = circle with a radius of 18 m)	Composite samples inside the placette (depth: up to 20 cm)	Georeferencing of the centre of the "placette"	Every 10 years
Soil Quality Inventory	Petit et Defoux 2001 (Office Wallon des Déchets, DPS)	ETMs, pH	2 100 plots sampled under a programme of waste re-utilisation in agriculture Composite sampling of the plots	Mean topsoil samples (25 elemental samples)	Georeferencing of plots but not of elemental samples	At least every 10 years
Agricultural Soil Quality Inventory of Luxembourg Province	Léonard, Sacré, Toussaint, Peeters, 2001	Soil fertility parameters: pH, C, P_{disp} , échangea.	80 plots, 2 x 40 holdings	Mean topsoil samples	Localisation of plots on a 1/10 000 scale map	no
Soil Map Database	Van Orshoven, Vandenbroucke, 1993 (AARDEWERK database)	Descriptive and fertility parameters	13 000 profiles but problem of comparability of the values	Samples from the diagnostic horizons of a soil pit	Localisation of the soil pits on a 1/20 000 scale map	no

Soil Services in Wallonia

The main bodies and institutions responsible for soil protection in the Walloon Region include:

a) Public and semi-regional bodies

- The Soil Protection Directorate of the Ministry of the Walloon Region's Directorate-General for Natural Resources and the Environment (MRW/DGRNE/DPS). This department is responsible for monitoring soil quality through the management of file on the agricultural use of exogenous matter, amongst other things; drawing up legislation; and managing the conditionality of treatment sludges and nitrates. (See http://environnement.wallonie.be/owd/dps/index.htm)

- The Walloon Waste Department's Soil Rehabilitation and Remediation Department (service Réhabilitation et Assainissement des sols - MRW/DGRNE/OWD/DIGD). This department's main tasks are to manage the plans for rehabilitating waste tips and remediating service stations and to draw up a data inventory of (potentially) polluted soils (see http://environnement.wallonie.be/owd/dgdsc/index.htm)

- The Rural Area Directorate (Direction de l'Espace rural) of the Ministry of the Walloon Region's Directorate-General for Agriculture (MRW/DGA/DER), which acts upon the territorial and environmental dimensions of agriculture by issuing opinions on permit applications, bringing stockfarming buildings in compliance with standards, and implementing agri-environmental measures (See http://agriculture.wallonie.be)

- The Operational Development Directorate (Direction de l'Aménagement Opérationnel) of the Ministry of the Walloon Region's Directorate-General for Regional Planning and Development, Housing and Heritage (MRW/DGATLP/DAO), which is responsible for redeveloping and rehabilitating certain abandoned sites, amongst other things (see http://mrw.wallonie.be/DGATLP/DGATLP/Pages/DAU/Pages/Directions/DirAmOp/DirAmOp.asp)

- The state-owned environmental quality company Société Publique d'Aide à la Qualité de l'Environnement (SPAQuE), which is in charge of rehabilitating "orphan" sites and polluted sites that are very hazardous for the environment and public health (http://www.spaque.be)

- The Public Service Scientific Institute (Institut Scientifique de Service Public or ISSeP), which participates in various scientific undertakings (state of pollution, risk analyses, expert opinions, etc.) and produces the reference compendium for taking, handlings, and analysing soil and water samples in the Walloon Region (http://www.issep.be).

b) Soil analysis laboratories

Several laboratories in addition to ISSeP are approved for carrying out soil analyses in the Walloon Region. They are primarily the laboratories belonging to the Réseau Qualité Sud (chaîne Minérale-sols et chaîne Nitrates: http://www.requasud.be/loca.shtm), BEAGx or the Environment & Analysis Office of Gembloux Agricultural College (Bureau Environnement et Analyse de la Faculté universitaire des Sciences agronomiques de Gembloux), and the Service Pédologique de Belgique or Soils Office of Belgium (SPB: http://www.bdb.be). These bodies handle orders from private individuals, farmers, and engineering offices working in the area of polluted soil remediation.

c) Research centres and centres of expertise

The Walloon Region has several research units (universities and public research centres) that participate in managing and improving knowledge about soils. These include Catholic University of Louvain's (UCL) Soil Sciences Unit (http://www.sols.ucl.ac.be/), the "Sol-Ecologie-Territoire" ("Soil-Ecology-Territory") and Agricultural Hydraulics Units of Gembloux Agricultural College (http://www.fusagx.be/fac/fr/unites/ha.asp; http://www.fusagx.be/fac/fr/unites/st.asp), and the Walloon Agricultural Research Centre (http://www.cra.wallonie.be/).

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Abstract

The 'Soil Country Analyses' series is the outcome of a collaboration between the European Environment Agency (EEA), the EIONET countries and the European Soil Data Centre from the IES-JRC.

In order to overcome the general scarceness of information on soil at European scale and to include socioeconomic aspects in the assessment of soils in Europe, the EEA initiated in 2007 the preparation of the soil country analyses, by putting together available information on the different soil aspects. This information was loaded into a questionnaire customised for each country. The countries were then asked to review the information and provide additional data where possible.

The country reports presented here are the final outcome of this process. The reports offer an overview of the status of soil resources at the national level and touch on the aspects presented in the Soil Thematic Strategy. These include the main soil threats, the different soil policy instruments (also economic instruments) in force, and the specific soil management programmes and monitoring activities implemented or planned in each country.

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