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Case Study – Belgium

Sustainable Agriculture and Soil Conservation (SoCo Project)

Ann Verspecht, Guido Van Huylenbroeck, Annemie Van den Bossche, Sara De Bolle, Bram Moeskops, Stefaan De Neve

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Authors:
Ann Verspecht, Guido Van Huylenbroeck[1]
Annemie Van den Bossche, Sara De Bolle, Bram Moeskops, Stefaan De Neve[2]

Editors:
Stephan Hubertus Gay, Monika Schmidt[3], Katrin Prager[4]

1 Ghent University, Faculty of Agricultural and Applied Biological Sciences, Department of Agricultural Economics
2 Ghent University, Faculty of Agricultural and Applied Biological Sciences, Department of Soil Management and Soil Care
3 European Commission, Joint Research Centre (JRC), Institute for Prospective Technological Studies (IPTS)
4 Humboldt-Universität Berlin, Faculty of Agriculture and Horticulture

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Joint Research Centre
Institute for Prospective Technological Studies

Contact information
Address: Edificio Expo. c/ Inca Garcilaso, 3. E-41092 Seville (Spain)
E-mail: jrc-ipts-secretariat@ec.europa.eu
Tel.: +34 954488318
Fax: +34 954488300

http://ipts.jrc.ec.europa.eu/
http://www.jrc.ec.europa.eu/

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Preface

Agriculture occupies a substantial proportion of European land, and consequently plays an important role in maintaining natural resources and cultural landscapes, a precondition for other human activities in rural areas. Unsustainable farming practices and land use, including mismanaged intensification and land abandonment, have an adverse impact on natural resources. Having recognised the environmental challenges of agricultural land use, in 2007 the European Parliament requested the European Commission to carry out a pilot project on 'Sustainable Agriculture and Soil Conservation through simplified cultivation techniques' (SoCo). The project originated from close cooperation between the Directorate-General for Agriculture and Rural Development (DG AGRI) and the Joint Research Centre (JRC). The JRC's Institute for Prospective Technological Studies (IPTS) coordinated the study and implemented it in collaboration with the Institute for Environment and Sustainability (IES). The overall **objectives of the SoCo project** are:

(i) to improve the understanding of soil conservation practices in agriculture and their links with other environmental objectives;

(ii) to analyse how farmers can be encouraged, through appropriate policy measures, to adopt soil conservation practices; and

(iii) to make this information available to relevant stakeholders and policy makers EU-wide.

In order to reach a sufficiently detailed level of analysis and to respond to the diversity of European regions, a case study approach was applied. Ten case studies were carried out in Belgium, Bulgaria, the Czech Republic, Denmark, France, Germany, Greece, Italy, Spain and the United Kingdom between spring and summer 2008. The case studies cover:

- a screening of farming practices that address soil conservation processes (soil erosion, soil compaction, loss of soil organic matter, contamination, etc.); the extent of their application under the local agricultural and environmental conditions; their potential effect on soil conservation; and their economic aspects (in the context of overall farm management);
- an in-depth analysis of the design and implementation of agri-environmental measures under the rural development policy and other relevant policy measures or instruments for soil conservation;
- examination of the link with other related environmental objectives (quality of water, biodiversity and air, climate change adaptation and mitigation, etc.).

The results of the case studies were elaborated and fine-tuned through discussions at five stakeholder workshops (June to September 2008), which aimed to interrogate the case study findings in a broader geographical context. While the results of case studies are rooted in the specificities of a given locality, the combined approach allowed a series of broader conclusions to be drawn. The selection of case study areas was designed to capture differences in soil degradation processes, soil types, climatic conditions, farm structures and farming practices, institutional settings and policy priorities. A harmonised methodological approach was pursued in order to gather insights from a range of contrasting conditions over a geographically diverse area. The case studies were carried out by local experts to reflect the specificities of the selected case studies.

This Technical Note is part of a series of ten Technical Notes referring to the single case studies of the SoCo project. A summary of the findings of all ten case studies and the final conclusions of the SoCo project can be found in the **Final report on the project 'Sustainable Agriculture and Soil Conservation (SoCo)'**, a JRC Scientific and Technical Report (EUR 23820 EN – 2009). More information on the overall SoCo project can be found under http://soco.jrc.ec.europa.eu.

BE - Belgium	**West-Vlaanderen** (Flanders)
BG - Bulgaria	**Belozem** (Rakovski)
CZ - Czech Republic	**Svratka river basin** (South Moravia and Vysočina Highlands)
DE - Germany	**Uckermark** (Brandenburg)
DK - Denmark	**Bjerringbro and Hvorslev** (Viborg and Favrskov)
ES - Spain	**Guadalentín basin** (Murcia)
FR - France	**Midi-Pyrénées**
GR - Greece	**Rodópi** (Anatoliki Makedonia, Thraki)
IT - Italy	**Marche**
UK - United Kingdom	**Axe and Parrett catchments** (Somerset, Devon)

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Acronyms

ABS	General Farmers' Syndicate (Algemeen Boeren Syndicaat)
AES	Agri-environmental scheme
BB	Farmer's union (Boerenbond)
CCEP	Coordinating Unit European Rural Development Policy
CKC	Centre of Quality Control (Centrum voor KwaliteitsControle)
EAFRD	European Agricultural Fund for Rural Development
FEA	Flemish Environmental Agency
FLA	Flemish Land Agency (Vlaamse landmaatschappij)
FLA-AP	Flemish Land Agency – Rural Development Division
FTE	full time labour equivalent
LNE	Department of Environment
LV	Department of Agriculture
LV-ADLO	Department of Agriculture – Division of Sustainable Agricultural Development
LV-AMS	Department of Agriculture – Flemish Division for Agricultural Policy Analysis
LV-MIB	Department of Agriculture – Flemish Paying Agency
MESAM	Measures against Erosion and Awareness Raising of Farmers for the Protection of the Environment (Maatregelen tegen Erosie and Sensibilisatie van Agrariërs ter bescherming van het Milieu)
MINA	Flemish Counsel for Environment and Nature
NUTS	Nomenclature of Territorial Units for Statistics
PDPO	Flemish Rural Development Plan (Programmerings Document Platteland Ontwikkeling)
POVLT	Provincial Research and Information institute for Agriculture and Horticulture (Provinciaal Onderzoeks- en Voorlichtingscentrum voor Land- en Tuinbouw)
RDP	Rural Development Plan
REO	Agricultural Auction Market for Roeselare and the surrounding area (Roeselare En Omgeving Veiling)
SERV	Social and Economic Council of Flanders
UAA	Utilized Agricultural Area
VLACO	Flemish Compost Organisation
VVSG	Flemish Association of Cities and Municipalities

1 Introduction to the case study area

The province of West-Flanders was selected because it is a province where a variety of important soil conservation issues are under discussion and are being investigated, which are related to the typical geography and cropping systems in this province.

The reason for choosing the scale of the province is that many statistical data are available and grouped at provincial level, which greatly facilitates the collection of these data. Provinces also have some level of independence with respect to agricultural research (e.g. provincial agricultural research centres) and implementation of agricultural policies.

From a policy perspective, this province has been monitored quite intensively during the recent past with respect to soil degradation processes, because of the urgency and severity of the problems mentioned. Therefore, the effect of measures that need to be implemented can be monitored relatively accurately.

The case study area comprises the province of West-Flanders with a total surface of 3,175 km². West-Flanders counted 1,123,786 inhabitants on 1 January 1997. This is 19.1 % of the total Flemish population. The total surface of West-Flanders amounts to 314,434 ha or 23.25 % of the total Flemish surface. Urbanized areas constitute 22.8 % of the cadastral surface of West-Flanders (Flanders 27.3 %) and agriculture and horticulture are well for 68 % (Flanders 46 %). The province of West-Flanders lies – as part of Flanders – in the economic core area of the European Union. The province is surrounded by the strong economic areas of the "Randstad" in the Netherlands in the North, the French metropolis Lille-Roubaix-Tourcoing in the South and London in the West. West-Flanders borders to the provinces of East-Flanders and Hainault and, as the only Belgian province, to the North Sea. Agriculture takes an important position. Agriculture and horticulture create mainly an open landscape. West-Flanders is one of the most rural provinces of Belgium.

RELIEF in West-Flanders is diverse. The coastal plain, existing of coast dunes and Polders, were formed in the last 10,000 years. The average altitude of the dunes lies between 3 and 5 m. Exceptions are the coast dunes, which can adopt altitudes up to 35 m. (e.g. in Koksijde). The coast makes up part of a larger plain that runs from Calais (France) until the Wadden isles in the Netherlands: an extremely flat area with dikes and dunes. The Polders have a micro relief with creek backs (elongated backs with altitudes of 3 up to 4 meters) and bowl grounds (depressions with a depth of 1 up to 2 meters). The creek backs have a firm (sand) sub soil, on which the most of (historical) farms have been built. The area between the coastal plain and the valley of the river Leie contains a consecution of backs and depressions. In the western part to the south of Ypres and Poperinge different hills dominate and this hill line passes through to France. The tops of the hills are characterised by iron sandstone which explains their capacity against erosion. The Flemish Valley is the result of erosion of material during the last interglacial period and an upholstering with sand by a strong wind functioning during the last ice age. The rivers Leie and Scheldt have both cut out a layer terrace during the last ice age.

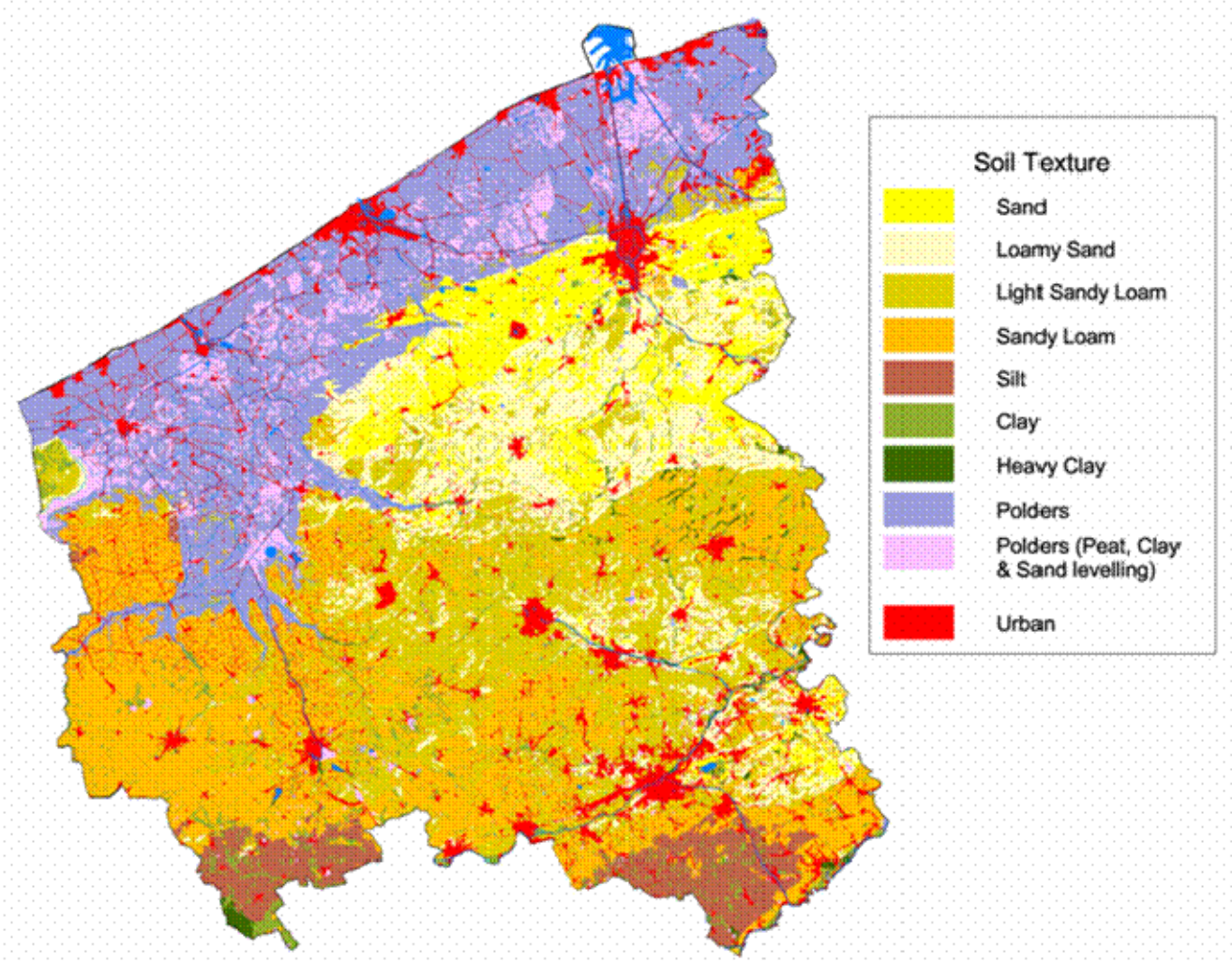
The river basins of West-Flanders are the Scheldt (with Leie, Mandel and the canal Roeselare-Ooigem), the Ijzer and the Polders (with the canal Bruges-Ghent). Within the river basins the navigable streams are fed by fine branched water flows. Surface water which is used for the production of drinking water has been bound to water production centres. Every production centre has a capitation area. These areas enjoy specific protection to ensure quality of the surface water. The need for drinking water in West-Flanders is satisfied for 33.4 % by groundwater.

The composition of the **SOIL** is mainly the result of the supply of sand and silt from the North Sea Canal during the last ice age (Würm). Sand has a heavier grain size than silt and was blown less far country-inward. The "Flemish Valley" was eroded and as a result this low plain

could be filled up with sand from the north. West-Flanders has therefore, taking into account relief, from North West to South East a sand region, sandy loam region and silt region (Figure 1). The “Polders”, which received their current form in the last millennium, consist mainly of clay soils with a Dune belt along the coast.

The main sediments in Lower and Central Belgium are sand and silt by eolian deposition so the composition of soil in West-Flanders is typical for Belgium.

Figure 1: Soil Texture Map of the province of West-Flanders



Source: OCGIS, 2001

AGRICULTURE in Flanders is a very intensive. The high population density as well as the spatial planning policy of the government resulted in a strong competition for open space. The evolution of farming types has largely been influenced by the scarcity of land. In the last century more and more arable land changed into living or industrial area. Farmers were forced to farm more intensively. This resulted in an explosion of intensive pig farming (1 million pigs in 1950 (Lips, 2004) up to 5.9 million in 2006 (FPS, Agric. census, 2008).

Agriculture is equally important in West-Flanders. Table 1 shows a UAA of about 21 million ares, which is high compared to the other provinces. The high importance of farming in West-Flanders reveals itself also in the percentage of Utilised Agricultural Area (UAA) of the total surface of the province: In West-Flanders 67 % of the land is agricultural land, in Flanders this is only 45 %, in Belgium 42 %. In terms of UAA, arable farming land is most important

(72 %) in West-Flanders; grassland covers only 27 % of the total UAA. These values are in line with the general figures for Flanders. (VILT, 2008)

Table 1: Agricultural characteristics of the Belgian case study

	Belgium	%	Flanders	%	West-Flanders	%
UAA (are)	138,238,998		62,520,683		21,063,600	
Land use (are, within UAA)						
Arable	84,166,559	60.9	43,462,582	69.5	15,165,951	72.0
Cereals	32,961,445	39.2	14,571,347	33.5	4,569,591	30.1
of which wheat	20,132,995	23.9	7,199,772	16.6	2,939,762	19.4
Sugar Beet	8,291,173	9.9	3,096,771	7.1	1,212,906	8.0
Potatoes	6,726,682	8.0	4,211,449	9.7	2,205,427	14.5
Arable fodder	25,335,593	30.1	16,847,459	38.8	4,731,075	31.2
Vegetables	4,047,059	4.8	2,811,033	6.5	1,750,433	11.5
Grassland	51,730,554	37.4	16,943,339	27.1	5,744,639	27.3
Other	2,341,885	1.7	2,114,762	3.4	153,010	0.7
Forest	60,638,139		10,805,897		684,309	
Farm Structure						
Number	49,850		33,272		10,892	
of which fulltime	35,482	71.2	23,643	71.1	8,282	76.0
of which part-time	14,368	28.8	9,629	28.9	2,610	24.0
of which natural persons	46,172	92.6	30,757	92.4	10,117	92.9
of which legal persons	3,678	7.4	2,515	7.6	775	7.1
Work force	92,405		64,983		21,537	
of which family labour	78,478	84.9	54,170	83.4	18,946	88.0
of which hired labour	13,927	15.1	10,813	16.6	2,591	12.0
full time labour equivalent	67,978		48,114		15,825	
full time labour equ. per farm	1.4		1.4		1.5	
Farming systems- Livestock						
Cattle	2,663,076		1,332,923		424,495	
of which dairy cows in production	507,327		283,727		83,842	
Pigs	6,294,904		5,924,171		3,217,207	
Poultry	32,866,650		28,14,820		10,516,374	
Sheep	153,976		97,359		34,730	
Irrigation	2,246,909	1.6	1,986,644	3.2	1,014,411	4.8
Drainage	13,510,703	9.8	10,437,863	16.7	7,583,869	36.0
Land tenure						
Own Land	44,381,997	32.1	21,179,214	33.9	7,137,328	33.9
Rented land	92,441,960	66.9	40,323,366	64.5	13,569,205	64.4
Share tenancy	1,415,041	1.0	1,018,103	1.6	357,067	1.7

Source: FPS Economy, SMEs, independent Professions and Energy, Census of agriculture, May 2006
*Source: FPS Economy, SMEs, independent Professions and Energy, Statistics of the land use, 2005

Compared to the rest of Flanders, the biggest difference is noticed for potatoes and vegetables. The percentage of the UAA used to grow potatoes is with 14.5 % considerably higher than the average for Flanders (9.7 %). The area grown with vegetables (11.5 %) is also considerably higher than the average for Flanders (6.5 %). The area of forest in West-Flanders is 684,309 ares, which is only 6.3 % of the total area of forests in Flanders. (NIS, 2006)

In total, there are 10,892 farms in West-Flanders, which is 32.7 % of all farms in Flanders. There are more full-time farmers in West-Flanders than the average for Flanders. Expressed in full time labour equivalents (FTEs), West-Flanders has 15,825 which correspond to an average of 1.5 per farm. (NIS, 2006)

West-Flanders. Also the poultry sector is represented more in West-Flanders, with 37.4 % of all poultry in Flanders located in this province. (NIS, 2006)

Drainage is considerably more important in West-Flanders (36 % of UAA) than in the rest of Flanders (16 % of UAA). (NIS, 2006)

Table 1 also shows the situation concerning land tenure in West-Flanders. This follows the average over the whole of Flanders, with 33.9 % of owned land, 64.4 % rented land and 1.7 % of land in shared tenancy.

The following **SOIL DEGRADATION PROCESSES** can be distinguished in order of their relevance:

1. Diffuse soil contamination
2. Soil erosion by water
3. Decline in organic matter

These degradation problems, the drivers and their impacts will be described further in Section 3.1. In addition to these soil degradation issues there are further soil degradation problems that need attention.

Soil sealing is the loss of soil resources due to the covering of land for housing, roads or other construction work. This type of soil degradation is not specific for the province of West-Flanders but is a serious problem in the whole of Belgium, where there is a very strong competition for land between different alternative land uses. Agricultural land is still being converted to land for housing, industries and roads, which poses a serious threat to the sustainability of food production in the long term.

Loss of soil biodiversity is a type of soil degradation which is poorly studied in Belgium, and only recently there have been initiatives to monitor a number of important biological soil parameters. However, it is very likely that soil biodiversity has declined in the past decades and is declining still. Indeed, soil biodiversity is strongly affected by physical soil deterioration, loss of soil organic matter, soil erosion and excessive nutrient content in soil, which are all processes which have been taking place increasingly over the last decades.

2 Methodology

An overview of all conducted interviews is provided under Chapter 0.

To answer Questionnaire 1 (Expert Questionnaire) we used the soil and agricultural experts' knowledge residing in our department and the guidelines for tackling erosion published by the government of Flanders (Thomas et al., 2004).

For Questionnaire 2 (Farmer survey), we focused on erosion and diffuse contamination, which are the two main problems in West-Flanders and selected two groups of farmers. The data of farmers who have the most problems with erosion were divided into two analyses. Data concerning the issue of erosion was generated from one interview (Farmer 1) and interviews conducted as part of a previous study (Farmers 8-16, based on the MESAM questionnaire: Anonymous, 2006[5]). The farmers confronted with diffuse contamination were selected

[5] MESAM (Measures against Erosion and Sensibilisation of Farmers for the protection of the Environment) was an Interreg IIIa project (January 2003 - March 2007) aimed to control soil erosion across regional, provincial and national borders: Nord-Pas de Calais, Hainaut, West- and East-Flanders. One of the actions was a survey on soil erosion measures, based on a questionnaire, with 143 farmers, of which 41 interviewees were from West-Flanders (www.mesam.be)

based on their management intensity (intensive vegetable production or intensive live stock breeding). In West-Flanders intensive agriculture is highly important (see Chapter 1) and it has resulted in areas highly sensitive to diffuse soil contamination. The farmers interviewed for diffuse contamination are Farmer 2-7 (see list of interviews in Chapter 0) and all of them were interviewed face-to-face.

For Questionnaire 3 (Administrator survey) we interviewed the different administrative services of different geographical levels. We interviewed the Flemish administrations for agriculture and environment. Sometimes different divisions have been interviewed within the same policy domain because of different tasks or responsibilities. Provincial and municipal public servants were questioned as well. In addition we included a more independent service in our survey, whose task it is to evaluate the state of the environment and nature.

Questionnaire 4 focuses on other actors which operate outside public bureaucracies. Therefore we interviewed environmental or nature organisations, farmer's unions, research institutions and other related involved actors as fruit and vegetable auctions or farmer extension services.

The interviewed organisations which represent the interest of the farmers are the regional division of Boerenbond (the Farmers' Union), ABS (Algemeen Boeren Syndicaat – the General Farmer's Syndicate) and the REO auction. The REO (Agricultural Auction Market for Roeselare and the surrounding area) is a cooperative fruit and vegetable auction where over 3,000 producers work together. CKC (Centrum voor Kwaliteitscontrole – Centre of Quality Control) is an organisation which controls the food quality for the industry and the government. POVLT (Provinciaal Onderzoeks – en Voorlichtingscentrum voor Land – en Tuinbouw, Provincial Research and Information Institute for Agriculture and Horticulture) is an organisation which undertakes research to advise farmers and to assist the government in implementing rules.

We interviewed a representative of the MINA Council (the Flemish Council for Nature and Environment), and a representative of the umbrella organisations of the environmental organisations in Flanders.

The Flemish Compost Organisation (VLACO) and the Regional Landscape West-Flemish Hills are probably organisations that have not a big influence on regional policy makers, but are interesting organisations from the point of view of soil conservation or initiating local actions.

Number of interviews conducted:

Questionnaire 2 (farmers):	8 (+ 9, which have been interviewed in a previous project on soil erosion, MESAM)
Questionnaire 3 (administrative actors):	10
Questionnaire 4 (civil society actors):	9

3 Perception of soil degradation in the case study area

3.1 Soil degradation processes

From interviews in the case study and from expert opinion, five degradation processes have been identified in West Flanders; namely, diffuse contamination, decline in organic matter, soil erosion, and soil compaction. The causes and impact of these specific soil degradation processes within the study area are listed in Table 2. Of these, diffuse contamination, soil erosion and loss in organic matter are considered to be the main soil degradation processes in the region.

Table 2: Experts' opinions on soil degradation processes in West-Flanders

Soil degradation process	Causes	Impact
Diffuse soil contamination	• Soil texture • Intensive animal breeding • Large production of animal manure • Intensive vegetable production • Overfertilization • Inappropriate timing of fertilization	• Nutrient leaching • Increase of mineralization capacity of soils • Eutrophication of nitrate and phosphorus in ground and surface water
Decline in organic matter:	• Intensifying of tillage practices • Change in legislation of application of animal manures	• Decrease of soil physical quality • Increased susceptibility to erosion (by wind and water) • Decrease of soil biological quality • Negative effect on greenhouse gas balances
Soil erosion by water	• Soil topography • Soil texture • Bare soils • Intensifying tillage practices • Changes in crop rotation	• Loss of productive topsoil • Poor emergence • Soil crusting • Outcrops of stony subsurface soil • Sedimentation of basins and small streams • Eutrophication • Flooding of roads • etc
Soil compaction	• Intensifying management practices • Heavy machinery • Changes in crop rotation	• Decrease of water infiltration and retention • Increase of surface runoff • Decrease of soil fertility and productivity

Source: Experts' interviews

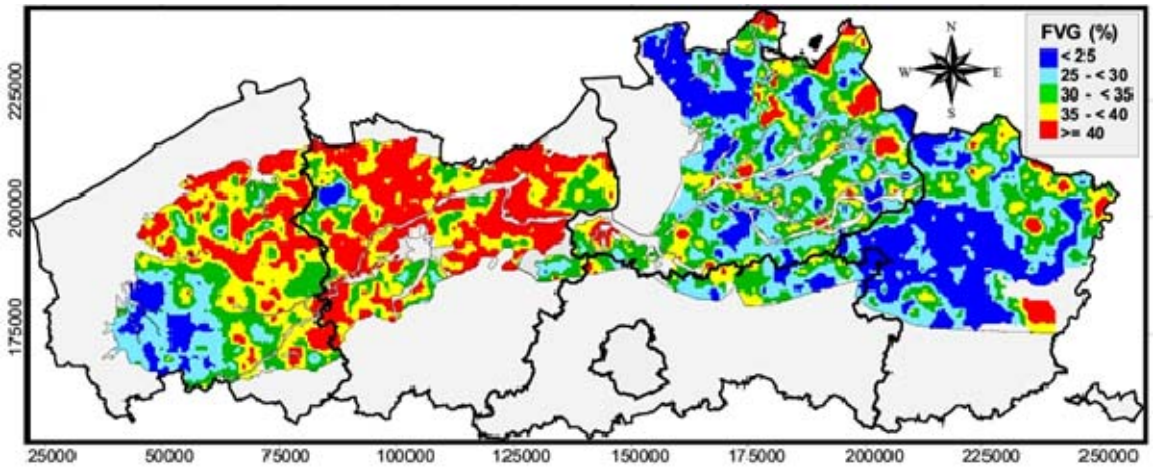
Diffuse soil contamination: the province of West-Flanders is characterised by very intensive agriculture, including intensive animal breeding (mainly pig breeding) and intensive vegetable production. There is a large production of animal manures, which are to a large extent land applied (manure treatment is becoming more important, but still represents a small share of total manure production), and in intensive vegetable production areas, additionally large amounts of mineral nitrogen fertiliser are being applied. This situation has been going on for a number of decades, and it wasn't until the beginning of the nineties that strict limits were imposed to the amounts of fertiliser and manure that could be applied. This has resulted in soils that are chemically very rich, i.e. contain large amounts of nutrients and relatively labile soil organic carbon (as a result of large inputs of labile organic matter such as in animal slurries and in crop residues). This has caused a gradual eutrophication of ground- and surface water in following manners. Large amounts of mineral nitrogen are leached below the rooting zone during winter, resulting in high amounts of nitrates in ground and surface water; more than 40 % of measuring points in surface water exceed the threshold value of 50 mg NO_3/l at least once a year. High accumulation of phosphorus in sandy loam soils

leads to P-saturation and high amounts of ortho-phosphate in the surface water (ca. 0.3 mg ortho-P/l). Detailed maps of areas of different degree of P saturation have been compiled during the nineties as a result of a collaborative project between the universities of Ghent and Leuven (Figure 2). While leaching losses of nitrogen can be remediated fairly rapidly by management (time scale of two years), the eutrophication by phosphorus is much more difficult to control. Once there is excess P in the soil, this can only be mined very slowly by agricultural crops, and P losses to the groundwater are likely to continue for a very long period, which is not possible to influence by management.

Due to the intensive character of the agriculture, **diffuse soil contamination** is seen as an enormous soil degradation issue. Interviewed farmers are aware of this problem and understand the impact of overfertilisation on the amount of nitrate and phosphate in soil. However, they mention that the amount of nutrients leaching to ground and surface water is also depending on soil type, climate, characteristics of the crops and not only on the amount of nutrients added by fertilisation. Moreover, through the Manure Decree soil samples were taken between 1st of October and 15th of November to determine if there is a risk of eutrophication to surface and ground water. But farmers quote that this measurement can only give a random indication at a given moment in time and while it does not point out the risk of eutrophication of nitrate. So farmers are prepared to undertake activities to reduce this threat by better fertilisation management, but on the other hand they also ask to differentiate the general rules taking into account previously mentioned factors.

Experts and administrative people believe this to be a serious soil degradation issue. Experts also mention the contamination of the soils with heavy metals due to the presence of heavy metals in the manure.

Figure 2: Map of the P saturation degree (FVG) of acid sandy soils in Flanders



Source: OCGIS, 2001

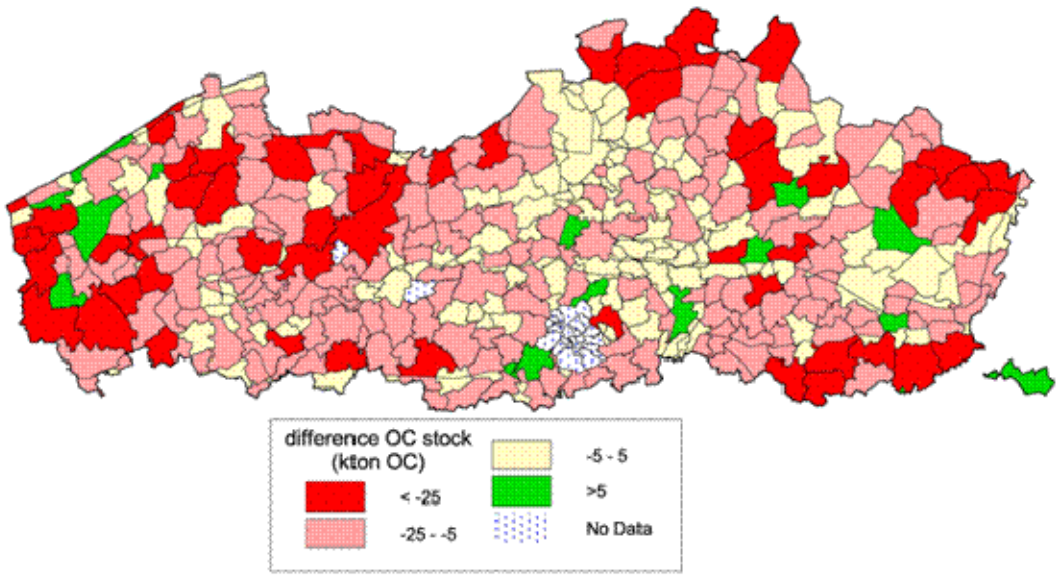
Soil erosion by water is an important soil degradation issue in the Southern part of the study area, where the landscape is undulating but still under agricultural use, and where soils are sandy loam to loam. Soil erosion in this area causes large on-site problems, including loss of productive topsoil, poor emergence, soil crusting, outcrops of stony subsurface soil, etc. which represent an important economic loss for the farmer. However, off-site problems are also severe, and include sedimentation of basins and small streams, an important source of eutrophication (it is the main source of P loss in these soils), and flooding of roads, all with serious costs to the society. Soil erosion problems in the area were aggravated along with the change in agricultural practices, including the creation of larger (longer) fields, more intensive tillage practices, changes in cropping pattern. However, during the last decades great efforts were made to survey the erosion problems and raise farmers' awareness. A number of measures have been investigated for their efficiency in combating erosion and are now being promoted.

Some farmers consider erosion in the upper soil layer by water run-off and flooding a severe soil degradation issue on their farms. However, they characterise soil erosion as a local problem depending on the topography, the soil type and crop rotation on the parcels. Wind erosion is regarded as a negligible problem in the area of West-Flanders. However, some farmers in the sandy region mentioned a limited sensitivity to wind erosion if soils are left bare.

Experts consider the erosion problem also serious in West-Flanders, yet to a lesser extent than the issues of diffuse contamination and loss of soil organic matter.

Decline in soil organic matter: starting from the early nineties a general trend of declining soil organic matter has been observed in the province of West-Flanders, in particular in the polder region and on loamy soils. This decline followed a period of build-up of soil organic matter which took place roughly speaking between the period of the soil survey for the Belgian soil map (fifties of the last century) and the end of the eighties. The Department of Soil Management (UGent) has carried out extensive research on both this period of build-up of soil organic matter (Van Meirvenne et al., 1996) and the subsequent decline (Sleutel et al., 2003). Figure 3 shows a map of the actual evolution of soil organic matter during these periods. This decline of soil organic matter is of great concern because it induces deterioration of the soil physical quality and increases susceptibility to both water and wind erosion, and may negatively affect the greenhouse gas balance.

Figure 3: Change in soil organic carbon stock in Flanders (Northern Half of Belgium) at the municipality level between 1990 and 2000



Source: Sleutel, 2005

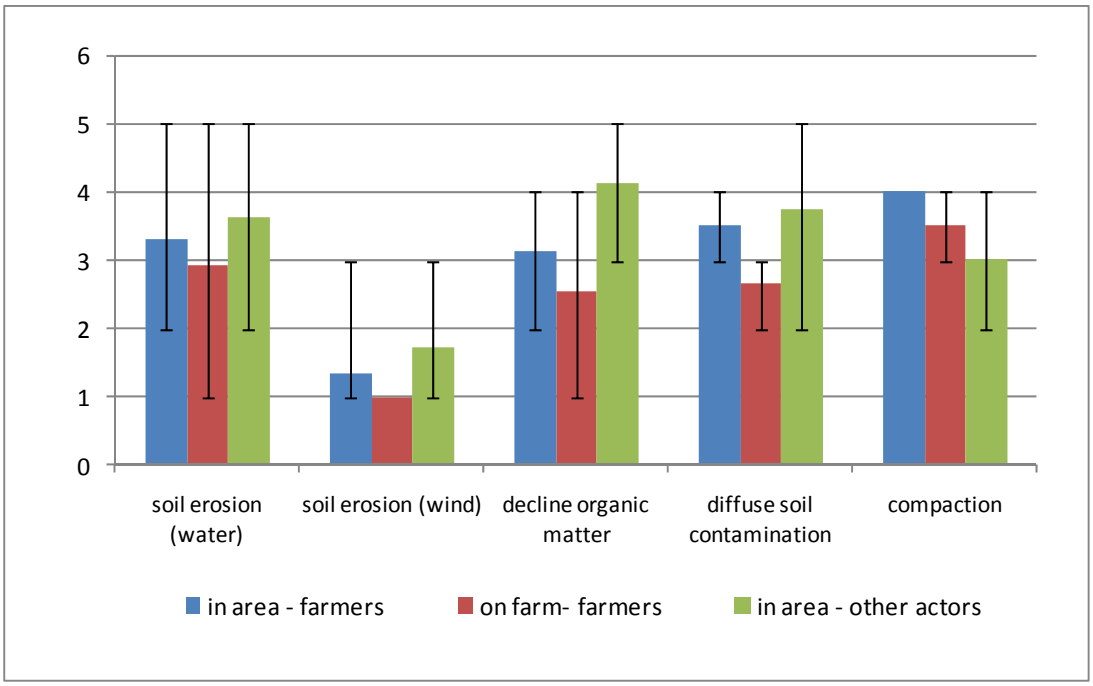
Although farmers try to augment the soil organic matter status, low contents of soil organic matter are still a problem in the area of this case study. Low soil organic matter content results in a descent of soil structure and enhance the susceptibility to soil water erosion.

The issue of soil organic matter is of great concern for the governmental organisations and the non-governmental organisations. Often the interviewees score this problem as high as the diffuse soil contamination. Therefore, it is remarkable that only some weak policy measures have been introduced to tackle the problem. Presumably, people are only recently becoming aware of the seriousness of the problem.

Farmers also mention that possibilities for increasing the soil organic matter status is limited due to restrictions in adding exogenous organic matter by the Manure Decree (MAP III, C-2006/37097). Many farmers are not aware of the exception rule in the MAP III which allows adding compost without effect for the manure applications standards.

Figure 4 also compares the farmers and other actors' perception regarding soil degradation processes on their farms and in the wider area. The perception of farmers and other actors is not so different. Other actors in general value the perceived problem to be more serious, except for compaction problems on their farm are usually valued less seriously than they perceive to be in their neighbourhood.

Figure 4: The perception of severity of soil degradation processes in West-Flanders



Source: SoCo-CS questionnaires

3.2 Trends in soil degradation and consequences

Trends and consequences of soil erosion

Most of the farmers find that soil erosion and flooding arise as much as ten years ago. However, nowadays farmers in sensitive areas are aware of the problem and are prepared to implement soil conservation measures. Still the majority of the investigated farmers have no idea of the amount of soil lost by erosion.

In contrasting with the farmers' viewpoint, some interviewees of governmental and non-governmental organisations believe that erosion worsened compared to 10 years ago. Some other governmental people, who were familiar with the erosion measures, did see an improvement compared to 10 years ago.

The following consequences of soil erosion were identified:

- Loss of fertile soil up to 30 ton per ha per year, at a cost of 3-15 Euro per ton (Anonymous, 2006);
- Loss of nutrients;
- Loss of soil organic matter;
- Degradation of soil biodiversity;
- Decrease of crop yield;
- Sedimentation of soil in streets and rivers at a cost of 100-300 Euro per ha per year (Anonymous, 2006); and
- Eutrophication of rivers.

Trends and consequences of diffuse soil contamination

According to farmers' perception, this soil degradation issue has declined during the last ten years. They see that adding excessive amounts of fertiliser is unnecessary and costly. Thus, farmers are in favour of adding less fertiliser for example by incorporating organic amendments, using row fertilisation or fertilisation based on scientific advice after soil sampling as long as these measures do not imply lower yields.

However, experts believe diffuse soil contamination to be still a prevalent problem in the case study area these days.

Compared to 10 years ago, most interviewees of governmental and non-governmental organisations assume a status-quo or a small improvement considering the diffuse soil contamination due to the effects of the Manure Decree.

Diffuse soil contamination has no direct influence on-site. However, adding excessive amounts of N and P leads to nitrate and phosphate leaching which results in eutrophication and pollution of ground and surface water.

Trends and consequences of decline of soil organic matter

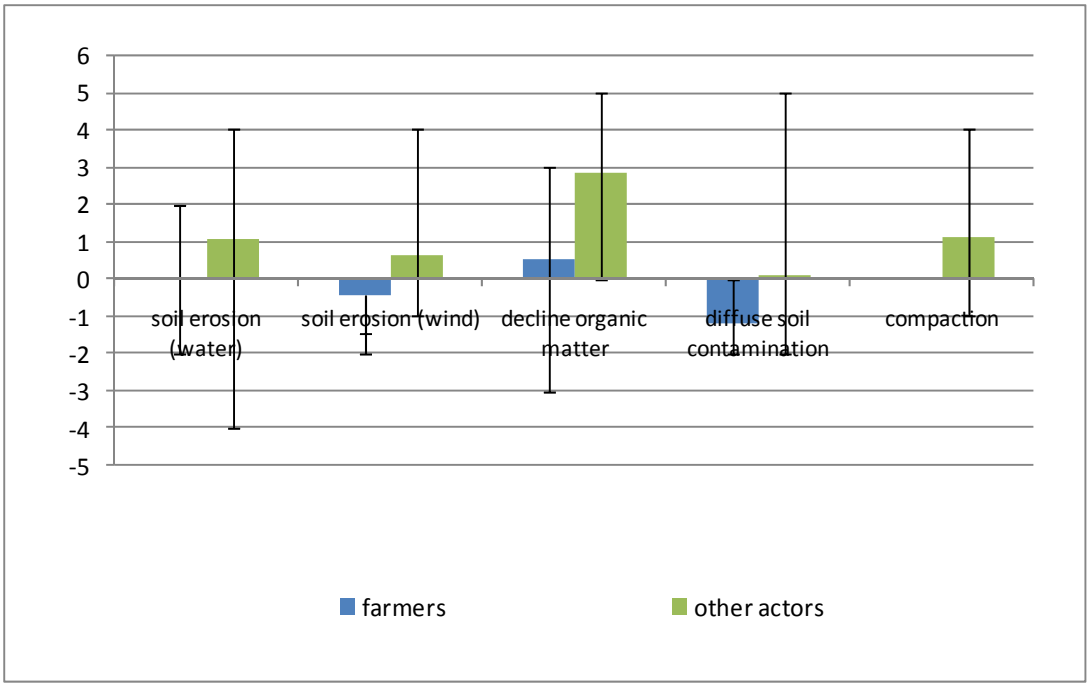
Since the early nineties a remarkable decline in soil organic matter status was observed. However, the farmers mention that this decline has stagnated during the last years and some farmers noted a small increase of organic matter content on their farms. The halt of the decline stagnation is due to farmers' increased awareness of the important role of soil organic matter.

In contrast, the interviewees of governmental and non-governmental organisations believe that the decline in organic matter is much more severe than 10 years ago. Experts also claim that soil organic matter content is still declining. During the last years the percentage of fields with an inadequate amount is even growing. The present organic amendments (combined with a conventional tillage by mouldboard ploughing) do not succeed in remaining the organic matter content at a constant level. Specific measurements at field scale are required.

The decline of soil organic matter leads to a degradation of the soil's physical quality, i.e. soil structure, which in turn increases the soil's susceptibility to erosion and leads to negative effects on greenhouse gas balance and on soil biology.

The perceived trends in soil degradation over the last 10 years in the catchment are presented in Figure 5. Other actors do believe that most problems have increased during the last 10 years. This is especially true for the decline in organic matter. Farmers are more optimistic and they believe problems have decreased. They certainly value their efforts regarding diffuse contamination in regard to the manure policy and believe this has an effect.

Figure 5: Trends in the mean perception of soil degradation in West-Flanders over a 10 year period



Source: Soco-CS questionnaires

4 Farming practices and soil conservation measures

4.1 Farming practices and their effects on soil

During the 20th century an explosive population growth in Western Europe resulted in a high food demand. Therefore arable (and vegetable) as well as animal production needed to increase through an intensification of agriculture. This intensive agriculture was based on mechanisation, intensive use of agrochemicals and organic manure and was focused on maximum food production without considering the long term impact on soil fertility or the environment. As a consequence modern agriculture is nowadays confronted with a number of pressing problems.

Tillage practices

The conventionally practised tillage involves the inversion of soil, normally with a mouldboard as the primary tillage operation, followed by secondary tillage. The main objective of the primary tillage is weed control through underploughing, and the main objective of the secondary tillage is seedbed preparation. The most obvious properties of the soil affected by tillage are probably the soil physical surface structure, total porosity, pore size distribution; tillage has therefore a great influence on the movement of water in the soil system. A negative aspect of the conventional tillage system is that the soil lacks a protective residue cover and is left practically bare, hence susceptible to soil and water losses through erosion.

Continuously ploughing itself also has some other disadvantages. Ploughing homogenises and breaks down the top layer, but on the other hand continuous ploughing can result in a compacted layer beneath the ploughed layer. As a result, water infiltration in the soil is reduced, while the rate of run-off and erosion increases. Conventional tillage also affects the soil chemical quality and soil organic matter content, as soil fertility highly declines while tillage intensity increases. Management practices with large amounts of soil disturbance accel-

erate losses of C (decline in organic matter status), promoting net N, P and S mineralisation. Biological properties are also affected. Population and activity of soil organisms are affected either through direct physical effect or indirectly by changing the soil environment.

These concerns have promoted some less intensive tillage operations, such as conservation tillage, aiming at reducing soil erosion and balancing nutrient inputs with environmental interests.

Crop rotation

Crop rotation can be a factor that both causes and prevents soil degradation, depending on which crops are selected. On parcels with a high susceptibility to soil erosion it is important to select a specific crop rotation which maximises soil cover e.g. by adding cereals or intercropping, as opposed to maize, having the soil left bare for a long time.

On the other hand crops such as potatoes or leek are causing the soil to be more susceptible to soil erosion due to their specific sowing pattern in ridges.

Harvesting

Good timing of harvesting plays a crucial role. Maize, sugar beets and potatoes are harvested between September and November, a period normally characterised by heavy rainfall. This results in wet soils and a high risk of soil degradation and compaction when harvesting.

Fertilisation

Fertilising has both advantages and disadvantages on soil conservation. Generally fertiliser is applied by (heavy) machines which entail the risk of soil compaction, and thereby decreasing the soil quality.

The effect of fertilising on soil conservation depends primarily on the kind of fertiliser used. When mineral fertiliser is applied, there is no added application of water or another liquid. This has advantages for soil conservation especially regarding erosion but there is the risk of salinisation or acidification if a farmer applies an excessive amount of mineral fertiliser.

If a farmer applies animal manure it is important to know which kind of manure he applies. Liquid manure (slurry) will have a quick and high release of nitrogen contrary to stable/farmyard manure. This is good if the crop has a rapid demand of nitrogen; if not, the possibility of nitrogen leakage is higher than with stable manure. Liquid manure contains a higher percentage of water than stable manure which impacts negatively on soil stability. Stable manure will release the nutrients more gradually and will contribute to the soil stability by adding e.g. straw (which composes is a large part of stable manure).

When manure is spread without being directly incorporated, a large part of the nitrogen will be lost through volatilisation (ammonia). This effect is less important to soil conservation but is very important for the environment.

In Table 3 the most typical **cropping systems** and their vulnerability to soil degradation processes are shown. The type of crop selected in the rotation can have an influence on the intensity of the soil degradation.

Winter wheat results in a maximum soil cover due to sowing in autumn and early harvesting which gives the ability to sew a green manure afterwards. This optimum soil cover causes a low vulnerability of the soil to water and wind erosion. After harvesting winter wheat, straw can be left at the surface which can also have a positive effect on the build-up of soil organic matter and decline the risk of diffuse soil contamination.

In contrast to cereals, **maize** leaves the soil bare for a long period of time, which results in a high vulnerability to soil water erosion. The opportunity to leave stubbles and straw on the field after harvesting and the possibility of direct drilling and/or undercropping can reduce this

vulnerability and augment the soil organic matter status and reduce the risk of diffuse soil contamination.

Cauliflower, a vegetable crop, regularly produced in this case study area is highly vulnerable to diffuse soil contamination due to its high N demand and the easily decomposability and resulting high available N content of the leaves left after harvest. More detailed control of soil nitrate content can help to decrease the risk of overfertilisation.

The specific sowing pattern of **potatoes** in ridges results in a high vulnerability of this crop to soil water erosion. Moreover, potatoes are normally harvested between September and November, a period characterised by heavy rainfall, which augments the risk of soil compaction and so the risk of soil water erosion. Restricting wheel pressure or implementing thresholds between the ridges can prevent soil depletion. On the other hand the shallow rooting of potatoes early harvest can result in a high mineral N residue in deeper layers (medium vulnerability to diffuse soil contamination).

On the one hand, soil cover can be augmented by sewing **sugar beets**, which decrease the threat to soil erosion. On the other hand harvesting of sugar beets is characterised by heavy machinery which can increase the risk of soil compaction and soil erosion (medium vulnerability). Specific attention has to be made to restrict wheel pressure of harvest machinery.

Leek is highly vulnerable to soil water erosion due to its specific sewing pattern (ridges) and is also highly vulnerable to diffuse soil contamination because of overfertilisation related to its high N demand, and consumer behaviours. Fertilisation based on frequently sampled soil nitrate analyses is urgently asked.

Table 3: Typical cropping systems, their characteristics and the estimation of impacts of soil degradation processes in the case study Belgium (West-Flanders)

Crop	Soft wheat, winter - Grain	Maize, Fodder - silage	Cauliflower - Ware	Potato – Root	Beet, sugar – Fodder	Leek – Ware
Production orientation	conventional	conventional	conventional	conventional	conventional	conventional
Farm type	arable farm	livestock farm > 1.5 LU	arable farm	arable farm	arable farm	arable farm
Tillage type	ploughing	ploughing	ploughing	ploughing	ploughing	ploughing
Irrigation type	no irrigation	no irrigation	no irrigation	no irrigation	no irrigation	no irrigation
other management options	leave straw on the field	leave stubbles and straw on the field; undercropping; direct drilling	soil sampling and analyse of nitrate content to focus fertiliser threats	thresholds between ridges; restricting wheel pressure of harvest machinery	leave crop residues on the field; restricting wheel pressure of harvest machinery	thresholds between ridges; restricting wheel pressure of harvest machinery and soil sampling and analyse of nitrate
Soil quality class[a]	2	2	1	2	2	2
Soil degradation process						
soil erosion water	low vulnerability	high vulnerability	low vulnerability	high vulnerability	medium vulnerability	high vulnerability
decline in organic matter		low vulnerability	medium vulnerability	low vulnerability	low vulnerability	medium vulnerability
negative carbon balance		low vulnerability	medium vulnerability	low vulnerability	low vulnerability	medium vulnerability
diffuse contamination	low vulnerability	low vulnerability	high vulnerability	medium vulnerability	medium vulnerability	high vulnerability
compaction		low vulnerability		medium vulnerability	medium vulnerability	low vulnerability

a: There are two soil quality classes in the case study: class 1 means sandy soils (poor quality, very sensitive to nitrate leaching and phosphate saturation); class 2 means sandy loam soils (good quality).

Note: in addition to these results further statements to typical cropping systems were given in the framework of questionnaire 2.

4.2 Suitable soil conservation measures

The effects of soil conservation measures are presented in Table 4 and Table 5 and will be discussed Chapter 5.

Table 4: Effects of cropping/tillage soil conservation measures on soil degradation processes

	Soil degradation process									
Measures	soil erosion water	soil erosion wind	decline in organic matter	negative carbon balance	diffuse contami-nation	compaction	salinisation	acidification	decrease of water reten-tion capacity	Off-site damage
intercrops	2		1	1	2	0				1
grass strips	1		0	0	1	0				2
no tillage/ direct drilling	2	2	1	1		2				1
reduced tillage	2	2	1	1		2				1
contour tillage			0	0					1	2
wheel sizes and pressure / re-stricting excessive heavy ma-chinery use	1					2				
restrictions on the max. amount of (liquid) manure application					2					2
restrictions of manure application to a certain time period					2					2
restrictions on the max. amount of N- fertilisation					2					2
restrictions on the max. amount of P-fertilisation					2					2
thresholds between ridges pota-toes	1	0	0	0	0	0	0	0	2	2

Legend: The numbers indicate *the general effects of soil conservation measures on soil degradation processes in the case study*, examined in questionnaire 1 with the following units: 2 = farming prac-tice highly mitigates the threat, 1 = farming practice mitigates the threat, 0 = farming practice has no effect on threat. The grey marked cells are not relevant because this measure has no relationship to the threat.

Table 5: Effects of long term soil conservation measures on soil degradation processes

	Soil degradation problem									
Measures	**soil erosion water**	**soil erosion wind**	**decline in organic matter**	**negative carbon balance**	**diffuse contamination**	**compaction**	**salinisation**	**acidification**	**decrease of water retention capacity**	**Off-site damage**
use of organic soil improvers/exogenous organic matter	1	1	2	2		1				No
liming	1	0	1	1	1	0	1	2	0	0
change of field patterns and sizes	1	1	0	0	1					1
retention ponds	1	0	0	0	0	0	0	0	0	
subsoiling						2				

Legend: The numbers indicate *the general effects of soil conservation measures on soil degradation processes in the case study*, examined in questionnaire 1 with the following units: 2 = farming practice highly mitigates the threat, 1 = farming practice mitigates the threat, 0 = farming practice has no effect on threat. The grey marked cells are not relevant because this measure has no relationship to the threat.

5 Evaluation of soil conservation measures

This section describes the main conservation measures being applied by farmers in West-Flanders. Six measures are included. The first one, intercropping, is most widely adopted. Secondly, the restrictions on fertilisation imposed by the Manure Decree are discussed. Fertilisation restrictions are highly necessary to control eutrophication, but are controversial among farmers. Thirdly, the use of exogenous matter and its conflicts with the Manure Decree are addressed. Finally, three measures to control soil water erosion are presented: contour tillage, grass buffer strips and corridors, and conservation tillage.

5.1 Intercrops

Intercrops are sown after the main crop, before winter. They serve two main goals. Firstly, they reduce erosion by covering soil that would otherwise be left bare. Secondly, they mitigate nitrate leaching by taking up the residual nitrate in the soil. After incorporation of the intercrop, its residues contribute to the soil organic matter pool and provide an additional source of nitrogen for the next crop. Most sown intercrops in West-Flanders are white mustard (*Sinapis alba* L.), grasses (mostly Italian rye-grass, *Lolium multiflorum* Lam.) and phacelia (*Phacelia tanacetifolia* Benth.). Almost all interviewd farmers sow intercrops.

Economic costs

- Farmers perceive sowing seed to be rather expensive.
- The Flemish government stopped subsidising intercrops in 2007, the objective of which was to get soil cover widely adopted. Most farmers regret the decision, but continue to apply the measure nonetheless. The nature and environmental organisations acknowledge the use of intercrops but believe this is good agricultural practice and should not be paid for. One farmer remarked that the subsidy was anyhow rather low (€ 50/ha). Several municipalities continue to subsidise intercrops.

Technical restraints

- In grain rotations (e.g. wheat-maize) rye-grass becomes soon a bothersome weed.
- In cabbage rotations (e.g. cauliflower) white mustard may promote cabbage specific pests and diseases, such as club root and cabbage root fly.
- The development of large amounts of aboveground biomass (e.g. with white mustard) hampers the destruction and incorporation of the green manure. The most used technique for destruction is herbicide application. Experts mention that this is not such a constraint as one can sow white mustard later in time, or mow it before seed production.
- Maize and sugar beet are harvested late. Intercrops sown after those crops may not produce sufficient biomass.
- Winter control of gastropods and fungi is not possible.

Environmental effectiveness

- Several demonstration experiments proved that intercrops strongly reduce erosion. This is also confirmed by the experience of the farmers.
- Farmers report that intercrops increase the organic matter content of their soils. However, experts indicate that the effect of intercrops on the build-up of organic matter is limited.

5.2 Restrictions on fertilisation

The European Nitrates Directive (91/676/EC) was translated in Flanders into a Manure Decree, of which the latest version is operational since January 2007. The Manure Decree

poses two main restrictions on fertilisation. First, the time period in which fertilisation is allowed is restricted. Application of slurry and chemical fertiliser is forbidden between the 1st of September and the 15th February, except for the heavy clay soils of the Polders where the fertilisation period is extended until the 15th October. Farmyard manure and compost must not be applied between the 15th November and the 15th of January. Secondly, maximum fertilisation norms were set. For vegetables (except legumes and chicory) the nitrogen norm is 275 kg N/[ha/year], or 345 kg N/[ha/year] if two crops are grown in the same calendar year. Furthermore, the nitrate residue left in the soil between the 1st October and the 15th November is not allowed to exceed 90 kg N/ha. The ultimate goal of the Manure Decree is to reduce the nitrate concentration in ground and surface water to ≤ 50 mg NO_3^-/l. Some exceptions can be made on these maximum fertilisation norms, the so-called derogation for certain (combination of) crops (pastures, combination grass-maize, and at least winter wheat) and when the farmers comply with certain extra prescriptions (still under construction).

Economic costs

Vegetable growers find it very difficult, if not impossible, to comply with the Manure Decree. According to them, the regulation affects their yield and hence their income negatively; hence their request to fertilise after the 1st of September if leek is grown in autumn. In arable farming, the Manure Decree can be adhered to without economic losses.

Technical restraints

Vegetable growers ask for support and fertilisation advice that reconciles high yields and observance of the Manure Decree. Besides controlling, it is the Manure Bank's task to give farmers fertilisation advice. Vegetable growers are receptive to advice but report that it is not provided. According to them, the Manure Bank works too theoretically and lacks the knowledge for giving feasible advice.

Environmental effectiveness

Diffuse soil contamination by nitrates is a serious soil degradation process in West-Flanders. A rigorous Manure Decree is needed to reduce the nitrate load in ground and surface water. In order to achieve the goal of 50 mg NO_3^-/l, the amount and time period of fertilisation should be restricted. However, the relationship between fertilisation and the nitrate concentration in ground and surface water should be refined. Regulations should be differentiated according to soil type and crop. Norms are more stringent for sandy soils. Leaching, for example, occurs faster in light sandy soils, compared to heavy, clayey soils. An adaptation of the residue norm of 90 kg N/ha according to the soil texture therefore seems reasonable to the farmers.

5.3 Use of exogenous organic matter

Soil organic matter is a key attribute of soil quality. It contributes for example, to a structured soil and stable aggregates which in turn reduce erosion. It also serves as a permanent source of nitrogen for the crops. The interviewed farmers are convinced of the importance of organic matter and know that they should increase its content in the soil. Besides farmyard manure (and slurry), residues of grain maize and earth foam are mostly applied as exogenous organic matter. Two policy measures are of relevance: cross-compliance rules oblige farmers to do soil analysis for the organic matter content and the acidity of the soil every three years. If the sample proofs the organic matter is too low, the farmer should undertake some action. Another policy measure trying to motivate farmers to undertake some action for the organic matter of the soil is the exception rule in the Manure Decree, where a farmer can apply additional compost to augment the soil organic matter status (objective of mid term review). Provided that the nitrate residue norm of 90 kg N/ha was not exceeded in the previous calendar year and that the organic matter in the soil is low, until 10 tons vegetable-fruit-garden compost or 15 tons green waste compost may be applied without any consequence for the maximum fertilisation norms.

Economic costs

Exogenous organic matter, e.g. compost, is not expensive.

Technical feasibility

Farmers should observe the restrictions of the Manure Decree when applying exogenous organic matter (except crop residues). Exogenous organic matter, like earth foam and compost, is also considered as a fertiliser by the Manure Decree. No ban is imposed on exogenous organic matter that slowly releases N as for example compost.

In order to reconcile the increase of soil organic matter pools and the control of eutrophication, more research is needed about when and how nutrients are released from (different types of) exogenous organic matter.

Environmental effectiveness

- Farmers report that the use of exogenous organic matter increased the organic matter pools of their soils.
- The use of secondary waste products entails possibly a risk because it is not exactly known what their content of hazardous chemicals, like heavy metals, is.

5.4 Contour tillage

Contour tillage is tillage parallel to the contours of the slope. It reduces run-off and soil erosion by water. 65 % of the Flemish farmers interviewed by the MESAM-project adopt contour tillage. There were some doubts on these results. Probably there was a misinterpretation of the meaning of contour tillage.

Economic costs

Economic losses are linked with the technical restraints.

Technical restraints

- time loss because of additional movements
- no straight sowing lines
- heavy harvest machines get out of balance

Those farmers who adopt contour tillage selectively, do not apply it for crops grown in rows (leek, potatoes and sugar beets). The environmental and nature organisations do believe this should be common sense and that no exceptions should be authorised.

Environmental effectiveness

Most farmers applying contour tillage are convinced that the practice reduces soil erosion on-farm and off-farm.

5.5 Grass buffer strips and grass corridors

Grass buffer strips are barriers for diffuse run-off. They slow down the water running off. As a result the water infiltrates and the sediment is deposited. In case of concentrated run-off (e.g. in dry valleys) grass corridors are needed. They prevent the formation of gullies. 35 % of the Flemish farmers interviewed by the MESAM-project adopt grass buffer strips or grass corridors.

Economic costs

- additional costs for maintaining and mowing grass strips and corridors
- loss of parcel surface, and hence reduction of yield

The additional costs and loss of yield are compensated by subsidies regulated in agri-environmental schemes. Several farmers find the conditions of these schemes too restrictive.

Technical restraints

Farmers prefer grass strips at the border of their parcels; a strip in the middle of a parcel is not considered feasible because it splits the parcel.

Environmental effectiveness

In the topographical conditions of West-Flanders a grass buffer strip of 5-6 meters wide already reduces run-off and erosion strongly. Grass buffer strips and grass corridors need to be well maintained and sown species well considered to ensure permanent and dense soil cover.

Some experts mention the broader use of these grass buffer strips or corridors as a shelter for birds and small mammals and therefore regret that no prescriptions have been made for postponed mowing dates.

5.6 Conservation tillage

Several demonstration experiments by the (provincial) authorities promote the adoption of conservation tillage. In Belgium, conservation tillage is adopted on 10 % of the total agricultural area (ECAF, 2005). Mainly, two types of reduced tillage, namely reduced tillage with a cultivator or soil loosener and by direct drilling are practiced. Continuous no till is very rare in Belgium because of the high disturbance of the soil at the formation of the ridges and harvest of root and tuber crops. Moreover, organic manure is often applied and needs to be incorporated in order to minimise ammonia losses (D'Haene, 2008).

Currently, there is no survey of coverage of conservation tillage in Flanders. However, experts claim that this percentage is rather low and that more subsidising measures are needed to implement soil erosion controls by conservation tillage.

Economic gains and costs

- Most farmers adopt no tillage because it saves time.
- The fuel consumption is reduced.
- The yield of grains remains the same; for root crops a yield reduction is possible.

Technical feasibility

- coarser seedbed
- less tractive power needed
- more weeds, increased risk of gastropods and fusarium
- planning of activities (e.g. sowing) less flexible

In general farmers ask for more technical support. Of those farmers interviewed by the MESAM-project who do not adopt conservation tillage yet, 70 % would be interested if they got professional support.

Environmental effectiveness

- most efficient technical measure against erosion
- increased bearing power of the soil
- increased content of soil organic matter in the upper soil layer
- increased biological activity
- better soil structure and better water infiltration

5.7 Conclusion

Intercropping is an easy practice that has many positive effects on soil conservation. Most farmers are already convinced of the advantages. Although the Flemish government stopped subsidising intercrops, farmers will not abandon the practice. Experts do agree that intercropping can have several constructive effects on soil conservation: it reduces the threat of nitrate leaching and soil erosion. However, they mention the importance of early sowing these intercrops. After harvesting maize, potatoes and sugar beets, the sowing of green manures can be delayed, which results in inadequate soil cover during winter.

Diffuse soil contamination by nitrates is a serious soil conservation issue in West-Flanders. Although already two decrees precede the current Manure Decree, compliance with the regulations, in particular by animal breeders and vegetable growers, is still problematic. Vegetable growers do not consider the imposed measures economically feasible. They need technical support and sound fertilisation advice. If accompanied with a well-considered differentiation of the regulations, support and advice will motivate vegetable growers to comply with the Manure Decree. If the nitrate content of ground and surface water is to be reduced all farmers will have to collaborate. Experts recognise the seriousness of this soil degradation process and herein the importance of the Manure Decree. But they argue that the decree still has to be improved and indicate that more research on the different factors influencing nitrate release in soil has to be done.

According to the farmers, intercrops, contour tillage and grass strips are the most effective measures against soil erosion. Farmers are more receptive to measures that also offer technical and organisational advantages. Measures that only reduce erosion are less interesting to them. The latter measures only seem to be adopted if they experience economic losses due to erosion and/or if financial support is provided. Experts also mention the importance of the use of exogenous organic matter. Application of exogenous organic matter can increase the soil organic matter status, which contributes to a better soil structure and reduces the risk of soil erosion and diffuse soil contamination.

In general, farmers are aware of the environmental impact caused by intensive farming. Nonetheless, they are only prepared to adopt conservation practices if they do not lose income, or if so that loss of income is fairly compensated by subsidies.

6 Soil related actors

6.1 Actors in the farming practices arena

6.1.1 Description of characteristics and attitudes

As described in Chapter 2, the characteristics and attitudes of farmers were separated according to the occurrence of either erosion or diffuse contamination.

The farmers confronted with erosion are mostly owners of the majority of the cultivated land. The interviewed farmers were of all ages but there was a trend to farmers between 30-39 years old. They are the farmers who will play a dominant role in agriculture for the next 20 years, assuming that they will be a farmer for at least 20 years. The size of the farms visited was between 9 and 55 ha which is typical for the region. Most of the farms confronted with erosion were mixed farms but two of them had no animals on the farm. The cropping patterns on the farms are typical for West-Flanders. The main crops produced are: maize, (winter) cereals, sugar beets and vegetables.

The farmers interviewed concerning diffuse contamination also owned most of the land they cultivated. They take the management decisions. For advice the farmers usually go to the

REO-auction (Agricultural Auction Market for Roeselare and the surrounding area) or the POVLT. The average size of the consulted farms was around 25 hectares. The cropping patterns used were the same as for the farms with erosion problems but with a higher importance/proportion of vegetable production.

Farmers have different channels to receive information. They are informed through the written press or the internet. But also farm extension workers, contacts with the auction, or suppliers of animal feed or fertilisers provide information. Farmers receive more general information at agricultural fairs, at demonstration sites and projects in research institutes. The administration responsible for a certain policy measure usually informs about a new or amended policy. They publish in the written press, but also organise information sessions. The administrations sometimes even personally contact the farmers to explain, inform and advice the farmers. Farm planners do this for the Agri-Environmental Schemes (AES) of the FLA (Flemish Land Agency). They actively visit farmers to persuade them to participate and advice them on where and what kind of AES is most suitable.

Farmers are most often involved in the design process of policies through the farmers' associations; however the latter sometimes lack practical knowledge. Some governmental organisations believe that direct contact with the farmers provides useful information concerning the technical and administrative feasibility of new or amended policies. Therefore they pursue direct contact with farmers. To this end, informal meetings where the policy, the implementation process and the technical measures are discussed may be organised on a regular basis. In that regard more practical information about the constraints for adoption or possible bottlenecks become more obvious.

6.1.2 Factors influencing adoption of soil conservation measures

Table 6 summarises the factors influencing adoption of the above-described soil conservation measures.

Table 6: Factors influencing the adoption of selected soil conservation measures

Measure	Awareness	Adoption	Appropriateness and Adaptability	Farmers' perception
Intercrops	Almost all farmers know of intercropping and adopt it.	Farmers adopt intercropping because on the one hand it contributes to soil conservation, and on the other hand it does not involve big efforts or high costs	Farmers are free to adopt the practice according to their own needs Experts believe this to be an efficient measure against erosion.	Farmers perceive intercropping as an easy and rewarding practice.
Fertilisation restrictions	All farmers are aware of the restrictions imposed	Farmers are obliged to observe the restrictions, although in practice adherence to the regulations is problematic	Apart from some exceptions, the restrictions are not differentiated according to soil type or crop. The control of the nitrate residue in autumn is only a random indication of observance of the regulations. The outcome of the analysis is influenced by several (abiotic) factors such as the weather conditions at the moment of sampling. Also interviewees from Q3 or Q4 sometimes find this policy too stringent.	Vegetable growers find the restrictions very rigid and hard to observe.
Use of exogenous organic matter	Farmers know of the importance of soil organic matter	Farmers traditionally use farmyard manure as source of organic matter. Its use is, however, restricted by the Manure Decree. Little knowledge is available about the use of more stable and less nutrient rich sources of organic matter.	All experts agree on the need for improving the organic matter content of the soil.	Few farmers know about the exception rule in the Manure Decree.
Contour tillage	Farmers are aware of the advantages of contour tillage for erosion control	Adoption is less evident for crops grown in rows (e.g. leek, potatoes, sugar beet)	Most farmers applying contour tillage are convinced that the practice reduces soil erosion on and outside their farm.	

Measure	Awareness	Adoption	Appropriateness and Adaptability	Farmers' perception
Grass buffer strips / Grass corridors	Farmers are aware of the advantages of the measure	Farmers are reluctant to lay out grass strips/corridors because they lose productive surface. Subsidies may convince farmers to adopt the practice.	Grass buffers/corridors are very suited to control erosion. Experts mention the need for prescriptions to protect fauna and flora in these buffer strips or corridors. However others warn that prescriptions to protect fauna and flora would make farmers reluctant to apply these grass buffer strips as they would fear that the strips would soon become a protected natural area which they are not allowed to cultivate any longer.	
Conservation tillage	Farmers are aware of the advantages of the measure	Although already several demonstration projects were started, more technical assistance is needed to convince farmers to adopt the practice.	Conservation tillage is one of the most efficient technical measure to control erosion	

6.2 Actors in the policy design and implementation arena

This section discusses the actors involved in the design and implementation of policy measures. Some actors are involved in all policy measures; others are involved only in one policy. Certain advisory bodies are consulted for all policies, but for every policy a consultation structure with different stakeholders has been developed where the policy is presented, discussed and adapted.

6.2.1 Governmental organisations

Belgium is a federal state, which means that the political decision-making is decentralised. Flanders, Wallonia and Brussels-capital region have legislative authority within their region. The Flemish Ministry of Agriculture and the Flemish Ministry of Environment act thus on the Flemish territory. There is no Belgian Ministry of Agriculture or Environment involved in soil protection.

The Flemish ministries consist of the minister and staff, the department and the agency (except when it is independent as the Flemish Land Agency, FLA). The departments are responsible for the design of the policy. The implementation of the policy is done by the agencies. This at least is the general view and was introduced in 2005 by the reorganisation of the Flemish Government. As visualised in Figure 6, it will be clear that the responsibilities of agencies and departments still interfere.

The Department of Agriculture (LV) has a number of different divisions. Relevant for soil conservation is the Division of Sustainable Agricultural Development (LV-ADLO), which is responsible for part of the Agri-Environmental Schemes (AES) in the Flemish Rural Development Plan (PDPO). Two other divisions in the Department have a link with AES: the Division Organisation and Strategic Policy, which coordinates PDPO and the Division of Agricultural Policy Analysis (LV-AMS) which is responsible for the monitoring and evaluations of the Rural Development Plan. The contracting of the AES is done by LV-ADLO. The central office is in Brussels; every province has a provincial office, for closer contact to the farmers. The only division in the Agency that is involved in the implementation of the AES is the Paying Agency (LV-MIB).

The Department of Environment within the Ministry of Environment also has a number of different divisions. The relevant division for soil conservation is the Division of Land and Soil Protection. It is responsible for design of new policies, also responsible for the design of some AES in the PDPO. This division is implementing the Erosion Decision[6] in everything that has to do with local authorities. The implementation of some AES is done by the Flemish Land Agency, Rural Development Division (FLA-AP), although sometimes they are also involved in the design. An important task of the Flemish Land Agency is to draw up the policy concerning manure. This is done in the division of the Manure Bank (FLA-Manure Bank). This is again an exception to the common division of tasks between departments and agencies. The Manure Bank is also responsible for the implementation of the manure legislation. Both divisions have a central office in Brussels and provincial offices.

In addition to these bodies, local governments are involved. In the framework of the Erosion Decision, they can perform small infrastructural works.

The province of West-Flanders employs a full time person working on erosion. Half of this position is dedicated to the implementation of the Erosion Decision, with advising and coordinating power; the other half is dedicated to Interreg projects concerning erosion.

[6] A policy of the Flemish Government making subsidies available for infrastructural erosion works carried out by local government.

In Flanders there is an agency having the task to monitor the changes of environmental condition in Flanders: the Flemish Environment Agency (FEA). This happens independently of the existing policies. The Agency registers, monitors and calculates a large set of environmental and soil related indicators on a yearly (or two-yearly) basis.

6.2.2 Civil society and non-governmental organisations

Different organisations have an advisory role in the policy design process (see Figure 4). There are no civil-society or non-governmental organisations that take part in the implementation process.

The Umbrella of Flemish Environmental NGOs, namely Bond Beter Leefmilieu, and some nature organisations are important players in the Environment and Nature Council of Flanders (MINA). This advisory council for the Flemish government and the parliament can freely, or on request, give advice and recommendations on new policies. It consists of representatives of environmental organisations, farmers' organisations, labour unions, universities, etc. Due to the composition of this council, the advice is based on consensus.

VVSG is the Association of Towns and Municipalities of Flanders. VVSG is a member of the Council of European Municipalities and Regions. This organisation supports the local government in carrying out its tasks and activities, and organises management trainings for the local governments. They also promote the interests of the localities in different contexts. They are especially the spokesperson of the local governments in debates regarding policies where the municipalities are directly involved. As the Erosion Decision lays many responsibilities with the local governments, VVSG has been an important player in the design of this Decision and helped to find a manageable implementation process.

In addition, research institutes are involved in the design process. They include different researchers for the different policies according to their field of research. Universities as well as Flemish or provincial research institutes can take part in the design or have an advisory role in the process.

There are some smaller organisations which have no big influence on the regional policy makers, but are interesting organisations because they play a role in initiating small initiatives that in the long run find access to the design. VLACO (the Flemish Compost Organisation) and the Regional Landscape West-Flemish Hills are examples of such organisations.

The Regional Landscapes were initiated in 1990 by the nature development plan of Flanders, following the example of the German Naturparks and the French Parcs Naturels Régionaux. The concept 'Regional Landscape' received a legal base in the 1997 Decree Concerning the Protection of Nature and the Natural Environment. Municipalities, provinces, the Flemish regional government and local volunteer groups (nature conservation, hunters, and tourism organisations) are represented in these non-profit organisations. The Regional Landscapes are responsible for the promotion of the regional characteristics, the nature recreation, and environmental education, the joint use of an area for recreational and other purposes as well as the conservation and management of small landscape elements (Vanempten, 2007). The objective behind this cooperative was to link initiatives with regard to the environment and landscape protection and the development of joint use for recreational and other purposes, in order to reach effective implementation of necessary measures, more attention for the region and a broader public support (Ministry of the Flemish Government, 1997, Art.54; Regionale Landschappen 2006). They are established on a voluntary basis and receive a small European subsidy (in pursuance of the EEC decree no. 1257/1999 of the Council of 17 May 1999 on the support for rural development of 10 October 2003), with which landscape facilitators and landscape teams are put to work to achieve this development in the field.

The Regional Landscape 'West-Flemish Hills', where we interviewed an employee, was one of the first to acknowledge the severity of erosion in that region. The group started with several small scale demonstration projects where different measures to reduce erosion were

explained to local farmers. Later on some of these measures were integrated into the Flemish policy and were no longer the responsibility of the Regional Landscape.

The Regional Landscapes also initiated the idea of the farm planner. The farm planner actively visits farms and discusses with the farmers how and where it could be useful to implement Agri-Environmental Schemes (AES). Nowadays, the farm planners have their office at the Regional Landscapes but are paid by the Flemish Land Agency. The big advantage of the farm planners is the individual approach: farmers are more willing to undertake AES, they start trusting the farm planner and discuss certain problems about AES with him.

VLACO, the Flemish Compost Organisation, is the reference centre in Flanders in relation to composting (and digestion), both centralised and domestic composting. It is a non-profit organisation, which has the task to promote the use of compost. The organisation is sometimes consulted about soil degradation processes and tries to encourage policymakers to design measures which convince farmers of the usefulness of compost.

6.2.3 Resources, capacities and networks

Figure 6 gives an overview of the relation of the different governmental and non-governmental organisations previously discussed. Design and implementation happen within the Ministry, except for the Erosion Decision where also local governments are involved. Indirectly the provincial erosion officer can coordinate or give advice to the local governments. Concerning soil conservation the Ministry of Agriculture has a number of Agri-Environmental Schemes (AES) such as 'Soil Cover', and of course some cross-compliance rules that farmers have to follow. Within the Ministry of Environment, more polices are designed affecting soil degradation processes. The Division of Land and Soil Protection (Department of Environment) is responsible for the design of some AES such as for AES Erosion or AES Water and the Erosion Decision. The design of the Manure legislation is done in the Flemish Land Agency, which also implements this policy. Another division within the FLA is responsible for the implementation of the AES.

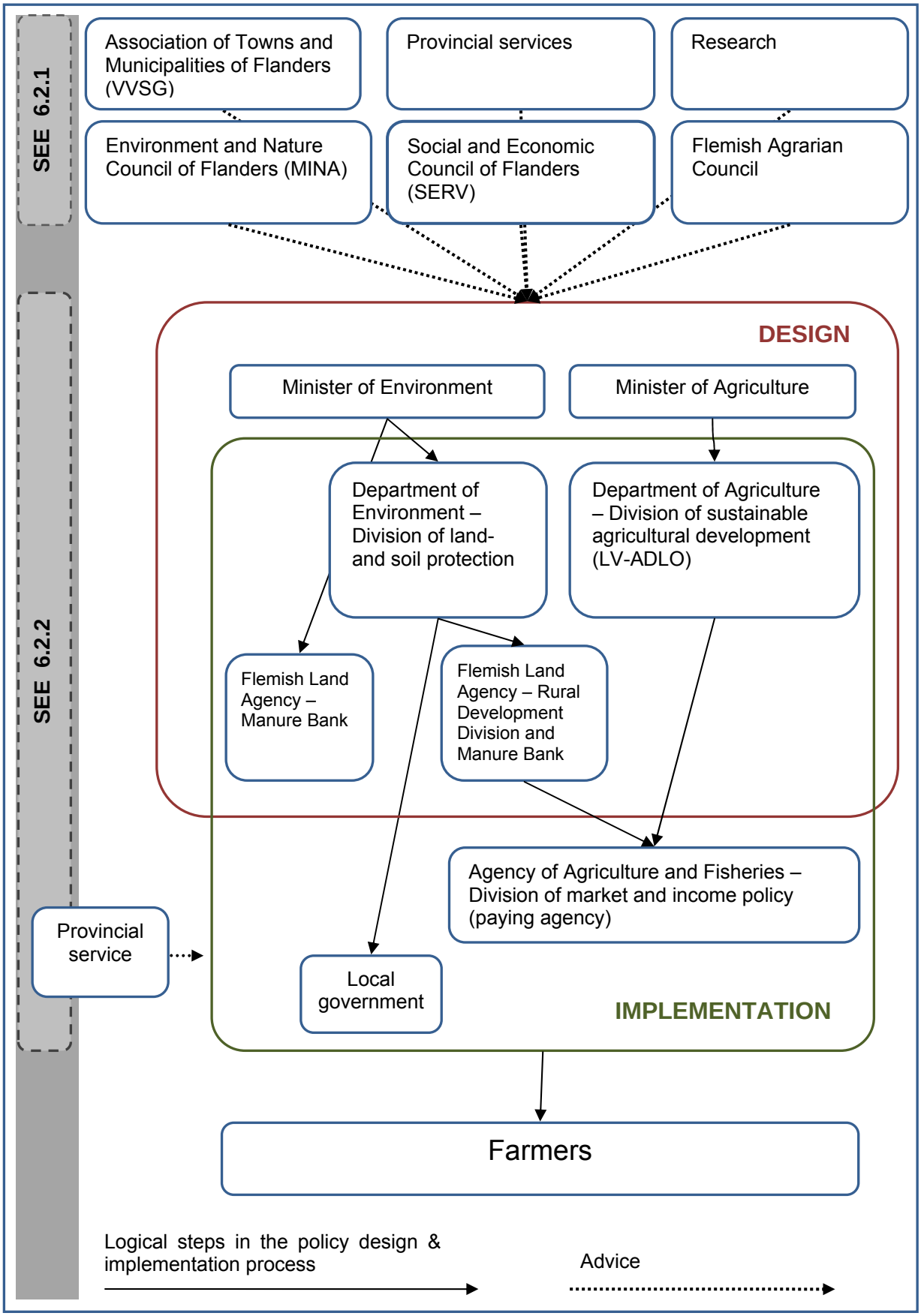
During the design process, different actors are concerned. Depending on the kind of policy, different structures can be used. Most often there is a multi-sectoral monitoring committee that can give advice. The usual members of these kinds of committees have been described in section 6.2.2.

Environmental and nature organisations consider that evaluations and advice is not taken sufficiently into account. Further they sometimes doubt the efficient use of means and question if the set of instruments really is sufficient to tackle the problem. Another aspect often raised was the lack of an overall view; most policy domains stick to their core business and do not integrate with other policies. An example is the erosion policy that has an obvious link with the dredging problem. The erosion sediments will end in watercourses that then have to be dredged. Some experts value the cost for dredging higher than for more efficient prevention measures tackling erosion.

Different interviewees mentioned the problem of controlling the policies. Often the policy is edited, implemented and controlled by the same organisation. In that way the danger exists for loose controls.

Most interviewed actors think enough resources and capacities are available for the FLA-Manure Bank. The division in FLA responsible for AES is understaffed. The Manure Bank has about 300 employees, there are 6 employees working in the Division of Rural Development. The Division of Land and Soil Protection of the Department of Environment is a small unit compared to the divisions responsible for air or water; it has only 5 persons working. This can be interpreted to indicate the rather low priority rating of soil conservation issues in the Flemish policy.

Figure 6: Network of the organisations involved in the design and implementation of policies regarding soil conservation in Flanders



6.3 Conclusions

In general, initiative is taken by the responsible authorities to design new policies. Agricultural related topics are defended by the farmers' associations, which have historically a certain influence in politics. Commonly a lot of stakeholders are grouped in a committee to discuss and give recommendations about the policy, which is prepared by the administration. The implementation is almost exclusively undertaken by the administration.

Good practices were often about the participation or engagement of the different stakeholders and administrative staff. For the implementation of the policy, it is seen as an advantage that administrative people (for AES these officers are called farm planners) are in close contact with the farmers and thus increase participation. This personal contact enhances trust and willingness. Also in the design process, it is useful to test directly the feasibility and acceptability of the policy measures with the farmers.

Nature and environmental organisations believe that the measures applied are not far-reaching enough to tackle the problems. They mention the lack of a vision of the Flemish Government and believe that policies should be more integrated over the different domains of agriculture, environment, nature, water, soil and land.

Most interviewees agree on the need of a combination of policy instruments. They largely support the voluntary measures where the initiative rest in the hands of stakeholders. For serious problems, obligatory measures are necessary.

7 Policies for soil conservation

Different policies linked with soil conservation exist in Flanders in general and in West-Flanders in particular. This overview focuses on policies that address the main soil conservation problems, i.e. diffuse soil contamination and soil erosion.

Diffuse soil contamination: In the past several policies and measures have been implemented to comply with the EU Nitrate Directive. Yet the expected water quality improvement was not achieved. Therefore 100 % of Flanders will be designated as nitrate vulnerable zone instead of the former 46 % (Deuninck, 2006). Therefore, from 1 January 2007, a new Manure Decree has entered into force. This resulted in a Manure Action Plan III (MAP3).

Cross-compliance rules regarding the Nitrate regulation are somewhat the same as described in the Manure Decree.

In addition to the compulsory measures of the MAP3, there is an agri-environmental scheme (AES-Water) (noted in the Flemish Rural Development Program the transposition of the EU Regulation No. 1698/2005 (or the former Reg. No. 1257/99)) that gives incentives to farmers to go beyond the obliged standards. Conditions are that the location of the field must be in designated vulnerable area (demarcated in 1991) and that the maximum amount of manure disposal is at least 30 % less than the fertilisation standard set by the decree. In Nature sensitive areas (outside Natura 2000) and Natura 2000 there is a compensation payment for the zero-fertilisation obligation.

Erosion: For erosion the Decision on the Flemish Government in December 2001 gives an incentive to municipalities to draw up an erosion control plan and to carry out small measures on erosion control on their territory.

There is a non-profit organisation in the province of West-Flanders, the provincial centre for agriculture and environment (PROCLAM). For all erosion related aspects an erosion employee is appointed. Besides helping the municipalities with their erosion action plans this erosion employee has also the task to inform and support the farmers about erosion control measures.

Farmers with soils that are very susceptible to erosion are bound to cross-compliance rules. A scientific model used by the Department Environment, Nature and Energy classifies all Flemish soils into 3 erosion susceptible categories: very susceptible, susceptible and low-susceptible soils. One of the nineteen legislative acts for cross-compliance is about erosion control. The hereby defined actions are also dependable on the crop (different rules for permanent crops, grain, flax and other crops).

In Flanders there are Agri-environmental schemes particularly designed to control soil erosion (AES-Erosion). Condition is that Cross-compliance acts are fulfilled and that local authorities did not compensate the farmer for the same action.

The code of Good Farming Practice also includes recommendations about erosion control, e.g. leave a strip along riverside untilled, grow a soil cover during winter season, contour ploughing, etc.

Objectives for all Flemish environmental aspects are defined in the Environmental Policy Plan.

Relevant soil related measures are:

	Policies	**Measures**
Diffuse soil contamination	Manure Decree	*declaration and registration duty *regulations regarding time, circumstances and place *determined methods for applying and ploughing in the manure *manure processing duty. *local water quality groups of farmers
	AES-Water	*Zero or reduced manuring
Erosion	Erosion Decree	*Municipal Erosion Plan *Small infrastructural works (erosion ponds, erosion dams, grass corridors and grass buffer strips)
	AES-Erosion	*source oriented schemes (non-inversion tillage, zero-tillage) *symptom treatment (grass buffer strips, grass corridors, talus or erosion pools)

7.1 Existing policies and their classification

In Flanders soil conservation has a rather low priority in agricultural and environmental policy. Various interviewees announced this view at the beginning of the interviews. In Table 7 an overview is given of the different policy measures and their classification. Only the Erosion Decision and the Interreg project MESAM have soil conservation as primary objective.

Remarkable is that these two policy measures act at a more local level. The Erosion Decree encourages local governments to consider erosion and decide which actions to undertake. After the formulation of the municipal soil erosion plan, local governments can undertake some small infrastructural works to implement the plan. They can also give incentives to farmers to implement technical erosion measures. Such infrastructural works and incentives are paid with Flemish financing and with co-financing of the province and the local government. The Interreg project was set up with West-Flemish, Flemish, Walloon and French partners in neighbouring provinces and aims at building a knowledge base and network on erosion. By giving demonstration on technical erosion measures, in cooperation with selected local farmers who were willing to trial some measures, they reach more local farmers.

The Manure Decree which implements the European Nitrate Directive in Flanders is a very stringent policy that is mostly based on command and control. Farmers have accepted it with reluctance. However, this policy also gave rise to the establishment of the Manure Bank.

Table 7: Classification of policy measures in West-Flanders

Type of Policy Mechanism/ Mode of governance (A)	Practical classification – Nature of the Policy Objective (B)			Policy relationship to agriculture (C)	Geographical level (D)	Analytical classification – Channels of Impact (E) Please note that policy measures may lead to more than one change, if so please specify Primary (1) and Secondary (2) impacts – secondary impacts will be the consequence of the primary impacts e.g. to support their delivery or resulting from the changes they bring about. Y = Yes, N = No		
	Soil conservation is the **primary objective** of a policy measure	Soil conservation is the **secondary objective** of a policy measure ie specified as an objective to contribute towards but not specific policy aim	**By-product** ie soil conservation is not a stated aim or objective of the policy measure but results from implementation	Please specify if Agricultural (AG) or non Agricultural (NAG) focused policy	Specify if European (E), national (N), regional (R) or local (L) measure. Specify policy reference if appropriate	Developing new/altering existing rules (institutions)	Developing and/or altering governance structures/ implementation approaches	Directly impacting on farmer behaviour/ decision making/ factor allocation and management practices
Command and Control			Manure Decree (=MAP III, Manure Action Plan III)	NAG	E - Nitrates Directive (91/676/EC).	Y – Setting up of new rules to register manure production and lay down new fertilisation norms (1)	Y – development of governance structures to support Manure policy (2)	Y – all kinds of bans on the use of fertilisers in certain areas (2)
		Cross-compliance ie funding linked to SFP requiring good farming practice among which soil protection		AG	E but varies at N			Y
Incentive-based measures/ economic instruments		Agri environmental measures requiring good farming practice and specifying soil protection		AG	E but varies at N RDP (EC 1257/99 and EC. 1698/2005)		Y – development of payment agencies to deliver payments (2)	Y – Payments for conducting certain action (1)
	Erosion Decision			NAG	R and L		Y – gives incentives to municipalities to draw up an erosion action plan (new implementation approach) (1)	Y – Payments by the municipality for conducting certain actions (2)
Moral Suasion Initiatives		Organic farming		AG	R			Y- Payments for conversion to organic farming
Information and capacity building measures	MESAM (Interreg III project)			NAG	L		Y – developed a research network on soil erosion (1)	Y - demonstration of erosion measures for farmers

7.2 Description, analysis, and evaluation of policy measures

7.2.1 Fiche 1: Manure Decree

Part A: Summary of Measure	
Formal title of measure and date of implementation	Decree concerning the protection of water against the contamination through nitrates for agricultural sources [C-2006/37097]. The manure decree has come into force December 22, 2006 in Flanders. The decree is implementing the European Nitrate Directive of 1991 (91/676/EU) for Flanders.
Short description of the measure	The Manure Decree's main objectives are reducing the nitrate load in water bodies and reducing the phosphate saturation problem in Flanders. The new Manure Decree is an improvement of the old manure decree that came into force in 1991. The Manure Decree has existed for 17 years and during this period the policy has been adapted several times in order to establish the best possible measures to tackle the problems at hand.
Type of policy measure	The Manure Decree is a policy which is classified as a "Command and Control" type of policy. Soil conservation is a by product of the Manure Decree. The Manure Decree is a broad policy which acts on almost every aspect related to nutrients on the farm. The Manure Decree is an agricultural policy. The Geographical level of the Manure Decree is Regional (= the whole of Flanders) and it is an implementation of the European Nitrate Directive.
Objective of policy measure and relevance	The main objectives of the Manure Decree are reducing the nitrate loads in water bodies and the phosphate saturation problem in Flanders. The Manure Decree prescribes a nitrogen amount lower than 90 kg N/ha between the period of 1st of October and 15th of November over a depth of 0-90 cm on all fields in Flanders. Another objective of the Manure Decree is the decrease of animal breeding in Flanders, which would result in a lower amount of animal manure applied on the fields. The ultimate objective is to achieve a nitrate load below 50 mg Nitrate-N per litre water. Environmental organisations believe that this MAPIII is still not far reaching enough and even has possibilities to increase the numbers of livestock.
	How relevant are the objectives of the measure to the soil degradation threats in your region? ☐ ☐ ☐ X ☐ Not very Very
Indirect effects	The Manure Decree states rules for e.g. the maximum amount of manure and fertilisers that can be put onto the field, the application time and the manner of application. With these rules the policy aims to improve the water quality. The decree also attempts to have a maximum nutrient efficiency of the fertilisers without having (excessive) losses and thereby preserving the soil and water quality.
Linkages to other policy measures	The Manure Decree is the rule with the most influence on fertiliser application in Flanders. This also affects conservation policy. A relationship to soil conservation measures is the use of green manure or catch crops. The use of catch crops protects the soil against erosion during winter but it also retains nitrate in the soil instead of allowing it to leach to the (ground)water.

Funding	Farmers are obliged to implement the measure since the regulation is obligatory in Flanders; therefore there is no specific funding. Funding is only available to farmers that voluntarily subscribe to “AES Water” (see fiche PDPO II).
Summary of assessment and conclusions	The new Manure Decree of 2007 is already a step forward. It contains rules and tables with maximum fertiliser amounts, spreading conditions and other details, but there are still some bottlenecks in the Manure Decree. The Manure Decree classifies the whole of Flanders as ‘vulnerable zone water’ in terms of contamination by nitrate for at least 4 years. This period has been put into the decree so that it has to be evaluated within 4 years to see if the measures and rules in the Manure Decree are sufficient enough or if new, more specific or different rules are necessary.
Recommendation	Despite the improvements in the Manure Decree compared to previous decrees it still needs adjustments. The most important bottlenecks that still have to be handled are the working coefficients for mineralisation of manure and the extra or better rules for P-application.
Part B: Detail on the Measures Design, Implementation, Enforcement and Impacts	
Policy design	As it is a measure which has its effects on nutrients, there are a lot of stakeholders potentially involved in policy design such as the government, farmers, nature organisations and researchers. While policy design is usually the responsibility of the Departments, the Manure Decree is an exception. In this case, the Flemish Land Agency (FLA) - Manure Bank initiates the policy and prepares the Manure Decree. The first Manure Decree was drafted a steering group that could give advice on the policy. This group consisted of members of environmental and agricultural organisations of the SERV (see 6.2.2) and researchers. This steering group became a technical group who is involved in the design process (more than only advising) based on consensus. The Minister of Environment sets out the first lines of the Decree and has the last word concerning the Decree. Agricultural organisations informally lobby the Minister to some extent. The FLA-Manure Bank would like to see a more scientific foundation of the policy and technical measures preferring this to the consensus procedure.
Policy implementation I: Implementation at administrative level	The Manure Decree is the regional implementation of the European Nitrate Directive. At administrative level the implementation of the Manure Decree is undertaken by the FLA. The farmers are in direct contact with the FLA. The FLA has local offices in the provinces for contact and support to the farmers. Some 300 persons are working for the FLA-Manure Bank handling the administration and extensive calculations regarding the Manure Decree. Farmers have to register their manure production, manure spreading, manure transport and other indicators on a yearly basis. In addition, producers of animal feed or inorganic fertilisers have a registration duty.
Policy implementation II: Method of delivery to farmers	As the Manure Decree is a rule of the government it is published in the Belgian Law Gazette. Farmers’ unions, information magazines, farm extension workers, and animal feed suppliers all provide information to the farmers. The FLA handed out folders, held information days and workshops. Demonstration plots have been established on research stations to demonstrate to farmers what different measures imply, which management parameters will be affected and need to be taken into account and what the effects on har-

	vest yields are. Overall, interviewed farmers find that there is a good delivery of information to the stakeholders. However, in some cases farmers find that there is too much information or that there are too many changes so that it becomes difficult to keep up with changes. The fear is that some farmers would not bother to apply the new rules, thereby taking the risk to get caught and fined.
Targeting	The Manure Decree targets the whole agricultural sector but more specifically animal husbandry. The Manure Decree targets the nitrate load and phosphorus saturation to reach the values Flanders has established by implementing the European Nitrate directive.
	To what extent does the implementing body have flexibility in the targeting of the policy measure so that it is adapted to local conditions? ☐ x or x ☐ ☐ Low High
What Drives Uptake?	Flemish farmers are obliged to follow the rules and implement appropriate measures. If they do not comply with the rule they can be fined.
	x ☐ ☐ ☐ ☐ Obligation Financial incentive Information & support Exhortation Other
Technical measures	The Manure decree contains a table with maximum amounts of mineral fertiliser or manure that a farmer can apply onto a field depending on crop and on soil texture. It also contains a list of conditions a farmer has to comply with e.g. application time and manner of application. The Manure Decree notes that a farmer needs an adequate capacity to store manure depending on the amount of animals and type of farming. It also contains rules stipulating the processing of manure. In MAPIII, nutrient emission rights have been established: nutrient production has become tradable, farmers may enlarge their production if they buy emission rights from other farmers.
Enforcement and control	The Manure Decree applies to the whole of Flanders. Each year during the period 1 October and 15 November soil samples (controls) are taken which cover around 5 % of Flanders. These soil samples are not chosen at random, but are combined with the 5 % control on the derogation farms and some other criteria as the location of the parcels, unbalanced manure registration, excess manuring or earlier non-compliance. The control involves a control of the parcel for which the AES has been applied, a control on the field itself to see if the prescriptions of the AES are fulfilled (e.g. green cover, nitrate residue measuring, etc.) and possibly a control of the invoices. These samples are analysed for mineral nitrogen (nitrate and ammonia). If the result is above the limit of 90 kg N per hectare (in 0-90 cm) or the farmer does not comply with another rule of the decree he may be fined. The Decree specifies the penalties: from a warning to substantial fines.
Monitoring and evaluation	If a field has a value between 90 kg N and 150 kg N per hectare the FLA will guide the farmer and advise them in nutrient application to achieve the enforced level of 90 kg N per ha in a depth of 0-90 cm. FLA-Manure Bank produces a yearly report on their activities, progress and number of farmers not complying. Concerning the environmental follow-up, the FEA (see section 6.2.1) has started a water measure network that moni-

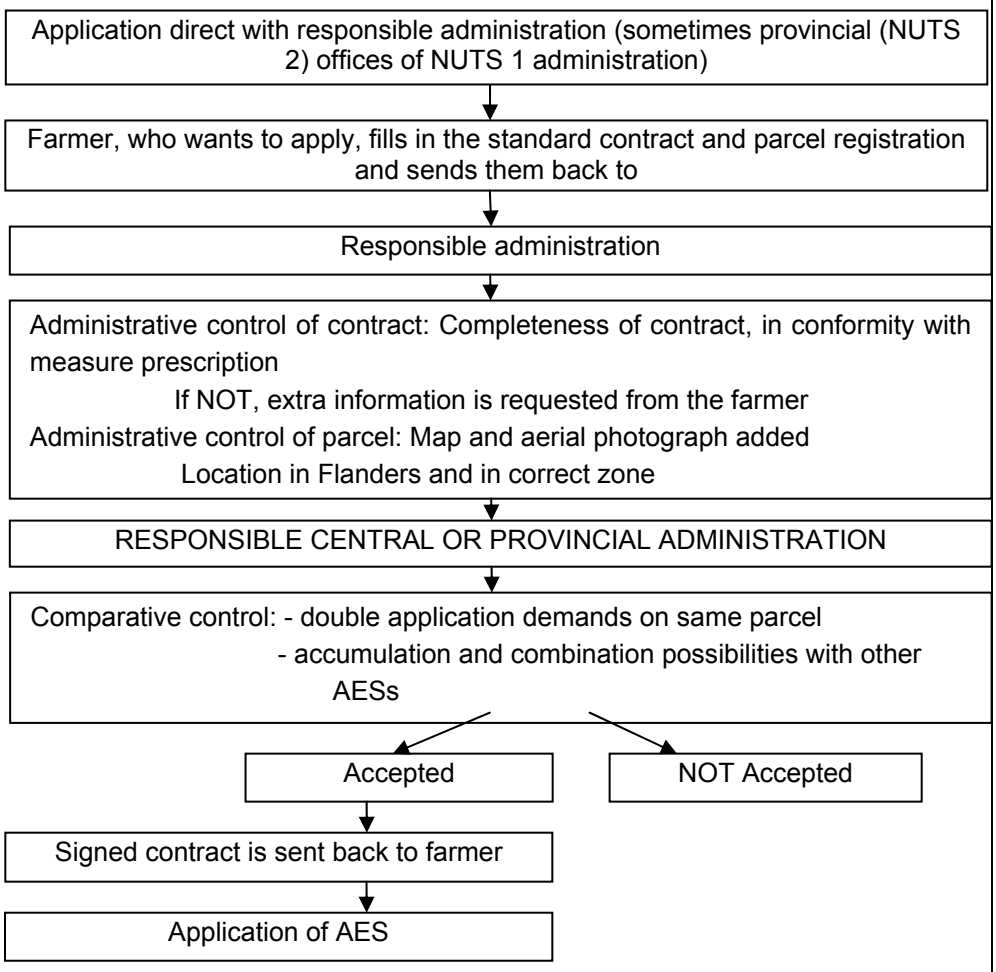
	tors the groundwater and the surface water quality.
Outcomes of policy measure	The achievements of the measures are still small because the measure has been in force only since 2007. However, due to the old and new Manure Decree there is already a decrease in animals in Flanders, the animal feed contains less P_2O_5 and the nitrate load decreases slowly.
Analysis of drivers of policy measures' outcomes	New rules for the registration of manure production and fertilisation norms were established. The rules are accompanied by authorities enforcing them. The instruments in the Manure Decree (bans on fertiliser use) are directly influencing farmers' behaviour.
Part C – Evaluation of the Policy Measure	
Effectiveness of policy measure (in relation to the extent to which objectives are achieved, and cost-effectiveness)	The policy measure is rather complex and broad. Farmers and other suppliers are obliged to keep detailed documentation. Therefore a large administrative structure has been set up (FLA-Manure Bank (300 persons)). The water quality problem was and still is a serious problem so drastic rules became necessary.
Constraints to achieving full potential of the policy measure	One of the constraints of the measure can be the large amount of information and the rather rapid evolution of the rules as well as the fact that it is a delicate matter in terms of politics. The interviewed farmers perceive the former as a problem and there is a risk that farmers will not know anymore what they are expected to do. The farmers consider the administrative procedure they have to follow to be very extensive and repetitive so they end up investing a lot of time filling in forms which makes them resent the measures. The FLA-Manure Bank also acknowledges the complexity of the policy as a problem making it very difficult to control and implement the Manure Decree. Most farmers with intensive vegetable production claim that it is difficult to comply with the Decree without having a high decrease in yields.
Reasons for the success of the policy measure (where appropriate)	One of the reasons the Manure Decree can be a success is that it is enforced: farmers have to comply with the Decree, it is a rule. The Decree, and all other rules, have the most chance of succeeding if the rules are not to drastic at once. The rules can be complied with by a large part of the agricultural sector and therefore the percentage of complying farmers as such is higher.

7.2.2 Fiche 2: Agri-Environmental Schemes in the Rural Development Program

Part A: Summary of Measure	
Formal title of measure and date of implementation	Flemish Rural Development Program (PDPOI (2000-2006) 25/10/2000 and PDPOII (2007-2013) 23/10/2007) the implementation of Directive Reg. EU nr. 1257/99 and EU nr. 1698/2005)
Short descrip-	Voluntary agri-environmental schemes with a broad spectrum of objectives.

tion of the measure	Soil conservation is not set as a strategic objective, yet 3 schemes or technical measures can be identified that have an effect on soil conservation: AES Water, AES Erosion (since 2004) and Soil Cover (only in PDPOI). Flanders was late in implementing agri-environmental schemes; in fact PDPOI was the first implementation of AES. Since then AES have found their way to the farmer; especially AES Water and Soil Cover are well accepted.
Type of policy measure	AES are incentive-based measures. It is the implementation of a European directive as part of the Agricultural Policy, yet AES are designed at Flemish level. For AES Erosion, soil conservation is a primary objective, while this is not the case in the PDPO.
Objective of policy measure and relevance	The PDPOI includes in general the task of agriculture concerning environment, nature, landscape and water. PDPOII contains reference to the task of agriculture concerning the 'green' and 'blue' services to achieve environmental and nature conservation objectives. The individual objective of AES Erosion and Green Cover states their role in erosion reduction.
	How relevant are the objectives of the measure to the soil degradation threats in your region? ☐ X ☐ ☐ ☐ Not very Very
Indirect effects	There are no indirect effects.
Linkages to other policy measures	AES Water has a link with the Manure Policy: this scheme goes further than the standards set in the Manure Policy. AES Erosion has a link with the Erosion Decree. Similar AES can also be financed by the local government (for a period of 20 years). No accumulation of the two policies is possible. There is also a link with the cross-compliance rules, farmers with very erosion susceptible parcels have to undertake at least one erosion measure without financial compensation.
Funding	AES are 50 % co-financed by EU (EAFRD) and 50 % by the Flemish government. It is Belgium that receives the money from the EU, while the division of money to the Walloon and Flemish Region is taken politically. The decision on how much money is available for each measure is decided in a similar way as by the design of new AES (see further). About 30 % of the EU co-financing goes to axis 2.
Summary of assessment and conclusions	The voluntary measures are well accepted by farmers. AES Water is output-oriented. It is a good approach for making farmers familiar with a problem or with a certain agricultural practice. The farm planners who visit and motivate farmers actively can enhance the uptake of AES. Because of higher grain prices, farmers are less interested: the financial incentive is not sufficient to convince farmers.
Recommendation	Some schemes are not far-reaching enough in comparison with the financial incentive for the measure. Dead weight effects are not eliminated: farmers chose parcels were they would already apply the measure. This applies less for the AES Erosion.

Part B: Detail on the Measures Design, Implementation, Enforcement and Impacts	
Policy design	The development of the Flemish RDP started with an agricultural conference. At this conference, pressure groups such as farmers' organisations, local policy makers and environmental groups were invited to make suggestions on the priorities for this plan. These pressure groups were later represented in the Monitoring Committee. Most of the AES were initiated by the administration, who use their field knowledge or integrated proposals of farmers, farmers' organisations, nature organisations or environmentalists. In the case of AES Water proposed by the Flemish Land Agency, study groups of people with different backgrounds were initiated. AES Erosion was initiated by LNE in contact with farmer organisations. These study groups formulated the objectives of the AES and drafted the prescriptions for the new AES. These measures were then proposed on a well-founded basis in the Monitoring Committee for approval by its members. For advice these new AES are then presented in the Flemish Council for Environment and Nature. After the approval of a new measure or changes to an existing measure by the Monitoring Committee, the proposal for AES is sent to the European Commission for approval. During the time needed for approval, a provisional bill of the AES is drawn up. This contains e.g. the type of contract, the eligibility rules, control and sanctions. When approved by the EU, this bill is proposed to the Flemish government (after integrating changes proposed by EU). After a first fundamental decision of the Flemish government, the financial services can make objections. The AES are then again presented to the Flemish Government. After their approval, the measure is published in the Law Gazette, which is the official start of the AES. The decision on how much money is available for each measure is decided in a same way. The administration makes an estimate of the money needed for the measure. This budget is discussed, changed if needed and approved by the Monitoring Committee.
Policy implementation I: Implementation at administrative level	The governance structure for the PDPOII (somewhat different than for PDPOI) has a vertical component and a horizontal component. The horizontal component is for the overall management of the program. It contains the Monitoring Committee, the Management Committee, the Coordinating Unit European Rural Development Policy (CCEP), the Paying Agency and the Flemish Rural Network. In the Monitoring Committee, different stakeholders are gathered such as agricultural and environmental NGOs, auctions, input sector, administrative bodies, etc. Some have voting power, most have advising power. The vertical component is for the concrete implementation of the AES. For AES Water and AES Erosion this is the Flemish Land Agency (FLA), a part of the Environmental administration. For soil cover (only PDPOI) this was the Division Sustainable Agriculture of the Agricultural Administration. Sometimes these administrations have local desks in the provinces (NUTS 2). Sometimes these provincial administrations also have decision authority. In that case the task of the central administration is to collect and register all the contracts, to design the AES, to inform the Minister of Agriculture and the EC.
Policy implementation II:	The FLA works with farm planners who are in direct contact with the farmers. They visit farmers and inform them about available AES and suggest

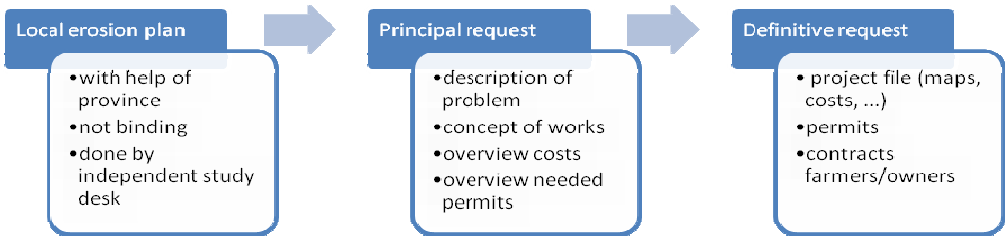
Method of delivery to farmers	which parcels are suitable. This approach has the potential to break down any barriers and convince a lot of farmers. Due to the personal contact, farmers are more willing, have more trust and know who to approach with their questions. The framework below describes how the implementation and the application requirements are handled. A first administrative control is done by these services. The documents and registration of parcels are checked for completeness and the eligibility of the farmer is checked. Additional information is requested if data is missing. The file is then transmitted to the central administration where a check on double applications per parcel is carried out. They also check if the farmer receives support for other AES on the same parcel, which are not compatible with the AES applied for. When all these controls are positively evaluated, the contract is signed and sent back to the farmer. At that moment he is officially applying for the AES.  **Framework of the application process for AES**
Targeting	The AES Soil Cover is not targeted as most of the other Flemish AES. The AES Erosion has an eligibility prescription: the parcel should be erosion susceptible. The maps for erosion susceptibility are drawn up yearly. This has consequences for the farmers: one year his parcel can be erosion susceptible, the next year it can be very erosion susceptible and he has to comply with cross-compliance rules. A common reason is the combination of two erosion susceptible parcels into one bigger, and thus more erosion susceptible parcel.

	The subscription to the AES Water is only possible in 6.5 % of Flanders. The zones that are eligible are the areas that are important for surface water collection.
	To what extent does the implementing body have flexibility in the targeting of the policy measure so that it is adapted to local conditions? ☐ ☐ ☐ X ☐ Low High
What Drives Uptake?	Farmers are mostly driven by the financial incentive this incentive-based policy offers. For AES Water and Soil Cover the payments are (were) adequate for the required tasks. The impact of the farm planner indicates that "information and support" also drives uptake. For AES Erosion, farmers become more and more aware of the need to undertake action (mentioned as other).
	☐ Obligation X Financial incentive X Information & support ☐ Exhortation X Other
Technical measures	AES Water: Manure standards are more restrictive than what is prescribed in the Manure legislation. AES Erosion: source-oriented schemes (non-inversion tillage, zero-tillage) OR symptom treatment (grass buffer strips, grass corridors, talus or erosion pools) Soil Cover: sowing a cover crop during winter months.
Enforcement and control	There is a compliance commitment for AES Water. Farmers are contractually bound to analyse soil samples on the residual nitrate amount. AES Water is outcome-oriented because depending on how well the farmers perform they receive a higher payment. When exceeding a certain norm, they do not receive payment. After two years of insufficient samples, the contract is ended. For AES Erosion the FLA sends the contract to LNE, where it is checked if the technical measures are in an erosion plan. If not, the decision for approval is made by the FLA, else it is made by LNE. Control is done in two ways, as the EU prescribes: - An administrative control is done by each application demand and each year. Yearly the farmer is contacted and asked to return the parcel registration for each AES. This is controlled. If this registration is not returned or filled in properly before a certain date, the contract is ended. - An on-site control is undertaken by the administration. The EU asks for an annual rate of 5 % over the total AES. In Flanders at least 5 % of the total number of schemes is controlled. These 5 % farmers are not chosen at random, but depending on length of the contract, contracted area, earlier non-compliance, etc. The control involves a control of the parcel for which the AES has been applied, a control on the field itself to see if the prescriptions of the AES are fulfilled (e.g. green cover, nitrate residue measuring, etc.) and possibly a control of the invoices. The results of the controls (compliance/payment/end of contract) are transferred to the Paying Agency which then calculates and does the payments.

Monitoring and evaluation	The Flemish division for agricultural policy analysis (LV-AMS) is responsible for the organisation of the annual monitoring of the rural development programme, as well as its evaluation. For the evaluation, LV-AMS is coordinating, but the evaluation is carried out by external organisations. The information needed for the monitoring is gathered with the support of different administrations. Ex-ante, mid term and ex-post evaluation have been completed.
Outcomes of policy measure	An increasing number of farmers who participate in AES: Soil Cover: 78,031 ha (LV, 2007); AES Water 28,911 ha (FLA, 2007); AES Erosion: 1,732 ha (FLA, 2007).
Analysis of drivers of policy measures' outcomes	AES are instruments directly impacting on farmers.
Part C – Evaluation of the Policy Measure	
Effectiveness of policy measure (in relation to the extent to which objectives are achieved, and cost-effectiveness)	Most interviewees are positive about the voluntary measures. Most AES are not outcome-oriented and most often, no measurement of the real impact of these AES is possible. This is probably the reason why environmental organisations doubt the cost-effectiveness of these measures.
Constraints to achieving full potential of the policy measure	The Soil Cover scheme and its technical measures were already applied by a lot of farmers. Maintaining soil cover is now considered Good Agricultural Practice. AES Water is sometimes applied on less fertile or not easily accessible parcels, where a farmer would already apply less or no manure. The outcome-oriented approach and soil-sampling of AES Water leads to discussion with the farmers. The result of the soil sample (residual N) is depending on a lot of factors, that are not related to the manuring (for instance the rainfall during a season, the time and temperature during the sample taking, and the soil type). Recently, high grain prices have been competing with AES for agricultural area. A farmer may choose to apply one of the schemes or to use the area for grain production. The FLA-Rural Development already noticed farmers terminating their AES contract because of the more profitable production of grain.
Reasons for the success of the policy measure (where appropriate)	AES are voluntary measures and most interviewees agreed on the stimulating effect of this kind of policy measures. Soil Cover and AES Water had good financial compensations. Due to the efforts in awareness raising and communication on the erosion problem, AES Erosion starts to be well-known and well-accepted.

7.2.3 Fiche 3: Erosion Decision

Part A: Summary of Measure	
Formal title of measure and date of implementation	Decision of the Flemish Government concerning the subsidising of small infrastructural erosion works carried out by local governments (07/12/2001).
Short description of the measure	After some very serious muddy floods, erosion appeared on the political agenda. This Decision provides local authorities with the opportunity to draw up an erosion plan and undertake targeted action. Introduced in 2002.
Type of policy measure	It is an incentive-based measure. Local authorities receive a subsidy from the Flemish Government for the preparation of the local erosion plan. Local authorities can give a financial compensation for certain erosion measures, but they can eventually also expropriate landowners. It is a Flemish policy, but local authorities can take the initiative. It is not a part of agricultural policy.
Objective of policy measure and relevance	The policy's primary objective is to decrease erosion. It represents a source-oriented approach to counter erosion-related problems with effects to the community such higher costs for dredging water courses, damage to homes and infrastructure caused by mud flows. The loss of fertile top layers of the soil is also considered.
	How relevant are the objectives of the measure to the soil degradation threats in your region? ☐ ☐ ☐ X ☐ Not very Very
Indirect effects	Less sludge and thus less dredging needed.
Linkages to other policy measures	Similar technical measures for farmers are included in the AES of the Flemish Rural Development Program (PDPO). No accumulation of the two policies is possible. In the policy about waste management for dredging, there is also a section on prevention of erosion. Environmental and nature organisations believe that there is an over-supply of erosion measures in different policies.
Funding	The Flemish Government gives a subsidy (12,5 €/ha) to local authorities to draw up the erosion plan. The province coordinates and helps the communities with this task (clustered approach, several municipalities may join). The local authorities pay 0,5€/ha to the province for this service. For the execution of small infrastructure works, the Flemish government is responsible for up to 75 % of the costs. 15 % of the costs are subsidised by the province. The other part is covered by local authorities.
Summary of assessment and conclusions	This policy places the initiative with local governments. They know where the acute problem areas are, but sometimes lack the knowledge or misjudge the seriousness of the problem. Due to personal contact they can reach a lot of people.

Recommendation	The complicated and slow procedure before action can be undertaken should be simplified. The local erosion plan is not binding: municipalities do not have to undertake the intended actions. Since this is a task of the local government there could also be a problem of control: due to a lack of knowledge and personal contacts among actors in small municipalities the control could be too tolerant.
Part B: Detail on the Measures Design, Implementation, Enforcement and Impacts	
Policy design	As erosion was put on the political agenda, the Minister asked the administration to work out a first draft. LNE prepared this draft and discussed it with the Association of Towns and Municipalities of Flanders, the responsible provincial administrations, the Division of Wood and Nature, the Flemish organisation of Water Management Associations and other involved administrative bodies. Advice was asked of the financial service as well. A more technical manuscript was edited with good practices to draw up an erosion plan. This was done by LNE who consulted several times the different administrations, agencies and organisations concerned with water, agriculture and nature as well on the Flemish, the provincial as the local level.
Policy implementation I: Implementation at administrative level	1. From Flemish to local authority: The provincial erosion administrations and LNE help and advise local authorities in drawing up their plan. The plan is then sent to LNE for approval. The plan is not binding. For the execution for this plan, local authorities sent a principal request with an overview of the costs prior to the start of the works. When this is approved by the Minister, the local authority has to send a definitive request, after approval of this, the works can start. It is a long and slow administrative process. If there is good cooperation between partners, the process can be finished in less then a year. But it can also take more than 2 years from the principal request to the beginning of the works.  2. From local authority to farmers/users: Local authorities can enter a contract with the user and the owner of the parcel for some technical measures (erosion dam, buffer strips, elevation of country tracks). These contracts are for 20 years. Construction is done by the local government. Maintenance is the responsibility of the user or the local government or its representative. But a local authority can also choose to expropriate landowners to implement the erosion plan.
Policy implementation II: Method of delivery to farmers	Local Authorities have to inform farmers before the drawing up of the erosion plan. Sometimes however they were only contacted before the definitive request. Exceptional farmers where contacted before the drawing up of the plan. With the definitive request farmers where contacted by meetings and personal visits usually with the help of the provincial erosion officer. In the case study area there was close cooperation between the provinces, local authorities and the provincial office of the FLA, responsible for the AES. When visiting the farmers administrators tried to convince farmers to take action to mitigate erosion. If farmers did not wanted to sign a contract

	with the local authority then also the voluntary AES were mentioned. Sometimes as a last resort administrators pointed at the possibility of the local government to expropriate.
Targeting	The advantage of this policy is the local approach. Farmers know how erosion-susceptible their parcels are, but this policy makes it possible to look locally where small infrastructural works or technical measures are best placed. For example, a farmer on the top of the hill can be the cause of the erosion problem downhill; the negative effects are for the farmers downhill. The farmer on the top will not be prepared to undertake erosion works as he/she believes to have no problem. A local authority may then implement works on or next to this uphill parcel.
	To what extent does the implementing body have flexibility in the targeting of the policy measure so that it is adapted to local conditions? ☐ ☐ ☐ ☐ x Low High
What Drives Uptake?	Since the Erosion Decision farmers have become more and more aware of the effects of erosion. Also the local approach makes them more concerned. Often they have had personal contact with the executing officers. The financial aspect could also play a role.
	☐ Obligation ☐ Financial incentive ☐ Information & support x Exhortation ☐ Other
Technical measures	Technical measures include buffer strips, grass corridors, erosion ponds, embedded straw bales, embedded faggots, elevation of country tracks or collectors for sludge and sand. If these measures have already been entered in the local erosion plan farmers can not really choose. The farmer is free to apply additional measures.
Enforcement and control	On-site control of the technical measures is undertaken by the responsible local (environmental/agricultural) service, sometimes together with LNE. Until now, only few investments have been realised and so far no control has been carried out.
Monitoring and evaluation	There is no real monitoring. LNE keeps an overview on the number of plans made and implemented, and on the budget of the investments. In the yearly Flemish Environmental and Nature Report different indicators are registered on erosion. This report is compiled by the Flemish environmental agency.
Outcomes of policy measure	• Higher awareness of the erosion problem. • A number of local erosion plans are drawn up and are in the process of being implemented. • Not a lot of environmental outcomes because very few works have been accomplished until now in the case study area.
Analysis of drivers of policy measures' outcomes	Most of the outcomes have come about because of agenda setting. The local government is encouraged to consider the erosion problem on their territory and thus come to action. The local approach as proposed in the Erosion Decision is a new rule. The policy creates a new implementation approach. This policy can also directly impact on farmers' behaviour by giv-

	ing payments to conduct certain actions.
Part C – Evaluation of the Policy Measure	
Effectiveness of policy measure (to the extent to which objectives are achieved, and cost-effectiveness)	A lot of municipalities are presently drawing up their erosion plan. It is too early to evaluate the effectiveness of the small infrastructural works. Environmental and nature organisations assess that the cost for dredging are directly linked to the erosion measures. They believe that the erosion problem is serious and thus more stringent rather than voluntary rules are needed. Presently funding is not sufficient. Therefore the costs for dredging are enormous.
Constraints to achieving full potential of the policy measure	The slow administrative process: the erosion decision dates from the end of 2001 and only now local authorities are starting to implement their plan. For the definitive request all contracts with farmers and owners have to be submitted as well, which takes a lot of time (therefore the process takes sometimes more than 2 years).). LNE mention that this is predominantly due to the low priority local governments give to erosion problems rather than time required for administrative processes. Sometimes local authorities are somewhat careless when carrying out these small infrastructural works. The control is also a task of these local governments. Because of the lack of sufficient knowledge and because of more personal relations, this can have consequences on the thorough control of the measures. The farmers uphill are sometimes not aware of the effect that run-off has on fields downhill and are unwilling to undertake action.
Reasons for the success of the policy measure (where appropriate)	The measure has some advantages: the local erosion plan has a cluster approach (municipal cross-border approach) and is locally designed. It is a measure where local initiative is supported. The local authorities get a lot of support from provincial services (coordination of the plan, visiting farmers or assistance with the request). There is a good relation and cooperation between the different implementing bodies.

7.2.4 Fiche 4: Interreg-project MESAM on Soil Erosion

Part A: Summary of Measure	
Formal title of measure and date of implementation	MESAM is an Interreg IIIa project. The project duration was January 2003 to March 2007. A follow-up project is in the process of approval. MESAM stands for 'Measures against Erosion and Awareness Raising of Farmers for the Protection of the Environment'.
Short description of the measure	The project aimed to control soil erosion across regional, provincial and national borders: Nord-Pas de Calais, Hainaut, West and East-Flanders. The project involved a survey of farmers and policymakers on erosion control measures, an inventory of the bibliography on erosion and soil conservation in these regions, set-up of demonstration and trial fields (tillage alternatives, grass buffer strips, cover crops and others), awareness raising of farmers and policy makers and socio-economical analyses of erosion control measures at farm and basin level.

	Other similar projects were carried out in other provinces of Flanders.
Type of policy measure	This project is not really a 'policy' measures as such, but could be classified as an information and capacity building measure, because of the importance it had in the awareness raising with farmers of the erosion problem and getting acquainted with adapted farming practices. Soil conservation is its primary objective and is agriculture related as it mainly focuses on farmers. It is a local initiative, but across boundaries. A research network on erosion was developed and farmers received information through demonstration projects.
Objective of policy measure and relevance	Objective of the project was to control soil erosion across regional, provincial and national borders, by giving demonstration, elaborate knowledge on erosion problems and measures. A priority was to make farmers and policy makers aware of the soil erosion problem.
	How relevant are the objectives of the measure to the soil degradation threats in your region? ☐ ☐ ☐ ☐ X Not very Very
Indirect effects	There are no indirect effects.
Linkages to other policy measures	The project is closely related to the Erosion Decision. In the case study area, one and the same provincial servant is responsible for the MESAM project and the coordination of the local erosion plans.
Funding	The project was co-funded with 50 % from the European Commission and the rest contributed by the different project partners. The Flemish Government also cofinanced this project.
Summary of assessment and conclusions	This Interreg IIIa project tackled the erosion problem in neighbouring regions of France, Wallonia and Flanders. The local level of the project was an advantage. The main objective was to raise the awareness of people concerning the erosion problem. The project team achieved this by establishing demonstration sites and distributing information.
Recommendation	As farmers accepted this project positively, the funding of future similar projects will have effect. Also for other soil degradation processes (decline in organic matter), these kinds of projects can raise the awareness of farmers.
Part B: Detail on the Measures Design, Implementation, Enforcement and Impacts	
Policy design	The initiative for the proposal of this Interreg IIIa project came from the provincial service on erosion. The project partners were contacted and a joint proposal was submitted.
Policy implementation I: Implementation at administrative level	Not applicable.

Policy implementation II: Method of delivery to farmers	The project staff wanted to achieve an active and conscious participation of civil society, including various institutions, organisations, agricultural schools, universities and municipalities, but above all, farmers. Therefore they organised field demonstration days and workshops and they also accompanied and helped the individual farmers whenever needed.
Targeting	It was a local project carried out at basin level.
	To what extent does the implementing body have flexibility in the targeting of the policy measure so that it is adapted to local conditions? ☐ ☐ ☐ ☐ x Low High
What Drives Uptake?	Uptake is not really an issue here. The project's activities were only demonstration or information spreading activities.
	☐ Obligation ☐ Financial incentive x Information & support ☐ Exhortation ☐ Other
Technical measures	Demonstrations were given on: • grass buffer strips and grass water ways: to evaluate the retention of the eroded sediment on selected arable fields; • cover crops; • alternative soil tillage systems such as non-inversion till, no-till, reduced till and under-sowing of cover crops for different.
Enforcement and control	Not applicable
Monitoring and evaluation	Not applicable
Outcomes of policy measure	Awareness raising of farmers and local stakeholders
Analysis of drivers of policy measures' outcomes	Not applicable
Part C – Evaluation of the Policy Measure	
Effectiveness of policy measure (in relation to the extent to which objectives are achieved, and cost-effectiveness)	Not applicable

Constraints to achieving full potential of the policy measure	Not applicable
Reasons for the success of the policy measure (where appropriate)	Local network and the objective for participation of farmers and other stakeholders resulted in a well-spread information on the project and thus increased awareness of the erosion issue in the region.

7.3 Summary of policy use and effectiveness

In the accompanying fiches the four most important policy measures are described in order of their importance to the soil degradation processes in the case study area of West-Flanders. The four most important policy measures are:

- The Manure Decree
- The agri-environmental schemes in the Rural Development Program
- Erosion Decision
- Interreg IIIa project: MESAM project

The **Manure Decree** has been prepared by the Manure Bank (of VLM). A steering committee on the Flemish Manure issue can give advice on this decree. This committee consists of different actor groups i.e. agricultural and environmental organisations, food industry as well as the Flemish coordination centre for manure processing. It implements the European Nitrate Directive in Flanders by setting up new rules to register manure production and laying down new fertilisation norms to support the Manure policy and has come in force in 2006. The main objectives of the Manure Decree are reducing the nitrate and phosphate load in waters in Flanders. It is a very stringent policy that is mostly based on command and control. Therefore various fertiliser bans were introduced in certain areas e.g. restrictions on the maximum amount of N and P fertilisation, as well as restrictions on the application period and method of organic amendments.

Soil conservation itself is a by-product of the Manure Decree because it is a broad policy which acts on almost every aspect of nutrient management on farms. Still, due to its regional level of influence and its aim to reduce eutrophication in ground and surface water, it is a relevant policy measure to control soil degradation processes (in particular diffuse soil contamination) in West-Flanders. The Decree is not locally implemented or targeted and is therefore not adopted to local (biotic and abiotic) conditions as soil texture, rainfall or temperature; especially this is however indicated as one of the most important constraints of this policy.

Most interviewed farmers find that there is a good delivery of the information to the stakeholders. However, in some cases farmers find that there is too much information or that there are too many changes so that it becomes difficult to keep up with changes. This in turn creates the risk that some farmers will not know anymore what they are expected to do, which can result in a failure of the new Manure Decree III of December 2006. On the other hand, farmers also claim that the monitoring of the Decree by taking samples between 1st of October and 15th of November to determine if there is a risk of eutrophication to surface and ground water, can only give a random indication at a given moment in time and does not point out the risk of nitrate leaching. Therefore farmers are willing to undertake efforts to diminish this threat by better fertilisation management; on the other hand they also ask to dif-

ferentiate the general rules taking into account soil type, crop characteristics and climate conditions. Adherence to the regulations is still problematic, in particular by animal breeders and vegetable growers, even though two decrees already preceded the current Manure Decree. Vegetable growers do not consider the imposed measures as economically feasible. They need technical support and sound fertilisation advice. If accompanied with a well-considered differentiation of the regulations, support and advice are likely to motivate vegetable growers to comply with the Manure Decree.

Not only farmers but also policymakers find the manure policy very complex. As this measure is impacting considerably on the management practices of the farmers, farmers' organisations invest into lobbying. Nature conservation and environmental organisations appreciate the previous efforts of farmers but criticise that the Manure Decree offers the possibility to increase the numbers of livestock. These organisations see livestock as the main cause of the nitrate overload.

The most important bottlenecks that still have to be tackled are i) determining the working coefficients for mineralisation of manure, ii) additional or improved rules for P-application, and iii) solving the conflict between the Manure Decree and the need to augment the soil organic matter status by adding exogenous organic matter. In future, regulations also need to be differentiated according to soil type and crop, whereby further research on these different topics is needed. On the other hand, the Manure Decree is already a very complex and broad policy, in addition to which farmers are obliged to keep detailed records, which requires a lot of time and specific knowledge and causes farmers to resent the policy measure.

The **Agri-Environmental Schemes (AES)** are part of the Flemish Rural Development Program and are initiated by the agricultural or environmental administrations, using their field knowledge, integrating proposals of farmers, farmers' organisations, nature organisations or environmentalists or sometimes study groups were formed to work out objectives and prescriptions for the AES. They vary from European policy measures to national policy measures. Farmers receive incentives for conducting these voluntary measures. The measures have a broad spectrum of objectives, wherein soil conservation is a secondary objective (not a specific aim of the policy), although there are some AES that have tackling soil erosion as their primary objective. These incentive-based measures have a direct impact on farmers' behaviour.

In general, the objective of these measures is very general and not really relevant for the case study area. However the individual objectives of AES Erosion and AES Water are tackling certain soil degradation processes in the case study region (West-Flanders).

These voluntary measures are well accepted by farmers. It is a suitable approach for making farmers familiar with a problem or with a certain agricultural practice. Farm planners facilitate the delivery of the measures to the farmers. They personally visit farmers and inform them about available AES and their suitability to their farm. This way of working is breaking down barriers and convinced a lot of farmers. Due to the personal contact, farmers are more willing, have more trust and know where to go with questions. This is seen as a good practice example. On the other hand, due to the higher grain prices, farmers are less interested: the financial incentive is not sufficient to convince farmers. The FLA-Rural Development already notices farmers terminating their AES contract because of the more profitable production of grain.

In contrast to the farmers, nature and environmental organisations believe these AES not to be efficient. They often state that farmers are paid for Good Agricultural Practices. They criticise that little notice is taken of the evaluations of this policy and of their recommendations regarding this policy.

One of the constraints of this policy measure is that sometimes they are not far-reaching in comparison to the financial incentive for the measure. Dead weight effects are not eliminated because farmers choose parcels were they would already apply the measure.

The **Erosion Decision** is an incentive-based, non-agricultural focused policy which encourages municipalities to draw up an erosion action plan and co-finance certain actions by the municipalities. This policy is a Flemish policy and has the primary objective to decrease erosion. The Erosion Decree has been prepared by the Environmental Administration.

Due to its local focus, this policy measure is relevant to the soil degradation processes in the case study (West-Flanders). The Erosion Decree encourages local governments to consider erosion and decide which actions to undertake. After the formulation of the municipal soil erosion plan, local governments can undertake some small infrastructural works to implement the plan. They can also give incentives to farmers to implement some technical erosion measures. Previous works and incentives are paid with Flemish financing and with co-financing of the province and the local government.

Nature conservation and environmental organisations criticise that the policy concerning erosion is too fragmented, i.e. too many different policy measures are tackling this problem. They sometimes doubt the efficiency and believe costs for dredging should be taken into account.

The implementing administration reported a lot of goodwill and interaction between the different stakeholders during the design process. They also see the advantage of being in direct contact with a group of farmers to directly find out about constraints in implementation.

The interviewed farmers are aware of the problem of erosion. The local approach makes them more concerned. Often they have had personal contact with the executing officers. Usually they are willing to implement the measures composed by the local authorities. Due to the slow administrative process only a few works have been accomplished so far, hence it is too early to evaluate the effectiveness of these works.

This administrative process can be identified as a constraint: the Erosion Decision was introduced in 2001 and only now local authorities are starting to execute their plan. The whole process takes a lot of time, sometimes more than 2 years before action can be started. Sometimes local authorities are somewhat careless when carrying out these small infrastructural works. The control is also a task of the local governments. Local authorities' lack of knowledge and more personal relationships among stakeholders may have consequences for valuing the adequateness of the execution and maintenance of the measure and the way controls of the measures are carried out. Another constraint is that the farmers uphill are sometimes not aware of the effect that run-off has on fields downhill and are unwilling to undertake action.

The **Interreg IIIa project** (MESAM or 'Measures against Erosion and Awareness Raising of Farmers for the Protection of the Environment') is also a non-agricultural focused policy, which has soil conservation as a primary objective. The MESAM project developed a research network on soil erosion. The project was set up in January 2003 with West-Flemish, Flemish, Walloon and French partners, by giving demonstration on technical erosion measures, in cooperation with local farmers who were willing to trial some measures. The main objective of this policy measure was raising the awareness of farmers concerning the erosion problem. The project ended in March 2007, but a follow-up project under approval. The measure is classified as information and capacity building measures.

As the Erosion Decision, the Intereg IIIa is a local initiative so it is very relevant to the degradation issues of the case study (West-Flanders).

To summarise, soil conservation is not a priority in Flemish policy. Only few people in the administration have this as their core business. There are some related policies with effects on soil degradations problems and they all focus on soil erosion. Only the Erosion Decree and the Interreg project MESAM have a first order objective concerning soil conservation. This leads some interviewees to doubt the existence of a long term vision of the government. Policies have been developed as a reaction to acute problems for example the Erosion Deci-

sion. Some soil conservation problems such as the decline in organic matter that can only be improved over a longer period of time are not tackled.

Another issue that was often mentioned in the interviews is the fragmented view of policy-makers. The interviewees emphasise the importance of the integration of different policy domains for tackling soil conservation issues. An integrated policy approach where soil matters, spatial planning, nature conservation and dredging among other things would lead to more comprehensive, far-reaching and long-term solutions to the problem. Most interviewees agree on the need of a combination of policy instruments. They largely support the voluntary measures where the initiative is laid with the stakeholders. For serious problems they see obligatory measures as necessary.

Evaluation of effectiveness of soil conservation policies

The effects of the policy measures are not monitored directly but the two-yearly Flemish Environmental Report (MIRA-T, 2006) describes the progress of different environmental aspects in Flanders (e.g. surface water quality, ground water quality, overfertilisation).

Diffuse soil contamination

The Flemish Environmental Report of 2006 includes figures on the surplus of nitrogen and phosphor in the soil balance. This report also contains information on the quality of surface and ground water. The quality of the surface water has been measured since 1999 by the Flemish Environmental Agency in the Manure Action Plan-measurement net for surface water. For Flanders the winter year of 2005-2006 the norm for nitrogen of 50 mg N/l was exceeded in 42 % of the points. For West-Flanders, the norm for N was exceeded in 67 % of the measurement points. For the quality of ground water, there is an analogues measurement net. Here the report claims that in spring 2006, in 38 % of the measurement points, the norm was exceeded.

Erosion

Because of the fact that the measures concerning soil erosion are quite new, there are no data available yet on their impact. Concerning implementation, the Manure Bank gives a yearly overview of the progress of the Manure policy in Flanders. For the last five years about 85 % of the Flemish farms complied with the rules imposed by the Manure Decree.

The Flemish Land Agency (VLM) keeps an overview of the total area, number of contracts under AES and compliance rate in Flanders.

Table 8: Surface under AES for Flanders

	2000	2001	2002	2003	2004	2005	2006
AES-Water (ha)	13.702	22.014	24.247	25.324	27.392	20.739	28.911
AES-Erosion (ha)	0	0	0	0	17	700	1732

Most of the municipalities with erosion susceptible soils have already drawn up an erosion control plan. In West-Flanders only two municipalities carried out erosion control activities. Nonetheless in 2007 27 other erosion control projects were in still progress.

Flanders is the only European Region that uses the residual nitrate nitrogen concentration in the soil as a measure of nitrate leaching losses, and hence as an indirect measure of sound fertilisation practices. However, the relationship between residual nitrate N and effective nitrate leaching losses is not straightforward, and is very much affected by weather conditions during autumn and winter, the N mineralization capacity of the soil, mineralisation from crop residues left after harvest, and certainly whether or not there is still an actively growing crop at the time of sampling. This is often a point of discussion for farmers.

8 Conclusions

When interviewees were asked about good practices, they often referred to the participation or engagement of the different stakeholders and administrative people in policy design processes. For the implementation of the policy, they see as an advantage that administrative people (for AES these are called farm planners) are in close contact with the farmers and thus increase participation. The personal contact between farmers and farm planners enhances trust and willingness. In addition, broad participation in the design process allows to directly test the feasibility and acceptability of the policy measures with the farmers.

Another positive aspect is the local approach of some policies. For some local soil conservation issues such as erosion, the effectiveness of the measure will depend on the local targeting of the measure.

An overall constraint is the administrative burden linked with the policies. Sometimes the policy itself has been amended so many times and is so complex (e.g. Manure Decree) that farmers “do not see the wood for the trees”. The farmers themselves are obliged to a lot of administration. Another example is the long period before local governments can implement small infrastructural works against erosion due to administrative processes (e.g. Erosion Decision).

Nature conservation and environmental organisations believe that the measures applied are not far-reaching enough to tackle the problems. They mention the lack of vision of the Flemish Government and believe that policies should be more integrated over the different domains: agriculture, nature, water, etc.

One of the most suitable technical measures is the use of intercropping by sowing green manure. This is an easy and effective practice for soil conservation, mitigating diffuse soil contamination as well as soil erosion. This technical measure was implemented in the agri-environmental schemes and the Erosion Decree, but is abandoned since 2007. However, most farmers are already convinced of its advantages and continue to apply it. Other technical measures such as contour tillage and grass buffers were also indicated as effective conservation measures against soil erosion and were implemented by the Erosion Decree and in the agri-environmental schemes of the Rural Development Plan. Farmers are more receptive to measures that also offer technical and organisational advantages. Measures that only reduce erosion are less interesting to them. The latter measures only seem to be adopted if economical losses due to erosion are incurred and/or if financial support is provided.

The main outcome of all discussed policies is an increase in farmers’ awareness soil degradation the issues. Even command and control measures such as the Manure Decree have had this effect. Farmers are acknowledging the importance of certain environmental problems and are becoming accustomed to consider environmental objectives in their farm management.

The concern of soil degradation promoted research on alternative ways of agricultural production that reduce soil erosion and balance nutrient inputs with environmental concerns. Conservation tillage is increasingly being adopted worldwide, mainly because of its role in protecting the soil from wind and water erosion. However, conservation tillage is mainly practiced in monocultures of grain crops and is only recently (last 5 to 10 years) gaining importance in Western Europe. Constraints for conservation tillage in Western Europe are the lack of knowledge about the effects of conservation tillage under these specific climatic and soil conditions. There is also a lack of knowledge about how to include crop rotations with crops that seem less suitable under conservation tillage including root and tuber crops. In Belgium, the adoption of conservation tillage was limited until now. However, the promotion of conservation tillage among scientists and farmers is stimulated by the ‘Belgian Association in Research Application on Conservation Agriculture (BARACA)’, founded in 2001 (D’Haene, 2008). Recently more interest in conservation tillage is observed partly to the progress in

agricultural machinery, the high energy costs and the funding of some technical measures by the Erosion Decree.

On the other hand, organic farming in Europe has been growing steadily over the last decades both in area and number of farms and this growth is evident in nearly all EU countries. Organic farming is put forward as a sustainable alternative to the conventional way of farming (De Neve et al., 2006) due the stringent fertilisation rules. In Belgium, organic farming is more concentrated in the Southern part of the country, the Walloon provinces (± 25 000 ha) where more extensive dairy farms exist, whereas in Flanders, the Northern part of Belgium the intensive production system renders the conversion to organic farming more difficult (± 3,000 ha; Anonymous, 2008: www.statbel.fgov.be).

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Annexes

Annex 1: Overview of the results of Questionnaire 1

Main farm types	arable, livestock
Main crops	wheat, maize, cauliflower, potato, sugar beet, leek
Livestock	bovine (race: Holstein and Belgian Blue Beef), pigs
Main production orientation	conventional
Average field size	2 ha
Irrigation methods	none
Source of irrigation water	n/a
Usual salt content of irrigation water	n/a
Drainage systems	tube systems, ditches
Existing grass strips	yes
Separation of fields by hedges	no
Main soil degradation processes	water erosion, diffuse soil contamination, decline in organic matter
Applied soil conservation measures (cropping/ tillage measures)	intercrops, grass strips, no tillage/direct drilling, reduced tillage, contour tillage, wheel sizes and pressure / restricting excessive heavy machinery use, restrictions on the max. amount of (liquid) manure application, restrictions of manure application to a certain time period, restrictions on the max. amount of N- fertilisation, restrictions on the max. amount of P-fertilisation, thresholds between ridges potatoes
Applied soil conservation measures (long term measures)	use of organic soil improvers/exogenous organic matter, liming, change of field patterns and sizes, retention ponds, subsoiling

Annex 2: Glossary of policy measures

English title of policy measure (law, regulation, initiative)	**National title of policy measure**
Manure Decree (law)	Mestdecreet – Decreet houdende de bescherming van water tegen de verontreiniging door nitrate uit agrarische bronnen
Flemish Rural Development Plan (PDPO I & II)	Vlaams Programma Document voor Platteland-sontwikkeling (PDPO I & II)
Erosion Decision	Erosiebesluit
MESAM (Interreg IIIa) ‘Measures against Erosion and Sensibilisation of Farmers for the protection of the Environment’	Interreg project MESAM: ‘Maatregelen tegen Erosie en Sensibilisatie van Agrariërs ter bescherming van het Milieu’

Annex 3: List of interviews

Interview Date	Interviewee (affiliation/position)	Type of interview
27/03/08	Farmer 1 (erosion)	Q2
27/03/08	Provincial department Agriculture	Q3
01/04/08	Farmer 2 (diffuse contamination)	Q2
01/04/08	Farmer 3 (diffuse contamination)	Q2
04/04/08	Farmer 4 (diffuse contamination)	Q2
04/04/08	Farmer 5 (diffuse contamination)	Q2
14/04/08	Farmer 6 (diffuse contamination)	Q2
14/04/08	Farmer 7 (diffuse contamination)	Q2
21/04/08	Department of Environment – Division of land and soil protection	Q3
22/04/08	Local government	Q3
22/04/08	FLA-Manure Bank (provincial field service)	Q3
25/04/08	VLACO	Q4
25/04/08	FEA	Q3
29/04/08	FLA-Manure Bank	Q3
29/04/08	MINA council	Q4
29/04/08	Farmers' union Roeselare (Regional)	Q4
29/04/08	REO auction	Q4
05/05/08	LV-AMS	Q3
06/05/08	FLA-AP (provincial field service)	Q3
06/05/08	Regional Landscape	Q4
09/05/08	Umbrella Flemish NGO's	Q4
14/05/08	Member of the research team in field grown vegetables for the industry (POVLT)	Q4
14/05/08	Farmer 8 – 16 (Interreg IIIa MESAM)	Q2
14/05/08	Member of the CKC	Q4
19/05/08	ABS (General farmer's syndicate)	Q4
22/05/08	Provincial service for Erosion	Q3
27/05/08	FLA-AP	Q3

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Abstract

This Technical Note 'Case Study – Belgium' is part of a series of case studies within the 'Sustainable Agriculture and Soil Conservation' (SoCo) project. Ten case studies were carried out in Belgium, Bulgaria, the Czech Republic, Denmark, France, Germany, Greece, Italy, Spain and the United Kingdom between spring and summer 2008. The selection of case study areas was designed to capture differences in soil degradation processes, soil types, climatic conditions, farm structures and farming practices, institutional settings and policy priorities. A harmonised methodological approach was pursued in order to gather insights from a range of contrasting conditions over a geographically diverse area. The case studies were carried out by local experts to reflect the specificities of the selected case studies.

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