Final report on the project 'Sustainable Agriculture and Soil Conservation (SoCo)'

Executive summary english

The project 'Sustainable Agriculture and Soil Conservation (SoCo)' is a pilot project commissioned by the Directorate-General for Agriculture and Rural Development, in response to the request of the European Parliament (Administrative Arrangement AGRI-2007-336).

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Executive summary

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.

Regarding the first objective, a stock-taking was conducted throughout the EU, collecting information via a literature review, the use of parametric and empirical models, and a survey of policy measures. The second objective was mainly achieved by ten case studies across the EU and a series of regional workshops. The third objective will be met with this report and the planned dissemination process.

This report synthesises the findings of the SoCo project and translates them into conclusions and recommendations. Following the introduction (Chapter 1), Chapter 2 reviews soil degradation processes, soil conservation practices and policy measures at European level. Soil degradation risk was assessed through parametric and empirical models, whereas the review of soil conservation farming practices is based on the available literature. The literature review of policy measures is supplemented by a survey of policy implementation at national or regional level. Chapter 3 takes the analysis to the local scale by means of ten case studies distributed over three macro-regions. Aggregated environmental benefits of adopting particular soil conservation practices are explored with model calculations in Chapter 4. Finally, Chapter 5 discusses the effectiveness and efficiency of instruments for soil protection, maintenance and improvement in Europe, exploring opportunities and critical issues linked to the adoption of conservation practices. The report closes with policy-relevant conclusions as a basis for policy recommendations.

Nature, location and magnitude of soil degradation related to agriculture

Soil is defined as the top layer of the earth's crust and is composed of mineral particles, water, air and organic matter, including living organisms. It is a complex, mutable, living resource which performs many vital functions: food and other biomass production, storage, filtration and transformation of substances including water, carbon and nitrogen. Soil further serves as a habitat and a gene pool, and provides a basis for human activities, landscape and heritage, and the supply of raw materials.

Soil is also subject to a series of degradation processes. Six of the soil degradation processes recognised by the Commission (water, wind and tillage erosion; decline of soil organic

carbon; compaction; salinisation and sodification; contamination; and declining soil biodiversity) are closely linked to agriculture. Within SoCo, the magnitude of the related soil degradation risks was estimated at EU level and areas where these risks are most likely to occur were identified. The degree of 'risk' of soil degradation is established as a function of the underlying predisposing factors, and does not indicate the actual occurrence of degradation processes in particular areas.

The major drivers for water **erosion** are intense rainfall, topography, low soil organic matter content, percentage and type of vegetation cover, inappropriate farming practices and land marginalisation or abandonment. Several areas with a high risk of erosion (including some hotspots) are located in the Mediterranean area. Erosion risk is also observed across western and central Europe. The highest number of erosive days on bare soil per year, posing a wind erosion risk, is found across the sand belt covering southeast England, the Netherlands, northern Germany and Poland. Additionally, the areas exposed to high wind speed along coastlines show elevated levels of wind erosion risk.

Apart from soil characteristics (such as soil texture), and soil type, the soil organic carbon content is determined by land use, climate (mainly temperature and precipitation) and soil hydrology. Risk related to **soil organic carbon decline** is defined in terms of the potential of soils to lose organic carbon (removal of carbon from the soil) compared to rates of accumulation of soil organic carbon. The climate factor explains the existence of a north-south climatic gradient, with high soil organic carbon levels in the colder humid northern part of Europe and in mountainous areas, and lower levels in the warmer semi-arid southern part. The model results show that agricultural soils in Europe have very different actual soil organic carbon levels and are subject to different risk levels as regards soil organic carbon decline. Soil organic carbon is a major contributor to soil fertility and general soil conservation. Less well known are the interrelations between soil organic carbon and climate change. Soil organic carbon is the second biggest carbon pool on the planet after the oceans. There are more than 70 billion tonnes of organic carbon in EU soils, as compared to about 2 billion tonnes of carbon altogether emitted by the Member States annually. Releasing just a small fraction of the carbon currently stored in European soils to the atmosphere could wipe out emission savings in other sectors of the economy. Maintaining and optimising organic carbon levels (as a specific objective of land management) is important in contributing to climate change mitigation.

The natural susceptibility of soils to **compaction** mainly depends on soil texture, with sandy soils being least and clayey soils most susceptible. Human-induced compaction is caused by soil use and land management. European soils used for agricultural purposes have a predominantly low or medium natural susceptibility to compaction.

The main natural factors influencing soil **salinisation and sodification** are climate, the salt contents of the parent material and groundwater, land cover and topography. The most influential human-induced factors are land use, farming systems, and land management, such as the use of salt-rich irrigation water and/or insufficient drainage. The countries most affected by salinisation or sodification are Spain, Hungary and Romania. Other countries show localised occurrence of these conditions, which could have a devastating effect locally.

Because of a lack of data, SoCo has not been able to produce comprehensive risk assessments of the degree of **soil contamination** (by heavy metals and pesticides; excess nitrates and phosphates) or **declining soil biodiversity**.

Farming practices relevant for soil protection, conservation and improvement; their uptake and related environmental objectives

SoCo focused its review on two specific farming systems, namely conservation agriculture and organic farming, along with a range of farming practices. The review considered their impact on soil quality and assessed, as far as possible, the uptake and benefit-cost effects in a broader sense.

No-tillage and reduced tillage, in combination with permanent soil cover (cover crops, crop residues) and crop rotation, are essential practices in **conservation agriculture**. These practices minimise the risk of soil degradation by increasing the organic carbon stock, thus improving biological activity, soil fertility, soil structure and the water-retention capacity of soils. As a consequence, soil erosion and nutrient run-off are reduced (with positive effects on water quality), and soil resistance to compaction is improved. In addition, significant cost savings with respect to labour and fuel consumption are reported. Nevertheless, switching to conservation agriculture might require significant capital investment (for example, in sowing equipment) and greater attention in the use of chemicals for weed control. Within the EU-27, Finland and Greece show the highest uptake of no-tillage (more than 4.5 % of total arable land), while reduced tillage is practised on 40 to 55 % of the arable land in both Finland and the UK. Furthermore, conservation agriculture is a complex, site-specific farming system, requiring training of farmers and adaptation to local circumstances before maximum economic benefits can be obtained.

Organic farming, although different from conservation agriculture, has similar positive effects on soil organic carbon content and soil biodiversity. Energy consumption is reduced and beneficial effects are reported on water quality, in particular with respect to pesticides (which are strictly limited in organic farming), and on above-ground biodiversity (in particular species abundance and/or richness) and landscape. Net returns depend on yields, with some variation according to the crops. Over the period 1998-2005, the area under organic farming (including conversion areas) certified under Regulation (EEC) 2092/91 increased by 130 % in the EU-15, and by 2005 it amounted to 4 % of the total utilised agricultural area in the EU-25.

SoCo further reviewed the following **specific farming practices**: ridge tillage, contour farming, subsoiling, intercropping, grassland establishment and maintenance, agroforestry, buffer strips, and terracing. They were selected because of their potential to remedy soil degradation processes. For example:

- ridge tillage has positive effects on moisture-holding capacity, soil fertility maintenance and biological activity, and thus on water erosion and nutrient run-off;
- contour farming increases the soil's infiltration capacity, may have positive effects on soil organic carbon content and results in controlling water and tillage erosion;
- subsoiling has a beneficial effect on infiltration rate and capacity, but shows variable effects on nutrient cycling;
- terracing has beneficial effects on infiltration rate and capacity, and thus on controlling water erosion.

The information derived from the literature review afforded some insight into the cost and benefits of some of the practices, but on a case-by-case basis only. All studies reviewed clearly confirm that farming practice impacts are site-specific, which prevents extrapolation to the European level. Nevertheless, two examples are worth mentioning. Buffer strips lead to a

retraction in the productive area and investment in their establishment (seeding, planting). In return and depending on local conditions, they may replace or reduce the need for other nature restoration activities, in addition to mitigating the negative impacts of soil erosion and thus helping to improve the quality of watercourses. Cost-benefit analyses of terracing need to take social factors into account, since there is evidence that underlying trends in the socio-economic structure of the agricultural population have been leading to the abandonment of terraces and many authors report adverse effects of terracing once they are badly maintained or even abandoned.

Review of the regulatory environment and policy instruments that address soil degradation
To date, soil protection is not a specific objective of any EU legislation but features in some legislation as a secondary objective. Currently, the most important **EU environmental directives** with respect to soil quality are the Nitrates Directive (91/676/EEC) and the Water Framework Directive (2000/60/EC). Others, such as the Birds and Habitats Directives, the Sewage Sludge Directive (86/278/EEC) and the Plant Protection Products Directive (91/414/EEC), are expected to have beneficial effects on soil quality, but to a lesser extent owing to a more focused set of objectives.

In the framework of the Cardiff Process, environmental objectives are to be integrated into EU sectoral policies, including the **Common Agricultural Policy** (CAP). The CAP comprises two principal headings of budgetary expenditure: market price support and direct income payments (Pillar 1), and a range of selective incentive payments targeting rural development (Pillar 2).

Cross compliance, a horizontal tool for both pillars and compulsory since 2005, plays an important role in soil protection, conservation and/or improvement. The statutory management requirements (SMRs) create synergies between the Direct Payments Scheme and the need to ensure compliance with a number of relevant EU environmental directives, including the Nitrates Directive. The requirement to keep agricultural land (whether in productive use or not) in good agricultural and environmental condition (GAEC) aims to prevent land abandonment and ensure minimum maintenance of agricultural land. The elements of GAEC specifically target protection against soil erosion, maintenance or improvement of soil organic matter, and maintenance of a good soil structure.

Within Pillar 2 (Regulation (EC) 1698/2005), a wide range of measures can be supported and is potentially relevant to soil protection, conservation and/or improvement. Member States or regions are obliged to spread their **rural development** funding across three thematic axes: (1) competitiveness; (2) environment and land management; and (3) economic diversity and quality of life. ‘LEADER’ is a horizontal axis supplementing the three thematic axes. The axes contain measures which offer Member States the possibility of supporting actions to reduce soil degradation on agricultural land when such a need has been identified in their territories. Some of the most important are in Axis 2, where agri-environment measures can stimulate appropriate farming practices and farming systems such as organic farming and conservation agriculture. Measures should be well targeted and focused on actions above the reference level. As such, a range of rural development measures provides the Member States or regions with possibilities for encouraging farmers to go voluntarily beyond the reference level of soil quality, established through SMRs, GAEC requirements, minimum requirements for fertilisers and plant protection products and other relevant mandatory requirements established by national legislation.

The Commission published the **Soil Thematic Strategy** in 2006 (COM(2006) 231). Its overall objective is the protection and sustainable use of soil, based on the prevention of further soil degradation, preserving soil functions and restoring degraded soils to a level of functionality consistent with current and intended use. The proposed Soil Framework Directive (COM(2006) 232) requires Member States to identify areas at risk of soil degradation, as well as to set up an inventory of contaminated sites. Subsequently Member States have to adopt measures, which could be built on measures already implemented in national and Community contexts. However, Member States are free to decide on the level of ambition of their soil policy, to set their own targets and to decide how and by when to achieve them. The European Parliament adopted its first reading decision on the proposed Directive in November 2007, endorsing the proposal and calling for a directive on soil protection. In the Council meeting (environment) of 20 December 2007, despite the support and call for legislation from 22 Member States, five Member States (France, Germany, the United Kingdom, Austria, the Netherlands) voted against the compromise text prepared by the Portuguese Presidency, thus creating a blocking minority. The proposal is still under discussion in the Council.

SoCo conducted a **survey of policy implementation** at Member State and regional levels across the EU-27, which was extensive but not fully comprehensive. The results indicate that the existing policy measures have the potential to address all recognised soil degradation processes across the EU-27, even though not all policy measures are implemented in all Member States or regions, nor are they implemented in the same way. Measures are implemented using the flexibility provided within the legislative framework of the EU. Adaptation to local conditions improves implementation but not always to the desired degree. Typically, policy intervention in soil conservation is either through support for beneficial farming practices, or through the prevention or prohibition of damaging practices. A range of factors appear to influence the impact of different policy instruments. Compliance with prescriptions (mandatory measures) and levels of uptake of voluntary incentive-based measures, in particular, are both strengthened through increasing awareness and advice. However, the lack of monitoring and of a (quantitative) database prevents comprehensive evaluation of the impact, effectiveness and efficiency of the different policy measures at the present time.

Classification of soil degradation processes, soil conservation practices and policy measures

SoCo established a classification of soil conservation practices and related policy measures. It provides a schematic representation of the (expected) effects of farming systems (organic and conservation agriculture) and farming practices on soil degradation processes and related environmental issues, as well as indicating which policy measures encourage the adoption of such practices. The earlier-presented information on the impacts of farming practices on soil degradation processes is based on the scientific literature, which mostly concerns observed effects under particular geo-climatic conditions and farming characteristics such as farming type and tradition. In contrast, the survey of the implementation of EU policies at Member State or regional level did not throw light on the extent to which the links between farm technical requirements and soil degradation processes are based on actual measurements. Given differences in the use and implementation of policy measures, these hypothesised cause-and-effect models may not reflect what happens on the ground in the diverse and more complex agri-environmental reality.

Synthesis of land management practices and policy measures at regional level: case studies
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 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 synthesis focused on the **main soil degradation processes** encountered in each case study area:

- water erosion, which is closely linked to compaction and loss of soil organic matter, is a major issue in all case study areas, with the exception of the Bulgarian case study. Both organic matter decline and compaction are experienced to a moderate or severe degree in all case study areas;
- diffuse contamination (especially excess of nutrients) is of particular importance in more intensively farmed areas such as the Belgian case, but is also observed in other case study areas; and
- soil salinisation, which although a specific problem in the Bulgarian and Spanish case study areas, can be very severe wherever it occurs.

Comparing these results to the EU-wide stock-taking exercise, it is clear that these dominant degradation processes are not necessarily representative of the EU in its entirety. Other reported soil degradation processes include wind erosion, acidification (which is particularly problematic in eastern Europe) and soil sealing. Pressure arising from livestock farming, particularly nutrient loading from intensively stocked farms, was noted in some case studies and in the workshops, and is also well documented elsewhere in Europe.

There is considerable physical and spatial variability in the soil degradation processes analysed, which are not uniform even within relatively small areas. This is because the nature and extent of a degradation process is typically influenced by two interacting elements, namely the physical, environmental conditions in a given locality and the farming practices adopted.

The case studies further identified some of the **complex causal chains** between factors that shape the adoption of different farming systems and practices, and the ultimate impacts on agricultural soils. Some drivers are economic, such as agricultural commodity prices and energy prices; others are socio-cultural and technological, such as the trend towards using larger and heavier machinery to increase the efficiency of field operations.

Certain **farming practices** are compatible with good soil management in one location but not necessarily in another. That said, it is helpful to divide practices into those that are broadly beneficial and those that are generally inappropriate. Beneficial practices are those that are well adapted to local environmental and agronomic conditions, but also ones that serve to

alleviate the risk. Inappropriate practices contribute to soil degradation, primarily on the farmer's own land, but almost always have off-site impacts too.

Within the case study areas, there was a wide range of farming practices being used to protect, maintain or improve soil quality. Certain practices were associated with a particular type of farming system, some were pertinent only to a certain soil type, whereas others crossed these boundaries and could best be categorised as addressing a specific soil degradation process. Most of the promising practices for the sustainable management of agricultural (mostly arable) soils, however, were not consistently adopted. Adoption was impeded by a number of barriers, including technical factors such as the lack of adequate machinery and infrastructure, or the shortage of adequate information for farmers, economic factors including the costs of new machinery and the risk of income loss during transition periods, and because policy measures have not been appropriately targeted.

In addition, the case study interviews suggested that farmers were usually aware of the challenges, but did not necessarily regard them as pressing. They did not express marked concerns about likely future effects of soil degradation processes. In this respect, the case studies corroborated evidence from the impact assessment for the Soil Thematic Strategy and additional literature about the causes and drivers of soil degradation processes.

In most cases, stakeholders saw a **mix of policy measures**, combining voluntary incentive-based measures, mandatory measures, advice and support, as the way forward. More coordination, targeting, technical support and stronger monitoring were considered priorities. It appears that, by embodying new requirements with the potential to address key soil conservation, cross compliance has raised awareness of soil conservation among farmers. Provision of incentives through agri-environment measures was widely regarded as necessary to increase the adoption and development of certain practices, ideally helping to bring about a transition to more sustainable practices, with farmers adapting to higher standards and an enhanced level of responsibility for soil quality with time.

Lack of data on the precise levels of soil degradation in many areas and rather limited monitoring of the impacts of adopting specific farming practices emerged. This leaves uncertainties as to which practices, adopted under what circumstances, might be most appropriate and cost-effective. Robust evaluation of policy impacts on soil conservation appears even scarcer.

Modelling environmental benefits of adopting soil conservation practices

In order to assess the potential environmental benefits of adopting agricultural soil conservation practices EU-wide, the Erosion-Productivity Impact Calculator (EPIC) was used to simulate two scenarios over the period 1990-2004. The first scenario assumed adoption of no-tillage practices for producing barley, and the second the introduction of a cover crop before maize is sown. The results of the scenarios were compared to those under conventional agricultural practices (ploughing and no cover crop).

The modelling allowed those EU regions to be identified where the adoption of conservation farming and/or soil conservation practices would have the biggest potential benefits for the environment. It emerged that no-tillage practices can effectively contribute to the reduction of erosion across Europe. The number of areas (10 x 10 km) with the most serious erosion dropped by 7.5 %, while the areas with soil erosion below 0.5 t/ha increased by one quarter. Concerning the spatial distribution, most of the benefit (between 7 and 23 % reduction of

erosion) is achieved in France, northern Italy, central Europe, Portugal and southeast Spain. Introduction of the cover crop was shown to be an effective means of reducing erosion in non-irrigated maize, although the benefit declines with water stress. However, results varied widely in areas with no water stress.

The modelling supports the general conclusion that long-term policies aiming at widespread adoption of conservation agriculture practices (no-tillage and cover crop) will reduce soil erosion effectively in most regions of the EU.

Existing policies for soil conservation

The SoCo study has shown that the existing suite of policy measures, including mechanisms for advice and support, is in general adequate for addressing soil degradation processes in the EU. However, there are issues in relation to the effectiveness of implementation and the relative weight given to different types of instruments. The effectiveness of the policy measures could be significantly increased if the reference level were clearly defined, if incentive payments were better targeted and monitored, if greater levels of advice and support were provided, and if all relevant policy measures were coordinated and specifically targeted to soil protection.

Cross compliance has clearly contributed to establishing a common reference level for sustainable soil management across the EU. Although there are considerable differences between Member States regarding interpretation of the standards, and therefore in the obligations introduced, the number of mandatory measures relating to soils at national level has increased as a result of the GAEC requirements. The degree to which these have been implemented or adopted at farm level is less evident and is likely to vary considerably between regions. However, partial evidence from the case studies and from discussions at the stakeholder workshops indicates that certain standards have had a positive impact, and certainly appear to have increased awareness of soil conservation within a range of governmental institutions as well as among farmers and farm unions. The effectiveness of GAEC standards could be improved by ensuring more focused specification by Member States.

Rural development measures are an important instrument for assisting farmers' transition to higher levels of soil quality rather than for providing permanent support for measures that need to be accepted as good practice. They should aim to facilitate those changes in management practices that are more extensive or costly, and be accompanied by training and advice to provide information and to develop expertise in soil-friendly farming practices. The main policy instruments available for incentivising farmers to adopt soil-enhancing farming practices remain the agri-environment measures, despite the fact that soil quality and management have not been treated as a key objective within agri-environment schemes in most Member States. Improved targeting of agri-environment schemes towards specific local priorities, backed up by stronger information and advice, would increase the impact of this approach.

The complementarity of agri-environment measures with the requirements under GAEC (reference level) is critical in order to ensure that incentive payments are not used to pay for practices that should be provided through basic good practice. In general, policy measures the positive effects of which are relatively clear to the farmer and will accrue in a short period of time, show a relative high degree of uptake and meet with public support beyond the farming community. On the other hand, measures appear less positive if the benefits are not very clear

or cannot be realised in the short term, and if they involve major cost burdens, particularly on smaller farms.

Effectiveness and efficiency of farming practices and policy measures

There is a wide range of **farming practices** available to farmers throughout the EU for mitigating or even reversing soil degradation processes. The case studies and the EU-wide stock-taking exercise resulted in a detailed synthesis establishing and analysing the interrelation of farming practices and soil quality in the context of the current policy setting. However, the issue of which farming practices are preferable or should be further promoted to avoid or mitigate soil degradation processes needs further investigation. Generally, controlling the soil degradation process itself, rather than mitigating its off-site effects, is regarded as more effective, even though the result might not be immediate. For example, avoiding the occurrence of soil erosion is more effective than damming off silt.

A stronger commitment to monitoring would strengthen the knowledge base for policy making and help to establish the right balance between the different **policy measures** in an integrated approach. In particular, it is important to monitor the uptake of voluntary incentive-based measures, as this shows how well these measures suit the social, economic and natural environment of farms. The use of the indicators developed under the Common Monitoring and Evaluation Framework of Rural Development should meet that need.

Information and advice are essential to support any changes in farming practices. Farm advisory services should support the implementation of farming practices aimed at sustainable soil use. However, stakeholders in nearly all case study regions mentioned the lack of routine advice and encouragement for farmers to practise soil conservation. On the one hand, this indicates the apparently limited effort devoted to soil conservation by the formal farm advisory and extension services. On the other hand, it points to the low profile of the soil issue in the public debate and in organisations engaging with farmers, such as food processors and retailers or input suppliers. The latter is in contrast to the higher profile given to water and biodiversity concerns in recent years.

The absence of detailed information on the cost of different measures means that general conclusions about their efficiency in addressing soil degradation cannot be drawn, beyond the reasoning set out above.

Recommendations

The EU-wide stock-taking exercise and the case study analysis have shown that there is a range of measures within the current rural development policy (EAFRD) that are appropriate for supporting sustainable soil management, over and above the mandatory reference level, including agri-environment measures and measures facilitating the provision of advice and training to farmers. Given the appropriateness of these existing instruments, and the clear case for promoting certain beneficial farming practices, the existing role for rural development policy to address some of these soil conservation needs and challenges should at least be continued into the future.

If the conservation of agricultural soils is to become a rural development priority, it is recommended that a number of preparatory steps be taken. More work is needed to improve policy makers' and stakeholders' understanding of the appropriate reference levels that determine which agricultural practices farmers should adopt and are responsible for in line with the polluter pays principle, and those that produce public benefits beyond mandatory

requirements and for which farmers should be remunerated. While some basic requirements might conceivably be similar throughout Europe, there is a need for more clarity on how minimum standards are interpreted to ensure their compatibility with a commonly established reference level. Given the scale of the challenge and the fact that a degraded soil resource will seriously constrain the capacity to achieve other environmental objectives, the Soil Framework Directive should be adopted to provide the essential targeted policy framework while leaving enough flexibility to allow for regional implementation. Soil conservation objectives should also be included more explicitly in the Rural Development Strategic Guidelines and the intervention logic of appropriate rural development measures.

The implementation of Pillar 2 measures is subject to structured monitoring and evaluation requirements. This is supported by a Common Monitoring and Evaluation Framework, a suite of indicators designed to help assess the effectiveness of rural development interventions and the impacts of the programmes relative to a baseline. It would be helpful to invest in the development of reliable, comprehensive and operational indicators on (i) the state of soils (soil degradation), (ii) the social impact (cost) of soil degradation, and (iii) the impacts of soil protection, conservation and improvement practices, as encouraged in the proposed Soil Framework Directive. With proper investment in indicators, data and monitoring over the next few years, it should be possible to produce a more accurate baseline estimate of the condition of European soils at the start of the next rural development programme. This would allow better future evaluation of the impact of any soil conservation measures adopted, which is essential if the effectiveness of policy interventions is to be properly assessed over the longer term.