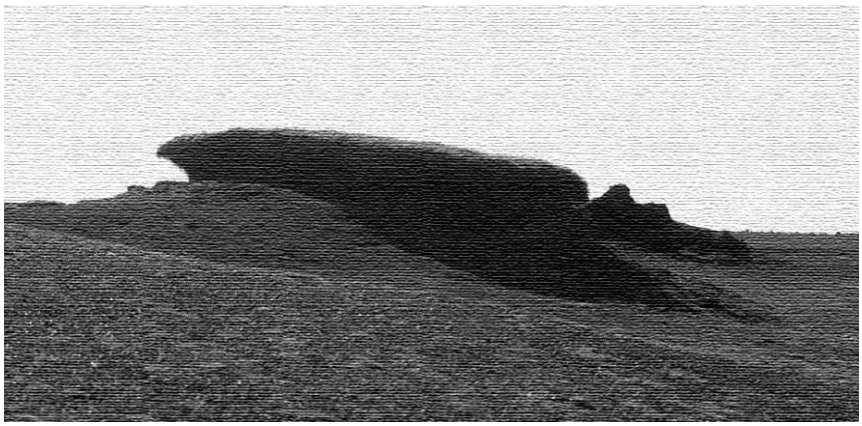
Rit LBHÍ nr. 4
AUI Publ. no.

Strategies, Science and Law for the Conservation of the World Soil Resources

International Workshop
Selfoss, Iceland
September 14-18, 2005



scape Soil Conservation And Protection for Europe

Landbúnaðarháskóli Íslands
Agricultural University of Iceland

2005

Rit LBHÍ nr. 4
AUI Publication no.

ISSN 1670-5785

Strategies, Science and Law for the Conservation of the World Soil Resources

International Workshop
Selfoss, Iceland
September 14-18, 2005

Soil Conservation And Protection for Europe

Contents

IV Research and case studies

V Strategies and policies

Strategies for Soil Conservation and Protection:

Introduction to the Selfoss Workshop, Iceland 14-18 September 2005

A.C. Imeson

University of Amsterdam / SCAPE Project Coordinator, Email: a.c.imeson@science.uva.nl

Organization

This International Workshop is organized by SCAPE (Soil Conservation and Protection in Europe) in conjunction with a group of legal and scientific experts from around the world, and with The Soil Conservation Service of Iceland, the Agricultural University of Iceland and other Icelandic institutions. Other associated key institutions with specific interests in legislative and scientific aspects of soil conservation include the International Union of Soil Sciences (IUSS), the World Conservation Union (IUCN), and the European Confederation of Soil Science Societies (ECSSS).

The workshop will include seminar presentations and discussions as well as field excursions, exploring issues of land degradation and soil erosion, mitigation work and strategies, policies, programs and law for achieving goals of soil conservation and sustainable land use. Briefing papers of most presentations can be found in this compilation.

From a European aim to one linked to the Global Dimensions

Soil Conservation and Protection Policy has to be based on both scientific knowledge and the reality of existing world organisations and power structures. At its previous meetings SCAPE used local case studies to identify useful strategies that Europe could build upon and to identify fruitful areas for new research. SCAPE also looked at Case Studies from other continents and recognized that the land degradation problems of Europe are linked to problems or policies in other continents by a global dimension. The global dimension includes obvious links with climate through the way in which soils affect the production and sequestration of greenhouse gasses, the albedo and the heat balance, as well as the links with biodiversity and desertification.
But there is much more. The world is also linked by existing flows of money, goods and services, by laws and by ideas. And some of these ideas are linked to concerns that many scientists have regarding the state of the world's soils, not just of European ones. What ideas can we formulate at this meeting and how can these help develop and promote an action plan?

This meeting is a great opportunity because it brings together people with a background in Law, Nature Conservation and all aspects of the Earth and Biological Sciences. We can anchor or future ideas about strategies of soil protection in the separate areas of complimentary knowledge that we have from different parts of the world.

So the goal of SCAPE at this meeting is to coordinate and integrate its vision of where Europe needs to go with soil protection and conservation into a shared vision with all of you, having different other backgrounds, who are at the meeting.

Soil Conservation Strategies for Europe

During the last three years the SCAPE Project has provided a platform for discussing the scientific basis that can support the development of soil conservation strategies for Europe. It has functioned as an integrated project bringing together different disciplines, stakeholders and interest groups, and it has involved scientific research and extension, governments and responsible authorities at different levels, NGO's and other organisations, as well as interested citizens and the business world.

SCAPE is an independent entity, where all opinions that are supported by scientific and accurate knowledge are respected and legitimate. Considerable effort was made to establish the factual situation regarding the true state of Europe's soils and the impacts that the different soil threats are having on them. Also efforts have been made to understand, discuss and report openly the complex reasons that make a soil conservation and protection strategy necessary. Nevertheless, understanding and explaining the reasons for soil protection issues is not what SCAPE is really for. SCAPE is action oriented, focusing on what short and long term actions and strategies European citizens should coordinate in order to achieve the sustainable management of land in order to protect and conserve the soil and all of the functions we value.

SCAPE has two main interests:

1. What are the implications of the above for the future research, data and monitoring needs.
2. How can existing research contribute to the soil strategy.

For those of you weren't at the first SCAPE meeting, the questions or aims of SCAPE were formulated as follows:

- How can sustainable soil conservation and protection actually be achieved?
- How should the key functions of the soil be measured and monitored?
- What is actually known about protecting and conserving soils from good practice and case studies?
- Proposing strategies for conserving and protecting Europe's soils.

These aims were considered in the context of different settings at the four workshops that were held in Spain, Italy, Austria and Norway, as well as in reports prepared from other parts of the world. One aim of this workshop is to review and bring together the findings and conclusions from these workshops, all of which can be viewed at and obtained from the project internet site www.scape.org.

Because SCAPE operated in parallel with the development of the Soil Strategy by DG Environment the policy context of SCAPE and its relation to the soil strategy have changed. In practice, the role of the governments who Chair the Commission as well as the interests of European Commissioners and Scientific and Administrative Officers has a great impact on policy development and resources allocated. At the start of SCAPE, the SCAPE steering committee was able to play a pro-active role in helping to write some of the Technical and Working Group reports that were to be used to develop the soil strategy. SCAPE was also able to contribute to the development of the Soil Protection research agenda at the Vital Soil Conference held last November. Since then, there have been announcements that the Commission would be producing a soils directive this year but in fact this did not happen. At the moment DG Environment has

launched a Stakeholder Consultation on the Internet on the Soil Thematic Strategy (www.europa.eu.int/comm/environment/soil/index.htm)

SCAPE and Future Research Needs

One of the tasks of this meeting is to report on future research needs for soil conservation and protection. In an earlier communication, a research strategy based on the outcomes of the DG-ENV Working Group on Research has already been presented (Blum et al., 2004). Also, the past meetings and discussions of SCAPE have identified many other ideas that can form part of broader or more specific elements of a research strategy. Much has been learnt from the data and monitoring studies that have been reviewed as well as from the case studies of best practice. Time is ripe for promoting and applying more complete methodologies for analyzing complex issues such as soil conservation (e.g. adaptive management paradigm) and that these will have great benefits for policy.

SCAPE is one of a cluster of EU projects within an area described as land degradation or desertification. A strategy often mentioned for combating land degradation is that of sustainable land management (GEF 2002) and this is also at the heart of SCAPE.

In view of its importance at this meeting we have decided to install a special working group on Desertification. Reports dealing with Desertification can also be found at www.scape.org

During the meeting, at the working groups and session discussions we will be focusing on key emerging issues and frequently asked questions.

Another question concerns different aspects of globalization. There are not enough trained experts who can go into the field to explain problems. Students are increasingly relying on virtual knowledge, not on acknowledge acquired by themselves from real world experience.

Case Studies and Knowledge About what works

SCAPE has considered many different case studies in order to find out what works in different places. These studies will be discussed at the meeting. There is a paradox. On the one hand there are great differences in Europe regarding both the threats facing the soil and the way people deal with it. As a consequence, we can't always generalize, and all problems have a strong local dimension. There is a need for new criteria for planners. Every agricultural system needs its own site specific soil conservation measures. On the other hand many situations seem to be fundamentally the same. The system always seems to end up at one of a few states of attraction where the same problems occur. Understanding these similarities and the causes of the attraction may make it possible to provide generic solutions for the issues.

Models often try to explain what is happening on the basis of hypothesized cause and effect. There is sometimes too little data or knowledge about the causes to enable much confidence to be put into the details of the results. A modeling approach that looks at attractions rather than causes could give more contrast to the research.

Data and monitoring requirements

SCAPE has posted a statement on Data and monitoring which is also at www.scape.org. The meeting will provide an opportunity for you to discuss this with the authors as well as to present any ideas or suggestions.

Key Emerging Messages

We hope that before or at the meeting we can formulate some key emerging messages. The author will resist the temptation to tell you his before he hears about yours.

I Introductory session: overview presentations

The state of European Soils

Luca Montanarella

EUROPEAN COMMISSION, JOINT RESEARCH CENTRE, Institute for Environment and Sustainability
TP 280 I-21020 Ispra (VA), Italy, Email: luca.montanarella@jrc.it

Introduction

An analysis of the status of European soils may identify that most soils are seriously threatened by a number of degradation processes. Despite this situation, soil protection has never been ranking high among the priorities for environmental protection in Europe. This is probably due to a lack of awareness within the general public of the hidden implications for every European citizen of these degradation processes. Soils are commonly not well known by the European citizens, particularly since only a small fraction of the European population is currently living in rural areas and having a direct contact with soils.

The majority of the urban population in Europe has only little understanding for the features and functions of soils. The most common perception is usually that soils are a good dumping site for all kind of wastes and that soils can be quite useful as surfaces for building houses and infrastructure.

Only during the last 2-3 years the need for a coherent approach to soil protection has come on the political agenda in Europe and was therefore introduced as one of the thematic strategies to be developed within the Community's 6th Environment Action Programme (6th EAP). The rationale behind the development of a coherent approach to soil protection is based on the recognition of the multi-functionality of soils. Soils are not any more considered only as dumping sites, construction surfaces or means for production (agriculture) but also as a fundamental environmental compartment performing vital ecological, social and economic services for the European citizens: filtering and buffering of contaminants allowing us to have clean drinking water, pool of biodiversity, source of raw materials, sink for atmospheric carbon dioxide, archive of cultural heritage etc.. These functions are now recognised of equal importance as the traditional soil functions commonly attributed to soils: production of food, fibre and wood (agriculture and forestry) and surface for housing and infrastructure (spatial development).

In order to develop a soil protection policy it is important to recognise that soils have distinctive features that make them quite different from the other environmental compartments, like air and water. Soils are first of all highly diverse both in space and over time. Soil properties can be completely different for soils only at few meters distance one from the others. The development of a common soil map of Europe has helped describing the very high spatial variability of soils across the European continent (fig. 1). Soils are not static but develop over time. The timescale for these changes is usually very long (hundreds of years). Therefore, for policy making purposes, we consider soils as essentially a non renewable resource. The high variability of soils implies that any soil protection strategy needs to have a strong local element build in. It is at local level that we can act in specific ways that are appropriate to the features of these particular soil types. This of course brings up the important distinction that needs to be made in identifying the actors that must develop and implement soil protection measures. It should be recognised that, while there are important local elements that need to be build in any soil protection strategy, there are nevertheless, clearly identified off site effects of soil degradation that justify an European or even global approach to soil protection. Erosion, decline of organic matter, soil contamination, soil compaction, soil sealing, loss of biodiversity have

very important off-site consequences, like silting of hydropower stations, increase of atmospheric carbon dioxide, contamination of drinking and bathing waters, contamination of food, increased frequency of flooding and landslides, etc.. All these off-site effects seriously threaten human health and have substantial economic implications.

Status of soils in Europe

A key feature for developing a soil protection strategy is the recognition of the implications linked with the fact that soils in Europe are the result of thousands of years of human activities. Hardly any soil in Europe can be considered as truly "natural". Maybe just in few remote areas in high mountains and in boreal zones of Scandinavia we can still find pristine soils not influenced by man.

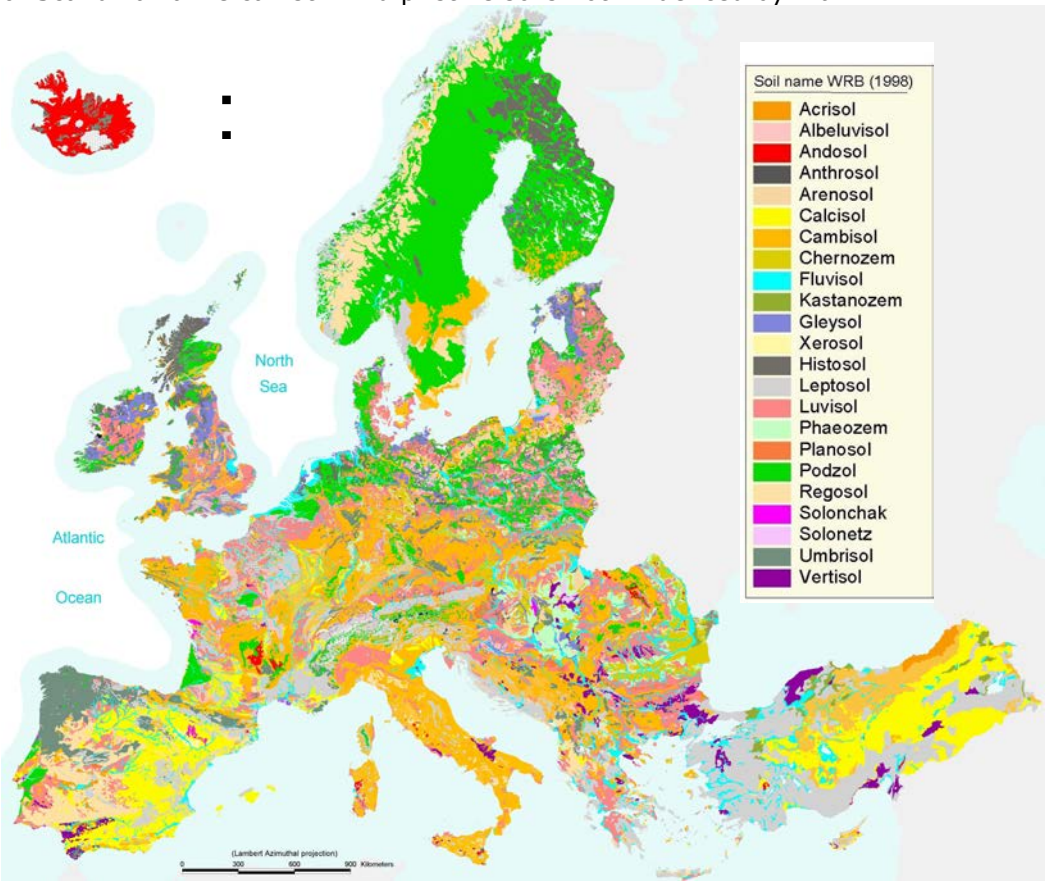


Figure 1: Soil map derived from the Soil Geographical Database of Europe at scale 1:1,000,000.

The distribution of soil types, as represented within the Soil Geographical Database of Europe at scale 1:1,000,000 (figure 1), is therefore giving the distribution of the major World Reference Base (WRB) soil groups not taking into account human influence, but only based on soil formation factors determined by natural conditions.

In reality, European landscapes are the results of the hard work of rural populations that shaped the territory over thousands of years, strongly influencing also soil properties.

We can therefore consider the distribution of the soil types as reported in the soil map of Europe (figure 1) as the climax situation, towards which the soils would evolve if not influenced by human activities.

These "natural" soil types have a number of properties that have been strongly modified by human activities, like for example soil organic matter content, that are crucial to the functioning of soils within the ecosystem. Since the EU soil protection strategy is building upon the recognition that the important functions of soils are threatened by severe degradation processes, there is the need to quantify these degradation processes and to put them in relation with the historical development of the European soil cover. The major threats identified so far are soil erosion, decline in organic matter content, loss of soil biodiversity, soil contamination, salinisation, soil compaction, soil sealing and major hydro-geological risks (flood and landslides). In this paper we will briefly review the status of European soils in relation to four of these major threats, namely the decline of soil organic matter, soil erosion, soil compaction and salinisation.

Decline in organic matter

Soil organic matter is extremely important in all soil processes. It is essentially derived from residual plant and animal material, synthesised by microbes and decomposed under the influence of temperature, moisture and ambient soil conditions.

There are two groups of factors that influence inherent organic matter content: natural factors (climate, soil parent material, land cover and/or vegetation and topography), and human-induced factors (land use, management and degradation). Heterogeneity is the rule for the organic matter content of mineral soils (figure 3).

The European distribution of topsoil organic carbon is the best example of the importance of taking into consideration the historical evolution of European landscapes. The current levels of topsoil organic carbon in Europe are essentially the result of human activities since the first agricultural revolution of the Neolithic age. Natural levels of organic carbon in soils under stable climatic conditions have been substantially depleted by land use changes due to the expansion of agriculture at the expense of the naturally forested areas of Europe and subsequently further depleted by the introduction of the successive improvements in agricultural technologies, like deep ploughing, rapid rotations, etc. (figure 2). Therefore, considerations within the EU Thematic Strategy for Soil protection should aim at the introduction of good agricultural practices allowing for the organic carbon levels in European soils to increase, possibly reaching again the "natural" climax, which is to be considered as the maximum achievable level for each of the specific soil types within Europe. This consideration is particularly important, if the potential of European soils to act as a sink for atmospheric CO_2 needs to be evaluated as a possible option for mitigation of climate change. Soils can not accumulate organic carbon indefinitely, but can reach an optimum stable level corresponding to the "natural" levels specific for each soil type.

Soil organic matter decline is of particular concern in Mediterranean areas. Based on the limited data available, nearly 75% of the total area analyzed in Southern Europe has a low (3.4%) or very low (1.7%) soil organic matter content. Agronomists consider soils with less than 1.7% organic matter to be in pre-desertification stage. Effective measures to revert this trend exist: reduced tillage, zero tillage, conservation agriculture, cover crops, and application of manure, compost and sewage sludge. Land use changes like conversion to grassland and reforestation can have a very positive effect on soil organic matter content.

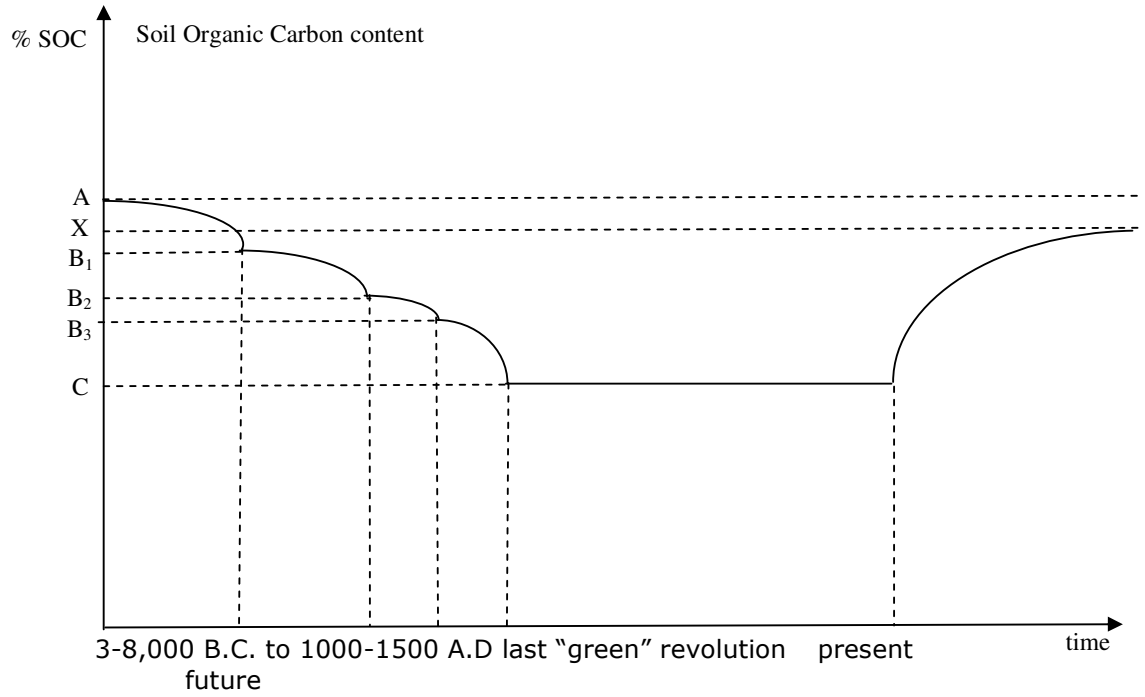


Figure 2: Evolution of soil organic carbon over time for a specific soil type (arbitrary scales). A - Natural, soil type specific, level of Soil Organic Carbon under stable climatic conditions, B_{1-3} – Depletion of soil organic carbon by stepwise intensification of agricultural practices, C – Stable conditions today, X – Possible levels of SOC that could be reached by the introduction of good agricultural practices.

Soil erosion

Soil erosion is a natural process, occurring over geological time, and indeed it is a process that is essential for soil formation in the first place. With respect to soil degradation, most concerns about erosion are related to accelerated erosion, where the natural rate has been significantly increased mostly by human activity. Soil erosion by water is a widespread problem throughout Europe. As for the decline of soil organic carbon, erosion has been triggered in Europe by human activities already in ancient time, mainly through the extensive deforestation processes that took place in large parts of the Mediterranean area.

By removing the most fertile topsoil, erosion reduces soil productivity and, where soils are shallow, may lead to an irreversible loss of natural farmland. Even where soil depth is good, loss of the topsoil is often not conspicuous but nevertheless potentially very damaging. Severe erosion is commonly associated with the development of temporary or permanently eroded channels or gullies that can fragment farmland. The soil removed by runoff from the land, for example during a large storm, accumulates below the eroded areas, in severe cases blocking roadways or drainage channels and inundating buildings.

Erosion rate is very sensitive to both climate and land use, as well as to detailed conservation practice at farm level. The Mediterranean region is particularly prone to erosion because it is subject to long dry periods followed by heavy bursts of erosive rain, falling on steep slopes with fragile soils. This contrasts with NW Europe where soil erosion is less because rain falling on mainly gentle slopes is evenly distributed throughout the year and consequently, the area affected by erosion is less extensive than in southern Europe. However, erosion is still a serious problem in NW and central Europe, and is on the increase. In parts of the Mediterranean region, erosion has reached a stage of irreversibility and in some places erosion has practically ceased because there is no more soil left.

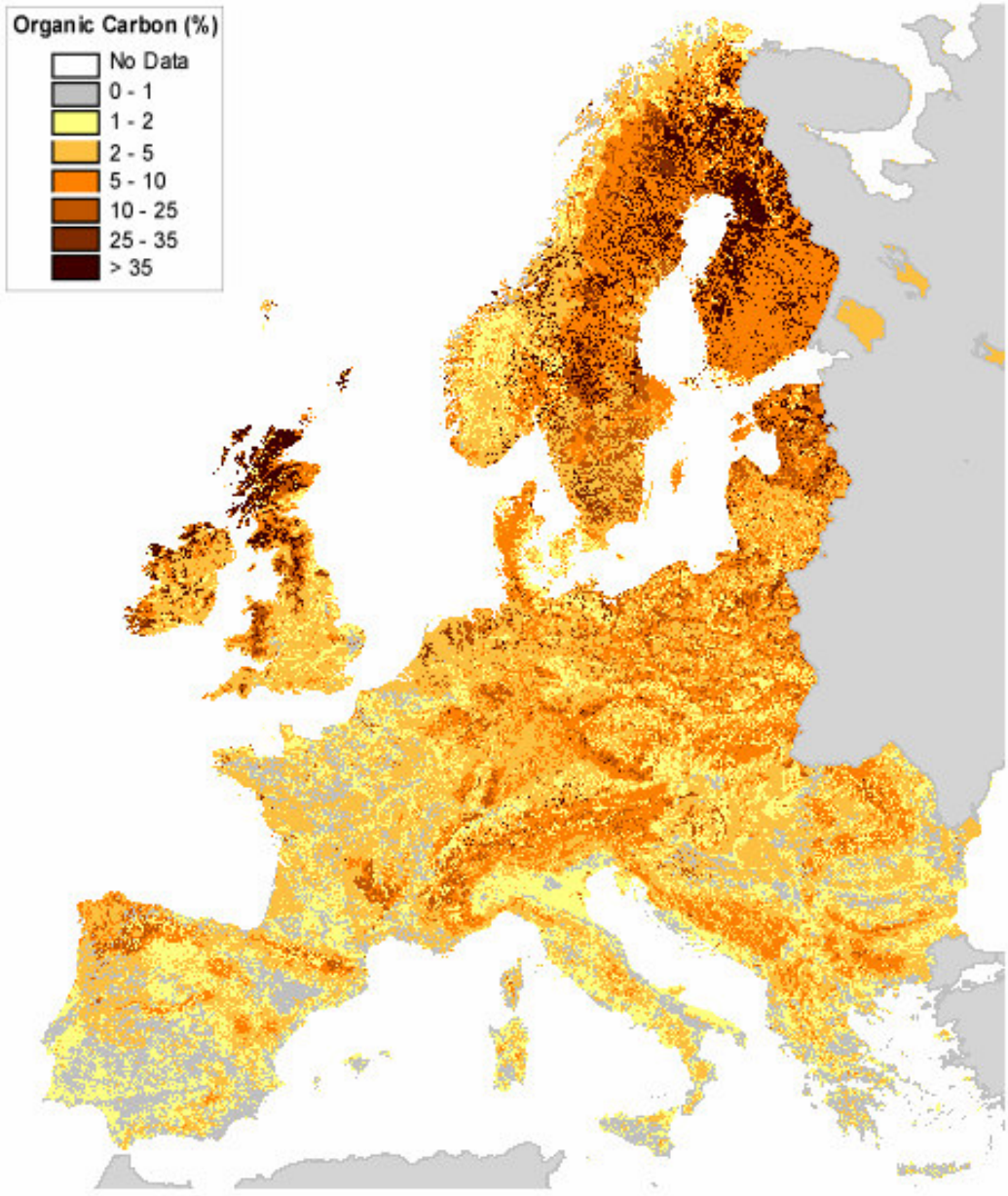


Figure 3: Estimated Organic Carbon contents in the topsoil of Europe.

With a very slow rate of soil formation, any soil loss of more than 1 t ha-1yr^{-1} can be considered as irreversible within a time span of 50-100 years. Losses of 20 to 40 t ha^{-1} in individual storms, that may happen once every two or three years, are measured regularly in Europe with losses of more than 100 t ha^{-1} in extreme events. The main causes of soil erosion are still inappropriate agricultural practices, deforestation, overgrazing, forest fires and construction activities.

In a period of rapid changes in both climate and land use, due to global change, revised agricultural policies and changing international market forces, it is vitally important to be able to assess the state of soil erosion at a European level, using an objective methodology. This methodology must also allow the assessment of erosion to be repeated as conditions change, or to explore the broad scale implications of prospective global or European-wide changes in land utilisation. The results of applying such a methodology can provide estimates of the overall costs attributable to erosion under present and changed conditions,

and objectively identify areas where more detailed study is needed and possible remedial action.

The Pan-European Soil Erosion Risk Assessment - PESERA - approach (Gobin et al., 1999) uses a process-based and spatially distributed model to quantify soil erosion by water and assess its risk across Europe. The resulting 1km x 1km annual soil erosion risk map (figure 4) reports estimated soil losses in t/ha/year. Aggregated results at NUTS3 level (figure 5) allow deriving more policy relevant information from this indicator.

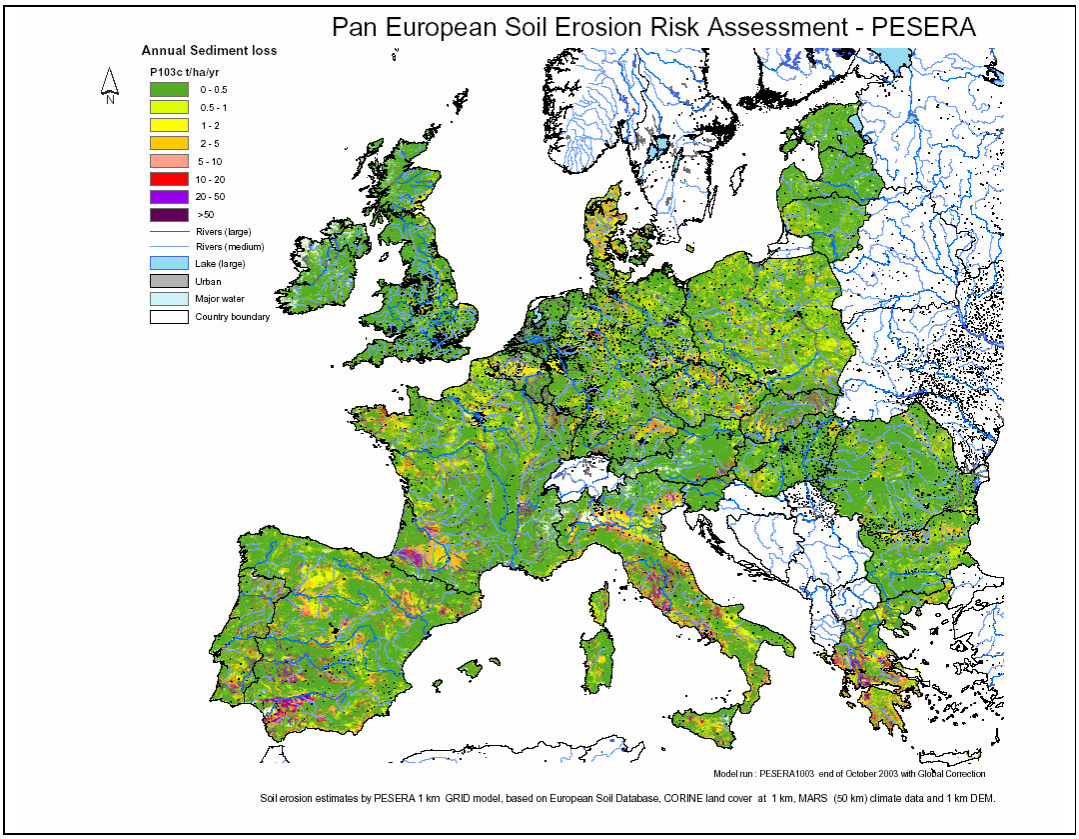


Figure 4: Annual soil erosion risk by water (original data from the PESERA project).

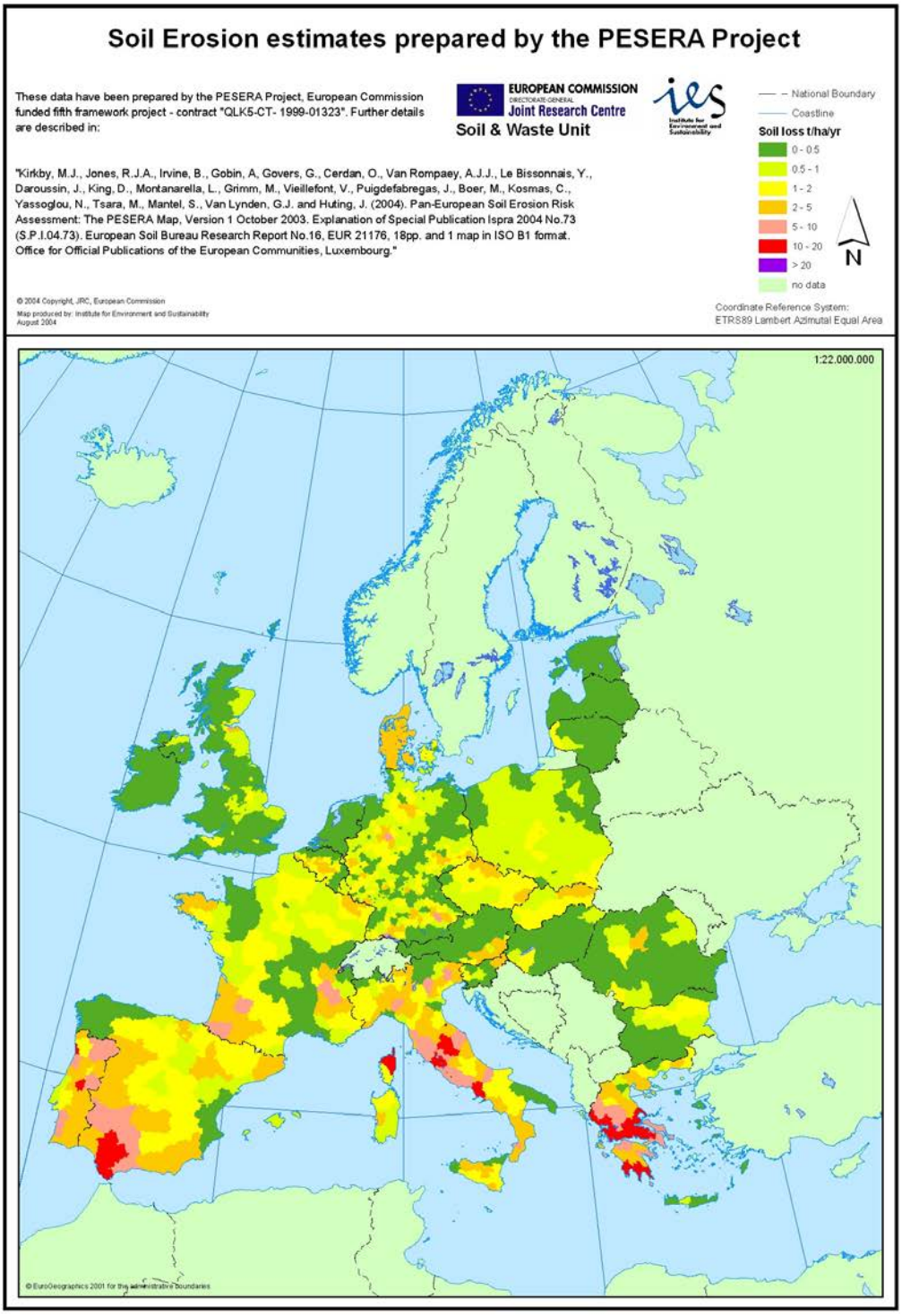


Figure 5: Annual soil erosion risk by water (aggregated results at NUTS3 level).

Soil erosion is regarded as one of the major and most widespread forms of land degradation. About 17 per cent of the total land area in Europe (excluding Russia) is affected by soil erosion to some degree. Water erosion is a more common form

of erosion. Wind erosion is also prevalent in some parts of Western Europe and Central and Eastern Europe, but is not currently covered by this indicator.

Three zones of erosion can be distinguished in Europe: a southern zone characterised by severe water erosion; a northern loess zone with moderate rates of water erosion; and an eastern zone where the two zones overlap and where former intensive agricultural practices caused significant erosion problems. Within all three zones, there are areas where erosion is more serious, the so-called hot spots.

The largest area with a high erosion risk is southern and western Spain (covering 44 per cent of the country's territory), with local erosion hotspots on the southern coast. Portugal, one-third of the country is at a high risk of erosion. In France, Italy and Greece, the areas with a high erosion risk cover from 1 to 20 per cent of the land surface respectively. In Central and Eastern Europe, Bulgaria and Slovakia are mostly affected by soil erosion, where around 40 per cent of land is affected.

Figure 3 reports administrative units (NUTS3) and their respective actual annual soil erosion risk. Areas with very high erosion rates are located in the Mediterranean. Most affected are zones in Andalusia, Corsica, Central Italy and Greece.

Salinisation

Salinisation is the process that leads to an excessive increase of water-soluble salts in the soil, in the soil solution.

The accumulated salts include sodium, potassium, magnesium and calcium, chloride, sulphate, carbonate and bicarbonate. A distinction can be made between primary and secondary salinisation processes. Primary salinisation involves accumulation of salts through natural processes due to high salt contents in parent materials or groundwater. Secondary salinisation is caused by human interventions such as inappropriate irrigation practices, e.g. with salt-rich irrigation water and/or insufficient drainage.

Table 1. Distribution and extent of salt affected soils in Europe (Szabolcs, 1974).

Country	Mapping unit					Total area in 1000 ha
	Saline soil	Alkali soil			Potentially salt affected soil	
		without structural B-horizon	with structural B-horizon			
			non-calc.	calc.		
Austria	0.5	–	–	–	2.5	3.0
Bulgaria	5.0	–	20.0	–	–	25.0
Czechoslovakia	6.2	7.5	2.7	4.3	85.0	105.7
France	175.0	–	75.0	–	–	250.0
Greece	…	…	…	…	…	3.5
Hungary	1.6	58.6	294.0	31.9	885.2	1271.6
Italy	50.0	–	–	–	400.0	450.0
Portugal	…	…	…	…	…	25.0
Romania	40.0	100.0		110.0	–	250.0
Spain	…	…	…	…	…	840.0
U.S.S.R.	7546.0	1616.0	20382.0	–	17781.0	47325.0
Yugoslavia	20.0	50.0	110.0	75.0	–	255.0

In dry land areas of Europe potentially affected by desertification (arid, semiarid and dry sub humid) the most affected zones are located in Hungary, Romania,

Spain, Italy, Albania, FYROM and Greece, according to several authors (Szabolcs, 1991); (Misopolinos et Szabolcs, 1996); (EEA, 1998).

Physical degradation

The most common form of soil physical degradation is soil compaction. Soil compaction occurs when soil is subject to mechanical stress through the use of heavy machinery or overgrazing, especially in wet soil conditions. In sensitive areas, walking tourism and skiing also contribute to the problem. Compaction reduces the pore space between soil particles and the soil partially or fully looses its absorptive capacity of water. Compaction of deep soil layers is very difficult to reverse (CEC, 2002).

The overall deterioration in soil structure caused by compaction restricts root growth, water storage capacity, fertility, biological activity. Moreover, when heavy rainfall occurs, the water can no longer easily infiltrate the soil. Resultant large volumes of run-off water increase erosion risks and are considered by some experts to have contributed to some recent flooding events in Europe.

It has been estimated that nearly 4% of soil throughout Europe suffers from compaction, but no precise data are available.

According to a recent study (Jones et al., 2001, 2003), more than a third of the soils in Europe are highly susceptible to compaction in the subsurface layers or horizons (fig. 7). Compaction of surface soil can, at least temporarily, be alleviated by mechanical loosening but in the subsurface horizons this is often difficult and expensive. Therefore any management system that is likely to increase subsoil compaction is not truly sustainable.

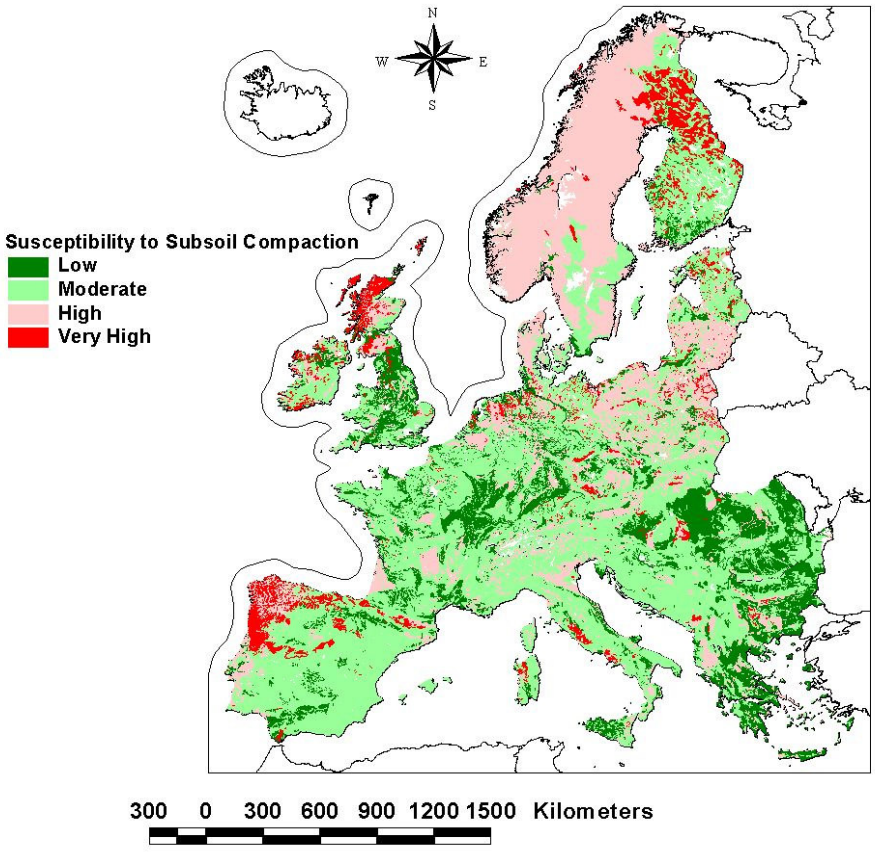


Figure 6: Susceptibility of soil compaction map of Europe.

Conclusions

The status of European soils is the result of human activities over the past millennia. European landscapes are our cultural heritage and deserve protection for future generations. Since they are human constructions, the widespread abandonment of rural areas is one of the main causes of the extensive degradation of these delicate landscapes, leading to soil degradation and in extreme cases to desertification. The EU Thematic Strategy for Soil protection aims towards the protection of the functionality of these complex soilscapes that have been the result of the hard work of generations of European farmers. Identifying the areas that are at risk of irreversible degradation by the major threats of soil erosion, decline of organic matter, compaction and salinisation allows to target our action in a more effective way.

References

CEC Soil Map of the European Communities, 1:1,000,000. CEC Luxembourg, 124pp., 7 maps, 1985.

COMMUNICATION FROM THE COMMISSION TO THE COUNCIL, THE EUROPEAN PARLIAMENT, THE ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS "Towards a Thematic Strategy for Soil Protection", COM(2002) 179 final, Brussels, 16.4.2002.

CORINE Soil Erosion Risk and Important Land Resources in the Southern Regions of the European Community. EUR 13233, Luxembourg, 1992.

De Ploey, J. A Soil Erosion Map for Western Europe. Catena Verlag, 1989.

De Roo A., L. Montanarella, G. Schmuck, "Das Europäische Bodeninformationsystem (EUSIS) und sein Anwendung für Überschwemmungssimulationen mit Hilfe von LISFLOOD"; BfG Mitteilung nr. 21, Koblenz, 2000, pp. 105-115.

Desmet, P.J.J. & Govers, G. A GIS procedure for automatically calculating the USLE LS factor on topographically complex landcape units. Journal of soil and water conservation 51, p. 427-433, 1996.

EEA, Europe's Environment: The Dobris Assessment, Chapter 7. Soil, 27pp. European Environment Agency, 1995.

EEA, Down to Earth: soil degradation and sustainable development in Europe. Environmental Issues Series, Number 16, 32pp. European Environment Agency, 2000.

EEA (European Environment Agency), 2003c: Assessment and reporting on soil erosion. Technical report No 94. EEA, Copenhagen.

Fournier, Soil Conservation - Nature and Environment No 5, Council of Europe, Strasbourg, 1972.
Gentile, A.R., Towards the development of a system of policy relevant indicators on soil. European Soil Forum, Berlin, 1999.

Grimm, M., Jones R. & Montanarella L., Soil Erosion Risk in Europe. EUR 19939 EN, 40 pp., Office for Official Publications of the European Communities, Luxembourg, 2002.

ICONA, 1991. Plan national de lutte contre l'érosion. Ministère de l`Agriculture, de la Pêche et de l`Alimentation. Institut National pour la Conservation de la Nature, Madrid.

Jäger, S. Modelling Regional Soil Erosion Susceptibility Using the Universal Soil Loss Equation and GIS. In: Rickson, R.J (ed). Conserving Soil Resources. European Perspectives, pp. 161-177. CAB International, 1994.

Jones, R.J.A., Spoor, G. and Thomasson, A.J. (2000). Assessing the vulnerability of subsoils in Europe to compaction. In: J. Arvidsson, J.J.H. Van den Akker and R.Horn (Eds.), Proceedings of 3rd Workshop of the Concerted Action 'Experiences with the impact of subsoil compaction on soil, crop growth and environment and ways to prevent subsoil compaction', 14-16th June 2000, Uppsala, Sweden p.160-172.

Jones, R.J.A., Spoor, G. and Thomasson, A.J. (2003). Assessing the vulnerability of subsoils in Europe to compaction: A preliminary analysis. [Soil & Tillage Research, 0, 000-000. In press].

King, D., Stengel, P. & Jamagne, M. Soil Mapping and Soil Monitoring: State of Progress and Use in France. In: Bullock, P., Jones, R.J.A. & Montanarella, L. (eds): Soil Resources of Europe. EUR 18991 EN, 204 pp. Office for Official Publications of the European Communities, Luxembourg, 1999.

Kirkby, M.J. & King, D Summary report on provisional RDI erosion risk map for France. Report on contract to the European Soil Bureau (unpublished), 1998.

Montier, C., Daroussin, J., King, D. & Le Bissonnais, Y. Cartographie vde l'aléa "Erosion des Sols" en France. INRA, Orléans, 1998.

Morgan, R.P.C. Soil Erosion in the Northern Countries of the European Community. EIW Workshop: Elaboration of a Framework of a Code of Good Agricultural Practices, Brussels, 21-22 May 1992.

Morgan, R.P.C. Soil Erosion and Conservation. Second Edition. Longman, Essex, 1995.

Morgan, R.P.C, Morgan, D.D.V. & Finney, H.J. A predictive model for the assessment of soil erosion risk. Journal of agricultural engineering research 30, p. 245-253, 1984.

Oldeman, L.R., Hakkeling, R.T.A. and Sombroek, W.G., World Map of the Status of Human-Induced Soil Degradation, with Explanatory Note (second revised edition) - ISRIC, Wageningen; UNEP, Nairobi, 1991.
Programa de Acción Nacional Contra la Desertificación (Borrador de Trabajo). Ministerio de Medio Ambiente. Madrid, Marzo, 2001.
Plan national de lutte contre l'érosion. Ministère de l`Agriculture, de la Pêche et de l`Alimentation. Institut National pour la Conservation de la Nature, Madrid, ICONA, 1991.
Renard, K.G., Foster, G.R., Weessies, G.A., McCool, D.K., Yoder, D.C. (eds) Predicting Soil Erosion by Water: A guide to to conservation planning with the Revised Universal Soil Loss Equation (RUSLE). U.S. Department of Agriculture, Agriculture Handbook 703, 1997.
Turner, S., Lyons, H. and D. Favis-Mortlock, Analysis and mapping of soil problem areas (hot spots) in Europe. Joint Final Report to EEA-UNEP, 62pp, 2001.
Van der Knijff, J.M., Jones, R.J.A. & Montanarella, L. Soil erosion risk assessment in Italy. European Soil Bureau, Joint Research Center of the European Commission, 1999.
Van Der Knijff, J.M., Jones, R.J.A. and Montanarella, L. Soil Erosion Risk Assessment in Europe, EUR 19044 EN, 34pp, 2000.
Van Lynden, G W J, The European soil resource: current status of soil degradation in Europe: causes, impacts and need for action. ISRIC, Wageningen. Council of Europe, Strasbourg, 1994.
Van Lynden, G.W.J. European soil resources. Nature and Environment No. 71. Council of Europe, Strasbourg, 1995.
Wischmeier, W.H. & Smith, D.D. Predicting rainfall erosion losses –a guide for conservation planning. U.S. Department of Agriculture, Agriculture Handbook 537, 1978.
World Atlas of Desertification. Edward Arnold, London, United Nations Environment Programme, 1992.
Yassoglou, N., Montanarella, L., Govers, G., Van Lynden, G., Jones, R.J.A., Zdruli, P., Kirkby, M., Giordano, A., Le Bissonnais, Y., Daroussin, J. & King, D. Soil Erosion in Europe. European Soil Bureau, 1998.
ZDRULI, P., JONES, R., MONTANARELLA L.. (1999). Organic Matter in the Soils of Southern Europe. DGXI.E3 Brussels.

Development and degradation of the soils of the world since the rise of agriculture

Hans-Rudolf Bork, Christine Dahlke, Stefan Dreibrodt, Andreas Mieth

Ecology-Centre, University of Kiel, Olshausenstr. 40, D-24098 Kiel, Germany
hrbork@ecology.uni-kiel.de

Abstract

Soils are intensively affected by land use and by the spatial structure of landscapes since the onset of cultivation. But the long-term quantitative consequences of human activities on the development and the destruction of soils are widely unknown. The complex long-term interactions of land surface – soil formation – soil erosion – climate - land use and landscape structures, were investigated and quantified by the authors in Germany, in China, in Chile, in South Africa and in the USA.

The destruction of the vegetation cover which occurred in very different periods and cultures enabled soil erosion. Whereas a large number of precipitation events of moderate intensity caused the formation of colluvial layers and thus a reduction of surface height differences and slope inclinations, extreme precipitation events cut deep gully systems into the slopes and valley bottoms, thus increasing height differences and slope angles. About a third of the total soil erosion during the last 1,500 years in Germany was caused by a few rare precipitation events during the first half of the 14th century. Intensive gullying and sheet erosion resulted in the abandonment of fields. In some cases people tried to manage the consequences of erosion. To be able to go on with horticulture and agriculture, farmers filled small gullies 4,750 years ago in Northern China and since several centuries in Central Europe.

Excluding the tremendous effects of rare and extreme rainfall events, soil erosion rates increased dramatically in all of the investigation areas with intensified agriculture and larger fields. During the 20th century soil erosion increased significantly. There were different reasons for example the reallocation of land (increase of field sizes), the introduction of new crops and new crop rotation systems (with longer periods without vegetation cover on soils), the use of new equipment (machines which compact soils intensively and enable the cultivation of steep slopes) and political decisions ("The Native Land Act" of 1913 in South Africa, the "Great Leap Forward" in 1958 in China).

Research deficits

A tremendous amount of research has been carried out in the past decades to quantify and model recent processes of soil erosion. Several authors broach the issue of the amount of recent soil erosion in different regions and countries and in a global perspective. Since most of these studies are using data based on short term measurements, the importance and the limitations of this data base have to be discussed. Laboratory measurements and small plot studies are undoubtly helping to get a better understanding and knowledge of the processes and the causes and effects of soil erosion on a micro scale. Field experiments on small plots, often with sizes much less than 0.1 ha, were used to quantify soil erosion, usually lasting only some years and rarely a few decades. But the plethora of conditions influencing soil erosion processes in real landscapes varies considerably in space and time. Therefore, the measurement of soil erosion on plots or in the laboratory can't provide soil erosion data valid in a long term perspective and on larger spatial scales. Rare but effective events with recurrence

intervals of several decades or some centuries often are excluded and it remains doubtful, that the duration of the measurement periods represents the long term average conditions. On the other hand it is impossible to gain reliable information of soil erosion on a regional, a continental or a global scale by the analysis only of the microscale. Soil erosion processes and thus the amount of soil erosion and the sediment delivery ration differs depending on spatial and temporal scales. Models and estimations are usually based on data sets generated by investigations on small plots. Therefore, most regional, national and global quantitative soil erosion data, extrapolated on long time scales, are at least speculative.

To obtain reliable mean data about soil erosion processes in landscapes, the causes and effects of soil erosion on soil development, environment and people sediments deposited on slopes, in valley bottoms and in lakes have to be analysed. If an appropriate methodology will be applied, these geo-archives deliver qualitative and quantitative data on different temporal and spatial scales. The temporal scale can be extended to several thousand years into the past, depending on the land use history and the duration of agriculture at an individual research area.

Research areas

For the quantification and evaluation of the complex interactions of land use dynamics, soil formation processes and soil erosion processes in a long term perspective the authors have analysed sites and catchments in East Asia, Central Europe, South Africa, North America, and on islands in the Eastern Pacific. The study areas were selected to investigate the effects of a wide range of land use systems for the differentiation of long term processes from rapid changes. Applications of the four-dimensional-landscape analysis at the following areas with varying land use histories are summarized:

- More than 2,000 sites in Northern, Western, Central, Eastern and Southern Germany. Several sites in areas covered with fertile loess soils and with calcareous sandy soils were often used agriculturally during prehistoric times (Neolithic Age, Bronze Age, Iron Age), during high Medieval Times and during Modern Times.
- The Zhongzuimao area near Yan'an, Shaanxi Province, Northern China, which is characterised by permanent horticulture and agriculture since 5000 years.
- On Poike Peninsula, Easter Island, Chile, the woodland protection was lost from about 1300 CE until 1550 CE. Polynesians cleared about 16 million palm trees, which had been used for agroforestry.
- On Robinson Crusoe Island, Archipelago Juan Fernández, Chile, goats and the felling of sandalwood and of chonta palm trees destroyed the vegetation cover of the soils namely in the late 18^{th}, 19^{th} and 20^{th} centuries.
- At Inxu Drift, Eastern Cape Province, Republic of South Africa, in the former homeland Transkei agricultural land use began around 1800 CE and is being practiced intensively since the 1920s.
- East Fork Cottonwood Creek, Central Oregon, USA, and Dwight's Creek, Palouse, Washington, USA. Farmers arrived in the east of Washington State and in Central Oregon during the second half of the 19^{th} century. They eliminated the protective woodland and the grassland until the early 20^{th} century. Since then the loess areas of the Palouse were used agriculturally whereas sites in northern Oregon were abandoned during the first half of the 20^{th} century.

- At Xixi near Xichang, Southern Sichuan Province, China, forest areas were cleared due to the political campaign of the "Great Leap Forward" in the year 1958 CE. Some areas were used agriculturally for several years, others were afforested in 1985.

Results

The reconstruction of past soil erosion processes and past land use changes in different ecosystems analyzed with the concept of the four-dimensional-landscape-analysis based on the geo-archives, shows clear evidence for the beginning of soil erosion in different parts of the world. The case studies have shown that soil erosion was enabled by the first significant removal of soil protecting vegetation by humans (e.g. by clearing of woodland) or by their grazing animals, resulting in a lower vegetation cover density. The soil erosion processes were then caused by intensive precipitation events. Soil erosion started with the beginning of agriculture in all areas which were investigated. Since the rise of agriculture the intensity of soil erosion varied highly in time and space on the surface of the earth:

In the early settled hilly regions of Northern China, for example on the Zhongzuimao, soils were eroded completely at most sites during the first thousands of years of agricultural land use (before 5,000 years BCE). Calcareous loess has been exposed since then in the loess plateau of northern China.

Only at a few sites in Germany soils were eroded completely during prehistoric times. In the hilly areas of Central Germany shallow soil covers were often eroded completely during Medieval Times and Modern Times on upslope and midslope areas. Deep soils were eroded down to the B-horizons on midslope areas in Northern and Northeastern Germany. In basins covered with loess (e. g. in Southern Lower Saxony) soils were totally eroded on steep midslope sections during that period.

Our investigations prove further that rare extreme weather events (100-year events, 1000-years event) were responsible for most of the soil loss in agriculturally used land in the long term perspective. In Germany about a third of the total soil erosion during the last 1,500 years was initiated by a few rare rainfall events during the first half of the 14th century. High runoff energy was responsible for the gully development. During events with moderate surface runoff rills incised, that were removed by the next ploughing of the field. The mixing and flattening processes after deposition created the shiny plane colluvial sequences at lower hill sections. The past erosion processes often corresponded with a reduction of soil fertility.

In the 20th century major changes of human society in general and especially of land use systems highly increased soil erosion rates in the research areas:

- Inxu Drift (Eastern Cape Province, RSA) in the 1920s,
- Poike Peninsula (Easter Island, Chile) in the early 1930s,
- Dwight's Creek (Washington, USA) in the year 1935,
- East Fork Cottonwood Creek (Oregon, USA) during the first two decades of the 20th century,
- Zhongzuimao (Shaanxi, China) in 1958,
- Xixi (SW-Sichuan, China) in the 1960s, and
- Germany during the 1950s, 1960s, and 1970s.

Causes of the dramatic raise of the soil erosion rates during the 20th century

What were the reasons for the raise of the soil erosion rates during the 20th century? During that time in none of the areas under investigation a significant increase in the number or in the intensity of heavy precipitation events was

recorded. As our studies show three major reasons are responsible for the significant increase of soil erosion, in some areas the beginning of gullying, in the 20th century:

- changes in the structure of vegetation and landscape
- the intensification of agriculture by technical improvements
- the modification of the political situation, of the social conditions and of the behaviour of rural people.

The case studies give (under temporal and spatial aspects) examples for the specific causes influencing the stability of the soils and the importance of soil erosion: In the 1920s at Inxu Drift most of the vegetation cover protecting the sensitive subsurface soils was removed when the number of people and cattle was rising due to the apartheid system. In the early 1930s on Poike Penisula on the Easter Island intensive sheep ranching with frequent burning of the grassland enabled gullying and micropedimentation. In 1935 in the Dwight's Creek in Palouse in the Pacific Northwest of the USA technical improvements enabled the agricultural use of steep slopes. Intensive grazing of highly sensitive ecosystems permitted gullying in Central Oregon early in the 20th century. Since 1958 on the Zhongzuimao the reallocation of land and changes of the political situation and the social structure as well as the introduction of new crops and farming practices multiplied soil erosion in the loess plateau of northern China. In the 1960s in Xixi in Southwest Sichuan the intensification of land use and the terrace construction without experience made erosion possible. Since the 1950s in Germany the removal of soil protective structures (such as terraces, hedgerows and grassland), the resulting increase of the field sizes and the compaction of soils due to the use of heavy machines tripled soil erosion rates.

Humans are not only influencing soil formation and soil erosion processes in Europe and East Asia since several thousands of years, in Southern Africa, in the Americas and in East Polynesia since several centuries. Soil erosion processes which were enabled by the first intensive human activity then determined the following land use phases and also the geomorphological development of landscapes. Gullying, the total erosion of soils and the exposure of bedrock resulted in the abandonment of the fields affected. In some areas (Easter Island, Robinson Crusoe Island) soil erosion that once started, continued after the end of intensive land use. Small pedimentation walls moving upslope are destroying relics of vegetation since centuries. The total erosion of soils in hilly and mountainous areas during prehistoric and historic times often caused the exposure of solid rock. Chemical and biological weathering (in cold or semiarid climates physical weathering, too) and soil formation processes develop there new soils that can be used agriculturally only after several thousands of years. Taking in consideration the time scale of a human life the total erosion of a soil is to be judged irreversible.

Soil Conservation: connecting the pieces

Roger Crofts

Independent Environmental and Management Advisor, Edinburgh, Scotland.
Email: roger@dodin.idps.co.uk

Abstract

There is no single solution to soil conservation. A six-fold package is outlined in the paper. First, perceptions of the importance of soil have to be changed to achieve common recognition that soil is a critical element in human survival, essential natural capital, part of healthy ecosystem function and essential for biodiversity conservation. Second, methods for placing a monetary value on soil are needed in order for it to be included in economic accounting systems and investment decision making. Third, knowledge needs to be improved, including soil sensitivity to erosion, and practical soil conservation measures. Fourth, improved means of knowledge transfer should be provided linking the laboratory to the farmer and the field. Fifth, incentives to stimulate soil stewardship are required. Sixth, a national legal framework should encapsulate a package of measures.

Introduction

There is no single solution to soil conservation. Legal instruments, for example, on their own will not persuade governments of the need to change land use policies and incentive systems. Increasing scientific knowledge about the causes of soil conservation will be of little value unless this can be directly related to the role of farmers and other users of soil resources. Likewise assuming that farmers, as the main users of soils, know intuitively how to be the stewards of the soil has proven to be a misnomer in many parts of the world.

It is clear from my personal experience working especially in Scotland and in Iceland, and more recently in central and eastern Europe, that decision makers, politicians, scientists, farmers, and advisors have not yet brought together the sum of their collective knowledge and experience to develop and implement approaches that will ensure the ecologically and environmentally sustainable use and socially just use of the individual nation's and the world's soil resources. Specifically from my experience as a government official in The Scottish Office responsible for rural development and for environmental policy, politicians and civil servants have so far failed to recognise the critical natural capital of soil and the need to ensure measures are in place to maintain and restore its productive capacity. It is equally clear from my role running a government natural heritage agency (Scottish Natural Heritage) for a decade that biodiversity conservation, as developed in the aftermath of the Convention on Biological Diversity, has been interpreted far too narrowly and traditionally in my own country of Scotland and in many other parts of the world: there has been an undue focus on species and a failure to consider effectively the ecological health and vitality of ecosystems. In recent years, my experience of the relationship between different parts of government ministries shows a total lack of a coordinated and consistent approach of the role that farmers play as custodians of natural resources such as soils along side their role as food producers.

And from my role as a non-executive director of an integrated agricultural institution in Scotland (the Scottish Agricultural College) and my reflections on

the role of participative approaches as a member of the IUCN-The World Conservation World Commission on Protected Areas, I see no other way forward than a much integrated approach to soil conservation. By this I mean the integration of policy and incentives for food and for stewardship of the soil, the stimulation of the positive role of farmers, the translation of scientific and other knowledge about soil management to farmers and their advisors, and the development of legal measures which combine both facilitative approaches and necessary regulation. Therefore, my simple argument is that soil conservation can only be achieved if all of the pieces of the jigsaw are brought together as an integrated whole. I shall develop these ideas in the rest of the paper.

1. Changing perceptions about soil

There are many common perceptions of soils that those attending this conference might recognise:
'Soils are infinite' 'soils are self replenishing' 'soil erosion does not occur' 'fertilisers and other additives will maintain productivity' 'soil is improving as a consequence of continued production' 'soil biodiversity does not matter' 'climate change will increase soil productivity in northern countries' etc etc.

I recall in the late 1980s in Scotland many of these views to the point that those responsible for advising the government on soils were adamant that soil erosion was not a problem, and that the claims by conservationists about overgrazing were nonsense as overgrazing, never mind its link to soil erosion, did not exist either! Even in the later 1990s when ideas of soil conservation strategies were being aired, the government refused to accept the offer from its statutory environmental agencies to develop, in consultation with other interests, a soil conservation strategy for the country. Instead it asked a group of academic scientists to review the position and, unsurprisingly, their main conclusion was that more research was needed! (Davidson et al, 2001).

I have detected a similar position in Iceland over the decade or so I have been visiting the country. Agricultural policy and soil conservation policy, although being the responsibility of the same ministry is not seen as part of the same overall issue of the better stewardship of natural resources. Even in the widely acclaimed Icelandic government sustainable development strategy the section on soils is not connected to the rest of the strategy (Ministry for the Environment, 2002).

It is instructive to consider the work of governments as signatories of the Convention on Biological Diversity. I have not been able to identify substantive discussion on soils as a fundamental biodiversity asset or the issues of soil conservation in any of the Proceedings of the Conference of Parties.

It will be very difficult to move forward effectively on more measures for soil conservation without changing the perception of society in all of its constituent parts about the value of the earth's soil resources and the need for their improved stewardship. This is a social and ethical issue, as well as an ecological and environmental issue.

The starting point for changing perceptions about soil should be a public campaign in as many countries as possible to explain the importance of soil, societal dependence on it and the need for its careful stewardship. Key facets of the campaign should include the value of the soil for food and fibre production, especially linking the productivity of the soil to its natural capacity and the problems resulting from overuse, heavy machinery, overgrazing, etc. In addition, the role of soil in other facets of environmental management should be promoted.

For example, there is the role of soils for the sequestration and storage of carbon and the contribution that this can have on the amelioration of climate change. For example, there is the role of soils in the natural functioning of ecosystems which provide a home for plant and animals species and a store and regulator for water. Bearing in mind the importance of the soil as the substrate for and home of many unique species of plants and animals and of a unknown number of microbial forms, then its role in maintaining biodiversity conservation, including genetic diversity, is another facet to be promoted.

Rather than focus changing perceptions on the scientific and soil using community, campaigns needed to be aimed at the general public through the most accessible media such as television and the web. The school curriculum can be used to get over the message of the importance of soil and the benefits of soil stewardship should be used a great deal more. Our experience in Scotland in working with geography teachers to produce packs on soils for use in the classroom has been beneficial according to the Scottish Association of Geography Teachers who have participated in the development and used the material in the classroom (Scottish Natural Heritage, 1995).

2. Valuing soil as a societal resource

Many natural resources are not recognised as economic and social assets and are not accounted for in evaluation mechanisms. The assessment of costs and benefits in decision making within government and also within business has tended to focus too narrowly on the immediate and direct factors such as the cost of raw materials and the benefits to society through the creation of jobs. These approaches are less than sophisticated in their assessment of the indirect and long-term implications for the use of natural resources, either in terms of the costs of overexploitation or the benefits of restoration or more sustainable levels of use. Progress is being made in many parts of the world to ensure that natural resource accounting is brought to the attention of decision makers and used effectively. However, progress is far too slow and more effort is needed to measure the value and importance of soil as natural capital and as societal goods and services. In Europe, cooperative research and development is needed to devise measures for use in assessments of strategies, programmes and projects for the EU as a whole and in its constituent parts as. More specifically, if soils as natural and societal capital are to be accepted, then their value needs to be recognised in countries national accounts alongside economic and social factors

3. Developing knowledge about soil conservation

A great deal of knowledge about soil erosion and its causes, and about measures for conserving soil already exists and has been published (see Royal Commission, 1996, and Scottish Natural Heritage, 1996). But, to me, as an outside observer, greater knowledge is needed on certain aspects of soils as a basis for improving knowledge of and measures for soil conservation. I suggest the following topics are worthy of further investigation.

Soil sensitivity to erosion

Soils have a varying sensitivity to erosion, for instance in relation to their structure, topography and precipitation regime, and their type of management and use. Therefore, developing methods for assessing and measuring soil sensitivity to erosion should be given priority. It would be preferable if this was undertaken as part of wider assessments of the landscape sensitivity to erosion and other environmental changes which have been developed in recent years by geomorphologists (see, for example, Thomas et al, ????).

Soil carrying capacity
There remains a need to understand better the carrying capacity of the whole soil system for different types and levels of use. All too often in my own country the assumption has been that the capacity is infinite and only in the longer term have the consequences for the productivity of the soil and its carrying capacity become evident: such as in relation to levels of grazing intensity by different native and domesticated species. More knowledge is also needed on the carrying capacity for pesticides and herbicides and other applications which have a rapid impact of growth but their longer term consequences are not always clear.

Rates and causes of soil erosion
Measures of rates of soil erosion do exist but there is a need for more comprehensive approach. Rates assessments on their own are not particularly valuable unless they are amplified by assessment of the various causes of erosion. Using this information targeted conservation measures are more likely to be successful.

Soil cultivation
Cropping regimes can have significant impacts on soil stability and its erosion potential. The trend in my own country to plough in the stubble from the previous seasons' arable crop and sow on the bare ground in the autumn or winter certainly increases the opportunity for bulk loss in extreme precipitation events during the winter. It also is claimed to have a detrimental effect on the provision of food for birds and other species in the winter season. While it is recognised that market forces and the need to provide flexibility to beat the weather are the drivers, the soil and biodiversity conservation benefits of maintaining stubbles are rarely recognised and acted upon. Similarly, the ploughing practice on steeper gradients seems to be determined more by health and safety issues than conserving the topsoil and reducing the flushing out of nutrients. Practical measurement of the benefits of more conservation friendly practices for the soil should be documented from the many field tests that have been undertaken in different soil types and environmental conditions.

4. Transferring knowledge to soil managers

A great deal of the technical knowledge on soil conservation does reach the practitioner on the ground. However, I have found little material in my own country on translating technical knowledge of soil erosion and conservation in an accessible way to those undertaking use and management of soil and those who own it, especially farmers (MAFF, 1993 and DEFRA, 2002). There are a number of improvements that could be made in many countries to provide better information in an accessible manner to farmer and other soil managers and users.

The use of **Extension Services** in rural areas is well tried and tested but in some countries there is now a view that the market should work better and that unless farmers are prepared to consider paying for advice then the sate will not provide them. On the other hand, from experience for example in Scotland and in Iceland, provision of locally-based advisers, either free or for payment of a modest fee in relation to farmers income, can be beneficial. It is essential that the advisers are practical, credible to the users and are able to translate the more technical material in way that is valuable to farmers.

The **translation of technical material** into understandable advice using accessible methods of communication, such as text messaging, web, and tractor cab cards, is an equally important component Long gone are the days when farmers have either the time of the inclination to look at detailed manuals.

One of the best ways of improving soil management is through the establishment of **demonstration farms** and plots. Farmers learn best from their peer group leaders and so establishing a demonstration on the land of a private farmer is likely to be much more effective than on a state-owned farm, although the value of the latter should not be discounted. In Scotland, for example, a series of demonstration farms to show case the most environmentally effective forms of management has been established as voluntary associations by farmers: the Farming and Wildlife Advisory Groups and the Linking Environment and Farming. These are proving to be an effective way of inducing other farmers to do likewise. And at the same time the Scottish Agricultural College has a series of farms for experimental and demonstration purposes and holds open days and special events for the farming community. This effort is paid for largely by financial support from the government.

Another important ingredient in transferring knowledge to farmers is through the development of **Codes of Practice**. Many countries have such codes and these have benefited from the knowledge and experience of farmers themselves as well as from soil research. In drawing up codes, it is essential that the farming community is involved both to share its practical experience and also to ensure that the final product is both useable.

5. Stimulating soil stewardship

Many farmers and farm ministries claim that the farmer is the best steward of the land, including the soil. But this has been questioned many times by those concerned with soil erosion and the sustainability of natural resources. Farmers are, of course, driven by the economics of the market place, both the real external market in the countries where this operates or the shadow market in those many countries where there are subsidies to encourage certain types of production. The gradual development of a global level playing field for agriculture with the removal of subsidies is one of the drivers of change but this would be most unfortunate if it resulted in the degradation of the soil and the decline in its natural productivity. As part of a package of measures flowing from the global commitment on sustainable development, the conservation of and sustainable use of biodiversity, and the achievement of the Millennium Development Goals of poverty reduction and access to safe water, then improved stewardship of the world's soil resources have a key role to play. It is not merely a matter of letting market forces determine the types and intensities of use with no thought for the longer term ecological and productive health of the soil. A package of measures embracing both 'sticks and carrots' would be justified.

Develop and implement basic soil stewardship code

There are many good examples (see MAFF, 1993, and DEFRA, 2002) and all nations should be encouraged along this course of action.

All soil managers and land owners should be encouraged to implement the code. It is for consideration whether a penalty for not implementing the code should be devised and enforced, and conversely, whether any incentives which farmers could obtain would be withdrawn if they did not follow the code.

Provide incentives for conservation

Traditional measures of cash for achieving higher levels of soil management are used in many countries. For example, in the UK a new scheme, arising from the review of the EU Common Agriculture Policy agreed in 2003, sets down the minimum requirements and preferred levels of soil management to be achieved before financial assistance is given and the higher levels of stewardship which can attract direct financial support (Scottish Executive, 2004). More innovative

schemes have been in existence in parts of Australia for a long time, including tax breaks which arguably provide a much greater incentive than grant assistance. Any such approach would need to comply with GATT subsidy and level playing field issues.

Soil conservation is perhaps best undertaken on an ownership unit but in countries where the units are small, as in many parts of Europe, and where ownership boundaries do not make sense in managing natural resources, such as soil, then longer term planning for soil conservation should be considered. The geographical unit for the plan needs to make sense locally to the farmers involved, with financial, technical and hardware support provided.

Involving farmers in developing conservation solutions

One of the most important lessons from the past is that solutions for soil stewardship imposed upon farmers and other land mangers will not work effectively. There is a growing body of experience in relation to the management of natural resources which points to the need to identify and actively engage all of the appropriate stakeholders throughout the development of new methods and schemes of they are to benefit from practical experience and if they are to have any chance of being accepted and implemented (Borrini-Feyerabend et al, 2004).

This experience therefore raises questions about the organisation for soil conservation at the national level. In my experience within government and state agencies in a number of countries there is never one ideal solution to organisational structures and mechanisms. It very much depends on the specific circumstances within the country: whether the normal approach is centralist and dirigiste or whether it is devolved and facilitative, whether there is political support from government or just local demand for action, whether there is a strong local presence of expert advice or whether this is centrally based, and whether the need for soil conservation action is seen largely at the official level or by those who own and manage the land.

Taking just two examples with which I am most familiar: Scotland and Iceland, lessons can be learnt from the different approaches. In Scotland, there is no formal lead responsibility for soil conservation nor any specific government agency charged with giving advice or providing resources. This probably stems from the view that soil conservation is not a priority and has only just been recognised as a management issue following the reorganisation of agricultural support under the EU Common Agriculture policy. As a result the issue of the stewardship of soil as a critical natural resource has not been taken seriously. In the complex bureaucracy that supports the farming industry in Scotland it is not really justified to set up a separate agency. Informally, both Scottish Natural Heritage and the Scottish Agricultural College play complementary roles, the former in relation to soil conservation and the latter in relation to soil management. But it is essential that there is more recognition by the Minister and his officials of the need for soil conservation as a critical component of good agricultural practice and the need for advice on soil management to be made available to farmers.

In Iceland, the establishment of the Soil Conservation Service almost a century ago was a reflection of the political and practical imperatives to combat soil erosion both as a natural phenomenon and a human-induced problem. Establishing a separate agency was the standard Icelandic way of proceeding by government and, whilst there have been suggestions in recent years for mergers with other state agencies, there remains a recognition of the need for government intervention in the fight against soil erosion. The lessons from Iceland are, briefly, that political support only continues while the problem being

addressed is being done so effectively band is of such magnitude that it cannot be solved quickly, that top down approaches ignoring the role of farmers and other land managers does not work as effectively as active engagement of these stakeholders, and that scientifically informed approaches allied to clear advice through locally based staff are likely to be more effective than the more traditional 'government knows best top/down approaches'.

6. Providing a legal framework

A legal framework at national level is preferred rather than informal approaches or relying on administrative arrangements as this gives greater authority to government in dealing with issues, and gives the constituencies of interest a yardstick against which to test action. The components of the legislative package will depend on national needs and circumstances, but the following are elements which are should be seriously considered for inclusion:

- providing a legal definition of the soil as a resource in terms of critical natural and social capital;
- providing a legal definition of soil stewardship and placing a statutory requirement on owners and tenants of land for achieving soil stewardship. A Code of Practice should be attached to the legislation as a Schedule, so that it can be readily amended in the light of changing circumstances;
- providing the statutory basis for 'Soil Conservation Areas' where special measures are or might be necessary to combat erosion;
- providing the statutory basis for the establishment of 'Soil Preservation Sites' where soils should be preserved for posterity because of their research and education interest and potential for example, palaeosoils recording key events in recent Earth history, ecological history sites, representative sites for different types of soils;
- providing for soil research, development and demonstration projects;
- providing the basis for financial incentives for exemplary management of soil resources; and
- providing for the opportunity to establish a specific authority or agency to promote soil conservation

Conclusion

Any strategy for combating soil erosion and stimulating the ethic and practice of soil conservation should encompass all of the 6 elements identified. They should be developed with active input from all relevant stakeholders and should be developed and implemented in an integrated manner. Natural, social and political circumstances will vary from country to country, but the suggestions made in this paper and the experience from a limited number of countries quoted, alongside the great amount of knowledge and information available, should help to in the longer term to increase soil conservation practice.

References

Boardman. J. 2002. *The need for soil conservation in Britain – revisited.* Area, 34.3, 419-427.

Borrini-Feyerabend, G., Pimbert, M., Farvar, M.T., Kothari, A. And Renard, Y. 2004. *Sharing power. Learning by doing in co-management of natural resources throughout the world.* IEED and IUCN, Cenesta, Tehran.

Crofts, R.S. 1996. Foreword. in Taylor, A.G., Gordon, J.E. and Usher, M.U. 1996. *Soils, sustainability and the natural heritage.* HMSO, Edinburgh.

Davidson, D.A. et al. 2001. *Issues associated with the development of a soil protection strategy for Scotland.* Scottish Executive, Edinburgh.

DEFRA. 2002. *Arable cropping and the environment – a guide.* Department of Environment, Food and Rural Affairs, London.

EUROPARC Federation. 2001. *Giving nature a helping hand.* EUROPARC Federation, Grafenau, Germany.
Hindmarch, C. and Pienkowski, M. 2000. *Land management: the hidden costs.* British Ecological Society, London.
McManus, J. 2000. *Soil erosion is Scotland's problem to.,* Landowning in Scotland.
MAFF. 1993. *Code of good agricultural practice for the protection of the soil.* Ministry of Agriculture, Fisheries and Food, London.
Ministry for the Environment. 2002. *Welfare for the future: Iceland's national strategy for sustainable development 2002-2020.* Ministry for the Environment, Reykjavik.
Royal Commission on Environmental Pollution. 1996. Sustainable use of soil. HMSO, London.
Scottish Executive. 2004. CAP Reform: cross compliance. Scottish Executive, Edinburgh.
Scottish Natural Heritage. 1995. Soils Advances Series:2' whose afraid of a bit of rain?' and 3 'What's under your wellies?' poster and teachers notes. Scottish Natural Heritage, Perth, Scotland.
Scottish Natural Heritage. 2004. New options for arable farming: TIBRE Arable Handbook. Scottish Natural Heritage, Perth, Scotland.
Sustainable Development Commission. 2001. A vision for sustainable agriculture. Sustainable Development Commission, London.
Taylor, A.G., Gordon, J.E. and Usher, M.U. 1996. Soils, sustainability and the natural heritage. HMSO, Edinburgh.
Wiseman, R. E. and Hopkins, E. A., (eds). 2001. Sowing the seeds of sustainability. IUCN, Gland, Switzerland.

Role of the World Conservation Union in the Development of Soil Law and Policy

Dr Sheila Abed

Directora Ejecutiva, Instituto de Derecho y Economia Ambiental, Asuncion – Paraguay, Email: sheila.abed@idea.org.py, Chair, IUCN Commission on Environmental Law.

Abstract

The World Conservation Union (IUCN) is the world's largest conservation network. It's mission, to "influence, encourage and assist societies throughout the world to conserve the integrity and diversity of nature and to ensure that any use of natural resources is equitable and ecologically sustainable", provides a sound platform for the Union to investigate the legislative and policy aspects of the sustainable use of soil.

This paper describes the organizational structure of the IUCN as it applies to the implementation of the IUCN's Soil program. The Soil Law program is managed by the Environmental Law Program of IUCN. The Programme consists of the Environmental Law Centre and the IUCN Commission on Environmental Law. The Soil Law program is based on the October 2000 IUCN World Conservation Congress Resolution for the Sustainable Use of Soil which requires the Environmental Law Program, in its development of legal guidelines and explanatory material, and investigation into a global legal instrument for the sustainable use of soil. It is tasked to pay particular attention to the ecological needs of soil, its ecological functions for the conservation of biodiversity and the maintenance of human life. The Resolution is directed to both the national and international levels of legal protection for soil.

Introduction

The World Conservation Union (IUCN) is the world's largest conservation network. It was founded in October 1948 as the International Union for the Protection of Nature (or IUPN) following an international conference in Fontainebleau, France. The organization changed its name to the International Union for Conservation of Nature and Natural Resources in 1956. IUCN brings together 82 States, 111 government agencies, more than 800 non-governmental organizations (NGOs), and some 10,000 scientists and experts from 181 countries in a unique worldwide partnership. IUCN's mission is: "to influence, encourage and assist societies throughout the world to conserve the integrity and diversity of nature and to ensure that any use of natural resources is equitable and ecologically sustainable". While the idea of conserving the environment has steadily gained political acceptance over the past few decades, people generally misunderstand the benefits that biodiversity and ecosystems provide to humans. Around 15,589 species of animals and plants are threatened with extinction. Many ecosystems – especially soil ecosystems – are being degraded and destroyed at an alarming rate, which is extremely disturbing, given the large range of highly valuable services they provide to human beings. Well-functioning soil ecosystems help in reducing poverty and improving livelihoods, societies and economies. It is appropriate that all ecosystems are properly evaluated as a basis for all land use decision-making (Shepherd 2003).

Ecosystem emphasis

In October 2000, IUCN acknowledged the key role that soils play in ecosystem management when it passed its "Soil Resolution" to investigate effective legal and institutional frameworks for the sustainable use of soil (See Hannam and Boer 2002; Boer and Hannam 2003; Hannam 2005). Information on soil ecosystems must be effectively integrated into the decisions and actions of local, national and international policy makers in all sectors. Moreover, in a broader sphere, IUCN generally continues to improve scientific understanding of what natural ecosystems provide to people and it seeks to ensure this knowledge is used in practical ways by bringing together scientists, policy makers, business leaders and NGOs to impact the way the world values and uses nature. The priority of IUCN's 2005-2008 Program is to build recognition of the many ways in which human lives and livelihoods, especially of the poor, depend on the sustainable management of natural resources. In this regard, IUCN is applying sound ecosystem management in its environmental law program, to conserve biodiversity and build sustainable livelihoods for those directly dependent on natural resources.

IUCN is actively engaged in managing and restoring ecosystems and improving people's lives, economies and societies and its databases, assessments, guidelines and case studies are among the world's most respected and frequently cited sources of information and reference on the environment. As the world's largest environmental knowledge network, the Union has helped over 75 countries to prepare and implement national conservation and biodiversity strategies. IUCN provides policy advice and technical support to governments, UN organizations, international conventions and other groupings such as the G8 and G77, including technical assistance to prepare national biodiversity strategies and action plans and providing technical support for drafting environmental laws and natural resource management strategies.

IUCN SOIL LAW PROGRAM

The IUCN Soil Law program commenced with the passing of the Soil Resolution at the 2000 World Conservation Congress. This paper will focus on the organizational and broad policy environment of IUCN in which the Soil Law program fits, whereas comprehensive information about the progress and achievements of the program will be given in the presentations by Ian Hannam and Ben Boer at this workshop. Primary responsibility for implementation of the Soil Law program rests with the IUCN's Environmental Law Program, including the Commission on Environmental Law and the Environmental Law Centre, but it also has important connections with core IUCN ecosystem management programs and the other five Commission of the IUCN.

The original basis on which IUCN initiated the Soil Law program included:

- The principal objective of the International Union for the Conservation of Nature and Natural Resources (IUCN) since its founding in 1948 to establish laws and treaties for the protection of nature;

- The important contributions made by the IUCN since 1965 in all fields of environmental law;

- The recognition that the scope of environmental is very broad, ranging from the legal systems of local authorities and the customary law of traditional societies and indigenous peoples, through to the laws of States and the international law among States;

- The significant cooperation and support that exists among the soil science community for the improvement of environmental law and policy for the sustainable use of soils, particularly in regard to the ecological functions of soil for the conservation of biodiversity and the maintenance of human life.

IUCN Environmental Law Program and Soil

The objective of the IUCN Environmental Law Program (ELP) is to advance sustainability through the development of legal and policy concepts and instruments and through building the capacity of societies to develop and implement environmental law and policy, in furtherance of the IUCN Mission. Increasingly, globalization has led to a greater recognition of the need for IUCN to address many of these issues through improved international, regional and national legislative systems. With the knowledge that soil ecosystems are subject to environmental and economic effects that transcend national boundaries, the ELP recognizes that solid legal frameworks at all levels, supported by sound institutions that have a respect for the rule of law, are critical to achieving the desired environmental objectives for soil. The challenge ahead for IUCN is to decide the best form for an international instrument, right through to ensuring that each country has at its' availably, comprehensive legislative guidelines to give the best opportunity to prepare quality national environmental law to protect the ecological functions of soil (Hannam and Boer 2002; Hannam and Boer 2004).

The effective implementation of an international instrument for sustainable use of soil will, in turn, rely on individual countries having the capacity to develop the necessary policies, legislation and institutions, and to have access to properly trained staff resources. Through its integrated program of activities, ELP can provide decision makers with information, legal analysis, advisory services, legislative drafting, mentoring and capacity building at national, regional and global levels. The Program provides the opportunity and the forum for governments, non-government organizations and others to network and to share information and discuss ideas. The ELP network which supports the Soil Law program includes:

- The Commission on Environmental Law (CEL), an extensive global volunteer network of over 975 environmental law specialists in more than 130 countries;
- The Environmental Law Centre (ELC), a professional international office established in Bonn, Germany in 1970 with 15 highly skilled legal, policy and information specialists; and
- The IUCN lawyers based in Regional and Country Offices around the world. Environmental lawyers or legal officer focal points now exist in IUCN offices around the world (the Asia Region currently having dedicated environmental lawyers based in Pakistan, Bangladesh, Nepal and Sri Lanka).

Commission on Environmental Law and Soil

The CEL is a network of environmental law and policy experts from all regions of the world who provide their knowledge and services to the ELP, as an integral part of the ELP. This worldwide membership gives CEL, in the implementation of the IUCN Soil Law project, access to a very broad range of expertise. In this regard, the CEL serves as the principal source of legal technical advice to the IUCN, its members and its collaborating institutions on all aspects of environmental law relating to the sustainable use of soil. This environmental law

network supports activities of various international governmental organizations, governments and non-governmental organizations to improve or develop legal and institutional infrastructure for soil protection (eg, the People's Republic of China, various Central Asian and Eastern European countries). A principal goal of CEL is to demonstrate the vital importance of such infrastructure within national and international strategies for environmental conservation. As a result of the IUCN resolutions on soil and the activities of the Specialist Group on Sustainable Use of Soil and Desertification, these goals specifically include the development of legal strategies for the sustainable use of soil within and beyond national jurisdictions.

Steering Committee

The CEL is led by a Steering Committee consisting of the Chair, the Deputy Chair and Vice Chairs. The Director of the ELC is an ex officio member of the Steering Committee. The Steering Committee meets at least once a year to discuss the implementation of the IUCN Law Program and to decide on the future of Commission initiatives. The Commission is primarily supported by a CEL Liaison Officer based in Asuncion, Paraguay and by the staff of the IUCN Environmental Law Centre, especially the Legal Officers. Overall, members of CEL come from diverse areas of expertise within environmental law and policy, but all share a commitment to work actively towards the progress of conservation law. They serve in their personal capacity, although they might come from governmental or non-governmental organizations might be active in private law practice, attached to a university or an international organization. They represent every region of the world and their interests and expertise span the full spectrum of environmental law from pollution issues to those related to biological diversity conservation.

One of the great strengths of the CEL is its "interdisciplinary" character. Because environmental law involves many intertwined disciplines, all of which are relevant to the sustainable use of soil, it can quickly access any legislative area of interest to assist with the Soil Law program. In this regard, CEL's system of Specialist Groups is organized to the meet the ever-increasing demands in promoting environmental law. For example, membership of the Specialist Group on Sustainable Use of Soil and Desertification come from many regions of the world - Australia, China, Brazil, Iceland, USA and Egypt.

Relationship between CEL and other <u>Commissions</u>

The CEL has forged relationships with the other five Commissions of IUCN. This inter-Commission network provides an effective medium to access the ecological expertise needed to support the Soil Law program. Overall, the six Commissions of IUCN are a principal source of guidance on conservation knowledge, policy and technical advice, and implement various parts of the Union's work program (priorities and work of the Commissions are also set every four years at the World Conservation Congress). Other Commissions include:

- Ecosystem Management (provides guiding on management of natural and modified ecosystems)
- Education and Communication (promotes sustainability through education and communication)
- Environmental, Economic and Social Policy(advises on economic and social factors that affect natural resources)
- Protected Areas (advises and promotes terrestrial and marine reserves, parks and protected areas); and

- Species Survival (supports species conservation and protecting endangered species).

PROGRESS OF THE SOIL LAW PROGRAM

To date the key outputs of the Soil Law program include the two Environment Law and Policy publications:

- *Legal and Institutional Frameworks for Sustainable Soils: A Preliminary Report;*
- *Drafting Legislation for Sustainable use of Soils: A Guide.*

However, an important part of the preparation of these publications has been the on-going interaction with the soil science community, with the specific involvement of a group of high level international soil science experts in the review and discussion process with the publications.

The first of these publications provides the background argument to an ecosystem-based approach to the sustainable use of soils, summarizes aspects of national soil legislation around the world, and canvasses the role and benefits of existing international and regional treaties and soft soil law relevant to soil. It also puts forth various options for an international legislative instrument for soil and a set of recommendations for the ELC and IUCN in general to advance the arguments for improved international and national soil law.

The second of the publications is a much-awaited guideline for national entities to use in the review or preparation of new soil legislation. A main feature of this publication is that it proposes legal and institutional elements that specifically address the needs of disadvantaged people, particularly women. This is unique, as there are not many examples of legal frameworks relating natural resource management that specifically seek to accommodate the concerns of the poor. The guideline has already been used by a number of jurisdictions in beginning to revise their soil policy and law.

CONCLUSIONS

The organizational structure of IUCN provides an effective and comprehensive network of legislative and technical programs to implement its Soil Law initiative. The Environmental Law Programme is pleased to be associated with this workshop, and look forward to its results. We also look forward to further fruitful interaction with the soil science community. Specifically, we will welcome suggestions for the further development of the Soil Protocol from all participants.

References

Boer, B.W. and Hannam, I.D., 2003, "Legal Aspects of Sustainable Soils: International and National, 12(2) *Review of European Community and International Environmental Law*, 149-163.

Hannam, I.D, 2005, *Legal Framework for the Ecological and Biodiversity needs of Soil: Progress towards an International Instrument for the Sustainable Use of Soil*, International Workshop on Strategies, Science and Law for the Sustainable Management and Conservation of the World's Soil Resources, 14-18 September 2005, Iceland.

Hannam, I.D. and Boer, B.W., 2002, *Legal and Institutional Frameworks for Sustainable Soils: A Preliminary Report*, Environmental Law and Policy Paper No 45, IUCN Gland Switzerland and Cambridge, UK, and Bonn, Germany.

Hannam, I.D and B.W. Boer, 2004, *Drafting Legislation for Sustainable use of Soils: A Guide*, IUCN, Gland Switzerland and Cambridge, UK, 100pp.

Shepherd, G, 2003, *The Ecosystem Approach, Five Steps to Implementation*, Ecosystem management Series No 3, IUCN, Gland, Switzerland.

Progress towards a Draft Protocol for the Conservation and Sustainable Use of Soil

Ian Hannam and Ben Boer [1]

Abstract

In April 1999, the IUCN Commission on Environmental Law (CEL) established the Specialist Group for Sustainable Soils (SGSS)[2] to investigate the national and international dimensions of the legal protection of soils. The impetus for this Working Group arose out of contacts of CEL members with the principal international soil science organizations. In October 2000 the IUCN World Conservation Congress passed a Resolution (later supplemented at the 2004 World Conservation Congress) requesting the IUCN Environmental Law Program (ELP), in its development of legal guidelines and explanatory material, and investigation into a global legal instrument for the sustainable use of soil, to pay particular attention to the ecological needs of soil and their ecological functions for the conservation of biodiversity and the maintenance of human life. The paper begins with the premise that soil is the basis of virtually all terrestrial life. It is both an inherent part of biological diversity as well as the major element of its foundation. Without soil, human and many forms of life on earth could not exist. The effects of the increase in the human population on the world, especially in terms of the decline in food security, indicates that soil has ecological limits which change according to the variations within ecosystems and the cultural relationships with the land and soil resources. The paper reviews the progress towards the preparation of a global legal instrument for the sustainable use of soil, including: the survey of national, regional and international instruments relating to the sustainable use of soils; development of the legal and institutional frameworks for the sustainable use of soil; preparation of guidelines for drafting legislation for sustainable use of soils; and options for an international instrument for sustainable use of soils. The paper refers to this instrument as the draft Soil Protocol.

BACKGROUND

IUCN Commission on Environmental Law specialist group on soil law

In April 1999, as a result of meetings with members of soil science organisations, the IUCN Commission on Environmental Law (CEL) initiated the establishment of a Specialist Group for Sustainable Soils (SGSS) to investigate the national and international dimensions of the legal protection of soils. The impetus for this Working Group arose out of contacts of CEL members with the principal international soil science organizations that continue to be concerned about the need for improved legal protection of soils on a global basis. In June 2005 the Steering Committee of the IUCN Commission on Environmental Law expanded the responsibilities of the Specialist Group to include "desertification" (SGSS&D).

[1] Dr Ian Hannam, Environmental Law and Policy Specialist, Environment and Agriculture Unit, Asian Development Bank, 7th Floor Block D, Beijing China Merchants International Financial Centre, 156 Fuxingmennei Ave, Beijing 100031 China, ihannam@adb.org; Member IUCN Commission on Environmental Law; Chair, CEL Specialist Group on Sustainable Use of Soil and Desertification; Ben Boer, Professor in Environmental Law, University of Sydney, New South Wales Australia 2000, benboer@law.usyd.edu.au Member IUCN Commission on Environmental Law; Foundation Chair and now Member, CEL Specialist Group on Sustainable Use of Soil and Desertification

[2] Note - "Desertification" was added to the Specialist Group in June 2005 - "Specialist Group on Sustainable Use of Soil and Desertification" (SGSS&D).

The IUCN Amman and Bangkok Resolutions on Soils

In October 2000 the IUCN World Conservation Congress in Amman, Jordan, passed a Resolution which gave the imprimatur of the IUCN to further investigate the international and domestic legal protection of soils, and called upon members of the Union to support this work. The SGSS&D had the principal responsibility to develop the guidelines and prepare reports under the Resolution. The main part of the Resolution requests the Environmental Law Program – "in its development of legal guidelines and explanatory material, and investigation into a global legal instrument for the sustainable use of soils, to pay particular attention to the ecological needs of soil and their ecological functions for the conservation of biodiversity and the maintenance of human life". The full text of the Resolution is directed to both the national and international levels of legal protection. The report - Legal and Institutional Frameworks for Sustainable Soils: A Preliminary Report (Hannam and Boer 2002) was the first major outcome under the objectives of the Resolution. The second outcome was Drafting Legislation for Sustainable use of Soils: A Guide (Hannam and Boer 2004). In late 2004 at the IUCN World Conservation Congress in Bangkok passed a further resolution, Legal aspects of the sustainable use of soils. That resolution included the following substantive passages:[3]

> 1. REQUESTS the IUCN Director General to work with IUCN members to prepare outlines of the various options for a global legal instrument for the sustainable use of soils, as set out in Section 5 of EPLP No. 45, to be considered for implementation by IUCN;
>
> 2. REQUESTS the IUCN Director General to continue the effective communication of the outcomes of the Sustainable Use of Soil programme among the environmental law and soil-science communities and to prepare further legal guidelines and explanatory material on the ecological needs of soil and their ecological functions for the conservation of biodiversity and the maintenance of human life, as necessary to support the introduction of a global instrument for sustainable use of soil; and
>
> 3. REQUESTS the IUCN Director General to continue efforts with interested and desirous countries for the development of national legislation for sustainable use of soil, in particular working with developing nations on the improvement and reform of their national soil legislation, contributing to institutional capacity building and assisting in the development of national environmental policy and strategies.

HUMAN POPULATION AND ECOLOGICAL LIMITS

It has been forecast that the global human population will increase from the present 6.4 billion up to 7.5 billion by the year 2020, and some 9 billion by 2050 (UN 2004). This inevitably means greater pressure will be put on prime lands, and especially those with the most fertile soils, to provide the extra food required. As demand increases, there will be increasing pressure also on the less productive soils, where the impact of soil degradation is most dramatically seen, even resulting in the displacement of people from their homelands (Bridges et al 2002, Hurni and Meyer 2002). The effects of the increase in the human population on the world, especially in terms of the decline in food security, indicates that soil has ecological limits which change according to the variations within different ecosystems and the cultural relationships with the land and soil resources (Penning de Vries et al 2002). This challenge has been taken up by the

[3] The full resolution is set out in the Appendix to this paper.

international soil science community (Hurni and Meyer 2002) with the main objectives to:

- Change the attitude of humans about the vital importance of soils;
- Remind humans that soil is the foundation of human physical development and has a fundamental role in sustaining societies;
- Raise the "status" of soil by advising governments of the world of the way to manage their soil as a non-renewable resource;
- Build an international network of specialists to impede the progress of soil deterioration.

It is contended that to successfully achieve these objectives, a holistic, interdisciplinary approach must be promoted, which brings the expertise of a wide range of specialists together, in shift the paradigm of soil conservation from a narrowly focussed scientific framework to one which will bring the issue of soil degradation to a level of global concern. In order to achieve this, a wide range of disciplines must be tapped, and a broad spread of institutions must become involved. This workshop is already a manifestation of this approach, with the coming together of soil scientists, policy analysts and environmental lawyers. The drafting of a Protocol must reflect a broad canvass of interests and views in order to ensure that all stakeholders and rights holders are adequately represented.

DEFINITIONS

National and international frameworks for soil legislation need to be based on a clear understanding of the often-confusing differences in the use of terminology in the soil science, sociological, and ecological disciplines. The draft Soil Protocol being discussed at this workshop elaborates the definition of a number of words and phrases. Key among these are the following:

Soil and soil functions

For the purposes of the Soil Protocol, soil is defined as:

> the natural dynamic ecosystem of unconsolidated mineral and organic material situated at the interface between the earth's surface and bedrock, consisting of successive horizontal layers with specific physical, chemical and biological characteristics, including porous sedimentary rocks and other permeable materials together with the water that these contain.

The definition of soil (Council of Europe 1990, Gobat et al 2003) indicates that soil has a fundamental role in the terrestrial ecosystem as a three-dimensional body performing a wide range of functions, principally being ecological, cultural functions, and land-use functions. Any alteration of soil processes can lead to changes in the function of ecosystems (Sheals 1969). It is essential the principal functions of soil must strongly influence the preparation of legal frameworks for soil. The functions of soil have been incorporated within at least one international convention[4] and many national soil laws refer to various individual soil functions (Hannam and Boer 2002). In the draft Protocol, "soil functions" are defined as including:

[4] See *Protocol on the Implementation of the Convention concerning the Protection of the Alps of 1991 in the area of Soil Protection* (Salzburg, 1991), Article 1, <http://fletcher.tufts.edu/multi/texts/bh993a.txt>, but not yet in force. Article 1 sets out the multifunctional role of soil in an effective manner. See also the draft revised European Soil Charter of 2002 (found at <http://www.nature.coe.int/CO-DBP6/codbp02e_02.doc>), which includes an explicit description of the functions of soil.

ecological functions, habitat functions, water regulation functions, land use functions and human cultural functions;

Soil biodiversity

A premise of this paper and of the draft Protocol is that soil bodies are effectively ecosystems and, as living mediums, can be regarded as having species characteristics. Any discussion of soil conservation and sustainable use is therefore necessarily seen as a specialized aspect of the conservation and sustainable use of biological diversity in general. Soil is also the basis for sustaining all other terrestrial organisms, including, of course, people. In examining the publication *Global Environmental Outlook*, published by the secretariat to the Convention on Biological Diversity,[5] soil and its constituent elements is recognised as part of the Convention's approach to biodiversity in a number of places.

In order to emphasise the role of soil as the fundamental aspect of terrestrial biological diversity, the term "soil biodiversity" has been defined in the draft Protocol to mean:

> the variability among soil bodies, including biological diversity within soil bodies, between soil bodies and of soil ecosystems.

Soil degradation

Soil degradation is broadly defined as a loss or reduction of soil functions or soil uses, thus lowering the potential capability of the soil to produce ecosystem services. It includes physical, chemical, and biological deterioration, including loss of organic matter, decline in soil fertility, decline in structural condition, erosion, adverse changes in salinity, acidity or alkalinity, and the effects of toxic chemicals, pollutants or excessive flooding. The most important factors that contribute to a state of soil degradation must be taken in account within a legal framework, i.e. water erosion, wind erosion, water-logging and excess salts, chemical degradation, physical degradation, and biological degradation (Bridges et al 2002).[6] In the draft Protocol, soil degradation is defined as including:

> aspects of physical, chemical and biological deterioration, including loss of organic matter, decline in soil fertility, decline in structural condition, soil erosion, adverse changes in salinity, acidity or alkalinity and the effects of toxic chemicals, pollutants and excessive flooding.

THE ECOSYSTEM-BASED APPROACH

As advocated by IUCN, an ecosystem-based approach is an appropriate strategy for soil because it promotes conservation and sustainable use in an integrated and equitable way, based on the application of appropriate scientific methodologies. At the fifth meeting of the Conference of Parties (COP) of the CBD, governments and relevant bodies were urged to apply the ecosystem approach in their environmental law reform and the COP adopted 12 broad principles for the application of the ecosystem approach with a clear rationale underlying each principle (IUCN 2003).

An effective legal system for the protection of soil will therefore depend on the selection of appropriate ecological concepts and the development of a legal structure with the appropriate ecological elements and standards to implement these concepts (Hannam and Boer 2002). The values and standards of soil

[5] http://www.biodiv.org/gbo/gbo-pdf.asp#

[6] See further Draft Protocol, note 3 above.

consumption should be rigidly defined by the ecological limits of different forms of land use. These specific *ecological soil standards* should be developed to evaluate the potential for any sustainability-oriented concept, or practice that may seem appropriate to meet the goal of sustainable use of soil. The standards can also be used as a basis to formulate elements for soil legislation, with the same goal (Hannam and Boer 2002).

NATIONAL LEGAL AND INSTITUTIONAL FRAMEWORKS FOR SOIL

The detailed investigation carried out by the IUCN ELP found that legislation has been used for many years in many countries in a piece-meal fashion, to manage specific types of soil problems and control land use activities which directly cause soil degradation problems, and to indirectly control soil management problems. Legal and institutional frameworks used in most countries still approach soil conservation in a fragmented way. In the past, the main type of legislation aimed at the control of soil degradation has been "soil conservation law" (Grossman and Brussaard 1992). Soil legislation has mainly had a land utilization focus and was generally introduced to prevent, mitigate or manage soil erosion on arable or pastoral land, mainly at the farm level. Some of the legislation had provisions for land management planning at a watershed scale (Bradsen 1988, Huong and Guss, 1997, Krasnova 2000). By the mid-1990s, and in pursuance of a sustainable land management goal, it was acknowledged that a range of land management programs, policies, and educational initiatives, as well as national and local laws, were necessary to successfully change the behaviour of land users to achieve such a goal (Hurni and Meyer 2002). The IUCN ELP has made the following observations with regard to legislative systems relevant to soil (see Section III - Hannam and Boer 2002, Boer and Hannam 2003):

- Some States have developed a framework of legislation to manage soil and land use problems. However, this legislation often lacks linking or coordinating mechanisms to ensure that there is effective institutional implementation of the legal mechanisms.
- The majority of pieces of legislation do not take into account the inherent ecological characteristics and limitations of soil bodies as the premise for land use decision-making. Rather, most soil legislation generally addresses soil problems *ex post facto*; i.e. to try to rectify the problems caused by poor land use planning or inappropriate land use in the first place;
- The legislation does not acknowledge soil as an ecological element with a central role in terrestrial ecology and the conservation of biodiversity;
- The primary functions of soil are not well represented in the legislation in most jurisdictions and only a few laws refer to the ecological features or needs of the soil;
- A dominant characteristic of existing national soil legislation is that it is directed to the physical problems caused by inappropriate land use, mainly agriculture and forestry (reflecting short-term private interests as against long-term public interest);
- The structure of some laws indicates that they are a reaction to political or institutional issues, rather than being designed to effectively manage the soil;
- There is a general lack of consistency in the use of standard scientific soil terminology, and often there is an absence of definitions, or inadequate and poorly stated definitions.

Development of national legal frameworks

The development of frameworks for national soil legislation should be approached from a sound conceptual and ethical basis, with the goal of protecting and managing the ecological aspects of soil to enable its use in a sustainable manner. For such a framework to be effective, States must be willing to accept new elements in a legal system for the soil. Two alternative approaches, using a mix of regulatory and non-regulatory elements, can be taken to establish legal and institutional frameworks for sustainable use of soil (Hannam and Boer 2004):

- The first approach is based on a short time-frame for implementation. It considers minimal change to an existing legislative regime, minor reforms of soil use policy, definitions and concepts, minimal changes to related laws, and minimal rearrangements of institutional and human resources. This approach will not usually provide the legal and institutional measures needed to manage all aspects of soil.
- The second approach considers a medium to longer time-frame for implementation and involves substantial reform of existing laws, policies and institutional and sectoral arrangements. This approach would go a long way to providing most of the legal and institutional elements necessary to achieve the sustainable use of soil.

Guide to elements for soil legislation

The second major outcome of the ELC SGSS&D program to date is the "*Guide for Drafting Legislation for Sustainable use of Soils*" (Hannam and Boer 2004). The Guide contains over 100 'sample' legal and institutional elements that are appropriate for national soil legislation. The elements are "generic" at this level and individual States would need to ensure that adequate background work is done to clearly identify the actual physical, cultural, institutional and socio-economic issues which need to be taken into consideration when preparing specific national soil legislation. These elements can also be used to assess the capacity of an existing law to meet prescribed standards of performance for the sustainable use of soil. It is important, when a State is designing such a regime, that it reviews its current organisational system to ensure that it has the capability to effectively administer a new law (Hannam and Boer 2004).

Key Principles for the Sustainable Use of Soil

The ecological principles and elements that should be observed in formatting legislation for soil (Hannam and Boer 2002) include both national and international considerations:

- Soil degradation affects the global environment because it represents a loss of integral components of the world's ecosystems and global biodiversity;
- Accelerated soil degradation is mostly human-induced and occurs in all eco-regions of the world, irrespective of social, economic, and political conditions;
- Recognition that soil degradation has a significant impact on the total environment in any particular State;
- Soil degradation causes damage to the soil resource by erosion, contamination, change of physical or chemical state and loss of nutrients and organic matter;

- A significant proportion of the degradation of the atmosphere is due to greenhouse gas emissions caused by various forms of soil use associated with agriculture;
- Loss of biodiversity is generally related to land use changes: deforestation, agricultural intensification and urban expansion, which cause soil degradation;
- Accelerated soil degradation exacerbates the scarcity of productive lands and is a major threat to global food security and induces poverty.

INTERNATIONAL LEGAL AND INSTITUTIONAL FRAMEWORKS FOR SOIL

The IUCN SGSS&D has reviewed many existing international and regional instruments that make reference to soils in some manner (Hannam and Boer 2002). It has discussed various relationships between different hard and soft law mechanisms that have been developed in the international environmental law as they relate to soil. While the problem of soil and land degradation has not gone unnoticed by the world community there has been little discussion until recently on the role of international environmental law and soil degradation (Boer and Hannam 2003).

Role of international environmental law

A key response to the rapidly changing political and social aspects of the world and the ever-expanding environmental problems has been the accelerated development of international and domestic environmental law. Environmental law is an essential component for setting and implementing global, regional, and national policy on environment and development. There is an increasing recognition of the role of international environmental law to overcome the global problem of soil degradation, including its ability to provide a juridical basis for action by nations and the international community. *Agenda 21*, the Action Plan from the 1992 UN Conference on Environment and Development (UNCED), identified concrete steps to integrate environment and development. Since the early 1900's, over 200 multilateral and bilateral environmental treaties, agreements and protocols have been developed, covering flora and fauna conservation, protection of fisheries, pollution management, regional conservation protection, Antarctic conservation, settling disputes, civil liberties in relation to environmental damage, protection of world cultural and natural heritage, endangered species, and landscape protection. While a number of these contain elements that can assist in achieving sustainable use of soil, the research carried out under the auspices of the IUCN Environmental Law Program argued that none are sufficient in their own right to meet the requirements of international environmental law in relation to soil. Some of the existing instruments assist by managing some of the activities that directly lead to, or can control, soil degradation but this role is not readily apparent (see Section V - Hannam and Boer 2002).

Approach to an international framework for soil

It is contended that the principal underlying ethic of an international framework for soil is to recognize soil as the most significant ecological element of terrestrial biodiversity. Thus basic rights of humans in regard to the role and use of soil and the obligations on respective parties to observe these rights is the same as that under the Convention on Biological Diversity. The ethic which should be the basis of the draft Soil Protocol should convey principles that recognise:

- A right to an ecologically healthy soil environment;

- A right of access by all people to accurate soil information, particularly knowledge of the global and regional status of soil degradation;
- A right for persons to participate in planning and decision-making processes for soil;
- A right of access to judicial and administrative proceedings, including redress and remedy in exercising their rights and obligations;
- A right for a State to take legal action against another State for harm to its soil and any associated waters arising from the transboundary effects of unsustainable land use;
- A right to expect the world community as a whole and respective States, to protect and conserve soil for the benefit of present and future generations.

FUTURE DIRECTIONS

The path selected by the IUCN ELP to meet the environmental law needs of soil is conscious of a number of interacting factors, including:

- An awareness of the poor recognition of soil in current international environmental law, and that national soil legislation is generally inadequate to manage the type and severity of soil degradation problems experienced around the world;
- The need to consider the ecological function of soil for the conservation of biodiversity and the maintenance of human life;
- The need to satisfy the high level of recognition amongst the soil science community of the benefits of introducing an international instrument to raise the awareness of the serious situation of soil degradation, and the need to develop suitable legal tools for individual nations to improve the capability of their domestic law to protect and manage soil in a sustainable way. Of particular concern is the continued high rate of expansion of soil degradation globally, the increase in degree and severity of individual soil degradation processes and the periodic emergence of new forms of soil degradation. Of major concern is the prediction that this situation will worsen in the 21st century (Bridges et al 2002). The data clearly shows that in the immediate future the world will be placing even greater pressure on its soils than it is today, to produce sufficient food to meet the ever-increasing food deficit;
- A general realization that the world community must take action sooner rather than later to more adequately cater for the ecological functions and needs of soil in the international and national environmental law regimes, as an integral part of the overall framework of environmental law and policy for environmental management;[7]
- Recognition that a number of existing multinational agreements which have specific objectives and responsibilities to improve the condition of the terrestrial environment are not being implemented to their full potential. This situation may influence the choice of the type as well as the substantive provisions of a global instrument for soil. Some developed nations with a major leadership role in global environmental management continue to display an unsatisfactory attitude toward some of their most important domestic responsibilities;

[7] As indicated in the Amman Resolution; IUCN CEL SGSS&D mandate; the Soils Objective of Montevideo Program III; and WSSD 2002.

- In the recent past there have been some positive national soil law reforms and in a few instances new statutes have been either passed or tabled with the respective parliaments. These moves have stimulated some other nations, and some regions, to actively seek assistance to develop new national soil law, but they represent a small portion of the world in number and area;
- The decision to develop international and national soil legislation frameworks should also include the provision to develop the accompanying support materials and explanatory guidelines necessary to ensure the effective implementation of the separate frameworks.

Some Options

In summary, some of the options presented by the IUCN ELP include (see section V.10 Hannam and Boer 2002) are as follows:

National

- Promotion of the generic "Guide", which consists of a range of general elements which may be drawn upon by individual nations when amending an existing law or developing a new law for soil (see Hannam and Boer 2004, *Guide for Drafting National Soil Legislation*);
- Preparation of regional legal frameworks for soil, to be used in conjunction with the basic generic legal elements, which should include a range of specific elements to deal with the physical and legal characteristics of the particular region.

International

Binding instrument options:

- A specific treaty setting out the essential elements for the sustainable use of soil;
- A framework treaty, which identifies the soil elements in existing treaties (E.g., in the *Convention to Combat Desertification*, and the *Convention on Biological Diversity*) and links them through a separate binding instrument. The new instrument would contain additional, specific legal rules for soil;
- A protocol to an existing treaty that creates specific rules for soil. For the present, we have chosen to place the draft Protocol within the framework of the Convention on Biological Diversity as its the most logical home. However, in the future, given the promotion of synergies between international environmental conventions to make their implementation more efficient and effective,[8] the development of a Protocol for the *Convention to Combat Desertification*, and possibly, for the *Framework Convention on Climate Change* could also be considered.

***Non-binding options*:**

- A non-binding international charter for soil;
- A non-binding declaration on soil.

[8] See, for example, 'Charting the Way Forward', http://www.biodiv.org/doc/newsletters/news-collaboration-CITES-en.doc and *Promoting CITES-CBD Cooperation and Synergy*, http://www.bfn.de/09/skript116.pdf, documenting a workshop on synergies between the *Convention on International Trade in Endangered Species* and *Convention on Biological Diversity*.

SUGGESTED ACTIONS

To adequately fulfil the terms of the IUCN World Congress Amman Resolution of October 2000, and its Supplementary Resolution of November 2004, the terms of reference of the SGSS&D, to accommodate the soil objectives of the Montevideo Program III, and to address the suggestions of various soil science conferences, we would call for a number of actions to promote the findings and conclusions of the ELP reports:

1. The IUCN ELP to host a meeting of representatives of the principal international soil institutions to seek ongoing commitment to the SGSS&D project, and to canvass opportunities for these institutions to input to the project in the interest of achieving a better overall legal strategy for the sustainable use of the world's soils; such a meeting would be intended to build on the foundations set by the Selfoss workshop in Iceland;
2. The ELP to expand the terms of reference of the SGSS&D project into a more comprehensive and substantial sustainable soils project within the IUCN as a whole. Formal links will need to be forged with other IUCN Commissions, specific program areas, and with IUCN regions;
3. The ELP to propose that the IUCN Council request the IUCN Director General to develop a specific soil education campaign to raise the awareness of the national and international legal needs of soil and promote the need for the community to adopt an ecologically based paradigm for soil. The ELP would be a key component of this campaign. Such an initiative would support existing initiatives of the global soil science community;
4. The ELP to actively promote the 2004 *Guide for Drafting National Soil Legislation* among regions of the world where soil degradation is the most severe;
5. The ELP to complete the drafting of the international instrument for the sustainable use of soils as soon as possible, including accompanying support and guideline materials for its effective implementation;
6. The ELP to take the appropriate steps to ensure that its initiatives for improved legal and institutional frameworks for sustainable soils continue to be addressed at international environmental and national environmental conferences.
7. The ELP and the IUCN Director General to work with relevant soil science organisations to promote endorsement of the instrument at State party level.

CONCLUSION

The papers prepared for this workshop cover a wide variety of themes, from the soil science, institutional and legal perspectives, and from many different jurisdictions. The perspectives and insights offered will need to be taken into account in redrafting the Soil Protocol in order to reflect the requirements of the soil science community, institutional imperatives and the limitations and opportunities of the international and national legal frameworks.

References

Boer, B.W, and I.D Hannam, 2003, 'Legal Aspects of Sustainable Soils; International and National,' *Review of European Community and International Environmental Law*, 12:2, 149.

Bridges, E.M., I.D., Hannam, L.R. Oldeman, F. Penning de Vries, S.J. Scherr, and S. Sombatpanit, 2002, (Eds)., *Response to Land Degradation*, Science Publishers, Inc, Enfield, (N.H), USA.

Council of Europe, European Conservation Strategy - Recommendations for the 6th European Ministerial Conference on the Environment (Council of Europe, 1990).

Gobat, J.M, M. Aragno and W. Matthey, 2003, *The Living Soil, Fundamentals of Soil Science and Soil Biology*, Science Publishers, Inc, Enfield, NH 03748, USA.

Grossman, M. and Brussaard, W., 1992, Eds., *Agrarian Land Law in the Western World*, CAB International, Wallingford.

Hannam, I.D and B.W. Boer, 2004, *Drafting Legislation for Sustainable use of Soils: A Guide*, IUCN, Gland Switzerland and Cambridge, UK, 100pp; PDF version http://www.iucn.org/themes/law/pdfdocuments/EPLP52EN.pdf

Hannam, I.D. and Boer, B.W., 2002, *Legal and Institutional Frameworks for Sustainable Soils: A Preliminary Report*, Environmental Law and Policy Paper No 45, IUCN Gland Switzerland and Cambridge, UK, and Bonn, Germany; PDF version: http://www.iucn.org/themes/law/pdfdocuments/EPLP45EN.pdf

Hurni, H and K. Meyer (Eds)., 2002, *A World Soils Agenda, Discussing International Actions for the Sustainable Use of Soils,* Prepared with the support of an international group of specialists of the IASUS Working Group of the International Union of Soil Sciences (IUSS), Centre for Development and Environment, Berne, 63p.

IUCN 2003, Subsidiary Body on Scientific, Technical and Technological Advice.

Penning, de Vries, F.; H. Acquay; D. Molden; S.J. Scherr; C. Valentin; and O. Cofie. 2002. *Integrated land and water management for food and environmental security*. Comprehensive Assessment Research Paper 1, Colombo, Sri Lanka: Comprehensive Assessment Secretariat.

Sheals, J.G., Ed., 1969, *The Soil Ecosystem*: Systematic Aspects of the Environment, Organisms and Communities, The Systematics Association, Publication No. 8, Staples Printers Ltd, London.

UN 2004, Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, *World Population Prospects: The 2004 Revision* and *World Urbanization Prospects; the predictions differ slightly according to the variants used; http://esa.un.org/unpp/p2k0data.asp /*

APPENDIX

World Conservation Congress Resolution 2004

"Legal Aspects of the Sustainable Use of Soils"

RES 3.072 Legal aspects of the sustainable use of soils

RECALLING that one of the objectives of the International Union for the Conservation of Nature and Natural Resources (IUCN) since its founding in 1948 was the establishment of laws and treaties for the protection of nature;

RECOGNIZING the important contributions made by IUCN since 1965 towards establishing the field of environmental law;

NOTING the significant and substantial work done by the IUCN Environmental Law Programme (ELP), through the Commission on Environmental Law's Specialist Group on Sustainable Use of Soil in implementing Resolution 2.59 Legal aspects of the sustainable use of soils adopted by the 2nd World Conservation Congress (Amman, 2000), in cooperation with the soil science community, for the improvement of environmental law and policy for the sustainable use of soils, particularly in regard to the ecological functions of soil for the conservation of biodiversity and the maintenance of human life, including:

(a) Publication of IUCN Environmental Policy and Law Paper (EPLP) No. 45 – Legal and

Institutional Frameworks for Sustainable Soils;

(b) Publication in 2004 of EPLP No. 52 – Drafting Legislation for Sustainable Soils: A Guide;

(c) Communicating widely the outcomes of the IUCN ELP Sustainable Use of Soil programme among the international environmental law and soil-science communities and receiving substantial support and encouragement for the introduction of a global instrument for the sustainable use of soil;

and

(d) Having undertaken the necessary preliminary investigation work to now proceed to the preparation of various options for an international instrument for the sustainable use of soil; and

ACKNOWLEDGING that a specific global environmental law instrument for the sustainable use of soils is now justified;

The World Conservation Congress at its 3rd Session in Bangkok, Thailand, 17–25 November 2004:

1. REQUESTS the IUCN Director General to work with IUCN members to prepare outlines of the various options for a global legal instrument for the sustainable use of soils, as set out in Section 5 of EPLP No. 45, to be considered for implementation by IUCN;

2. REQUESTS the IUCN Director General to continue the effective communication of the outcomes of the Sustainable Use of Soil programme among the environmental law and soil-science communities and to prepare further legal guidelines and explanatory material on the ecological needs of soil and their ecological functions for the conservation of biodiversity and the maintenance of human life, as necessary to support the introduction of a global instrument for sustainable use of soil; and

3. REQUESTS the IUCN Director General to continue efforts with interested and desirous countries for the development of national legislation for sustainable use of soil, in particular working with developing nations on the improvement and reform of their national soil legislation, contributing to institutional capacity building and assisting in the development of national environmental policy and strategies.

Note: The Department of State, United States, provided the following statement for the record: State and agency members of the United States voted against this motion.

Assessment and Monitoring of United States Soil Resources

Craig A. Ditzler* and Micheal L. Golden

United States Department of Agriculture, Natural Resources Conservation Service
craig.ditzler@lin.usda.gov, micheal.golden@wdc.usda.gov
*corresponding author

Introduction

This paper will briefly discuss the role of the USDA-Natural Resources Conservation Service in resource inventory and monitoring, and in assisting land owners to conserve the soil and other natural resources on the nation's non-federal lands. This is accomplished by utilizing the soil survey to provide information about the location and properties of the soil resources, the National Resources Inventory to assess the status and trends of the nation's non-federal lands, and with conservation programs passed by the Congress to provide technical and financial assistance to farmers, ranchers, and other land managers to protect and enhance their resources.

Soil Survey program – An inventory of the soils of the United States

The soil survey began in the United States in 1899 and continues today. Its legislative authorities include the Agricultural Appropriations Act of 1896 and subsequent laws passed by the Congress in 1903, 1928, 1935, and 1966. Taken together, these legislative actions direct the Secretary of Agriculture to:
1) Make an inventory of the soil resources of the United States;
2) Keep the soil survey relevant to ever-changing needs;
3) Interpret the information and make it available in a useful form; and
4) Promote the soil survey and provide technical assistance in its use (Soil Survey Division Strategic Plan, 2005, unpublished).

The soil survey program is lead by the Soil Survey Division of the Natural Resources Conservation Service (NRCS). The soil survey includes numerous partners by way of formal memoranda of understanding. These include other federal agencies such as the U.S. Forest Service, Bureau of Land Management, National Park Service, and Bureau of Indian Affairs, the Agricultural Experimentation Stations associated with the Land Grand University System, and numerous state and local agencies and organizations. This partnership is formally called the "National Cooperative Soil Survey" (NCSS). One of the hallmarks of the NCSS is a common set of standards for conducting soil surveys including Soil Taxonomy (Soil Survey Staff, 1999), the Soil Survey Manual (Soil Survey Division Staff, 1993), and the National Soil Survey Handbook (Natural Resources Conservation Service, 2005c), as well as a repository of over 20,000 official soil series descriptions that have been described, classified, and established for the nation (Soil Survey Staff, 2005). Information about soil properties and response to management can be transferred from one location to another where the same soil series is recognized, resulting in a powerful technology transfer mechanism.

There are approximately 3,300 soil survey areas in the United States. Most are between 100,000 and 200,000 hectares in size, but some, especially in remote areas such as Alaska wilderness, are much larger. About 857 million hectares (over 90 percent of the country) have a completed survey. With a cost of about $7.50 per hectare, the replacement value for the existing soil survey is about 6.4 thousand million dollars.

There remain about fifty million hectares of federally owned lands and twenty seven million hectares of non-federal lands that do not have a survey,

mostly in the western United States. Of the existing soil surveys, about one-third are more than thirty years old and another one-third are between twenty and thirty years old. These surveys, while very useful, do not meet all current needs and require varying levels of updating to reflect modern standards. In addition, existing soil surveys do not join perfectly with one another and so there is a large need to join the existing survey areas into a coordinated whole. Although completing soil survey for all as-yet unmapped lands is a priority, the approximately 550 field soil scientists of the NCSS are increasingly involved with modernizing, coordinating, and interpreting existing surveys rather than creating new ones.

Modern soil surveys consist of several parts. There are maps showing the location of the soils. The most common map scales are 1:24,000 and 1:12,000, but smaller scales are used in remote areas where less detail is required. Orthophotgraphic coverage is available for virtually the entire country and these images are used as a base map so users can easily orient to their location on the ground. In addition to the maps there are descriptions of the soil map units, an extensive database of measured and estimated soil property data and interpretations for multiple uses including cropland suitability, building site development, forest management, wildlife habitat, recreational use, and others. Soil surveys and related data are considered public domain and are available free of charge in printed form as well as on-line at: http://soils.usda.gov/survey.

Having a detailed soil inventory covering virtually every hectare of the nation with maps, data, and interpretive information is a major achievement equaled by few others. As important as the soil survey maps and data are to land managers and decision makers in conserving and enhancing the nation's natural resources, it is just one part of what is necessary for an effective national conservation program.

Resource Condition Assessment

Policy makers need an unbiased assessment of the nation's resources in order to identify important problems and make decisions for allocating limited funding to address resource issues. In the 1930's we learned through the terrible experience of the dust bowl that many of our lands were fragile and required conservation practices to hold the soil in place and protect it from wind and water erosion. From that experience the U.S. Soil Conservation Service (now Natural Resources Conservation Service) was born (Economics and Social Sciences Division, 1992). The United States Congress has since directed the NRCS to assess and monitor the state of the nation's resources on non-federal lands on a regular basis. The National Resources Inventory (NRI) is used to accomplish this mission.

The NRI is a scientifically based, longitudinal panel survey of the soil, water, and related resources of the non-federal lands of the United States. It was designed in close collaboration with the staff at the Iowa State University Center for Survey Statistics and Methodology (http://cssm.iastate.edu/). It allows resource managers, policy makers, and the public to see and assess conditions and trends in 5 year increments. It is used to develop effective public policies, fashion legislation, design conservation programs, assist in targeting financial and technical assistance, and to improve the public's understanding of resource issues. Results of the inventory indicate how the nation's non-federal lands are used, their current condition, and how land use patterns have changed over time.

The NRI uses a two-stage stratified area sampling design (Nusser et. al., 1998; Nusser and Goebel, 1997; Goebel, 1998). The first stage consists of about 300,000 area-based primary sampling units (PSU), mostly about 65 hectares in size. Data about overall conditions within the PSU are recorded such as the area of farmsteads or urban land, extent of water bodies, climate factors, and categories of ownership. The second stage consists of specific points located within the PSU. There are about 800,000 sample points. Specific data for

conditions at the point are recorded, including conservation practices applied, land cover/use, wetland classification, habitat distances, parameters for modeling erosion, cropping history, and others. In addition, each point is identified as a particular soil series and is thereby linked to the data contained in the soil survey database. Modern inventories were completed in 1982, 1987, 1992, 1997, and 2003.

The following four examples, adapted from Natural Resources Conservation Service, (2005b), illustrate how the NRI is used. Figure 1 shows estimates of land use on non-federal lands. Forest and Range Lands together make up nearly 56 percent of the non-federal lands. Cropland is next at 25 percent. Conservation Reserve Program lands (13.2 million hectares) are those the government has paid producers to take

Figure 1. Landuse, Non-federal Lands, 1997. (Hectares x 10^6; and percent)

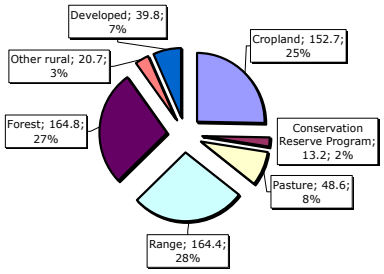
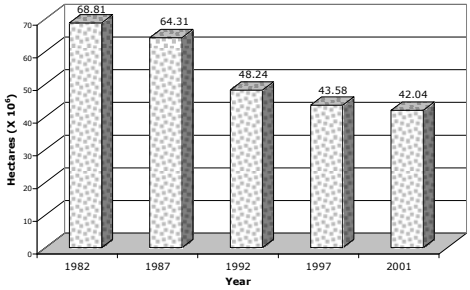


Figure 2. Cropland With Unsustainably High Erosion Rates



out of production due to their highly erosive nature. Figure 2 shows how the number of hectares of land subject to unsustainably high erosion rates has been reduced during the period 1982 to 2001. This was in response to the 1985 Farm Bill which, among things, required farmers to control erosion of "highly erodable lands" to remain eligible to participate in other farm programs. Significant reductions were achieved, but it appears that little additional progress may have been made since about 1997. Based on these data there remain about 42 million hectares of US cropland that continue to erode at high rates.

Figures 3 and 4 illustrate a more complex analysis. Figure 3 contrasts the change in palustrine and estuarine wetlands in the southeast USA with changes in

Figure 3. Combined Palustrine and Estuarine Wetland Change 1992 - 1997

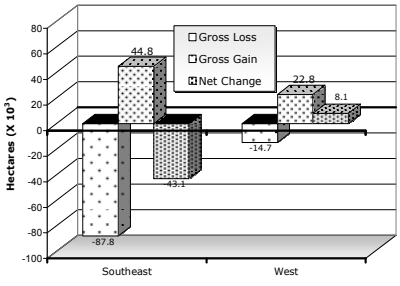
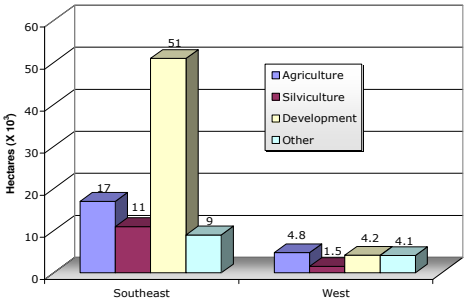


Figure 4. Resons for Wetland Losses



those same wetland categories in the west for the period 1992 to 1997. The southeast had the largest net loss of wetlands in the USA. An estimated 88 million hectares were lost while about 45 million hectares were restored through government programs, for a net overall loss of about 43 million hectares. The western region, while losing an estimated 15 million hectares, gained about 23 million, for a net gain of about 8 million hectares. Figure 4 shows what type of land conversions contributed to the loss of these wetlands in each region. For the

southeast, more than half (about 51 million hectares) were converted for development purposes such as homes and shopping centers. Lesser amounts went to agriculture, silviculture, and "other" uses. In the west, wetland losses were about evenly caused by conversion to agriculture, development, and "other" uses, with a small amount converted to silviculture. This kind of information can be a valuable aid to policy makers in assessing the success of programs like the Wetland Reserve program and in targeting future efforts.

Conservation Programs to Address Resource Needs

Having a soil survey and an unbiased assessment of resource conditions and trends is still not enough for effective conservation. A vehicle is needed to allocate funding and provide technical assistance to address the problems. Conservation programs provide technical and financial assistance to help people reduce soil erosion, enhance water supplies, improve water quality, enhance fish and wildlife habitat, restore and conserve wetlands, improve woodlands, and reduce damages caused by floods and other natural disasters. In 2005, over 1.5 thousand million dollars has been allocated through USDA-NRCS for technical and financial assistance for conservation programs of various kinds. A few of the major programs are briefly described here.

Conservation Technical Assistance (CTA)

The CTA program provides the infrastructure for delivery of science-based conservation technology and tools. CTA funding supports the cadre of professional conservationists headquartered in nearly 3000 field offices providing assistance to locally organized conservation districts throughout the United States. CTA does not provide direct financial assistance to program participants, but rather provides technical assistance in the form of solving natural resource problems on non-federal lands through conservation planning and implementation. It also supports the development and maintenance of science-based technical standards and tools such as computer models, databases, and technical handbooks.

The Chief of the NRCS establishes priorities to focus CTA efforts on specific objectives. For 2005, the priorities are focused on helping farmers and ranchers comply with environmental regulations by developing comprehensive nutrient management plans, reducing non-point source pollution, reducing emissions that impair air quality, reducing soil erosion, and enhancing habitat for at-risk species. Many technical resources are available for the conservation professional to use in providing technical assistance to achieve these objectives. Two important resources that form the foundation of the technical assistance program are the *Field Office Technical Guide* (Natural Resources Conservation Service, 2005a), and the *National Planning Procedures Handbook* (Natural Resources Conservation Service, 2003).

Each of the nearly 3,000 NRCS field offices have a technical guide containing information about the conservation of soil, water, air, plant, and animal resources. Each technical guide is tailored to reflect the local conditions where it is used, but all meet national standards. The Technical Guide consists of five sections. 1) General References including maps, estimated conservation costs, information on laws and regulations, cultural resources, protected plant and animal species, and other general information. 2) Soil and Site Information, including detailed information about soil, water, air, plant, and animal resources of the area. The local soil survey is included here. 3) Conservation Management Systems, including information on quality criteria for resource conditions that will provide for sustainable use. 4) Practice Standards and Specifications for all conservation practices. 5) Information describing expected effects of each conservation practice on the identified resource concern.

The National Planning Procedures Handbook provides a framework for the conservation professional to use in developing, implementing, and evaluating conservation plans that are of consistently high quality across the nation. It is a three-phase, nine-step process. Phase 1 "Collection and Analysis" is used to understand the problems and opportunities presented by the specific resource concern. This phase consists of the first four steps of the planning process; 1) identify problems and opportunities, 2) determine objectives, 3) inventory resources, and 4) analyze resource data. Phase 2 "Decision Support" is used to understand the potential solutions to the problem. It contains the next three steps of the planning process; 5) formulate alternatives, 6) evaluate alternatives, and 7) make decisions. Phase 3 "Application and Evaluation" involves understanding the results. It consists of the final two steps of the planning process; 8) implement the plan, and 9) evaluate the plan's achievements.

Conservation plans developed through the CTA program may serve as the basis for participating in other programs that provide financial assistance to clients in achieving resource management goals. Some of those programs are described next.

Conservation Security Program (CSP).

The CSP provides payments to reward farmers and ranchers who protect and enhance soil, water, air, plant, animal, and other resources. Eligible practices include crop rotations, cover crops, conservation tillage, prescribed grazing, protection from wind erosion, filter strips, grassed waterways, restricting cattle access to streams, nutrient and pest management, and irrigation water management. The program provides equitable access to benefits throughout the United States regardless of size of operation or kinds of crops produced.

A three-tier system is used to determine payment levels. Tier 1 requires producers to address soil and water quality to a minimum treatment level on part of their operation. Contracts run for a maximum of 5 years and are limited to a payment of no more than $20,000 per year. Participants who meet minimum soil and water requirements on their entire operation and agree to address one additional resource concern are eligible for participation at the tier 2 level. Contracts run from 5-10 years with a maximum payment of $35,000 per year. To participate at the tier 3 level, the participant must have addressed all identified resource concerns to a "resource management system" level as described in the NRCS Field Office Technical Guide. Contracts run from 5-10 years and payments cannot exceed $45,000 per year.

In 2005, USDA expects to enter into contracts with about 12,700 producers, covering about 3.6 million hectares, costing about 202 million dollars. Over the life of the contracts, the total cost will be about 1 thousand million dollars. Because total funding is limited, the program is targeted to specific watersheds in any particular year. Of the 2119 watersheds covering the nation, producers residing in 220 of them are eligible to compete for benefits in 2005. This approach targets watersheds with the most pressing resource concerns first, thus focusing funding more effectively in priority areas. It is expected that over an 8 year period, producers in all watersheds will have an opportunity to compete for program benefits. The actual number of selected participants in any year depends on the level of funding provided by Congress. The CSP is designed to "reward the best and motivate the rest."

Environmental Quality Incentives Program (EQIP).

EQIP provides incentive payments, including cost-share of up to 75% for conservation practices. Payments may be provided for up to 3 years to encourage participants to implement conservation practices they would not normally adopt without financial incentive. This program addresses priority resource concerns

identified by local conservation districts. High priority is given to meeting water quality objectives with practices such as manure management systems, pest management, and erosion control. A conservation plan is developed in cooperation with the participant that meets NRCS technical standards. In 2005, nearly 1 thousand million dollars have been allocated across the country for EQIP.

Wetland Reserve Program (WRP).

WRP provides both technical and financial assistance to restore, enhance, and protect wetlands. The goal is to achieve the greatest wetland functions and values and to improve wildlife habitat. Congress sets goals each year in the form of number of hectares to protect, rather than total dollars. Goals in 2005 are to restore and protect about 16,200 hectares. Landowners apply for inclusion in the program, and the NRCS and local officials use a ranking system based on cost and ecological benefits to determine which projects to fund. The NRCS works with other non-governmental conservation groups such as Ducks Unlimited, California Waterfowl Association, and the Nature Conservancy to deliver this program. Depending on the specifics of the project, financial assistance ranges from a simple payment of up to 75 percent of the restoration costs in return for maintaining the wetland for a minimum of 10 years; up to a payment of 100 percent of the restoration costs as well as a payment for a permanent property easement to ensure that the land remains a wetland. Typical projects are about 70 hectares with a cost of about $3,500 per hectare for restoration and easement acquisition.

Other conservation programs that can be used to provide assistance in implementing conservation plans include the Conservation Reserve Program, Grazing Lands conservation initiative, Wildlife Habitat Incentives Program, as well as others. Information on these and other conservation programs administered by NRCS is available on-line at http://www.nrcs.usda.gov/programs/.

Assessment of Conservation Program Effectiveness

It is important to assess the effectiveness of conservation programs in achieving their stated goals. In the United States there is a significant body of evidence, both anecdotal and published in the literature, regarding the benefits of conservation practices at the field scale. Few attempts have been made to quantify the environmental benefits at the national scale (Mausbach and Dedrick, 2004). For example, we know that installing vegetated buffers between cropland and adjoining water bodies has a beneficial impact on water quality, but we have not quantified the effectiveness of the many kilometers of buffers installed on the nation's farmlands in recent years. In response to demands by policy makers and the public to demonstrate results, we are beginning a new assessment program known as the Conservation Effects Assessment Project (CEAP).

CEAP will assess the environmental benefits of conservation programs on agricultural lands at both national and watershed scales. The results will allow policy makers to assess the effectiveness of these programs in meeting stated goals of environmental protection and enhancement. CEAP is a cooperative project between the Natural Resources conservation Service and the Agricultural Research Service. CEAP was begun in 2004. It will integrate data collection, model development, model application, and research with an additional goal of developing the necessary databases and applications to monitor key indicators and performance measures to document the effectiveness of conservation programs. (Mausbach and Dedrick, 2004). This program is in the early stages of reviewing the existing literature, documenting what is known now, identifying further research needs, and establishing the scientific underpinning for the assessment. It will take about 5 years to carry out.

CEAP has two components. First, it will use the NRI framework to obtain about 30,000 cropland sample points for simulation model analysis, and farmer surveys to obtain additional information about the sample points such as crops grown, tillage practices, and nutrient and pesticide applications. Multiple physical process models will be used in combination to estimate effects. EPIC (erosion-productivity impact calculator) models the fate and transport of nitrogen, phosphorous, sediment, salt, and pesticides through the soil to the bottom of the root zone and as surface movement to the edge of the field. The EPIC results will be coupled with the HUMUS (hydrologic unit modeling for the United States), and SWAT (soil and water assessment tool) models to simulate transport of water from the land to receiving water bodies and eventual downstream flow to estimate in-stream concentrations of nutrients and sediments. Benefits will be described by measures such as tons of soil saved from erosion or reductions of in-stream sediment or nutrient loads.

The second component of CEAP will utilize twenty watersheds throughout the country to quantify environmental benefits of specific conservation practices at the watershed-scale. Specific concerns targeted are nutrient management, pest management, tillage systems, irrigation water use, drainage management, wetland protection and restoration, and wildlife habitat and riparian restoration. These studies will help to refine and validate the models used to estimate effects. The first annual report documenting environmental benefits is expected in 2006.

Conclusions

Effective protection and enhancement of natural resources on the private working lands of the United States relies on a multifaceted approach. Basic information about soil resources has been gathered over a period of more than 100 years through the Soil Survey. This inventory shows the location of the more than 20,000 series recognized in the USA and provides basic soil property data needed to properly design conservation systems to fit the characteristics of the land as well as to drive models to estimate erosion, pesticide leaching, and other dynamics. The National Resources Inventory provides an unbiased time series of the status and trends of the nation's resources, and is also in the initial stages of being used to quantify the environmental benefits of conservation programs. Congress, as well as state and local governments address conservation needs by fashioning programs to provide both technical and financial assistance to farmers, ranchers, and other land managers to design and implement conservation plans. An additional remarkable feature of the US conservation effort is that this is mostly accomplished not by mandatory regulations, but rather through voluntary programs that depend in large part on the continued ethic of good land stewardship that is common to the American farmer and rancher.

References

Economics and Social Sciences Division. (1992) Readings in the History of the Soil Conservation Service. Historical Notes No. 1. Soil Conservation Service, Washington, DC. on-line (in 5 parts) at: http://www.nrcs.usda.gov/about/history/articles/

Goebel, J. J. (1998) "The National Resources Inventory and Its Role in U.S. Agriculture," "Agricultural Statistics 2000", Proceedings of the conference on agricultural statistics organized by the National Agricultural Statistics Service of the US Department of Agriculture, under the auspices of the International Statistical Institute. On-line at: http://www.nrcs.usda.gov/technical/NRI/1997/stat_design.html.

Mausbach, M. J. and A. R. Dedrick (2004). The length we go: Measuring environmental benefits of conservation practices. Journal of Soil and Water Conservation, 59:(5) 96A-103A. Online at: http://www.nrcs.usda.gov/technical/nri/ceap/

Natural Resources Conservation Service (2003). National Planning Procedures Handbook (NPPH), Amendment 4. Online at: http://policy.nrcs.usda.gov/scripts/lpsiis.dll/H/H_180_600.htm

Natural Resources Conservation Service (2005a). Electronic Field Office Technical Guide. Online at: http://www.nrcs.usda.gov/technical/efotg/

Natural Resources Conservation Service (2005b). National Resources Inventory. Online at: http://www.nrcs.usda.goc/technical/NRI

Natural Resources Conservation Service (2005c). National Soil Survey Handbook. Online at: http://soils.usda.gov/technical/handbook/

Nusser, S. M., F. J. Breidt, and W. A. Fuller (1998) "Design and Estimation for Investigating the Dynamics of Natural Resources," Ecological Applications, 8(2):234-245. On-line at http://www.nrcs.usda.gov/technical/NRI/1997/stat_design.html

Nusser, S. M., and J. J. Goebel (1997) "The National Resources Inventory: A Long-Term Multi-Resource Monitoring Programme," Environmental and Ecological Statistics, 4(3):181- 204. On-line at http://www.nrcs.usda.gov/technical/NRI/1997/stat_design.html

Soil Survey Division Staff. (1993). Soil Survey Manual. Agr. Hndbk. No. 18. Government Printing Office, Washington, DC. Online at: http://soils.usda.gov/technical/manual/

Soil Survey Staff. (1999). Soil Taxonomy: A Basic System of Soil Classification for Making and Interpreting Soil Surveys. Agr. Hndbk. No. 436. Government Printing Office, Washington, DC. On-line at: http://soils.usda.gov/technical/classification/

Soil Survey Staff. (2005). Soil Classification File Database. Online at: http://soils.usda.gov/technical/classification/scfile/

Iceland

Land Degradation and Desertification in Iceland

Olafur Arnalds

Agricultural University of Iceland, oa@lbhi.is

Introduction

Soil erosion and land degradation are active processes in Iceland, resulting in severely damaged ecosystems, barren deserts, and an unstable soil environment. Soil erosion has been surveyed in all of Iceland, and the resulting database is a unique tool for land use decisions. The extensive degradation and desertification in sub-arctic and mostly humid Iceland provides an interesting conceptual perspective on the term deserts and desertification. The following text draws from already published papers on land degradation and desertification in Iceland, especially chapter on Iceland in the forthcoming book "Soil Erosion in Europe" (ed. by Boardman and Poesen). A list other relevant publications is presented on www.rala.is/desert and in the reference list below.

Background

Iceland is located on the active North-Atlantic Rift Zone. It is about 103 000 km^2 in area. Its northerly oceanic location, strongly influenced by the Gulf Stream, results in a cold temperate to sub-arctic climate with frequent freeze-thaw cycles. Precipitation generally varies between 600 and 1500 mm per year in lowland areas, but large tracts of Northeast Iceland receive less than 600 mm. However, summer months are few (3-6) and much of the precipitation falls as snow in winter in North Iceland and in highlands, but winter thaw is common, especially in the southern part. Mountain ranges extend to the shoreline in many areas, but lowland areas are situated along the coastline and river plains.

Classified satellite images (LMI, 1993) show that land with relatively continuous vegetation covers about 28 500 km^2, but an additional 23 900 km^2 has less continuous or non-productive plant cover (total of 52 400 km^2 of land with some vegetation to continuous vegetation). More than 37 000 km^2 is barren desert, some of which has formed after the settlement (874 AD).

The vegetation composition of rangelands reflects grazing by sheep, with species tolerant to grazing dominating most communities, such as small woody species and sedges. Birch woodlands used to cover a large proportion of the country but are now only about 1% (Aradottir and Arnalds, 2001). The barren surfaces are often sandy, consisting of volcanic glass and crystalline materials that are basaltic, coloring the surfaces dark or black. Almost all of Iceland was covered with glaciers during the Quaternary glacial period, but at the present time glaciers cover about 11 300 km^2 (LMI, 1993).

Soils

The formation of Icelandic soils is influenced by a steady flux of eolian materials which originate from unstable desert surfaces. The rate of deposition commonly varies between 0.01 and 1 mm yr^{-1}, depending on distance from eolian sources. These materials are primarily vitric in nature (volcanic glass). In addition, most regions are subjected to periodic ash-fall events during volcanic eruptions. The thickness of each layer is also quite variable, often 1-30 mm. Undisturbed soils of Iceland are primarily Andosols (Arnalds, 2004), which are soils that form in volcanic parent materials.

Soil drainage is also an important factor influencing Icelandic soils. Water permeability is rapid within the volcanic belt resulting in freely drained soils. Permeability is slower in the rock strata outside the belt of volcanic activity. This results in > 22 000 km^2 of wetland soils which are chiefly Andosols, but Histosols (organic soils) are uncommon in spite of the sub-arctic climate because of the eolian and tephra deposition which lower the organic content of the wetland soils.

The soils of Icelandic deserts are termed Vitrisols (Arnalds, 2004). They consist of coarse grained tephra materials, chiefly volcanic glass, but also varying amounts of clay minerals and some organic matter.

The properties of the Andosols are important in relation to the extensive erosion that takes place in Iceland. The soils are characterized by poorly crystalline clay minerals such as allophane and ferrihydrite, metal-humus complexes and considerable organic content. They are very friable and lack cohesion which is usually provided by phyllosilicates in other soil types and many Icelandic soils exhibit tixotrophic characteristics. These characteristics make the soils susceptible to erosion by water and slope failures.

Soil Erosion Assessment

A National Soil Erosion Assessment was completed in 1997 and published in 'Soil Erosion in Iceland' (Arnalds et al., printed in English in 2001). The book includes both tables and maps for all of Iceland, regions, counties, municipalities and for communal grazing areas. The results are stored in a GIS database which includes about 18 000 polygons with information about erosion types and severity. The project was awarded the Nordic 'Nature and Environmental Award' in 1998.

Erosion in Iceland occurs on rangelands. Erosion associated with cultivated land is limited in extent. A distinction has to be made between erosion on desert areas, which lack vegetation cover for protection, and erosion associated with Andosols and vegetated ecosystems. A major characteristic of erosion of Andosols is that the entire soil mantle, often 50-150 cm thick, is removed by erosion processes, leaving the barren Vitrisol surface behind. Erosion on deserts follows more conventional patterns, both by wind and water, but frost activity (blocking infiltration) and needle ice formation also play a major role.

The assessment was carried out in the field at the scale of 1:100 000.

Erosion

The soil erosion survey was based on erosion forms, with a view on site-specific differences (Table 1). It is partly based on geomorphology.

Of the erosion forms, '*Rofabards*' are perhaps the most distinctive (see also Arnalds, 2000). They are escarpments that range from about 20 cm to >3 m in height. *Advancing fronts* (encroaching sand) are active tongue-shaped sandy surfaces extending into vegetated areas. Sand fronts move into the vegetated land as continuous flux of sand abrades the Andosol mantle and finally the new surface may be 1-2 m lower than the original surface. The advancing fronts are a major problem that threatens fully vegetated systems, and they can advance over 300 m in a single year. Encroaching sand has desertified large areas in South and North-east Iceland, especially during the last part of the 19th century. *Isolated spots* are small bare patches in otherwise vegetated land. They are usually associated with hummocks, and are often a clear sign of overgrazing when they occur in lowland areas. *Solifluction* is active on most slopes, and where those features are most pronounced (lobes and terraces), the danger of landslides is greater when isolated spots are dotting the landscape.
Landslides are very common, hence the lack of stability of Icelandic Andosols.

Table 1. The Icelandic erosion classification system (erosion forms).

Erosion forms associated with erosion of Andosols/Histosols	Desert erosion forms (Vitrisols)
Rofabards	Melar (lag gravel, till surfaces)
Advancing erosion fronts (sand encroachment)	Lavafield surfaces
	Sandur (bare sand, sand sources)
Isolated spots	
	Sandy lava fields
Isolated spots and solifluction features on slopes	Sandy melar (sandy lag gravel)
Water channels	Scree slopes
Landslides	Andosol remnants

Deserts are divided into seven erosion forms based on geomorphology and stability of the surface. '*Melur'* (glacial till or lag gravel surfaces) are usually surfaces that have lost their Andosol mantle because of erosion processes, but also occur at the margins of receding glaciers. The surface of melur is subjected to erosion by wind and water, and intense cryoturbation processes. *Lavas* are sparsely vegetated rock surfaces of the Holocene lavas that lack Andosol cover. Most often they are recent (< 1000 yr) or denuded surfaces by erosion processes. There is little erosion taking place on the lavas. *Scree slopes* are very common in mountainous areas. Many of these slopes may have been previously vegetated. Gravitational and water erosion processes are active on the slopes.

'Sandur'. The black basaltic desert sand-flats of Iceland are unique on a global scale. They are mostly formed by glacio-fluvial processes, during floods in glacial rivers or where glacial waters disappear into porous bedrock, leaving the sediments on the surface. Some of the sand-flats have been formed by flow of eolian materials from these sources. Sandur also includes sediments deposited during volcanic eruptions. These surfaces are extremely unstable and are subjected to severe and often quite spectacular wind erosion events. The sandy areas of Iceland were reviewed by Arnalds et al. (2001). The sandy materials are often moved by wind erosion and deposited over various desert surfaces. Two sandur surfaces represent such conditions: the *sandy melur* and the *sandy lavas*.

The severity of erosion in Iceland

The severity scale has a direct reference to land use decisions (Table 2). A policy statement by the Agricultural Research Institute and the Soil Conservation Service is built into the scale: no restrictions because of erosion are suggested for areas receiving low severity classes (0-2), but areas designated with erosion severity classes 4 and 5 are not considered suitable for grazing. Areas with erosion class 3 need further consideration and usually improvement. If such an area is a desert, it should not be grazed. The decision that grazing of Icelandic deserts is not acceptable land use has been thoroughly explained in several documents (see Arnalds and Barkarsson, 2003).

Areas with severe and very severe erosion, which may be considered erosion hotspots in an European context, occur on about 17% of Iceland. Considerable (severity class 3) occurs on 22% of Iceland and therefore erosion can be considered a substantial problem on 40% of Iceland (classes 3-5), or

about half of the country when glaciers, water bodies and high mountains are excluded.

Table 2. Erosion severity classes and land use policy of the Agricultural Research Institute and the Soil Conservation Service related to each class.

Erosion Class		Suggestions regarding grazing
0	No erosion	No suggestion
1	Little	No suggestion
2	Slight	Care needed
3	Considerable	Reduce or manage grazing
4	Severe	Protect – no grazing
5	Very severe	Protect – no grazing

Desertification in Iceland?

Is there desertification in Iceland? This of course depends on how desertification is perceived. If it is considered as a severe degradation, ultimately leading to near barren, unproductive areas, then desertification is a major problem in Iceland. The original meaning of the word desert is desolate or deserted (see Arnalds, 2000b). It is argued that climatic restrictions on the term are very questionable, and the Icelandic conditions demonstrate that well. Many of Icelandic desertified areas are rather dry (400-600 mm yr^{-1}). But these areas have a short summer and the water in the soil is frozen much of the year. Furthermore: when fertile Andosols are present, moisture shortage is rarely a problem, even in the driest areas. After erosion has stripped the surface of good soils, water shortage becomes acute, even in areas receiving >1000 mm rainfall (lack of water holding capacity, and the black surface gets warm in sunshine). In addition, other stress factors, such as instability of the surface, and damaging frost effects, are even more detrimental than lack of moisture, both in dry and wet conditions. A holistic ecosystem approach to the problem would not limit the stress factors that contribute to severe land degradation to single one (rainfall, evapo-transpiration).

Conclusions

Erosion is perhaps more active in Iceland than in any other European country. Natural conditions, the combined effect of such factors as fragile soils, volcanic activity, heavy land use, and harsh climate, differs from conditions in other parts of Europe, resulting in different erosion processes and landforms. The Icelandic National Soil Erosion Assessment is an example of country specific methodology designed for local conditions and objectives. The assessment places Iceland in different situation than most other European countries, with a detailed coverage of the erosion problems in the country. This view is based on field survey, but not on modeling of erosion/erosion risk or by assessment of erosion in parts of the country.

A complete soil erosion assessment has lead to important changes in how society deals with the problems. Debates about the nature and extent of the problem have changed and the present discussion focuses more on solutions. Important steps towards more sustainable use of range resources in Iceland have recently been taken, partly as a result of the erosion assessment. Its methodology is now used on a regular basis for land assessment on farmland.

Lack of erosion assessment should not, however, prevent development of laws for prohibiting land use that causes soil erosion. This and the facilitation of

programs such as land-care or participatory projects that increase land literacy and stewardship are both equally as important venues for securing sustainable land use, and both should be carried out.

References

Aradottir, A.L, and Arnalds, O., 2001. Ecosystem degradation and restoration of birch woodlands in Iceland. In Nordic Mountain Birch Ecosystems. Man and the Biosphere Series 27. Wielgolaski FE (ed). Parthenon Publishing, New York, USA. pp. 293-306.

Arnalds O. (2000a). The Icelandic 'rofabard' soil erosion features. Earth Surface Processes and Landforms 25, 17-28.

Arnalds, O. (2000b). Desertification: an appeal for a broader perspective. In Arnalds, O. and Archer, S. (eds), Rangeland Desertification. Kluwer Academic Press, Dordrecht, the Netherlands. pp 5-15.

Arnalds, O. and Barkarsson, B. (2003). Soil erosion and land use policy in Iceland in relation to sheep grazing and government subsidies. Environmental Science and Policy 6,105-113.

Arnalds O. (2004). Volcanic soils of Iceland. Catena 56, 3-10.

Arnalds O, Hallmark, C.T., and Wilding, L.P. 1995. Andisols from four different regions of Iceland. Soil Science Society of America Journal 59, 161-169.

Arnalds O., Gisladottir F.O., and Sigurjonsson, H. (2001). Sandy deserts of Iceland: an overview. Journal of Arid Environments 47, 359-371.

Arnalds, O., Thorarinsdottir, E.F., Metusalemsson, S., Jonsson, A., Gretarsson, E., Arnason, A. (2001). Soil Erosion in Iceland. The Soil Conservation Service and Agricultural Research Institute, Reykjavik, Iceland. Translated from Icelandic version (published in 1997).

LMI. 1993. Digital vegetation index map of Iceland. National Land Survey of Iceland: Akranes, Iceland.

A century of soil conservation in Iceland

Andres Arnalds and Sveinn Runolfsson

Soil Conservation Service, Gunnarsholt, 851 Hella, Iceland.
andres@land.is, sveinn@land.is

Introduction

The 1100 years of human settlement in Iceland are characterized by severe ecosystem degeneration and subsequent soil erosion. Organized efforts to halt the land degradation and desertification began in 1907 with a national "law on forestry and preventing soil erosion". There are many important lessons to be drawn from the history of land use in Iceland and the almost century of successes and failures in soil conservation and healing the land.

The first decades of soil conservation work in Iceland may be characterized by top-down approaches dealing with single-issue and localized problems. Although the most threatening erosion fronts and advancing sand dunes were halted, not enough was being attained on a national scale. Subsequent work illustrates the importance of creating the right blend of incentives and disincentives for caring for the land. This has to be based on an analysis of the health of the land, the underlying reasons for land degradation and means to overcome the barriers to better land management.

Among main tools in combating the problems of land degradation and desertification and restoring land health are attaining sustainable land use; increasing knowledge of problems and solutions; educating and advising; enhancing land user responsibility; improving legislation; and encouraging wide ranging participation. Carbon sequestration as a tool in meeting Iceland's obligations under the Kyoto Protocol has also become an incentive for restoring land health.

Desertification in a humid environment

The nakedness of many parts of Iceland may be regarded as one of its most striking features. Most of this reflects ecosystem damage, and a large proportion of the deserts may have been created during the last millennium by the interaction between unsustainable land use and natural forces in a sensitive environment.

Iceland is located just below the Arctic Circle, on the Mid-Atlantic ridge. It has a land area of 103 000 km2 and a human population of 290 000. The climate is cold temperate to alpine, with monthly mean temperatures in the south ranging from around -1° to +11°C. Rain is ample for vegetation growth in most parts of the country.

Iceland was settled by Scandinavian Vikings around AD 874. They came to a vacant country, although some Irish monks may have dwelt there. The Saga period, the first few centuries of settlement, was a time of prosperity. The foundation for the initial wealth of the Icelanders was the fertility of the land. Up to two-thirds of the country may have been vegetated, and at least 25% of the area was covered with woodlands, mostly birch (Betula pubescens) (Aradottir and Arnalds 2001).

There are several indications that land decline was greatly accelerated by the settlement. The woodlands were cut for fuel and timber, or burned to provide space for agriculture and grazing. Regeneration was hampered by heavy grazing, and the woodlands receded. With the reduction in woodland cover, sensitive soils lost their shelter. Unsustainable land use, interacting with frequent volcanic

eruptions and climatic fluctuations, marked the beginning of dramatic ecosystem destruction, a process that has continued to the present (Arnalds 2004).

For the first 1000 years of inhabitation, Iceland was almost entirely a country of self-subsistence, to a large extent founded on hay- and grazing-based livestock production in a harsh environment. Woods and shrubs were extensively cut for fuel. The ecosystems were vulnerable to land use pressures following settlement, interacting with natural forces. Ecological capacity was exceeded and catastrophic soil erosion and desertification has devastated large parts of the country. About half of the vegetative cover may have been lost, implying that about 3 million hectares have become eroded. Only 1% of the area of Iceland is covered by woodlands, compared with at least 25% originally. Much of remaining vegetation is severely degraded. Biological diversity has also been greatly reduced, land fertility diminished, hydrology altered and microclimates changed.

A national survey of the nature and extent of soil erosion was completed in 1997, revealing that serious soil erosion characterizes about 40% of Iceland (Arnalds et al. 2001). Immense amounts of soil and organic carbon – the foundation of land fertility – have been lost.

Lessons from the past

The severity of land degradation in Iceland prompted in 1907 the establishment of Northern Europe's only designated, and possibly the world's oldest, Soil Conservation Service (SCS) (Runolfsson 1978, 1987). The Forestry Service, originally established by the same law as the SCS, had the role of combating the destruction of woodlands in Iceland and overseeing the task of reforestation.

In the almost 100 years of soil conservation in Iceland, much has been achieved in the battle against soil erosion, despite limited resources for most of this time. The first sixty years were almost entirely devoted to the urgent task of halting sand dune advance and other forms of catastrophic soil erosion in pastures and rangelands that left barren deserts behind and threatened the existence of several communities. This work was mainly conducted by fencing and seeding the native sand stabilizer, Leymus arenarius (Runolfsson 1987). With more availability of fertilizers and better equipment around 1950, revegetation of some of the vast areas of denuded land slowly began. Emphasis on grazing management and other preventive measures emerged still later.

The fight against the rapidly encroaching sand dunes was highly successful. However, on a national scale, not enough has been achieved in the battle against desertification and in restoration of lost resources. The conservation work has been limited only to selected parts of the country, the areas with the most severe problems. Only a fraction of the affected areas have been treated and precious soil and vegetation is still being lost through erosion.

It is not only in Iceland that soil conservation programmes of the past have not been effective enough in attaining their overall goals. A part of the explanation may be universal in nature, as the same strategy and organizational mistakes have been seen in many other, widely differing, countries, e.g. the top-down approach, lack of local involvement and "curing symptoms but not the causes" (Douglas 1996; Sanders 2000; Hannam 2000).

In general terms, lack of incentives for land user participation and more sustainable land use characterized the first 80 years of SCS activities. Project planning and implementation was commonly undertaken by SCS staff members, using agency machinery, and there was very limited local involvement. Land users were not held responsible for the effects their actions had on the land. Over time, this led to a conceptual problem of "ownership" and a low level of conservation awareness and ethics. As a consequence, soil erosion came to be regarded as the responsibility of government, but not the responsibility of the land users or of others living in the affected areas.

Early work focused only on halting localized erosion. In most cases, only the symptoms of degradation were dealt with, not the actual causes, such as improper and gradually intensifying use of sensitive soils. Off-site effects were generally neglected, and there were few incentives to protect land on a wider scale. This aggravated the "problem of problem ownership" syndrome, and, until recently, there were many blocks to the development of conservation awareness.

Since 1990 there has been an increasingly participatory approach to soil conservation, which has markedly increased the adoption and success of conservation projects (Arnalds 1999). Furthermore, this period has seen an increasing shift away from localized single-issue soil conservation, towards ecosystem management for multiple uses, with more holistic and integrated approaches for land husbandry.

How to care for the land?

It has become increasingly clear that a comprehensive framework is required in order to prevent further damage to Iceland's ecosystems and to restore lost resources. Such a framework must be based on clear, long-term goals and a broad range of views; harmonizing all laws that can affect land use and condition; integrating a wide range of supporting factors such as planning, research, extension and education; and searching for incentives that also stimulate knowledge, awareness and conservation ethics. International conventions and agreements can provide important guidelines.

In 2002, the Parliament of Iceland decided on a comprehensive programme that gives SCS an operational framework for the period 2003–2014. The main goals are mitigation of land degradation and desertification, revegetation of eroded land, and attaining sustainable land use. The main tools for its achievement are described, and financing improved substantially, mainly for halting desertification, extending farmer involvement in healing the land, and a new land care incentives programme.

Sustainable land use

Icelandic experience illustrates clearly that ecological sustainability of grazing and other land uses is a large determinant of land health. Most of the island is accessible for grazing, but the ecological conditions over large areas are poor, and there is an urgent need to minimize erosion and enhance vegetation succession on degraded land. In areas of severe land generation and desertification, grazing can have a dramatic effect. In other degraded areas, grazing above certain limits, or even any livestock grazing, can significantly slow vegetation recovery. Sustainable land use is therefore fundamental to conservation of healthy ecosystems, prevention of further desertification, and recovery of degraded land. In many areas, major management changes are needed, including relieving the most degraded rangelands from grazing.

Sheep production in Iceland is costly, mainly as a result of a long indoor feeding period in winter, and has been receiving a high level of governmental support, with more than half of farmers' income being subsidized. To meet public concerns and give the land users a larger conservation role, the current contract between the sheep producers and government has a cross-compliance clause. Starting in 2003/2004, farmers must verify the ecological sustainability of their operation to the SCS in order to obtain a full subsidy (Arnalds and Barkarson 2003). Farmers not meeting standards must submit a conservation and land improvement plan for SCS approval. This represents a major step towards increased ecological sustainability.

Horse grazing is also an important, but more localized, determinant of land health. In this sector, a voluntary "bottom up" quality control of sustainability is emerging. Crop production has been limited in Iceland, but with new strains of

barley and a more favourable climate in recent years, crop acreages are rapidly increasing, and a new soil conservation concern is emerging.

Involving land users and the public

Since 1990, there has been an increasingly participatory approach to soil conservation in Iceland, which has markedly increased the adoption and success of conservation projects (Arnalds 1999). The *Farmers heal the land* Project includes a 'cost share' partnership with farmers, with conservation work jointly funded by government and farmers. With machinery, work and a small part of the cost of materials, the farmer's share may average around 50% of project cost. This 'bottom up' approach encourages involvement and individual ownership of conservation projects. The programme has been important in building mutual trust between farmers and conservation authorities, which is a foundation for resolving many other issues. Participants have also been active in developing new methodologies, in cooperation with the soil conservationists, greatly advancing the knowledge base for local for soil conservation.

The SCS also emphasised working with rural and urban authorities concerning grazing management and revegetation issues. A wide range of clubs and associations, and individual volunteers, have become active in various elements of the conservation work. Working with such groups can be important in bridging the divide between rural and urban communities. The rapidly increasing prominence of forestry in Iceland, which has a large role in conservation and land improvement, also has a strong farmer and public participation focus.

Good farm and land use planning is one of the main keys to long-term sustainability. An evolving cooperative programme of such planning, Better farms, combines the forces of soil conservation, forestry, extension and nature conservation in aiding land users in producing their own property plans. This is a very promising programme, with the aim not only to make farmers the active partners in the planning process, but also to improve coordination between the various institutions and organizations that work with farmers. In this participatory approach to farm planning, the participants are provided with good quality aerial photographs and taught the elements of reading the land, information seeking and making their own plans.

Skills and conservation ethics

Knowledge is a primary fundamental when building up attitudes, awareness, skills and conservation ethics, which in turn may govern long-term success in protecting and improving natural resources. Research, education and knowledge transfer are therefore among the key elements of the Icelandic 2003–2014 soil conservation programme. SCS operates research and land information departments that work closely with other related agencies. The institute also works with schools, the public and other sectors on education related to soil conservation issues. There is also good cooperation with the agriculture extension service. Among future objectives is to ensure that all government-funded services to agriculture incorporate due respect for the goal of sustainability.

Financing

Financing the urgent task of the healing land in Iceland is a major burden for a nation of only 290 000 people. The SCS 2004 budget is US$ 6 millions or about US$ 21 per capita. This is for all activities. In addition, farmers, volunteers and clubs, district authorities, and a number of other interest groups, provide – in cash or kind – significant contributions towards the healing of Iceland. One of the larger private financers of conservation programs is the Retailer Association, with funds from revenue created by charging for plastic grocery bags in stores.

Iceland and climate change

The global task of preventing human-induced climate change has brought a new dimension to soil conservation and forestry in Iceland, because reducing emissions, preventing degradation of soil and vegetation, and carbon sequestration are all important tools to meet the goals of conserving climate. With regard to land fertility, CO_2 may be considered a misplaced resource that vegetation can convert back to organic matter, to be stored in biota and soil.

Iceland is blessed with plentiful hydropower and geothermal power, and the transformation to sustainable energy took place before 1990, the baseline year of the Kyoto Protocol. Left with limited options for reducing greenhouse gas emissions, and encouraged by the success of mitigation and restoration work for 90 years, the Icelandic government decided to use carbon sequestration to meet emission targets for year 2000, and established a special action programme for 1997–2000. This led to a 30% fund increase for halting soil erosion, revegetation and reforestation (Arnalds 2004). The carbon sequestration is regarded as an added benefit, but not a goal in itself. A misplaced resource is being returned to the land for a variety of purposes that benefit both current and future generations.

Summary

The experience gained in Iceland is illustrative of failures and successes in conservation work in many parts of the world. With its 1100 years of land degradation and almost 100 years of mitigation work, Iceland provides unusually vivid examples, not only of the long-term consequences of unsustainable land use, but also possible means to halt destructive forces and restore lost resources.

The scale of ecosystem disturbance in Iceland, where barren deserts have replaced vegetation and thick soils in many areas, despite ample precipitation, demonstrates the global nature of land degradation and desertification. As in most parts of the world, the management of livestock grazing and other land uses is a key determinant of rangeland health. Clear guidelines for conservation of the natural resources must be set within effective environmental policy and enabling legislation. A major step was taken in the current agreement between the Icelandic government and sheep producers, partly linking subsidies to ecological sustainability of grazing.

Increased knowledge and locally-led community involvement, based on a high degree of land literacy, is one of the foundations of the Icelandic 2003–2014 soil conservation programme. Involvement at all stages of the conservation work has proved a very powerful incentive, with wide ranging effects at all levels, from grassroots to Parliament.

References

Aradottir, A.L. and Arnalds, O. (2001). Ecosystem degradation and restoration of birch woodlands in Iceland. In: F.E. Wielgolaski (ed). Nordic Mountain Birch Ecosystems. Man and the Biosphere Series, UNESCO, Paris, and Parthenon Publishing, Carnforth. 27, 293-308

Arnalds, A. (1999). Incentives for soil conservation in Iceland. In: D. Sanders, P.C. Huszar, S. Sombatpanit and T. Enters (eds). Incentives in Soil Conservation. Science Publishers, Inc., Enfield, New Hampshire, on behalf of WASWC, IBSRAM, SWSCT, and DLD, Bangkok, 135–150.

Arnalds, A. (2000). Evolution of rangeland conservation strategies. in: O. Arnalds, and S. Archer (eds). Rangeland Desertification. Advances in Vegetation Sciences Series. Kluwer, Dordrecht, the Netherlands, 153–163.

Arnalds, A. (2004). Desertification in a humid environment – An example from Iceland. Encyclopedia of Soil Science. In press.

Arnalds, A. (2004). Carbon sequestration and the restoration of land health. Journal of Climate Change, In press.

Arnalds, O., Thorarinsdottir, E.F., Metusalemsson, S.M., Jonsson, A., Gretarsson, E. and Arnason, A. 2001. Soil Erosion in Iceland. Soil Conservation Service and Agricultural Research Institute, Reykjavik. 121p.

Arnalds, O. and Barkarson, B.H. (2003). Soil erosion and land use policy in Iceland in relation to sheep grazing and government subsidies. Environmental Science and Policy, 6, 105–113.

Douglas, M. (1996). A participatory approach to better land husbandry. In: S. Sombatpanit, M.A. Zöbisch, D.W. Sanders and M.G. Cook(eds). Soil Conservation Extension from Concepts to Adoption. Soil and Water Conservation Society of Thailand. 107–121.

Hannam, I.D. 2000. Soil conservation policies in Australia: successes, failures and requirements for ecologically sustainable policy. in: E.L. Napier, S.M. Napier and J. Tvrdon (eds). Soil and Water Conservation Policies and Programs: Successes and Failures. Boca Raton, Florida: CRC Press, 493–514,

Runólfsson, S. (1978). Soil conservation in Iceland. In: M.W. Holdgate and M.J. Woodman (eds). The Breakdown and Restoration of Ecosystems. Plenum Press, New York, 231–240.

Runólfsson, S. (1987). Land reclamation in Iceland. Arctic and Alpine Research, 19, 514–517.

Sanders, D.W. (2000). The implementation of soil conservation programmes. In: O. Arnalds and S. Archer (eds). Rangeland Desertification. Advances in Vegetation Sciences Series. Kluwer, Dordrecht, the Netherlands, 143–151.

II Global Aspects

Globalisation, sustainability and resilience from the soil's point of view

Pieter Jungerius and Anton Imeson

University of Amsterdam, Email: juan.GenL@inter.NL.net and a.c.imeson@science.uva.nl

Be it under slightly different names, globalisation and sustainability and perhaps to a lesser extent resilience, have been part of soil science long before these concepts became generally acknowledged in the wider world. It is worthwhile to examine the lessons that can be drawn from what soil science has to say about these concepts after more than a century of directly or indirectly dealing with them. This paper pretends to be no more than an illustration of this claim, as a stimulus to use the achievements of the past to design strategies for the future. Above all, we will try to give practical suggestions for converting the available knowledge into a form which can be applied to European soil problems.

Globalisation

Globalisation and the production of international soil maps

There are as many definitions of the term globalisation as there are disciplines to which the concept applies, but most of them involve effacing national boundaries. If this is indeed the main characteristic of globalisation, soil science can pride itself of having a longer record of globalisation than many other disciplines. Beginning in the 19th century with the study of soils in the field, the process of globalisation culminated in the production of the FAO-Unesco Soil map of the World in 1974 (Unesco, 1974). Many years of combined efforts of soil scientists the world over preceded the publication of this map. Even at the height of the Cold War, it was a common sight: American, European and Soviet soil scientists gathered in a soil pit, in heated but friendly discussion about the place of the soil profile in front of them, in the 7th Approximation or related global soil classification. Although there has been a period that countries had their own classification developed independently from other countries, it was superseded by a time that successful efforts were made to find common elements. The boundaries of their maps trespassed the national boundaries. The Soil map of the European Communities was published in 1985 (Office for Official Publication of the European Communities, 1985).

The seed for the global consent was laid by the Russian soil scientists in the 19th century who discovered that soils are natural bodies resulting from the combined influence of soil forming factors, particularly climate (Dokuchaev, 1883). The names they invented for some of their climate-related soils like chernozem and podzol are still found in soil classification schemes all over the world. In the USA, Hilgard wrote a report on the relation of soil to climate as early as 1892. Apparently, with the recognition of climate as a major factor of soil formation, globalisation entered the scene. Perhaps no physical property of our planet transgresses national boundaries more consistently than climate. That is perhaps why climate is the first factor in Jenny's (1941) soil forming equation when he formalized what was already known for many decades:

$$soil = f\,(climate, organisms, relief, parent\ material, time)$$

Cross-border consent was not limited to soil categorization and classification. Soil profile descriptions were also globally standardized. It is a great asset that soil scientists the world over can read and understand each others' descriptions, due

to the common use of guidelines such as the Soil Survey Manual (Soil Survey Staff, 1951) and their formalization in the FAO guidelines for soil profile description (1977), and the acceptance of the Munsell Soil Color charts as a standard for colour designations. Characteristic soil profiles from each country were collected and displayed in the international soil museum ISRIC in Wageningen. In short, the members of the soils world operated as a globalised group with great solidarity and mutual understanding, thanks to a common conceptual approach based on the acceptance of a globally applicable hierarchical model of factors (Klijn, 1995), in combination with a common methodological approach. To show what this means, let us compare the soil map of Europe of 1985 (Fig. 1) with the map of European landscapes recently produced within the

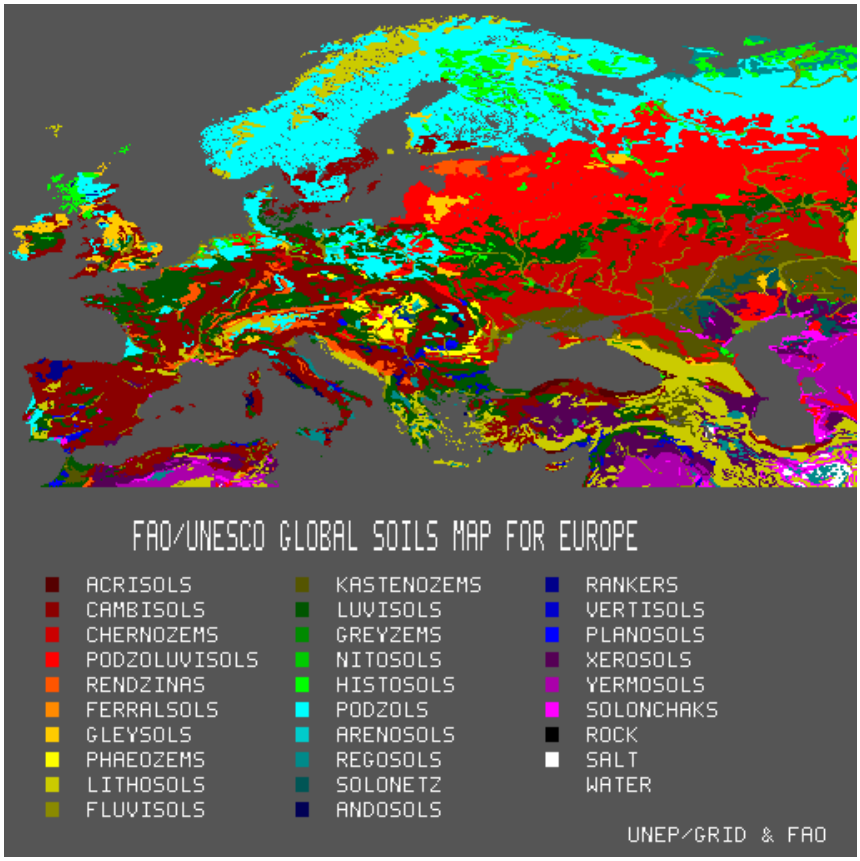


Fig. 1. The soil map of Europe of 1985.

framework of the European Landscape Convention (Fig. 2). The latter shows that many countries apparently have no information on landscapes available and that the countries that do have the information use staggeringly different classifications. This is indeed peculiar, because the factors of landscape formation in the widely accepted hierarchical landscape ecological model (Fig. 3) are in fact similar to those in Jenny's soil forming equation. So long as this hierarchy or a comparable unifying concept is not accepted, Europe has a long way to go towards a common landscape map.

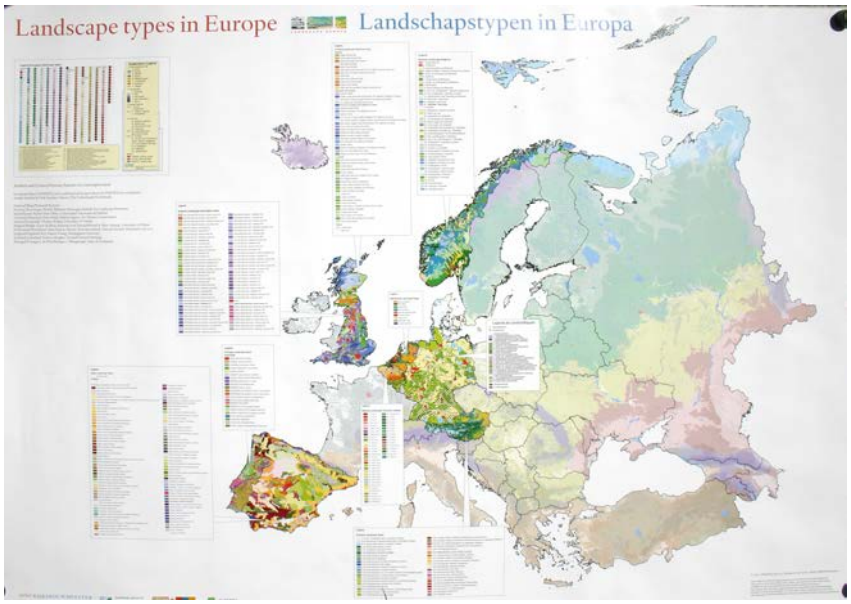


Fig. 2. Map of European landscapes issued for the European Landscape Convention.

It would be interesting to know why soil scientists were so much of one mind. It is not because the United Nations meant more than the European Union. Neither were the soil scientists of those days scientifically more superficial than we are today: many bookshelves can be filled with deep delving chemical studies on aspects of podzolisation or other pedological process. And tyrants dictating the decisions that had to be taken in a discipline existed no more in those days than they exist now. Perhaps one reason was that soil science was from the start a practical discipline directed towards agriculture or, as in Russia, spatial planning. Even today, the group of scientists dealing with the Soil strategy seem to be more coherent than its counterpart dealing with the Landscape Convention. The boundaries of a single value maps such as the PESERA map of the Pan-European Soil Erosion Risk Assessment project (Kirkby *et al*, 2003; Vieillefont *et al*., 2003) cut right across national frontiers. Other examples are given by Montarella *et al*., 2003)

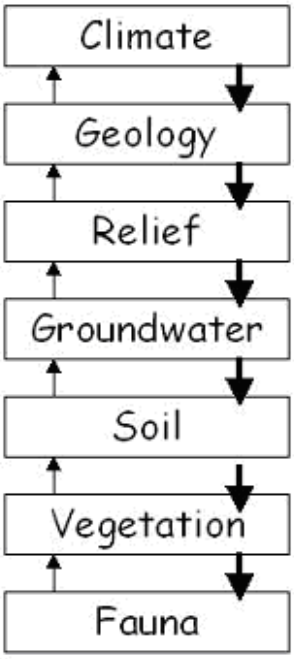


Fig. 3. The hierarchical landscape ecological model.

This means we are still on the right track, but we have to remain vigilant, because anti-globalisation forces even in soil science are strong in Europe with its multitude of state boundaries. A case in point is the Ecopedological map of the Alpine territory which is faced with the problem that soil data have always been described and mapped in different ways in the seven countries participating in the Alpine Convention, but the problem is clearly outlined and the will to cooperate is strong (Gandon *et al*., 2004; Zanolla & Vrščaj, 2004). The actions needed to come to harmonised soil information for the Alps are also indicated by Montanarella (2004).

Globalisation and the need for dynamic soil data

The vast database of soil maps and the associated soil information appear to have been relatively little used for the development of the Soil Strategy, although the maps depicting soil erosion risks use some of the principles. This has several

reasons. One is that the soil scientists involved in soil classification could not resist developing an artificial terminology for soil properties that is not readily accessible to non-pedologists. Terms such as Fimic Anthrosol and gelundic phase are discouraging examples. More important is that the information stored in the maps, classifications and descriptions is largely of a static nature. Present-day applications need a dynamic set-up, with data that can be adapted to the changing needs of the user. It is the task of the European community of soil scientists to translate the need for dynamic soil information into global terms. This is far from easy. It is like converting photographs to a movie film. Off-hand one would say that dynamic properties can only be derived from monitoring programmes, i.e. measuring changes of soil properties over time. On the other hand, it is possible that the existing international databases of static soil descriptions could provide parameters that can be translated in dynamic terms. Possibilities are indicated in the chapter on climatic zones in Technical Paper 20 of the FAO-Unesco Soil map of the World (Unesco, 1974). An example is perhaps organic matter content which is at the same time dependent on and variable within specific climatic conditions, particularly temperature and water availability. This is worked out further in the next section on sustainability.

Globalisation and Internet

There is another field of data production where globalisation is in full swing. It is becoming increasingly easy to obtain data on soils through the Internet. Search engines such as Google provide a staggering amount of general information provided the right key words are known, and specific software is available to specialists. This development has reached the point that employees of research institutes are discouraged from going into the field or use the laboratory to generate their own data. This is a dangerous development that might well turn an alluring avenue into a dead-end road. The danger is not so much that no new knowledge is added to the existing pool, but that the quality of the scientists deteriorates, because the creative skills needed to convert own observations into science are no longer trained. We see that happening at the universities where the relatively expensive field exercises are increasingly replaced by the much cheaper training in the use of computers. The virtual reality of the Internet should build upon and be additional to the actual field experience of the student with real living soils.

It was the other way round in the 17th Century when own observations began to replace the acquisition of knowledge from existing sources often dating back to ancient philosophers. This heralded the era of Enlightenment. Newton has been credited to be the pioneer by making observation part of the scientific method in his book *'Philosophiae naturalis principia mathematica'* published in 1687, but cutting up corpses to see what a human being looked like inside became common medical practice much earlier in that century. If the transition from external sources to own observation heralded the beginning of the age of Enlightenment, the opposite transition from own observation to consulting Internet could be postulated to be the beginning of the age of Endarkenment.

Globalisation and subdivision

A soil classification based solely on climate would not be practical. Subdivision according to other criteria is necessary in order to have units that are functional for the problem at hand.

If globalisation is a matter of effacing boundaries, subdivision by setting clear margins to soil properties is its opposite. Soil forming factors other than climate usually have this effect. The sharp boundaries between parent materials and land form classes are readily found on topographic and geological maps which are available for all European countries. This also applies to vegetation maps and ecological units such as the European habitat types. If we replace

vegetation and fauna by Man as a soil-forming factor, we can use maps or classifications depicting land use, erosion or any other man-induced conversion of the natural soil. Again, the problem is the static nature of the information.

Sustainability

Sustainability has been an issue in (soil and economics) science right from the 18th century (Thomas Malthus). Huxley in 1886 was farsighted enough to understand the role of soil organisms in creating a sustainable foundation for their own future existence, as well as creating conditions that made agriculture and human existence possible. He pointed out that nearly all of the work of crop production is done by (micro)-organisms and that man's efforts were in comparison minor. In the 19th Century sustainable farming could not "neglect" the necessary goods and services provided by other organisms. The long term effect of neglect is the soil and land degradation that we see today, When farmers no longer so dependent on the capital of the soil (e.g. because of alternative sources of capital,) they are able to risk the consequences of neglect. Trade, by creating capital means that there is an interesting link with globalisation.

Although globalisation and sustainability have a very different meaning, there is some sort of relationship between the two: whereas globalisation is a concept of space, sustainability is a concept of time. In this way they represent two different dimensions of the soil ecosystem. If globalisation in soils can be achieved by a global factor that changes gradually and in a predictable way over long distances, sustainability in soils is achieved by slow and predictable change over long tracts of time. Just as globalisation, sustainability has no intrinsic value; it is considered to be a favourable property of the soil only if it applies to a condition that approaches the original, natural condition.

The concept of sustainability has been applied to many aspects of soils, clearly because our society profits from having sustainable soils. Usually, emphasis is given to the sustainability of the production and regulation functions of the soils that can be described in terms of the ecological services that the soil is providing.

Our first concern with sustainability in this paper is much more limited and refers to the soil as an entity in itself. If it is our aim to repair soils damaged by erosion or any other form of destruction, it is of vital importance to know its predecessor from the time before the damage was done. To cure a patient we have to know what the healthy body looked like. The soils we can use as reference are of two very different types.

Zero-state soils

Good examples of sustainable soils are well-developed soils formed during a long period of natural conditions. These soils are in dynamic equilibrium with the soil forming factors. Changes do occur, but they are slow and remain below thresholds that are critical for the stability of the system. Natural soil erosion is at the rate of the *geologic norm*, i.e. rate of soil loss and production of soil material are in equilibrium on the slopes. This is a zero-state condition. Most zero-state soils in Europe occur in areas outside the reach of agriculture and other human use e.g. in the forests of northern Europe. Their sustainability is not at stake as long as the forests are maintained.

Much more important are natural, zero-state soils that survive in agricultural zones. From the time of their origin, the properties of these soils have been determined by the well-know soil forming factors (Jenny, 1951). They can be found in nature reserves and perhaps at sacred groves. An inventory of these

soils could therefore be carried out by mapping the nature reserves, but it is more practical to use a map showing the European habitat types. Several habitat types include references to Great Soil Groups explicitly in their descriptions; others use terms that can be translated to a soils connotation (European Commission, 1999).

The question is whether the soils in nature reserves are representative of the original soils in the surrounding agricultural area. Many nature reserves are founded in places where slopes are too steep or parent materials unsuitable for agriculture. Such soils are of no help when we try to find the original predecessors of agricultural soils. Still, it is unlikely even in a region with intensive agriculture, that all original soils have disappeared, and it is worthwhile to try and locate them.

Throughout the United States and Canada, zero state soils at national ecological reference sites are used as a standard for evaluating the adjacent more degraded soils as part of a methodology for collecting dynamic soil and ecosystem data (Pellent et al 2002).

Zero-change soils
If the original, pre-agricultural soils were the only sustainable soils that could be used as reference, the future of Europe would look rather bleak. Fortunately there are vast areas that have been in agricultural use perhaps for centuries and have soils that can still be considered sustainable. These soils have lost much of their original characteristics, but are nevertheless in dynamic equilibrium with the degradation processes and retain part of the original solum. Therefore they could be called zero-change soils. They are usually soils that are well cared for by the farmers. These are the soils Europe needs and the reference for their degraded counterparts.

The search for representative parameters
To identify and map soils for sustainability it is not necessary to take all their characteristics into account. Only properties that are chosen as parameter for sustainability are of consequence. The term *parameter* is used here in the sense of a concept characterizing a system. All other soil characteristics are of no importance for this survey even though they may be related. Also, it is not necessary to sample all soils all over Europe. A selection of representative soil occurrences derived from the national or European soil maps suffices for our purpose. These soil occurrences must be monitored to see if the chosen parameter lives up to expectations. To scientists from other disciplines it might seem reckless to apply the principles of ergodicity so ruthlessly but the fact is that similar soils are formed under similar conditions so that it is not necessary to sample the entire population of soils when the soil forming factors are correctly evaluated.

The soil characteristic that can act as parameter for sustainability should be chosen by mutual consent. Together we must be satisfied that they are representative for the soil quality we try to measure and preferably help to maintain sustainability by slowing down the degrading processes. Moreover they must be easy to register, preferably in the field with simple equipment. It must be a simple test that can tell farmers, miners, foresters, park authorities and other managers whether the land in their care is improving or getting worse (CSIRO, 2005). In a way the parameter must satisfy the definition of indicator given by Imeson (2004): 'Indicators are a quantitative and easily measurable variable that in some way enables critical aspects of the behaviour of complex systems to be measured in a very simple way'. On the other hand, indicators serve a much wider purpose. They are seen 'as being needed as tools of

communication that can connect science with both policy and affected people'. In both cases the parameter serves as a 'pars pro toto', but in this paper we limit ourselves to communication among ourselves, the soil people. Expanding the parameter to meet the practical challenges of the much more active indicators (early warning capability, promoting sustainability, allowing evaluation and monitoring) is a possible next step.

Which soil property to choose as parameter for sustainability? A property which is invariant and remains unchanged in threatened soils is unsuitable. Textural attributes for instance are generally inherited from the parent material. On most of our old continent this means that the primary sand grains are composed of quartz which is the only mineral that has survived the long periods of weathering. The clay fraction consists of secondary minerals which have been formed in equilibrium with the prevailing climatic conditions and are unlikely to change any more.

Other basic components of the soil such as air and water are also unsuitable. A better choice is organic matter which is an important control of the sustainability of eco-geomorphic systems (Imeson, 1995; Chenu & Roberts, 2003). Organic matter is sensitive to deteriorating processes on the one hand, and generates favourable soil properties on the other hand. It helps in soil re-vegetation and erosion control (Alexander 1999; Pariente & Lavee, 2003). Data sets on soil organic matter are widely available and can easily be expanded because measurement of the organic matter content of the soil with the loss-on-ignition technique is simple. An estimate can be made in the field from the soil colour, if a qualitative approach is sufficient. A disadvantage of using soil organic matter is that it is a black box when measured with simple techniques. It consists of a number of components each with a different behaviour towards sustainability.

Therefore, although it lacks some of the practical advantages of soil organic matter, soil structure appears to be a more reliable proxy of soil sustainability. Soil structure determines the partitioning of rainfall at the soil surface between runoff and infiltration, and the transmission of water through the profile, which in turn determines the amount of water available to plants and strongly influences the amount of soil lost to erosion (Cass *et al.* 1996). Soil structure has a number of properties by which it can be measured, often indirectly such as infiltration rate, hydraulic conductivity, water holding capacity, soil strength, soil consistence, penetration resistance and bulk density.

More direct is soil structure as it is known by soil surveyors and other soil scientists in the field. It refers to the aggregation of primary soil particles into individual compound particles known as 'peds' (FAO, 1977). According to the Soil Survey Manual (US Dept. of Agriculture, 1954), the importance of soil aggregation as a soil quality can scarcely be overemphasized. Traditionally, it is described in terms of shape, size, distinctness and durability. The latter property, aggregate stability, appears to convey best the notion of sustainability.

Therefore, perhaps the best single parameter to characterise the state of a soil in terms of sustainability is the stability of the soil aggregates. Determining the amount of stable aggregates in the surface horizon by dry or wet sieving is one of the quickest, cheapest and easiest way to determine the structural stability of a soil, although care should be taken to standardize measuring conditions (Imeson & Jungerius, 1976; de Meester & Jungerius, 1978). Large, stable aggregates favour permeability which is one of the best remedies against soil erosion. A map showing aggregate stability might be an appropriate way to bring the sustainably used soils of Europe in the picture. It is clearly a dynamic property of the soils and lends itself to monitoring.

Very recently, this idea is being increasingly operationalised in the United States whereby farmers and extension workers routinely measure the water stability of soil aggregates directly in the field using a soil stability kit developed for this purpose. This parameter is considered to be the best overall indicator of soil quality by the Natural Resources Conservation Service (NRCS).

Soil Aggregate stability as a key parameter for soil sustainability

In this short paragraph we wish to stress that there is sufficient data and experience to adopt soil one or more soil aggregate stability parameters as a key indicator for sustainability. It is possible to identify areas that are not being managed, simply by means of changes in the soil aggregation properties and behaviour. This can be done by anyone using simple easy to learn skills. Not only this but early warning of potentially unstable conditions can also be followed. The real reason for much of the flooding in Europe is not because the climate has changed but because the soil has lost its ability to store and regulate water and nutrients following compaction and soil degradation. This effect is also expressed in soil aggregate stability. Any move towards more sustainable land use can also be seen in the soil structure. Soil aggregation is therefore an ideal parameter for monitoring the progress being made in combating land degradation and desertification. In conclusion, soil aggregation satisfies all of the conditions mentioned in an earlier paper (Imeson, 2004). The next step should be to agree on protocols for monitoring and collecting such measurements. In the USA, as mentioned above a soil aggregation water stability kit is now being employed and farmers trained to use it.

Finally, soil aggregation would be valuable as an indicator for both developing and monitoring cross-compliance regulations.

Resilience

The third concept we will examine through the eyes of a soil scientist is closely connected with the concept of sustainability: resilience. Resilience is also implicit in the ideas of Huxley and to the practise of crop rotation.

With Dorren & Imeson in their paper on Soil erosion and the adaptive cycle (Scape, 2003) we follow Holling (1978) in differentiating between *engineering* resilience as the speed of return of a system to equilibrium state following a disturbance, and *ecological* or *ecosystem resilience* as the amount of disturbance that a system can absorb before it changes to an alternative stable state. A resilient ecosystem can withstand shocks and rebuild itself when necessary. A more general definition is: resilience is the capacity to cope with, recover from, or adapt to hazards.

In the scientific world, soil resilience is strongly linked with soil biodiversity of organisms in the soil, i.e. the complex world of earth worms, bacteria, soil born fungi, mycorrhizas, protozoa, nematodes and others organisms. It is an important aspect of so-called soil health. No doubt it is mainly to the activities of these organisms that the soil ecosystem can recover after a adverse disturbance. Today's knowledge in this area is, however, fragmented and remains largely in the research domain with limited practical application by farmers (FAO, 2005). It means that there are no simple ways to determine soil ecosystem resilience from the diversity of soil organisms. Methods include such expensive and time-consuming procedures as measuring and monitoring changes in soil respiration, microbial population, and dehydrogenase activity of soil. Oxidation with hydrogen peroxide is not enough. Only earthworms are a relatively easy to measure indicator of soil biological activity but they are not universally present.

What remains as a possibility is trying to assess soil resilience from a soil attribute for which data are readily and widely available, preferably a soil attribute which is the effect of the activities of soil organisms. The basic problem is the fact that soil resilience based on soil organisms is a dynamic quality whereas the target soil attribute is static. In ecosystem terms it means linking state to a virtually unknown process.

The question is the same as in the case of sustainability: what is the best attribute to choose? Organic matter is once again a good candidate. Soil organisms break down decaying plant matter and detritus to become humus, and humus affects soil structure and moisture holding capacity. Conversely, humus stimulates the growth of microbial populations that are essential to the stability and resilience of the soil ecosystem. Organic matter is therefore an important benchmark indicator for soil health (Strong, 2004). A major disadvantage is that the amount of organic matter required to sustain a healthy soil varies with latitude, elevation, soil texture and climate. Also, organic matter has the same disadvantages as were noted in the case of sustainability. It consists of various fractions with different types and degrees of activity. Only the humic carbon fraction is formed by soil biota and consists of the polysaccharides and humic compounds which hold soil particles together in structure aggregates.

These difficulties can be circumvented once more by selecting aggregate stability. Stability has been described as the capacity to resist displacement from an equilibrium condition which according to Eswaran (1994) would make it the opposite of resilience. But this is not strictly true: as every soil surveyor knows, soil aggregates often vary in shape, size, distinctness and durability, adapting to seasonal or other climatic conditions, but in a resilient soil system the structure is always restored.

Resilience in the broader, landscape context

What could be objected is that accelerated soil erosion removes the complete solum and without the solum, a soil has by definition lost all resilience. This however is too narrow a view. Dorren and Imeson (2003) show that in order to understand soil erosion, soils should be considered as integral parts of the ever-changing landscapes. This means that the geological and more specifically, the paleo-pedological history of the soil landscape must be understood. This can be achieved by the available field and laboratory techniques, but knowing the CV of a deteriorated soil landscape is not enough to reach the proper diagnosis (Imeson & Lavee, 1998). A soil has different functions depending on environmental context and scale, in other words, it is a dynamic ecosystem. To deal with the changes at different levels of time and space, it is helpful to represent the ecosystem dynamics by an adaptive cycle. In an adaptive cycle successive stages of construction and creative destruction can be identified (Holling, 1978). It is one of the key properties of an adaptive cycle that ecosystem resilience expands and contracts as the phases proceed (Peterson, 2005). Panarchy goes a step further by linking adaptive cycles of natural and human systems (Gunderson & Holling, 2002).

These concepts are largely theoretical and difficult to put into practice (Clark, 2003), but as in the case of globalisation and sustainability, soil science is blessed by having a research tradition which makes it possible to absorb modern resilience theory. Dorren & Imeson (2003) give an example, by linking soil erosion to landscape change in the south-eastern part of the Netherlands where soil erosion was and sometimes still is considered a problem. The changing functioning of the landscape during the last 15000 years is mirrored in sediments and fossil and modern soils. When translated in adaptive cycles the relationship

between the erosion potential and regulation capacity of the landscape can be expressed in a diagram relating erosion potential and regulation capacity (Fig. 4).

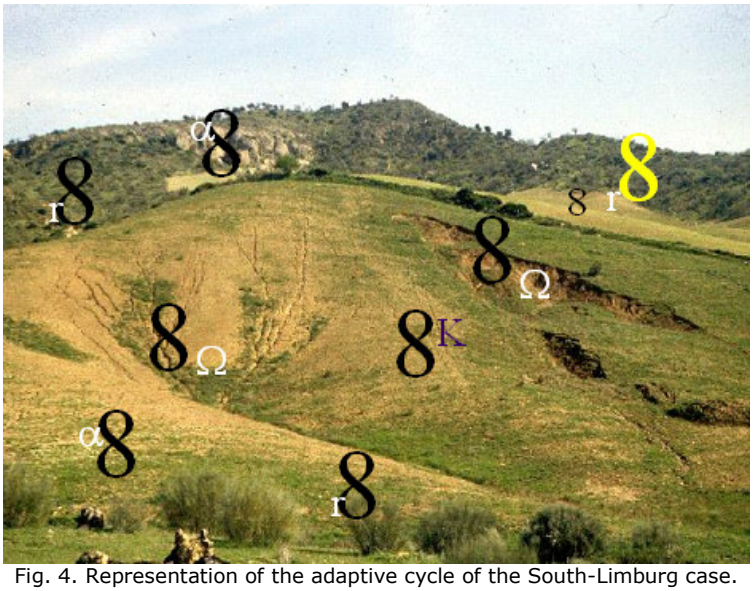


Fig. 4. Representation of the adaptive cycle of the South-Limburg case.

Seen in panarchy perspective it appears that erosion is an integral part of landscape evolution. What remains to be done is the reconstruction of what happens to aggregate stability or another soil property representing resilience when it follows the cycles.

Future research

There are many suggestions that could be made for future research. In our opinion, there is a huge amount of wasteful research effort because inefficient and outmoded paradigms are used. Now policy makers and scientists treat all areas the same. This is like thinking the earth is flat. In prescribing an answer to the problem, the most important point is to know where we are in time. Which parts of the landscape are in which stage of an adaptive cycle with respect to different soil threats. Paradoxically areas that have just been eroded often present no risk of erosion as they have just passed through the release phase of the cycle. Soils on steep slopes are not at risk because there is no accumulation of erodible soil. A totally different picture of landscape sensitivity to erosion results when an adaptive cycle paradigm is applied compare to the paradigms of cause based erosion models. We recommend case studies that apply this paradigm in different areas for use in policy development. The Case Study from South Limburg that we mentioned illustrates the possibilities that the approach offers.

In terms of sustainability, we recommend that more research should be done to help understand better the architecture of the soil and the soil as a habitat. In this way we will be able to develop soil organisms as instruments for improving both the sustainability of the soil and its resilience.

We recommend also that soil aggregation be developed into an operational indicator at the European level.

Finally in conclusion

For the decision maker:

Soil science is fortunate to have at its disposal of vast amount of data on soils, collected all over the world and readily available. We have to explore the ways these data sets can be applied to state-of-the-art studies of globalisation, sustainability and resilience before new approaches are invented for which no data is available. It is imperative that the choice of the most appropriate parameters to characterise the three concepts should be made by common consent. With that, it should be possible to produce maps at different scales as basis for European decision making.

For our own understanding

New ways to understand the historic role of soil in landscape development and emphasize its function in resource management can be explored by translating paleo-pedological reconstruction into panarchy terms. This should be explored in a number of case studies. The most difficult but also the most challenging part will be to establish the regulation capacity of a landscape. This requires the study, with carefully chosen representative parameters, how soil resilience expanded and contracted in the course of time. This knowledge will put the present soil problems into a perspective

References

Alexander, R., 1999. Compost markets grow with environmental applications. Biocycle 40, 4: 43-48.

Cass A, N., McKenzie & H. Cresswell, 1996. Physical indicators of soil health. In: J Walker & D.J Reuter (Eds), 'Indicators of Catchment Health - A Technical Perspective. CSIRO Publishing, Melbourne.

Chenu, C. & M. Robert, 2003. Importance of organic matter for soil functions. Briefing Papers of the 1st Scape workshop in Alicante (ES): 81-82.

Clark, 2003. Adaptive cycles and the resilience of the Parks Canada Agency. Conservation Ecology.

CSIRO, 2005. World test for sustainable soils. Global Relations Project 465. Australia.

Dokuchaev, V.V., 1883. Russian Chernozem (Transl. from Russian). Israel Prog. Sci. Transl. Jerusalem 1967.

Dorren, L. & A. Imeson, 2003, Soil erosion and the adaptive cycle metaphor. Briefing Papers of the 1st Scape workshop in Alicante (ES): 31-40.

Eswaran, H. 1994. Soil resilience and sustainable land management in the context of Agenda 21. In: D.J. Greenland and I. Szabolcs (Eds) Soil Resilience and Sustainable Land Use. Publ. CAB International, Wallingford, England. 21-32.

European Commission, 1999. Interpretation manual of European Union habitats. Document Eur 15/2.

FAO, 1977. Guidelines for soil profile description. Rome.

FAO, 2005. Soil biodiversity management for sustainable and productive agriculture.

Gandon, P., I. Vinci & S. Obber, 2004. The ecopedological map of the Alpine territory. Briefing Papers of the 3rd Scape workshop in Schruns (AU): 45-52.

Gunderson, L.H. & C.S.Holling (Eds), 2002.Panarchy: understanding transformations in human and natural systems. Island Press, Washington, D.C.

Hilgard, E.W., 1892. A report on the relations of soil to climate. U.S. Dept. Agric. Weather Bull. 3: 1059..

Holling, C.S., 1978. Adaptive environmental assessment and management. John Wiley and Sons, New York, NY.

Huxley, T.H. A universal indicator of sustainability. Volume IX, Evolution & Ethics and Other Essays, of Huxley's Collected Essays

Imeson, A.C., 1995. The physical, chemical and biological degradation of the soil. In: R. Fantechi, D. Peter, P. Balabanis & J.L. Rubio (Eds), Desertification in a European context: physical and socio-economic aspects. Proc. Eur. School of Climatology and Natural Hazards course, Alicante 1993: 291-306.

Imeson, A.C. 2004. The use of indicators in soil erosion and protection. Briefing Papers of the 2nd Scape workshop in Cinque Terre (IT): 195-200.

Imeson, A.C. & P.D. Jungerius, 1976. Aggregate stability and colluviation in the Luxembourg Ardennes; an experimental and micromorphological study. Earth Surface Processes 1, 259-271.

Jenny, 1941.Factors of soil formation. A system of quantitative pedology. McGraw-Hill Book Company, New York and London.

Kirkby, M.J. and many others, 2004. The PESERA Map, version 1 October 2003. Explanation of Spec. Publ. Ispra 73, S.P.I.04.73.

Klijn, J.A., 1995. Hierarchical concepts in landscape ecology and its underlying disciplines. SC-DLO Report 100, Wageningen.

Meester, T. de & P.D. Jungerius, 1978. The relationship between the soil erodibility factor K (Universal Soil Loss Equation), aggregate stability and micromorphological properties of soils in the Hornos area, S. Spain. Earth Surface Processes 3, 379-391.
Montanarella, L., 2004. Towards an Alpine Soil Information System. Briefing Papers of the 3rd Scape workshop in Schruns (AU): 87-96.
Montarella, L., A. van Rompaey & R. Jones, 2003. Soil erosion risk in Europe. http://ies.jrc.cec.eu.int/Projects/ESP/
Munsell Color Company (undated). Munsell Soil Color Charts, Baltimore, USA.
Office for Official Publication of the European Communities (1985). Soil map of the European Communities.
Newton, 1687. Philosophiae naturalis principia mathematica. London.
Pariente, S. & H. Lavee, 2003. Soil organic matter and degradation. Briefing Papers of the 1st Scape workshop in Alicante (ES): 83-88.
Peterson, 2005. The adaptive cycle and resilience. In: C.S. Holling, L.H. Gunderson & Peterson (Eds). Sustainable futures. Chapter 2.
Strong, R., 2004. Soil health based on organic matter. www.soilandhealth.org.
Unesco 1974. FAO-Unesco Soil map of the World. Rome.
Soil Survey Staff, 1951. Soil Survey Manual. U.S. Dept. Agriculture Handbook 18. Wahington D.C.
Vieillefont, V., Van Rompaey, R.J.A. Jones, E. Rusco & L. Montanarella, 2003. Validation of soil erosion estimates for Europe. Briefing Papers of the 1st Scape workshop in Alicante (ES): 21-25.
Zanolla, S. & B. Vrščaj, 2004. Building the cross-border Soil Information System in Alpine region. Briefing Papers of the 3rd Scape workshop in Schruns (AU): 53-62.

Geodiversity and Geoheritage within the framework of the Soil Strategy

J.A.M. van den Ancker[1], P.D. Jungerius[1] and M. Gray[2]

[1]Stichting Geomorfologie & Landschap, Oude Bennekomseweg 31, 6717 LM Ede, juan.GenL@inter.NL.net
[2]University of London, Department of Geography, Queen Mary, End Road, London, E1 4NS, UK, J.M.Gray@qmul.ac.uk

1. Summary

This briefing paper discusses and elaborates on the significance of geodiversity and earth heritage for soils, with special reference to the EU Soil Strategy. It is the draft for the position paper on these subjects. At first the concepts geodiversity, geoheritage and earth heritage are introduced. A short historic overview clarifies that soils are systems that integrate socio-economic aspects. A slight improvement of the present definition of soil in the EU Soil Strategy is suggested. The paper then describes what needs to be done to introduce geodiversity and geoheritage in EU policy. It finalises by proposing a work-out to make geodiversity and geoheritage operational in relationship to soils.

The examples in the boxes serve as illustrations. They all come are from the Netherlands, because we are best acquainted with the situation there. It is our intention to include examples from other countries in the position paper to be produced later.

2. The concepts of geodiversity and geoheritage in relationship to the soil system

The need to integrate sustainable soil development in spatial planning strategies and land use policies asks for appropriate terminology. In this communication the terms *earth heritage, geodiversity* and *geoheritage* are used when referring to the sustainable use of soil systems in spatial planning.

Over the last years the concepts of geodiversity, geoheritage and geoconservation have been discussed thoroughly in geological and geomorphological conservation circles. Recently Gray (2004) defined them as follows:

1. *Geodiversity* refers to the topography, structure and natural form of the land: the natural range of soil, geomorphological and geological features. It includes their assemblages, relationships, properties, interpretations and systems.

2. *Geoheritage* comprises concrete examples of geodiversity which may be specifically identified as having conservation significance.

3. *Geoconservation* is the endeavour of trying to conserve geodiversity and geoheritage.

Earth heritage is used by those wanting to stress that geoheritage is not only about geological phenomena but also about geomorphology, soils and their assemblages and relationships. In the Gray's definition geoheritage and earth heritage are in fact synonymous, making the latter term superfluous. Another argument against the use of earth heritage is its reference to the system earth as

a whole. For these reasons we have chosen to use geoheritage in this paper, in contrast to our earlier paper on this subject written for the EU Soil Strategy (Gray, Jungerius & van den Ancker, 2004).

Conservation *senso stricto* as well as spatial planning and land management procedures aiming at a sustainable use and respecting the natural potential and history of a soil, are aspects of geodiversity. They are also different aspects of geoconservation. With respect to soils: soils in nature areas, soils in zero-degradation situations, benchmark soils and soils that are historically sustainably managed soils, are all considered to be part of our geoheritage. One could refer to them more specifically as to our *soil heritage*.

3. Developments in soil science and its relationship to modern society

Before working out the concepts of geodiversity and geoheritage for soils, we will first step back into the history of soil science.

The study of soils began with the rise of agricultural chemistry in the nineteenth century, when it appeared that soils gave unforeseen reactions to the application of artificial fertilizers. Soil chemistry and physics are now among the best developed disciplines in agricultural and environmental research. During the second half of the 20th century, research and computer modelling added knowledge of quantitative chemical soil-water interactions and water movement within the soil system to soil science, often in relationship with pollution. These aspects of soil science are of great assistance in defining and alleviating the modern problems of soil contamination which also are a concern of EU policy.

But modern society not only aims at minimizing soil contamination but at minimizing other adverse processes such as well as soil erosion, sealing, compaction and degradation of organic matter. Knowledge of the functioning of the soil systems and instrumental skills have improved, thus making this technically possible.

However, market prices, EU policy and competition force farmers to produce at low costs. In general they do not judge soil erosion, loss of structure, sealing, oxidation and setting to be serious problems. Some reasons are: these processes occur slowly and changes are hardly perceived; direct financial losses are relatively low; problems occur largely outside there lands e.g. in nature areas, rivers and water reservoirs; and farmers and society are educated to live by economic instead of sustainable standards. An example of a soil in search of sustainable as well as an modern economic use is the Dutch peat soil described in box 1.

Box 1

Up to the 1960's -70's land use in The Netherlands was largely soil dependent. Now grasslands and maize are grown everywhere independent of soil type. Growing maize is considered normal even on low-lying grounds bordering brooks, or on peat soils as on this photograph near Uitgeest, province Noord-Holland.

Setting and oxidation of peat soils can only be limited if water levels in summer are 25 cm within of the land surface. Water levels generally are kept too low because of grass production and carrying capacity. Yet, while once cattle from Denmark and the North of Germany were brought here to be fattened up for the markets of Holland and Antwerpen, now economic production is hardly possible in these peat areas. Sheep instead of cows dominate the characteristic Dutch peat-grasslands rich in ditches. Even nature organisations have financial problems managing these lands and consider turning them into forest swamps and reed lands. Although this is a more sustainable use from a certain

point of view, these grasslands are Natura 2000 areas for meadow birds such as the black-tailed godwit of which 90% of the population breeds in The Netherlands. Furthermore, they are our most characteristic Dutch landscape, often having kept its Early Medieval parcelling. Through oxidation a considerable percentage of these lowland peat areas are in danger of disappearing, including the important geological information about sea level and climatic changes they contain. Increased CO2 production, sea level rise and encroachment of settlements are other problems these areas are facing.

---

4. Soils are systems

The former section and the example in box 1 show that soils although natural in origin, now are also part of complex socio-economic systems. What once was a highly valued soil, can change into a problem soil.

Already the Russian pioneers of soil science in the nineteenth century saw soil as a system. In 1941 Jenny improved this approach by more systematically exploring the relationship of soil development to the five main soil-forming factors parent material, climate, topography, time and organisms including man.

Within the framework of the EU Soil Strategy soils is defined as: *"the top layer of the earth's crust. It is formed by mineral particles, organic matter, water, air and living organisms. Soil is an extremely complex, variable and living medium."* The Soil Strategy then proceeds: *"Soil - the interface between the earth, the air and the water - is a non-renewable resource performing many functions vital to life: food and other biomass production, storage, filtration and transformation of many substances including water, carbon, nitrogen. Soil has a role as a habitat and gene pool, serves as a platform for human activities, landscape and heritage and acts as a provider of raw materials. These functions are worthy of protection because of their socio-economic as well as environmental importance."*

It is only in the second part describing the *functions* of the soil that its ecological, historical and socio-economic relationships are elucidated. In our point of view soil is more than a complex medium of particles, other components and soil fauna. There is a logic in these components and their surroundings relating us about their origin and position in the landscape, their geological history as well as their historical use by society. This system approach should be part of the definition of soil itself and not just of its functions only.

In fact each soil is an individual entity, reflecting the underlying geology, the geomorphology, topography and history of the site. It brings us back to the concept of the 'pedon' such as defined the Soil Taxonomy and links up with the holistic approach and modern visions of adaptive cycles and panarchy (e.g. Durren & Imeson, 2003) of the end of the 20th century.

5. Including geological and geomorphological heritage in the EU Soil Strategy

The concept of soil as described in section 4 and the concept of geodiversity defined by Gray (2004) are almost synonymous. Sustainable use of soil means sustainable use of the soil system, including its geomorphology and geology and relationships with vegetation, land use, landscape and history. A European policy for soils will therefore largely overlap with a policy respecting Europe's geodiversity. In an ideal world the subjects geomorphology, soils, fossils, minerals should all have their own legislation. For practical reasons it is logical to combine geodiversity and soil protection within the framework of the EU Soil Strategy. In The Netherlands the Soil Law is the instrument most often used to protect geodiversity. This applies to the special conservation sites, the "Aardkundige Monumenten", as well as to environmental planning procedures.

6. What needs to be done

The functions and threats to the soil system are described in Geodiversity and Geoheritage as features of Soil Protection (Gray, 2004 and Gray et al., 2004). Bringing the eight major threats in focus has been the main concern of the EU Soil Strategy.

The possibilities to improve the knowledge of the geodiversity and geoheritage functions of the soil system are in line with those of the eight threats studied in the Soil Strategy:

4. raising awareness of sustainable use and conservation through advisory and educational approaches,
5. regulatory approaches,
6. fiscal approaches such as green taxes or subsidies for sustainable management of land,
7. inventory and Monitoring and the setting apart of natural and sustainable managed soil systems,
8. development of improved and economic viable land use planning and management techniques.

Concerning monitoring there is a need:

9. to describe the characteristic geodiversity and geoheritage soil values of the European regions that are important for spatial planning activities,
10. to list these variables and regions in the soil catalogue and in national and regional atlases and geographical information systems and databases,
11. to select criteria for the designation of European Soil Heritage Sites and benchmark soils,
12. to select indicators for monitoring geodiversity and geoheritage,
13. to develop planning systems respecting geodiversity,
14. to develop methods for reviewing the effectuation of the soil policy measures,
15. to establish institutions for monitoring and reviewing.

Also the links with the other EU conventions, declarations and resolutions (Table 1) should be established and elaborated on.

Table 1. International conventions, declarations and resolution bearing reference to geoheritage and geodiversity.

Other international conventions, declarations and resolutions bearing reference to the concepts of geodiversity and geoheritage and recognizing the need to protect, preserve and improve the state of the environment and to ensure sustainable and environmentally sound development
1971 Convention on Wetlands of International Importance Especially as Waterfowl Habitat (RAMSAR).
1972 United Nations Convention Concerning the Protection of the World Cultural and Natural Heritage.
1992 Rio Declaration On Environment and Development at the United Nations Conference on Environment and Development.
1993 Resolution of the EEG Council of 25 October 1993 concerning the Resolution on Biological Diversity.
1994 United Nations Convention to Combat Desertification in those Countries experiencing serious Drought and/or Desertification, particularly in Africa.
1994 Charter of European Cities and Towns Towards Sustainability (The Aalborg Charter).
1995 Final Declaration of the 4th International Symposium of the Pan-European Ecological Network "Marine and coastal biodiversity and protected areas".
1998 United Nations Convention on access to information, public participation in decision-making and access to Justice in environmental matters done at Aarhus, Denmark.

7. Benchmark soils and natural, historical and modern sustainably managed soil systems

In the last section of this paper we make a start with the work-out of the concepts geodiversity and geoheritage in relationship to soils.

Within the work-out of the ***Geoheritage*** concept the following types of soil protection are distinguished:
- *benchmark soils,*
- *soils in nature areas,*
- *sustainable historical and cultural soils.*

The concept of ***Geodiversity*** gets a first work-out in:
- *indicators for sustainable soil systems,*
- *development of sustainable planning procedures,*
- *instruments for reviewing.*

These six items are now elaborated on. You will notice the work-out to be better developed for geoheritage than for geodiversity, but all items need further deepened in the position paper. The illustrations are again Dutch, the position paper will incorporate examples from other countries.

Geoheritage - benchmark soils

To treat soils as systems is in line with modern European societies' wish and need for sustainable use and development. It also calls for recognizing the distinction between what we will tentatively call 'steady state'** soil systems formed by nature or by agricultural practices directed at sustainability, and systems that are upset by adverse practices.

To understand how far an actual soil system deviates from its 'steady state' point of departure, natural and stable human-used soil systems should be set apart as 'bench mark' soils. Benchmark soils can be used as control sites for accelerated soil erosion, deterioration of organic matter, sealing, compaction, salinisation, pollution and other adverse processes affecting the soil. They are zero-influence situations necessary to specify the deviation of a certain soil type from the steady state system and to study the soil's resilience.

The system of benchmark soils has to be soil type sensitive and therefore needs a regional work-out. The benchmark soils will in most cases coincide with already designated natural habitats and nature and forest areas. In agricultural or built-up areas stable, steady state soils situations will need to be designated for this purpose. Preferably benchmark soils should be catena's or even larger areas, but this might not always be possible of which box 2 is an example.

** *A steady state is not synonymous with invariability. Natural soil erosion for example affects any soil in sloping areas. This is called the geologic norm of soil erosion, conveying the concept that natural soils are part of the geology of an area. And ecosystems studies over the last decades made us realize that in reality steady state does not exist, systems are constantly changing, but in general change is slow.*

Box 2

Natural pristine remnants of the original riverbanks are rare in The Netherlands. They are small stretches of land ('oeverlanden') dispersed over large areas. The photograph on the right shows a wooded natural growth of about 4 by 20 metres along the river Winkel.

Setting up a system of benchmark soils asks for designation, protective measures, indicators, monitoring, institutes, long term financing and scientific research. The study of soil has a long tradition of international cooperation, international soil maps, prescriptions for profile description and institutes exist (Jungerius & Imeson, 2005 in this bundle). Even benchmark soils have already been described, though for other purposes. Benchmark soils can for example be found in the International Soil and Reference Information Centre (ISRIC). Much more than basic ingredients for setting up such a system of benchmark soils are available.

Geoheritage - soil systems in nature and naturally managed areas

In nature areas not only the flora and fauna, but also the soil system that supports these should be protected, to safeguard the role of the soil as carrier and as an important component of the ecosystem. Natura 2000 offers opportunities to achieve this. As already mentioned, there might be an overlap in these two categories because soils in nature areas can also act as benchmark soils.

Geoheritage - historical and cultural sustainable soil systems
Apart from benchmark soils and soils in nature areas, specific historical soil systems known for the quality of their soils and their relationships with specific cultural landscapes need protection. Examples are the dehesa soils in Spain, the cultura mixta of Toscane and the plaggen soils in the Netherlands (box 3). Apart from being part of a soil protection system these soils should also be integrated in historical landscape protection. The European Landscape Convention of the Council of Europe is such a protective instrument. It aims at raising public awareness of historical land values, but has limited legal instruments.

- - - - -

Box 3

The thick plaggen soils of the eastern part of The Netherlands originated through spreading a mixture of sheep manure and sods of heath- and sometimes grassland on nutrient-poor sandy fields. Over the centuries this gave rise to low dome-shaped landscape forms, so called essen (see photograph) and typical soil profiles. The structure and water and nutrient holding capacity of the soils greatly improved through the addition of the mixture of manure and sods. They form a separate soil group in FAO classification and Soil Taxonomy. It is estimated that more than 80% of this special cultural European soil-type is located in the eastern part of The Netherlands. Most are rich in archeological findings. Only one of the six main provinces they are located in, has an active interest in their conservation, although in two other provinces interest of conserving of what is left, has grown. Because these soils are located near villages and towns many of them have been destroyed by sealing during the past decennia. In some cases the plaggen soil was removed and sold before building over. Through harvesting modern agricultural products such as lilies and trees large quantities of the plaggen soil material are removed from the 'essen'. The amounts removed list among the highest rates of soil erosion in Europe (Jungerius, 2005).

- - - - -

Geodiversity - Defining with sustainable use and limits
To safeguard the potential of the soil for future generations, a sustainable level of use should be defined for each soil. Also the conditions how to maintain system equilibrium should be specified, minimizing soil erosion, sealing and decline of humic substances. These specifications will be soil type dependent. The Australian farm management system is an example.

To define the level of sustainable use of our European soil resources, more knowledge is needed of the role of organic substances, soil fauna, soil-vegetation interactions and of the other subjects as described in the overview produced by the TWG5 Research (Anon, 2004c).

Geodiversity - Planning with sustainable use and limits
An interesting approach concerning planning procedures offers the designation of 'natural areas' by English Nature. They divided the land into more or less homogenous landscapes on the basis of a combination of geomorphological,

geological and land use criteria. Each *natural area* is characterized by abiotic phenomena and has characteristic and historical relationships with landuse.

Another useful planning system is the former CSIRO system of land description. It was developed in the sixties of last century in Australia for land development. Updated with modern techniques such as Geographical Information Systems, Laseraltimetrie and simulation techniques it could be developed into a planning instrument for geoheritage and geodiversity.

------- ----

Box 4

In the Netherlands there is a fast developing tendency to cover over vegetable and flowers growing, and glass houses are built everywhere. Most provinces try to prevent them sprawling all over the countryside by assigning them to certain areas through spatial planning instruments.

— ------ ----

Geodiversity - monitoring and other systems of reviewing

Apart from legislation a system of monitoring and reviewing is required.

9. Geoheritage and geodiversity with respect to geology and geomorphology

In geology and geomorphology the work-out of concept of geoconservation is much more advanced than in soil circles. For the Council of Europe they produced Recommendation 2004 (3) which has a emphatic focus on geological site protection (Anon, 2004b). Apart from the recommendations it contains an overview of important European projects and activities in this field.

The International Association of Geomorphology (IAG) and the organisation ProGEO on the Conservation of Geological Heritage developed a European wide system for geomorphological and geological inventory and designation of heritage sites.

The European Geopark Network(EGN) is most advanced in integrating protection of spectacular geoheritage sites with socio-economic improvements and education. The IAG is searching for standardizing planning procedures for tourism. The European Federation of Geologists is most active in influencing EU policy and working on certification. The UK Nature Conservation Committee and

English Nature are among the best European examples embedding of protection of geoheritage and geodiversity in society.

Also in geological and geomorphological circles the concept of geodiversity is much less operational than the description, selection, appointment and management of geoheritage sites. But in both fields apart from legislation, a large amount of scientific work still awaits.

References

Anon, 1991. Declaration of the Rights of the Memory of the Earth, The 1st International Symposium on the Conservation of our Geological Heritage Digne, France.

Anon, 2003a. Resolution of the European Parliament on the Commission communication 'Towards a Thematic Strategy for Soil Protection' (COM(2002) 179 _ C5_0328/2002 _ 2002/2172(COS)).

Anon, 2003b. Working Group on the Geological Heritage - Report of the meeting. Committee for the activities of the Council of Europe in the field of biological and landscape diversity.

Anon, 2003c. Revised European Charter for the Protection and Sustainable Management of Soil adopted by the Committee of Ministers of the Council of Europe. CO-DBP (2003) 10.

Anon, 2004a. EU Manifest on Earth Heritage and Geodiversity.

Anon, 2004b. Recommendation Rec (2004)3 on conservation of the geological heritage and areas of geological interest. Council of Europe - Committee of Ministers.

Anon, 2004c. Scientific Basis for the Management of European Soil Resources - Research Agenda, BOKU, ECSSS, Scape and Joint.

Anon, 2004d. Eururalis version 1.0. LEI, Alterra, WUR, The Netherlands.

Dorren, L. & A.C. Imeson, 2003. Soil erosion and the adaptive cycle metaphor. Briefing papers of the first Scape Workshop in Alicante (ES): 31-40.

Gray, M. 2004.Geodiversity valuing and conserving abiotic nature. Wiley, London.

Gray et al. 2004. Geodiversity and Geoheritage as features of Soil Protection. Communication advice of the Temporary Expert Group Geodiversity and Geoheritage of the European Union Soil Thematic Strategy.

Jungerius, P.D. 2005. Bodemverlies door lelieteelt en bodemerosie op esgronden. Report for the Province of Drenthe.

Imeson, A.C. & P.D. Jungerius, 2005. Globalisation, sustainability and resilience from the Soil's point of view. This report.

Weighell,T. & H. Torfason, 2002. Geological and geomorphological conservation: a review of global, European and national programmes. Working Group on the Geological Heritage Committee for the activities of the Council of Europe in the field of biological and landscape diversity.

Are sustainable soil management and increased food security mutually exclusive?

Stephen Nortcliff

Secretary General, International Union of Soil Sciences, Department of Soil Science, University of Reading, PO Box 233, Reading, RG6 6DW, United Kingdom
Email: iuss@rdg.ac.uk

Abstract

There is increasing global concern about food insecurity and the potential impact this has on a large proportion of the population, particularly in many of the less developed countries. To many, food insecurity is linked to misuse of soil and land and resultant soil and land degradation. Whilst there is often a close correlation between regions of highest food insecurity and soil and land degradation, there is not necessarily a direct causal linkage. Whilst care must be taken to identify lands for new agricultural developments, ensuring that the lands are suitable and that appropriate land management practices are operated, increasing food production in established areas is possible without degrading the soil resource if the complex inter-relationships operating in the soil system are fully understood and land management practices incorporate knowledge of these processes. In many cases, particularly in the tropics and sub tropics when the farmers are resource poor the most successful strategies are likely to involve few external inputs and often are scientifically based modifications of existing practices.

1. Introduction

At the present time globally we are faced with a whole series of political, social, economic and environmental problems. Increasingly in recent years there has been a global focus on the problem of food insecurity and associated with this have been highlighted examples of major occurrences of soil and land degradation. There is often a perceived causal link between the two, but it is unclear whether food insecurity and starvation is part of the cause of soil and land degradation or whether the food security occurs because of soil and land degradation. In truth it seems likely that a single causal link will not provide the explanation to this problem, but rather there is a complex relationship between these two broad phenomena. The United Nations and its agencies, particularly since the Johannesburg Summit of 2002, have been seeking to ensure food security for all, whilst at the same time endeavouring to ensure that soil and land are used sustainably. The fundamental question to be answered is whether enough food can be made available to all the global population whilst maintaining the soil resource in a state which will allow it to continue to meet the production needs of the future.

2. Population Growth and Food Demand

Globally the demand for food has grown relentlessly, firstly because the global population has grown rapidly, from 4 billion in 1974, to 6.5 billion in 2000, with a predicted estimate in the region of 10 billion by 2030. In addition to this remarkable rate of growth, there are in many regions, dramatic increases in the standard of living, with commensurate increases in food consumption. The global demand for food is increasing at a more rapid rate than the increase in population. Coupled with these increases there is also a rapid shift in some countries from a predominantly rural community with agricultural production as

their principal activity to an increasingly urban community with increased demand for food from a declining rural population.

There are marked regional differences in the rates of population growth. For example in the next 25 years it is anticipated that the population in Western Europe and North America will remain more or less constant, whilst there will be population increases of the order of 60% in Asia and Oceania, 100% in Latin America and well over 100% in Africa. This highlights a major disparity which still exists, there continues to be a major 'North – South' divide. The 'North' has a more or less steady population and is able to satisfy its growing food needs, not necessarily by food production from within its own region, but by moving food across the globe. In contrast the 'South' has a rapidly rising demand for food with often only limited capability to move food to satisfy this demand, even within a single country. The consequence is a high level of poverty in much of the South. Table 1 provides estimates of the population below the United Nations poverty level in selected regions over the final years of the twentieth Century. Whilst there have been marked improvements in some regions, particularly in Asia, the situation in Africa is still a cause for concern with almost 50% of the population of sub-Saharan Africa below the poverty line.

Table 1. Estimates of the percentage of the population below the UN defined poverty level in selected regions (based on FAO data).

	1985	1990	2000
South Asia	51.8	49.0	36.9
N. Africa and Middle East	30.6	30.6	30.6
Sub-Saharan Africa	47.6	47.8	49.8
Latin America	22.4	24.9	24.9

Set against the increasing demand for food there is frequently pressure on existing land for food production and a scarcity of new land for food production. Much of the land suitable for agricultural production is currently being used and in addition agricultural production is often being undertaken on land of lower suitability. In many situations land for future development for agricultural production is often of marginal potential. This marginal potential may arise for many reasons including soil related constraints such as limited fertility, limited availability of water, shallowness and stoniness; land constraints such as slope steepness where disruption of the natural ecosystem may result in slope instability and erosion; ecological constraints where the ecological value of the land is greater than the value for agricultural production; and the lack of access to the land due to ownership by private individuals, companies or governments and government agencies. Frequently where marginal land is transformed in to agricultural land production levels are often relatively low and unless carefully managed the soil may rapidly degrade.

3. Sustainable soil management

Using FAO's 1995 definition of sustainable land management as a basis (FAO, 1995), sustainable soil management may be defined as:-

'Management and conservation of the soil resource and the orientation of technological and institutional change, in such a manner as to ensure the attainment and continued satisfaction of soil use for present and future generations. Such sustainable use of soil should be environmentally non-degrading, technically appropriate, economically viable and socially acceptable.'

Young (1989) summarised it succinctly:-

Sustainable Soil Use = Production + Conservation.

4. Soil degradation

Soil degradation is an often complex process, but can be summarised under three broad headings; Physical, Chemical and Biological.

Physical degradation of the soil includes compaction, sealing, crusting, and structural degradation, soil loss due to soil erosion, soil loss due to urbanisation, and soil damage through excess water and sodification.

Chemical degradation of the soil includes loss of plant nutrients through extraction by plants (soil mining) and through leaching and run off and immobilisation in the soil system reducing availability. In addition chemical degradation may occur through acidification, salinisation and sodification.

Biological degradation of the soil, which includes decline in the levels of soil organic matter and loss of biological (fauna and flora) diversity was until recently often barely considered, but has been considered by many to be a key component in determining the long term sustainability of soil use.

Table 2. Harmful effects of agricultural activities on soil properties (based on Wild (2003)).

Activity	***Effects on soil***
Destruction of vegetation By burning, felling and Ring barking	▪ Breaks the natural nutrient cycling ▪ Increases rate and amount of run off, leading to erosion
Cultivation and growth of arable crops	▪ Reduces the level of soil organic matter ▪ Exposes soil surface to erosion actions of wind and rain ▪ Depletes soil nutrients
Use of fertilisers	▪ Fertilisers containing ammonia, ammonium salts or urea can cause acidification
Irrigation	▪ Can cause waterlogging and salinisation
Overgrazing	▪ Compacts soil ▪ Removes vegetative cover and together With compaction leads to erosion

Many of these degradation processes are initiated by practices which aim to increase food production, either through intensification of the agricultural practices (for example inappropriate or excessive tillage, over fertilisation, under fertilisation or mistimed application, inappropriate cropping combinations, or excessive irrigation) or through inappropriate land conversion techniques when transforming savanna or forested lands to agricultural production. Wild (2003) provided a short list of the negative consequences of agricultural activities on soil properties (Table 2).

In addition these pressures are often compounded by the reduction of agricultural land through urban encroachment, the poor education of the farmers, the absence of extension support, problems related to ownership of the land, the pressures of tourism and the consequences of war and civil conflict.

Whilst these processes occur across the globe, the problems are highlighted within developing countries, particularly in the tropics and sub tropics. Scherr (2002) estimates that 16% of agricultural land in developing countries and a much higher proportion of arable land, has experienced significant soil degradation in the last 50 years. This deterioration of the chemical, physical and biological attributes of the soil has resulted in reduced yields and increased production costs, either in terms of labour or other resources, to achieve even these lower yields. In addition there is often an associated decline in the food consumption by the rural poor. Scherr presents considerable evidence that significant yield losses (10% or more) due to soil degradation have been found in over half of the rainfed agricultural lands in Asia and Africa and in over a third of the rainfed agricultural lands in Central America.

Oldeman (1994) and Scherr (1999) have estimated that a land area in the region of 5 to 7 million hectares per year have been removed from agricultural production in recent years as a result of soil degradation, with a further 2 to 3 million hectares per year lost to urbanisation. In part this loss is offset by an annual conversion of 16 million hectares of forest and savanna lands to agricultural production, but frequently

Table 3. Degraded lands by land use type and loss in arable and pasture production in the second half of the twentieth century for selected global regions (adapted from Zoebisch and De Pauw, 2002).

Production	**Degraded Areas**								**Loss in**	
	Arable Land		**Pasture Land**		**Forests**		**Total**			
Pasture %	**Mha**	**%**	**Mha**	**%**	**Mha**	**%**	**Mha**	**%**	**Arable**	**%**
Africa	121	65	245	31	130	19	494	30	25	6.6
Asia	206	38	197	20	344	27	744	27	12.8	3.6
S & C America	92	51	78	13	137	15	307	21	23	2.6
N. America	63	26	29	11	4	1	196	9	8.8	1.8
Europe	72	25	54	35	92	26	218	27	7.9	5.6

much of this land to be converted is not ideally suited to agricultural production and frequently gives lower levels of production and may rapidly succumb to degradation more rapidly unless very carefully managed. Zoebisch and De Pauw (2002) present estimates of the degraded lands and the estimated loss in production in the second half of the twentieth century for different land use types in the major regions. Table 3 presents some of these data.

When global food production statistics are examined there appears to be little or no impact arising from this soil degradation. In part this is because of the dominant position of the North which is able to move food across international frontiers to meet its demands. In contrast in the poorer countries of the South there is often little or no international movement of food, indeed there is frequently only limited movement of food within some countries. Under these circumstances local soil degradation may result in the population suffering severe food shortages, although globally there maybe sufficient or even an excess of food for global needs. Many resource poor farmers in resource poor countries do

not have the support or financial capability to pursue strategies to prevent this degradation, and as their main asset in agricultural production is the soil, if this degrades they are on a downward spiral.

Greenland (1975) writing over 30 years ago highlighted five broad soil management principles which should provide guidance for achieving sustainable development in arable systems, pastures and forestry, particularly in the tropics and sub tropics:-

1. Replenish plant nutrients depleted during cultivation
2. Maintain soil physical properties (structure), principally by managing soil organic matter.
3. Ensure weeds are suppressed and pests and diseases controlled.
4. Correct problems arising from soil acidity and associated problems of element toxicity (e.g. Al and Mn)
5. Control soil erosion

Focusing on plant nutrients in the soil, there needs to be careful consideration of the balance between inputs and outputs:-

Inputs will include:-

i. Atmospheric inputs
ii. Releases during weathering
iii. Natural recycling through vegetation and incorporation of crop residues
iv. Fertiliser additions (imported)
v. Organic matter 'carry on'
vi. Organic matter breakdown

Outputs will include:-

i. Leaching (in solution)
ii. Run off (in solution)
iii. Erosion (in particulate)
iv. Volatilisation
v. Transformations from available to less available forms
vi. Crop offtake

In this context sustainable soil management will involve ensuring that the inputs at the very least match the outputs. Increases in yields will result in increases in crop offtake and this must be matched by increased inputs. The 'perfect' crop nutrient supply would:-

i. provide nutrients in the correct quantity in perfect synchrony with plant demand,
ii. avoid nutrient losses from the system, both to ensure efficient use of often scarce resources and to avoid environmental problems through losses to ground and surface waters.

Whilst this seems an obvious and relatively simple objective, there are many examples where overall nutrient pools in soils have declined. Sanchez (2002) indicated that even in the low agricultural productivity regimes of much of Africa, since 1970 annual soil losses per hectare of cultivated land were 22 kg of Nitrogen, 2.5 kg of Phosphorus and 15 kg of Potassium, indicating that at even these low levels of production (and with almost 50% of the population at or below the poverty level as shown in Table 1), there is still a net export of nutrients. With such a net nutrient export the levels of food production will continue to decline. In marked contrast in much of Southern Asia there is regional sufficiency

in terms of total food, the problem of food shortages is not principally soil related but is one of distribution.

Developing the theme of nutrient depletion, Sanchez (2002) stresses that a first step in addressing the problem of Africa's declining agricultural productivity is to develop a programme of replenishment of the nutrient status. Once this has been achieved the task of maintaining the nutrient status and associated soil conditions will be part of a sustainable soil management strategy. Sanchez suggested that because of the economic status of much of Africa the task is to achieve this replenishment without the use of expensive external inputs. He suggests three strategies which should assist in the accomplishment of this replenishment process:-

i. Introduce nitrogen fixing leguminous trees as a fallow (whilst the major focus on fallow trees has been with respect to nitrogen, it is known that some fallow species are capable of tapping other nutrient resources deep in the soil which are not readily accessible to arable crops. The fallow cycle might incorporate these species in addition to nitrogen fixing species).
ii. Use indigenous rock phosphates in phosphorus deficient soils
iii. Transfer biomass (for example *Tithonia diversifolia*) from nutrient accumulating shrubs to the soil. (Transferring biomass will have the additional advantage of increasing the organic matter inputs in to the soil, which may increase soil biodiversity and improve soil physical properties.)

In some locations Sanchez reports that this has proved an effective nutrient replenishment strategy, but there are also many examples of failures, for example due to land users considering fallow an unproductive part of the land management cycle and excluding it from their land management strategy, the widespread non-availability of reactive phosphate rich rocks, and the absence of high nutrient accumulating plants across the African continent.

Sanchez argues that this programme of replenishment is an essential first step in sustainable soil management, it must be supported however by agricultural practices which are sustainable, including measures to maintain the overall soil fertility supported by integrated pest management. One of the positive consequences of higher crop outputs is there is a commensurate increase in below ground organic matter additions to the soil system and larger quantities of residues, which when recycled to the soil will both enhance the nutrient pool, but also increase the overall soil organic matter content of the soil.

5. Conclusions

There is no doubt that whilst globally there is sufficient food to provide for the world's population, at a regional scale there are many areas where food insecurity is a major concern. Frequently the regions of food insecurity are in the tropics and sub tropics and often correspond to areas where soil and land degradation or the potential for degradation is most prevalent, and the rates of increase in these degradation processes greatest in recent years. Increased food security in the most affected regions (such as Africa) is most likely to be solved by seeking to increase food production in these regions. Taking Africa as an example, Sanchez (2002) argues strongly that the often perceived linkage between increased food production and soil and land degradation is not an inevitable consequence. If we more carefully analyse the agricultural and other productive land management systems in terms of inputs and outputs and endeavour to ensure that the inputs at least match the outputs through modifications of our soil management

strategies, degradation is avoidable. Where systems are already degraded this same strategy of input-output analysis will enable a recovery process to be planned. Such recovery processes provide the first steps in moving towards sustainable land management and increasing food production and consequently global food security at a continental and regional scale. In conclusion therefore, sustainable soil management and increased food security are not mutually exclusive. If we are to achieve increased food security it is essential that sustainable soil management is an integral part of crop production activities. The task is to identify soil management strategies which are appropriate to the regions and to the land managers in those regions. To ensure acceptance and uptake amongst an often resource poor population such strategies must frequently involve the use of no external inputs and are often most effective if introducing modifications of land management practices rather than innovative procedures. Examples of these procedures proving successful in parts of Africa, include the use of a. Agroforestry techniques, particularly in managed fallows, b. the more careful management of organic matter additions, particularly through 'carry on approaches, c. conservation farming techniques, d. increased water use efficiency through water harvesting, water efficient irrigation schemes and reductions of evaporative loss from the surface and e. the use of rock based additions of inorganic nutrients. Similar low input strategies which are linked to an understanding of the processes operating in the soil system are more likely to be successful as components of sustainable soil management in much of the tropics and sub tropics where farmers have limited access to land and other resources.

References

FAO (1995): Planning for sustainable use of land resources: Towards a new approach. FAO Land and Water Bulletin 2, FAO, Rome.

Greenland, D.J. (1975): Bringing the green revolution to the shifting cultivator. Science, 190, 841-844.

Oldeman, L.R. (1994): The global extent of soil degradation. In Greenland, D.J. and Szabolcs, T. (Editors) Soil Resilience and Sustainable Land Use. CABInternational, Wallingford, 99-118.

Sanchez, P.H. (2002): Soil fertility and hunger in Africa. Science, 295, 2019-2020.

Scherr, S.J. (1999): Soil degradation: A threat to developing country food security in 2020.Food, Agriculture and the Environment Discussion Paper no. 27, International Food Policy Research Institute, Washington, DC.

Scherr, S.J. (2002): Degradation, food security on a local/eco-regional scale. In Lal R. (Editor) Encyclopaedia of Soil Science, Marcel Decker, New York, 287-291.

Wild, A. (2003) Soils, Land and Food. Cambridge University Press, Cambridge.

Young, A. (1989): Agroforestry for soil conservation. CABInternational, Wallingford.

Zoebisch, M.A. and De Pauw, E. (2002): Degradation, food security on a global scale. In Lal, R. (Editor) Encyclopedia of Soil Science, Marcel Decker, New York, 281-286.

III Law, legal management and solutions

Contaminated Land Legislation and Liability, and the impact of waste management legislation

By Andrew Waite*

Partner, Planning and Environment Department, Co-ordinator of the Environment Group, Berwin Leighton Paisner, Solicitors, Email: Andrew.Waite@blplaw.com

1. Introduction

Liabilities will generally only arise to the extent that contamination on a site harms or threatens to harm people, property, water supplies or wildlife. Contamination by itself is not a problem if it is immobile and presents none of the threats mentioned. However, contaminating substances tend to migrate through groundwater and can become mobile if the ground is disturbed in the course of development.

In practice, the real risk of liability has to be considered in the light of the sensitivity of the surrounding area. For example, if the neighbouring land is just as contaminated as the site in question and local rivers and groundwater supplies are of poor quality (not associated with the site), the likelihood of significant harm being caused by contamination moving off site is small. Provided that adequate remedial work is undertaken to protect people using the site in future, the real risk of liability falling on the site owner would be slight.

Liabilities could arise in two main forms: action by the regulatory authorities and court action taken by private parties.

2. Regulatory Action – the Authorities

Two regulatory authorities are likely to become involved in contaminated land problems:

The local authority *is the principal authority responsible for contaminated land except in certain serious cases (special sites) where the Environment Agency is responsible.*

Apart from special sites, The Environment Agency *(EA) deals with water pollution caused by contaminated land and also land contaminated by illegally deposited waste or failure to comply with a waste management licence for the site.*

3. Contaminated Land

Part IIA of the Environmental Protection Act 1990 contains provisions on contaminated land which came into force on 1 April 2000.

Land will only be classified as contaminated if it is giving rise or is likely to give rise to significant harm to the health of living organisms (including people) or significant interference with their ecosystems or water pollution[1].

The meaning of the term 'significant' is amplified in detailed statutory guidance which the authorities are obliged to follow[2]. A high threshold is applied to the

---

* Formerly President of the European Environmental Law Association and Vice Chair for Western Europe of the Commission on Environmental Law of the International Union for the Conservation of Nature; email address: andrew.waite@blplaw.com

[1] Section 78A(2) of the Environmental Protection Act 1990 (EPA).

[2] DETR Circular 2/2000, Annex 3.

term. However, "water pollution" is not qualified by the Guidance and so bears its ordinary meaning. It follows that even if only minor water pollution is caused or threatened, it would be sufficient to trigger a designation as contaminated land. The Water Act 2003 contains a provision aligning the two limbs of the definition of contaminated land so that in future only significant water pollution will trigger a designation[3]. However, that provision is not yet in force.

Contaminated sites are under the jurisdiction of the local authorities unless they are designated as "special sites" because the actual or potential harm is serious or the expertise of the Environment Agency is required. In that case the Environment Agency is the enforcing authority[4].

Where land is designated as contaminated, the enforcing authority has a duty to serve a remediation notice specifying the investigation, remedial work or monitoring which needs to be carried out[5]. However, except in emergencies, there must be prior consultation with the parties concerned[6]. It is possible to appeal against a remediation notice[7]. The grounds of appeal are set out in Regulations[8].

Remediation is only required:

> *to the extent necessary to ensure that the land no longer falls within the definition of contaminated land; and*
> *provided that it is reasonable having regard to the likely cost and the seriousness of the harm to humans or the environment.[9].*

This is the so called 'suitable for use' standard

If it appears that the responsible party will take the necessary remedial action voluntarily, no remediation notice can be served[10].

Liability for remediation falls on the parties who caused or knowingly permitted the contaminating substances to be present ("Class A persons"). If no such person can be found, liability will fall on the owner or occupier (Class B persons")[11]. "Causing" refers to the original act of placing the substances on land. "Knowingly permitting" includes the on-going passive role of an owner who fails to remove the contaminating substances when he knows of their presence and fails to remove them when he has the power to do so, e.g. in the context of development.

The liability of Class B persons only extends to remediation on site, whereas Class A persons are also responsible for any contamination which migrates off site as well as any water pollution which is caused[12].

If more than one person within a Class is potentially liable, the decision as to which party is to be held responsible must be reached in accordance with the Guidance[13]. An agreement between the parties on the allocation of remediation

---

[3] Section 86 of the Water Act 2003.
[4] Sections 78B, 78C and 78D of the EPA.
[5] Section 78E of the EPA.
[6] Section 78H of the EPA.
[7] Section 78L of the EPA (as amended by Section 104 of the Clean Neighbourhoods and Environment Act 2005).
[8] Contaminated Land (England) Regulations 2000, SI 2000/227.
[9] Section 78E(4) and 78H(5)(a) of the EPA; DETR Circular 2/2000, Annex 3, Chapter C.
[10] Section 78H(5)(b) of the EPA.
[11] Section 78F of the EPA.
[12] Sections 78J and 78K of the EPA.
[13] Section 78F(6) of the EPA; DETR Circular 2/2000, Annex 3, Chapter D.

costs should be given effect by the enforcing authority (in the absence of a challenge to its applicability) unless it would result in liability falling on the public purse. The Guidance also sets our several "tests" under which one or more parties may be excluded from liability which then falls on the other potentially liable parties within that Class. For example, if the property is sold, in circumstances where the buyer had information sufficient to enable him to appreciate the broad measure of contamination, the seller is excluded from liability (subject to certain conditions) if both parties are Class A persons.

If more than one person remains in the class of liable persons after applying the exclusion tests, liability must be apportioned between then in accordance with the Guidance[14].

Failure to comply with a remediation notice without reasonable excuse is a criminal offence. If is a *defence* to show that a remediation notice has not been complied with solely because another party liable to bear a proportion of the cost of the works has refused or is unable to do so[15].

In default of compliance with a remediation notice, or where it is necessary to prevent serious harm or serious water pollution, or where no Class A or Class B person has been found, enforcing authorities may undertake the necessary work and recover the cost from the responsible party[16].

The Environment Agency will continue to exercise their separate water pollution and waste management functions. In particular, the Environment Agency has power to require "causers" and "knowing permitters" to take preventive or remedial steps to deal with actual or threatened water pollution[17]. Informal guidance on the relationship between the contaminated land legislation and water pollution legislation indicates that the former should be used in preference to the latter where the former is applicable. However, where contamination has already passed into the groundwater, only water pollution legislation applies.

Liabilities in the event of redevelopment

When it is proposed to redevelop a contaminated site, the local planning authority generally consults the Environment Agency and the environmental health department of the local authority[18]. Those authorities often seek to impose more onerous requirements on the developer than would apply under the normal regulatory law if the site were not being redeveloped. Generally, they seek to achieve some environmental improvement of contaminated sites. An example is a requirement to remove contamination "hotspots". In addition, the site must be made safe for its proposed use. Local planning authorities often impose a legal requirement for suitable remediation by way of a condition attached to the planning permission.

General Guidance is currently available in Planning Policy Statement 23, Annex 2, *'Development on Land Affected by Contamination'*.

[14] Section 78F of the EPA; DETR Circular 2/2000, Annex 3, Chapter D.
[15] Section 78M of the EPA.
[16] Section 78N of the EPA.
[17] Sections 161A-D of the Water Resources Act 1991 (see post).
[18] Planning permission is required for building and engineering operations under the Town and Country Planning Act 1990.

Tax relief for the remediation of contaminated land

Following the entry into force of the Finance Act 2001 on 11 May 2001, tax relief may be claimed for remediation work carried out on contaminated land in respect of the same tax period as that in which the work is carried out (although the relief can be carried forward to a later period)[19]. The tax deduction is equivalent to 150 per cent of the allowable expenditure, which equates to an actual saving of 45 per cent of that expenditure. Alternatively, the allowance can be cashed in for 16 per cent of the allowable expenditure.

For the purpose of this allowance, 'contaminated land' is defined more widely than is the case under the contaminated land legislation: although the definition is very similar, the 'harm' does not have to be 'significant'.

Several conditions must be met for entitlement to the relief to be applicable.

4. Waste management licensing

In certain circumstances a waste management licence is required in connection with remediation or groundworks[20]. If possible it is better to avoid the necessity of a waste management licence which may take some time to obtain and can be difficult to surrender. It could therefore have a blighting effect on the site.

The definition of waste

The important question is whether contaminated soil is "waste" under the Waste Framework Directive (WFD).

The definition of "waste" in the WFD which is mirrored in the UK legislation, is "any substance or object….which the holder discards or intends or is required to discard". The interpretation of "discard" is not straightforward.

The European Court of Justice (ECJ) has had to wrestle with the problem on a number of occasions. In recent years, it has reached the view that materials which are not the primary object of a production process are not waste if they are required for use by the holder, where the likelihood of re-use is high, particularly if there is a financial advantage to the holder in doing so[21].

On that basis, if soil (whether contaminated or not) is removed from its location but is required for use on the same site or elsewhere it should not be treated as waste. Accordingly, soil or other material deposited on site which is required for land raising purposes should not be treated as waste. However, it must be clear that this is not just a means of getting rid of surplus material. For this purpose, it is useful to demonstrate that if the material in question were not available, other material would have to be acquired for the same purpose.

[19] Schedule 22 of the Finance Act 2001.
[20] Part II of the EPA.
[21] *Palin Granit* (2002) ECR I–03533, paragraphs 34-37; *AvestaPolarit Chrome Oy* (2003) ECR I–08725, paragraphs 36-39; *Saetti and Frediani* (2004) ECR I–1005

The ECJ has indicated that if residual material has to be processed before use, it is waste[22]. On that basis, contaminated soil which requires treatment before reuse is automatically waste. It is strongly arguable that that conclusion does not apply where the contaminated soil has a designated end use even though it needs to be treated. However, the regulatory authorities in the UK favour a literal interpretation of the ECJ's judgements in this area.

After contaminated soil has been treated so that it is suitable for use, then provided that it has an intended use it is no longer waste[23].

However, the position outlined in the preceding paragraphs has now been thrown into turmoil by the ECJ judgement in *Van de Walle*[24]. That case concerned a leakage of hydrocarbons from defective petrol storage facilities at a Texaco service station in Brussels. The hydrocarbons migrated to the cellar of the building on the adjoining property, which required remediation.

In the course of criminal proceedings against Texaco and its chief officers, the question of whether the contaminated soil was waste was referred to the ECJ. The ECJ held that the contaminated soil was waste within the meaning of the WFD. The reasoning of the ECJ was essentially as follows:

> The accidentally spilled hydrocarbons are not a product which can be re-used without processing. They are therefore residues which are discarded, albeit involuntarily.
>
> Under Articles 4 and 8 of the WFD, Member States have a duty to ensure that waste is recovered or disposed of by its holder.
>
> It follows that the contaminated soil (which cannot be separated from the hydrocarbons) is required to be discarded and therefore disposed of or recovered in order that the obligation not to abandon and to recover or dispose of the waste hydrocarbons is complied with.
>
> It follows further that the fact that soil is not excavated has no bearing on its classification as waste.

The question arises as to the extent to which the ECJ interpretation of the contaminated land in question as waste, should be interpreted as applying to all contaminated soil. The reasoning of the ECJ suggests that the *Van de Walle* judgment is limited to cases where spillage or leakage of material has occurred whilst under the control of an identified person, in circumstances so as to give rise to an obligation to recover or dispose of it.

There are a number of situations in which it can be argued that contaminated soil is not waste and is not subject to any positive obligation to recover or dispose of it.

In particular, *Van de Walle* should not apply to:

> spillages or leakages which occurred before the implementation date of the WFD in 1977;
>
> cases where no immediate remediation is required;
>
> spillages which can be recovered most effectively by leaving them in the ground and allowing them to degrade or disperse naturally;

[22] *Palin Granit*, paragraph 36; *AvestaPolarit Chrome Oy*, paragraph 41
[23] *Mayer Parry Recycling Ltd* (2003) ECR I-06163
[24] [2005] Env LR 24

cases where contaminated material has been deliberately deposited in order to create made ground and not to dispose of it;

materials which, although originally disposed of, have been recovered subsequently e.g. by becoming part of the ground. An obvious example is a prehistoric waste tip.

In practice, many people have interpreted the *Van de Walle* judgment to imply that all contaminated soil is waste. The shocking implications of that conclusion have led to moves to consider removing contaminated soil entirely from the WFD and regulating it under the proposed EU Soil Directive. If that happens, it is to be hoped that the Soil Directive will approach the problem on the basis of risk assessment rather than by imposing binding soil guidelines values. In the meantime, the *Van de Walle* judgment appears to have been sidelined in practice.

Licence requirements

If contaminated soil is waste then, subject to exemptions, a waste management licence is required:

for disposal of contaminated waste soil on site, eg because that is the cheapest disposal option. In that case, a permit will be required under the Landfill Regulations 2002;

for ex-situ remediation (i.e. excavation of remediated soil, treatment and replacement on site);

for in-situ remediation of soil, i.e. treatment without moving it from its present location.

In cases where mobile plant is to be used for treating contaminated material for the purpose of remedial action with respect to land or "controlled waters", a mobile plant licence can be obtained, which is not specific to any particular site[25]. That helps to avoid any blighting effect.

However, several exemptions from the requirement for a licence may be applicable[26]. These include exemptions relating to:

the treatment of land used for agriculture with certain wastes;

spreading certain wastes on land;

the manufacture of soil from construction and excavation waste;

the beneficial use of waste without further treatment;

the use of certain wastes for construction work.

The impact of waste management licensing on contaminated land remediation remains fraught with difficulty. Regrettably, in some cases, the Environment Agency consider that material is waste and insist on the need for a waste management licence, or decide that an exemption is inapplicable, in cases where the opposite decision should be reached. However, the Environment Agency is reconsidering its view of the law on the meaning of waste.

[25] Waste Management Licensing Regulations 1994, Regulation 12, as amended by the Waste Management Licensing (England and Wales) (Amendment and Related Provisions (No.3)) Regulations 2005, SI 2005/1728.

[26] Waste Management Licensing Regulations 1994 SI 1994/1056 (WMLR), Regulation 17 and Schedule 3 as amended by the Waste Management Licensing (England and Wales) (Amendment and Related Provisions (No.3)) Regulations 2005, SI 2005/1728. Note that except as stated in the Schedule, the exemptions do not apply to hazardous waste.

5. Other Regimes

Two other regimes regulate contaminated land but in neither case do they deal with the legacy of historic contamination.

The Pollution Prevention and Control (England and Wales) Regulations 2005 which implement the EU Directive on integrated pollution prevention and control[27] provide that "upon the definitive cessation of activities, the necessary measures should be taken to avoid any pollution risk and return the site of the installation…..to a satisfactory state."[28] Government guidance[29] explains that "the aim of IPPC is to take preventive measures against pollution to ensure that there is no deterioration of the site during the operation of the plant……". This may be significantly stricter than the "suitable for use" test of the contaminated land regime in Part IIA of the EPA 1990 and similar controls on redevelopment. While "suitable for use" is appropriate for pre-existing contamination, it is not the right test for the preventive IPPC regime which aims to eliminate any increase in contamination over the period when the permit is in force. As a result, restoration under IPPC is not constrained by the future use of the land.

The Environmental Liability Directive30 applies to "environmental damage" caused by Annex III activities (a list of activities governed by various EC environmental directives) and to any imminent threat of such damage after the date when the Directive must be transposed and implemented i.e. 30 April 2007. Environmental damage includes land damage – i.e. any damage that creates a significant risk of human health being adversely affected as a result of land contamination: Arts 2.1, 2.2.

There is uncertainty as to the meaning of 'adverse effects' which is not defined (cf. the Statutory Guidance on the meaning of significant harm for the purposes of Part IIA of the Environmental Protection Act 1990 – paras A.23 ff.). It is worth noting the different standards for land damage and other kinds of environmental damage. In the latter case, the threshold is significant adverse effects.

Articles 5 and 6 of the Directive impose a requirement on the operator to take the necessary preventive or remedial measures where there is an imminent threat of environmental damage occurring or where environmental damage has occurred respectively.

Article 7 and Annex II set out the principles for choosing the appropriate remedial measures.

In relation to the remediation of land, the measures taken must "ensure, as a minimum that the relevant contaminants are removed, controlled, contained or diminished so that the contaminated land, taking account of its current use or approved future use at the time of the damage, no longer poses any significant risk of adversely affecting human health. The presence of such risks shall be assessed through risk-assessment procedures taking into account the characteristic and function of the soil, the type and concentration of the harmful substances, preparations, organisms or micro-organisms, their risks and the possibility of their dispersion. Use shall be ascertained on the basis of the land use regulations, or other relevant regulations, in force, if any, when the damage occurred.

---

[27] 96/61/EC
[28] Regulations 11(3) and 19(4)
[29] Integrated Pollution Prevention and Control, Practical Guide, Edition 4 (2005) DEFRA, paragraph 14.26
[30] 2004/35/CE

If the use of the land is changed, all necessary measures shall be taken to prevent any adverse effects on human health.

If land use regulations, or other relevant regulations, are lacking, the nature of the relevant area where the damage occurred, taking into account its expected development, shall determine the use of the specific area.

A natural recovery option, that is to say an option in which no direct human intervention in the recovery process would be taken, shall be considered."[31]

The interaction of the IPPC and Environmental Liability Directives demonstrate that the operator may be liable to remediate its own site to baseline levels in relation to any contamination caused by the operation of the installation. However, the remediation of off-site damage caused by the same installation is to be carried out on the basis of risk assessment. Provided that there is no longer any significant risk of adverse effects on human health, it is unnecessary to carry out further work.

6. Conclusion

The 'fit for purpose' standard of remediation based on risk assessment seems appropriate to deal with historic contamination. It would not be feasible to ascertain the baseline condition, nor a proportionate response to seek to achieve it. Higher standards may be expected from operators working under modern environmental law and that is reflected in the IPPC and Environmental Liability Directives. However, the underlying approach of the Environmental Liability Directive is that of risk assessment which is preferable to a slavish adherence to soil guideline values.

Liability is, and should be, based on the 'polluter pays' principle. However, that does not adequately address the problem of the legacy of historic contamination where the polluter may long since have disappeared. For such cases, new principles are necessary, unless the polluter pay principle is extended to cover present owners or occupiers of contaminated land or others with the power and opportunity to remediate it.

[31] Annex II, paragraph 2

Six Priority Forestry Programs and Legal Issues on Conservative Forestry Development in the PRC

Dr. Qun DU

Professor, Law School of Wuhan University, Wuhan City, Hubei Province, 430072, PRC; Member, IUCN Commission on Environmental Law. Email: qdu@whu.edu.cn.

Abstract

The flood and dust storms disasters happened in China during 1998 and 2001 greatly aroused high social and political concerns on ecological conservation issues and natural forest conservation in northeast region. Six priority forestry programs therefore are initiated by the forestry authority to combat the deterioration of the ecosystem and land degradation. They are:(i) the natural forests protection program (NFPP), (ii) the cropland conversion to forest program (CCFP), (iii) the key shelterbelt development programs in regions of the three-north and the middle-lower reaches of Yangtze River, (iv) the sandification control program in Beijing vicinity area, (v) the wildlife conservation and nature reserve development program, and (vi) the forest industrial base development program in key regions with focus on fast-growing and high-yielding timber plantations. This paper introduced the implementation of Six PFPs, reviewed the primary laws and policy for PFPs and discussed key legal issues. Six PFPs represents the current trend of conservative forestry development in PRC. In perspective of law and law enforcement, issues observed from PFPs could be interpreted as ones of current forestry development in the PRC, mainly on institutional arrangement, top-down approach, land tenure, and benefit sharing of forestry development.

Introduction

Forests' roles in economic development and in soil and water conservation and biodiversity protection are well recognized in the PRC. Events in recent years have focused attention on forests' important role in stabilizing the environment. In 1997 the water shortage in the Yellow River caused substantial economic losses to downstream industry and agriculture, particularly in Shandong Province. In 1998 major floods in the Yangtze and Songhua rivers caused serious loss of life and economic damage. The frequency and severity of sand and dust storms originating in the Western Region is increasing around 1999 to 2000. These successively happened disasters greatly aroused high social and political concerns on ecological conservation issues and natural forest conservation in northeast region. Two significant policies were made in response to it, *the National Planning of Ecological Environment Construction* and *the National Compendium of the Conservation of Ecological Environment* (NCCEE)[1] issued respectively in 1998 and 2000 by the State Council.

Since 1998, based on the long-term ongoing three-north forestation program, the forestry sector has been initiating the river-belt forestation program in river basins of the Yangtze, Yellow, Huai and Tai Lake and Liao. Further programs of cropland conversion and natural forests protection have launched. In August 2001 all forestry programs were formally reformed into six Priority Forestry Programs (PFPs), and *the Overall Planning of six PFPs* was formulated by the State Forestry

Notes

[1] As the Environmental Protection Law 1989 most addressed the regulation of industrial activities in urban or sub-urban areas, this document has recognized as one of basic regulatory documents on the conservation of the natural /ecological environment, special focused activities in natural resource use and management, including agriculture, farming, mining and etc.

Administration (SFA) and got approved by the State Council. This PFPs planning became a milestone in China's forestry development. In 2002, the implementation of the overall planning of six PFPs was all-around launched[2] Later in 2003, PFPs' implementation was largely fostered with the *Decision to Facilitate Forestry Development* of the State Council being brought into forestry field.

The objective of PFPs is forestry conservation by imposing the central investment in forestry programs to improve public interested ecological functions. As the implementation of PFPs challenges existing institutions and forestry administration, the broader meaning of PFPs than planting trees in legal perspective would be issues to be discovered and sought for solutions in perspectives of forestry integrated management, forestation joint venture and benefit sharing among stakeholders.

PFPs' operation

Natural Forests Protection Program (NFPP) is a key program of six PFPs. It was started in 1998 mainly to rehabilitate and develop natural forests. A key component of NFPP is a logging ban on 30 million hectares (ha) of natural forests in the upper reaches of the Yangtze and upper and middle reaches of the Yellow River. For other areas including in the northeast, Inner Mongolia, and Xinjiang. The policy has been imposes logging restrictions. It was aimed at reduction of timber production by about 20 million cubic meters, developing 12.7 million ha of new plantations, maintaining 94 million hectare of forests, and redeploying 740,000 state forest enterprise workers by 2010.[3] The fiscal investments for meeting these targets mainly are from the central government. By 2003 the governments has invested 38 billion RMB yuan, reaching 38% of total program budget for 2000-2010, of which 93.5% from fiscal finance. [4]

About 60 million hectare of agricultural land is on slopes of over 25%. Of the 2 billion tons of silt released into the Yangtze and Yellow rivers annually, about two thirds of which came from sloping croplands. In 1999 the Government adopted a policy to convert steep cultivated lands into forests and grasslands, which SFA is implementing as so-called Conversion of Cropland to Forest Program (CCFP). In 2001, the State Council approved the Regulation for Conversion of Cropland to Forest.

Planning and implementation of the CCFP are more complex than that of the NFPP because the CCFP deals with millions of small farm householders, and the NFPP only with hundreds of forest enterprises. The CCFP's financial arrangement also differs from NFPP's. The NFPP was designed to ease the hardship of state-owned enterprises and facilitate their transition from traditional logging to forest stewardship. The CCFP is essentially a public payment scheme, that the Sate compensates private farmers for conversion of farmland back to tree cover (or grasslands in particular cases) with the supply of grain and cash subsidy for tree seedlings, based on the size of converted land.[5] The income of participating farmers is often increased as long as the compensation payments are applicable.

---

[2] National six PFPs all-around launched: <Http:// www.zjep.gov.cn/sy, 2002-8-5>.

[3] Data source: the Overall Planning of the Natural Forests Protection Program, SFA, 2000.

[4] Data source the 2003 Public Statement on Statistic of Six PFPs , SFA, 2003.

[5] The payment for Per mu of cropland conversion to forest was set at 120 kg grain to Yangtz river area or 100 kg to Yellow river area, and 50 RMB yuan for tree seedlings, plus 20 RMB yuan cash to household of converted cropland. This payment scheme lasts 5 years for conversion to ecologically functioned trees, and 8 years for conversion to economically utilized trees. The lcropland converted to economically utilized trees could not be allowed to exceed 20% of total converted land See: the Regulation for Cropland Conversion to Forests, State Council, 2001.

This reflects that the standard of payment has been set higher than actual yield of cropland. [6]

CCFP was started in Sichuan, Shaanxi, Gansu in 1999, in which year the nation's grain stock was supply over demand. [7]This became critical element for policy-makers to generate the CCFP payment scheme to deal with ecological function protection shortly after the disasters in 1998 and 2001. Priorities of CCFP were the origins of rivers of Yangtze and Yellow, wind shelterbelts for Beijing and Tianjin, catchments of reservoirs, River Basins of Hei, Hong Shui, Tarim etc. By 2003, total payment of CCFP had amounted to 39.5 billion RMB yuan, of which 93% from fiscal finance. [8]

The key shelterbelt development programs in the three-north China and the middle-lower reaches of Yangtze River and the sandification control program in Beijing vicinity area are more of cross-sector program, involving departments of water, agriculture and poverty alleviation. The targets of the two programs are to increase vegetation, control water erosion and soil loss, and restore sandy land by means of manpowered forestation, natural forest preservation, aircraft plantations and resettlement.[9] The second phase (1998-2003) of the three-north shelterbelt program and the Yangtze-Yellow rivers shelterbelt program by 2003 had accomplished 1073,300 hectare forestation, with the investment of 5.247 billion RMB yuan, of which 51% from fiscal finance. The sandification control program in Beijing-Tianjin area was started in 2002 shortly after 2000-2001 dust storms. The program covers over 458000 square kilometers land of the Autonomous Region of Inner Mongolia, Municipalities of Beijing and Tianajin, and Provinces of Hebei and Shanxi, of which 25% is desertified land needed to be restored. In 2003, fiscal finance in this program reached 2.39 billion RMB yuan, which took 92.54% of the program's total investment.

The wildlife conservation and nature reserve development program started in 2001. It includes wild flora and fauna conservation, nature reserve zone establishment, wetland conservation and genetic resource protection. Its target to land protection is to establish 16% of nation's land as nature reserve zones and 94 national demonstrative sites for wetland conservation and rational use. The investment in 2003 amounted to 524 million RMB yuan, of which 256 million RMB yuan from fiscal finance. The accelerated investment in this program has been approximately 662 million RMB yuan, of which the state invested 58.79%.

The forest industrial base development program is the unique one of market-based forestry development events. Different from the other five programs, it aims at forestry economically intensive production rather than forestry ecological function. This reflects that governments have tried not to be the main investors to activities purely pursuing forestry economic benefit. Non-state-owned entities are incentivated by the governments to involve in this program. In 2003, its total investment was about 312.97 million RMB yuan, of which only 4.55 million RMB yuan came from fiscal financing. Priorities areas that the state incentives were imposed are those physical conditions suitable for forestry fast growing, such as

[6] Some argued that the payment standard of CCFP should be set at appropriate level close to actual gain of cropland, whilst others supported the current operation that CCFP should continue to be a scheme coincided with poverty aids to household in the hardship of steeping cropland.

[7] In 1999 national grain stock amounted to 225 billion kilograms, in addition to farmers'grain stock estimated at 200 billion kilograms.

[8] See the 2003 Public Statement on Statistic of Six PFPs , SFA, 2003.

[9] The financing standard for each means differs: upon per mu, the state pays 120 RMB yuan for manpowered forestation inclusive of five years stewardship, 70 RMB yuan for natural forest preservation inclusive of five years stewardship, 100 RMB yuan for aircraft plantations, and 240 RMB yuan for watershed treatment. See: the Overall Planning of Six PFPs, SFA, 2002.

tropic and sub-tropic zones in South China, and temperate zone in Yellow and Hui river basins, and frigid temperate zones in North-east China.

Review of Laws and Policy special for PFPs

Greatly alarmed by the 1998 flood and 2000-2001 dust storms, six PFPs have rapidly developed as most forceful and powerful forestry policy for not only forestry development but also nationwide ecological function rehabilitation and construction in China. How does the law deal with them or guide the policy on them?

In a broader sense, there did exist a range of laws and regulations to provide a legal basis for PFPs in both international and domestic context. Looking at the domestic legal regime, primary rules for PFPs exist in the following forestry-concerned laws and policy.

Constitutional Law1982[10] provided fundamental rules for sustainable resource use and conservation. Under Constitutional Law a branch of principal national laws dealing with land, water and other natural resources sustainable development including conservative forestry and soil protect are: *Grassland Law 2002, Agriculture Law 2002, Water Law 2002, Environmental Impact Assessment 2002, Desertification Prevention and Control Law, Forestry Law 1998, Land Administration Law 1998* [11]*, Flood Prevention Law 1997, Energy Economisation Law 1997, Mineral Resources Law 1996, Prevention and Control of Water Pollution Law 1996*[12]*, Water and Soil Conservation Law 1991, Environment Protection Law 1989, , and Wild Animal Conservation Law 1988, ect.*

Although Constitutional Law stated of the concept of conservative forestry in her articles, it yet was a recent event that conservative forestry development enters China's legal framework in the forestry and natural resource sustainable development. Previous Forest Law did not take the dual concept of 'conservative development' into account of forestry legislation until *Forestry Law the 1998 Amendment*[13]**.** The 1998 amendment established a complex legal and institutional framework for forest utilization, conservation and administration. Its notable conceptual change than before was that the sustainability of forest or conservative forestry was addressed as an independent objective by formal forestry legal institutions.

Moreover, the 1998 Amendment of Forestry Law for the first time produced accountable mechanism for conservative forestry management, such as forest categorizations based on objectives of forest function or use, administrative arrangements for each categorized forest, financial instruments, compensation fund for public-interest forests, forestation program/policy and so on. These institutions by the 1998 Amendment are gradually pushing, however its

[10] The current Constitutional Law was promulgated at the 5rd meeting of the Standing Committee of the 5th National People's Congress on 4th December1982, amended at the 2nd meeting of the Standing Committee of the 9th National People's Congress on 15th March 1999. Section 2 Article 26 declared as 'the State protect and improve living and ecological environments, prevent and treat pollution and other public hazards. The State organizes and encourages tree planting and protection '. Section 2 Article 9 said 'the State safeguard to use natural resource in rational means, conserve rare flora and fauna. Any entity and individual is forbidden to seize and destroy natural resources by any means'. These rules are constitutional foundation for ecological conservation legislation and forestry sustainable development.

[11] These enactments were respectively updated from *Grassland Law1985, Agriculture Law 1993, Water Law1988, Forestry Law1984/1998 and Land Administration Law1986/1998*.

[12] This enactment was updated from *Water Pollution Prevention and Control of Law 1984 /1996*.

[13] *Forestry Law* was first promulgated at the 7th meeting of the Standing Committee of the 6th National People's Congress on 20th September 1985 and took into force on 1st January 1985. It was amended at the 2nd meeting of the Standing Committee of the 9th National People's Congress on 29th April1999.

proceeding has seemed obviously lagged since key PFPs became more and more dominant in the forestry sector later after 2000.

Desertification Prevention and Control Law (DPCL)[14] is one of primary laws most important for PFPs. The introduction of the DPCL itself was a legal phenomenon in reflection to dust storms in North China around 2000. Its role was later analyzed two, to intensify forestry conservation in support to *Forestry Law 1998 amendment*, and to build up linkage between forestry sector and other natural resource sectors. The DPCL was formulated by taking special account of the issues and experiences derived from several pilot forestry projects e.g. the first phase of three-north wind shelterbelt, the pilot farmland conversion and the Yangts river shelterbelt in 1998-2001. The most significant contribution of the DPCL to PFPs and all conservative forestry development in China, which is also regarded as an outstanding feature of the DPCL, was to safeguard financial support from central fiscal source in forestry conservation programs, although currently limited to tree planting (e.g. the wind/ river shelterbelt, the farmland conversion to forestland) or protecting programs (for example the natural forestry program aimed to dismiss employees of state-owned forestry entities). The DPCL's provisions on forestland tenure, forestation joint venture and forestation interest sharing, were pioneer of institutional reform in terms of land benefit sharing among various involved subjects.

The DPCL is an integrated law special for desertification control. Provisions in the DPCL can be grouped into forestry-sector and inter-sector measures. Forestry-sector measures are led and conducted by the forestry bureaus to prevent land desertification, including: (i) monitoring, statistics analyzing land desertification; early warning of droughts and dust storms (Article14); (ii) establishing sand breaks and windbreak shelter-belts or networks of perennial shrubs and grasses (Article 16); and (iii) establishing Enclosed Protection Areas of Desertified Lands, where no re-settlement will be allowed and all local residents shall be relocated outside of these areas (Article 22).

The DPCL's inter-sector measures are a unique feature in later legislation on natural resources in the PRC, as it addresses cross-sector issues on such as water, agriculture and livestock production within a single law. The DPCL Article 17 is a complex provision related to vegetation protection and referring to *the Regulations on Wild Foliage Protection of State Council 1996* and *the Provisions on Agricultural Wild Foliage Conservation of Ministry of Agriculture 2002*. It requires county-level governments to formulate a vegetation management and protection system, in which special institutes for vegetation protection to be installed in townships and villages. Vegetation wardens will observe and survey vegetation management on farm or grazing land. The DPCL Article 18 relates to *Grassland Law*. It begins by re-affirming the principle that the maximum number of livestock shall be determined by grass-cover availability. It then puts specific focus on the responsibilities of the administrative body in charge of agriculture/animal husbandry. DPCL Article 19 has some provisions connected to *Water Law.* It stipulates that within desertified lands integrated water allocation and management should be based on the carrying capacity of the river basin or the watershed region. To avoid decreases in vegetation and land desertification the water utilization plan should take into account water needs in vegetation protection throughout the whole region. This is intended to reduce desertification caused by the excessive development and over-utilization of surface water and upstream water. Water-saving agriculture and other water-saving industries are strongly promoted. DPCL Article 20 draws on the *Agriculture Law*. No cultivation is allowed on woodlands or grasslands lying on the desert margin. Where the

[14] *Desertification Prevention and Control Law of the PRC* was adopted at the 23rd meeting of the Standing Committee of the 9th National People's Congress on 31st August 2001.

cultivation of land has a negative ecological impact, cultivated lands shall be converted to woodlands or grasslands.

The DPCL also provides a legitimate basis for two essential policy tools. Under Chapter 2 of the DPCL, the National Planning for Combating Desertification (NPCD) is the first basic strategic instrument for combating desertification. The purpose of the NPCD is to identify desertified lands where human activities will be regulated or prohibited within a specified time limit. The task of NPCD is to formulate Action Plans for Combating Desertification (APCDs) within specific schedules, steps and measures. The APCDs are the main measures to ensure targets of the NPCD are met; i.e. to reduce desertified land and halt desertification expansion. There are three levels of the APCDs, national, provincial and city/county levels. Articles 10 to 11 of the DPCL entitle the NAPCD to provide an overall action plan for combating desertification. The other policy instrument under the DPCL is the desertified land restoration programme, from which the six PFPs were born.[15] Restoration is targeted at desertified lands, which can be owned by the State or by collectives.

In terms of land tenure title of the forestation land in restoration, there are two scenarios to help determine whether a restorer holds land's user's rights over it or not. When a restorer does not hold user's rights over the land to be restored, or is not the owner of the land, he/she (likely the entity) must first take over the desertified land's user's rights, by signing a contract with landowners for the transfer of those user's rights. County-level governments will validate the transfer of rights by issuing a land user's certificate. If the desertified land is owned by a collective, the transfer then must be strictly processed by procedures, referred to in the *Country Land Contracting Law 2002*. [16] All rights derived from the restoration of desertified lands such as new vegetation, woods, grasses, etc. and new earnings belong to the new land users under the DPCL. In this regard, the DPCL was the first law before 2002 that enabled the collective-owned land to transfer its land user's rights to a outsider that does not have membership to the collectives; this however, was only limited to the desertified land restoration programs in a short period before the enforcement of the *Country Land Contracting Law 2002.* All restoration activities for desertified lands should follow specific administrative procedures including application and validation of projects, designing the intervention, financing arrangements and so on. The forestry administrative body has to set up vegetation restoration criteria for the final review of the project. To encourage restoration of desertified lands, the State provides preferential policies such as financial subsidies, tax discounts, reductions or exemptions to all groups involved in activities to combat desertification.

Based on primary laws on conservative forestry development, a series of specific ministerial-level binding rules of forestry conservation programs in particular PFPs have been set out by the State Council or State Council-authorized ministries since 1998.

Key legal issues on conservative forestry development

Although the environmental benefits of the PFPs have yet to be fully evaluated, they have evidently had an impressive impact on the environment and ecology[17]. However, studies on NFPP and CCFP has noted that potentially adverse social,

[15] Idem, DPCL Chapter 4.

[16] The Country Land Contracting Law was adopted at the 19th meeting of the Standing Committee of the 9th National People's Congress on 29th August 2002, taking into force 1st March 2003.

[17] On 18th July 2005, the international day of combating desertification, SFA declared that the increase of land desertification in China has for the first time shown declining. See: China Daily, 18th July 2005, Page 1.

economic and fiscal consequences.[18] Concerned general issues included reduced livelihoods, diminishing fiscal returns, high costs of implementation, tenure insecurity, accelerated increases in timber imports and lack of a proper monitoring and evaluation (M&E) system. Six PFPs represents the current trend of conservative forestry development in the PRC. In perspective of law and law enforcement, issues discussed in PFPs could be examined and interpreted as typical ones as of forestry development in the PRC. They appear in fields of institutional arrangement, top-down approach, land tenure and equality, and benefit sharing mechanism of forestry investment both in conservation and development.

Institutional arrangements

PFPs operation in the past five years showed that institutional arrangements are highly sector-focused and identically have a top-down approach. Six program offices were set at the central level within the supervision of the State Forestry Agency responsible for corresponding programs. At the local levels including provincial, city and county, vertical program offices were established to correspond and administrate actual launching to locals. The program planning and exercise designation were carried out by the technical teams within the forestry sector, for those programs that could be executed more independently by SFA, e.g. NFPP and CCFP, program consultations and coordination with other sectors e.g. agriculture and water resource and land resource often seldom happened.

With the DPCL fostering integrated development in desertification control, two shelterbelt forestry programs belong to cross-sector implementation, involving the agencies responsible for watershed treatment, animal husbandry and poverty reduction. In this circumstance, the committee of development and reform or the agency of finance is usually taking charge of comprehensive planning and exercise designing of programs. It could be explained the forestry agency was not strong enough to play the coordinative role of the executive agency of the programs. However the proportion for cross-sector programmatic activities were minority of overall. Of six PFPs only the commercialized forests development program is market-based and reliant on participatory approach, and its objective is obviously non public interest in ecological conservation. The recent exercise of PFPs proved that command-control approach in programs was intended to fade out of governmental direct intervention instead of to address the involvement of farmers or non-state owned entities. For example, *the Regulation for Cropland Conversion to Forest 2002* required that all farmers committed to join the CCFP must be of good and free will and sign contracts with the program offices or the subjects on their behalf. This rule was abided by in other activities of all PFPs conducted in collective-owned lands.

The implementation of PFPs being over top-down is another institutional concern. Top-down operation directly referred the financial mechanism is vertically top-down setting. Fund flows from the central down to the local, from governments to individuals. Top-down approach of PFPs also implied lack of procedures for bottom-lined communities and households/farmers to access decision making.

The weakness of institutional co-ordination could be a reflection of unadequacy in regulation for implement ting the DPCL. Implementing inter-sectoral provisions set out in the DPCl would be reliant on whether all relevant agencies keep their administration in an integrated course. In technical context, lack of regulations for technical definition on the land that DPCL aimed at to restore and protect also was an obstacle for institutional coordination. The technical approach of DPCL is

[18] See: the reports of Task Force 11 of the China Council for International Cooperation on Environment and Development (CCICED) in 2003.

to conduct soil conservation and prevent desertification off water and wind forces over scoped particular land, the 'desertified land'as the DPCL defined. Therefore definitions and classifications of 'desertification' and 'desertified land' are key terminologies for all legal instruments set by the DPCL. Technical resolution of issues about 'desertification' and 'desertified land' has to be examined and agreed among all administrative agencies and sectors by regulations under DPCL to ensure its consistent compliance. This would provide a measure to avoid of planting trees in barren deserts, or in sound grasslands and wetlands.

Another institutional issue on debate is whether forestry conservation programs or projects should be regulated by the environmental impact assessment under *the Environmental Impact Assessment Law 2002*.[19] The current situation answers not. However the environmental protection agencies poses it contrary.

Land tenure for PFPs

Possession of the world's largest population always has made China's land attained preeminent value to her citizens. According to the Constitutional Law in principle and the *Land Administration Law 1998 in specification,* all land in China can be defined into two types of land ownership, state-ownership and collective-ownership. State-owned land includes urban lands, urban outskirts and some cultivatable farmland in the country, and collective-owned land mainly includes farmlands, grasslands, other agricultural lands, which are predominantly county land owned by village collectives.[20] Under the *Land Administration Law 1998* the practice of land use planning[21] usually divides land into two categories, exploited land and non-exploited land[22]. Exploited land is further sub-grouped into construction use land and agriculture land use. [23] State-owned lands have been well regulated by a series of laws and regulations which includes land use rights (usually for 50 years or 70 years), its transferring and trading operation and estate market regulation. Collective-owned lands, mostly referred to as 'responsibilities land', have been contracted to farmers and herders since the agricultural land reforms in the 1980's. Farmer's land tenure was effectively guaranteed across the country and drove agricultural motivation to increase production. Herder's land tenure had not been as widely applied as farmland. Land use rights over collective-owned lands were non-transferable and non-tradable until the DPCL 2001. The transferable country land tenure innovated by the DPCL 2001 was further recognized by *Country land Contracting Law 2002. [24]*

Non-exploited land was initially owned by the State, and could exist for any possible use. The State may transfer land ownership to collectives or land user rights to any civil entity. In 2001 and 2002, state-owned non-exploited lands experimented to have been transferred to collective-owned or company-owned (land use rights only) for the particular purpose of combating desertification by law.[34] The State identified desertified lands in specific areas and invited civil entities to restore these lands. These entities had to prove their capacity for carrying out the work, and in return were endowed with the land user's rights for

[19] *Environmental Impact Assessment Law 2002,*was adopted at the 30th meeting of the Standing Committee of the 9th National People's Congress on 28th October 2002, and came into force on 1st September 2003.

[20] *Land Administration Law1998,* Article 8 and 9. This law was first adopted at the 16th meeting of the Standing Committee of the 6th National People's Congress on 25th August 1986, and first amended at the 5th meeting of the Standing Committee of the 7th National People's Congress on 29th December 1988, and second amended at the 4th meeting of the Standing Committee of the 9th National People's Congress on 29th August 1998. The 1998 amendment took into force on 1st January 1999.

[21] *Idem,* Chapter 3.

[22] *Idem,* Article 39-40.

[23] *Idem,* Chapter 4 and 5.

[24] Du Qun, Legal issues on land desertification in natural resource legislation in the PRC, Law Review, Law School of Wuhan University, 2004 January.

a period no less than 50 years. As most non-exploited lands lies in areas where exploitation is difficult, for example the Gobi Desert, barren lands and rocky land, land rights arrangements can be one of the most effective incentives to encourage people to participate in land desertification control. This practice of land tenure transition under the DPCL has been widely exercised in the six PFPs.[25]

Since the fund for PFPs is mostly from fiscal finance, the executive agencies-forestry authorities obviously take state-owned lands prior to collective-owned lands into account of 'desertified land" under programs. It thus inevitably happens that some land selected for programs is less considering forestry conservation than concerning to retain the fund to state-owned entities or some particular entity preferable to be engaged in the programs. The standard of payment schemes of PFPs is higher than actual yield of corpland to most remote farmers, yet the involvement to PFPs is regarded as an opportunity of a better land use. Top-down or 'command-control' approach of PFPs underlines land rights equality issue on the admission to PFPs. Social and civil issues on the rural poverty households or collective-owned lands engaging in PFPs have been observed in recent study[26].

Benefit sharing mechanism

In the period of 1998 to 2003, PFPs' forestation land had accumulated 20.09 million hectare; the total investment of PFPs reached to 94.67 billion RMB yuan, of which 83.46 % was invested by the State. 80% forestation is ecologically functioned forest/trees, and its economic benefit is only returned in 40-50 years. However, it is always a widely concerned issue that who shares economic benefit of forestation and stewardship funded by PFPs, in another word by the State? Will it be the governments (if so who is eligible representative bodies?), or the involving entities (somebody who provide the land, referring to the land users or land owners; or somebody who bring the fund/technique service)? Will fiscal investment have to occur to state-owned lands or state-run entities? If not and it should be not since the desertified land could happen to any type land, what differential principles should be brought into the law among state-ownership, collective-ownership and country land contractors? Legislation under DPCL and specialized policy for PFPs' investment, or for especially the fiscal investment is a loophole. It was obviously the underlining reason for executive agencies of PFPs not keen to invest PFPs fund to collective-owned lands, with who or which they do not have direct or indirect institutional interest.

In reality, state-owned or state-run forestry farm/enterprises no doubt have more privileges to access the fund of PFPs than collectives and farmers. However, in past three years PFPs' implementation, almost all state-owned land eligible to forestation or conservation have almost been included into programs, in which of course state-run forestry farms/enterprises exercise all works and fund. In very recent years, the forestry authority has to target PFPs on collective-owned lands. The area that the DPCL and regulations of PFPs did not cover now became a real issue to solve.

The practice under PFPs in collective lands has been found formed into several business models according to the Survey[27]: (A) the collective itself or its members direct engaging with the PFP equally to the state-owned entities; (B)

[25] It was observed in the survey of a study on the assessment of poverty alleviation effects on the PFPs, sponsored by ADB and Ministry of Finance, April-August 2004.
[26] Idem.
[27] Idem.

collective-land contractor (collective outsider) engaging with PFP[28]; and (C) the joint venture of the collective and contracted entities.

Almost 80% of PFPs-implemented collective lands were dealt with by the joint venture of the collective and the state-run forestry farm/enterprise in the past two years according to the Survey[29]. Under the joint venture agreement of the business model C, the state-run forestry/enterprise obligated to bring PFP fund to collective land and provide technical service in plantation, in turn shared 30% up to 50% benefits from future production of the forestation land under PFPs.[30] In the business model B that collective-contractors engaged with PFPs, some negative cases were discovered. Some enterprises intervened into collective land with very low contracting offer, and further approached to the fund of PFPs and did restoration the contracted collective-land, and finally transferred the land to some diary company with tripled price.[31] Yet the law and policy on PFPs have not specified rules and principles to these issues. Will the joint venture model and land contracting system under PFPs need more wise guidelines addressing social and equal land rights on forestry development? PFPs' executive agencies and social practitioners should start to be aware of it. At least a rational benefit sharing mechanism needs to be firmly emphasized in the legal framework to ensure the just ecological, social and economical achievements of PFPs.

[28] The collective-contracted outside-member means who does not have membership of the country-collective whilst with whom he/she has land-contract under the compliance with *Country Land Contracting Law 2002.*

[29] Idem Note 25.

[30] Idem Note 25. The survey in Pingquan County of Hebei Province.

[31] Data source: the Survey in2003 in Yunnan Province of the project-Yunnan Province Ten-year Planning of Animal Husbandry Industry, sponsored by Yuannan Provincial Government.

Laws to promote sustainable soils in the United States

J. William Futrell

President, Sustainable Development Law Associates, Email: Sdla2003@aol.com

Institutional arrangements to promote sustainable soils in the United States blend the actions of county, state, and federal officials in a unique effort that demonstrates the effectiveness of a federal system when the participants realize that a government of separated and divided powers calls for cooperative politics. During the last decade these arrangements and a major increase in federal funds for conservation on private lands have dramatically reduced soil erosion and promise to do more in the future. The effort to protect soil quality has focused on the agricultural sector, the leading source of erosion and water pollution from sedimentation and nutrient runoff. Future progress will depend on bringing the enforcement provisions of environmental law to bear on the sectors contributing to nonpoint source pollution: agriculture, forestry, ranching, and mining.

The Dust Bowl and the Soil Conservation Service

The institutions and laws governing soil protection in the United States were created in a time of great national crisis, the early 1930s, when the economic devastation of the Depression combined with the natural destruction of eroded soils of the dust bowl to set the stage for the New Deal of Franklin Delano Roosevelt. At the heart of the New Deal were programs to put people back to work. Agricultural support programs were key and a range of programs including price subsidies, production quotas, and central planning were enacted. The Soil Conservation Act of 1935 announced a national policy "to provide permanently for the control and prevention of soil erosion".[1]

Within a year the newly created Soil Conservation Service in the Department of Agriculture was operating 23 experiment stations, working with 454 Civilian Conservation Corps Camps, and conducting 147 demonstration projects using workers on relief in the Works Project Administration. Technical assistance to farmers voluntarily seeking to protect their land was the watchword of the SCS whose employees were missionaries seeking to persuade farmers to adapt now standard practices such as rows of trees for windbreaks, contour plowing, crop rotation and to develop new management practices for land stewardship.[2] Over the next seventy years, the SCS became an established and respected force for land stewardship in rural America. In 1994 the SCS was renamed the Natural Resources and Conservation Service in recognition of the agency's concern with wetlands and water as well as soil quality. Today the NRCS's 11,500 employees work in 3,050 field offices in almost every county in the United States. An important work is updating the National Resource Inventory, a detailed county-by-county assessment of soil quality.

The scientific and engineering expertise of the NRCS forms the background to leadership in protecting soil quality. The Service's work in establishing the universal soil loss equation to predict erosion from water and wind was the foundation for establishing a tolerance level for different types of soils that became the basis for later standard setting in state laws and in administrative regulations on agricultural subsidies.

---

[1] 16 USC 590a.

[2] See Neil Sampson FOR LOVE OF THE LAND, National Association of Conservation Districts, League City, Texas, 1985.

Federalism and The Standard State Districts Act

The problem of the recalcitrant or negligent landowner remained. The New Deal leaders correctly analyzed that a regulatory program would not be politically palatable nor would it stand up to attack in the Courts. Indeed, the U.S. Supreme Court voided significant portions of the New Deal legislation finding some acts promoting agricultural planning to be unconstitutional. Environmental programs in the United States cannot be initiated on a national level without following the Constitutional framework that separates power between the executive, legislative, and judicial branches, that divides powers between the states and the national government, and that limits the power of the national government to only those powers enumerated in the U. S. Constitution.

For years, conservatives held that the U.S. Congress lacked Constitutional authority to pass environmental regulatory legislation. The struggle with the U.S. Supreme Court was the major battle of FDR's political life. It ended only with the change of personnel on the Supreme Court, which found a basis for Congressional authority to legislate on regulation of the economy in the 1930s on civil rights in the 1960s, and on the environment in the 1970s.

However, the bias against national environmental regulation continued for years. As recently as 1960 President Dwight Eisenhower vetoed a federal clean water study bill with the message that water pollution was a distinctly local problem and not an issue for the federal government. In the 1970s Congress passed a series of bills that transformed environmental management in the United States. The Clean Water Act, the Clean Air Act, and hazardous waste laws all promulgated national standards and set up a framework for state administration of these laws overseen by the U. S. Environmental Protection Agency. No such arrangement exists to protect soil quality. The air and water programs are regulatory programs overseen by U.S. EPA. The federal programs most associated with protecting soil are lodged in the U.S. Department of Agriculture and center around economic incentives.

Indeed, at this time, soil is not seen as fragile a resource as air and water. That attitude may change during the coming decade. Under current U.S. law efforts to protect soil quality depend on the human activity involved. There are separate legal and administrative approaches to soil loss from agriculture, forestry, mining, chemical contamination, and construction activity. Indeed, to understand the legal and institutional arrangements governing soil protection efforts, we have to go back to the late 1930s.

The legal approach to soil protection was formed when the New Deal leaders sought to expand on the success of the Soil Conservation Service's demonstration projects and provision of technical advice by engaging farmers in a partnership with the agency. In February 1937, following his reelection to a second term, President Roosevelt sent a letter to all the state governors forwarding the Standard State Districts Act and recommending that each state pass a soil conservation statute and establish local districts to carry out soil protection efforts.[3]

A form of the Standard State Districts Act has been enacted in all fifty states[4], however, some have amended it to establish extensive regulatory authority[5] while

[3] Id. p.25

[4] Most states use the term soil and water conservation district; others vary calling the unit's resource conservation districts or natural resource district. The diversity reflects the fact that each state statute is different and needs to be analyzed on its own terms.

[5] Illinois Compiled Statutes, 70 ILCS 405/ Soil and Water Conservation Districts Act.

others have kept the bare bones of the original statute[6]. The Virginia statute is typical of these in that its main thrust focuses on the mechanics of establishing local soil conservation districts. The Virginia statute establishes a state Soil and Water Conservation Board with the power to approve petitions for local conservation districts.[7] The original Standard State Districts Act had recommended that the local district boundaries be tied to watersheds and that the local Conservation District have land use enforcement powers. These recommendations were seldom followed and most state legislatures created Conservation Districts along county lines, while vesting general government county officials with land use enforcement powers.

The Districts are special-purpose agencies of state government and are administered by more than 15,000 board members, an extraordinary mobilization of citizens to participate in the work of soil protection. Local districts implement farm conservation practices, work with developers to prevent soil damage at construction sites, protect groundwater, plant trees, conserve and restore wetlands.[8]

State Erosion and Sedimentation Laws

With the rising concern over environmental quality in the 1970s, people realized that soil erosion and sedimentation remained a major problem. The Council of State Governments published a model state act to prevent soil erosion.[9] The Council recommended that the proposed erosion and sedimentation legislation should take the form of an amendment to the existing conservation district's enabling laws. The Model Act calls for the State Board to adopt a statewide plan to guide the local conservation districts in a regulatory system to control prohibited land disturbing activities. To assist the conservation districts, the State Board shall develop guidelines that "contain conservation standards for various types of soils and land uses, which standards shall include criteria, techniques, and methods for the control of erosion and sediment resulting from land disturbing activities."[10]

The emphasis is on local governance. The federal government under the United States Constitution does not possess the police power, the usual governmental power used to justify regulation. In the United States, the police power is vested in the states. The governance challenge is complicated further by the fact that most states have devolved power to county and city governments under Home Rule amendments to the state constitution.

The local Conservation District in turn is charged with assessing soils in the district and promulgating standards for the district's soils and land uses, consistent with the state guidelines.[11] The heart of the Model Act is section 5 on prohibited land disturbing activities requiring any person seeking to undertake such a project to do so pursuant to a plan for erosion and sediment control approved by the District Board.

---

[6] Va. Code §10 1-500 et seq.
[7] Va Code §10 1-506
[8] National Association of Conservation Districts web site www.nacd.org/about/aboutcds.htm
[9] The Council of State Governments, 1973 SUGGESTED STATE LEGISLATION, MODEL STATE ACT FOR SOIL EROSION AND SEDIMENT CONTROL, The Council of State Governments, Lexington, Kentucky, 1973. A survey of state statutes is found in Huong N. Tran, et al., NATURAL RESOURCE CONSERVATION LAWS, U.S. Department of Agriculture, 1999.
[10] Id. §3b3
[11] Id. §4b

Illinois follows the recommended pattern. The erosion and sedimentation provisions embedded in the state Soil and Water Conservation Act[12] require adherence to a land use plan that becomes valid when approved by three-fourths of voters in the District. The statute is supplemented by regulations of the Illinois Department of Agriculture, which uses "T values" as the yardstick for regulation. "T values" are "the average annual tons per acre soil loss a given soil may experience and still maintain its productivity over an extended period of time. Both physical and economical values are considered"[13] The Code then sets a standard for soil loss on agricultural lands, stream banks, non-agricultural lands and construction sites. The standard for agricultural lands is expressed, "All conservation systems and practices applied to agricultural land in the state of Illinois shall seek to reduce soil loss to levels at or below "T" values."[14] Section 650.30 continues with a timetable to bring all agricultural land in Illinois in compliance. If the owner of eroding farmland ignores the Conservation District, it can step in and perform the needed conservation measures itself and be reimbursed for its expenses.[15]. This is a legal framework pointed toward achieving sustainable soils. The law has clearly designed standards and an enforcement mechanism. However, officials in Illinois and other states report that this enforcement provision is seldom if ever used for erosion on agricultural lands.

In most states the soil erosion statutes and implementing county ordinances are used to curb erosion from construction sites. Vermont is the rare example of a state using its regulatory authority to curb agricultural pollution[16] and this is done not by reliance on the state erosion statute but by an aggressive prosecution of erosion discharges into the waters of the state.

The Clean Water Act and Nonpoint Source Pollution

In the United States, the best strategic approach to protecting soil quality is in enforcement of water quality laws. The Clean Water Act of 1972[17] created a potentially powerful new force to control agricultural runoff and soil erosion. The purpose of the Act is to "restore and maintain the chemical, physical, and biological integrity of the waters of the United States". Everyone recognizes that sedimentation is a major source of water pollution, but for years the Act has been an unused tool in curbing erosion. Hopefully, that will change in the future. In its early years, EPA waged major political and judicial struggles to bring industrial and municipal pollution under control and made a considered policy judgment to exempt agricultural pollution from its major regulatory programs.[18]

The Clean Water Act divides water pollution into two major classes: point sources such as a factory pipe dumping directly into the waters of the United States and nonpoint sources. Congress and the EPA have established a highly effective permitting system for point source dischargers, which requires industry to use best available technology[19], but efforts to regulate nonpoint source pollution have languished.

---

[12] 70 ILCS §§405/23-25
[13] 8 Illinois Administrative Code §650.20
[14] Id. §650.30
[15] Id. §650.25
16 Interviews with officials of Vermont Environmental Court
[17] Federal Water Pollution Control Act. 33 U.S.C. §§1251et.seq.
[18] *In J.B. Ruhl,* The Environmental Law of Farms: 30 Years of Making a Mole Hill Out of a Mountain*, 31 ELR 10203 (2001), the author writes, "—farms are virtually unregulated by the expansive body of environmental law that has developed in the United States in the past 30 years."*
[19] Agricultural operations resulting in point sources such as concentrated animal feeding operations are regulated by the Act. See 68 FR 7176 Feb. 12, 2003.

Today, nonpoint sources such as urban stormwater discharges and agricultural runoff are the major sources of water pollution. Section 303(d) of the Clean Water Act requires each state, with EPA oversight, to set water quality standards, then to identify waters that do not meet these standards and to set total maximum daily loads (TMDLs) for them. Following this an implementation plan involving reduction of nonpoint sources and point sources should be set in action to bring the load of pollutants down. If the states do not act, EPA has the duty to step in and implement. None of this happened. The states and EPA ignored §303(d) for more than 20 years. No one wanted to take on agriculture.

The states and EPA's failure to address nonpoint source pollution was challenged by a series of environmental lawsuits brought by citizens in the late 1990s seeking to speed the process of setting TMDLs for the state's waterways[20]. To do this, the state had to establish an effective nonpoint source regulatory system.[21] More than 40 lawsuits have resulted in all 50 states having a TDML program, even if in name only. In 1998, EPA listed 36,000 water bodies as failing. Currently, agricultural interests and EPA are litigating every phase of the TDML program in courts across the United States in lawsuits brought by environmental NGOs.

Friends of agriculture tried to head off regulation of nonpoint sources with an amendment to the Clean Water Act in 1987 that limited EPA and the states to drafting plans to curb nonpoint source pollution.[22]

EPA and state environmental officials gradually realized what an extraordinary resource Conservation Districts presented in the struggle to curb nonpoint source pollution. Their 70 year experience with conservation plans to curb soil erosion fits hand in glove with the new interest in reducing agricultural runoff.[23] In Virginia, the State agency's strategy on nonpoint source pollution rests on engaging the Conservation Districts.

Congress gave EPA another tool to promote soil quality with passage of the Superfund Law in 1980,[24] which set up a program of emergency response for spills and a remedial action program to restore chemically contaminated soils. The saga of Superfund's trials and triumphs cannot be described here, but the EPA experience in dealing with contaminated soils on mining and industrial sites may suggest a more important role for it in future soils policy. While, the TMDL lawsuits may drag on for years, the law is clear. EPA has the duty to ensure that nonpoint source pollution is curbed.

Economic Incentives

The soil situation at the beginning of the 1980s had reached a state of quiet crisis when the United States Congress considered ways in which to strengthen the federal presence in soil protection efforts. Congress was still unwilling to use the stick of regulation to protect soil quality and turned to the carrot of economic incentives by channeling funds previously used for agricultural price supports to

---

[20] The history of the lawsuits and the regulations are analyzed in OLIVER A. HOUCK, THE CLEAN WATER ACT TMDL PROGRAM: LAW, POLICY, AND IMPLEMENTATION (2000).

[21] Many states do have measures to curb nonpoint source pollution; the problem is the political will to do the job. For a survey of these measures, see James McElfish, ENFORCEABLE STATE MECHANISMS FOR THE CONTROL OF NONPOINT WATER POLLLUTION, Environmental Law Institute, 1997.

[22] 33 U.S.C. §1329(b), FWPCA §319(b). The failure of §310 to achieve real world results because of not enough carrot and not enough stick is discussed in David Zaring, *Agriculture, Nonpoint Source Pollution, and Regulation,* 20 Harv. Envtl. L. Rev. 515 (1996).

[23] See John H. Davidson*, Conservation Plans in Agriculture*, 31 ELR 10501 (2001).

[24] Comprehensive Environmental Response, Compensation, and Liability Act, 42US C§§9601-9675.

conservation purposes. Starting in the 1930s, Congress and the U.S. Department of Agriculture created a massive system of price supports and commodity quotas in a centrally directed agriculture sector. Since 1985, some of these funds have been shifted to conservation payments with increased budgets in the succeeding Farm Bills in 1990, 1995, and 2002. The next farm bill slated for consideration in 2007 will undoubtedly continue this trend.

American farmers have made great progress in the last twenty years in curbing soil erosion. The NRCS's National Resources Inventory on soil loss reports,

> "The significant gains in erosion control that were made between 1982 and 1997 were sustained in the period between 1997 and 2001. Soil erosion on cropland declined from 3.1 billion tons per year in 1982 to 1.8 billion tons per year in 2001. Sheet and rill erosion dropped by almost 41 percent during this time period, while wind erosion dropped by 43 percent." [25]

Both government officials and private citizens attribute this to the economic incentives that empower the local Conservation Districts and the NRCS to work with farmers to improve the land and protect water quality.

The Food Security Act of 1985 created the Conservation Reserve Program[26], which linked farmers' eligibility for government aid through price supports and crop insurance to their conservation performance. A swampbuster provision blocked funding for farmers who drained wetlands and a sodbuster provision did the same for farmers bringing highly erodible land into production. The original Conservation Reserve Program of 1985 paid farmers to withdraw highly erodible land (sodbuster) or wetland (swampbuster) on a 10 to 15 year contract. For the first time, Congress enacted a sanction for noncompliance; a farmer who violated the agreement became ineligible for funds. In Horn Farms v Johanns,[27] the Seventh Circuit held that a farmer who converted wetlands on his land to agricultural use became ineligible for federal agricultural subsidies under the swampbuster legislation.

For political reasons, Congress placed the administration of the program with the Farm Services Agency, an agency focused on disbursing funds from the plethora of diverse subsidies disbursed by the Department of Agriculture (USDA). As originally administered by the FSA, grants were not targeted to priority lands. With each Farm Bill, Congress became more focused on requiring strategic application of funds[28] and fine tuned the system. With each successive farm bill, Congress created new conservation programs and escalated funding levels, but placed many of the programs in the Natural Resources and Conservation Service, which has increasingly become a more programmatic agency, carrying out projects and not just offering advice.[29] Examples of such targeted efforts are the Environmental Quality Incentive Program (EQIP)[30], Wetland Reserve Program[31], and Wildlife Habitat Incentives Program[32] administered by the NRCS. Each program's goals, methods, and requirements vary and are established by USDA regulations.

---

[25] Natural Resources Conservation Service, NATIONAL RESOURCES INVENTORY 2001 NRI, accessed at http:\\www.nrcs.usda.gov.
[26] 16USC§3831.
[27] 35 ELR 20025a (2005).
[28] See General Accounting Office, STATE ADVISORY COMMITTEES VIEW ON HOW USDA PROGRAMS COULD BETTER ADDRESS ENVIRONMENTAL CONCERNS, GAO-02-295, February 2002
[29] The programs are found at 16 U.S.C. Chapter 58, Erodible Land and Wetland Conservation and Reserve Program, 16 U.S.C. §§3801-3839.
[30] 16USC§3839aa.
[31] 16US §3837.
[32] 16USC§3839bb-1.

Enforcing compliance with the agreements has been problematic. The NRCS is responsible for compliance reviews to see if the farmer is carrying out the agreed upon management practices and that erosion is being curbed, while the Farm Services Agency (FSA) is responsible for withholding payments for noncompliance. A survey by the General Accounting Office, an oversight agency of the U.S. Congress, found that the FSA waived NRCS's noncompliance recommendations in 4,948 out of 8,112 appeals by farmers.[33] The FSA structure follows that of the NRCS with an FSA office in almost every county in the United States disbursing government payments. The FSA district is governed by a locally elected board. The GAO report concluded that these locally elected boards are reluctant to take funds away from their neighbors.[34]

From the beginning the Soil Conservation Service had entered into cost share agreements. The expanded conservation funding allowed a dramatic expansion that revitalized private sector efforts for soil protection.

Cooperative Governments and Dynamic Federalism

The increased activity available because of these funds has pumped new life into the activities of the Conservation Districts. The interplay of officials at the county, state, and federal level demonstrates the strength of federalism in achieving national goals with a mobilized citizenry at the local level. The NRCS's 11,500 employees work in 3,050 field offices and interact with the 8,700 employees of the State and Conservation District offices. More than 15,000 volunteers serve in elected or appointed positions on Conservation Districts' governing boards. They work directly with more than 2.3 million cooperating land managers nationwide, and their efforts touch more than 778 million acres of private land.

The institutional arrangements are not simple. Within each state, there are two parallel hierarchies, one in state government, the other in the federal agencies. For instance, in Virginia, the Director of the Department of Conservation and Recreation appoints a Director for the Division of Soil and Water, who oversees the state employees who coordinate the activities of the local Conservation Districts, which are staffed by District employees and governed by board members elected by District voters. The budgets of the Conservation Districts come from a mix of county and state funds.

On the federal side, the NRCS State Conservationist administers a staff who serve in the field in each of the states counties and Conservation Districts. In most counties, they are in the same office space as the staff of the local Conservation District and work closely with them. Observers who are familiar with the often uneasy interactions of state and federal workers in the EPA programs are struck by the closeness of cooperation between county, state, and federal offices in the farm programs. In the state capital a program staff oversees the core programs that the Service has been conducting for years: soil surveys, demonstration projects, and cost share agreements.
What has changed is that the expanded funding that started in 1985 with the Conservation Reserve Program has now grown as new programs such as EQIP, Conservation Security Program, and Wetland Reserve Program have been added. The heart of the new conservation funding is the cost share grant for a conservation project between the NRCS and the private landowner. The NRCS Manual calls for the process to be initiated at the local Conservation District level with hearings in which needs are assessed and projects suggested. The Conservation District forwards its suggestions to a US Department of Agriculture

[33]GAO-03-418, April 21, 2003,
[34] Id. p.6.

working group, which makes recommendations to the state NRCS technical committee. This technical committee includes not only NRCS and FSA staff but also has representatives of the state's agencies insuring a mesh between federal and state efforts at the state capitol level as well as at the Conservation District. The State Conservationist forwards the prioritized recommendations to NRCS headquarters where decisions are made which assess the cumulative needs at the national level and allocate funds on the basis of where they can do the most good. The same process is followed in reverse with the NRCS representative and the landowner in the cost share agreement entering a contract for funding and a conservation plan to improve the land.[35] Within each program, different national priorities may limit the discretion of the State Conservationist and NRCS field staff. For instance, Virginia receives its EQIP funds from Washington, with instructions that at least 60% of them must be used for animal operations. This stricture is followed in allocating the funds to the field.

Agricultural Subsidies and the WTO

Many observers believe conservation funds will be greatly expanded in the 2007 Farm Bill because of the current disputes in the World Trade Organization. The heavy subsidies Congress pays to American farmers are skewed in favor of a few select crops in an attempt to make them competitive for export. Title I of the Farm bill provides subsidies for commodity producers of cotton, soybeans, rice, wheat and corn and is intended to keep these crops competitive with the rest of the world's production of these commodities. Growers of produce such as lettuce, tomatoes, grapes do not receive funds[36]. Title II is composed of conservation funds and grants that can go to both kinds of farmers. Brazil has attacked Title I payments at the WTO and African countries have protested U.S. subsidies for cotton.[37] Many think the growth of the global trading system depends on branding these subsidies as unfair trade practices. Conservation payments are not considered such trade distorting subsidies and are labeled as Green Box measures by the Agreement on Agriculture. Many European countries are bolstering their agricultural sectors in this way.

The Road Ahead: Politics and Sustainable Agriculture

Despite the great gains since 1985, the loss of soil and the pollution of waterways by agricultural effluents remain deeply disturbing. The NRCS Strategic Plan reports that 232 million acres of cropland, 280 million acres of rangeland, and 222 million acres of private forestland are in need of conservation treatment.[38] The Plan envisions a greatly accelerated pace of activity and increased funding for conservation.

And yet, the NRCS faces an enormous backlog in applications for assistance. Because farmers seeking to enroll in these programs face a $3 billion backlog, four-out-of-five of their applications are annually rejected. The lines are being drawn for the debate on the 2007 Farm Bill in this year's budget. The Grassley-Dorgan bill, S. 385 would limit Title I commodity subsidies sharply, thus making more money available for conservation funding. A coalition of environmental organizations is seeking to mobilize public support.[39]

---

[35] US Department of Agriculture, NATURAL RESOURCES CONSERVATION SERVICE GENERAL MANUAL, 440-CONSERVATION PROGRAMS MANUAL, www.nrcs.usda.gov/scripts/lpsiis.dll/GM/GM.html.

[36] See Timothy Egan, *Subsidies Rest on What Kind of Row You Hoe*, N.Y.TIMES, Feb. 18, 2005.

[37] See Vance E. Hendrix, *The Farm Bill of 2002, the WTO, and Poor African Farmers: Can They Coexist,* 12 Tulsa J. Comp. & Intnl. L. 227, Fall 2004.

[38] NATURAL RESOURCES CONSERVATION SERVICE STRATEGIC PLAN 2000-2005, pp. 12, 17, and 21.

[39] American Farmland Trust, Environmental Defense, *Diverse Voices Find Common Ground at Farm Policy Reform Leadership Summit*, accessed at www.farmland.org.

But even if funding were increased to a sum that would fund the hundreds of millions of acres that need conservation treatment, an unlikely event considering the unwillingness of Congress to pay for environmental services, the problem of the recalcitrant or negligent landowner remains. A leading commentator on agricultural law observes, "A weak point in the erosion control effort has been its dependence on voluntary action. Thus, those who are conservation minded from the outset tend to participate while those with erosion prone land and a disinclination toward conservation remain untouched. The latter group has the clear majority."[40]

The growth of conservation funding in the farm bills demonstrates the national commitment to investing in sustainable soils. In time, Congress may demand that the states protect that investment with strengthened regulatory controls at the state and county level to curb soil deterioration,[41]perhaps by barring distribution of conservation funding within states that do not adequately enforce their erosion and sedimentation laws. The current attitude of the Bush administration and Congress is that if the public wants to abate nonpoint source pollution, then the public should pay for it. EPA has the potential to make a valuable contribution in devising a regulatory strategy on nonpoint source pollution; a strategy that would be implemented by the states. Looking beyond the Farm Bills, the spotlight is on state leadership. The partnerships formed by the NRCS, the states, and the Conservation Districts offer an avenue for creative federalist endeavor. They have achieved much. They can achieve more.

[40] John H. Davison, *Sustainable Development and Agriculture in the United States,*32 ELR 10543, 10556 (2002).
[41] J.B. Ruhl, *Farms, Their Environmental Harms, and Environmental Law,* 27 ECOL. L. Q. 263 (2000) argues that the time has come to devise a two tier system of regulation, one fashioned for agroindustry (In 1997 about 157,000 large farms, with annual agricultural sales averaging about $900,000,accounted for 8% of all U.S. farms but 72% of all farm sales.) and the other, for smaller farms, would rely on a mixture of incentives.

Legal methods and strategies to promote the sustainable use of soil: 'Integrated Environmental Management' in New Zealand

David P Grinlinton

Associate Professor of Law, The University of Auckland, New Zealand. Email: d.grinlinton@auckland.ac.nz

This paper focuses on the legal and policy reforms in recent years in New Zealand which have attempted to integrate the principle of "sustainable management" into the use of air, land and water resources. The statutory purpose of the main legislative regime regulating natural resource use (the Resource Management Act 1991) is to "promote the sustainable management of natural and physical resources". This applies to (amongst other things): policy formulation, planning and decision-making on the use of soil and water resources at all levels of management, including central government, local government and the specialist Environment Court. The system strives to achieve "integrated environmental management" in the pursuit of sustainable management, and provides a useful blueprint for examination and possible adoption in other jurisdictions.

Introduction

Although the subject-matter of this Workshop is not focused primarily on Iceland, it is interesting to draw some parallels between this country and my own. Australia and New Zealand are often referred to as the "Antipodes". Greek in origin, the word means "any two places or regions that are on diametrically opposite sides of the earth". New Zealand and Iceland fit that description, although the exact "antipode" of Iceland lies somewhere in the Southern Ocean between New Zealand and Antarctica. We are both island nations surrounded by ocean. Our climates are described as "temperate". We both rely on primary resources for a large part of our export income. In Iceland's case, fisheries. In New Zealand's case, dairy products, frozen meat, forestry and also fisheries. We are both mountainous countries with glaciers, fjords and geothermal features. Our populations are low and dispersed, of largely European origins, highly independent and self-sufficient, and with a strong democratic tradition. We don't suffer greatly from industrial pollution. And, we are largely self sufficient in primary energy, utilizing hydro and geothermal resources for most of our electricity production.

There are also many differences. Iceland is at a significantly higher average latitude than New Zealand. Population density is around one fifth that of New Zealand. GDP is higher; unemployment lower. New Zealand's indigenous peoples, the Maori, comprise around 15% of the population, and maintain a rich and unique cultural identity. There is also a strong Pacific Islands' influence, and with recent immigration, an increasingly diverse ethnic and cultural mix. Tourism is a rapidly developing industry. Of direct relevance to this Workshop, New Zealand has considerably more forest and bush cover than in Iceland. Nevertheless, as with Iceland, soil erosion and soil degradation is an increasingly problematic issue, along with biodiversity, managing human impact including urban sprawl, and providing for "sustainable development".

Over the last two decades New Zealand has pursued a very active program of environmental and resource management reform. It has involved change at every

level, from central and local government administrative restructuring, through legislative reform, to operational management at the local authority and municipal level. In the context of sustainable management and conservation of soil resources New Zealand has progressively introduced a number of policies and legal measures which take an integrated approach to land and water management incorporating the principles of "sustainability" and the "precautionary approach". This paper will outline a number of those measures which may provide something of a model or blueprint for the use of legal methods to achieve integrated and sustainable soil management in other jurisdictions.

The soil problem

The science and technical aspects of soil erosion and degradation, and possible responses, will no doubt be covered much more effectively and comprehensively in other papers given at this Workshop. However, a brief summary of the main issues in New Zealand is useful to put the legal and policy responses in context. The following particular problem areas have been identified:[1]

- Erosion, including surface, mass movement, fluvial and stream bank erosion;
- Loss of carbon and organic matter;
- Compaction and loss of soil structure;
- Nutrient depletion;
- Soil acidification; and
- Chemical contamination from industry and agriculture.

Geologically New Zealand is a relatively young country born of active tectonic movement in the subduction zone where the Pacific plate is forced beneath the Indo Australian plate. Along with faulting and folding, glacial scouring and volcanic activity, this process has created a physically diverse country of soaring mountains, swiftly flowing rivers, heavily indented coastal topography, and highly mixed geology.[2] Over two-thirds of New Zealand has slopes of greater than 12 degrees, and nearly one half of the country greater than 28 degrees. Three fifths of the country has a vertical elevation over 300 metres, and one fifth over 900 metres.

Prior to human settlement, 78% of New Zealand was under forest cover. Since Polynesian, and later European settlement, only 24 % of the natural forest cover remains, with a further 6% covered by planted production forest.[3] European settlement from the early 19th century resulted in the rapid conversion of forested land into cleared pasture and open farmland, which now comprises 51% of New Zealand's land area. Add to these factors that almost 75% of New Zealand is covered by easily eroded sedimentary rock and soils and has a relatively high annual rainfall of between 600 and 1600 mm, rising to 10-12,000mm in the Southern Alps, and one can see why soil erosion has long been a major problem in New Zealand.[4]

---

1 See Ministry for the Environment, *Sustainable Land Management Strategy*, (1996), available at http://www.mfe.govt.nz/issues/land/soil/strategy.html

2 Statistics New Zealand, "Quick Facts", available at http://www.stats.govt.nz/quick-facts/land-envmt/geology-and-soils.htm

3 See, Statistics New Zealand, "Quick Facts", available at http://www.stats.govt.nz/quick-facts/land-envmt/environmental-and-resource-mgmt.htm

4 For a concise summary of the problem of soil and coastal erosion in New Zealand, see P Ali Memon & H Perkins, *Environmental Planning and Management in New Zealand* (2000, Dunmore Press Ltd, Palmerston North), at pp 148-149, and 152.

Early responses

The importance of preservation and proper management of forest cover was recognised very early in New Zealand with the passage of The New Zealand Forests Act 1874, the preamble to which stated:

> Whereas it is expedient *to make provision for preserving the soil and climate by tree planting*, for providing timber for future industrial purposes, for subjecting some portion of the native forests to skilled management and proper control, and for these purposes to constitute State Forests. [Emphasis added]

Although the measure also had a developmental purpose, it was relatively effective in slowing the rate of soil erosion in areas that had suffered loss of forest cover since human settlement. On the down-side, the progressive introduction of "plantation forests" using non-native species such as radiata pine and douglas fir have been counterproductive in some areas as their high water demands have caused downstream loss of vegetation cover and increased susceptibility to soil erosion and leaching. Other early measures often focused on specific land, water and vegetation issues in an isolated way.[5]

In 1941 a "new era"[6] of integrated soil and water conservation began with the passage of the Soil Conservation and Rivers Control Act. This measure was designed to promote soil conservation, prevent and mitigate soil erosion, and prevent damage by flooding. The system was aligned to natural catchment areas to better reflect the natural processes relating to water and soil. It gave wide powers to various "catchment authorities" to organize and carry out soil conservation, river control and drainage works. The measure had mixed success often due to parochial interests, the political strength of private landowners, and the multitude of different authorities involved in administering the Act.

The Water and Soil Conservation Act 1967 took the integrated approach a step further, by removing common law rights to water and vesting control of water "in its natural state" in the Crown. Users had to obtain licences from the relevant local catchment authorities, which were reconstituted as Regional Water Boards. The system was of limited success in controlling soil degradation for similar reasons to the Soil Conservation and Rivers Control Act, and also because the main focus of the Act was on the *use of water*, rather than protection of soil. Town planning legislation[7] imposed some control on land uses causing soil degradation and erosion. Again, however, these measures suffered from a top-heavy bureaucracy, artificial divisions of responsibility for land and water use, and a pro-development ethos.[8]

The causes of soil degradation are multi-faceted reflecting complex biological, chemical, geological, geomorphological, hydrological, atmospheric, and climatological factors and interrelationships. As well there are various economic, demographic and sociological factors that influence the location and extent of human activity impacting upon soils. An effective soil management structure must reflect these interrelationships at all levels of law and policy.

---

5 For example, the Public Reserves Act 1881, Land Acts of 1877, 1885, 1924 and 1948, State Forests Acts of 1885, 1908, and Forests Act of 1921 and 1949.

6 I L Baumgart & P A Howitt, "Trends in Law Relating to Conservation and Preservation of Natural Resources", (1979) 2 *New Zealand Journal of Ecology* 67 at 68.

7 Such as the Town and Country Planning Acts of 1953 and 1977.

8 See Baumgart & Howitt, supra n 6, esp at pp 68-70, and K A Palmer, *Planning and Development Law in New Zealand, Vol II,* (2nd ed, 1984, Butterworths, Wellington), esp at pp 830-845.

'Integrated Environmental Management' in New Zealand

In recent years New Zealand has attempted to create a policy and regulatory structure that reflects the complexity of environmental interactions in the broader context of land, air and water use. Such "integrated environmental management" must be applied not just to isolated statutory measures, but across the full spectrum of administration, regulation and implementation, including:

- administrative structures,
- policy-making and planning,
- legislation and regulation,
- processes of participation and decision-making, and
- operational implementation including environmental monitoring, impact assessment and enforcement of actions and responsibilities.

A number of central government administrative reforms took place in New Zealand in the mid-1980s, including:

- Establishment of a "Ministry for the Environment" under the Environment Act 1986;
- Creation of the Office of the Parliamentary Commissioner for the Environment (or "Environmental Ombudsman") under the same Act;
- Establishment of a Department of Conservation under the Conservation Act 1987 to manage New Zealand's `conservation estate';[9] and
- Local government reform with the rationalisation and restructuring of regional government and municipal authorities.

In the late 1980s and early 1990s the government, through the newly created Ministry for the Environment, proceeded to develop and implement a range of new policies and legislation. Underlying these environmental reforms was the desire to incorporate the normative principles of "sustainability" and the "precautionary approach" at every level of environmental and resource management.[10]

The Resource Management Act 1991 ("RMA") was central to the reforms. It attempted to integrate into one statute the law relating to the management of land, air and water and replaced over 50 other Acts dealing with these matters.

The RMA has as its central purpose " ... the sustainable management of natural and physical resources" (s 5(1)). All functions and decision-making carried out under the Act must be guided by this purpose, and must actively promote it. In this sense the Act itself provides a powerful statement of government policy.

The RMA creates a vertically and horizontally integrated structure for environmental management. Under the Act central government may promulgate "National Policy Statements" and "National Environmental Standards" pertaining to various aspects of environmental protection and natural resource management. Strategic planning and operational management of land air and water resources is largely devolved to regional councils and municipal authorities (city & district councils). [11] Regional councils have largely taken over the roles of

---

9 The `conservation estate` comprises approximately 30% of New Zealand's total area and includes reserves, parks, most of the coastline, and other publicly owned land.

10 For an account of the reform process see D Grinlinton, "Contemporary Environmental Law in New Zealand", in K Bosselmann & D Grinlinton, *Environmental Law for a Sustainable Society*, NZCEL Monograph Series, Vol 1 (2002, NZCEL, Auckland), at 19-46. See also Williams *et al, Environmental and Resource Management Law in New Zealand*, (2nd ed, 1997, Butterworths, Wellington) chapters 2 and 3.

11 See Palmer *Local Government Law in New Zealand,* (2d ed, 1993, Law Book Co, Sydney) at 564-568, and Grinlinton, ibid, at 19-20. Regional government is the middle level of government

Regional Water Boards under the old water and soil conservation legislation. They now have primary responsibility for managing water use and discharges into water, and uses of land that have regional significance. This includes soil conservation and erosion control measures. District and city councils have primary responsibility for land use and subdivision, air use and discharges of localised significance.

Coastal management policy is primarily the responsibility of central government through the Department of Conservation although some management of the coastal area is delegated to regional councils. Coastal erosion is managed through this Department of Conservation/Regional Council management structure.

The use of land, air and water is controlled through the specific provisions in the RMA itself; through policies contained in "Policy Statements" prepared by central and regional government; and through detailed rules contained in Regional and District Plans prepared by regional and territorial authorities. This hierarchichal policy and planning structure is both vertically and laterally integrated. The RMA requires that Regional Policy Statements must "give effect to" National Policy Statements.[12] Similarly, Regional and District Plans "must not be inconsistent with" higher level Policies and Plans.[13]

People wishing to undertake activities with environmental effects are required to apply for "resource consents".[14] Often a number of different resource consents may be required for a particular activity. For example, a factory may require a range of land use permits, water use permits and discharge permits to operate.

These permits will often be required from different consent authorities. Under the RMA, further integration of decision-making is providing for by "joint hearing committees" made up of representatives of the various consent authorities, and which can conduct hearings and grant all resource consents required in one hearing and decision-making process.

When publicly notified, hearings for applications are open to objections and submissions by any person without the need to have *locus standi* ('standing').[15] Appeals may be brought to the specialist Environment Court[16] by any party. Further appeals may be made to the ordinary Courts on points of law.[17]

Soil conservation under the RMA structure

General provisions

Part III of the RMA contains a number of enforceable "duties and restrictions". Section 9 prevents the use of land in a way that breaches the Act itself, any regional or any rule in a regional or district plan unless a resource consent is

---

comprising some 12 regional councils covering the entire country. Municipal ("Territorial") authorities (City and District councils) are the lowest level of government comprising some 72 municipalities.

12 RMA, s 67(2).

13 RMA, s 67(2)(b) & 75(2).

14 "Resource consents" include land use consents, subdivision consents, water permits, coastal permits and discharge permits under the RMA: ss 2 & 87.

15 Traditionally under the common law, "standing" requires the litigant to have a property interest or some special interest greater than the general community. While "any person" can theoretically make submissions and objections to proposed plans, and also to resource consent applications that are publicly notified, in reality less than 5% of resource consent applications are notified, so "open participation" is an illusion!

16 The Environment Court (previously the Planning Tribunal) is a specialist judicial body set up to arbitrate and adjudicate on environmental disputes (Part XI, RMA).

17 RMA, ss 299 & 301.

obtained. Even more onerous are the prohibitions in ss 12, 14 and 15, on coastal activities, water use, or discharges of contaminants into water or into the atmosphere unless permitted in a plan, or a resource consent is obtained.

Furthermore, s 17(1) of the RMA provides:

> Every person has a duty to avoid, remedy, or mitigate any adverse effect on the environment[18] arising from an activity carried on by or on behalf of that person, whether or not the activity is in accordance with a rule in a plan, [or] a resource consent, …

This general duty can be enforced through "abatement notices" issued by a regional council or territorial authority, or "enforcement orders" issued by the Environment Court. Failure to comply with these orders constitutes an offence under the Act leading to the possibility of imprisonment or heavy fines.[19]

Central government policy and guidance

There are as yet no "National Policy Statements" or "National Environmental Standards" specifically on soil conservation produced under the RMA. This is something of a failing of the RMA system. There are, however, a number of other statements and documents provide guidance to regional councils and others.

In the global context, New Zealand is a signatory to a number of international statements of policy and agreements which include references to the prevention and management of soil degradation. These include the *World Conservation Strategy* (1980), the "Brundtland Report" (*Our Common* Future),[20] the *Rio Declaration on Environment and Development* (1992)[21] and *Agenda 21* (1992).[22]

Following on from the *Rio Declaration* and *Agenda 21*, in 1995 the Government produced the *Environment 2010 Strategy*[23] which contained a number of environmental goals, including:

> Goal 6.1: To maintain and enhance the quality, productivity and life-supporting capacity of our soils, so that they can support a variety of viable land use options.

In 1996 a more detailed *Sustainable Land Management Strategy for New Zealand*[24] was implemented by the Government. While only a "soft law" policy

---

18 "Environment" is defined in s 2, RMA, to include "ecosystems and their constituent parts", and "all natural and physical resources". The latter is further defined to include "land, water, air, soil, minerals, and energy, all forms of plants and animals … and all structures".

19 The RMA provides very strong enforcement mechanisms, including imprisonment for up to 2 years, fines up to $NZ200,000, strict liability and vicarious corporate liability. To date, there have only been 3 prison sentences imposed on environmental offenders: In *Franklin District Council v McCollum* (District Court, CRN 3057005960, 14 February 1994), a pig farmer was convicted, fined $5,000 and sentenced to 6 months imprisonment for allowing pollution, but the sentence was suspended; in *R v Borrett* [2004] NZRMA 248 the Court of Appeal upheld a sentence of 3 months for illegal earthworks and removal of protected native vegetation); and in *R v Conway* [2005] NZRMA 274 the Court of Appeal upheld a sentence of 3 months for pollution of waterways with oil and fuel. In all cases the offences were at the serious end of the spectrum and involved almost complete disregard for the law.

20 World Commission on Environment and Development, *Our Common Future* (1987, Oxford University Press, Oxford).

21 Agreed at the United Nations Conference on Environment and Development, 3-14 June 1992, Rio de Janeiro, Brazil.

22 Ibid.

23 Ministry for the Environment, *Environment 2010 Strategy: A Statement on the Government's Strategy on the Environment* (September 1995, MfE, Wellington).

24 Ministry for the Environment, *Sustainable Land Management Strategy*, (1996, MfE, Wellington): http://www.mfe.govt.nz/issues/land/soil/strategy.html

statement, it does provide background guidance to councils when preparing their policy statements and planning instruments.

This was followed in 1997 by *The State of New Zealand's Environment*.[25] This provides an updateable "stocktake" and extensive scientific analysis of New Zealand's atmosphere, land, waters and biodiversity. Chapter 8 covers New Zealand's land environment, and includes a comprehensive section on "The State of Our Soils".

The Government has also produced a very comprehensive *Soil Conservation Technical Handbook*[26] which comprises a comprehensive collection of information about soil conservation in New Zealand, including "best practice" soil conservation techniques.

The scientific agency, NZ Landcare Research, administers the *New Zealand Land Resource Inventory*.[27] This is a spatial database containing around 400 maps and worksheets covering the whole of New Zealand. The maps describe parcels of land in terms of five characteristics or attributes: rock; soil; slope; erosion; and vegetation. The database can be used for determining soil types and characteristics, and to make land use capability assessments in specific areas.

All of these materials, however, are of only persuasive force for councils preparing Policies and Plans. If such measures as the *Sustainable Land Management Strategy* were promulgated as National Policy Statements, then Regional Policies and Plans would have to comply with them.

Regional Council responsibility

Under s 30(1)(a) of the RMA, Regional councils are required to establish and implement measures to achieve "integrated management of the natural and physical resources" of their region. Section 30(1)(c) specifically mandates them to "control … the use of land for the purpose of … soil conservation".

An example of how this is achieved under the RMA structure can be found in the Auckland Regional Council's *Regional Policy Statement*[28], and its *Proposed Auckland Regional Plan: Air, Land and Water*.[29]

In the *Policy Statement,* chapter 13 is devoted to soil conservation. It sets out the background to soil resource issues and problems in the Auckland region; specifies a number of objectives for soil protection mitigation of soil degradation; and then sets out the policies and methods to achieve those objectives. Policies include:[30]

- protection of soils from new activities which are not functionally dependent on, or adversely affect, the productive capacity of soils;
- location of activities not dependent upon the soil resource on poorer quality land;
- preference for urban expansion to be restricted to land with the lowest capability for agricultural production;
- control of clearance of protective vegetation to avoid soil erosion;

---

25 Ministry for the Environment, *The State of New Zealand's Environment*, (1997, MfE, Wellington): http://www.mfe.govt.nz/publications/ser/ser1997/html/entry.html

26 Ministry for the Environment, *Soil Conservation Technical Handbook* (June 2001, MfE, Welington), available at: http://www.mfe.govt.nz/publications/land/soil-conservation-handbook-jun01/index.html

27 Available at: http://www.landcareresearch.co.nz/databases/nzlri.asp

28 Auckland Regional Council, *Auckland Regional Policy Statement* (1994). Available at: http://www.arc.govt.nz/arc/index.cfm?FFD47E84-48A8-4396-8A35-781BB944C63C

29 Available at: http://www.arc.govt.nz/arc/publications/regional-policy-and-plans/proposed-arp-alw.cfm

30 Supra, note 28, at pp 13-1 – 13-5.

- control of the excavation of topsoil to minimize soil degradation; and
- promotion of sustainable land use practices to minimize soil degradation and adverse effects on water quality.

Methods to achieve these policies include:[31]

- through appropriate rules in Regional and District Plans;
- development of a regional database identifying high productive value soils and areas of susceptibility to soil degradation;
- initiation of a regional landcare programme for wise land use;
- provision of a soil conservation advisory service;
- an education programme; and
- provision of financial incentives to promote soil conservation initiatives of regional benefit.

The *Regional Plan*, which "must not be inconsistent with"[32] the *Regional Policy Statement* sets out more detailed and specific objectives, rules and procedures for undertaking specific activities. For example, Chapter 5 covers "Discharges to Land or Water". It recognizes the power of the regional Council under s 30(1)(c) of the RMA, to "control the use of land for soil conservation", and the restrictions on land use and discharges in ss 9 and 15 of the RMA. In paras 5.5.31 and 5.5.32 it sets out a range of "Permitted" and "Controlled" Activities. Permitted Activities are those that can be carried on by a landowner within certain specified limits within the plan, and include:

> 5.5.31 The cultivation of soil for commercial crop production and associated management of surface water and discharge of sediment [provided];
>
> - Soil stabilizing vegetation is retained up to 5 metres from inland water bodies, and to 10 metres from the coastal marine area;
> - The slope is less than 15º (27%);
> - The land not be exposed for more than 30 days between 30 April and 1 October (Autumn/Winter); and
> - That appropriate surface water management measures be implemented to prevent significant off-site movement of soil and sediment.

Controlled Activities are those that require the landowner/user to apply for resource consent from the Council, and in this case are:

> 5.5.32 Any cultivation of soil for commercial crop production that does not comply with Rule 5.5.31.

In the process of granting consent to Controlled Activities the Council has control over a number of matters, including:

- Soil conservation measures for minimizing off-site movement of soil;
- Alternative cultivation practices to minimize soil disturbance;
- The use and extent of cover crops;
- The length of time the soil surface is left unvegetated;
- The provision of a Surface Water Management Plan;
- Slope length and angle to minimize erosion;
- When the activity is undertaken;
- Monitoring; and
- Effects on adjacent management areas.

---

31 Ibid.

32 RMA, s 67(2)(b).

There are other Rules in the Plan that deal with matters relating to soil conservation and degradation issues but time and space precludes their consideration.

The integrated nature of the system is further illustrated by the resource consent application procedure. Applications for resource consents may be made on a publicly notified or non-notified basis in accordance with statutory notification criteria. The Council hears the application and, where notified, "any person" may make submissions. The decision must be made in accordance with the statutory purpose of "promoting sustainable management" and in accordance with the objectives and criteria in the Plan. The Plan, in turn, must not be inconsistent with any higher level regional or Government Policy statements, and is also subject to the sustainable management purpose. The decision can be appealed to the specialist Environment Court by both the applicant and any objectors. This appeal can be on both law and merits issues. The Environment Court is also bound by the sustainable management purpose of the Act. Further appeals to the High Court and Court of Appeal can only be on matters of law, including judicial review.

Other provisions and initiatives relevant to soil conservation

Conservation land

The RMA has only limited effect in National Parks, Reserves and other public lands administered by the Department of Conservation. These lands comprise collectively around 30% of New Zealand's land area.[33] However, the Conservation Act 1987 sets out a very similar system of land management policy-making and planning as under the RMA. People wishing to undertake activities on DoC land are required to comply with these policies and plans, and to apply for licences or "concessions". These applications are rigorously assessed for compliance with the conservation principles in the legislation, and any relevant polices and plans.

There are also a number of quasi-governmental initiatives and non-governmental organizations involved in promoting soil conservation awareness and implementing practical measures.
For example, the Ministry for the Environment works closely with the private sector, the Department of Conservation and the Gisborne District Council to implement The East Coast Forestry Project. Set up in 1992, the project aims to plant 60,000 hectares of commercial forest over the next two decades on some of then most severely eroded land in the East Coast of the North Island. Landholders tender for government grants to fund the cost of establishing and managing the forest.[34]

Similarly, the New Zealand Landcare Trust was formed in 1996. It is a non-governmental organization funded by the Ministry for the Environment, and a corporate sponsor, Transpower New Zealand. Its purpose is to facilitate sustainable land management in association with rural communities.[35]

The Trust provides support and information to assist individuals and community groups to manage their land more sustainably. Grants are made for re-vegetation and other works which will improve soil conservation. There are over 250

[33] For information on DoC's conservation responsibilities, see: http://www.doc.govt.nz/index.html
[34] Further information on this initiative can be found at: http://www.maf.govt.nz/Forestry/forestmanagement/ecfp/index.htm
[35] For further information on the Landcare Trust, see: http://www.landcare.org.nz/

Landcare groups around the country and, according to Landcare's website and supporting materials, the initiative has been very successful.

Conclusion

There is no simple answer or universal model to address the challenge of sustainably managing and conserving the world's soil resources. International agreements, conventions and strategies such as the *Rio Declaration* and *Agenda 21* provide States with some normative guidance. However, the difficulty is to implement these global themes at the national level in an effective way that recognizes the complexity of the problem, and in particular, the geophysical, ecological and sociological interactions and influences that contribute to it.

An "integrated" problem requires an "integrated" solution. Integration must occur at a number of levels. First, and probably foremost, any system for the management and conservation of soils must have strong normative guiding principles. "Sustainability" and the "precautionary approach" provide these. Secondly, these principles must be fully integrated into every level of administration, policy-making, regulation and implementation of the system. Thirdly, the system itself must be part of an integrated environmental management structure reflecting the interrelatedness of soil health with other aspects of the biosphere.

New Zealand has implemented such a system. The pre-existing regime required significant reforms, including the integration of administrative structures at central and local government levels, and integration of environmental and resource legislation. The main environmental statute resulting from the reforms, the Resource Management Act 1991, has as its core purpose the "sustainable management of natural and physical resources", of which the obligation under s 5(2)(b) to "safeguard the life-supporting capacity of … soil" forms a fundamentally important component. The Act provides a vertically and horizontally integrated policy-making, planning and decision-making structure, and effective means of dispute resolution and enforcement. While not without some flaws, it provides an interesting and reasonably effective example of integrated environmental and natural resource management based on sustainable management.

The Development of EU Soil Protection Law

Dr. Irene L. Heuser

Kurstraße 9 14129 Berlin, Germany, Email: Irene.Heuser@lv-bb.brandenburg.de

Abstract

At EU level protecting our soils against biological, chemical und physical damage does so far not take place in a systematical way. A turning point was marked by the 6th Environmental Action Programme with the intention to develop a specific EU strategy for soil protection. Effective models for the further development may be seen in existing legislation of EU Member States as well as international organizations. According to reflections de lege ferenda, principles and instruments of EU soil protection law could be developed on the basis of direct and indirect possibilities of regulation. The main focus could be concentrated on the instruments of planning, responsibilities, legal standards and economic solutions of soil protection. These general considerations should be evaluated with regard to the EU competences and the principle of subsidiarity.

Introduction

Since the beginning of the 1970's the European environmental policy increasingly committed itself to cleaning air and water, whereas only in recent years the problem of the protection of soils has attained more awareness. Due to the previous use of the medium soil which predominantly happens to be in private property in Europe, it came to an endangerment of the various (in particular the natural) functions of the soils. Following the FAO classification of soil types there are 312 soil classes listed in the European soil map. In contrast to the effects of air and water pollution which usually shows up after relatively short periods of time and more directly affects human beings, the entry of pollutants into the soils and their ecological consequences are, due to their storage and buffering capacity, perceived only with considerable temporal delay. Building up soil layers of 30 cm requires a period of 1000 to 10000 years. Meanwhile about 52 million hectares, i.e. more than 16 % of the land surface, in the old EU-15 are affected by soil degradations; in the states which joined the EU in 2004 even approximately 35 % of the soils are affected.

From the EU legal system point of view I would like to answer the questions if and in which intensity the protection of the soils meanwhile form part of the environmental policy of the European Union and whether this activity would still have to be intensified in order to reach an effective level of soil protection.

EU Soil Protection de lege lata

Although the European Union already set up important Community wide standards in many policy areas with direct or indirect effects on the soils, a special soil protection policy is still in its infancy. A common policy should be developed firmly and independent from the national approaches of the Member States. The analysis of the founding treaties and their secondary legislation in the context of the first EU pillar (EC Treaty, Euratom Treaty) as well as of the general specifications of the EU Treaty shows that the instruments of soil protection in the Euratom Treaty can only rudimentarily contribute to prevent the soil from chemical, biological and physical endangerment by measuring the amount of radioactivity in the soils. As expected, the main emphasis lies on the EC Treaty

which offers reasonable protection mechanisms.

Until now the development of the EU soil protection law took place in three phases: before the adoption of the Single European Act in 1987, soil protection neither found consideration in the context of EC agricultural policy nor in the initial EC environmental policy. This changed in a second development phase with the inclusion of the environment chapter in the Single European Act and the beginning of a common policy on the environment and led to a consideration of particular aspects of soil protection in different intensities in the Community policies. Besides a first ray of hope in form of the sewage sludge directive no. 86/278/EWG which forms the first legal instrument for the protection of the soils, in general agricultural policy, research policy and particularly environmental policy are relevant. Moreover transport policy, regional policy and development policy could have further side effects on the soils. The sixth environmental action programme adopted on 22 July 2002 by the European Parliament and the Council marks the beginning of the so far important third development phase with the intention to work on a specific thematic strategy for the protection of the soils in the Community.

Primary and secondary legislation

The interpretation of the terms of "preserving, protecting and improving the quality of the environment" and of "prudent and rational utilisation of national resources" (formulated in the first paragraph of Article 174 EC Treaty) by referring to the environmental action programmes, in particular the fourth and the sixth programme, shows that the chemical (by contamination from various sources) and biological threats (by organic matter decline and soil biodiversity loss) as well as the physical threats of the soils (e.g. by erosion, compaction or sealing) are tackled by the objectives of the EC environmental policy. This point of view corresponds to the demands of soil science and form the basis for the legal reflections.

The European Community pursues the objectives of soil protection with a set of mostly indirect instruments which form the "acquis communautaire" of soil protection. Along with the environmental policy the common *agricultural policy* reveals references to the protection of the soil which is – within the framework of its function as a production basis - also covered by the agricultural objectives. Although agricultural policy is shaped by another motivation (especially an increase in output and production), the individual actions of the common agricultural policy refer to different aspects of environmental protection which consider the protection of the soils in a positive way, at least since the agricultural reforms of the years 1992 (MacSharry) and 1999 (Fischler), but even more according to the proposed European Agricultural Fund for Rural Development. Examples are the so-called accompanying measures of rural development policy to encourage environmentally friendly farming, the supplementary legislation concerning the law of agricultural commodity markets (for instance the set-aside regime or the nitrate or pesticides directives) or the food quality in form of the organic farming regulation. Already the specifications of the nitrate directive as the only environmental protection directive directly related to fertilizers have caused limitations of the maximum amounts of nitrogen and contributed especially in endangered areas to a reduction of the nitrate concentrations of the soils.

More directly than agricultural law the *environmental provisions* for the prevention of pollutant entries via the paths air, wastes, dangerous substances and sewage sludge have an effect on the soil, because they clearly provide limiting values or other regimes for pollutant minimization. However these

measures don't go by the requirements of soil protection, e.g. by soil-related limiting values, so that they are only partly effective. The present measures of environmental law mostly refer to regulatory law (e.g. obligations for keeping up direct environmental provisions or legal prohibitions) or to economic instruments or they try to achieve effective prevention of the entry of contaminants by the respective permission and implementation regulations. At the moment a change in the regulatory philosophy of European environmental law is noticeable which also affects the protection of the soils: in recent years the legislation most likely according to the British system follows an immission-oriented point of view. For the policy of the Member States environmental quality standards are mainly given, whereas the emission-referred environmental action standards are rather the exception; this is particularly true for air pollution control. The IPPC directive doesn't establish any emission limits, however contains trans-medial requirements on the operation of certain industrial plants, in particular permission provisions for larger industrial plants on the basis of the application of the best available technique.

Within special fields of regulation, in particular the landfill directive, European waste management law includes the aspects of avoidance and reduction of the pollutant entries from wastes into the soil, but it lacks to distinguish between the different soil types and their prior pollution. A classification and provisions for the treatment of contaminated land are completely missing. On the other hand the effects of the sewage sludge directive on the protection of the soils have to be evaluated as extremely positive; this directive which sets up soil protection values concerning the content of heavy metals appears to be the first and only EC soil protection directive until now and will be supplemented by important other soil-relevant parameters soon. Furthermore EC chemicals law and water protection law prevent the entry of dangerous substances into the soil. With the new "REACH" system of registration, evaluation and authorisation of chemicals a comprehensive life cycle analysis is to be carried out for highly soil-damaging harmful substances in the future. Because of the approach of the water framework directive with its environmental quality standard of achieving a good ecological surface and groundwater status and its environmental action goal of implementing this condition within 15 years, the indirect aim of preventing pollutant concentrations in the soil has to be realized. Due to the inclusion of soil protection into the protection of special areas of conservation according to the directive on the conservation of natural habitats and of wild fauna and flora this "habitats directive" forms the basis for a comprehensive consideration of all natural components of a natural habitat including the soil and its instruments can show itself as a model for soil protection.

The general provisions of environmental law (e.g. the environmental impact assessment directive), which have a strong procedural orientation and above all provide informative elements, make a further contribution to a more comprehensive and conscious handling of the problems of soil protection.

To sum up, only a few action standards and strategies for the accomplishment of soil contaminations and degradations exist. Regarding the aims of environmental policy it must be kept in mind that the imperative for its development grew from the increasing integration of the internal market and that its primary purpose was to allow economic integration to happen. Considering the pressure from national industrial interests and the current discussions in the present European Commission about the extent to which environmental policy is still needed, it is astonishing that the EU appears to have become a major player in an international environmental context almost in spite of that.

The EU *research policy* has already developed with regard to the prevention of pollutant entries and the protection against soil erosion and desertification, however concerning other protection aspects it is still at the beginning. Recently the European Union initiated several Community projects, e.g. the European Soil

Bureau and the European Soil Forum, within the range of the comparative and systematic evaluation which has lead to a constructive and promising cooperation between the Member States.

The protection of the soils in the EC legislative system is carried out in some directives and regulations in the fields of environmental protection and also in agriculture and research policy, but it remains fragmentary and incomplete. The entry of particular pollutants into the soil can partly be prevented by the above mentioned provisions concerning air pollution, wastes, sewage sludge, pesticides, fertilizers and other chemicals, although there are fundamental possibilities for improvement, for example in the field of standardization. Beside the regulations concerning chemical pollutants the field of biological and physical soil protection present themselves in the Community policy as "stepchildren". In EC environmental law and in the context of the accompanying regulations of agricultural law only few instruments exist for the physical soil protection. The need for action in this field is particularly obvious regarding soil erosion - in several surveys the European Commission already pointed out that the protection of the soils against further wind and water erosion is urgent. The evaluation of existing EC law shows that these dangers are - de lege lata - not sufficiently faced. Thus on EU level the soil protection "faithfully" sticks to its image as a cross cutting subject and is only achieved in partial aspects. The particular measures and instruments are quite differently concerned in respect to the protection of the soils.

Compared to the level of application more instruments of soil protection could be applied. The general impression of the implementation of soil protection in EC law appears to be a "patch work". Even the most far reaching interpretation and consequent implementation of the existing regulations could not revise this impression or lead to a sufficient protection of the soils. This seems mainly due to the fact that the legislation in the European Community was not orientated on the different soil endangerment paths and the protection of the various functions of the medium "soil". Altogether there are many positive approaches in existing EC law, but these do not prevent for the impression as a mosaic at present. For this reason there is still no specific or particular policy of the European Community for the protection of the soils yet. Nevertheless the term "EU/EC soil protection law" should be used for the existing fragmentary law which undoubtedly has its positive effects concerning soil protection. Further amendment is needed especially in the field of general and physical soil protection.

Recent developments

In order to put the sixth environmental action programme in concrete, the Communication from the Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions with the title "Towards a thematic strategy for soil protection" of 16 April 2002 was published. It analyses the threats for the soils and the existing political attempts of the European Union and the Member States and their effects on the soils and sets for the future European Union soil protection policy. It can’t be so much considered as a political program – rather than a compilation of scientific aspects about the endangerments of the soils and the past EC activities connected with prudent prospective considerations. However all initiatives and initial stages of soil protection were scarcely analyzed for the first time in this EC document which the commission exclusively dedicated to all aspects of soil protection. Due to the historical roots of the European Union as a pure economic community the overdue of soil protection policy could be evaluated as a "quantum leap".

The Communication announces a soil protection strategy in the direct future especially based on the principles of precaution and prevention. As its elements

the Commission firstly mentions direct initiatives in the environmental field (e.g. the amendment of the sewage sludge directive or the development of a compost directive), secondly the inclusion of soil protection into other policies, in particular the CAP, thirdly a soil monitoring system which still has to be presented and fourthly the future development of new measures on the basis of the monitoring results. Despite its broad and rather describing content the Communication forms the basis and the starting point for further actions on EC level. After adoption by the Commission it was discussed in the European Parliament, the Council, the Economic and Social Committee and the Committee of the Regions. All sides appreciated the document, despite critical notes about the details.

As the first step the work on parts of the specific soil protection strategy and especially the aspects of a soil monitoring directive already began. An integrated and holistic approach form the basis of this strategy; it should be cost effective, refer to the entire land surface and contain both short term goals and long-term visions on EU, national, regional and local level. In June 2004 the proposal for a soil monitoring directive and a new Communication of the Commission with concrete actions for the three priority aspects organic matter, soil erosion and soil contamination as well as for the further aspects of sealing, compaction, decrease of biodiversity, salinisation and floods and landslides were expected to be published; due to various internal and external reasons they were not presented until now. For the preparation of these documents five "technical working groups" (on monitoring, erosion, organic matter, contamination and re-search) as well as a "advisory forum" were established in April 2003 with participation of the Commission, GD Environment. At the end of July 2005 a new public consultation process was launched in the Internet to gather opinions on possible elements of a proposal for a soil thematic strategy.

Legal comparison

In order to develop a European soil protection law, possibilities for the regulation of either the whole matter or special aspects of soil protection can be created by a problem-orientated comparative law study, which must be found through analysis of the efficiencies of existing EU legislation. Effective models can be found in legislation of EU Member States and other states, especially the soil protection acts of the Netherlands, Germany and Italy, as well as approaches of international organisations. It could also be interesting to have a look at other soil protection policies outside the EU, such as the integrated approach in the Environmental Protection Act of Switzerland or the Soil Protection Act of Japan as well as the protection of highly erodible land according to the American Farm Bills. In the following context I would like to touch on the most interesting specific acts of the three mentioned EC Member States.

The Italian Act No. 183 of 18 May 1989 about the organizational and functional protection of the soil only has very few substantive regulatory content. Due to the definition in Article 1 (3) lit. a) not only the protection of the soil in the conventional meaning, but also different aspects of land use (e.g. by the soil or land consumption) are included in the term "soil protection". Even if many measures indirectly or directly pursue the objectives of soil protection, it must be taken into consideration that this causes considerable limitations on the effects of this act. In this respect the Italian "soil protection act" mainly deals with water protection and land use whose measures are particularly to be pursued by the planning instrument of the catchment area plan. It puts its emphasis on institutional and organizational regulations, for which no need for standardisation exists at present at EC level.

The German federal soil protection act (BBodSchG) of 17 March 1998 contains extensive and legally complicated provisions of basic obligations (e.g. to prevent

hazards or to take precautions), sets up definite soil values together with the "Federal soil protection and contaminated sites ordinance" and makes official orders possible. In detail however also conceptual restrictions are noticeable in the BBodSchG. Particularly due to the substantial delimitation of the scope of application, which excludes essential aspects of soil protection from the act, and the filtering effect of the term of harmful soil changes, the BBodSchG is not able to fulfill the requirements of a comprehensive soil protection law. For the physical soil protection the meaning of the subsidiarily applicable and -as regards content - restricted act appears as rather low (good agricultural practice). Of course the German federal soil protection act could be a model for soil protection in special aspects (e.g. the definitions or the formulation of the soil protection obligations).

In the Dutch soil protection act (WBB) of 3 July 1986 the protection of the soil in its natural functions has been put into the foreground in a programmatic way. Next to the positive total conception and the objective of the WBB as well as the possibilities of the classification of soil protected areas, important soil protecting functions are primarily realized by the action obligations of the Articles 6 ff., though putting it in concrete terms remains reserved for general administrative orders. Aims of preventing soil endangerment are followed up with that particularly. Despite the blanket clause like possibility of Article 11, the main emphasis obviously lies on the aspects of chemical soil protection. In the WBB soil rehabilitation has been given a broad space after the incorporation of the Dutch Interim Act Soil Remediation. The regulations of the Dutch soil protection law represent a framework whose putting into action is essentially incumbent on the local and regional administrations. On the one hand because of its definite concerning with the chemical and – in a limited sense also - physical problems of soil protection and on the other hand due to the implementation by the provinces in accordance with the natural soil characteristics, the act fulfils the expressed expectations concerning its transferability to EC law to a sufficient extent. Despite a change in the strategy of the Dutch soil protection good possibilities exist for enabling the underlying protection objectives, which are fundamentally based on the wording of the general action obligations and in particular the supplementing obligation of care – within the frame work of political realism.

International environmental law, which could also influence the development of EC law, is still far from achieving comprehensive, legally relevant soil protection. According to the present level of knowledge, the problems of soil protection in their entirety are not conceptionally laid down by the law of international organisations in an obligatory form, but in most cases only as so-called "pré-droit"; to that extent they could be of importance for developing countries, but hardly for the advancement of the soil protection law of the European Community. In this respect the UN Convention to combat desertification (UNCCD) of 17 June 1994 (which entered into force on 26 December 1996) sets up rules for the sustainable use and protection of the soils by the establishment of strategies, national, regional and subregional action programmes, international cooperation, research, financial and institutional mechanisms etc.. It forms the framework for international law activities within the range of the fight against soil erosion and desertification and was implemented by the EU in the research project MEDALUS ("Mediterranean Desertification and Land Use"). Beside that, the ideas of a future international soil protection convention, which would contribute to a more intensified dealing with the problems of soil protection in all its facets, point in the right direction.

The achievements of the Council of Europe, which initiated international attention to the problems of soil protection by the adoption of the European Soil Charter already in the year 1972, go far beyond other regulations of international law - in particular by the recent decision on the "Revised European Charter for the protection and sustainable management of soil" of 28 May 2003. However

they are also subject to the reservation of their binding nature and the requirement of putting it in concrete terms. As the provisions are instrumentally limited, they are able to develop suggestions for the EC law only to the extent, that they contain particularly concise or progressive instruments in the individual case, which could systematically and conceptionally have some influence on the view de lege ferenda.

Reflections de lege ferenda: Instruments of EU Soil Protection Law

According to reflections de lege ferenda instruments (as well as principles) of EU soil protection law could be developed on the basis of direct and indirect possibilities of regulation. As a premise soil protection should be understood not only as a defense against harmful impacts on the soil and the minimization of damages, but rather as comprehensive care and development to precaution and prevention of irreversible pollution of and harmful impacts on its functions (precautionary principle, prevention principle, source principle, polluter pays principle etc., Article 174 (2) EC Treaty).

For soil protection a mix of instruments like in other fields of environmental law would be appropriate and could lead to a combination of regulative and non-regulative instruments particularly consisting of those of planning, of direct and indirect behaviour control, of company organisation and of private law. Used judiciously, the impact of these instruments should be complementary and mutually supporting. The main focus should be on the instruments of planning, obligations, legal standards and economic solutions of soil protection.

Both the setting up of soil protection plans and the classification of soil protection areas appear to be useful instruments especially in precautionary handling of chemical and other endangerments of the soils. Apart from the registration of harmful impacts on the soil, soil protection plans cause a concretising of protection objectives and could contribute to establish evaluation and action catalogues. By the classification of soil protection areas endangered soils could be protected in particular against harmful impacts and these interests could be coordinated with town and country planning. The basis of these planning instruments should be the collection of harmful soil impacts in a soil pollution register.

Within the range of direct behaviour control, notification obligations, the completion of the testing extent of the Environmental Impact Assessment directive, prohibitions of extremely soil-endangering pollutants as well as the establishment of soil protection obligations and soil values serve to set up important standards for the assessment of the limits of harmful impacts on the soils. The main focus lies on substantive soil protection obligations which go beyond the existing IPPC obligation triad of precaution, protection and after-care and could be formed following the Dutch regulation in Articles 6 ff. WBB and the precaution obligation in the German BBodSchG. They could particularly be concretised by the definition of soil values in the form of trigger values, action values and precaution values. In order to quickly stop the use of extremely soil-endangering pollutants the classical instrument of prohibitions in EC pesticides, biocides and fertilizer law as well as in chemicals law seem to be indispensable. Moreover the existing "principles of good agricultural practice" could be extended with regard to the management obligations, in particular for the physical soil protection.

In the field of indirect behaviour control a EU-wide soil information and monitoring system which at the moment only exists for the protection of forest soils ("Forest Focus") could primarily be set up; the planned soil monitoring

directive pursues the significant objective to remedy the lack of harmonization and comparability of data about the soil and his protection. Beside other informative instruments this has both for the precaution and for the after-care of soil protection a great importance in EU soil protection law. Unfortunately the economic instruments (like grants, aids, taxes, certificates) are not yet used for this purpose. Moreover supplementing the state grants for information, training and consultation and the existing agri-environmental grants for aspects of soil protection would be welcomed. A special tax on the use of mineral nitrogen fertilizer could contribute to the reduction of the entries into the soils. With the instrument of trading with land utilisation rights (certificates) in combination with a soil sealing tax further soil sealing could effectively be prevented and unsealing and on a long-term basis a trend reversal in the land consumption might be achieved.

On a voluntary basis a "soil inspector" could give advice to farmers about the soil protec-ting use of their land and could control the keeping of the substantive soil protection obligations within the range of agriculture. An extension of the EC environmental liability directive including an extensive liability for soil damages appears to be politically not practicable at present; in addition to that there is no more need for the introduction of further instruments of private law on Community level. Concerning criminal instruments it was stated that minimum standards in EU criminal law would supplement the development of common soil-protecting administrative standards in the future and in particular could have deterring effects for soil protection; these - at present for lack of administrative regulations not yet useful -instruments partly concern co-operation within the range of the third pillar of the European Union.

Formal Aspects of legal soil protection

These general reflections about the instruments of EU soil protection law should be evaluated with regard to the competences and the principle of subsidiarity. Concretising the environmental competences in EC law a differentiation has to be made between measures for the chemical and biological soil protection as well as for the physical protection against soil erosion and soil compaction in accordance with Article 175 (1) EC Treaty on the one hand and the aspects of the protection against soil and landscape consumption (inclusive of the protection against soil sealing) in accordance with the exceptional regulation of Article 175 (2) subpara. 1, lit. b) (3) EC Treaty on the other. In the sense of the latter competence provision "measures affecting land use" only define those aspects of soil protection which have effects on the use of the sovereign territory or the space of the respective member state. According to Artic le 175 (1) EC Treaty besides chemical and biological soil protection, soil erosion and soil compaction are also included. Thus at least the introduction of a notification obligation concerning the putting on of decontaminated or treated soils or their residual substances on the soil, the prohibitions of extremely soil-endangering substances in dangerous materials, the determining of soil quality standards and soil values and -as temporally prior - the setting up of a EU-wide soil information and monitoring system on the basis of Article 175 (1) EC Treaty could to be realized. General environmental political activities -like the amendment of existing permissions in the context of the IPPC directive, the EIA directive and other general legal instruments concerning further soil-endangering plants and activities – fall under Article 175 (1) EC Treaty as well. Depending on their arrangement and if introduced separately, the instruments of soil protection planning and the classification of soil protection areas are to be based on Article 175 (2) subpara. 1 lit. b) (1) EC Treaty. For the suggested instruments of the introduction of a soil sealing tax and a special tax on the use of mineral nitrogen fertilizer Article 175 (2) subpara. 1 lit. a) EC Treaty is not relevant.

A condition for the adoption of a (possibly comprehensive) directive for the protection of the soils on the basis of the determined competence provision of Article 175 (1) EC Treaty is that the principle of subsidiarity doesn't appear as an obstacle or limitation for the particular allocation of the Community powers. The aim and objective of Article 5 (2) EGV is to limit the increasing influence of the Community in all competence areas. Contrary to the often misunderstood meaning of the principle of subsidiarity, it serves as "competence pursuance and competence distinguishing barrier". According to Article 5 (2) EC Treaty, the Community shall take action in areas which do not fall within its exclusive competence, "only if and so far as the objectives of the proposed action cannot be sufficiently achieved by the Member States and can therefore, by reason of the scale of the effects of the proposed action, be better achieved by the Community." As reasons for the necessity of EU-wide measures for soil protection in particular the multi-functionality of the soils, the requirement of the preservation of a sensitive balance between the soil and other environmental media and the close correlation between soil degradation and other environmental problems are to be mentioned. In this respect, the need for a comprehensive Community regulation results in the nature of this matter, especially the extent, the severity and the effects of soil endangerments.

Conclusions

It seems to be politically quite realistic to assume that not all proposed instruments of soil protection could be realized at the same time. The contents of a directive shall be formed following the substantial principles of soil protection in the context of the modules of information gathering, precaution and prevention, damage remediation and standardization. An interaction of the preventive and repressive instruments mentioned in the sense of a "mix of instruments" is to be preferred. The module of standardisation regularly only becomes relevant if empirically established figures within the other module ranges are present. In the course of the present activities on European Union level the possibility exists that the EU soil protection law could emerge from its past shadowy existence and could develop to a "genuine" soil protection policy on European Union level.

References

Commission of the European Communities, COM (2002) 179 final of 16/04/2002, p. 1 ff.

Hannam, I.D., with Boer, B.W., Legal and Institutional Frameworks for Sustainable Soils: A Preliminary Report, IUCN Environmental Policy and Law Paper No. 45, 2002

Heuser, Irene L., Europäisches Bodenschutzrecht – Entwicklungslinien und Maßstäbe der Gestaltung, Berlin 2005

Jans, Jan H., European Environmental Law, 2nd ed. Groningen/Amsterdam 2000

Kiss, Alexandre/Shelton, Dinah, Manual of European Environmental Law, 2nd ed. Cambridge, New York 997

Krämer, Ludwig, Casebook on Environmental Law, Oxford, Portland 2002

Wissenschaftlicher Beirat der Bundesregierung "Globale Umweltveränderungen", Welt im Wandel: die Gefährdung der Böden, Bonn 1994

Legal issues regarding the sustainable management of contaminated soils with examples from Australia

Dr Steven Berveling

Barrister, Sydney, Phone: +61 2 8227 9600
Email: berveling@mpchambers.net.au

Introduction

This paper provides a short introduction to the need for legislation concerning contaminated sites, difficulties in managing contaminated sites through the common law, and appropriate contents of contaminated sites legislation. It then concentrates on notification requirements, registers, and powers to order investigation or remediation.

An implicit objective of legislation concerning contaminated sites would be to ensure that such sites can be re-used effectively as far as possible; to provide for the maintenance and enhancement of the health, diversity and productivity of the soil for plants and animals to be able to use it as biological habitat, gene reserve and for food production, and to protect the food chain and groundwater from adverse compounds (Prieur M, at 251).

Non-remediation maintains the negative impacts caused by contamination and is contrary to the principle of inter-generational equity.

It is estimated that chemical deterioration currently affects 2.4 million square kilometres of the Earth's surface, (Prieur M, at 251) an area about ten times the size of the United Kingdom (at 230 608 km^2 in area), and about equal to Saudi Arabia or Western Australia (Western Australia is 2,527,623 km^2 in area, Saudi Arabia 2,263,600 km^2). As can be expected, the affected land is located in settled areas, rather than in parts of the Earth where humans have not lived.

It has been suggested that there are about 60,000 contaminated sites in The Netherlands, and that Finland Germany and Great Britain respectively have some 10,000, 70,000, and 100,000 sites (Seerden and Deketelaere, 2000, at 94, 153 and 190, at 289). In 1998 the various USA State authorities collectively claimed approximately 69,000 sites on their records as being suspected or known contaminated sites, of which some 24,000 had been evaluated as requiring further evaluation or some level of clean up (Environmental Law Institute, 1998). In 2001, the USA federal EPA advised that more than 41,400 sites had had some clean-up (http://www.epa.gov/superfund/sites/topics/archinv.html, accessed 25 October 2001), but this figure contrasts with the figure of 29,000 sites considered by the Environmental Law Institute in 2001 (Environmental Law Institute, 2001). Either which way, there are a lot of contaminated sites.

Contamination of land may arise from a wide variety of activities which largely fall into two main groups: firstly from the intentional deposit of material on land, and secondly, in the course of industrial activity. Soil contamination of a site can also arise due to contaminants in groundwater migrating across the site's boundaries. Contamination of a riverbed can also cause soil contamination to occur elsewhere, such as when the river overflows its banks (CONSOIL 2000).

Various jurisdictions have prepared List of Activities that may cause contamination as an incident of industrial activity (eg NSW, Queensland, Western Australia). Lists are the primary triggering mechanism for determining whether land may be contaminated and whether contaminated land legislation might apply. Increased detail in the lists would increase the likelihood of recognising the possibility of contamination.

ESD and Contaminated Sites

The principle of inter-generational equity, the precautionary principle and the polluter-pays principle are particularly relevant to contaminated sites. The principle of inter-generational equity and the precautionary principle are considered ultimately more important than the polluter-pays principle (and should take precedence over it) because, in effect, the latter merely seeks to direct liability for remediation to a particular party. In contrast, in relation to contaminated sites, the principle of inter-generational equity would seek that the site be remediated for the benefit of future generations who might otherwise be affected by continuing contamination.

Unique Features of Contaminated Site Issues

A substantial time difference can occur between the action of contamination and its manifestation as a problem, raising difficulties in attributing liability. Further, an important feature of contaminated sites is its locational stability, in that the contamination *generally* remains at or near the location where the contamination was caused, or moves slowly in groundwater. This contrasts with air and water pollution, which can move easily from the site where they originated.

Problems with Common Law Actions for Remediation and Contamination

The common law is based on litigation instigated by individuals dealing with single instances, and issues such as liability can only be determined through common law when a dispute has arisen. In contrast, legislation can impose obligations and deal with matters regardless of whether a dispute has arisen. This is more appropriate for addressing issues concerning contaminated sites.

Difficulties exist when seeking to use the common law for contamination issues. Whereas nuisance or negligence may be contemplated with respect to liability for contamination, the general locational stability of the contamination, and the frequent time difference between the act of contamination and its discovery render in practice these actions unsuitable in most cases when dealing with contaminated sites.

The tort of private nuisance is "the unreasonable interference with a person's use or enjoyment of land" (Marcrory, 1982). The primary relief sought in an action for nuisance is an order to stop the interference. Nuisance cannot be used to stop previous owners from undertaking an activity. The source of the nuisance needs to be a property different from that affected.

Through negligence, a person can be sued for damages arising from conduct falling below a particular standard demanded for the protection of others against unreasonable risk of harm (Flemming, 1998, at 101). The tort of negligence may be relevant to contaminated sites but the first question to be asked is whether there had been a breach of a duty of care. A duty of care arises "where a defendant knows or ought reasonably to know that its conduct is likely to cause harm to the person or tangible property of the plaintiff unless it takes reasonable care to avoid that harm" (*Perre v Appand* (1999) 164 ALR 606 at 623). This is determined by reference to what the defendant knew or ought reasonably to have known when he or she undertook the allegedly negligent activity. It may be difficult to find negligence if, at the time of the contaminating activity, there was little or no knowledge about contamination or about substances causing contamination. Negligence may have more application to contamination that has been caused recently or currently.

Appropriate Contents of Contaminated Site Legislation

The following elements are considered fundamental for effective legislation dealing with the management and regulation of contaminated sites:

1. Comprehensive definitions to deal effectively with the subject matter of contaminated sites;
2. Consistency of definitions between related statutes of the particular jurisdiction;
3. Inclusion of principles of ecologically sustainable development in objectives of the legislation, and guidelines for their practical application in the implementation of the main legislation;
4. Mechanisms for the notification and identification of contaminated sites;
5. Lists of potentially contaminating uses to assist in determining the possibility of contamination;
6. Mechanisms for the most knowledgeable person to advise prospective purchasers of contamination or action that has been taken in relation to contamination;
7. Publicly accessible registers;
8. Powers to order or direct that contaminated sites be investigated and, if necessary, remediated, with the range of possible orders being as wide as possible and the possible recipients beginning with the polluter, in line with the polluter-pays principle;
9. Mechanisms whereby a recipient of an order can seek to recover costs incurred in complying with the order from other persons by merely proving that the other persons undertook activities on the site which used chemicals which caused the contamination, but without having to prove that the other person's activities actually caused the contamination;
10. Involvement of experienced people, either through accredited auditor schemes as exist in some of the Australian States, or by ensuring that contaminated land issues are dealt with by government officers with appropriate expertise;
11. Mechanisms to determine when a lender might become liable for costs associated with contamination of a site; and
12. Criminal sanctions and civil enforcement for non-compliance with orders or directions.

Australian Legislation regarding Contaminated Sites

Australia is a Federation, comprising 6 States and 2 Territories. By reason of the Australian Constitution, the States and Territories are predominantly responsible for environmental matters.

The legislation governing contaminated land is dealt with by some States in subject-specific legislation (eg NSW, Queensland (repealed) and WA), but by most in environmental-generic legislation (Queensland, Victoria, South Australia, Tasmania, Western Australia, Australian Capital Territory). It is considered that the subject-specific legislation is generally more effective, because it can rely on specific definitions, and its wording does not need to apply to many different situations. Also, by drafting subject-specific legislation, the draftsman concentrates on the subject to hand, rather than seeking to draft legislation that serves multiple purposes.

In generic legislation, definitions and offences are often weakened in order to deal with a much greater variety of issues. For example, the offence of contaminating soil previously found in s. 13 of the Queensland *Contaminated Land Act* 1991 (Qld) has been diluted through its incorporation into a section prohibiting generally the causing of an environmental nuisance (s. 15 of the *Environmental Protection Act* 1994 (Qld)). Rather than merely needing to show that the defendant caused the land to become contaminated, now it is necessary to show that the person wilfully

and unlawfully, or merely unlawfully, caused an environmental nuisance (see s. 440 of the *Environmental Protection Act* 1994 (Qld)), and then thereafter to deal with the elements of environmental nuisance (Ss. 9 + 15 of the *Environmental Protection Act* 1994 (Qld)). Also, generic legislation may not provide effectively for notices to remediate contaminated land.

It is not possible in this paper to refer in detail to the legislation of the various Australian States and Territories. Rather, the paper concentrates on how that legislation deals with (a) Notification requirements; (b) Registers concerning contaminated land; and (c) Powers to order investigation and remediation.

Notification Requirements

An underlying objective of the obligation to notify is the collection of information about contaminated sites so that, if necessary, appropriate action can be taken. To achieve such an objective, the obligation to notify contamination, or suspicion thereof, should be imposed as often as possible.

A duty to notify the relevant government authority of contamination of land is found in the legislation of all States except Victoria. The following Table provides a summary of the various notification requirements found in the various statutes examined above:

Table 1 - Notification Requirements.

Act	Who must Notify?	When?
Contaminated Land Act 1991 (Qld) (repealed), s17	Owners, occupiers, local councils, government departments and authorities, persons who caused or permitted likely land contamination	On becoming aware of contamination or its likelihood.
Environmental Protection Act 1994 (Qld), ss 371, 372	Owner, occupier, local council	If aware that a notifiable activity has been or is being carried out on the site, or that the land is or has been contaminated by some other means.
Contaminated Land Management Act 1997 (NSW), s 60	Owner, and a polluter (a person who becomes aware that the person's activities have contaminated the land).	When owner becomes aware that the land has been contaminated so as to present a significant risk of harm, or when polluter becomes aware that his or her activities have contaminated the land so as to present a significant risk of harm.
Environment Protection Act 1997 (ACT), s 23A	Occupier	As soon as practicable after becoming aware that the land is contaminated so as to present, or be likely to present, a significant risk of harm to human health or risk of serious or material harm.
Environment Protection Act 1993 (SA), s 83	Person who undertakes an activity	When, in the course of undertaking the activity, an incident occurs which causes or threatens serious or material environmental harm from pollution.
Environmental Management and Pollution Control Act 1994 (Tas), s 33	Person	When an incident occurs which causes or threatens to cause serious or material environmental harm.

Act	Who must Notify?	When?
Environment Protection Act 1986 (WA), s 72	Occupier	When a discharge or waste occurs as a result of an emergency, accident or malfunction, or otherwise than in accordance with a works approval or licence or with a requirement contained in a pollution abatement notice, or if it is of a prescribed kind or a kind notified in writing to the occupier, and which has caused or is likely to cause pollution.
Contaminated Sites Bill 2002 (WA), cl. 11	Owner, occupier, polluter.	Upon knowing or suspecting that a site is contaminated.
Environment Protection Act 1970 (Vic)	None on the EPA, but occupier must advise a potential future occupier (section 60A)	None.

As can be seen from the above Table, the different States impose the duty to notify on various persons, such as the owner, occupier, polluter, local councils, or others. What is required to be notified also varies between the States. Where generic legislation is used, contamination is not specified and the notification requirements are not nearly as effective as those contained in subject-specific legislation dealing with contaminated land.

The requirement in the *Environmental Protection Act* 1994 (Qld) to notify the occurrence of a 'notifiable activity' (*Environmental Protection Act* 1994 (Qld), ss 371(1), 372(1)) may not provide for notification of contamination or possible contamination, despite the breadth of the different activities encompassed in the list of notifiable activities (*Environmental Protection Act* 1994 (Qld) Sch 2). 'Contamination' is a concept different from 'activity', and some contaminated sites may be missed, unless notification of actual contamination occurs. An example of a site that was contaminated as a result of an activity that is not a notifiable activity is a residential allotment on which a watchmaking home occupation had occurred in the 1940s and 1950s, utilising radioactive translucent paint for the dials. Such a site in fact happens to exist in suburban Sydney (Nelson Parade, Hunter's Hill) and could just as easily have occurred in Queensland.

Both the Queensland *Environmental Protection Act* 1994 and the Western Australian *Contaminated Sites Act* 2003 place or will place the onus of any merit assessment of the state and extent of contamination upon the relevant Government authority.

The provisions of the *Contaminated Sites Act* 2003 (WA) may well become the most effective when the legislation commences. The Act proposes that any person may report any site that he or she knows or suspects to be contaminated, and, in addition, it imposes an obligation that such sites be reported by an owner, occupier, polluter, an officer of a public authority, or an auditor (*Contaminated Sites Act* 2003 (WA), s. 11 (still awaiting commencement)).

Requirements to Disclose to Purchasers and Lessees

The need for disclose of contamination or possible contamination of land the subject of a sale or a lease is separate from, and in addition to, the notification requirements to government agencies referred to in the preceding section. With respect to contamination, disclosure requirements are found either in the conveyancing legislation of a State (eg *Conveyancing Act* 1919 (NSW); *Land and Business (Sale and Conveyancing) Act* 1994 (SA); *Sale of Land Act* 1962 (Vic)) or else in its legislation concerning contaminated land (eg *Contaminated Land Act 1991*

(Qld) (repealed); *Environmental Protection Act* 1994 (Qld); *Contaminated Sites Act* 2003 (WA) (still awaiting commencement)).

Registers

Registration of notification is a natural consequence of an obligation to notify. The advantages of a register are clear: only with a comprehensive and complete register can a government determine the extent of the problem of contaminated sites and create a list of the sites in order of priority for remediation, determining which sites require clean-up as soon as possible and which sites may be left for some time in the future. Private organizations can gauge the extent of any market for remediation technology and practice. Further, potential purchasers of land would have an authoritative source of site-specific information.

An issue arises whether a register should be limited to sites that are known to be actually contaminated, or whether it should also include possibly contaminated sites and remediated sites. The omission of remediated sites from registers arises from a belief that the remediation program will not require subsequent review or further action in the future. However, the principle of inter-generational equity suggests that information should remain available for future generations.

A second issue about registers is whether they should be of sites that are known to be or may be contaminated, or whether they should be merely of notices or orders that have been made about sites. A register of notices or orders precludes the register from containing information about all contaminated sites, because not all such sites are the subject of a notice or order. In contrast, a register of contaminated sites answers the most basic information (about contamination of such sites) sought by interested parties.

The Queensland register is a list of sites, and is now divided into two separate registers, the environmental management register (which contains land on which known or possibly contaminated activity occurred) and the contaminated sites register (which are known to be contaminated). At the end of 1999, there were 16,122 sites on the environmental management register and 10 sites on the contaminated sites register (Environment Protection Authority of Queensland, 2000, at 3.43).

In contrast, the New South Wales register is a list of orders made in respect of contaminated sites, and as of 7 August 2005, it contains 639 notices relating to 250 sites (http://www.environment.nsw.gov. au/clm/aboutregister.aspx accessed 7 August 2005). This figure contrasts dramatically with the number of suspected contaminated sites in New South Wales, which exceeded 7,000 in the early 1990s (Grant in Rowe and Seidler, 1993 at 81).

A register can provide no more than information. The usefulness of a register of contaminated sites depends on the accuracy and completeness of the register. No conclusion can be reached from the fact that a site is not entered on it.

People are often concerned about the stigma that attaches to registration, and any devaluation arising therefrom. However, the real cause for any devaluation is the existence of contaminants, and not mere entry on a register.

The following Table summarises the position of registers in each State:

Table 3 – Registers of Contaminated Sites

State / Act	Register of What?	Possibly Contaminated Sites?	Remediated Sites?
NSW, *Contaminated Land Management Act* 1997	Record of Actions by EPA	not included, but investigation orders are included	not included
ACT, *Environment Protection Act*	Record of orders	not included, but investigation orders are included	not included
Qld, *Contaminated Land Act* 1991	Register of Sites	were included	were included
Qld, *Environmental Protection Act* 1994	Register of Sites	included in environmental management register	no longer included
SA, *Environment Protection Act* 1993	Register of numerous things, including environment protection orders, clean up orders, or clean up authorisations	not included	not included
Vic	Informal register of sites believed to present an unacceptable risk to human health or the environment, and of clean up notices	may be, but only if EPA believes site presents an unacceptable risk to human health or the environment.	--
NT, *Waste Management and Pollution Control Act* 1999	No register as such, but the issue of a pollution abatement notice is recorded in the Register kept under the *Real Property Act*	not included	not included
Tas, *Environmental Management and Pollution Control Act* 1994	Register of environmental protection notices	not included	not included
WA, *Contaminated Sites Bill* 2002	Register of sites and underground water plumes, and also of various actions by the EPA	included but access to information is restricted	included but access to information is restricted

Orders in Respect of Contaminated Sites

A power to order investigation and, if appropriate, remediation, is crucial to the effective operation of legislation for the management of contaminated sites. Site investigation and remediation should not be left to be done only voluntarily. To ensure that the work be properly done and supervised, a legislative regime in

respect of orders for the investigation and remediation of contaminated sites should provide for supervision by appropriately qualified experts.

The orders should enable a very wide range of actions to be ordered. In some instances, the appropriate action may only need to be as simple as erecting a fence or a sign or notice. At the other extreme, complete remediation of the site can be ordered.

Furthermore, a wide range of possible recipients is appropriate, and whilst the most appropriate recipient would be the polluter, this is ineffective if the polluter is unable to do comply with the order. A trend can be seen in the various State legislative schemes to provide a hierarchy of possible recipients for orders relating to contaminated sites (eg *Contaminated Land Management Act* 1997 (NSW), s. 12), *Environmental Protection Act* 1994 (Qld), s 376). The hierarchy primarily targets the polluter and seeks to ensure that contaminated sites are investigated and remediated pursuant to the polluter-pays principle. If that is not practicable, then the principle of inter-generational equity comes into play to ensure that investigation and remediation occurs and the developmental and environmental needs of present and future generations are nevertheless maintained (Rio Declaration, 1992, principle 3).

The following Tables indicate in summary form the various recipients of orders and the activities that may be ordered pursuant to the various State statutes:

Table 4 – Summary of Recipients of Orders

Possible Recipient of Order	**Statute**
Polluter	*Contaminated Land Act* 1991 (Qld) (repealed)
	Environmental Protection Act 1994 (Qld)
	Environment Protection Act 1970 (Vic)
	Contaminated Land Management Act 1997 (NSW)
	Environment Protection Act 1997 (ACT)
	Protection of the Environment Operations Act 1997 (NSW)
	Environmental Protection Act 1986 (WA)
	Contaminated Sites Bill 2002 (WA)
Owner	*Environmental Protection Act* 1994 (Qld)
	Contaminated Land Management Act 1997 (NSW)
	Environmental Protection Act 1986 (WA)
	Contaminated Sites Bill 2002 (WA)
Local Council	*Contaminated Land Management Act* 1997 (NSW)
	Environmental Protection Act 1994 (Qld)
Occupier	*Environmentally Hazardous Chemicals Act* 1985 (NSW) (repealed)
	Protection of the Environment Operations Act 1997 (NSW)
	Environment Protection Act 1970 (Vic)
	Environmental Protection Act 1986 (WA)
"any person"	*Environment Protection Act* 1993 (SA)
"appropriate person"	*Contaminated Land Management Act* 1997 (NSW)

Table 5 – Summary of Possible Activities that Can be Ordered

Possible Activity that Can be Ordered	Statute
Prescribed activity	*Environmentally Hazardous Chemicals Act* 1985 (NSW) (repealed)
	Environment Protection Act 1970 (Vic)
	Contaminated Land Management Act 1997 (NSW)
Clean-up	*Protection of the Environment Operations Act* 1997 (NSW)
	Environment Protection Act 1993 (SA)
Investigation	*Contaminated Land Management Act* 1997 (NSW)
	Environment Protection Act 1997 (ACT)
	Contaminated Land Act 1991 (Qld) (repealed)
	Environmental Protection Act 1994 (Qld*)*
	Contaminated Sites Bill 2002 (WA)
Remediation	*Contaminated Land Management Act* 1997 (NSW)
	Environment Protection Act 1997 (ACT)
	Contaminated Land Act 1991 (Qld) (repealed)
	Environmental Protection Act 1994 (Qld)
	Contaminated Sites Bill 2002 (WA)
Prevention	*Protection of the Environment Operations Act* 1997 (NSW)
Abatement	*Environmental Protection Act* 1986 (WA)

Conclusion

Only by enacting legislation dealing specifically with contaminated sites is it possible to deal effectively with the problems and issues peculiar to contaminated sites, embrace the principles of ecologically sustainable development, and ensure the continued sustainable use of land and soils.

An objective of legislation concerning contaminated sites is the remediation of such land regardless of the cause of contamination, or who did it. Investigation and remediation of contaminated sites should be favoured regardless of who might have caused it, to enable something positive to be done.

References

Consoil 2000 Seventh International FZK/TNO Conference on Contaminated Soil, in co-operation with UFZ, 18-22 September 2000, Leipzig, Germany, for which the Danish, UK and German EPAs were asked to formulate a strategy.

Environment Protection Authority of Queensland *State of the Environment Report 1999*, Brisbane, 2000, at 3.43.

Environmental Law Institute, *An Analysis of State Superfund Programs: 50-State Study, 1998 Update*, (Washington, Environmental Law Institute, 1998), at 10.

Environmental Law Institute, *An Analysis of State Superfund Programs: 50-State Study, 2001 Update*, (Washington, Environmental Law Institute, 2001), at 13.

EPA of NSW *Managing Land Contamination: Planning Guidelines* ("the 1998 Planning Guidelines"), (Sydney, Government Printer's Office, August 1998); Schedule 2 to the *Environmental Protection Act* 1994 (Qld); Department of Environmental Protection (WA), *Potentially Contaminating Activities, Industries and Landuses*, (Perth, Government of Western Australia, December 2001), at 5-12, containing some 43 different potentially contaminating activities, industries and landuses.

Fleming J, *The Law of Torts,* 9th edition, (Sydney, The Law Book Company Limited, 1998), at 101.

Gifford K H, 'Private recourse for Environmental Harm – Australia' in McCaffrey S and Lutz R E, *Environmental Pollution and Individual Rights: An International Symposium*, (Deventer, The Netherlands, Kluwer, 1978), at 4.

Grant C, 'Insights from Experiences in the Management of Contaminated Sites in NSW', in Rowe G and Seidler S (eds), *Contaminated Sites in Australia – Challenges for Law and Public Policy*, (Sydney, Allen & Unwin, 1993) at 81.

http://www.environment.nsw.gov.au/clm/aboutregister.aspx accessed 7 August 2005.

Legislation*:*

Contaminated Land Management Act 1997 (NSW);
Contaminated Land Act 1991 (Qld) (repealed);
Contaminated Sites Act 2003 (WA) (still awaiting commencement);
Conveyancing Act 1919 (NSW);
Environmental Protection Act 1994 (Qld);
Environment Protection Act 1993 (SA);
Environment Protection Act 1970 (Vic);
Environmental Management And Pollution Control Act 1994 (Tas);
Environment Protection Act 1997 (ACT) (Division 5 of Part 9);
Environmental Protection Act 1986 (WA);
Land and Business (Sale and Conveyancing) Act 1994 (SA);
Sale of Land Act 1962 (Vic).

Macrory R, *Nuisance* (London, Oyez Longman Publishing Limited, 1982), at 1.

Perre v Appand (1999) 164 ALR 606, at 623 per McHugh J.

Prieur M, 'Legal Protection for Soil', in Kiss A and Shelton D, *Manual of European Environmental Law*, 2nd ed, (Cambridge, Cambridge University Press, 1997), at 251. See also Dubbin W, *Soils* (London, Natural History Museum, 2001), at 5.

Seerden R and Deketelaere K, *Legal Aspects of Soil Pollution and Decontamination in the EU Member States and the United States* (Antwerpen-Groningen, Intersentia Uitgevers, 2000), at 94, 153 and 190, at 289.

United Nations Conference on Environment and Development, *Rio Declaration on Environment and Development* ("Rio Declaration"), UN Doc A/Conf.151/5/26 (12 August 1992), Principle 3.

IV Research and case studies

Vegetation classification and assessment to improve the management of soil resources New South Wales Australia

John Benson

Botanic Gardens Trust, Mrs Macquaries Road Sydney NSW Australia 2000
john.benson@rbgsyd.nsw.gov.au

Introduction

Soil and vegetation types often correspond spatially. If vegetation is being managed sustainably it is most likely that soil will be too. This paper describes a vegetation classification and assessment database project (NSWVCA) in New South Wales (NSW), Australia and its outputs and rules could be used to set priorities for natural resource conservation and in regulations and compliance under various environmental laws. These rules include the development of IUCN-like threat categories for plant communities and thresholds for assessing their adequacy of representation in protected areas.

NSW is located in the south-east corner of Australia (see inset in Figure 1) and is 80 million hectares in size. The State contains 18 of the 80 Australian Bioregions (Figure 1) (Thackway & Cresswell 1995). Its wide array of environments include sub-tropical and temperate rainforests, coastal *Eucalyptus* tall forests, *Eucalyptus* grassy and shrubby woodlands, *Acacia* scrublands, chenopod shrublands, mallee-*Eucalyptus* shrublands, temperate and semi-arid grasslands, alpine herb fields and montane bogs, and a range of inland and coastal freshwater and saline wetlands (Benson 1999, Keith 2004). There are over 6000 native vascular plants in NSW and probably about 1000 mappable or describable plant communities that occur on a wide range of soil types. Since the 1980s, detailed soil mapping at 1:100,000 and 1:250,000 has covered much of the State (NSW Department of Infrastructure, Planning and Natural Resources 2005). Soils range from high nutrient krasnozems derived from basalt to desert sands with extremely low nutrient levels. Most of the semi-arid inland of NSW contains alluvial or aeolian sands and clays. Podsolic soils are common in the wetter regions of the east coast and ranges. Most NSW soils are ancient, infertile and susceptible to water, wind or sheet erosion.

Natural resource legislative reforms in 2003 directed the management of soils, salinity, vegetation and biodiversity through statutory catchment action plans that are being completed for 13 Catchment Management Authority areas (CMAs) (Figure 1). State Targets and Standards for natural resource management are set by the NSW Natural Resources Commission. These include targets on vegetation retention or re-vegetation, soil management, salinity, threatened species, wetlands and coastal estuaries The NRC also audits CMA regional targets set in the CMA plans (Figure 2).

Assessing and meeting any target requires land use decision-making procedures and agreed basic data such as a uniform classification of landscapes. The native vegetation classification and assessment database (NSWVCA) will assist land managers to make decisions and set priorities for spending limited public funds in natural resource management.

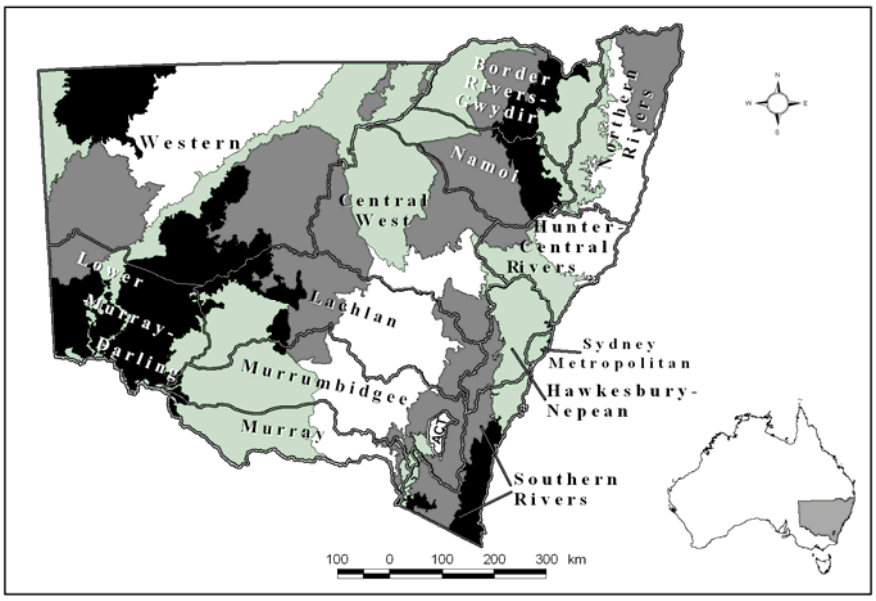


Figure 1. The 18 Australian Bioregions in NSW (shaded areas) overlayed by the 13 CMA natural resource planning areas (drawn and named) in New South Wales.

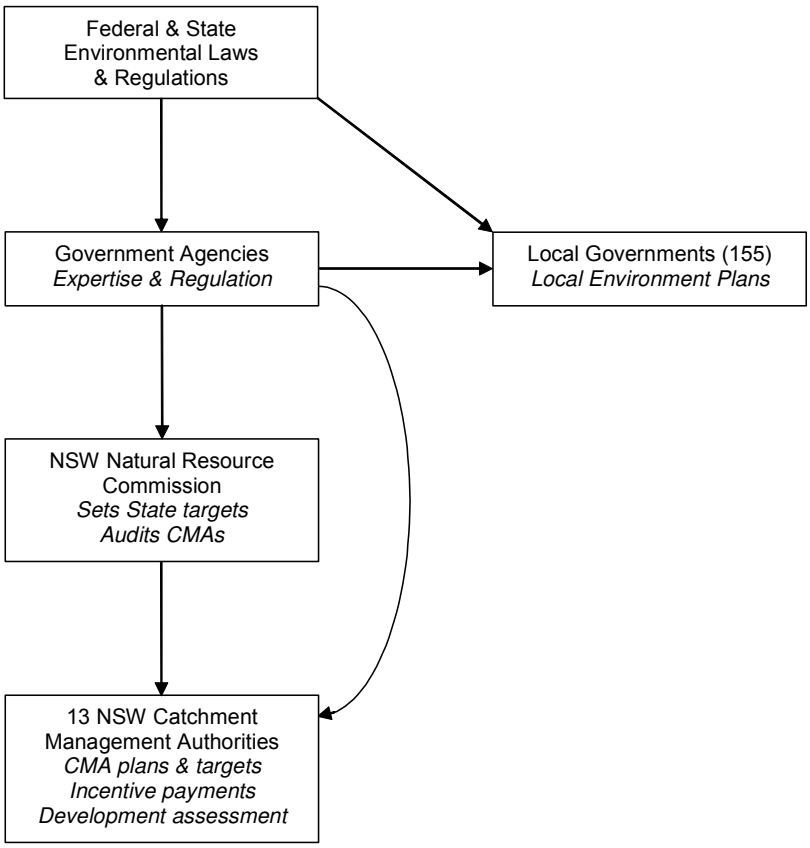


Figure 2. Relationship between laws, organisations and their responsibilities in New South Wales.

1. Developing the NSW vegetation classification and assessment (NSWVCA) scheme

The NSWVCA is a floristic/structural vegetation classification that builds on a description of Australia's vegetation in Beadle (1981). There are hundreds of vegetation maps and vegetation reports of various quality and scale that cover NSW. Additionally, there are thousands of floristic field plots that can assist with numerical vegetation classification. Given this disparate state of vegetation data, the NSWVCA has adopted a similar approach to classification as the United States terrestrial vegetation classification developed by The Nature Conservancy (Grossman et al. 1998). Expert judgment is applied in conjunction with data analysis to assimilate vegetation data into a single vegetation typology. This is placed on a database thereby facilitating easy access and manipulation. The classified plant communities are extensively field checked.

The steps in developing the NSWVCA are outlined below:

- The vegetation classification is progressively developed across NSW using the literature, field checking, data analysis and expert review. Plant community descriptions include listing characteristic plant species and abiotic attributes including soils and substrate. The methods of this classification are described in Benson (in review A). The first stage of the NSWVCA describes 212 plant communities in the arid and semi-arid Western Plains of NSW over 47 million hectares (Benson in review B.). Figure 3 and 4 show two of these communities. When the project is complete including the bio-rich diverse NSW east coast, it is anticipated that about 1000 plant communities will be described and listed;
- A relational database has been constructed in MS Access that contains 90 fields of information (Table 1) for each listed plant community. The database structure, fields, tables and reports are described in Benson (in review. A.).
- An assessment of the distribution, abundance and average condition of each listed plant community is undertaken. This includes estimating pre-European extent (1788 – the date when modern human-induced environmental change began), current extent and distribution in various planning regions such as bioregions, CMAs and Local Government Areas (LGAs). Database reports can be generated to assist with land management decision-making;
- Threat categories and threat criteria have been produced for assessing the threat status of plant communities (Benson in review A). The threat categories mirror the World Conservation Union (IUCN 2001) threat categories for species being: Critically Endangered, Endangered, Vulnerable, Near Threatened and Least Concern. The plant community threat criteria include: remaining extent compared to 1788, loss of key species, restriction in distribution, degradation of ecological processes and rate of change;
- An area of occurrence is determined of each plant community in protected areas that comply with the IUCN (1994) definitions of protected areas. These include public conservation reserves and long-term property resource management agreements over private land. A protected area adequacy status is defined by assessing the proportion of each plant community in protected areas against its estimated pre-European (1788) extent. Protected area adequacy thresholds, based on those produced for forest reservation by JANIS (1997), vary depending on the original extent of a community.
- When all data is collated, a combined threat/protected area status code is allocated in the database. This overall status code indicates the relative importance for conservation action of any listed plant community.

Figure 3. Old Man Saltbush (*Atriplex nummularia*) open shrubland on desert loam soils in the semi-arid plains of the NSW Western Plains. This is an example of a plant community that has been greatly reduced in extent through over-grazing by domestic stock and is considered to be "endangered".

Figure 4. Grey Mallee (*Eucalyptus morresii*) with White Cypress Pine (*Callitris glaucophylla*) on siliceous rocky ridges with skeletal, lithosol soil in the semi-arid zone of the NSW Western Plains. This is an example of a plant community that remains relatively intact due to its topographic position. It has a "least concern" threat category.

Table 1. Fields in the NSW Vegetation Classification and Assessment database. (some fields have standardised table options for data entry)

1. Vegetation community ID No	31. Vegetation description	61. Recoverability
2. Common Name	32. Mapped or modeled	62. Threatening processes
3. Scientific Name	33. Mapping information	63. Threatening processes lookup
4. Original data entry	34. Adequacy of plot sampling	64. Variation/ natural disturbance
5. Date of entry	35. Climatic Zone	65. Adjoining communities
6. Last modified by	36. IBRA Bioregion	66. Fire regime
7. Last modified date	37. IBRA sub-region	67. Conservation reserves (ha)
8. Formation Group	38. Botanical Division	68. Total area in reserves (ha)
9. State Vegetation Map	39. Local Government Area	69. No. of reps. in reserves
10. State landscapes (Mitchell 2002)	40. Catchment Management Authority Areas (CMAs)	70. Explanation of protected areas
11. NVIS major sub-groups	41. Murray-Darling Basin	71. Secure property agreements (ha)
12. Forest type (RN 17)	42. Substrate mass	72. Total area in secure property agreements (ha)
13. Characteristic trees	43. Lithology	73. Number of reps in secure property agreements
14. Characteristic shrubs, vines epiphytes	44. Great Soil Group	74. Total area protected
15. Characteristic groundcover	45. Soil texture	75. Total area protected accuracy
16. Characteristic weed species	46. Landform pattern	76. Protected pre-European extent (%)
17. Weediness	47. Landform elements	77. Protected current extent (%)
18. Threatened plants	48. Land use	78. Total reps in protected areas
19. Threatened fauna	49. Impacts of European settlement	79. Protected area code
20. Mean native species richness	50. Pre-European extent (ha)	80. Key sites for protection
21. Characteristic species qualif.	51. Pre-European accuracy	81. Threat category
22. Authority(s):	52. Pre-European qualifiers	82. Threat criteria
23. Authority qualifiers	53. Pre-European comments	83. Threat/protected area code
24. Reference list	54. Current extent (ha)	84. Planning controls
25. Interstate equivalents	55. Current extent accuracy	85. Planning and management
26. Classification confidence	56. Current extent qualifiers	86. Listed under legislation
27. Level of classification	57. Current extent comments	87. Recovery plan
28. Rainforest structure	58. Percent remaining	88. Recovery plan status
29. Structure	59. Percent remaining accuracy	89. Photograph fields (1, 2, 3)
30. Height class	60. Degree of fragmentation	90. References

2. Correlation with soil types and soil erosion.

The NSWVCA database lists the Australian Great Soil Groups (Stace et al. 1968) that are found in each plant community. It also lists soil texture, substrate, landform pattern and landform elements based on the Australian classification of these features in McDonald et al. (1990). Notes on soil erosion, levels of soil nitrification, pollution or salinity are provided for each plant community in the database.

3. Querying the NSWVCA database for decision making

The fields in the database are listed in Table 1. Queries of combinations of these fields can be made and provide a basis for numerous inquiries relevant to land use planning and legislative responses. A number of standard reports have been developed. These allow the user to list all plant communities that occur in planning regions and conservation reserves or under commonly used broader vegetation classifications.

4. Biodiversity and Natural Resource laws in NSW and Australia

Australian Federal and State environmental laws have expanded substantially in number and scope over the last 30 years. The vegetation classification and assessment database is an important source of biogeographic data that is used at various levels in statutory land use decision-making and compliance procedures under a wide variety of State and Commonwealth environmental law, including:

- **NSW Environmental Planning and Assessment Act 1979**: overarching legislation to which other NSW laws refer. Governs local, regional and state environmental plans and the development application process at both the State and local levels;
- **NSW National Parks and Wildlife Act 1974**: deals with the establishment and management of public reserves and wildlife conservation on private land including voluntary conservation agreements and wildlife refuges;
- **NSW Threatened Species Conservation Act 1995**: allows for the listing of plant and animal species, populations, ecological communities and threatening processes as critically endangered, endangered or vulnerable via an independent Scientific Committee. Provides for recovery planning and wider regional planning for protection of listed species and communities. As of 2005 over 86 species were presumed extinct and 800 species, 31 populations and 69 ecological communities were listed as threatened. The NSWVCA is most relevant to defining and listing threatened ecological communities but it also cross references plant communities with occurrences of threatened species where data are sufficient;
- **NSW Native Vegetation Act 2003**. This law regulates vegetation clearing and management in NSW via a Property Vegetation Plan (PVP) developer computer decision support tool that deal with assessing biodiversity, vegetation, soil condition and salinity. The PVP tool also provides a framework for allocating incentive payments to landholders for biodiversity, salinity or soil conservation management on private land;
- **Australian Environmental Protection and Biodiversity Conservation Act 1999:** This legislation deals with many aspects of environmental protection within the limits of the power of the Australian Government under the Australian Federal Constitution. It includes national listings of threatened species, ecological communities RAMSAR wetlands, World Heritage Sites. It gives the Federal Government the power to intercede on State issues under when certain thresholds of environmental threat or damage are breached.

5. Relevance of NSWVCA scheme in planning, setting targets and regulatory compliance

The threat categories, protected area status and the definitions and descriptions of the plant communities in the NSWVCA are used to:

- Assist with the development of Property Vegetation Plans under sections 28, 29 and 51 (Regulations) of the NSW Native Vegetation Act 2003. These plans need to evaluate the importance of a vegetation type in a location for incentive funding or clearing application;
- Assist to define "protected regrowth" under section 10 of the NSW Native Vegetation Act 2003 with the consequence that vegetation clearing of threatened and poorly protected types of regrowth could be minimised;
- Assist with compliance action against illegal clearing of native vegetation under the Native Vegetation Act 2003 by provided State-wide perspectives on ecological community status;
- Assist to set priorities and targets in CMA catchment action plans made

under part 4 of the NSW Catchment Management Act 2003. The status of a plant community listed in the NSWVCA could be used to set targets for spending public funds on protected area or on-farm improvements to vegetation and their associated soils;

- Assist with auditing NSW-wide Standards and Targets set by the NSW Natural Resource Commission (NRC) under the NSW Natural Resource Commission Act 2003. For example the NSWVCA could help with auditing the decrease or increase in extent of plant communities of native vegetation by 2015 and additions of vegetation types in protected areas;
- Form a basis for nominations and descriptions of ecological communities under the NSW Threatened Species Conservation Act 1995 and the Federal Environmental Protection and Biodiversity Conservation Act 1999. A number of communities described in the database have been listed under these laws. Ecological communities listed under threatened species laws are given additional protection across all tenures of land and may be subject to "recovery" planning.

Conclusions

There is a trend toward an ecosystem approach in protecting natural resources (Shepherd 2004). The development of a comprehensive vegetation classification and assessment schemes in a database formats, such as the NSWVCA described here, helps to set priorities for environmental protection. Similar to soil classifications around the world, vegetation classifications vary considerably even within single countries. Unifying approaches and scales of resolution would help to overcome inter-jurisdictional differences and provide national and international perspectives for spending limited resources on the natural environment. Sound ecological classifications can help with the selection of new conservation reserves, provide perspectives when making land use decisions and environmental impact assessments, help with listings of ecological communities under endangered species/ecological community laws, assist with setting rehabilitation or retention targets in national, state, regional or local plans and assist with compliance of natural resource management regulations. Because the NSWVCA correlates vegetation type with soil types, landforms, substrate and other physical landscape features, it can also help to protect landscapes as a whole.

Given the current emphasis on managing native vegetation in recent legislative changes in NSW, extensively to control vegetation clearing, it is important that the soils that underpin the existence of native vegetation are also protected.

References

Beadle, N.C.W. 1981. *The Vegetation of Australia* (Cambridge University Press: Cambridge England).

Benson, J.S. 1999. *Setting the scene: the native vegetation of New South Wales*. Background Paper No. 1 (Native Vegetation Advisory Council: Sydney).

Benson, J.S. in review A. Classification and assessment of the native vegetation of New South Wales, Australia: Part 1. Introduction, methods, the NSWVCA database, threat categories and threat criteria. To be published in Cunninghamia (Royal Botanic Gardens and Domain Trust: Sydney).

Benson, J.S. in review B. Classification and assessment of the native vegetation of New South Wales, Australia: Part 2. The plant communities of the NSW Western Plains. To be published in Cunninghamia (Royal Botanic Gardens and Domain Trust: Sydney).

Department of Infrastructure, Planning and Natural Resources of NSW. 1989-2005. Soils landscapes mapping program of New South Wales (DIPNR: Sydney).

Grossman, D. H., D. Faber-Langendoen, A. S. Weakley, M. Anderson, P. Bourgeron, R. Crawford, K. Goodin, S. Landaal, K. Metzler, K. D. Patterson, M. Pyne, M. Reid, & Sneddon, L. (1998) International classification of ecological communities: terrestrial vegetation of the United States. Volume I. The National Vegetation Classification System: development, status, and applications (The Nature Conservancy: Arlington, Virginia, USA).

IUCN 1994. Guidelines for Protected Area Management Categories. Commission on National Parks and Protected Areas with the assistance of the World Conservation Monitoring Centre (IUCN: Gland, Switzerland).
IUCN 2001. IUCN Red List Categories: Version 3.1 Prepared by the IUCN Species Survival Commission (IUCN: Gland, Switzerland and Cambridge, UK).
JANIS (Joint ANZECC/MCFFA National Forest Policy Statement Implementation Sub-committee) 1997. Nationally agreed criteria for the establishment of a comprehensive, adequate and representative reserve system for forests in Australia (Commonwealth of Australia: Canberra).
Keith, D.A. 2004. From Ocean Shores to Sand Dunes: the Vegetation of New South Wales and the ACT (CSIRO Publishing: Canberra).
McDonald, R.C., Isbell, R.F., Speight, J.G., Walker, J. & Hopkins, M.S. (1990) Australian Soil and Land Survey: Field Handbook. 2nd edition (Inkata Press: Melbourne).
Shepherd, G. (2004) The Ecosystem Approach: Five Steps to Implementation (IUCN: Gland, Switzerland and Cambridge, UK).
Stace, H.C.T., Hubble, G.D., Brewer, R., Northcote, K.H., Sleeman, J.R., Mulcachy, M.J. & Hallsworth, E.G. 1968. A handbook of Australian soils. (Rellim Technical Publications, Glenside: South Australia).
Thackway, R. & Cresswell, I.D. (eds.) (1995) An interim biogeographic regionalisation for Australia. Version 5.1 (Australian Nature Conservation Agency: Canberra).

Documentation and evaluation of case studies of soil and water protection using conservation tillage in Europe

G. van Lynden

ISRIC World Soil Information; Wageningen, The Netherlands, Email: Godert.vanLynden@wur.nl

Introduction

Soil erosion has been recognised as one of the major threats to the sustainable use of soil and land resources in Europe. Although soil erosion is a natural phenomenon, human intervention in the form of improper land management can accelerate loss of soil by erosion resulting in declines in soil depth, selective removal of nutrients, organic matter, agro-chemicals, seeds and trace elements, and a reduced soil microbial population. This in turn leads to decreased soil fertility and productivity, so that less protective vegetation cover and root mass remains to protect against erosion processes in subsequent years. This way a vicious circle of "erosion – loss of topsoil – poor vegetative biomass – erosion" is established. Indirect consequences of soil erosion include damage to emerging plants, exposure of less fertile sub-soil, and a reduction in water holding capacity. Once eroded, the sediments enter water courses leading to increased turbidity, pollution from the sediments and any contaminants adsorbed onto them, changes in water temperature, light penetration and available oxygen, and deposition of sediment. All of these factors can have detrimental effects on aquatic flora and fauna. Many studies have shown the sensitivity of aquatic ecosystems to even low levels of water pollution by sediment and its associated contaminants.

Land preparation and crop agronomy requires many field operations. Numerous tillage operations are required to break up the soil to ensure good contact between drilled seeds and soil media. Whilst in the short term soil surface roughness levels are high, thereby encouraging surface ponding of water, this roughness is lost as aggregates slake and breakdown more easily when subjected to raindrop impact after one or two rainfall events,

The degraded soil structure can result in redistribution of dislodged fine particles to create surface seals and caps that have negative impacts on seedling emergence, reduce infiltration and thus encourage surface runoff, often with high sediment concentrations. Repeated trafficking and wheeling from numerous field operations increase bulk density and reduce porosity; two factors detrimental to control of runoff and causing high soil losses for instance for winter cereals in the UK and sugar beet in Belgium or on the hillside vineyards of France and olive groves in southern Spain, threatening the viability of farms. An erosion process that's been going on for centuries has been exacerbated in recent years by tempestuous storms and flash flooding associated with climate change.

SOWAP and ProTerra

This paper describes two projects that aim to addresses some of these issues respectively on arable land in northern and central Europe (SOWAP), and on perennial cropland in S. Europe (ProTerra). A third project, WOCAT, is contributing to the documentation and evaluation of the implemented practices as well as the dissemination of project results

SOWAP is an acronym for an EU-LIFE Environment-supported project called "Soil and Surface Water Protection Using Conservation Tillage in Northern and Central Europe". SOWAP focus is on the UK, Belgium, Hungary and as of late includes the Czech Republic. Field sites (at the farm scale) with collaborative farmers are identified for each country, and a form of conservation tillage system

is applied at each site, with details of implementation depending on the local conditions and farmer preference. Consultation and participation by all stakeholders is critical to the success of SOWAP. Besides agronomic aspects the ecological impacts on for instance wildlife (birds in particular), insects and aquatic species are monitored, as well as soil biological aspects (earthworms, microbiology). The economic viability of these tillage systems is also assessed, which is one of the most important key aspects for farmers. The SOWAP team members are many and varied. They include commercial agri-business companies/ consultancy companies (Syngenta, Vaderstad; Agronomica), Academia (KU Leuven, WOCAT, Hungarian Academy of Sciences, NSRI of Cranfield University; Harper Adams University College) and private or public organisations (e.g. in the UK: National Trust, Royal Society for the Protection of Birds, the Allerton Trust, Farm Wild Life Advisory Group, Ponds Conservation Trust).

ProTerra is a similar project in its objectives, but its focus is on perennial crops such as olives and vines in Spain, Italy and southern France. Its range of collaborating institutions is presently also smaller than with SOWAP and funding has so far been exclusively from Syngenta (but additional funds are sought to expand the scope of the project).

Both SOWAP and ProTerra aim to assess the viability of a more "conservation-oriented" agriculture, with fewer tillage operations that minimise negative impacts on the environment. The projects work at the farm scale, although detailed monitoring takes place at the plot level, allowing sufficient resolution and replication of data. There is a considerable gap between what is known about the principles behind soil conservation practices and what is applied in practice. Both projects aim to overcome the constraints to adoption and implementation of soil and water conservation strategies by demonstrating practical and realistic erosion control solutions, concentrating on the use of conservation tillage. The objective of conservation tillage is to "maintain a fertile seedbed in the soil, whilst retaining maximum resistance to erosion".

With these principles in mind, SOWAP aims to demonstrate:

- the environmental impacts associated with "conventional" arable land use practices.
- the viability and effectiveness of "conservation oriented" arable land management systems in protecting soil resources, improving catchment water quality and promoting biodiversity.

Dissemination

Of critical importance to the success of SOWAP and ProTerra is dissemination of the information generated to farmers, land managers and other stakeholders. To this end SOWAP has expended an enormous amount of effort:

- At the local level with farmers and their advisors. In all participating countries a number of successful farmers' days and demonstrations have been held, where open discussions were held with the farmers about the benefits and disadvantages of conservation agriculture.
- At the national level with bodies in each country that influence the agricultural environment through regulation or advice.
- At the European level by providing technical advice on soil and water conservation. SOWAP and ProTerra have recently been requested by the European Commission (ESB) to prepare a technical guide to soil and water protection in European agriculture (now called CAMEO). The guide is currently in production and the first full draft should be available by November of this year. The guide will be translated in all 21 EU languages providing a huge opportunity for the projects to meet their pan-European task.
- With the media, informing and explaining the importance of soil and water conservation to society at large. Articles have appeared in the press and

documentaries have been shown on television. This has involved highlighting the costs to society of inappropriate land management practices, and demonstrating that the farming community can be a part of the solution of these problems.
- At academic conferences, to ensure the intellectual credibility of the project.

Method

To be able to demonstrate and disseminate the costs and benefits of "conservation" tillage, field sites are required. SOWAP works at the farm scale, with additional detailed technical monitoring taking place at the experimental plot level (in the order of 200 m2). Field sites with collaborative farmers are identified for each country, and a form of conservation tillage system is applied at each site, the details depending on the local conditions and farmer preference. The farmers are involved in a consultation process to enhance the proposed conservation system to be as practical and adoptable as possible (without losing the potential environmental benefits of that system). This initial period of consultation and (continued) participation by the landowner and other stakeholders is critical to the success of SOWAP.

Recognised indicators are monitored throughout the trial period, e.g. costs of cultivations, levels of energy consumption, ease of cultivation, land management problems, incidence and intensity of soil erosion, soil moisture deficits, crop agronomy, including the presence of pathogens, yield (total biomass and harvest yield, etc.).

Besides agronomic aspects the ecological impacts on for instance wildlife (birds in particular), insects and aquatic species are being monitored, as well as soil biological aspects (earthworms, microbiology). The economic viability and advantages and disadvantages of these tillage systems is also assessed, which is one of the most important key aspects for farmers.

"SOCAT"

SOWAP builds upon the work of the World Overview of Conservation Approaches and Technologies programme (WOCAT). ISRIC - World Soil Information, as a member of the WOCAT Management Group, represents WOCAT in the SOWAP project and is responsible for the documentation and dissemination task.

During the past decade WOCAT has developed and tested a standard methodology to document, monitor and evaluate soil and water conservation (SWC) know-how and to disseminate it around the globe in order to facilitate exchange of experience. A set of three comprehensive questionnaires and a database system have been developed to document all relevant aspects of SWC technologies and approaches. The methodology comprehensively assesses the costs and benefits, advantages and disadvantages, uptake, area coverage, etc as well as the bio-physical and socio-economic environments of the various practices being implemented.

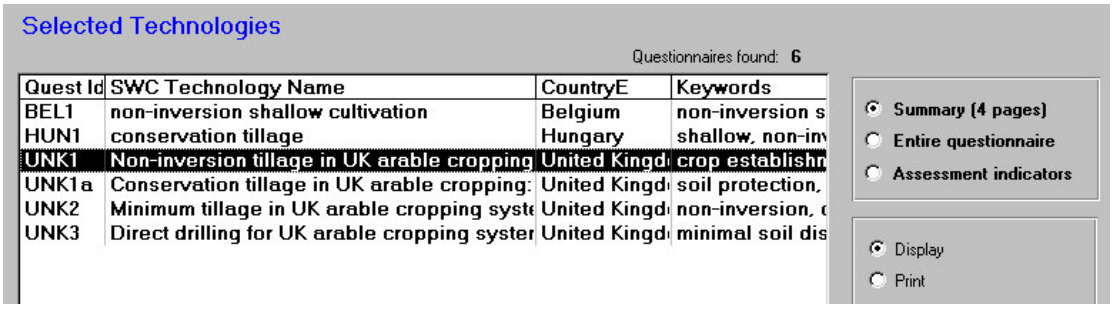
A SWC technology is defined by WOCAT as: "the agronomic, vegetative, structural or management measures (or combinations of these) that control soil degradation and enhance productivity in the field. A SWC approach constitutes "the ways and means of support that help to introduce and implement, adapt and apply a SWC technology in the field", in other words what is needed for the successful implementation of a technology (WOCAT, 2005).

WOCAT offers SWC professionals a common framework and methodology to document and evaluate their own experience or critically assess other experiences. One proven benefit of filling in the questionnaires is an in-depth analysis and evaluation of one's own SWC activities (Liniger et al., 2004).

The WOCAT methodology is currently used by more than 35 national and regional institutions worldwide for documenting and evaluating case studies of

soil and water conservation (SWC). In this paper the use of the WOCAT methodology in general, and in documenting three case studies from the SOWAP project in the UK, Belgium and Hungary in particular, will be discussed.

Within the SOWAP project the WOCAT method is being used to document and evaluate the tested practices. So far information has been collected for three technologies and three approaches in the UK, and one technology plus one



approach for both Belgium and Hungary. The information from the latter two countries however is still rather incomplete. All technologies concern some form of conservation or minimum tillage:

They are all applied on annual cropland with a crop rotation including cover crops and/or green manure such as winter barley, yellow mustard. There may be some disturbance of the soil (e.g. rolling, or working with discs and tines rather than mouldboard plough) but soil inversion is kept to a minimum, or nil in the case of direct drill.

Rather than an "add-on" SWC technology as in the case of "conventional" SWC technologies such as soil bunds, gully plugs, etc. a system change is involved where it is difficult if not impossible to distinguish a separate SWC component. It is therefore also difficult to calculate the additional SWC costs and the entire system needs to be compared to a conventionally worked comparable field or farm. Another difference with conventional SWC technologies is that reduction of erosion is not necessarily the major driver behind the take-up of the technology. To maximise the area under winter crops, the speed at which ground can be worked in the autumn is critical: one month earlier planting can mean an extra ton in cereal yield. Conditions in autumn generally become increasingly wet and less suitable for access with agricultural machinery because of trafficability and subsoil compaction. Traditional inversion tillage is slow and costly. By moving to high speed non-inversion 'conservation tillage' farmers can spread costs over a larger area (Leake, 2005, in Liniger and Critchley, in prep.). In the WOCAT case studies, the following issues are mentioned as major advantages to the land user:

- timeliness (earlier establishment of crops),
- lower costs per unit area,
- better trafficability,
- less fuel consumption, as less frequent and/or less heavy field operations are required
- reduced workload,
- reduced compaction thanks to higher biological activity (e.g. earthworms) and increased SOM
- compliance with (expected) EU legislation

Crop yields increase per unit area is generally marginal (5%) or non-existent and therefore not a direct driver to the farmer, although the amount of land prepared in time for winter sowing has increased, thus improving overall production (Leake, in Liniger and Critchley, in prep.). Less of direct importance to the land user, but more to the society as a whole are benefits like higher biodiversity (e.g.

more birds, insects, earthworms and soil micro-organisms), less CO2 emissions and air pollution because of reduced field operations, and of course last but not least less runoff and erosion, which also reduces pollution of surface waters with sediments and pesticides/fertilisers.

Special machinery is involved in the application of non-inversion tillage. This machinery does not replace the conventional equipment, because ploughing these may occasionally still be needed, e.g. ploughing to reduce weeds. Therefore short term returns compared to investment costs can sometimes be neutral or even slightly negative (Loddington case study). The machinery can also be used for contracted work and/or joint ventures with other landowners, which will reduce the overall costs per operated unit area. The total recurrent annual costs for conservation tillage operations, US$ 180 per ha, compares with US$ 260 for conventional tillage (drilling/ sowing not included). Subsequent application of additional herbicides represents an extra cost above conventional tillage of about US$ 80/ ha. Thus in balance the costs per ha are similar, but the key difference is that more hectares (about four times as many) can be prepared in time for autumn planting under conservation tillage (Leake, in Liniger and Critchley, in prep.).

The project applies the principle ALAP-AMAN: As Little As Possible, As Much As Needed. This applies to the use of herbicides, which is an essential element in the implementation of conservation tillage under modern mechanised agriculture. Herbicides are used to suppress weeds and to kill off cover crops and volunteers. The same principle also applies to ploughing, which may sometimes be required in one way or another (see above) in order to minimise the occurrence of weeds and pests (e.g. slugs).

Conclusions

Although the current project duration of two years is too short to make strong statements about the impact of conservation agriculture in Europe, the first results show a positive tendency for many investigated aspects (SOWAP Website, 2005):

Soil and Water

- Conservation tillage techniques have reduced soil loss (up to 90% on some plots) and water run-off (up to 40%) from fields compared to ploughing in all 3 SOWAP initial countries (Belgium, UK, Hungary).
- Considerable variability in results between fields and even within fields requires further investigation before clear conclusions can be drawn.

Biodiversity

- Higher numbers of some birds are associated with conservation-tilled fields rather than ploughed fields; however, bird numbers are considerably higher still in over-wintered stubble areas. As such, stubbles appear more important than conservation tillage in providing resources for wintering birds.
- Early results suggest that earthworm numbers can be higher in conservation-tilled fields than in conventionally ploughed fields.
- Tillage treatment appears to have an effect on biomass at the UK site at Loddington but no effect has been observed at the Tivington site.
- In Hungary, greater numbers and weights of earthworms were found in conservation-tilled fields than in conventionally ploughed fields under two different crop rotations in Autumn 2004.

Yields

- Yields of winter wheat, winter oilseed rape, sugar beet and maize are roughly similar from both ploughed and conservation-tilled fields

Water

- First results from catchment studies comparing the effects of conservation tillage and conventional plough-based cultivation on stream water quality show:
- In winter, streams in conservation-tilled catchments had lower sediment loads than streams in conventionally-tilled catchments.
- In winter, total phosphorus concentrations were lower in 'conventional' streams and slightly elevated in 'conservation tilled' streams; however, phosphorus levels in all of the study streams were quite low and at levels where only minor biological damage would be expected.
- There was no difference in nitrogen concentration between 'conservation tilled' and 'conventional' streams; both were significantly higher than the natural woodland background level.

The WOCAT data and the other SOWAP results show that the positive impacts of conservation agriculture for the farmer may take some time to become apparent and that the return of investment will therefore appear over the longer run. Especially joint ventures and other types of collaboration with farmer-colleagues offer possibilities to take the best advantage of the system change.

The SOWAP project is aiming to extend its present three year duration with another phase to achieve more meaningful results. The present phase is ending in 2006.

References & further reading

Liniger H.P., Douglas M. and Schwilch G. 2004: Towards Sustainable Land Management – 'Common sense' and some of the other key missing elements (the WOCAT experience). Proceedings of 13th International Soil Conservation Organisation Conference – Brisbane, July 2004

Liniger, H.P. and Critchley, W.R.S. (ed's) (2005): WOCAT Overview Book (exact title yet unknown)

SOWAP (2005). www.sowap.org

SOWAP (2002). EU-Life Project document; EU, Brussels.

Van Lynden, G.W.J. and M. Lane, 2004. Soil and Water Protection Using Conservation Tillage in Northern and Central Europe. Proceedings of 13th International Soil Conservation Organisation Conference – Brisbane, July 2004

WOCAT (2005). www.wocat.net

Traditional strategies for soil and water conservation in the Maghreb Mediterranean mountains

Sabir Mohamed[1] and Roose Eric [2]

[1]National School of Forest Engineers, BP 511, Salé, Morocco, sabirenfi@wanadoo.net.ma
[2]Roose Eric, IRD, Agropolis, BP 6450, 34394 Montpellier, France. Eric.roose@mpl.ird.fr

Abstract

Maghrebien mountains have got a bad reputation concerning erosion. As these semi-arid landscapes are never well covered, rains are erratic and slopes steep are long, gully erosion, landslides and floods may be dramatic during the cool rainy seasons. As long as natural vegetation covers the hill slopes, erosion is relatively moderate, but with successive civilizations, people extended cropping and grazing on the mountains, built cities and roads, provoking high peak flow, degradation of riverbeds and fast siltation of reservoirs. To survive to this increasing aridity, farmers and holders developed numerous traditional strategies to manage scarce water, biomass and soil fertility. In this paper, some examples have been taken in the Maghreb. The systems have been classified in relation to their objectives, their functioning and their ecologic situations:

- *Systems Collecting runoff under impluvium and storing it in* the soil;
- *Systems* storing *runoff in tanks* for- watering men, animals and gardens;
- *Runoff harvesting in the valley*;
- *Total infiltration;*
- Runoff diversion;
- *Runoff energy dissipation.*

In semi-arid areas, water is one Key for life: most of the traditional SWC systems insure irrigation supplement and soil fertility restoration. Today most of them are abandoned, not because they aren't efficient any more, but because labor is better paid elsewhere. The study of these traditional systems allows to better know climatic and human conditions of marginal grounds. An effort must be made to complement these well adapted traditional systems with modern technology (fertilization, etc.) in order to improve their economic efficiency.

Key Words: Maghreb areas, soil and water conservation structures, traditional systems, cultural practices, ecological classification.

Introduction

Areas around the Mediterranean Basin have the reputation of very high erosion hazard for ecological, arid and human reasons (Hudson, 1987). Because the rains are erratic and rare, landscapes are poorly covered during the winter rainy season. For geological reasons, the relief is very young, the hillslopes are very steep and long. Finally because the forests were cleared up for fire wood, cropping and grazing and for building commercial or battle fleets. At the end of the cool rainy season, soils can be saturated provoking high runoff, rills becoming gullies, high peak flow degrading the riverbeds, landslides, floods and inundation, sedimentation in the reservoirs and destruction of roads, bridges and constructions. As long as natural vegetation covers the slopes, erosion and runoff are moderate, but they become spectacular when very heavy or long storms fall on bare saturated ground (Roose, 1991).

Historically, the Maghrebien area was a passage for many civilizations. For centuries people built numerous large cities, cleared the forest, and extended agriculture in the plains, but also cropping and grazing on the Mountains to escape enemies invading the country. Successive civilizations have met degradation problems of the green cover, soil fertility, salinization of plains, soil crusting or scouring, gullies along the roads, inundations and destruction of cities.

Therefore, for centuries people developed strategies to minimize erosion hazard and degradation of natural resources in water, biomass and soil fertility (Lowdermilk, 1975; Roose, 1996). This Maghrebien area is thus an excellent area to analyze traditional soil and water conservation systems developed before the modernization and the mechanization of the agriculture in the 20th century.

This Paper is a synthesis of studies of traditional strategies observed in the countries of Maghreb (Morocco, Algeria, Tunisia). After a description of diversity and originality of semi-arid to semi-humid areas, we will analyze the relative importance of various erosion processes in relation to hillslope management for agricultural production. Facing the most important problem of water management in these semi-arid areas, we will classify traditional antierosive systems taking into account the rainfall and runoff hazard at the level of fields (cultural practices) and hillslopes (conservation structures).

The specific Maghrebien environment

Steep slopes and gullied landscapes

On aerial photographs, Maghreb's areas appear as deeply gullied hillslopes, stony colluviums, torrential wadies and sediment filled reservoirs: all of these signals are indicators of important runoff, even on semi-arid areas. Nevertheless, measurements on the fields showed that these landscapes with a very old human colonization are less fragile, as it seems at a first superficial sight. Of course, the mountains are young, the slopes are steep and often long, the valleys narrow and the wadies torrential. But as long as these mountains are covered by forests or not too overgrazed, runoff is limited and soil losses on the hillslopes are not very significant: more or less 1 mm / year after Heusch (1970) on marl hills of Rif and Laouina (1992) in Morocco, Delhumeau. (1981) and Delhoume (1987) on limestone of Tunisia and Roose *et al.* (1993) on various soils of Algeria. Many gullies are inherited and no more functional, except during exceptional rains failing on bare saturated soils**.** In semiarid areas, rare events are much more important than in the tropical countries. As ground is generally poorly covered, the exceptional rains or rainfall series have a deep impact on runoff, gullies, landslides and peak flow leaving, the landscape definitively marked by spectacular erosion manifestations (Roose, 1972). Slope steepness does not always increase runoff and even erosion: rocks and crusted compacted soil may protect the summit of many hills but the colluviums at the contact of concave hillslopes with the valley may collect a huge amount of runoff and cause rills and deep gullies. The topographic position of a field may be more important than the slope steepness (Heush, 1970; Roose, 1972; Roose *et al*., 1993).

Historical circumstances (successive colonizations), demographic pressure (population doubled in the last 25 years) and economic pressures (importance of deforestation, grazing, cereals or cannabis cropping for poor farmers survival) have broken the precarious landscape stability.

A stunted vegetation deeply degraded by overexploitation for energy and grazing

Semi-arid vegetation deeply exploited by man, cropping cereals and overgrazing, poorly protect the soil during the cool rainy winter season and the dry hot summer (Masson, 1980). Presently, forests (<5% of the Surface) are

overexploited and overgrazed areas are cleared by farmers for cereal cropping and land appropriation (Sabir *et al*., 2002). This can develop landslides on steep slopes, rills and gullies at the middle of the slope, sedimentation in the valley, degradation of the riverbeds, destruction of the best soils of the recent terrace and finally aridification of the whole landscape.

Nor fruit trees plantations, nor extensive cereals-legumes rotations, nor grazed fallow, nor vineyards protect efficiently soils against rainfall and runoff energy during the rainy periods (100 to 300 mm in one to three days). Tillage practices delete rills and other indicators of concentrated runoff, but the depth of soils is scoured and the soil productivity has decreased (Masson, 1980; Roose *et al*., 1993). Because soils are poor (deficiencies in N and P), the yield of extensive crops are very low (0.4 to 1 t/ha) and the cover very poor.

Maghrebien climates: importance of exceptional rains

Maghrebien areas receive most of their rainfalls during the cool winter and spring seasons. Moreover, the climate is well known for it's erosive rainstorm. Some summer or autumnal storms are actually redoubtable and provoke disasters.

Contrary to general opinion, the ordinary rainfalls have much less energy in Mediterranean mountains than in tropical areas (Roose, 1980; Arabi et Roose, 1989). Therefore it is important to note that the erosion source depends more on the energy of runoff concentrated at the bottom of the slopes and in large wadies than on rainfall energy (Heush, 1970). Therefore the fight against erosion must be organized chiefly around the concepts of water management on the hillsides, improvement of infiltration capacity and soil resistance to runoff energy for exceptional storms.

Soils are resistant to rainfall but not to runoff energy

Regosols, red fersiallitic alfisols, brown calcareous soils, black rendzines and grey vertisols who take up most of the hillslopes, are generally well structured, well aggregated, rich in clay, calcareous or free iron, stony, permeable and resistant to splash, but not necessary to gulling or slumping. The presence of gypsum and soluble salts into marl increases the terrain fragility (tunneling). The high resistance of soils under natural vegetation is limited in space and time (K USLE varied from 0.001 to 0.30). With overgrazing or cropping without any organic matter recycling, runoff on the field remains clear because there are many traps (clodiness, grassturf, stony surface) but as soon as rills appear the, sediment in suspension (MES) increases from MES = 1-3 g/l in sheet erosion to 5-20 g/l in rills and up to 20-200 g/l in gullies and wadies.

The main erosion problems in Maghrebien areas

Because ecological and human situations are various**,** there is a large diversity of erosion problems, but traditional systems are adapted to specific problems of natural resources management.

Soil fertility degradation

Forest and mattoral bring to the soils 3 to 10 t/ha/year of organic matter as litter and dead roots. As soon as the forest is cleared, grazed, or burned and cropped, the balance is broken and the soil organic matter (SOM) content decreases until a lower equilibrium in relation to the new farming system. Under a threshold of 0.8 to 1.5 % of SOM (depending on clay content), the meso-faunal activities decrease, the macro pores collapse and the infiltration capacity is reduced: the aggregate stability decrease, indicates increasing risk of runoff and erosion (Barthes et al., 2000, Sabir et al. 2004). It is the reason why the management of

biomass (and mineral fertilizers) is essential for soil conservation and water management in semi-arid areas (Roose and Barthes, 2001).

Sheet erosion

Selective sheet erosion is active every where on bare soils: where raindrops strike the soil, packing and sealing the surface, they decrease the infiltration capacity to less than 10 mm/h and increase runoff and erosion risks. Measurements of sheet erosion on runoff plots in Morocco, Algeria and Tunisia as well showed that sheet erosion is not very significant (less than 1mm/year) but has an effect on soil fertility degradation (Roose and Barthes, 2001).

Linear erosion

This is the erosion process best discerned by farmers and most of the traditional systems of soil and water conservation are considered to decrease linear erosion manifestations. If nothing is made on cropped fields after the rainstorms, sheet runoff will organize it in rills, gullies and later in torrential gullies and badlands: these are indicator signals that runoff is abundant and that runoff energy pass beyond rainfall energy. In Mediterranean areas where runoff often begins with soil saturation, green cover is less efficient than in tropical countries to reduce runoff and erosion problems: it will be necessary to develop water management systems well adapted to steep slopes, rock debris or soft soil covers.

The main factors influencing gully processes are runoff volume and speed and soil resistance to the shearing stress developed by running water.

Mass movements

Processes of mass movements are various but frequent. Landslides, solifluxion and torrential lava are related to exceptional rainstorms: farmers are afraid of them but have no parade, (except eucalyptus plantation). Creeping is active on steep slopes but also on tilled fields.

In conclusion, the studies about traditional strategies of SWC are mainly concerned with runoff management on hillsides: to capture runoff locally in cisterns or in the soil to irrigate fruit trees or cropped fields, to improve the soil infiltration rate, to capture excess water, to drain it outside cropped fields or to dissipate the runoff energy through permeable micro-dams. This paper will not discuss traditional strategies to fight sheet erosion nor mass movements: it will focus the discussion on attempts to manage surface water in order to increase the crops productivity.

Water management for soil conservation in relation to the Mediterranean climate

Systems harvesting runoff under impluvium in arid and semi-arid areas

Runoff harvesting and storing into soils

Runoff farming: hilltop overgrazed producing runoff in the cereal fields planted in the colluviums at the bottom of a marl hillside was observed near Gabes in Tunisia (Bourges *et al*. 1979). With mechanization facilities, farmers plow the base of the hills overgrazed, hoping that once in 2 or 3 years, the field will catch enough rain (100 to 250 mm) and runoff to produce 4 to 8 quintals of cereals and as much of straw for sheep grazing.

"Meskat" system covers 200 000 ha in Sousse, region in Tunisia. With 200 mm of rainfall, olive trees need a double surface to produce fruits. The stony and crusted tops of the hill are kept in bare fallow and the runoff is lead to the

cultivated area (called manka). A bund (tabia) is constructed around the cultivated plot, which can retain the 50 years daily maximum amount of runoff (El Amarni, 1977).

"Half moon" of ground and stories limiting a basin of 4 to 10 m² have been built at the bottom of a rocky hillside and planted in olive trees in the Karouan province of Tunisia (Rainfall 300 mm).

We recently observed "paved tracks" around a stony overgrazed hilltop collecting runoff and distributing it to the graded terraces intensively cultivated (fruit trees, vegetables and cereals) in occidental Rif area of Morocco (Sabir *et al*., 2000).

From a stony hillslope in oriental Rif (Morocco), people remove stones and build "piles" over a big rock that they cannot move. Later these piles are growing in discontinue stone bunds. The stones are mixed with numerous bushes grazed by goats. "Stone walls" are progressively built around individual fields to protect them from livestock.

"Irrigated traditional bench terraces" developed in China and in Far East 3000 years ago, came in Mediterranean areas with silk and slave traders about ten centuries ago: they were improved by stone walls protecting the embankment against storms. They are still working as well in Spain, in southern France, as in Oriental Morocco (Ait Hamza, 1996, Chaker *et al*., 1996). Their construction is progressive and may take 800 to 1500 days of labor per hectare managed. Their maintenance is time consuming, so that traditional bench terraces are abandoned if their production is not profitable enough. In favorable areas (vineyards or citrus plantations), stone walls are cemented to reduce the maintenance.

Systems storing runoff in tanks for men and animal watering and garden irrigation

"Matfia" in Morocco and "Magden" in Algeria are open field ponds catching runoff from roads, short stony or silty loam crusted impluvium (Sabir et al. 2000). The main problems are to improve the quality of the water to reduce sedimentation in the pond and maintain animals out of the pond for health reasons.

Runoff harvesting in the Valley

"Narrow terraces" in semi-arid areas where it is difficult to crop cereals on hillslopes, living hedges are implanted in the broad wadies to decrease the flood velocity, and harvest runoff and sediments in order to build a narrow terrace for gardening during the dry season, or to harvest clear water to nourish a "seguia", a channel running along the hillslope to irrigate the last terrace. The most frequent plants used are Provence cane, populars, salix, fraxinus, oleander and various permanent herbs (Ait Hamza, 1996).

"Jessour': In arid areas of southern Tunisia, earth dykes are built in the valleys to harvest runoff water and sediments from bare hillslopes and to build a series of terraces planted progressively with fruit-trees (figs, olive and palm trees) and cereals or leguminous like peas (Bonvallot, 1986).

"Earth dams" are built in Central Tunisia to harvest runoff from little watersheds which will be used for irrigation of lateral terraces downstream, or pumped on hillslopes for market gardening (Albergel *et al*., 1998).

Systems allowing total infiltration

Where annual rainfalls are inferior to 400 mm, farmers developed the famous "Mediterranean graded terraces" covering the whole hillsides up to 40% slope: on steeper slopes risks of landslide are increasing, mainly on argillite, marl, schist and gneiss. Depending on local material available, embankments are built in soil, reinforced with grass stuffs or stone walls (Morocco). More frequent are cultural

practices oriented to maximize infiltration like deep tillage on the contour, tied ridging or mulching (for market gardening).

Diversion of excess runoff during the humid periods

"Diversion ditches": Farmers open oblique ditches with the plow in order to drain rapidly the beginning runoff out of the cereal fields (plowed on the contour) to the plot boundaries or to waterways protected by grass or stones. Within the ditches, the slope must remain slight not to provoke gully formation.

Runoff energy dissipation

"Progressive terraces with permeable barriers". Instead of concentrating sheet runoff in diversion ditches or channels, this system tries to dissipate the runoff energy while dispersing excess water on the roughness of the soil surface (clods, mulch, weeds) and on permeable structures (like grass strips, hedges, stone bunds, etc.) which reduce the runoff velocity of water going down the hillslopes. This system is very frequent with embankments covered with various natural bushes and grasses (olive, almond trees, doum palm trees, etc). On lithosoils, stones are accumulated on piles, stone bunds or stone walls, depending on the stone qualities and quantities. While the embankments are, built progressively by tillage erosion (5 to 20 cm / year), the slope steepness decreases to a limit, but the runoff keeps draining down the hillslope in diffuse sheet, with low velocity and energy.

"Bench terraces with stone wall". It is possible to observe presently graded terraces built on the smooth slopes of the piedmont support rich olives and cereals mixed cropping systems. On the superficial lithosoils of the concave, hilltop, "terraces" support more rustic tree cropping (almond). Cultural practices increase the efficiency of these terraces, like rough plowing, mulching or direct drilling in the litter of crop residues.

Biomass and soil fertility management

In semi-arid areas, vegetal production is limited not only by water supply but also by nutrient deficiencies, mainly phosphorus and nitrogen, continually exported with cereal grains.

To restore soil production capacity, farmers developed traditional farming systems: cereals in rotation with leguminous plant, farm manure, various compostage systems, fallow and grazing areas, agro-forestry (olive- or almond-trees with cereals / beans rotation), sylvo-pastoralism (cork oak and grazing), etc. These complex restoration systems helped to maintain a minimal production of 4 to 15 quintals/ha/year. A complementary supply of N and P is needed with water management systems to improve the production.

Discussion and conclusions

Traditional soil and water conservation systems are numerous in the Maghreb: their extension areas and efficiency are limited to climatic and socio-economic conditions, which are very variable in relation to space and time. Because they are concerned chiefly by water management on the hillslopes, a classification was proposed in relation to local water budget, topography and functioning.

Most of the traditional systems are managed to catch water and its load for supplemental irrigation. Here irrigation improves water availability and soil fertility at the same time, but supplemental fertilizers (N+P mainly) are needed to valorize soil and water resources.

Presently, many of these traditional systems are being abandoned, not because they are not efficient to preserve the land, but because human conditions have changed. The population has grown too fast and farmers ask for more productive systems; these systems require a lot of labor for maintenance and labor is better paid in town or in Europe. Because of young people emigration, the maintenance is not insured by lack of labor and finance.

In the last 50 years, population pressure increased. In Maghreb's large plains the governments organized irrigation and intensification of the agriculture but nobody was responsible for improving agriculture in the mountains. In the mountains poor farmers still survived extending subsistence crops on steep slopes, sacrificing forests, mattoral and crop residues for breeding (which is the farmers bank), and for energy (30% of their time is spent to collect fire wood and forage), or cannabis production (the most profitable crop in the Rif mountains in Morocco). In many places rills became gullies, the bare ground left the hills to sediment in the reservoirs, leading to badlands formation and accelerated emigration.

To fight against this high erosion hazard last century, two strategies were proposed by central governments:

- SWC: Soil and Water Conservation, but soils are already so degraded that it is rarely profitable to restore them;
- DRS, Defense and Soil Restoration by forest plantation, terraces, gullies correction, etc. But where the farmers may live and produce?

The failure of these conventional strategies is now recognized (Hudson, 1991). Then a new strategy was proposed (Land Husbandry) based on farmers participation in the solution research for their problems: "sustainable valorization of their land and their labor". The challenge is to increase their productivity and simultaneously to reduce erosion risks. To give a chance to crops, to better grow and cover the soils, infiltration capacity and nutrients availability must be encouraged (Shaxson *et a*l., 1988). This approach has been tested Algeria, Morocco and Tunisia. In Algeria on vertisols, the yield increased from 8 to 50 quintals of cereal grains and the net income was multiplied by 10 with a simultaneous decrease of runoff and erosion risk (Roose et al., 1993, Roose, 1996). Traditional strategies studies are of great interest as a new departure point for a research about the sustainable management of natural resources at the regional level where erosion and runoff problems cannot be solved by technical approaches alone. Farmer's participation is necessary to improve our knowledge on their ecological and human environment and for the maintenance of rural management. Researchers, in close relation to farmers and state technicians, have to study the systems limitations and their possibilities for improvements.

References

Ait Hamza, M. (1996). La maîtrise de 1'eau : pratiques de CES dans le Haut Atlas marocain. In : Reij, C., Scoones, L; Toulmin, C (Eds.), Techniques Traditionnelles de CES en Afrique. CTA-CDCS-Kailhala, pp. 69-74.

Albergel, J.; Boufaroua, M.,, Pepin, Y. (1998), Bilan de l'érosion sur les petits bassins versants des lacs collinaires en Tunisie semi-aride. Bull. Réseau Erosion 18: 61-75,

Arabi, M., Roose, E. (1989). Influence de quatre systèmes de production en zone méditerranéenne de moyenne montagne algérienne. ORSTOM, Montpellierr. Bull. Réseau Erosion 9: 39-5 1

Barthès, B., Azontonde, A.; Boli, Z.; Prat, C; Roose, E. (2000). Field scale runoff and erosion in relation to topsoil aggregate stability in three tropical regions (Benin, Cameroon, Mexico), Eteropeaii J. Soil Science 51 (3): 485-495.

Bonvallot, I. (1986)- Tabias et jessours du Sud tunisien. Agriculture dans les zones marginales et parade à l'érosion. Cah. ORSTOM Pédol. 22 (2): 163-172.

Bourges J., Floret C., Girard G., Pontanier R. (1979). Etude d'un milieu représentatif du Sud tunisien type segui : la citerne Telman (1972-1977). Rapport ORSTOM-DRES, Tunis, 147 p.

Delhourne J.P. (1987). Ruissellement et érosion en bioclimat méditerranéen semi-aride de Tunisie Centrale. In << Processus et mesures de 1'érosion >> Edi.CNRS, Paris : 487-507.

Delhumeau M. (1981). Etude de la dynamique de l'eau sur parcelles du bassin de l'Oued Sidi Ben Naceur, Nord Tunisie. Rapport ORSTOM, Tunis, 80 p.

Demmak A. (1982). Contribution à 1'étude de 1'érosion et des transports solides en Algérie septentrionale. Thése Doct. Ing. Paris, 323 p.
El Amami S. (1977). Traditional technologies and development of the african environments. Utilisation of runoff water: the meskat and other techniques in Tunisia. African Environment, 3: 107-120.
Heusch B. (1970). L'érosion du Pré Rif : Etude quantitative dans les collines marneuses. Annales de la Recherche Forestières du Maroc 12 : 9-176.
Hudson N.W. (1987) Soil and water conservation in semi-arid areas. FAO Soils Bull.57,172 p.
Hudson N.W. (1991). A study of the reasons for success or failure of soil conservation projects. FAO Soils Bull., Rome, 64: 65 p
Laouina A. (1998). D6gradation des terres dans la région méditerran6enne du Maghreb. Bull. Réseau Erosion, 18: 33-53.
Reij C, Scoones 1. & Toulmin C. (1996). Techniques traditionnelles de conservation de l'eau et des sols en Afrique. CTA-CDCS-KARTHALA edi, 355 p.
Roose E. (1972). Comparaison des causes de l'érosion et des principes de lutte anti-érosive en régions tropicale humide, tropicale sèche et méditerranéenne. Com. Journées Etude du G.R., Florence: 417-441.
Roose E. (1991). Conservation des sols en zones méditerranéennes. Synthèse et proposition d'une nouvelle stratégie de LAE, la GCES. Cah. ORSTOM Pédol., 26, 2: 145-181.
Roose E. (1994). Introduction à la gestion conservatoire de 1'eau et de la fertilité des sols (GCES). Bull. Sols FAO, Rome, 70: 420 p.
Roose E. & Barthès B. (2001) Organic matter management for soil conservation In Africa. Nutrients Cycling in Ecosystems, 61 : 159-170
Roose E. & M. Sabir.(2001). Stratégies traditionnelles de conservation de l'eau et des sols en zones méditerranéennes. Séminaire Internat. Montpellier 2000 <<Hudrologie des régions méditerranéennes >> PHI-V. Doc.Technique en Hydrologic n° 51:101-109.
Sabir M., Roose E., Merzouk A., Nouri A. (1999). Techniques traditionnelles de gestion de l'eau et de lutte antiérosive dans deux terroirs du Rif occidental (Maroc). Bull. Réseau Erosion, Montpellier, 19: 456-471.
Sabir M., Barthes B., et Roose E., (2004) Recherche d'indicateurs de risque de ruissellement et d'érosion sur les principaux sols des montagnes méditerranéennes du Rif occidental, Maroc. Secheresse 15 (1) 24-31.
Sabir M., Roose E. et Nouri A., (2002). Spatialisation des techniques de gestion des ressources naturelles dans deux villages des montagnes méditerranéennes du Rif Occiental, Maroc. Actes du séminaire de l'UFR Sagert, CNEARC, Montpellier, 11pages.
Shaxson T.F., Hudson N.W., Sanders D.W., Roose E. et Moldenhauer W.C. (1988). Land husbandry. A framework for soil an dwater conservation. Soil and Water Conservation Society, Ankeny, Iowa, USA, 64p.

The Results of SCAPEs Case Studies

Anton C. Imeson

SCAPE Project Coordinator / University of Amsterdam, Email: a.c.imeson@science.uva.nl

Abstract

One of the main strategies of SCAPE was to use Case Studies for a range of different purposes. By focusing discussion on concrete real examples, more insight is obtained in the true nature of the issues that are being faced. The real examples being studied can be used to focus the exchange and development of ideas. Most case studies were either used to identify successful actions and strategies or to examine particular topics that our attention became focussed on as the project developed. Case Studies were also used from other countries to see how they had dealt with soil protection. Case studies close to the areas in which meetings were held were also visited. They formed a south –north transect from Alicante in the South to Oslo in the north. A complete description of a selection of the case studies has been prepared as part of the SCAPE Book and this will be on display at the Conference. The case studies revealed very many common strategies that have been used with success. The differences are less great than was originally expected.

Introduction

One of the main strategies of SCAPE was to use Case Studies for a range of different purposes. By focusing on concrete real examples, discussion was based on knowledge that could be critically evaluated and not on belief. The Case studies also drew attention to emerging questions and answers. Case studies outside of Europe enabled an evaluation to be made of for example the development of soil conservation in The USA and Israel.

The objective of this briefing paper is to explain the purpose of the case studies and to introduce some of the results. This is important because at the meeting we want to revue some ideas about what actions are successful and why.

Although the Case Studies were of different types, they all had the aim of identifying successful strategies of soil conservation and protection and of learning from the scientists, practitioners and people working and living in them.

Europe is extremely diverse so that it would not have been possible to have case studies that were representative of all of the Europe's regions. Nevertheless, SCAPE did succeed in considering a large number of cases and held workshops in five of them that formed a north south transect across Europe. The different biogeographic covered included the Mediterranean, the European Alps, the continental, boreal and Atlantic Europe.

Usually, the case studies either concerned specific regions or problems that were presented and discussed by scientists working in these areas, or thematic case studies such as those on urban soils, sealing and economic aspects of soil conservation. It is important to learn from experience outside of Europe, so that Case Studies in areas that have a long tradition of soil conservation were also included.

A special place in the project is provided by those case studies that SCAPE participants actually visited in the field. Excursions were organized to see first hand soil conservation and protection work that was taking place in the field. An up-to-date view of a particular area is achieved. Case studies reveal the 'real life' status or 'reality' of what is happening in the field. A case study dealing with soil conservation and protection has to be specific about scale and timeframe. Attention was given to understanding in these case study areas which actions had been successful and which had failed. The aspects discussed ranged from policy and economic instruments to technical and ecological measures of soil conservation.

Four field visits to case study areas were organised in contrasted Bio-geographic regions.

These were:

- Alicante (ES) which is representative for the Mediterranean biogeographic region located in the dry Mediterranean zone
- Cinque Terre (IT), representative for the Mediterranean / continental biogeographic region, located in the humid Mediterranean zone
- The Montafon region (AT) , representative for the Alpine biogeogaphic region
- Southern Norway, representative for the Boreal biogeographic region

All of these areas were for different reasons environmentally sensitive areas. Climate, slope or rock type as well as socio-economic circumstances meant that there were many threats to the soils present in these areas.

We invite visit the www.SCAPE.org web site to examine the research that was reported on more fully.

The Alicante and Murcia Case Study in Spain was interesting because the region is undergoing many rapid changes in land use. A lot of data is available on the different threats facing the soil. The results are available from many past or ongoing EU or National research projects. The region also contains badlands. The region is within the Target Area of the Spanish National Action Plan of the UNCCD. Tourism and Irrigated Agriculture are the main economic activities. Formerly dry land farming was an important activity. Large areas have been abandoned and are now covered with matoral or forest. Large areas are also frequently subject to wildfires. The field visit was organized jointly with other projects concerned specifically with restoration (REACTION) or desertification (MEDRAP).

The SCAPE excursion visited a large restoration project. The climate is semi-arid but there is a large interannual variability in precipitation so that there are often periods with droughts or relatively high intensity rainfall. Selected papers from the meeting will appear this year in the Journal Land Degradation and Development and manuscripts of the papers can be obtained by request. Two years later the number of Case Studies in Iberia has been expanded to cover a range of other locations and issues (irrigation, fire, government policy). For a full account reference is made to Chapter 4 of the SCAPE Book (Scape In Press 2005).

The Cinque Terre, (Italy) case study enabled a consideration of terraced management to be examined. The abandonment of terraced land is very common in many Mediterranean areas and on steep slopes the terraces and the soils they retain can be lost to erosion and landslides. Terraces as a case study were compared from different areas including Malta, Turkey and North Africa. The

Cinque Terre region was made into a National Park and has the status of a UNESCO world heritage. How the park status helped the region to protect its landscape and the prevention of the degradation of the terraces is without doubt and an important example for other regions. In many parts of the world National Parks with thousands of visitors provide an instrument not just for protecting the soil but also for informing visitors about the issues at hand. The strategies of many National and Regional Parks in Canada and the USA could serve as a model for Europe. The aim is to help people experience and understand the heritage value of the soil and landscape and this can only be done first hand.

The Montafon region (Austria) **case study** studied the specific problems of mountain areas. Mountain soils can be very vulnerable to erosion, compaction and mass movements. Forests with a direct protective function against rockfall, snow avalanches and landslides play a key role in landscape management in the Alpine Region. Such forests are managed in a way that they also protect their own sites against erosion and shallow landslides. In that sense, forest management, which mainly consists of selective 'close to nature' interventions, contributes to soil conservation. Tourism and hydro-electric power generation are major sources of income for the region. In the Stand Montafon, a regional land management and political body, which deals with forest, land and water management as well as with tourism, good practice and community action, is demonstrated. In both the Montafon and Cinque Terre, the local people had managed to ensure that capital generated in the region from other sources (tourism and energy) was able to support the conservation and protection of the land.

The Southern Norway case study focused primarily on the boreal zone where transforming marginal grasslands into arable farming land has increased erosion much. The erosion processes lead to the pollution of drink- and fishing water resources (blue algae). Legislation and a set of technical measures was developed to decrease the amount of soil erosion and to improve water quality. Case studies were presented from most Scandinavian countries. (see: www.SCAPE.org). In the field it was clear that land leveling after the second world war was a major cause of the erosion problems in the region. It was also clear that very steep slopes were being cultivated and that rill erosion was active.

It was particularly enlightening for participants from Portugal and Spain to encounter similar problems in Norway or Austria as they were used to at home.

Key Emerging Findings

Positive Experience

Throughout the world vast numbers of people are performing actions that are successfully contributing towards soil conservation and protection. The picture is far from bleak. If one looks around, or turns on the television, reads a paper or magazine, more often is one confronted with a negative than a positive example in the field of soil conservation or the environment as a whole. The point is, these are often the exception and for that reason news. In much of the area things are going reasonably well. The authors of our Scape Book conclude that it is a human feature to take the good things that surround us for granted instead of nurturing it and to focus on things that are wrong or bad. The problem is that the data and information that could be used to accurately demonstrate what is good or bad is either not present or not in place. Unfortunately it is a political fact of life that indicators demonstrating that things are getting worse are often used to claim more resources. It is not that the threats to the soil are not real, it is just that they are not always really understood or explained. There are some places in

Europe where soil erosion and contamination are happening at alarming rates and the consequences for the environment are tragic. Most communities in Europe, however, are trying to conserve and protect their environment which fortunately includes the soil.

Many positive measures and results were presented in the case studies and this is one aspect SCAPE will show to you.

A few Positive Conclusions

Local Action Groups

A Google search will reveal thousands of local action groups throughout the world involved in partnership actions. Some like those dealing with land care are involved explicitly with soil and water but others concern with preserving national and cultural heritage. Tens of thousands of world citizens are not only acting but training and passing their values on to young people. It maybe true that the soil is underrepresented in words but how can biodiversity be improved without improving the soil as a habitat? The soil should be included in nature conservation.

Soil threats are local and bounded in place and time

The case studies from Holland and Norway demonstrated that when soil erosion occurred society actually tackled it. This was the policy cycle in action. The direct trigger of much soil erosion in Europe has been land levelling and land consolidation. This has been the cause of much offsite damage. The erosion was the result of a one-off bulldozing of the land. Soil erosion models and concepts need to take advantage of this fact. The soil and farming systems are resilient and people will adapt to control any problem. Our luck is the extreme soil erosion risk is not related to rainfall but to land use policy. The policy of land consolidation in The Netherlands and in Norway were all that were needed. It was not the policy that was wrong but the way it was allowed.

Best Practices

By means of case studies SCAPE is able to promote guidelines and training instruments of best land management practises. Land users can be introduced to management techniques and other options for land use which are less degrading and which stress alternative combinations of functions.

Natural parks

A similarity found throughout all different workshops is the positive value that is brought about by the creation of a natural park. Making an area a UNESCO heritage site is especially important. The implementation of a natural park can be explained as a good practice. Not only does it increase the awareness of our vital resources, such as soil, amongst a bigger public, as people go these parks to enjoy 'a sniff of nature'. It also will significantly contribute to raising educational awareness levels concerning soil protection and conservation. Furthermore in general terms, does it imply that soil conservation and nature protection measures are implemented within these natural parks and can be assessed in the long or short term on its effectiveness, mostly showing, considering the case studies presented, positive outcomes in regeneration of species, biodiversity, increase in soil organic matter content, soil quality and so on. Concerning the interdisciplinary nature, positive outcomes are also found in economic status; the preciousness of a natural park also increases tourism incomes for which for

instance Parco nazionale della Cinque Terre was an outstanding example. In this park the amount of visitors is set to a maximum per day in order not to overpopulate the park which would have negative impacts. Also within the natural park local commodities are made and often derive from an 'ecological' background which are bought by people visiting the park, sharing some natural heritage.

Demonstration farms and Networks

Support by extension services is very positive. This can include helping land users set up trials or experiments to perfect their management techniques and solutions.

Some Gaps

During the presentation, research gaps and needs will be discussed. How can we get data and information to the people who could use it in the field?

Future research needs for the sustainable management of soil resources

Winfried E.H. Blum

Institute of Soil Research, Department of Forest and Soil Sciences, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Austria; E-mail: winfried.blum@boku.ac.at

Abstract

Under sustainable management of soil resources, we understand the spatial and/or temporal harmonisation of all six possible uses of soil and land, avoiding or minimizing irreversible impacts. This is a political and not a scientific issue.

In order to facilitate decisions about the harmonization of the different soil uses, indicators can be identified. In this context, indicators mean information for understanding and managing complex systems, for those at the stakeholder level, as well as those at the level of decision making and politics. Indicators can be direct or indirect, ecological, technical, social, economic and cultural ones.

For developing indicators, new research concepts are needed, which help to bridge between science on one side and politics and decision making on the other side. Such concepts for integrated soil research will be explained, defining priority research areas for soil protection and the sustainable management of soil resources.

Introduction

Under sustainable management of soil resources, we understand the spatial and/or temporal harmonisation of all soil and land uses in a given area, avoiding or minimising irreversible impacts. This concept is based on the fact that we are using soils at least in 6 different functions.

The three ecological functions and uses are:
- production of biomass, ensuring food, fodder, renewable energy and raw materials;
- filtering, buffering and transformation between the atmosphere, the ground water and the plant cover, protecting humans and the environment; and
- biological habitat and gene reserve.

The three technical, industrial and socio-economic functions are:
- physical basis for technical, industrial and socio-economic structures and their development, e.g. industry, housing, transport, sports, recreation, dumping of refuse etc.;
- source of geogenic energy, raw materials, such as clay, sand, gravel and others, and water;
- geogenic and cultural heritage, forming an essential part of the landscape, concealing and protecting palaeontological and archaeological treasures.

These 6 different functions and uses of soil are shown in Figure 1.

THE SIX MAIN FUNCTIONS AND USES OF SOIL

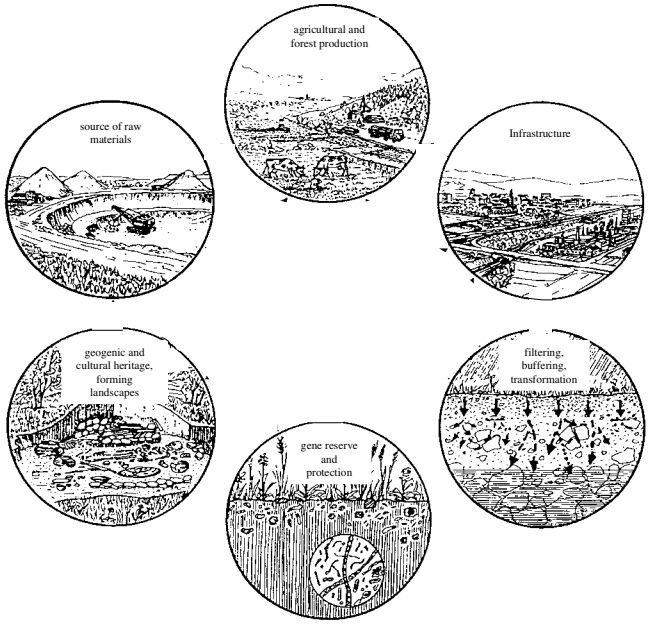


Figure 1. The 6 main functions and uses of soil.

Comparing Figure 2 (European Soil Resources) with Figure 3 (Europe's built environment, visible through nightlights) makes clear that there is severe competition between the different uses of soil and land, which can be distinguished on three levels:

- exclusive competition between the use of soil as a physical basis for the development of technical infrastructure, source of raw materials and geogenic and cultural heritage on the one hand and agricultural and forest production, filtering, buffering and transformation activities, as well as the soil as a gene reserve, on the other hand. Examples are constructions such as houses, industrial premises, roads and parking lots, which lead to soil sealing, thus excluding all other uses (soil multifunctionality).

- Moreover, intensive interactions between infrastructural land use and its development, and agriculture, forestry, filtering, buffering and transformation, as well as soil as a gene reserve exist. Examples are the loads from technical infrastructures (e.g. housing, industrial production, traffic) on the adjacent soils through the atmospheric pathway, the waterway and terrestrial transport.

- Finally, intensive competition even exists between the three ecological soil and land uses themselves. An example is the competition between maximum biomass production on top of the soil, using fertilizers and pesticides, and the quality of groundwater underneath.

European soil resources

Figure 2. European soil resources.

Europe's built environment

Figure 3. Europe's built environment, visible through nightlights.

Figure 4 shows the impact of human activities on soil in a comprehensive way.

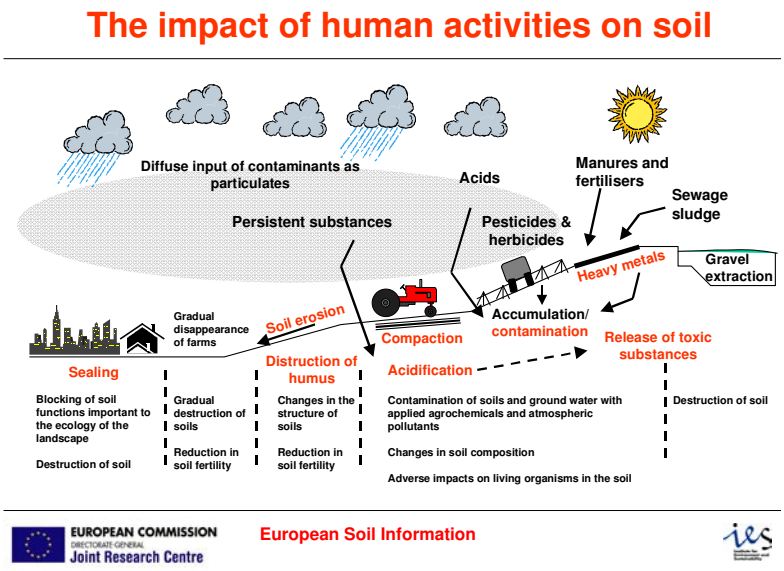


Figure 4. The impact of human activities on soil.

Main threats to soil

Based on this experience, in the communication from the European Commission to the Council and the European Parliament, entitled "Towards a Thematic Strategy for Soil Protection", which was developed and ratified by 15 ministers of environment of the European Union in 2002, 8 main threats to land and soil were defined (European Commission 2002):
- sealing through urbanisation and industrialisation;
- contamination (local and diffuse);
- erosion by water and wind;
- compaction and other forms of physical degradation;
- decline in soil organic matter;
- loss of biodiversity;
- salinisation and alcalinisation;
- floods and landslides.

Through a classification in order of urgency, the impacts of these 8 threats can be classified as reversible or irreversible ones. Defining irreversibility on the basis of a time span of 100 years (about 4 human generations), clearly shows that sealing through urbanisation and industrialisation, intensive local and diffuse contamination, erosion by water and wind, deep reaching compaction and landslides can be classified as irreversible, whereas decline in soil organic matter, loss of biodiversity, salinisation and alcalinisation can partly be handled as reversible.

All these threats and damages are caused by human activities, triggered by different local, regional and global policies, such as policies of agriculture, of regional planning, of energy use, of transport, of infrastructure development and others, with very few exceptions (e.g. global or climatic change).

Indications for the sustainable management of soil resources

The definition of sustainable use of soil resources as a spatial or temporal harmonisation of all soil and land uses in a given area, avoiding or minimising irreversible impacts, is therefore not a scientific but a political issue, which can be handled by top-down and bottom-up decisions. Looking into sustainable agricultural land use reveals that agricultural land use is only one of 6 possible uses of land and therefore depends on all other uses in a given area or region. Under these circumstances, agricultural land use can only be sustainable when all other land uses are sustainable as well. Based on this definition, sustainability is determined by technical, ecological, social as well as by economic and cultural factors. These factors can be made visible and understandable by indicators.

There exist direct and indirect indicators, which can be ecological, technical, social, economic and cultural:
- Ecological indicators can be soil quality, ground water quality, biodiversity and human health.
- Technical indicators can be access to the land, availability of tools and others.
- Social and economic indicators can be economic wealth and access to social resources.
- Cultural indicators can be based on educational levels.

In this context, indicators mean information for understanding and managing complex systems, especially for those at the stakeholder level, as well as those on the level of decision making and politics.

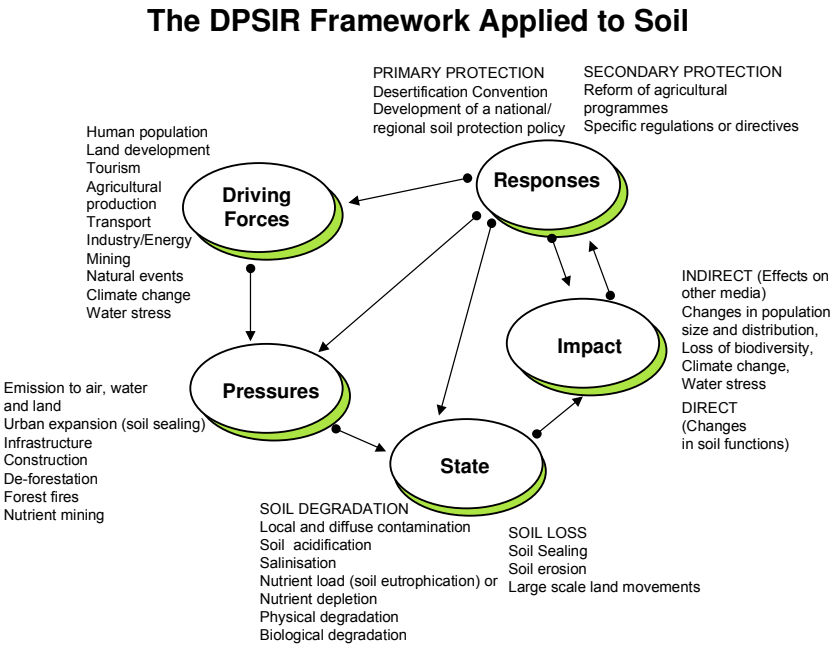


Figure 5. The DPSIR Framework Applied to Soil.

Figure 5 shows the DPSIR framework (European Environment Agency, 1999), applied to soil. This framework corresponds to the political cycle of decision making and can be easily understood, if we assume that we communicate with a decision maker or politician, informing of a certain state of soil degradation or soil loss. This person will ask us 4 different questions:

1. Why does the state of soil degradation or soil loss exist, for example a nutrient depleted soil? The answer to this first question will be that there are driving forces (D), e.g. insufficient market conditions for farmers, who do not receive an acceptable price for their agricultural commodities. These adverse market conditions lead to the pressure (P) of nutrient mining, because the farmer is not receiving enough money for replacing the nutrients which he takes out of his soil by harvesting. - Therefore the state (S) is a nutrient depleted soil.

2. The second question will be: What is the impact (I) of the state, in this case of the nutrient depleted soil? The answer will be that there are direct and indirect impacts. The direct impact is a considerable loss of soil fertility, leading to continuously lower harvests, and the indirect effects could be changes in population size and distribution, because people have to move to other areas, where they can obtain better harvests.

3. The third question then will be: What is the response (R) to this problem or what are possible responses? In the case of nutrient mining and nutrient depletion, the response will be an economic one, changing market conditions in such a way that the farmers receive enough income from their agricultural commodities and therefore can replace nutrients themselves. The distribution of fertilisers to farmers would be the wrong answer. - There are many possibilities for responses, ranging from legal to economic and technical instruments, according to the specific case.

Therefore, the criteria for indicators must meet the following requirements:
- policy-relevant, focussing on real demand and less on the supply of data;
- analytically sound, based on science and revealing a clear cause-response relationship;
- easy to interpret and understandable for farmers at the grass-roots level (stakeholders) as well as for decision makers and politicians;
- easily measurable and therefore feasible and cost effective in data collection, processing and dissemination.

4. The last question will be: Do we need new research concepts for defining indicators, based on the DPSIR approach?

   The answer is yes. This kind of research must follow the political cycle, allowing for bridging between science and decision making.

Future research needs

The concept for such an integrated research, based on the DPSIR-approach is given in Tab. 1, showing the main research goals, the research clusters and the sciences which have to be necessarily involved.

The five main soil research clusters, are shown in more detail in figure 6, distinguishing analyses of processes related to the threats to soil and their interdependency; development, harmonisation and standardisation of methods for the analysis of the state and their changes with time = soil monitoring; relating the threats to driving forces (D) and pressures (P), cross-linking with cultural, social and economic drivers, such as EU and other policies (e.g. agriculture, transport, energy, environment etc.), as well as technical and ecological drivers (e.g. global and climate change). In this context, it is important to understand that the dimensions of driving forces in space and time can differ widely, see figure 7.

Table 1. Concept for integrated research in soil science

Concept for integrated research in soil protection and soil resource management

	MAIN RESEARCH GOALS	RESEARCH CLUSTERS (see Fig. enclosed)	SCIENCES INVOLVED
1	To understand the main processes in the eco-subsystem soil; underlying soil quality and soil functions, in relation to land uses and soil.	Analysis of processes related to the threats to soil and their interdependency: erosion, loss of organic matter, contamination, sealing, compaction, decline in biodiversity, salinisation, floods and landslides.	Inter-disciplinary research through co-operation of soil physics, soil chemistry, soil mineralogy and soil biology.
2	To know where these processes occur and how they develop with time.	Development and harmonisation and standardisation of methods for the analysis of the **State (S)** of the threats to soil and their changes with time = **soil monitoring.**	Multi-disciplinary research through co-operation of soil sciences with - geographical sciences, - geo-statistics, - geo-information sciences (e.g. GIS).
3	To know the driving forces and pressures behind these processes, as related to policy and decision making on a local regional or global basis.	Relating the 8 threats to **Driving forces (D)** and **Pressures (P)** = cross linking with cultural, social and economic drivers, such as policies (agriculture, transport, energy, environment etc.) as well as with technical and ecological drivers, e.g. global and climate change.	Multi-disciplinary research through co-operation of soil sciences with political sciences, social sciences, economic sciences, historical sciences, philosophical sciences and others.
4	To know the impacts on the eco-services provided by the sub-system soil to other environmental compartments (eco-subsystems).	Analysis of the **Impacts (I)** of the threats, relating them to soil eco-services for other environmental compartments: air, water (open and ground water), biomass production, human health, biodiversity, culture.	Multi-disciplinary research through co-operation of soil sciences with geological sciences, biological sciences, toxicological sciences, hydrological sciences, physio-geographical sciences, sedimentological sciences and others.
5	To have operational tools (technologies) at one's disposal for the mitigation of threats and impacts.	Development of operational procedures for the mitigation of the threats = **Responses (R).**	Multi-disciplinary research through co-operation of natural sciences with engineering sciences, technical sciences, physical sciences, mathematical sciences and others.

W.E.H. Blum and J. Büsing, 2004

The next step, number 4, is the analysis of the impacts of the threats, relating them to soil eco-services for other environmental compartments, such as air, water (surface and ground water), biomass production, human health, biodiversity and culture, see Fig. 6. Research cluster number 5 aims at the development of operational tools for responses.

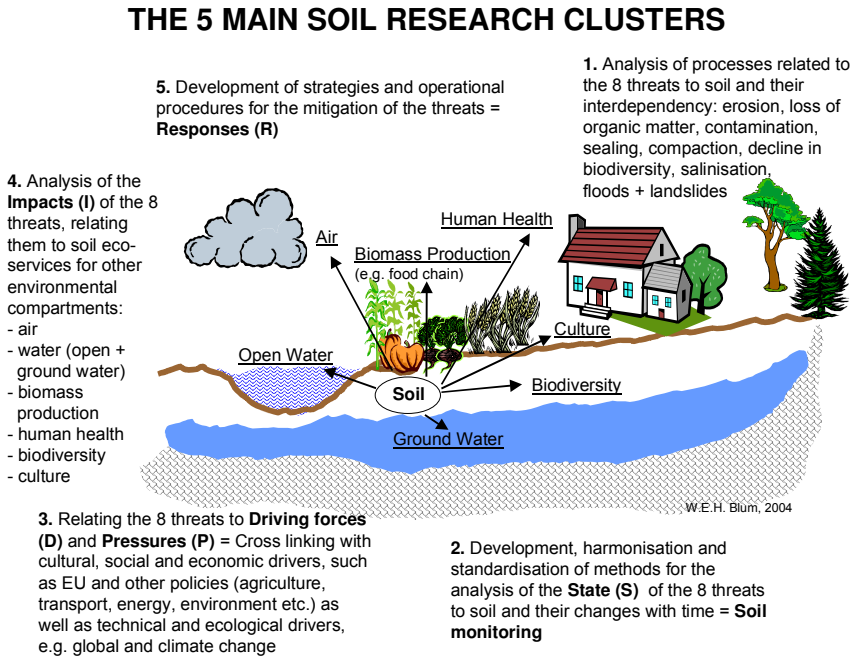


Figure 6. The 5 main soil research clusters.

Based on these 5 main soil research clusters, 5 priority research areas for soil protection and the sustainable management of soil were defined, as shown in figure 7.

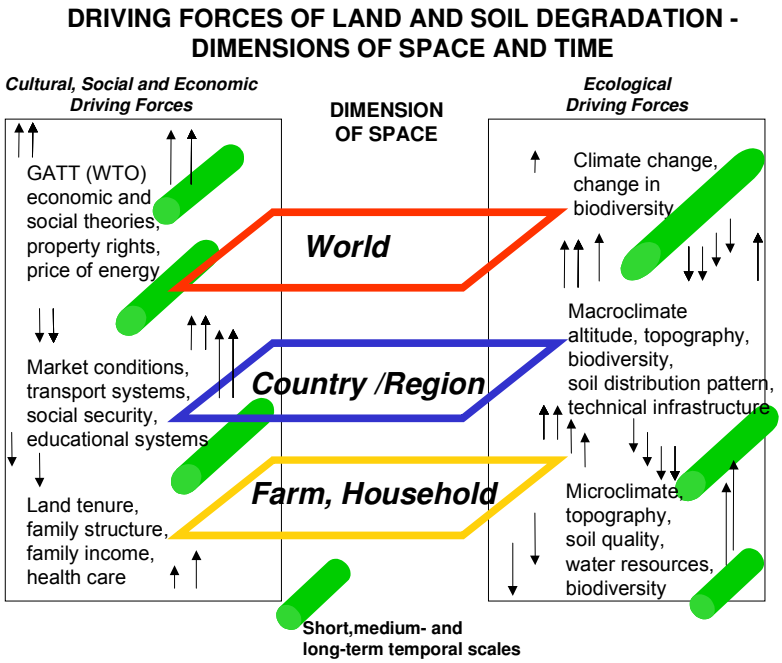


Figure 7. Driving forces of land and soil degradation – dimensions of space and time.

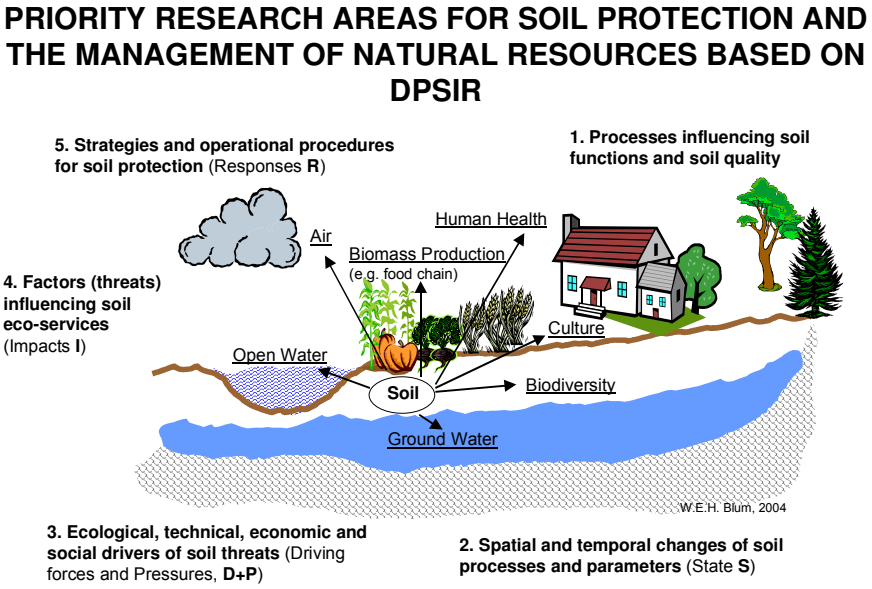


Figure 8. Priority research areas for soil protection and the management of natural resources based on DPSIR.

Conclusions

With the DPSIR indicator approach, it is possible to understand and to manage complex ecological/technical systems, such as soil resources. For the definition of indicators, new research concepts are needed, including interdisciplinary and multi-disciplinary approaches, bringing together technical, ecological, cultural, social and economic sciences.

Indicators based on this approach can bridge between science and technology on one side and stakeholders, decision making and politics on the other side, thus sharing knowledge between those who have it and those who need it, in order to enable them to manage soil resources in a sustainable way.

References

Blum W.E.H., J. Büsing, L. Montanarella (2004a). Research needs in support of the European thematic strategy for soil protection. Trends in Analytical Chemistry 23, 680-685.

Blum W.E.H., D. Barcelo, J. Büsing, T. Ertel, A. Imeson, J. Vegter (2004b): Scientific Basis for the Mangement of European Soil Resources – Research Agenda, 18pp, Verlag Guthmann-Peterson, Wien (ISBN 3-900782-47-4).

European Commission (2002), COM(2002)179 final

European Environment Agency (1999). Environment in the European Union at the Turn of the Century. EEA, Copenhagen, Denmark.

V Strategies and Policies

European framework for soil sustainability: Quality indicators for soil as a multifunctional medium

Jose L. Rubio

President of the European Society for Soil Conservation / Centro de Investigaciones sobre Desertificacion-CIDE (CSIC, Universitat de Valencia), jose.l.rubio@uv.es

European soils progressively faces a new perception and new uses and functions that previously were neglected. Nowadays traditional agriculture, pasture and forestry soil uses should be expanded to include also ecological functions, nature and landscape conservation, source of raw materials, foundation for urban and industrial infrastructures, etc. Under the driving force of the EU Common Agricultural Policy, the EU Strategy for Sustainable Development other EU environmental initiatives and probably under the future Soil Framework Directive, the use of soil and land will reoriented to a diversifying trend including multifunction aspects. In this context it should be also considered old and new environmental impacts which effects soils with different intensity in relation to their different taxonomic or pedogenic characteristics. The wide European pedodiversity implies a wide range of responses of the soil system to pressures such as: climatic change, loss of biodiversity, decline in organic matter, erosion and desertification, salinization, waste disposal or urban-industrial stresses.

Considering the above it is clear the conceptual and practical difficulties in establishing a common and simple framework to asses and predict the evolution trend, and general sustainable principles to guide the management of European soils. In this context the concept of soil quality could help into assessing multifunction land health qualities and pedodiversity.

In the present paper it is propose a scheme of intrinsic soil indicators base an a media, uses and functions approach. The proposal includes three different set of soil quality indicators derived from considering basic criteria of different soil uses. They are grouped on soil fertility, soil climax characteristics and soil physical-mechanical features.

Sustainable management of soil resources: policy integration, soil property regimes and public awareness raising

Helen Briassoulis

Department of Geography, University of the Aegean Mytilini, Lesvos, Greece.
Email: e.briassouli@aegean.gr

1. Introduction

This brief communication negotiates selected important issues that constitute basic requirements for the sustainable management of soil resources and have received considerable attention already by national and international organizations; namely, (a) the need for policy integration, (b) the establishment of soil property regimes and (c) public awareness raising and mobilization. The following discussion emphasizes certain facets that should be further elaborated to achieve a higher level of protection and sustainable use of soil resources.

Authoritative analyses of the legal and institutional dimensions of the protection of soil resources concur that current approaches are fragmented and uncoordinated at all levels, from the global to the local. This seems to be due to three main reasons: (a) the complex nature of soil, (b) the many different functions it performs and, consequently, the fragmentation of responsibility for these functions among many individuals, groups and organizations and (c) the relatively low priority it receives compared to other resources. Given the importance of soil resources and their threatened status worldwide, it follows that an effective approach to this problematic situation is to develop policy approaches and design proper institutional arrangements to eliminate overlaps and conflicts and to coordinate different policy regimes as well as to provide incentives to users to better protect this precious and scarce environmental resource.

Soil is a ***complex***, non-renewable environmental resource comprising a-biotic (water, air, mineral particles (sand, silt and clay), rocks) and biotic (organic matter, living organisms) components that exist in particular place- and time-specific combinations, in a dynamic equilibrium with other environmental resources and human activities. The net effect of the ***interactions*** among soil components and its broader environment gives rise to the physical, chemical, biological and mechanical properties of soil that, subsequently, determine its economic, social and cultural functions and value as an input in diverse production and consumption activities.

The principal functions soil performs are:

- *Food and other biomass production*
- *Storing, filtering and transformation*
- *Habitat and gene pool*
- *Physical and cultural environment for mankind*
- *Source of raw materials*

The status of soil resources is affected directly and indirectly by human activities. Direct influences either draw from (a) activities that use soil as a factor of production (e.g. agriculture, forestry) or (b) other activities that do not use soil directly (e.g. extraction, construction) but inevitably impact on it; the case of externalities. Indirect influences draw from human activities that use resources constituting basic components of soil such as water and inorganic materials.

The protection of soil resources is not a straightforward and clear-cut task because (a) soil resources are indivisible, not decomposable and reducible to their individual components, and difficult to separate from their land context (i.e. the broader territorial and spatial system), (b) the constituents of soil and the activities directly and indirectly impacting on soil are subject to different formal (policies) and other informal regimes (rules of ownership, appropriation and use) and (c) interdependence among soil uses (i.e. the intent to use soil) and among human activities frequently presents obstacles, but it can also present opportunities, for efficient resource management. The resolution of the soil protection issue evidently necessitates an integrated approach that aims to coordinate and harmonize the various formal and informal resource regimes involved. Efforts towards this direction have started already in the European Union in the context of preparing the European Thematic Strategy for Soil Protection. The next section argues that an important consideration is how policy integration is carried out while the other two sections negotiate critical prerequisites for the success of any effort to sustain soil resources of desirable quality to perform their many functions efficiently and effectively.

2. Policy Integration

This section first presents the various policies that the literature has identified as being directly or indirectly implicated in soil protection and, then, it suggests how policy integration should be approached to provide efficient and effective arrangements for the sustainable management and use of soil resources.

Ostrom (1990) distinguishes three levels of rules governing resource use: (a) constitutional (treaties, conventions, strategies), (b) collective action (policies) and (c) operational rules-in-use. These rules are more or less related to the three conventional spatial/organizational levels: international, national and regional/ local. The literature has mostly concentrated on the first two levels of rules and the possibilities for their integration. However, the last level seems to be the most critical as operational rules-in-use concern established, socially-sanctioned, customary practices of resource users with respect to resource use that if not changed the implementation of higher level rules cannot materialize and be effective.

2.1 Extant policies relating to soil use and protection

The following Table is a not-exhaustive compilation of resource and other regimes that relate to soil resources (Sources: Hannam, 2001, 2002; Quevauviller and Olazabal, 2003; Kraemer et al., 2004; MEDACTION, 2004a, b).

International level resource regimes (treaties, conventions, etc.)	• Stockholm Declaration • World Charter for Nature & World Conservation Strategy • World Soil Charter & World Soils Policy • RIO Declaration and Agenda 21 • United Nations Convention to Combat Desertification and Drought (UNCCD), 1994 • United Nations Convention on Biological Diversity (UNCBD), 1992 • Biodiversity Action Plans • United Nations Framework Convention on Climate Change (UNCCC) • European Climate Change Programme (ECCP) • Pan-European Biological and Landscape Diversity Strategy (PEBLDS) • European Landscape Convention (ELC)

European level regimes (treaties, strategies, policies)	• Treaties of the European Union • The EC Environmental Action Programs (EAP) • EU Sustainable Development Strategy • European Soil Charter • Convention on Biological Diversity: European Community Biodiversity Strategy
	• Communication COM (2002) 179, "Towards a Thematic Strategy for Soil Protection" • Common Agriculture Policy (CAP) • Regional Policy: Structural Funds and the Cohesion Fund • Environmental policy • Spatial Policy (European Spatial Development Perspective) • Integrated Coastal Zone Management (ICZM) • Transport Policy • Water Resources Policy (European Water Framework Directive, 2000/60) • Research & Development Policy • LIFE Programme
	More specific EU Directives & Regulations
	• Waste Framework Directive (75/442/EEC as amended by 91/156/EEC) • Sewage Sludge Directive (86/278/EEC) • Directive on the Disposal of Waste Oils (75/439/EEC as amended by 87/101/EEC) • Landfill Directive (1999/31/EC) • Water Framework Directive (2000/60/EC) • Nitrates Directive (91/676/EEC) • Urban Wastewater Treatment Directive (91/271/EEC) • Bathing Water Directive (76/160/EEC) • Communication on Flood Risk Management, Flood Prevention, Protection and Mitigation (COM(2004) 427final) • Air Quality Framework Directive (96/62/EC) and its Daughter Directives • Directive on National Emissions Ceilings (2001/81/EC) • Directive on Large Combustion Plants (LCPD) (2001/80/EC) • Directive on Integrated Pollution Prevention and Control (96/61/EC) • Plant Protection Products Directive (91/ 414/EEC) • Directive on the Authorisation and Marketing of Pesticides (91/414/EEC) • Directive on the Use Restrictions of Pesticides (79/117/EEC) • Directive on Biocidal Products (98/8/EC) • POPs - Persistent Organic Pollutants (EC No 850/2004) • Birds Directive (79/409/EEC) • Habitats Directive (92/43/EEC) • Environmental Impact Assessment Directive (85/337/EEC as amended by 97/11/EEC and 2003/35/EC) • Strategic Environmental Assessment Directive (SEA) (2001/42/EC) • Agri-Environmental Programmes (2003/1783/EC) • Cross-Compliance (2003/1782/EC) • Organic Farming (Regulation 2092/91, Regulation 1804/99 and European Action Plan for Organic Food and Farming • Internal Market Regulations on Product Quality • Guidelines on State Aids for Environmental Protection
Selected proposed legislation	• Sustainable production and consumption • Thematic strategy on pesticides • Thematic strategy on protection of soils • Thematic strategy on the urban environment

The Table does not include several policies that relate to activities such as industry, extraction, construction and recreation (tourism and other forms) as well as to forestry as these are matters of national and regional competence mostly and/or are not covered by EU policies.

National policies that relate to soil resources include (a) transposed EU policies and (b) national economic, industrial, environmental and spatial policies. The latter are important policy levers as they control the quantity and quality of human activity that directly or indirectly exerts pressure on soil resources.

2.2 Policy integration proposals

The current emphasis of most proposals such as those of the TWGs set up by the European Commission in the context of the preparation of the Thematic Strategy for Soil Protection (Kraemer et al., 2004; Sánchez et al., 2004), is on EPI – Environmental Policy Integration – as required by Article 6 of the EC Treaty that dictates the integration of environmental protection requirements into the definition and implementation of all Community policies and activities. In the case of soil protection this translates into integration of soil protection requirements into Community policies and activities. In other words, the aim is to give soil protection considerations an important place in decision-making in the context of other policies and to promote sustainable development (Kraemer et al., 2004).

Extant analyses have identified that the legal instruments that explicitly address soil issues are found in the area of waste, water chemical and air EU policies. In addition, instruments and measures of other EU policies, such as the Common Agricultural Policy, have a crucial impact on soil as well. With the last CAP reform, soil-related issues have been addressed in a more coherent way, especially through the introduction of the compulsory cross-compliance scheme. On the other hand, the policy measures and instruments in biodiversity conservation and climate change policy areas address soil only indirectly.

Kraemer et al. (2004) note that "the lack of a definition of soil protection and soil indicators has hindered and hinders the comprehensive integration of soil protection objectives into the Community policies …. In addition, the failure to adequately incorporate soil protection requirements is also due to the limited data availability and the lack of methods to evaluate potential impacts on soil." Also, "even if many pieces of legislation are relevant to soil contamination, there is no coherent framework for the instruments; therefore the overall effectiveness of these instruments and measures is questionable". Moreover, they note that "The existing policy instruments and measures address mainly qualitative soil protection issues and there are very few instruments at European level addressing land use planning and management. The increasing trend in soil sealing in European countries points out the ineffectiveness of the existing instruments. Moreover, in addition to the reduction of land consumption, the integration of soil quality objectives into land use planning stays a challenge".

Their proposal is that "In order to enhance the contribution of other policies and guarantee the coherence of all environmental legislation and related policy initiatives, it is necessary to agree on a common **definition of soil protection** as an explicit objective of EC policies, as well as the use of **soil indicators**. For example, this would allow to assess the soil-related impacts of measures funded through regional policy instruments in a more coherent and complete way and to introduce subsequently environmental agreements or environmental safeguards to limit or mitigate those impacts".

2.3 A proposed approach to policy integration

EPI, construed as a process of incorporating environmental concerns into an extant policy to produce ***an integrated policy*** (in the environmental sense), is a laudable approach towards attaining a certain level of environmental (and more specifically, soil) protection. However, it is a rather narrow and partial

interpretation of policy integration that cannot be effective as it does not take into account the social, economic institutional and other factors that influence policy making and policy implementation. It is proposed that a more comprehensive approach is Policy Integration (PI) that denotes a process of uniting, coordinating and harmonizing sectoral policies to produce ***an integrated and coherent policy system***. Its purpose is to achieve efficient and effective environmental protection, socio-economic cohesion, smooth and equitable service delivery; or, more generally, sustainable development (Briassoulis, 2005).

Focusing on the sustainable management of soil resources, it is argued that PI is preferable to EPI for three main reasons. First, given the inevitably multifarious and departmentalized nature of policy making, integration of the multitudinous current policies that influence soil protection better supports the transition to sustainable development. Second, the resolution of contemporary complex, multidimensional and cross-cutting socio-environmental problems, such as those related to soil protection, is rarely possible through single-purpose, however well environmentally integrated, but uncoordinated policies or of a super policy that integrates all relevant problem dimensions. Third, in such a state of affairs, narrower goals, such as soil protection, cannot be achieved by simply incorporating soil concerns into (even ideally all) sectoral policies to create environmentally integrated policies because the coordination among policies associated with particular environmental and economic issues (e.g. water, air, wastes, agriculture, manufacturing, tourism, etc.) would be still required.

The proposed PI approach rests on the recognition that the characteristic constituent elements of a policy are the policy object, the relevant actors and their goals, and the structures, procedures and instruments chosen to achieve the policy goals. The policy object, in particular, concerns: (a) the scope of and the theories about the policy problem (who and what is involved and why), (b) its spatial and geographical characteristics (spatial scale on which the problem manifests itself, spatial boundaries, spatial unit most relevant to the problem, particular geographic areas where the problem is most intense), (c) its temporal characteristics (time scale over which the problem occurs, duration, temporal unit most relevant to the problem) and (d) the social, economic, environmental, cultural and other features of the policy problem. The role of policy actors is critical in the present perspective because it is only through their actions that PI can materialize and produce results.

Therefore, the basic purpose of PI is to establish desirable relationships among the main constituents of the policies to be integrated; i.e. among their policy objects, actors and associated goals, structures, procedures and instruments (Figure 1). Desirable relationships among the constituents of the policies include commonalities, communication and collaboration among actors, shared perceptions and resources, joint decision making, and coordination and/or complementarity of procedures and instruments. This process is assumed to produce a policy system that functions in a coordinated fashion that secures minimization of conflicts and overlaps, cost savings and greater effectiveness in producing desired policy outputs. Based on the above conceptualization of PI, Briassoulis (2005) has proposed several criteria to use in attempting the integration of two or more policies.

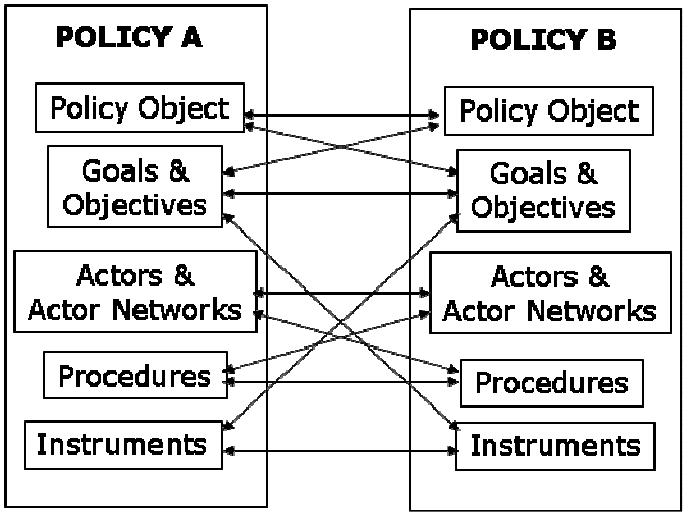


Figure 1. Schematic presentation of Policy Integration.

Because numerous policies are directly and indirectly implicated in soil use and protection, it is proposed that the guiding principle of PI should be ***parsimony*** (Occam's razor), i.e. using the simplest arrangements possible to produce a desired effect. This necessitates ***strategic simplification***; i.e. choice of the most critical policies in the context of addressing particular soil problems. Two considerations should guide this choice. First, the policies that are more critical in soil (and generally environmental) protection are those that drive activities with negative impacts on soils (demand management). Second, the complex nature of soil resources implies that actions in one policy domain, e.g. economic, regional, water, biodiversity policy, may contribute to soil protection (synergistic effects).

It is proposed that PI, as proposed above, should form the axis of the envisioned Community Soil Protection Strategy or Framework Soil Directive. The main thrust of PI should be to integrate carefully chosen agricultural, regional, industrial, transport, forest and spatial policies with the host of environmental policies implicated in soil protection as well as with particular soil-related policies following the approach suggested before at the Community level, at the national level as well as between the Community and the national levels.

3. Soil Property Regimes

An important requirement for the success of any environmental protection measure in general is the establishment of clear and unambiguous resource regimes in order to achieve efficient and just intra- and intergenerational allocation of resources. Because of the complex nature of soil resources, this is not the case at present and constitutes a factor that hinders their sustainable management to a considerable degree.

Based on the definitions of resource management regimes and resource property rights offered by Bromley (1991), the following definitions are suggested for the case of soil resources.

A ***soil management regime*** is a structure of rights and duties characterizing the relationships of individuals to one another with respect to soil resources[36]. ***Property*** is not an object, such as land, but a *right* to a benefit stream (good

[36] The important point is that a party with an interest in a resource has a right to this resource only if all others have a duty to respect this right (Bromley, 1991).

quality soil resources, in the present case) that is only as secure as the *duty* of all others to respect the conditions that protect that stream. Hence, a ***soil property regime*** is a complex constellation of rights, duties, privileges and exposures to the rights of others with respect to soil resources. To assign rights and duties with respect to soil use as well as to design enforcement mechanisms, it should be taken into account that soil users belong to one or more of the following categories: owners, appropriators and consumers (Ostrom, 1990).

Bromley (1991) distinguishes four (resource) property regimes: private, state, common property and open access (no regime). Common property resources are now more broadly called Common Pool Resources (CPR); these are resources characterized by indivisibility, non-excludability and substractability. Soil resources obviously belong to this category. Although the choice and implementation success of a resource regime is place- and time-specific, as it is a function of the prevailing political philosophy and value system, nevertheless, the intrinsic features of soil resources implies that they might be more properly protected by the establishment of appropriate CPR regimes.

The design of soil property regimes should take into account the fact that soil resources are degraded (a) directly by those activities that employ soil as a factor of production (agriculture, recreation) and (b) indirectly by other activities – the case of externalities. Therefore, soil property regimes should define separate sets of rights and duties for the direct and the indirect users (of all categories). The priority in assigning these rights and duties should be determined, among others, by the type of soil threat concerned and the soil function affected and will concern the relevant physical, chemical, biological and mechanical properties of soils. In any event, it is important to emphasize that because direct soil users degrade significantly soil resources, their rights should be strictly circumscribed and their duties (towards the rest of society) should be equally important. Obviously, soil should be clearly differentiated from land property rights and duties.

Because many resources that are constituents of soil (such as air and water) are already governed by established property regimes, care should be taken to avoid overlaps and duplications as well as conflicts and to encourage complementarity and harmonization among regimes. In other words, integration of resource property regimes is necessary to secure the efficient management of both soil and other environmental resources.

4. The critical factor: Public Awareness raising and mobilization

The successful implementation of the proposals made before, and not only, cannot be guaranteed without proper enforcement. This brings center stage the implementers and end users involved and the issue of raising their awareness of and sensitivity to the issues at stake so that they accept the proposed measures and cooperate for their implementation.

For a number of reasons that cannot be covered in this brief communication, soil is not perceived to be as critical and limiting a resource and factor of production as water or air even in rural areas. The dominance of the (quick) profit imperative has frequently led to land use intensification of all types and subsequent soil (and environmental) degradation. The case of agricultural subsidies that induced agricultural intensification and caused, among others, sometimes irreversible soil degradation is known. Proposals to halt these perverse subsidies have been made. The same is true for other – subsidized or not – economic activities that give rise to several soil threats but which are not moderated because public awareness of and sensitivity to the imminent soil degradation is low or absent. This is not unrelated to the low priority of agriculture as generator of income and

wealth *vis-à-vis* other economic activities and its gradual abandonment, even on prime agricultural land, in favor of activities such as tourism or residential development. A recent case in point is the rapid land conversion to tourism and urban development in the Mediterranean MS of the European Union. The lack of clear and enforceable soil property rights and of associated development incentives to mobilize land users towards sustainable management of soil resources is manifestly clear in this case.

Recapitulating, policy integration and the establishment of clear and unambiguous soil property regimes are necessary to facilitate the sustainable management of soil resources in the face of environmental problem complexity and interdependence in contemporary times. However, they will not be sufficient if parallel and intense efforts to raise public awareness and secure compliance of the end users with their provisions are not undertaken.

References

Briassoulis, H. (2005) Analysis of Policy Integration: Conceptual and Methodological Considerations. Chapter 2, in *Policy Integration for Complex Environmental Problems: The Example of Mediterranean Desertification*, H. Briassoulis, (ed.) London, Ashgate, pp. 50-80.

Bromley, D.W. (1991) Environment and Economy. Cambridge, Ma.: Blackwell Publishers.

Hannam, I. (with B. Boer) (2002) Legal and institutional frameworks for sustainable soils. A preliminary report. IUCN Environmental Policy and Law Paper No. 45.

Hannam, I. (2001) Ecologically sustainable soil: The role of environmental policy and legislation. In D.E. Stott, R.H. Mohtar, and G.C. Steinhardt, eds. Sustaining the global farm, pp.95-100.

Kraemer, R. A., R. Landgrebe-Trinkunaite, T. Dräger, B. Görlach, N. Kranz, M. Verbücheln (2004) EU Soil Protection Policy: Current Status and the Way Forward. Ecologic (Institute for International and European Environmental Policy), background Paper to the Dutch Ministry of Housing, Spatial Planning and the Environment (VROM). Thematic Assistance to the Conference "Vital Soil: the next step towards a European Soil Strategy", 18-19 November 2004 in the Netherlands.

MEDACTION, (2004a), Module 4: Design of a Desertification Policy Support Framework, Deliverables 33&34, Part A: International level. European Commission, DG-XII, Contract No. ENVK2-CT-2000-00085, (www.icis.nl/medaction).

MEDACTION, (2004a), Module 4: Design of a Desertification Policy Support Framework, Deliverables 33&34, Part B: European Union. European Commission, DG-XII, Contract No. ENVK2-CT-2000-00085, (www.icis.nl/medaction).

Ostrom, E. (1990) Governing the Commons: The Evolution of Institutions of Collective Action. Cambridge, MA: Cambridge University Press.

Quevauviller, P. and C. Olazabal (2003) Links between the Water Framework Directive, the Thematic Strategy on Soil Protection and Research Trends with Focus on Pollution Issues. Journal of Soils & Sediments 3 (4) 243 – 244.

Sánchez, C.V., L. Vandekerckhove and R. Jarman (2004) Introduction & Executive Summary. Working Group on Soil Erosion. Final Report. European Commission, Directorate-General.

Barriers and Incentives in Soil Conservation – Experiences from Iceland

Andres Arnalds

Soil Conservation Service, Gunnarsholt, 851 Hella, Iceland, andres@land.is

Introduction

Iceland has suffered immense land degradation and desertification since the first settlers ventured to Iceland around 874 AD (Arnalds, A. 2004, Arnalds, O. this issue). The settlement brought with it a devastating interaction between land use and the natural forces, with a long lasting lack of incentives to break this vicious cycle. The Soil Conservation Service of Iceland (SCS) derives from a law that was set in 1907 in order to halt the ecosystem destruction (Runolfsson and Arnalds, A. this issue). In this paper some of the barriers, incentives and disincentives to conservation of soil and vegetation in Iceland will be explored.

From an era of plenty to struggle for survival

The first human inhabitants were met by lush vegetation and fertile ecosystems. Icelandic law from the first centuries of settlement reflect a good understanding of the links between grazing intensity and livestock gain, with a strong disincentive not to overgraze the land. It also had strong property rights requiring owners to keep their livestock on own land.

However, the original respect for the land did not last long. Exploitation of natural resources in an era of plenty is not limited to Iceland and experience from too many countries suggests that breaking such land use habits has been one of the global barriers to conservation

Population density in Iceland soon increased, leading to a vicious cycle of declining land health and increasing pressure on the land, interacting with cooling of temperatures that lasted until about 1920. With damaged vegetation, ash from frequent volcanic eruptions started blowing over the surface, damaging the sward and exposing sensitive soils to the forces of wind and water. In the following struggle for survival the loss of the original incentives and knowledge soon became a severe barrier to caring for the land. The peak of ecosystem destruction may have been reached in the 19th century and with increased cultivation possibilities without adequate incentives for conservation severe human induced ecosystem degradation lasted until a few decades ago.

Lessons from early approaches in conservation

As described by Runolfsson and Arnalds, A. (this issue) soil conservation work in Iceland began in 1907 with the Parliament passing a law to prevent further destruction of the remaining woodlands and to halt the severe soil erosion and desertification that was threatening many districts. There were many initial conservation barriers that had to be overcome, such as scarce resources and lack of knowledge. Even worse were long lasting lack of land user responsibility, lack of belief in the work and the common land-user attitude that severe soil erosion was the "will of god" and that it was not within the human means to halt the destructive forces.

Many areas with rapidly advancing soil erosion, especially encroaching sand dunes, were fenced of for protection from grazing and seeded with stabilizer plants, such as *Leimus arenarius.* The successes of the first 70 years of soil conservation in Iceland are beyond the comprehension of current generation, especially considering limited financial and human resources. However, on a national scale not enough was being achieved, and overall land health kept declining. In retrospect, the reasons include:

1. *Localized soil conservation*, as only the spots of most severe erosion and desertification were being treated
2. *Single issue conservation*, as the focus was on halting the erosion, not preventive measures on a landscape basis
3. *Lack of land user and public involvement leading to low conservation awareness,* as the government conducted most of the work with own personnel and machinery.
4. *Insufficient inventories on the state of the natural resources and cause and effect relationships,* leading to unfertile debates between land users and conservation people on the seriousness of the soil erosion problems and the role of land use in the land degradation.
5. *Governmental subsidies to sheep production without environmental links,* as a high level of support led to an all time peak in sheep numbers in 1978. Poor grazing management led to severe overgrazing in many areas. The government was paying at both ends, indirectly for the damage to the land, and directly for its reparation.
6. *Weak law on soil conservation,* as the SCS in reality had no actual means to enforce proper protection of sensitive soils and vegetation. Theoretically, maximum numbers of livestock could be decided where needed, but the legal procedure was so complex, and still is, that this option for preventive measures was useless.

There are more reasons for the mixed success of the early soil conservation work. However, this period may be characterized by various sociological barriers to improved conservation and a lack of incentives to care for the land and disincentives to reduce unsustainable use of the land resources. These lessons from the initiation of the soil conservation work in 1907 up to about 1980 are in many ways similar to experiences from many other countries for this period (Hannam 2000, Roberts 1989).

Current approaches

Like in so many other countries, approaches to soil conservation in Iceland have been completely revised over the last two decades. Law improvements are lagging behind, but a great operational emphasis has been on creating a good blend of incentives and disincentives in order to take larger steps in halting degradation of vegetation and soil, healing the land and reaching goals of sustainable land use.

Indirect incentives

There is not always a clear distinction between direct and indirect incentives, as many such means can serve both roles. Overall, the Icelandic experience is much in agreement with Sanders (2000) in that indirect incentives are the most powerful and likely to have to most powerful effect. These include:

1. *Increasing the knowledge base* is one of the main foundations for any successful soil conservation programs. This includes assessments and monitoring of the natural resources. As an example, there was a wide disagreement on the extent and seriousness of soil erosion in Iceland, especially between land users and conservation oriented groups. A milestone in bridging this gap was the first national survey of soil erosion in Iceland, published in 1997, which indicated that about 40% of the land

area was affected by serious soil erosion. The combination of increased research and better use of local knowledge has also greatly improved available technologies for management and revegetation.

2. *Planning,* that can be divided into top down planning and participatory planning, with a wide range between. Icelandic authorities have so far made little use top down planning for the purposes of conserving and improving soil and vegetation. This could be done through land use restrictions based on f.x. land use capability classification, such as linked to vegetation cover and slope steepness. However, participatory planning approaches may be more efficient in the long run, educating and assisting the land users to make their own property plans. Such planning has been emerging over the last few years in Iceland, based on Australian experience (Brouwer et al. 1999). Among the many benefits from this promising approach are its use as educational tool and the fact that people tend to have more belief in their own work than plans "handed to them by government".
3. *The creation of conservation awareness.* This is a complex task, as it is based on a wide range of other factors. These include related knowledge and the creation of "land literacy", a term that originates in the Australian landcare movement being able to read the condition and needs of the land (Campbell 1995).
4. *"Stewardship",* which has with the end goal of creating desire among land users and all others that can affect land health to become the "true custodians" of the land.

Direct incentives

To be effective in the long run, incentives must be oriented towards the problems as perceived by the land users. If well thought out direct incentives can be very effective. With the limited financial resources of Icelandic farmers, they may be regarded essential to both the revegetation work and improved land management for reaching sustainability goals. The SCS now has two such main programs:

1. *Farmers heal the land*. Within this co-operative program farmers receive about 85% of fertilizer cost for revegetation of denuded land and grass seed as needed. They conduct all the work with own machinery, and this coupled with their 15% contribution to the cost of fertilizer, amounts to about 50% of project cost. Cost sharing is considered important, as it helps to create a feeling of ownership in the results. The bottom-up nature of the project has facilitated communication. The farmers are proud of their reclamation work, and enjoy being seen as a part of solution to the degradation problems. Local experimentation and decision is encouraged, and the program is kept simple based on the fact that mutual trust often works much better than much paperwork.
2. *Land improvement incentives program*. This program is aimed at large projects that are beyond the means of individual land-users and they may require wide co-operation at the community level. Among such recipients are landcare groups and district authorities and projects include revegetation and improved grazing management in communal grazing lands.

Agricultural support and sustainability of land use

A high level of agricultural support without regard to environmental consequences was for a few decades one of the blockages to reaching goals of soil conservation in Iceland. A milestone towards sustainability was taken with a new seven year subsidy agreement between sheep farmers and the government in 2000. It includes a direct incentive, as participants are entitled on an optional basis to a gradual increase in government support if they meet land condition and quality of

land use standards (Arnalds and Barkarson 2003). Starting in 2004, participating sheep farmers must apply to the SCS for verification of the quality of their land, based on factors such as vegetation cover and soil erosion. Farmers not meeting standards are in the process of submitting improvement plans for approval, with measures such as preventing livestock access to degraded areas, revegetation and improving grazing management.

This new link between governmental support and environmental quality has also become a very powerful indirect incentive. The process leading to applying for verification based on land quality has been rather long, but leading to a increase in land literacy which in turn has been a stimulus. Farmer led initiatives in restoring land and improving management are increasing as a result.

Governmental support to agriculture can be both a blockage to fulfilling goals of natural resource management, as seen in Iceland in the past, and a very powerful incentive as is now emerging, all depending on the policy behind the support. Without fully linking agricultural support to conservation, the government could be accused of actually maintaining, or even encouraging, land degradation. Such support should take into equal consideration food security, sustainable management of natural resources, and the vitalising of rural communities. Furthermore, publicly funded research and extension should be directed towards helping agriculture fulfil such indirect societal contracts.

References

Arnalds, A. (2004). Desertification in a humid environment – An example from Iceland. *Encyclopedia of Soil Science*, 6pp. See: http://www.dekker.com

Arnalds, A. (2004). Carbon sequestration and the restoration of land health. Journal of Climate Change 65: 333-346.

Arnalds, O. and Barkarson, B.H. (2003). Soil erosion and land use policy in Iceland in relation to sheep grazing and government subsidies. *Environmental Science and Policy,* 6, 105–113.

Brouwer, D., Clowes, A. & Thompson, B. (eds). 1999. Property Planning – Farming for the future. Department of Land and Water Conservation, NSW, Sydney, Australia.

Campbell, C.A. 1995. Landcare: participative Australian approaches to inquiry and learning for sustainability. *Journal of Soil and Water Conservation,* 50: 125–131.

Hannam, I.D. 2000. Soil conservation policies in Australia: successes, failures and requirements for ecologically sustainable policy. pp. 493–514, *in:* E.L. Napier, S.M. Napier and J. Tvrdon (eds). *Soil and Water Conservation Policies and Programs: Successes and Failures.* Boca Raton, Florida: CRC Press.

Roberts, R. 1989. *Land Conservation in Australia. A 200 Year Stocktake*. Soil and Water Conservation Association of Australia. 32p.

Sanders, D.W. (2000). The implementation of soil conservation programmes. In: O. Arnalds and S. Archer (eds). *Rangeland Desertification*. p143–151. Advances in Vegetation Sciences Series. Kluwer, Dordrecht, the Netherlands.

Which Strategy and Policy is needed to establish a more Sustainable Land Management – a SCAPE vision

Arnold Arnoldussen

Norwegian Institute of Land Inventory
Email: aha@nijos.no

1. Introduction

SCAPE has been active in different parts of Europe. We discussed the danger of desertification (Alicante), the degradation of terraces (Cinque Terre), the prevention of degradation of the mountainous environment (Schruns), soil degradation in a boreal environment (Ås). Now we are in Reykjavik to discuss amongst others soil degradation and desertification in Iceland. Besides these specific topics the SCAPE forum discussed more general aspects concerning legislation, economic impact of soil degradation, soil monitoring and research and education. To develop a basis for a Soil Thematic Strategy several members of the SCAPE team were active in different Technical Working Groups.

What did all these activities learn us about soil degradation and are we able to formulate a SCAPE vision which strategy and policy is needed to reach a more sustainable land management.

2. The reason for soil degradation

Soil degradation is occurring throughout Europe. Its form and severity varies from region to region.

The main reason for soil degradation is that present land management methods are not longer adapted to the local soil, terrain and climate conditions. Soil and terrain conditions can be considered as more or less constant, but the climate conditions can vary from year to year. With the present climate change the requirements for land management methods even more increase in importance to prevent the passing of thresholds, which trigger soil degradation.

After the Second World War agriculture developed itself fast. Mechanization and intensification was central. Productivity in agriculture increased and pesticides were developed to manage diseases. Subsidy systems were established to increase the production level and to make marginal areas more productive. Many agricultural areas in Europe should never have been put under the present form of agriculture as currently these systems are harmful to the soils and the environment.

Today a farmer has to invest large amounts of money in his farm with as a consequence increased financial risks and is obliged to maximise income. Globalisation of the marked makes it not easier. Economical constraints leave him often no other choice than using environmental unfriendly methods not suited for the local circumstances.

Education and research activities were decades long focussed at improving productivity. The soil was more or less considered as a factor which you could manipulate.

Present day agriculture characterises by both an intensification and extensification. Both developments can cause soil degradation. Many agricultural areas in Europe get marginalised because of socio-economic developments. Soil

degradation can in itself be a factor triggering marginalisation and even land abandonment.

Soil degradation is not a problem originating from the farmer/land owner, but is a problem resulting from developments in society as a whole. Finding solutions is a very complex matter.

3. A SCAPE vision how to establish a more sustainable land management

The main strategy to reduce the risk of soil degradation and erosion is to develop land management systems that are adapted to local soil, terrain and climate conditions.

This often means a shift away from production systems with only focus on production level to systems with focus on production quality and that takes into account landscape and maintenance of biodiversity. The challenge is to make this change possible within a sound socio-economic framework. This calls for innovation of new agricultural methods and a new view of society on land use and land management.

Measures to improve the situation should rely on sustainable land use and management. Land use systems always need to be sustainable and meet environmental, social and economic conditions (Bautista et al., 2004). Maintaining or increasing soil organic matter and improving water-retaining capacity of the soil are central issues in developing sustainable management systems.

To achieve the fastest improvement focus is especially needed at the areas in Europe, which are now prone to severe soil degradation and erosion and the areas, which are at risk.

To realize the strategy the ***policy*** should be to develop a set of instruments. These instruments can be divided in:

- Technical measures
- Change in land use and land management system
- Development of legislation
- The development of education and research programs and development of targeted extension services

Some of the instruments are relatively easy to realize, others will be difficult and very complex and will need a new view of society on land use and land management. On many places in Europe the realization of a sustainable land management will be conflicting with present policies on economical development, trade and globalization.

3.1. Technical measures

A central issue in preventing erosion is to keep, at least during critical periods, soils permanently covered by vegetation to improve water retention and to reduce the speed of run-off water. Technical measures can be introduced to prevent initiation of erosion. The tillage method should improve soil structure and organic matter content, leading to an increase in the water retaining capacity. Conservation tillage is increasingly used as a preventive method. This form of tillage appears to have large potentials for sustainable agriculture (Saturnino and Landers, 2002) and is now introduced in many European countries. However, the limitations of conservation tillage due to different climatic conditions, and sometimes increase in weed controlling substances, should be investigated and adjustments for regional and local conditions should be made.

Contour ploughing is used to reduce the speed of run-off water and special systems have been devised to enhance infiltration of water by making small elevations parallel to the contours.

Impact orientated technical measures, such as buffer strips alongside streams and sedimentation ponds, aim to prevent eroded material to reach streams and rivers.

Soil management practices need careful planning and timing; directed at the improvement of soil properties. Restoration of soil structure should include measures to limit the use of heavy equipment, especially during wet terrain circumstances. Organic matter content can be increased in fields by adding manure or compost. The quality of organic fertilizers needs to be monitored as they may be polluted and give problems in the long run.

To prevent competition for water and nutrients the soil surface of olive plantations and vineyards is often kept free of vegetation by using repetitive cultivation and herbicides. These systems however increase the risk for erosion considerably. Mulching and protective vegetation can reduce erosion risks under these conditions.

Extensive systems of terraces have existed on steep slopes in Southern Europe since Roman times. Under the current socio-economic situation the possibilities for increased agriculture in these areas is limited and many terraces are left abandoned or are leveled. Lack of maintenance causes the terrace walls to fail. The establishment of woody vegetation and the improvement of the water retaining capacity on the terraces increase the weight of the terraces, resulting in an increased pressure on the walls which increases the risk of failure. When the walls fail, severe and irreversible erosion processes often begin. It is therefore important to maintain the traditional management of terrace systems, although adaptation with other activities will be necessary (multifunctional agriculture and tourism).

3.2. Change in land management system

All land management systems should be adapted to the local soil, terrain and climate conditions and should fit in the socio-economic context of the farmer, community and society. In marginal areas this means that agricultural income will be restricted resulting in the need for developing other land uses on- and off farm. In some marginal areas income from other sources is already important with 60-80% of the farmers having other sources of income (Elgersma et al., 2005). Crops and other raw materials should primarily be grown for the local/regional market, which enhances the development of a small-scale agriculture adapted to the local conditions. Development of a multifunctional agriculture and ecological farming should be investigated in greater detail. In suburban areas, ecological farms, producing vegetables and fruits based on a subscription system have given interesting results (Dorren, 2004). Some of these farms have also developed education programs for schools and interested people on ecological food production. In more remote areas combination of agriculture with tourism and nature adventures are more and more common throughout Europe.

Knowledge about soil suitability and land capability has to be made accessible for landowners and authorities in order to develop agriculture adapted to the local conditions. Information systems are therefore needed to plan natural resource management at farm level, with emphasis on the risk of soil degradation and measures to reduce these risks. In some European countries (for example Spain and Norway) such information systems are already made accessible for farmers.

Regional and national soil information systems should be linked to the European Soil Information System to make applications possible at different scales.

Management of grassland areas

Special attention should be given to the management of marginal and abandoned land. Marginal land is often used for grazing. Increasing the number of grazing animals beyond the capacity of the land (Schnabel, 2003) and extensification in Southern Europe has lead to the initiation of erosion and landslides (Bautista et al, 2004). Stocking densities need to be adjusted to the need of the land and well constructed management goals. Since productivity of grazing lands varies considerably with climatic factors, such as drought, the density should vary and never exceed the resilience of the land.

In Southern Europe fire risk increases when abandoned or extensified areas are subjected to shrub invasions. Specific fire prevention measures are therefore often needed. In case of fires, erosion increases often dramatically and it takes years before a protective vegetation cover is regained.

Restoration of soil functions and afforestation

Combating desertification includes sustainable land use, prevention and/or reduction of land degradation, and restoration of degraded/desertified lands. It is important to look at the management consequences of the measures (Castillo et al., 2004). When reduced land use pressure does not improve the condition of the land, restoration measures need to be taken. Focus should lie on the conservation and capture of the hydrological functioning of the area.

Marginal and abandoned areas are often afforestated in Southern Europe. It is important that specific goals for locations to be afforestated are set carefully and the afforestation is planned accordingly. Species used for revegetation and afforestation should suit the natural ecosystem and local landscapes. Nowadays, new forests have usually multifunctional objectives: production, soil conservation, tourism, leisure and aesthetic values are often considered. Re-establishment of the soil functions should also be taken in account.
Soil quality should be the ruling basis for afforestation and reforestation projects.

The planting process in degraded areas and construction of forest roads can increase the vulnerability for erosion, which should be avoided. In building forest roads hydrological aspects should be prioritized. The initial species used in afforestation should be adapted to degraded situations. Species able to bind P en N to the soil and those able to develop a microclimate are preferred. This will create conditions for establishment of other species for greater value and increased soil conservation efficiency. Usually, it is a priority to cover degraded areas with protective vegetation as fast as possible, often with grass and shrub species. Establishment of a good soil structure for improving the hydrological function of the soil needs to be in focus. Young forest plantations should always be protected for grazing to protect the considerable resource investment associated with restoration and afforestation projects. In a later stage of forest development, controlled grazing activity may be allowed. The grazing activities should be adapted to the local circumstances and being controlled.

The occurrence of forest fires should be minimized as much as possible and measures need to be taken to prevent them and to reduce the damage in case they should occur. Fire prevention need to be part of all forest operations in dry climates.

In the case the organic matter content in the soil is very low in the areas to be afforestated, compost can be used to increase this. To avoid harmful effects to the soil, organic matter originating from bio-wastes should only be applied when it is free of soil contaminants (Crescimanno et al., 2004).

Saline soils

Marginal lands prone to salinisation can be planted with salt-capturing plant-species. Improvement of the hydrological cycle is needed to reduce the surplus of salt in the soil gradually. Salt-affected soils should be covered with vegetation as soon as possible.

3.3. Legislation, subsidies, cross-compliance and agri-environmental schemes

The prevention of soil degradation and erosion in Europe is not commonly regulated by a specific legislation. Regulations regarding soil protection may, however, be found within the framework of other legislations (Olmeda-Hodge et al., 2004). In many EU countries, the principal instruments to tackle erosion are economic instruments in the form of cross-compliance (imposed) and agri-environmental schemes (voluntary). EU countries differ in how they implement these kinds of schemes to reduce erosion. Some member states have introduced specific environmental requirements targeted to soil protection in relation to cross-compliance methods. Most agri-environmental schemes aim at building indirect measures to reduce soil degradation; they are specifically planned for soil conservation, enhancing biodiversity and landscape protection.

Many countries have formulated so-called "Codes for Good Farming Practice" (GFP), which give advice on soil protection and conservation. In many countries, the GFP is the underlying baseline for agri-environmental schemes. This means that farmers only get paid for the measures, which extend further than the advised GFP measures. A philosophy for the payments in agri-environmental schemes is that the farmer gets paid for the losses caused by adoption of environmentally protective framing methods.

It is remarkable that a "Code for Good *Forestry* Practice" is missing. Methods for an environmental friendly forestry practice are available, but these are not placed in a system like the "Good Farming Practice". It is advisable to make common rules for a good farming and forestry practice.

Member states should evaluate their existing regulations on practices that are harmful to the soil and on soil conservation and protection measures. However, there is also a need to develop new measures to improve soil conservation and protection.

The Common Agricultural Practice (CAP)

The Common Agricultural Policy (CAP) was initially targeted to enhance agricultural production and food safety. This led to the same support for example for the production of barley in all EU member states, also in areas not suitable for arable farming. This made it financially more feasible to plough marginal land for the short term profit. The CAP reform of 2003 demands that each measure needs to be evaluated based on its impact on the environment. However, to prevent the above mentioned situation, legislation should never be in contradiction with the local/regional potentials. This means that legislation at Community level should rather give a framework than detailed rules for all countries, which should be done at a national or regional level.

To stimulate adaptation of land management to the local land capability, agro-ecological regions across Europe need to be developed, which give information about production capability and possible land use systems. Information about soil quality, relief, climate and type of farming system is essential to define such regions. The current condition of the soil and the environment should also be considered. Funds (EU, national or local) should not be provided for unsustainable activities on severe degraded land.

Other EU regulations

Today many EU directives are important for soil protection. Besides the already mentioned CAP, the Water Framework Directive is very important. Reduction of erosion is one of the key measures for water conservation. The EU has placed soil conservation and soil protection on the political agenda and a Framework Directive on Soil Protection is under preparation.

Agri-Environmental Schemes

With the development of legislation and agri-environmental schemes interactions with land owners are needed, combining legislative and bottom-up approaches. Education of land users and spreading easily accessible information are crucial to ensure good understanding of the importance of soil protection for maintaining the productivity of their land.

If the condition of the land is poor, a total change in land management is may be needed. Profitable agriculture is in these situations often not possible without structural support in the form of payments (Fanta et al. 2005). Non-profitable agriculture will in these cases result in further marginalisation of agriculture and/or land abandonment. From a landscape perspective, maintaining the landscape mosaic, agriculture may still be needed in these areas. In other words: the role of the farmer changes and financial incentives make the transition possible.

Subsidizing technical measures

Reduced soil tillage is in certain cases a good way to reduce the risk on soil erosion. However the price of the needed equipment is often a hinder for the introduction of these techniques. Support to farmers to buy this equipment can contribute to better overall farming practices. Another option is to establish co-operative firms where farmers can borrow or rent the needed equipment.

Introduction of new technical measures should always be combined with educational programs.

3.4. Education and research

Education of farmers and foresters was in the past not focused on soil functions and prevention of soil degradation, but on enhancing production in agriculture by the development and use of new plant varieties and the use of pesticides.

Lack of focus on production in balance with the natural capacity of the environment deprived the present day landowners of awareness of the importance to preserve soil quality. However, they are not to blame for this situation.

Under the present situation the farmer should realize that his most important Bank is the Soil Bank. Soil biological activity, a good soil structure and organic matter are reducing the risk on degradation and are buffering production capacity. Maintaining good soil quality is both preventing damage and keeps the production level at a stable level.

Stability in production means security for the farmer. All too often has the farmer too little knowledge on how to sustain soil quality and how to improve it. In addition farmers are pressed to use non-optimal techniques for optimum cost-return benefits.

Development of educational programs for landowners directed to the prevention of soil degradation should be an obliged part in every agricultural and forestry study.

Attention should be given on soil functions and their role in biological production processes. Main focus should be on how the farmer and forester can influence the development of a good soil health and how to sustain it by explaining both how to organize the best farming system and the choice of the right equipment.

Local and regional extension services have developed knowledge about the best farming systems throughout Europe. In some cases, the soil compartment was included. Existing knowledge should be made available both nationally and internationally. In addition, extension services should be improved to build knowledge base about soils and land use. Experiences from one country cannot automatically be applied to the other, but can serve as a basis for new ideas and approaches. The development of small and effective national Soil Conservation Services, coordinated by a small European organization, could act as a catalyst to achieve this.

It is a known fact that results of scientific research are often not accessible for the landowner. On the other hand, information on practical solutions is not reaching the researcher. Channels need to be opened up for the interaction between researchers and landowners.

Research need to be focused on improvement of the knowledge of the functioning of the soil ecosystem under changing conditions, their thresholds and resilience.

4. Conclusions

Based on the activities of SCAPE it is possible to develop an independent SCAPE vision which strategy and policy is needed how to establish a more sustainable land management.

The most important strategy to reduce the risk of soil degradation and erosion is to establish land management systems that are adapted to soil, terrain and climate conditions. The challenge is to make the needed change possible within a sound socio-economic framework. This calls for innovation of new agricultural methods and a new view of society on land use and land management.

To realize the strategy the needed policy is to develop a set of instruments. These instruments can be divided in technical measures, change in land use and land management systems, development of legislation and the development of education and research programs and development of targeted extension services.

Some of the instruments are relative easily to realize, others will be difficult and very complex and will ask for a new view of society on land use and land management. On many places in Europe the realization of a sustainable land management will be in conflict with the present policies on economic development, trade and globalization.

Technical measures are all focussed on improving and protecting soil quality.
Knowledge about local soil suitability and land capability should be made available for farmers and land owners. Understandable information systems need to be developed.

Legislation at Community level, as the CAP, should function as a framework. Specifications adapted to the regional situation should be made and implemented at national level. To stimulate adaptation of land management to the local land capability, agro-ecological regions across Europe need to be developed, which give information about production capability and possible land use systems. Information about soil quality, relief, climate and type of farming system is essential to define such regions. The current condition of the soil and the

environment should also be considered. Funds (EU, national or local) should not be provided for unsustainable activities on severely degraded land. Other non-agricultural land uses should be supported here if needed.

Agro-Environmental Schemes are, in addition to a system of Codes for Good Farming Practice, a very good instrument to establish a good soil protection. All countries should evaluate there existing instruments and fill up the gaps.

A Code for Good Forestry Practice should be formulated.

Educational systems in agriculture and forestry should focus on production in balance with the natural capacity of the environment.

Knowledge of the Extension Services should be made available at both national and international level. Not to be copied, but to serve as a source for new ideas and approaches. Small national Soil Conservation Services could act as a catalyst in this.

References

Bautista, S., Martínez Vilela, A., Arnoldussen, A., Bazzoffi, P., Böken, H., De la Rosa, D., Gettermann, J., Jambor, P., Loj, G., Mataix Solera, J., Mollenhauer, K., Olmeda-Hodge, T., Oteiza Fernandéz-Llebrez, J.M., Poitrenaud, M., Redfern, P., Rydell, B., Sánchez Diáz, J., Strauss, P., Theocharopolous, S.P., Vandenkerckhove, L., Zuqúete, A., 2004. Soil Erosion. Task Group 4.1 on Measures to Combat Soil Erosion. In: Van Camp, L., Bujarral, B., Gentile, A., Jones, R.J.A., Montanarella, L., Olazabal, C., Selvaradjou, S.K. (Eds) 2004: Reports of the Technical Working Groups established under the Thematic Strategy for Soil Protection. Volume II Erosion. European Commission Joint Research Centre and European Environmental Agency. EUR 21319 EN/2: 199 – 214.

Castillo, V., Arnoldussen, A., Bautista, S., Bazzoffi, P., Crescimanno, G., Imeson, A., Jarman, R., Robert, M., Rubio, J.L., 2004. Soil Erosion. Task Group 6 on Desertification. In: Van Camp, L., Bujarral, B., Gentile, A., Jones, R.J.A., Montanarella, L., Olazabal, C., Selvaradjou, S.K. (Eds) 2004: Reports of the Technical Working Groups established under the Thematic Strategy for Soil Protection. Volume II Erosion. European Commission Joint Research Centre and European Environmental Agency. EUR 21319 EN/2: 275 – 294.

Crescimanno, G., Lane, M., Owens, P.N., Rydel, B., Jacobsen, O.H., Düwel, O., Böken, H., Berényi-Üveges, J., Castillo, V., Imeson, A., 2004. Soil Erosion. Task Group 5 on Links with Organic Matter and Contamination Working group and Secondary Soil Threats. In: Van Camp, L., Bujarral, B., Gentile, A., Jones, R.J.A., Montanarella, L., Olazabal, C., Selvaradjou, S.K. (Eds) 2004: Reports of the Technical Working Groups established under the Thematic Strategy for Soil Protection. Volume II Erosion. European Commission Joint Research Centre and European Environmental Agency. EUR 21319 EN/2: 241 – 274.

Dorren, 2004. Local care for natural capital in mountain ecosystems. In: S. van Asselen: Briefing Papers of the third SCAPE workshop in Schruns (AU) 11 – 13 October 2004: p. 107 – 113.

Elgersma, A.M. and Dhillion, S.S., 2005. Marginalisation and Multifunctional land use: a case from Tynset Kommune and Tylldalen. Case study paper EUROLAN project (QLK5-CT-2002-02346). http://www.umb.no/ina/forskning/eurolan/index_e.htm

Fanta, J., Zemek, F., Prach, K., Heřman, M., Boucníková, E., 2005. Roots of marginalisation across a Czech border area and its future landscape perspectives. Case study paper EUROLAN project (QLK5-CT-2002-02346). http://www.umb.no/ina/forskning/eurolan/index_e.htm

Olmeda-Hodge, T., Robles del Salto, J.F., Vandenkerckhove, L., Arnoldussen, A., Böken, H., Brahy, V., Düwel, O., Gettermann, J., Jacobsen, O.H., Loj, G., Martínez Vilela, A., Owens, P.N., Poitrenaud M., Prasuhn, V., Redfern, P., Rydell, B., Strauss, P., Theocharopoulos, S.P., Yordanov, Y., Zùquete, A., 2004. Soil Erosion. Task Group 4.2 on Policy Options for Prevention and Remediation. In: Van Camp, L., Bujarral, B., Gentile, A., Jones, R.J.A., Montanarella, L., Olazabal, C., Selvaradjou, S.K. (Eds) 2004: Reports of the Technical Working Groups established under the Thematic Strategy for Soil Protection. Volume II Erosion. European Commission Joint Research Centre and European Environmental Agency. EUR 21319 EN/2: 215 – 240.

Saturnino, H.M. and Landers, J.N., 2002. The Environment and Zero Tillage. 144pp. SRH-MMA, Embrapa, FAO. Brasilia.

Schnabel, S., 2003. Soil degradation in areas with silvopastoral landuse. In: Boix, C., Dorren, L., Imeson, A. (Eds): Briefing papers of the first SCAPE Workshop. Alicante, pp 55 – 58.

Combating desertification in Europe: NAPs and new Rural Development Programme

Giovanni Quaranta

Scientific responsible of the University Master GHEA "Combating Desertification, Landscape Management and Sustainable Development", University of Basilicata, Email: quaranta@unibas.it

Abstract

The sustainable use of natural resources requires an adequate management of the key activities associated to them. Most of the current political strategies that should aim at implementing, in each rural context, these resource conservation principles have been developed without considering the inter-dependency of such principles within the agro-eco-system as a whole. As a result, their implementation is rather unconnected and local policy or management measures are mostly taken as single piece of the puzzle. Land degradation, soil erosion and salinisation, water quality and quantity, as well as conservation of natural habitats, preservation of landscape of farmed semi-natural areas, traditional knowledge and cultural heritage, etc. are single problems addressed in separate EU and national legislation. They are, instead, environmentally interlinked and impact as such on the sustainability of the rural development. Mitigating measures for each of these threats, whether they are strategies defined from within either the Common Agricultural Policy (CAP), the Water Framework Directive (WFD) or the Soil Thematic Strategy, are converging but are still being defined and implemented separately. Many National Action Programs developed by Mediterranean countries in the context of international Conventions (Annex IV of UNCCD) mention among their priorities the necessity to integrate these policies, both as planning and funding measures. In such context seems to play a crucial role the new RDP proposed by the European Commission, to be implemented during the next programming period (2007/2013). In fact the land management-environmental axis provides measures to protect and enhance natural resources and agricultural systems of Europeans rural areas. The paper explores some opportunities on how to implement such measures in an effective manner to combat desertification in Mediterranean context.

***Key words**: Desertification, Rural Development Program, Policy Integration.*

1. Introduction

It is broadly recognized that environmental problems, such as drought and desertification, depend on climatic variables and, particularly in the European Mediterranean, from human activities. The intensive exploitation of the soil and the water resources, deforestation, inappropriate agro-pastoral practices, i.e. the unsustainable use of the natural resources leaded by policies are the key elements of this process. The crisis of the traditional agriculture, the abandonment of the interior areas leaded by past dominant development model based on intensive agricultural systems, urbanization patterns, especially along coastal areas, elevated energy consumptions and environmental pollution have deeply conditioned soil degradation. These phenomena have baited desertification processes both in physical and social terms. The international Community is responding promoting actions that encourage the sustainable use of natural resources trough a wide range of initiatives. The Conventions on Climate Changes, on Biodiversity and on Desertification represent the first institutional

step dealing with the issues. In the Mediterranean Europe, for instance, according to the UNCCD, have been developed National Action Plans (NAPs) to define specific actions to fight drought and desertification linking them to social, economic, energy, environmental and cultural policies. The EU has promoted specific policies schemes to contrast processes leading to environmental degradation through CAP, Regional and Cohesion Policies. Among them the Rural Development Programme have played a significant and increasing role in the management of natural resources both in terms of approach (integrated and multi-sectoral) and proposed measures.

Dealing with natural resources it is evident that their sustainable use asks for an integrated management of the actions. Although the existing legislation at European level has progressively recognized the interconnection among the different environmental problem, the formulated implementation strategies still remain separate. Soil degradation, erosion and salinization, water quality and quantity, pesticides concentrations, management of natural habitat, landscape and semi-natural areas, traditional techniques and cultural heritage preservation are considered in different and separate community legislative framework, despite they are deeply interconnected originating extensive impact on the sustainability of the rural territories. These links become particularly evident when the European rural development objectives and relative strategies should be implemented.

Analyzing both the new agricultural and rural development legislative frameworks and the strategies to combat drought and desertification foreseen by the European Mediterranean NAPs, the paper try to find feasible linkages between rural development measures and the actions to contrast and mitigate desertification as identified by the NAPs.

2. The Common Agricultural Policy today

Agriculture remains by far the largest land users, shaping the rural environment and landscape and so the agricultural policy. The importance and the relevance of the rural development and CAP as a whole have increased with the recent enlargement of the European Union. In line with the progressive change in the EU agriculture interventions, the reform of the Common Agricultural Policy in the context of Agenda 2000, building on measures introduced in the 1992 Mac Sharry reform, established the importance of rural development policies as the second pillar of the CAP and, within the market pillar of the CAP, introduced new environmental protection requirements including support in return for agro-environmental commitments, general mandatory environmental requirements or specific environmental requirements constituting condition for direct payments. Member States decide on penalties for non-respect of environmental requirements, which may include a reduction or the cancellation of the market support. A number of measures within the individual market regimes offer opportunities for soil protection. These include set-aside in the arable sector, the extensification premium in the beef sector and the possibilities within national envelopes in the dairy, beef and sheep sector.

An increased level of integration of environmental concerns into the CAP, following the sustainable development strategy defined during the Göteborg Summit and confirmed in the Lisbon strategy conclusions in Thessaloniki in June 2003, has been introduced by the Mid-term Review (MTR) of EU Common Agricultural Policy leading to a further shift of resources to rural development that provides new opportunities for agricultural techniques protecting soils.

Main elements of the agreement reached by the EU ministers on 26 June 2003 are:

- a single farm payment system which will no longer be linked to the volume of production[1], allowing the farmers to have their incomes ensured and steering their production towards the needs of the market and the demands of the consumers.
- Payments will only be paid in full if the cross compliance provisions are respected. The subsidies will be linked to the respect of environmental, food safety and animal welfare standards (cross-compliance);
- a strengthened rural development policy with more EU money;
- reduction in direct payments (modulation) for bigger farms to finance the new rural development policy;
- several other modifications of the market policies of the CAP in the areas of milk, cereals, rice, durum wheat, nuts, starch potatoes and dried fodder.

The MTR aims at shifting money from the First (Common Market Organization) to the Second Pillar and thus, making it available for Rural Development. The savings within the First Pillar are based on two main principles: Modulation, Capping and Cross-Compliance. **Modulation** covers the decrease of direct payments per farm by a certain rate. This mechanism consists of two components. First, dynamic Modulation is a regular cut of direct payments by an annual rate of 3% leading to a total cut of 20% at the intended final stage. As second component, Capping, would be implemented as an additional cut when direct payments exceed the maximum level of 300,000 per farm per year. In contrast to dynamic Modulation the saved money from Capping, as well as from not respecting cross-compliance, would be kept directly in national accounts for Rural Development measures. Modulation has been introduced by Agenda 2000 on a voluntary basis but would now become a compulsory principle. **Cross-Compliance** is one of the new key elements in the CAP reform, which makes the single farm payments dependant on the farmers respecting public health, animal health, environmental and animal welfare, EU norms and good agricultural practices. The Agenda 2000 CAP reform introduced the requirement for Member States to take the environmental measures they consider appropriate in view of the situation of the agricultural land used or the production concerned. This requirement was incorporated in the "Horizontal Regulation" (No 1259/1999), which provides the common rules in relation to all payments granted directly to farmers.

Member States had three options for fulfilling this obligation: giving support for agri-environmental commitments, fixing general mandatory environmental requirements (based on environmental legislation), and setting out specific environmental standards. Where farmers do not respect the environmental requirements, appropriate sanctions are to be applied, which may include the reduction or even the withdrawal of direct aids. Examples of environmental conditions are adherence to maximum stocking rates for cattle or sheep, compliance with specific conditions for the cultivation of sloping land, respect of maximum permitted volumes of fertilizers per hectare, and compliance with specific rules concerning the use of plant protection products. From 2005, all farmers receiving direct payments will be subject to **compulsory cross-compliance** (Council Regulation No 1782/2003) and Commission Regulation No 796/2004. 19 legislative acts applying directly at the farm level in the fields of environment, public, animal and plant health and animal welfare have been established and farmers will be sanctioned in case of non-compliance (partial or entire reduction of direct support). Beneficiaries of direct payments will also be obliged to keep land in good agricultural and environmental conditions. These conditions will be defined by Member States, and should include standards

[1] Member States can maintain a limited link between subsidy and production only under well defined conditions;

related to soil protection, maintenance of soil organic matter and soil structure, and maintenance of habitats and landscape, including the protection of permanent pasture. In addition, Member States must also ensure that there is no significant decrease in their total permanent pasture area, if necessary by prohibiting its conversion to arable land.

The new rural development programme

In 2000, also, a new rural development plans, considered as the key tool for the restructuring of the agricultural sector and to encourage diversification and innovation in rural areas, were approved. For the first time they include a definition of Good Farming Practice (GFP), based on verifiable standards where soil protection received considerable attention. GFP constitutes a core element of the new rural development policy: the granting of compensatory allowances in less favoured areas is conditional on the respect of GFP and agri-environmental measures provide compensation for undertakings going beyond this baseline. Good Farming Practice is defined as the standard of farming which a reasonable farmer would follow in the region concerned. It entails in any case compliance with general mandatory requirements including environmental legislation but Member States may establish additional requirements associated with good practice. Within the rural development plans, some Member States facing erosion risks included practices such as tillage following contour lines, while some with low soil organic matter have banned the burning of cereal stubble. Maximum livestock carrying capacities have been defined by several Member States to avoid soil degradation through overgrazing. Agri-environmental measures aimed at soil protection range from overall farm management systems such as organic farming (including maximum stocking rates) and integrated crop management (ICM) to specific measures such as no-tillage or conservation practices, grassland strips, winter covers, use of compost and the maintenance of terraces. Measures aiming at a reduced use of pesticides, such as integrated pest management (IPM) or promoting balanced rotations can also contribute to improve the condition of agricultural soils.

According to the route traced by the Agenda 2000 Reform, but with much more emphasis, RDP have been re-lunched for the new programming phase 2007-2013 with a own Fund. The main features of this new proposal that reflects the November 2003 Salzburg conference conclusions and the outcomes of the Lisbon and Goteborg European Councils[2], are:

- the establishment of a special fund, the European Agricultural Fund for Rural Development (EAFRD), separate from the normal CAP mechanisms, with simpler financial rules, and which includes EAGGF Guidance;
- three priority axes for spending (improving the competitiveness of the agricultural and forestry sector; land management (including animal welfare); and diversification of the rural economy and the quality of life in rural areas), with detailed measures under each axis;
- a requirement that a minimum of 25% of community support for each rural development programme is spent on axis II (land management), and that a minimum of 15% is committed to each of the other two axes;
- a mechanism for revising the designation of Less Favoured Areas (LFAs) based on handicaps wider than the physical one.

[2] Increasing the competitiveness of agricultural and forestry by means of support for restructuring; enhancing the environment and countryside by means of support for land management (including rural development actions related to Natura 2000 sites); and enhancing the quality of life in rural areas and promoting diversification of economic activities through measures targeting the farm sector and other rural factors.

Community strategic guidelines for RD proposed for the final Council decision in July 2005, set the priorities that Member States should stress when preparing their national strategic guidelines.

For Axis I, **improving the competitiveness of the agricultural and forestry sector,** the Commission proposes that the restructuring strategy would be built on measures relating to human and physical capital and to quality aspects, based on knowledge transferring and innovation in the food chain.

The axis II, **improving the environment and countryside**, gives priorities to three EU main areas: biodiversity and preservation of high nature value farming and forestry systems, water and climate change.

Axis 3, **improving the quality of life in rural areas and encouraging diversification**, is devoted to the overarching priorities of the creation of employment opportunities, promoting capacity building, skills acquisition and organization for local strategy development.

To protect and enhance the EU's natural resources and landscapes in rural areas, the axis 2 appears the most directly related with the actions proposed to combat desertification on Europe. The measures available under axis 2 should, in fact, be used to integrate environmental objectives and contribute to the implementation of the agricultural and forestry Natura 2000 network, to the Göteborg commitment to reverse biodiversity decline by 2010, to the Water Framework Directive objectives and to the Kyoto Protocol targets for climate change mitigation. In order to meet these priorities, the actions defined by member states should focus on:

- promoting environmental services and animal friendly farming practices;
- preserving the farmed landscape;
- combating climate change;
- consolidating the contribution of organic farming;
- encouraging environmental/economic win-win initiatives;
- promoting territorial balance.

3. The National Action Plans (NAP's) to combat desertification in Mediterranean Europe

The National Action Plans (NAP's) to combat desertification in Mediterranean Europe have been elaborated according to the UNCCD, each of them stressing the main desertification problems perceived by the national responsible authorities. Their elaboration have mostly coincided in time with the formulation of the past Regional programming phase for CAP and Rural Development Programme (RDP). This coincidence is considered as the main cause of not including any reference to any action proposed by the NAP's as possible beneficiary of founds available within the Rural Development Programmes set up by the local administration (Regions, province, etc). However, many NAP's have referred to the RDP's as founder for many actions proposed. In fact, looking trough the NAP's general objectives it is possible to identify many interesting links with the specific objectives and subsequent measures (line of funds) of the RDP.

Following are reported in a schematic manner, the main objectives of the Italian, Greek, Spanish and Portuguese NAP's (Dis4Me, Desertlinks project).

Italian NAP objectives:

The support necessary for Italian regions and watershed authorities to identify "areas vulnerable to desertification".
The adoption of standards and methods better suited to understanding, preventing and alleviating desertification phenomena in "vulnerable areas".

The preparation of the Italian contribution to the Northern Mediterranean Regional Action Programme aimed at ensuring adequate participation in the coordination works with the Annex IV partners.

The gathering of uniform soil data for all of Italy based on the activities of the National Soil Monitoring Centre, the regional Soil Services and other offices with similar duties, in close working relationship with the European Soil Office.

Greek NAP objectives:

Determination of the threatened areas and their extent. Estimation of the effectiveness of the applied policy and of the measures taken. More effective application and use of the existing structures and institutions. Elaboration of additional political, institutional, economical, social, and technical measures, and proposals on mechanisms required for their specification and implementation. Formulation of a national strategy, to prevent and mitigate desertification, and to promote sustainable land and water use, and to secure biodiversity, while minimising social conflicts concerning land use. Promotion of public awareness and encouraging active participation of affected populations and of their local agencies to the formulation and implementation of local and specialised measures. Selection and formulation of priorities and pilot - actions. Demographic and socio-economic rehabilitation of areas facing desertification. Establishment of a network for early diagnosis and warning. Co-operation with respective National Programs from other countries and linking to corresponding international networks.

Spanish NAP Objectives:

To contribute to the sustainable development of the arid, semi-arid and dry sub-humid areas by the prevention or reduction of land degradation, the rehabilitation of partly degraded land and the recovery of desertified land. The identification of the main factors and mechanisms of desertification in Spain and the definition of the practical measures to combat desertification. The integration in the National Policy of Sustainable Development. Promotion of the institutional co-ordination and the development and design of the policies needed for the various sector-oriented action plans. Definition of the Programme's role as a catalyst of the measures related to Desertification control. Promotion of the participatory process of all the involved sectors of society.

Portuguese NAP Objectives:

Soil and water conservation. To fix working-age population in rural areas. Recovery of affected areas Campaigns to raise public awareness of the issue of desertification. Making the fight against desertification an integral part of general and sectorial policy.

4. Linking NAPs and RDP

It is widely recognised that the new CAP promoted by the EU is moving towards environmental requirements, both market pillar and RDP containing measures or requirements able to contrast soil and territorial degradation. Looking at new RDP proposed by the EU to be implemented by the sub-national administration for the new programming phase 2007-2013, promoting a sustainable development in the rural areas of the EU, it can be an important tool to directly sustain actions to combat desertification.

As mentioned above, the new RDP foresees a set of measures distributed in 3 axis. Many of them could be implemented in a such manner as to both deal with the RD priorities and that foreseen by the NAP’s to combat desertification

and drought in the specific context. Table 1 combine the single RD measures distributed by axis, with the actions proposed by the NAP's for four Mediterranean countries. The table reports only the specific measures directly linked with actions proposed, however, most of the measures can be considered horizontally influencing many actions proposed by the NAP's. For example, sustaining the adding value for agricultural traditional products, produced with traditional knowledge/technologies, give opportunities to a large part of Mediterranean territories, to avoid land abandonment/degradation. Perhaps this kind of measures, difficult to link to a single action, may have a stronger impact on combating desertification.

Table 1: Actions proposed by NAP's and new EU RD measures

RDP Axis[3] ->	**1**	**2**	**3**
NAP's Measures in Italy, Greece, Spain and Portugal[4]	**Improving the competitive-ness of agricultural and forestry sector**	**Improving the environment and countryside**	**Improving the quality of life in rural areas and encouraging diversification**
Italy			
Soil protection, including forest management, slope protection and flood control.		B6	
Sustainable management of water resources, identification of water requirements and control of water demand.		A3	
Reduction of the impact of productive activities; prevention of physical, chemical and biological damage to the soil; production and use of compost.		A4	
Territorial rebalance, including reclamation and re-naturalisation; re-evaluation of traditional knowledge; integrated planning policies	B5, C1	A1, A2, B1, B2, B3,B3	A1, A2, A3, A4, B1, D
Greece			
Codes of good agricultural practice.		A4	
Subsidies for sustainable or biological agriculture.		A4	
Recovery and reconstruction of terraces.	B5		
Reduction of groundwater pollution.		A3, A4	
Regulation of livestock production to avoid over grazing.		A4	
Clarification of forest-land ownership.			
Improved forest management, to reduce fire damage, etc.	B5	B1, B2, B6	
Institutional and legal measures for sustainable management of water resources.		A3	
Repairing and renovation of irrigation networks.			
More dams to store water and combat drought			

[3] See EU COM (2004) 490 final, Bruxelles 14. 7. 2004 and Memo/05/215 del 21/06/2005

[4] As reported by Dis4Me, Desertlinks project.

Spain			
Fostering of sustainable agricultural practices for soil conservation.		A4	
Management of the extensive cattle-raising in the arid and semiarid areas.		A4	
Fostering of sustainable management of the forests.	B2	B1, B2, B3, B6	
Basins management and restoration in arid and semi-arid degraded areas.			
Prevention and combat of forest fires.		B6	
Sustainable management of the water resources		A3	
Assessment and monitoring of the desertification.			
Analysis, dissemination and usage of the results of the programmes of I+D+I on desertification. Promotion of Projects and Surveys.			
Incorporation of the social sectors affected by NAP development.			
Net of demonstrative Projects of restoration and sustainable management.			
Portugal			
Soil and water conservation.		A3, A4	
Keeping the population in rural areas.		A1, A2	A1, A2, B1, D
Recovery of areas most threatened by desertification.	B5	B1, B2, B3, B6	
Research, experimentation and diffusion.			
Ensuring that desertification is included in development policy.			

The new RDP is going to be funded with a large and increasing amount of money, nevertheless to be efficacy, at least for the directly involved measures, it is essential to give priorities to such as territory where the desertification phenomenon are more critical. The identification of such areas and priorities should be defined by the local administrations, in a very clear way trough all the available study and tools produced in many years of research activities on the field, when they elaborate the Regional (Local) Rural Development implementation plans.

References

Barbier, Edward B. (2000): Links between economic liberalization and rural resource degradation in the developing regions, *Agricultural Economics* 23 (2000) 299-310, Elsevier Science.

Communication from the Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions - Towards a Thematic Strategy for Soil Protection, Brussels, 16.4.2002, COM(2002) 179 final Directive 2000/60/EC

EU COM (2004) 490 final, Bruxelles 14. 7. 2004

EU MEMO/05/215 del 21/06/2005

Loguercio C. (1999): *Il ruolo dell'Italia nella lotta alla Desertificazione*, CUEN, Napoli

Seely, M. – Whol, H. (2004): Connecting research to combating desertification, *Environmental Monitoring and Assessment,* 99: 23-32, 2004, Kluwer Academic Publishers.

Stoate, C. et alii (2001): Ecological impacts of arable intensification in Europe, *Journal of Environmental Management* 63, 337-365, Academic Press, available online at http://www.idealibray.com on IDEAL

UN (1977): *Desertification, its causes and consequences*, Pergamon press, Oxford.

UN (1977): *Draft plan of action to combat desertification*, United Nations Conference on Desertification, Nairobi, 29 August-9 September 1977. Document A/CONF.74/L.36.UNEP, Nairobi
UN (1992): Biodiversity Convention
UN (1992): Climate Change Convention
UN (1994): Drought and Desertification Convention (UNCCD)
UNEP (1991): *Status of Desertification and implementation of the United Nations plan of action to combat desertification*, Nairobi
UNEP (1994): *United Nations Convention to combat Desertification in those countries experiencing serious drought and/or desertification, particularly in Africa*, UNEP, Geneve.
www.europa.eu.int
www.unccd.int
www.kcl.ac.uk/projects/desertlinks

The sustainability of brownfield redevelopment incentives[1]

Bernard Vanheusden

Research Assistant, Hasselt University (Belgium), PhD student, University of Leuven (Belgium)
bernard.vanheusden@uhasselt.be

Abstract

Brownfields are abandoned, vacant, derelict economic properties where expansion or redevelopment is complicated by real or perceived environmental contamination. Brownfield redevelopment frames within a sustainable development, because it re-uses former developed properties, instead of developing green and open space. At present, both at national and supranational (f.e. EU) levels, governments are trying to deal with this legacy of industrialization.

Reusing brownfields is frequently not enabled by the economic, environmental and social barriers present at the site. Therefore, within the EU, the European Commission and its Member States try to intervene by using different financial and legal incentives. This contribution analyses the benefits and deficiencies of these incentives and sees if the incentives are sustainable. For example, many site activities that take place on most brownfield redevelopment projects are subsidised. However, no consideration is made of the methods used to redevelop the brownfield sites. Often successful proposals use unsustainable methods, which is obviously untenable in an era when supposedly all policy is being driven by sustainable development principles.

The results of the deficit analysis show that the incentives are only partially effective in facilitating or delivering sustainable brownfield regeneration through reuse of soil/construction waste, maintenance of heritage buildings, land use/urban design and citizen participation processes. The European Commission and the Member States should give urgent attention to introducing a set of sustainability criteria to guide their soil policy and funding towards sustainable brownfield projects.

Introduction

The redevelopment of 'brownfields', a term coined in the US, has received a lot of attention in the past few years and has become a major soil-related problem. In 1994 the US Environmental Protection Agency (EPA) started the Brownfields Economic Redevelopment Initiative and developed the following definition of brownfields: "abandoned, idled or underused industrial and commercial facilities where expansion or redevelopment is complicated by real or perceived environmental contamination" (EPA 1996). The Brownfields Initiative was meant to promote the regeneration of brownfields, which offer immense development potential[2]. Indeed, strategic brownfield redevelopment can produce win-win scenarios for both the economy and the environment. Brownfield redevelopment also frames within a sustainable development, because it re-uses former

[1] This paper is based on an article that will be published in 2005 in the Journal for European Environmental & Planning Law: Thornton, G., Vanheusden, B. and Nathanail, P. (2005). Are Incentives for Brownfield Regeneration Sustainable? A Comparative Survey. Journal for European Environmental & Planning Law. The author would like to thank Gareth Thornton and Paul Nathanail from the University of Nottingham (Land Quality Management Group, School of Geography) for their part in the research.

[2] For example, cleaning up environmental hazards, removing neighbourhood eyesores while, at the same time, creating jobs, providing housing and promoting general economic health in local communities of all sizes.

developed properties, instead of developing green and open space. On 11 January 2002 President Bush signed the federal Small Business Liability Relief and Brownfields Revitalization Act[3]. This Act transforms EPA's policy into law (GUARIGLIA/FORD/DAROSA 2002; MITCHELL 2002).

There are estimated to be 500,000 to 1,000,000 brownfields in the US[4]. However, brownfields do not only occur in the United States, but in every industrialised country or region. At present, both at the EU and national levels, governments are trying to deal with this legacy of industrialisation[5]. The Union contains densely populated and built-up regions, and is faced with both historical and recent soil contamination. Some of the historical contamination dates back to the accelerated industrial development of the 19th Century and often the reluctance to redevelop brownfield sites is the uncertainty regarding the risks they pose (VANHEUSDEN 2003).

Brownfields, particularly in old industrial regions, are often economically *marginally viable (B sites)* or even *non-viable sites (C sites)* (FERBER 1997) as they are not competitive compared with greenfield sites without public intervention. Some common reasons for this are: wrong location, legacy of infrastructure, contamination[6]. Brownfield redevelopment therefore often requires public incentives. The use of incentives, so-called indirection regulation, instead of direct regulation (command and control) is quite new. Indirect regulation is something of the last 20 years: the bandwidth of forms of regulations has become wider (MAYNTZ 1997). The State can bring about a better competitive position for brownfields by implementing a wide variety of financial, fiscal, legal, regulatory and policy incentives.

This paper analyses the benefits and deficiencies of current financial, legal and policy incentives with direct or indirect relevance to sustainable brownfield regeneration. We look at incentives on the European level, the national level (Germany, UK and Belgium) and we compare these incentives to existing financial and legal incentives in the US[7]. Several of our findings, could be generalised to other soils than brownfield soils as well as to other Member States. The aim is to find out whether the incentives are sustainable. In other words, does the competent public authority, when enacting new incentives, consider the needs of the present and the future when using methods to redevelop brownfields? The basic norms of sustainable development about which there is a widespread agreement are the following: brownfields programs should simultaneously consider social, economic and environmental issues; they should substantively ensure a sustainable urban future; and last but certainly not least, they should strive for and achieve 'equity' (EISEN 1999). Governmental and private sector pronouncements of a connection between brownfields and sustainability are not hard to find. But are all of the incentives to promote brownfield regeneration really sustainable? Which brownfields programs will really lead to sustainable

[3] Public Law 107-118 (H.R. 2869), signed by the President on 11 January 2002. The full title of the Act is "An Act to provide certain relief for small businesses from liability under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, and to amend such Act to promote the cleanup and reuse of brownfields, to provide financial assistance for brownfields revitalization, to enhance State response programs, and for other purposes".

[4] President Signs Brownfields Bill, The White House, 11 January 2002, on http://www.whitehouse.gov/news/releases/2002/01/20020111-3.html [accessed 21-11-04]

[5] Thanks to the increased attention for brownfields in the US, the potential of such industrial contaminated sites in the EU received a lot of attention in the past few years.

[6] And the resulting high rehabilitation costs and reduced real estate value.

[7] The content of this paper is partially based on Deliverable 2-5.2: *Administrative Tools and Incentives for Sustainable Brownfield Redevelopment* of RESCUE, and is a result of considerable team input. RESCUE is a research project supported by the European Commission under the 5th Framework Programme contributing the implementation of the Key Action no 4: "The city of tomorrow and cultural heritage" within the "Energy, Environment and Sustainable Development" programme (See http://www.rescue-europe.com). RESCUE stands for "Regeneration of European Sites in Cities and Urban Environments". The full results of the research project are accessible through the internet. We would like to thank the European Commission for the financing of this research project.

cities? As EISEN already stated, "*any argument that all brownfields redevelopment is inherently sustainable is unjustified*" (EISEN 1999).

I. European incentives

A. EU Structural Funding

The most significant financial incentive for sustainable brownfield development is EU Structural Funding. Structural Funds are distributed at the national, regional and sub-regional level by organisations obliged to pursue the same outputs/measures contained in EU priority objectives and supporting guidance. While Structural Funds do not directly allocate funds to projects chosen by the Commission, the main priorities of a development programme are defined in cooperation with the Commission and the choice of projects and their management is solely the responsibility of the national and regional authorities (EUROPEAN COMMISSION 2004).

There is still little, if any, recognition of the need for sustainable brownfield regeneration practices and even now, as in the past, evaluating projects on the basis of a quantity of defined "hard" outputs such as number of jobs created, area of land reclaimed etc. is regarded as acceptable, but this approach must now be in question. At present, EU Structural funds are distributed to support brownfield redevelopment without considering either whether the development is sustainable, or whether the methods adopted to redevelop the project site are sustainable. This may impact negatively at EU, national, regional and sub-regional level and also may compromise co-financiers who include sustainability in their project evaluation criteria. This is obviously untenable in an era when all policy is supposedly being driven by sustainable development principles. In the absence of any evaluation of sustainability criteria such as those defined by the RESCUE project[8], the current EU-led approach ignores and therefore places no value on: 1) sustainable reuse of soil/construction related waste; 2) sustainable maintenance of heritage buildings; 3) sustainable land use and urban design strategies; and 4) citizen participation processes.

Although sustainable development is now, apparently, enshrined in all European political policy, it has no status at the point of local project delivery. Therefore, the European Commission should give urgent attention to introducing a set of sustainability criteria to guide Structural Funding towards sustainable brownfield projects[9]. The criteria should explicitly require applicants to declare how the principles of sustainable brownfield redevelopment are considered in the project[10].

B. Legal incentives

As a first step in the development of an integrated EU policy to protect soils against pollution and erosion, the European Commission recently published the Communication "Towards a Thematic Strategy for Soil Protection" (EUROPEAN COMMISSION 2002). The purpose of this Communication is to build on the political commitment to soil protection in order to achieve it more fully and systematically in the coming years. It sets out the necessary steps to achieve better soil protection. Obviously, the Communication can have a far-reaching impact on national soil strategies, including brownfield redevelopment.

[8] RESCUE has developed 33 sustainability objectives and 61 sustainability indicators, including qualitative as well as quantitative indicators (some checklists, some yes/no questions, and others with quantitatively measurable units).

[9] This counts of course *a fortiori* for structural funding at the national level.

[10] This will require an additional tier of evaluation criteria to adapt the current process: RESCUE's Sustainability Assessment Tool would be one option (RESCUE 2004).

However, soil has to be distinguished from "land". The concept of land is much wider and includes territorial and spatial dimensions. A separate Communication on "Planning and Environment – the territorial dimension" is under preparation[11] and will deal with land issues, such as rational land use planning[12]. It will take a number of soil-related aspects into account and address *inter alia* the preservation of greenfields and the appropriate re-use of brownfields. Knowledge of soil-related problems is clearly increasing in the European Union, but is also necessary in view of the extent of the brownfield issue.

Another important legal incentive to improve brownfield regeneration are the 'Community guidelines on State aid for environmental protection'[13] which are used to judge which environment projects receive state aid. The objectives of the guidelines are twofold: to ensure that state aid allowed for environmental purposes complies with the "polluter pays" principle and is consistent with the internal market and EU competition policies. They serve as guidelines to the Member States when applying for European Commission approval of state aid, but no criteria for sustainability are used.

Furthermore, the ruling of the European Court of Justice in the *Van de Walle et al*. case[14] could prove to be a very important ruling with regard to the European legal framework for brownfield redevelopment. In this case the Court broadens the definition of waste and decides that soil contaminated by fuels leaking from underground tanks should be regarded as waste under the Waste Framework Directive. The Court says the land is waste despite not being excavated or disturbed and the fact that the contamination is accidental[15]. However, in our opinion, the Waste Framework Directive should not be used to cover soil contamination and should therefore be 'decoupled' for brownfield soil to streamline the process for reusing waste from brownfield sites.

II. Incentives in the Member States: Deficit Analysis

A. Introduction

The soil is polluted in many Member States[16] and in a variety of ways[17]. Soil contamination has long been a consequence – intended or not – of land use. Several Member States or regions within a Member State recently introduced legislation on soil remediation. An evaluation of the currently available financial and legal incentives and existing obstacles for brownfield redevelopment in Germany, the UK and Belgium (Flemish Region) has been carried out to identify deficits. The evaluation is divided into sections covering the various aspects encountered during the sustainable brownfield regeneration process. For each

[11] According to drafts of the Communication, "Planning and Environment – the territorial dimension" was to be published in 2003.

[12] On the importance of land use planning for brownfield redevelopment, refer to Pendergrass, J. (1999). Sustainable Redevelopment of Brownfields: Using Institutional Controls to Protect Public Health. The Environmental Law Reporter, 10243-10258.

[13] *O.J.*, C 37, 3 February 2001.

[14] ECJ, Case C-1/03, 7 September 2004.

[15] ENDS Report 356, September 2004, 44.

[16] Although no Community inventory of such contaminated sites exists, some Member States have set up national inventories. For example, in Germany, the number of suspected contaminated sites registered is about 190,000. This figure does not include military sites and sites for the production of armaments. The total number is thought to be well over 240,000. Austria has a list of 2,584 contaminated sites, while Finland counts 10,400. In the UK, estimates run from 50,000 to 100,000, while France sometimes quotes a figure of about 1,000 contaminated sites (KRÄMER 2000). The European Environment Agency estimates that there are between 300,000 and 1.5 million contaminated sites in Europe (EUROPEAN ENVIRONMENT AGENCY 2000).

[17] There are former industrial areas and current industrial sites, dumps, wrecked cars heaps and river basins. In addition, many houses, especially in the old city centres, are built in former industrial zones or in areas where polluted soil has been used for construction work. Smaller cases of soil pollution occur at petrol stations or have been caused by leaking domestic oil tanks, illegal dumping etc. (SEERDEN/VAN ROSSUM 2000).

kind of incentive, we want to know whether the currently available incentives are effective and sufficient for sustainable brownfield regeneration, and whether they enable or impede the implementation of sustainable brownfield regeneration.

B. Incentives for sustainable brownfield soil and waste reuse

In general we see that there are no major financial or legal incentives in the Member States or at EU level that would promote sustainable brownfield soil and waste reuse. As f.e. prices for waste disposal are quite low in Germany, up to half of the remediation measures consist of disposal of contaminated soil in landfills. Planned reuses of contaminated sites very often fail due to high costs (or economic risks) for remediation compared to the potential asset value, as shortfalls are not generally compensated by external (public) funding or insurance cover. In the UK there are eighteen major structural funding programmes that impact on the extent of brownfield redevelopment, all with their own individual targets, objectives, territorial limits and delivery mechanisms. Although all of the programmes are highly relevant for supporting sustainable brownfield redevelopment, no sustainability criteria are stipulated for evaluating funding proposals. Furthermore, the five predominant tax incentives in use in the UK seek to encourage development from greenfield sites to brownfield sites, but they do not differentiate between sustainable remediation and unsustainable practices.

Contrary to Germany and the UK, the Flemish Region does promote sustainable brownfield redevelopment, albeit in a general way. The Flemish Government approved in 2002 a Decree establishing the Flemish Town Fund. 13 cities in Flanders can conclude a covenant with the Flemish Government and receive funding to outline a sustainable town policy. Another Decree of 2003 provides for financial support for the cleanup and for the establishment, expansion or modernisation of industrial estate. Again the Flemish Government can take the sustainability of the proposal into account. However, none of these decrees specify clear sustainability criteria for evaluating funding proposals.

Germany and the Flemish Region have a very clear legal framework with regard to the reuse of soil and waste. In Germany this leads to a frequent reuse of uncontaminated or slightly contaminated material for landfilling on site or for deposition on site. In recent years, several legal improvements have enabled a move towards sustainable brownfield regeneration. In the UK sustainable brownfield soil and waste reuse is governed almost exclusively by waste regulations. The regulations are generally, and appropriately, applied in a precautionary way. However, there are no current legal incentives that promote sustainable brownfield soil and waste reuse[18]. According to the Waste Framework Directive, waste legislation encourages in general firstly the prevention or reduction of waste, and secondly the recovery of waste by means of recycling, reuse or reclamation and the use of waste as a source of energy.

Governments should be a catalyst, using public funds judiciously to lever private capital into deprived neighbourhoods, but they should also ensure that adequate financial incentive(s) avoid giving financial advantages indiscriminately to any remediation/redevelopment project – it/they should rather consider the sustainability of land use, including the social, environmental and economical benefits and disadvantages. In order to be attractive for investors, the application processes and reporting systems of these incentives should avoid being too bureaucratic, complicated, slow and time-consuming. Unsustainable soil and waste disposal creates very significant impacts on human health, safety and the ecosystem. Better options to enable an increase in soil and waste reuse need, and deserve, support.

[18] The pending Comprehensive National Brownfield Strategy, for England, may seek to redress this, but this is in its formative phase and may take some time to develop.

C. Incentives for retention/partial reuse of buildings/infrastructure on sites

The reuse of previously developed land has been a central government policy. In fact, in the UK more than 60% of new developments are being built on such land and through conversion of existing buildings. However, developers are in fact encouraged more to demolish than to preserve and reuse due to all the remediation issues likely to be involved in brownfields. The EU and the Member States should more explicitly promote the inclusion of industrial buildings within listings of cultural heritage monuments to enable and facilitate preservation of industrial buildings and infrastructures.

Very often funding for the preservation of historical monuments is only available for listed buildings with great historic value and offers very limited potential to actually support the retention of listed buildings. On top of that, the funding schemes in general do not state that the granting authority has to take the sustainability of the project into account. The financial support that is available for listed buildings is rather small and the opportunities for follow-up uses are limited due to the mismatch with modern uses[19]. Therefore the philosophy of "preservation at any price" is not fruitful. In a difficult market environment, high redevelopment costs incurred by retaining old buildings cannot be recovered by the end value of land. Because of this, most stakeholders view monument preservation as an additional constraint on the economical viability of brownfield regeneration projects.

D. Incentives for reuse/recycling of buildings/infrastructure materials on sites

Apart from tax incentives on the landfill and incineration of waste, there exist no major public financial incentives or legal obligations for the reuse/recycling of construction materials of buildings and infrastructure[20]. The costs of dismantling carefully and storing safely for reuse may exceed the costs of purchasing new material. In that case items will only be salvaged and sold where there is a commercial demand for components[21]. In the same way, recycling these materials is market driven. Recycling and reusing material means saving both landfill disposal charges and acquisition costs for other material.

However, the cost effectiveness of reusing and recycling waste from existing buildings and infrastructure has significantly improved since the introduction of new legislations for soil and waste. In Germany f.e. the ban preventing mixed construction and demolition wastes being sent to landfill[22] presents a strong legal incentive for recycling material from buildings and infrastructures.

[19] Strict restrictions that ban changes of buildings declared as monuments are seen as a major obstacle to reuse. However, in general, altering buildings are a matter of negotiation between stakeholders interested in a reuse (e.g. proprietor, planner) and the monument protection authority.

[20] On the other hand, we should mention that several programs were worked out. The association of the German building industry committed to a 'voluntary obligation' to reduce dumped waste from building activities by half by 2005. In the UK the Waste & Resources Action Programme (WRAP) was established to promote sustainable waste management and create stable and efficient markets for recycled materials and products. The Programme does not provide incentives but a unique 'one-stop' source of practical information on the use of recycled aggregates. The Flemish Government approved in 1995 the Realization plan construction and demolition waste, which aims to prevent waste and instil appropriate reuse (recycling) of waste.

[21] However, in most Member States components of listed buildings have to be reused by legal obligation.

[22] Ordinance On The Management Of Municipal Wastes Of Commercial Origin And Certain Construction And Demolition Waste.

E. Incentives for saving resources in existing buildings/infrastructure on sites

There are several economic incentives for saving energy and using renewable energies available, albeit not brownfield specific. Most of these incentives are a direct consequence of European initiatives. In recent years energy has become quite an important topic within the EU policy. The same is true for the use of water. The price of water is often rather low. As there is no water scarcity in most of the northern Member States there are no direct incentives concerning water supply. The use of rainwater and grey water[23] is generally possible but under present conditions it's not economical. Apart from the financial incentives, there are no current legal incentives that promote saving resources per se in brownfield buildings and infrastructure, although the government can direct her policy through the environmental permit.

F. Incentives in leading spatial development to brownfield instead of greenfield land

The amount of greenfields, of open space, is decreasing. This is a major problem for densely populated countries like Germany, the UK and Belgium[24]. On the whole, the available financial and legal incentives fail to adequately encourage spatial development on brownfield sites. Low restrictions on the ready availability of greenfield sites and financial incentives for greenfield projects, being competitors to brownfield regeneration, contribute to a lack of brownfield regeneration. There is a very strict spatial planning and this makes that former industrial facilities cannot always be developed the way a developer would like. The alteration of the zoning scheme for a certain brownfield project also is a time-consuming process. Moreover, existing incentives and initiatives may often provide the 'starting point', but actual redevelopment depends on attracting (additional) private investment on brownfield sites.

G. Incentives to encourage sustainable land use and brownfield development where there is a weak real estate market

The Flemish Soil Remediation Decree and the German Soil Protection Act of 1998 are very much an instrument of a technical orientated environmental protection[25]. However, the obligation for remediation has not lead to substantial improvement in regeneration activities. In addition, the protection of neighbouring property against negative impacts make the industrial reuse of former industrial brownfields very difficult thus contributing to further suburbanisation of business and industrial land uses.

Brownfield related policies have to take in account regional conditions, especially in regions with a large stock of highly contaminated brownfields and/or a weak real estate market where brownfield regeneration will require a higher level of incentives[26]. Direct and indirect financial incentives for spatial development projects should be at a national scale, but there should be greater

[23] Used but not very dirty water.

1. [24] Currently in most Member States greenfield consumption continues, while at the same time, the number and extent of brownfields is still growing. On top of that very often more ha of industrial estate are needed, thus, the pressure on greenfields will increase. The German national sustainability strategy includes: the target to reduce the greenfield consumption to 30 ha/day by 2020, an increased priority for the tasks of internal development and brownfield redevelopment, the introduction of brownfield management approaches on local and regional levels. (BUNDESREGIERUNG 2004). Current space-related policies/strategies in the UK (ENGLISH PARTNERSHIPS 2003; ODPM 2004) promote the achievement of an 'urban renaissance' within the wider goal of achieving sustainable development.

[25] Especially setting limits for allowable contaminant concentrations.

[26] F.e. the Ruhr area.

ability to focus them on previously developed land at a regional scale[27]. Previously unabated greenfield consumption in these regions means there is a high priority for brownfield redevelopment[28]. Unfortunately, various structural deficits of many existing financial incentives limit their effectiveness for brownfield regeneration, especially the lengthiness and competitiveness of the application process[29].

I. Incentives in citizen participation on brownfield projects

The conceptual efforts on citizen participation have progressed over the last decade in the EU. The implementation of these concepts is lagging behind, as the development of concrete incentives didn't keep up with cultural and political changes. Sustainable development policies have often lacked substantive participation by impacted communities (SHAW/MURRAY 1999). The recent Directive 2003/35/EC[30], adopted under influence of the Aarhus Convention[31], forms an important improvement with regard to public participation[32]. However, on the whole, there is a lack of permanent possibilities for the funding of citizen participation and a lack of knowledge and understanding among developers, authorities and politicians regarding the potential added value that citizen participation can provide.

The evaluation of incentives for citizen participation on a national level is a difficult task. In Germany the approach to citizen participation on a national level – apart from some national regulations[33] – is to give the responsibilities for this topic to the lower levels. In general legislation covers only a level of citizen participation that is not adequate to achieve a planning process that fulfils RESCUEs sustainability criteria (RESCUE 2005). New measures are necessary. One could think of an obligation placed on developers to justify the quality of citizen participation adopted in their proposals and a link between public funding and this quality. However, there are good examples for projects in which

[27] Especially in areas that have a large stock of brownfield land. In the UK certain initiatives/programmes have their foundations in the national approach but are area targeted, for example: Urban regeneration companies, New deal for communities, Millennium Communities Programme, National Coalfields Programme, 'Key worker living' Programme.

[28] Another example can be found in the UK where the ODPM has set up programmes of public and private investment in areas where housing demand is weak, house prices are low and homes have been abandoned. Conversely, in areas where housing demand and house prices are high, the ODPM has set up a programme to develop affordable housing for 'Key Workers' such as in education, health, and community safety.

[29] Regarding the financing and risk management, the Flemish Public Waste Agency (OVAM) determined the following as the main bottlenecks (OVAM 2001): 1) the exactness of the estimation of (remedial) costs; 2) the double-financing mechanism: simultaneously a security (bank guarantee) as well as the payment of the remediation works; 3) the lacking of subsidy opportunities for the remediation works, including the preliminary site investigation. Other general problems are: the fact that they are not targeted on sustainable methods of delivering brownfield redevelopment; the limited applicability as the incentives are not attractive enough to outweigh 'costs' of redevelopment; the predominance of public funding (i.e. not market driven); the fact that programmes/incentives will change regularly based on the political will/economic success of the government in charge.

[30] Directive 2003/35/EC of te European Parliament and of the Council of 26 May 2003 providing for public participation in respect of the drawing up of certain plans and programmes relating to the environment and amending with regard to public participation and access to justice Council Directives 85/337/EEC and 96/61/EC (Official Journal, L 156, 25 June 2003).

[31] UNECE Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters, adopted on 25th June 1998 (http://www.unece.org/env/pp/welcome.html).

[32] The objective of this Directive is to contribute to the implementation of the obligations arising under the Aarhus Convention, in particular by (a) providing for public participation in respect of the drawing up of certain plans and programmes relating to the environment; (b) improving the public participation and providing for provisions on access to justice within Council Directives 85/337/EEC and 96/61/EC. The Member States had to implement the Directive by 25 June 2005 at the latest.

[33] Environmental Information Act 16/7/94 (*Umweltinformationsgesetz*), Federal Building Act and the Urban Construction (Promotion) Act, §10 of the Federal Immission Control Act, §3 of the Building Statute Book *(Baugesetzbuch),* Waste Avoidance and Waste Management Act, §29 of the Federal Nature Conservation Act *(Bundesnaturschutzgesetz),* Environmental Impact Assessment Act (UVP-Gesetz).

authorities implement citizen participation far beyond the legal requirements, but sometimes the issue is more one of lack of engagement by citizens rather than a lack of opportunity for them to be engaged.

III. Incentives in the US

EPA started in 1994 the Brownfields Initiative, which involved several legal and financial incentives to promote brownfield redevelopment. The legal incentives mainly aim at clarifying the liability scheme. Both the federal government and the states have recognized the benefits of offering financial incentives for the redevelopment of brownfields. These incentives have taken the form of grants, loans, and tax abatements or deferrals[34]. The Small Business Liability Relief and Brownfields Revitalization Act of 2002 is designed to relieve small businesses from the financial burden of CERCLA liability, promote brownfield redevelopment, define transactional due diligence standards, and encourage state primacy in enforcement matters (GUARIGLIA/FORD/DAROSA 2002). Furthermore, the Act provides legislative authority for brownfield programmes, including grants for assessments and clean-ups, as well as liability protection for prospective purchasers, contiguous property owners and innocent landowners. Finally, the Act authorises increased funding for state and local programmes that assess and clean-up brownfields.

However, the fact that there is considerable activity in the US does not necessarily mean that these initiatives also are sustainable, or are more sustainable than the initiatives in the EU. Clearly, some of the incentives are conscious efforts to incorporate the substance of sustainable development, f.e. the Green Buildings on Brownfields Initiative[35] and the publication by EPA of a study, which emphasizes the incorporation of the principles of sustainability into the redevelopment process (EPA 1998; EPA 1999). EPA uses the results of this study to evaluate the various approaches being taken by communities in order to refine or develop new policies and technical tools that may be needed.

So the US are definitely already a lot further in implementing sustainability criteria in their incentives than the EU and the Member States, although most of the programs advance only components of the sustainable development agenda. In the near future sustainability will become even more important to receive a grant. The Proposal Guidelines for Brownfields Assessment, Revolving Loan Fund, and Cleanup Grants and the Proposal Guidelines for Brownfields Job Training Grants show very clearly that an application for a grant has to aim at achieving a sustainable development[36]. These are all very interesting criteria, which could directly be implemented in EU policy.

---

[34] For an overview of all the existing financial incentives administered by EPA, refer to http://www.epa.gov/swerosps/bf/pilot.htm.

[35] This initiative is an EPA effort designed to promote the use of green building techniques at brownfields properties in conjunction with assessment and cleanup.

[36] See http://www.epa.gov/swerosps/bf/applicat.htm#pg. The first proposal guidelines use, among other ranking criteria, the sustainable reuse of brownfields and community involvement. With regard to the sustainable reuse of brownfields, the applicant has to describe how the grant would support the following specific goals and, how the plans, development regulations, policies and programs will achieve several goals: a) prevent pollution and reduce resource consumption (strategies to do so may include green building, clean energy production, alternative storm water management, eco-industrial development, environmentally beneficial landscaping, and/or others); b) promote economic benefits (e.g., an expanded tax base, increased investment, job creation, enhanced property values through adjacent green space creation, and/or others); c) promote a vibrant community characterized by a mix of uses, appropriate density, housing choice and walkability (strategies to do so may include smart growth, new urbanism, linked recreational and park areas, and/or others); d) reuse existing infrastructure (e.g., existing roads, rail/bus/subway services, buildings, utility services, sidewalks/pedestrian/bicycle trails, recreational services, landscaping, neighbourhood centres/institutions); e) promote transportation choices (e.g., public transportation, bike-to-work/walk-to-work opportunities, and/or others); and f) prevent future brownfields (through such activities as brownfields inventories, active communication with operating facilities, preventing land abandonment, and/or others). In addition, with regard to community involvement, the applicant has

IV. Conclusions

This paper has analysed the benefits and deficiencies of the current financial, legal and policy incentives with direct or indirect relevance to sustainable brownfield development and provided a set of problem related proposals to address the defined deficits. The results of the deficit analysis showed that the incentives are only partially effective in facilitating or delivering sustainable brownfield regeneration through reuse of soil/construction waste, maintenance of heritage buildings, land use/urban design and citizen participation processes. For example, many site activities that take place on most brownfield redevelopment projects are subsidised. However, no consideration is made of the methods used to redevelop the brownfield sites. The European Commission should give urgent attention to introducing a set of sustainability criteria to guide Structural Funding towards sustainable brownfield projects.

Integrated brownfield policies should focus on market-led incentives (indirect incentives, gap-funding etc) but enable public intervention (direct funding and public driven development) where necessary. Therefore, policies should: 1) eliminate the current legal obstacles to brownfield redevelopment; 2) provide legal incentives/regulations to encourage brownfield development; 3) provide direct and indirect financial incentives to encourage brownfield development; 4) discourage greenfield development f.e. by placing a tax on its development; 5) reduce public opposition to 'derelict land' by educating public on the benefits of reusing brownfield sites.

References

Bundesregierung (2004). Perspektiven für Deutschland – Unsere Strategie für eine nachhaltige Entwicklung. See http://www.bundesregierung.de/Anlage585668/pdf_datei.pdf [last visited on 03.08.2005].

Eisen, J. (1999). Brownfields Policies for Sustainable Cities. Duke Environmental Law & Policy Forum, 187-229.

English Partnerships (2003). Towards a National Brownfield Strategy. See http://www.englishpartnerships.co.uk/images/D8B222B7AC3A43299A6A0D072F0674D8.pdf [last visited on 03.08.2005].

EPA (1996). Support of Regional Efforts to Negotiate Prospective Purchaser Agreements (PPAs) at Superfund Sites and Clarification of PPA Guidance. See http://www.epa.gov/superfund/programs/reforms/docs/ppa_clar.pdf [last visited on 03.08.2005].

EPA (1998). Characteristics of Sustainable Brownfields Projects, 358. See http://www.epa.gov/brownfields/pdf/sustain.pdf [last visited on 03.08.2005].

EPA (1999). A Sustainable Brownfields Model Framework, 146. See http://www.epa.gov/brownfields/pdf/susmodel.pdf [last visited on 03.08.2005].

European Commission (2002). Towards a Thematic Strategy for Soil Protection. See http://europa.eu.int/eur-lex/en/com/pdf/2002/com2002_0179en01.pdf [last visited on 03.08.2005].

European Commission (2004). Working for the regions. See http://europa.eu.int/comm/regional_policy/intro/working5_en.htm [last visited on 03.08.2005].

European Environment Agency (2000). Management of contaminated sites in Western Europe. Topic report No. 13/1999. See http://reports.eea.eu.int/Topic_report_No_131999/en [last visited on 03.08.2005].

---

to do the following: a) discuss your plan for involving the targeted community (e.g., neighbourhood organizations, citizens' groups, borrowers, redevelopers, and other stakeholders) in cleanup decisions or reuse planning. Describe what community involvement activities, if any, have already occurred.; b) describe your efforts and/or plans to develop partnerships at the local, state, and/or tribal level with other stakeholders to ensure appropriate and sustainable cleanup and redevelopment of brownfields in your targeted community; c) describe your specific plans for communicating the progress of your project to citizens, including plans for communicating in languages indigenous to the community or other efforts to reach the targeted community as well as the broader community; and d) provide a list of the community-based organizations involved in this project and a contact person, phone number, and a brief description of the organization's activities and representation. Community-based organizations do not include the local planning department, the local fire department, or the mayor's office. The second proposal guidelines use, among other ranking criteria, measures of success. To define those measures of success, the applicant has to describe how his organization will ensure sustainable employment, including initial job placement, retention and continuous employment.

Ferber, U. (1997). Brachflächen - Revitalisierung, internationale Erfahrungen und mögliche Lösungskonzeptionen. In Sächsisches Staatsministerium für Umwelt u. Landesentwicklung (Hg): Materialien zur Altlastenbehandlung. 2/1997. Dresden.

Guariglia, D., Ford, M. and Darosa, G. (2002). The Small Business Liability Relief and Brownfields Revitalization Act: Real Relief or Prolonged Pain?. The Environmental Law Reporter, 10505-10511.

Krämer, L. (2000). EC Environmental Law. London. Sweet & Maxwell.

Mayntz, R. (1997). Soziale Dynamik und politische Steuerung. Theoretische und methodologische Überlegungen. Campus – Schriften des Max Planck Instituts für Gesellschaftsforschung. Band 29. Frankfurt am Main.

Mitchell, D. (2002). Brownfields' and Small Business Superfund Amendments: Important New Changes in Real Estate Practice and in Liability Relief. Environmental Liability, 147-152.

ODPM (2004). Creating Sustainable Communities. See http://www.odpm.gov.uk/stellent/groups/odpm_communities/documents/sectionhomepage/odpm_communities_page.hcsp [last visited on 03.08.2005].

OVAM (2001). Brownfields in Flanders: an overview, 18. See http://www.ovam.be/jahia/Jahia/cache/off/pid/176?actionReq=actionPubDetail&fileItem=57 [last visited on 03.08.2005].

RESCUE (2004). Administrative Tools and Incentives for Sustainable Brownfield Redevelopment. See http://www.rescue-europe.com/download/reports/2_5_2_Administrative%20tools%20and%20incentives%20-%20SAT.pdf [last visited on 03.08.2005].

RESCUE (2005). Development of an Analytical Sustainability Framework for the Context of Brownfield Regeneration in France, Germany, Poland and the United Kingdom. See http://www.rescue-europe.com/download/reports/1_Analytical%20sustainability%20framework.pdf [last visited 03.08.2005].

Seerden, R. and Van Rossum, M. (2000). Legal Aspects of Soil Pollution and Decontamination in the Netherlands. In: Seerden, R. and Deketelaere, K. (eds.). Legal Aspects of Soil Pollution and Decontamination in the EU Member States and the United States. Antwerpen – Groningen. Intersentia. 289-340.

Shaw, E. and Murray, K. (1999). Introduction. Duke Environmental Law & Policy Forum, 147-152.

Vanheusden, B. (2003). Towards a Legal Framework in the EU for Brownfield Redevelopment. European Environmental Law Review, 178-186.

Knowledge and Policy Making; Premises, Paradigms, and a Sustainability Index Model

Olafur Arnalds

Agricultural University of Iceland, oa@lbhi.is

Introduction

Science serves society, shapes it, and is a driving force for societal changes. Natural sciences help devising secure ways to manage our resources, and to ensure that there will be resources to fulfill the needs of future generations. I believe that care for land and water resources should be given as much attention and priority as health, education and care for the elderly. That the living land and soil should receive their rights and protection by law and conventions, as well as care by stewardship.

It is important that scientists take active part in how research findings are used for shaping societies, such as land use decisions; how public resources are used for agricultural and other land use related subsidies. The purpose of this paper is to present ideas to stimulate discussion about the possible means to tie knowledge and research with policy making. It draws in part from Icelandic experience of the author, but is focused on European conditions in general.

Knowledge generates reaction

Knowledge and synthesis of it precedes rational action. The author believes that many researchers are often distressed about the many directions discussions about land degradation lead. The public perception of the problem reflects this; lack of understanding of the value of soil conservation is often painstaking. However, the issue has come a long way since the onset of organized soil conservation, and great advances have been made in Europe over the past years, where the European Commission and many countries have put emphasis on the issue. This change in attitude in Europe is aided by awareness of poor water quality, soil contamination, flooding and other pressing environmental issues.

One way of presenting the uneven path to sustainable land use is shown in Figure 1. The curve is shown as a function of three factors; 1) public recognition, which makes actions possible; 2) income, which results in better education and also allows for more diverse land uses and less dependence on land use that is unsustainable; and 3) negative effect of conflicting interests, such as farming traditions and many other factors, which cause resistance to change. Other factors play a role, of course, but are left out for simplicity.

Environmental awareness often increases in wavelike manner, with periodic setbacks, especially if the problems are poorly understood or falsely presented. The issues at the early stages are often emotional in character. Poorly founded claims that create sensations can advance conservation issues temporarily. Examples of this would be dust-storms in large cities, such as Washington, Melbourne and Beijing, which had huge impacts on society. Development driven by sensation can, however, sometimes lead in the wrong direction. The infamous marching desert hypothesis in the Sahel form the 1970's (e.g., Forse, 1989) is a good example. Rapid advancement is often followed by setbacks when the actions taken are not fully justified (lack of knowledge, again is "marching desert" a good example), scientific knowledge is not widely known because of lack of efforts to reach the public and policy makers, and also because of short time-span of public attention.

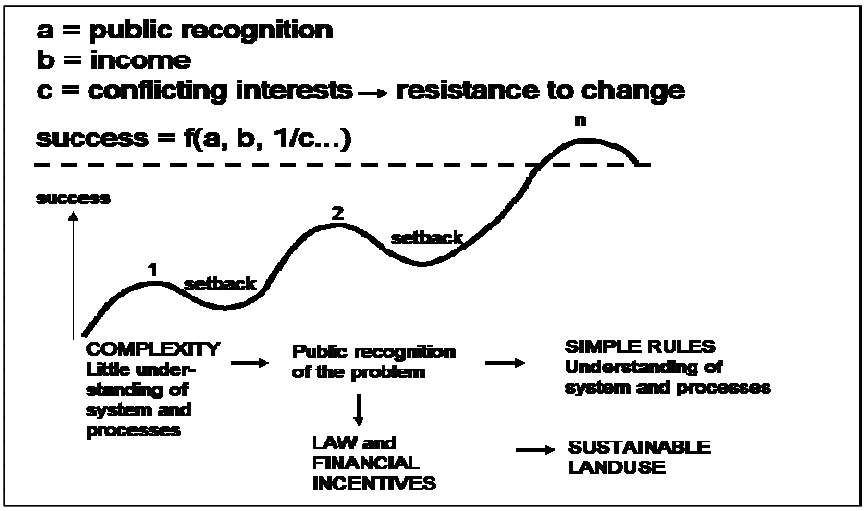


Figure 1. The path to sustainable land use. See text for explanation.

With improved understanding, the problems become less complex and discussions become more directed towards solutions. Simpler rules can be written for how to approach sustainable land use. Debates move from cause-effect relationships and endless case studies of problems and remedies, towards simple, wide reaching solutions. The key to solutions according to the Figure is to enhance public recognition of a problem to the point that the government has to improve law and provide financial incentives. This can not be achieved if income is too low or tradition is too strong. Financial incentives can be both positive (subsidies, Agri-Environmental measures, better prizes), and negative (market obstructions, fines etc). A wealth of publications has emerged that emphasize the importance of financial incentives (e.g. see Boardman et al., 2003; review by Robertson and Swinton, 2005).

This model is quite simple, but many environmental problems are following or have followed this path, including desertification issues (still rather low on the graph), climate change (considerably higher), soil protection (hopefully approaching the critical line of sustainability in Europe in many sectors). It also shows progress in dealing with land degradation caused by sheep grazing in Iceland (see Arnalds and Barkarsson, 2003), where financial incentives have been created, but law is extremely outdated. New law would provide the additional measure to reach the final goal, provided that public recognition has reached a critical stage, and that policy makers understand the problem. If not, a new law would create a new setback.

Premises and paradigms

With increasing understanding of land degradation problems, better solutions become available, often driven both by local actions and societal remedies such as laws, policies and financial remedies. However, all actors, including land users, agencies, society, and policy makers are often faced with uncertainties: do we know enough? Decisions on land use changes are difficult to make as they can influence all sectors of society in agricultural communities. Therefore, demand is often made on more research, more knowledge, while the land is still being degraded. The typical western viewpoint is deeply rooted in concern for food security, but current production techniques make Europe far more than sufficient in food production. View on soils is also strongly affected by the research driven quest to understand degradation processes, where we still long for more knowledge. But when is there sufficient knowledge for taking action? I would like

to offer some alternative premises and paradigms for consideration in relation to these questions, which are considered for modern day Western and Central Europe.

1. *The most important land conservation issue within EU countries is to ensure that subsidies and other such agricultural/rural assistance are used to enhance sustainable use of Europe's land resources.* This premise states that more research is not the bottleneck and highest priority for action. The tools for success are already in place in form of financial incentives with adequate knowledge. The importance of financial incentives is well documented (e.g., Boardman et al., 2003; Robertson and Swinton, 2005), and is reflected in the EU transition towards Agri-Environmental based assistance to farmers. It can easily be argued that these incentives are more important than most other actions that can be taken to preserve Europe's soils.

2. *Identification of cause-effect relationships are not important for decision making and regulation. Decisions can be made on the current condition of the land, based on current knowledge* (elaborated in the SIM model below). The cause-effect understanding is often emphasized, and understandably so (e.g., Thorns, 2001). A lot is known, however, and this premise simply states that we can go ahead with actions, based on easily identified indicators such as cover, organic matter, presence of A horizons, erosion evaluation, and the effects of present land use. Gisladottir and Stocking (2005) provided similar argument, pointing out that cause-effect analysis tends to identify the land user as the one "guilty", while primary drivers of degradation may occur at levers beyond the land user (policies, markets etc).

3. *Productivity for agriculture is often the wrong measure of soil and ecosystem health in Europe*. Other uses than agriculture, such as for water regulation, carbon storage, aesthetic values, and social services such as tourism and landscape conservation are just as important. This premise challenges that current land use and societal assistance are necessarily those that should determine action, e.g., when land is severely degraded. Another way of stating this, quoted from Robertsson and Swinton (2005), is as follows: "Managing for multiple ecosystem services can substantially reduce agriculture's environmental footprint".

4. *Population changes are part of societal change; changes in land use can be more beneficial than damaging*. Changes in geographical population texture are part of societal development. Movement from severely degraded areas does not have to be bad for society and occurs over time. But such changes can create new alternatives for rural development. Current land use, often heavily subsidized, can actually prevent beneficial rural development in the form of more diverse employment alternatives. New types of inhabitants are exploring the countryside, and activities include tourism, ecological restoration, forestry, "internet based employment", and diversity of other activities. The rural areas are becoming increasingly important alternative from urban areas, an alternative which sometimes is protected from development by conservative traditions and production methods, subsidies and maintained by central government (taxpayers). Diverting production subsidies towards alternative rural development is perhaps one of the most important means of conserving Europe's soil resources. However, rural development can also be very damaging to soils, with sealing and a host of other problems, so care should be exercised.

5. *Agronomic paradigms are often wrong in devising solutions for land conservation*. Agricultural goods are produced on immensely variable soil environments with spatial differences in climate, landscapes, vegetation, soils and people. Discussions about land degradation are sometimes stuck between two paradigms which can make solutions difficult if care is not exercised. The first is the paradigm of erosion modeling, in particular its response value (amount; t/ha/yr), and the second assumes that the soil can be considered separately from other parts of ecosystems. The root of these problems stand in the cultivated

fields of early soil conservation development, dust bowls etc. Both are derived from the traditional agronomy which relies on cultivated land and represent the so-called "*agrocentric*" views. It can be argued that the EU "Soil Communication" is often agronomic biased in its focus on the soil as a medium to grow crops, not as a diverse natural resource.

The history of soil science is agrocentric, and understandably so, crop production being by far the biggest industry in the world and foundation for culture and society. However, it can even be questioned that the soil alone is the best measure for conservation, rather than ecological values, and ecosystem services to human kind, such as the water cycle and nutrient cycle, not to mention the vegetation above. This is especially true when considering natural or semi-natural systems used for grazing or areas covered with forests.

6. *Not all soils and areas are rightfully used for agricultural production.* It is the view of this author that severely degraded soils in western ("rich") societies should not be used for agricultural production. The author further believes that in most cases, it is easy to identify, based on simple observations and measurements, which soils are severely degraded or too poor for given agricultural practice. The most severe abuse of soil systems in light of sustainability, is high input farming (e.g., in form of fertilizers, land leveling, and subsidies) on low output degraded land. Such use often involves questionable water use, pollution and long distance haul of products to markets. This is often the situation in areas susceptible to desertification in Europe, including Iceland.

7. *Is there such a thing as best practices?* When it comes to remedies, there is a wealth of information available in the literature. The term 'best practices' is commonly applied for methods and actions that reverse desertification, but the term can be quite misleading. The best practice must be relative to something, and is subjected to what goals are set and what changes occur within the system. It is good to bear in mind that in most degraded system, almost anything done to the system that involves more water and nutrients for plant growth will "work" to some degree (improve the land); hence the great wealth of success stories and lack of accounts of failure. Generalizations and claims of success are commonly made across "inappropriate" ecological boundaries, such as from agronomic systems to rangelands, from irrigated lands to rain fed systems and across other natural zones, which has often lead to confusion and the use of improper solutions.

8. *Changes in land use can be made with without rapid and dramatic effects on rural areas*. Changes in land use are often difficult to make. It is vital for the success of new European soil conservation policies that they are not implemented too hastily. Changes can be brought about by soft socio-economic measures aimed for slow changes. The generation change ("sunset") model is an interesting approach that has been suggested in Iceland. The model establishes grace periods for implementing land use changes considered necessary for conserving soils and nature. Such model allows each land user to complete his/her professional life (or e.g., 7-10 years of same land use), while the next generation is not entitled to the same production methods or subsidies, if the land is not suitable for production. Such "grace period" interacts with generation change of ownership and property market in an important manner. If it is known that certain production is on "grace-period", it is thereby known that the property has no value for that production after the grace period. Therefore, it can not be sold as such, and the subsidy rights are not extended from one generation to the next. Alternative uses will in many cases be explored, and actions taken to increase the value of the land (e.g., forestry). But the current farmer can continue until retirement with full grace ("sunset"). This reduces the damaging effect on rural communities; changes are slow but in the right direction.

Desertification

Desertification is a real, global phenomenon, affecting land and people in most climatic regions. There is a wealth of research and publications on the subject, documenting a great number of case histories and successes in dealing with desertification problems. It is, however, difficult to obtain an overview of problems and remedies, in spite of good efforts by the UN Convention to Combat Desertification (CCD) and numerous EU efforts, such as MEDALUS (see Geeson et al., 2002). It is without any doubt that the UN-CCD has made an impact on land degradation issues globally. In Europe, the effects are quite evident in considerable research and development programs such as MEDALUS, and large sums that are spent on desertification remedies and restoration efforts in the European Mediterranean region.

The European Union is a major player in the UN-CCD. There are several issues related to desertification and the UN-CCD that merit further discussions on the SCAPE platform, and an attempt is presented below. Similar concerns have also been viewed globally by writers, groups and organizations (e.g., see Hurni and Meyer, 2002).

Conceptual problems. The presence of severe desertification in Iceland (numerous publications, see www.lbhi.is/desert) gives an interesting aspect on the subject, including the problems with terminology (e.g., what is a 'desert' and what is 'desertification'?), and the prevailing agronomic bias in analyzing the problem globally and often locally as well. The conceptual problem was analyzed in Icelandic context by Arnalds (2000), which emphasized that the fate of water in the ecosystem, and the nature of the ecosystem are much more important than precipitation and potential evapo-transpiration alone for definition of areas sensitive to desertification. Such climatic definition may well be both 1) scientifically wrong with limited bearing on ecosystem functioning, 2) may impede success of the UN convention devoted to the problem, and 3) continue to create confusion and debates that hamper UN-CCD global work. Definition and conceptual debates have been quite visible during the past years, and will undoubtedly continue unless the conceptual problems of the CCD are resolved.

Old scientific paradigms. Much of the scientific debate during the CCD negotiations was based on science established during the "marching desert" period as witnessed by key documents and presentations from the first negotiation meeting in Nairobi in 1992; hence the African focus of the convention. There is an agronomic bias, (see discussion on agronomic paradigms above), and climatic definitions are "one dimensional" (e.g., amount of precipitation) rather than considering ecosystem functions. Other stresses than draught on ecosystems are not sufficiently considered in the context of desertification.

Lack of synergies with other UN conventions on biodiversity and climate change. Much of the carbon that can circulate between the atmosphere and ecosystems on land are stored in soils. A great deal of the green-house effect is attributed to agriculture and reduced soil organic carbon. Restoring organic carbon in soils and preventing land degradation does have an impact on green house gases. Restoration of degraded areas also has an impact on biodiversity, and it should be noted that there is more diversity of species below ground than on the surface. It has been pointed out that there is lack of synergies between the conventions, which obviously have many common goals. Synergies between the conventions were recently explored in paper by Gisladottir and Stocking (2005).

The African focus. The African focus is understandable in light of the huge food and social problems on that continent. However, a global convention for relief on one continent, under that hat of conceptually problematic environmental problem (and on problematic scientific background, see above) would undoubtedly benefit from scrutiny.

The possible need for separate soil degradation/soil protection convention? The UN-CCD is not designed to serve as a global convention on conserving soils and ecosystems in general. It may therefore be needed to establish a new Convention on soil conservation (e.g., Hurni and Meyer, 2002). Weynen (2002) concluded that public interest would be low for such convention, and the existing conventions needed to be broadened to include soils, as did Gisladottir and Stocking (2005). It is difficult to see how that can be achieved under current focus of CCD work, but recent emphasis on soils in Europe with the "Soil Communication" and a possible "Soil Protection Directive" changes this a bit. However, it should be stressed that Convention on soil protection is an instrument that would generate much increased interest in soils. Preferably, such convention is relatively simple (that soils should be conserved etc), with ample space for regional and national emphasis. It is also important to bear in mind that not all soils are cultivated, and soil should not be considered regardless of other parts of ecosystems (see point 5 in the preceding section).

European independent panel of experts? The CCD may benefit from increased scientific scrutiny, and given the amount of European funds invested in the problem, an independent panel of experts (independent from the CCD), such as the one that provides scientific foundation for the FCCC, should be considered, at least for the European platform.

Participatory approaches: Europe is not Africa. "Participatory approaches" and "Land care" can become "buzz terms" and should be examined more subjectively than is done in most available publications on the subject. Many such writings have the purpose to prove and demonstrate how well suited such methods are, without analyzing alternatives and resources spent (manpower and other). Many such approaches deal with finding means to sustain current land uses and means of food production, which in the case of poorer regions on Earth, is perhaps quite appropriate most of the time. But Europeans are not starving; on the contrary, they are producing too much food. It is also important that local participatory approaches are amended on the federal level by law and financial incentives, as discussed in the first section. In Europe, the well being of the land, for future generations should in all cases be the overriding factor for decisions, but bearing in mind soft socio-economic methods to facilitate changes.

Sustainable Index Model (SIM)

Land use decisions and financial aid for agriculture need to be based on knowledge about the state of the land, including the soil. However, other factors need to be taken into consideration, such as the importance of given production for society and the community, and its impact on the land. Several methods have been developed to assess condition and quality of the land (e.g., see Doran and Jones, 1996). It is important to link such measures to policy measures and most areas of farming operations, including market considerations and subsidies. It can be argued that many Agri-Environmental measures attempt to do. As land use change causes environmental changes, a feedback is needed to re-evaluate and monitor ecosystem changes, hence emphasis on monitoring in current European soil strategy debate (e.g., Huber et al., 2001; L. Montanarella this issue).

During the course of the SCAPE action, the author has developed an example of a model for how land use decisions can be made in relation to subsidies and land use policy. It is partly based on an Icelandic model developed for decision making for green payments for sheep production in Iceland (Arnalds et al., 2003; Arnalds and Barkarsson, 2003). The model assumes that there is a wealth of knowledge about soils, ecosystems, and methods to assess condition of the land. And it assumes that it is also known what impact various types of land uses have on the land. Land use varies, but can be defined, and thereby the variables need for the model for each land use, regional and local conditions.

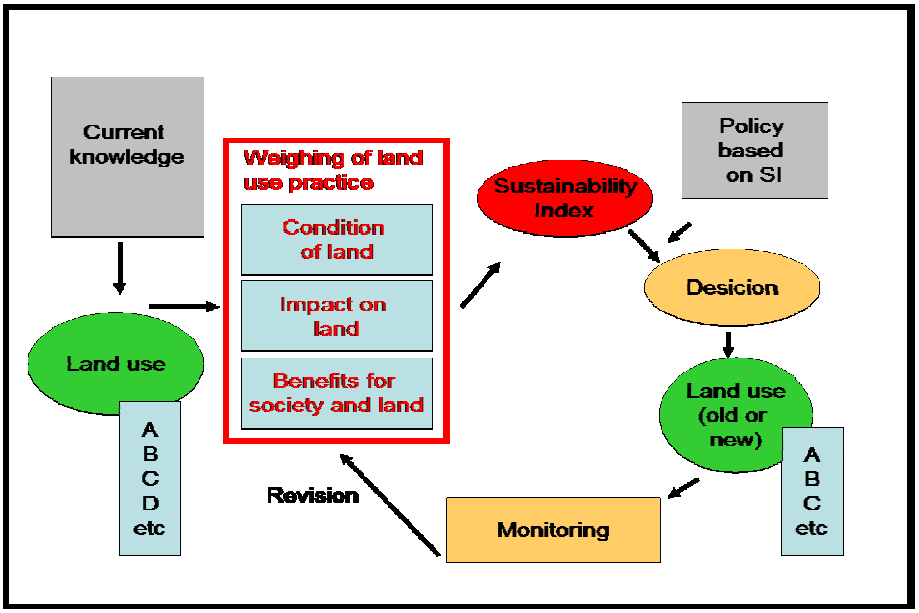


Figure 2. Sustainability Index. Current knowledge is used to weigh condition of the land, impact on the land and benefits for the society of a given land use, to derive Sustainability Index (see Figure 3). Land use decision is made based on the Index value derived.

The core of the model is that for any decision making, each land use practice needs to be evaluated. But it is not sufficient to weigh the condition of the land itself, but also the impact of current and potential land use practice on the state of the land. Thirdly, considering sustainability of the production, the benefits for the society and the land needs to be assessed. These three elements are discussed in more detail below. The model is shown on Figures 2 and 3. Land use (Figure 2 right) is determined and checked against the three main elements: condition of the land, impact on the land from specific land use, and the benefits for society. The condition of the land is valued by site or land use specific method (presence of A horizon, OM, vegetation on rangelands, etc). The impact (e.g., N inputs, pollution, actual and/or danger of soil erosion) is valued separately, and it also considers beneficial measures, such as winter stubble, organic methods etc; note that it does not only consider soil erosion. The benefits for society and community of each practice are balanced against need. Is there surplus production? Is the food healthy vs. unhealthy? Does the land use cause land fragmentation? Long transport distances? Does it require large societal subsidies?

The evaluation needs to be based on simple indices and an example of how this can be achieved is shown on Figure 3. Each element is rated on a scale 1-5, each given an equal weight. By multiplying these factors, an index can be derived, which is termed Sustainability Index (SI). A decision making scale for the index is shown, from sustainable land use practice (low index) to non sustainable (high index). A break point would possibly be about 27-30 (>3 x 3 x 3), with a marginal area from >20; however, not allowing any matrix with value of 5 (e.g., 2 x 2 x 5), as any land use with very bad consequences for land or society should not be considered for subsidies or allowed.

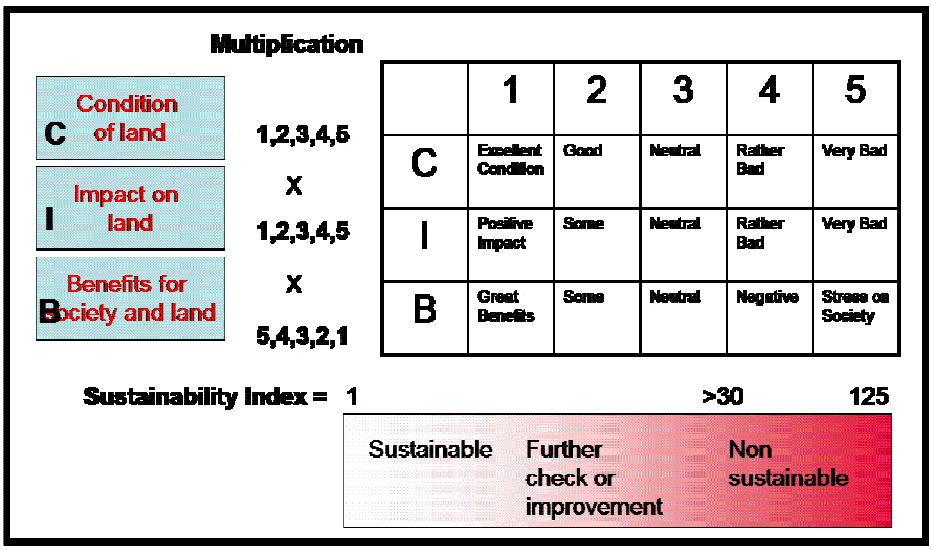


Figure 3. Sustainability Index Model. Evaluation method. Each of the factors(C=Condition of the land; I=Impact of use on land; B=Benefits for society and land) is multiplied by a factor ranging from 1 (very positive) to 5 (very negative). The result is the Sustainability Index (SI). Results > 30 (as an example) are considered to represent unsustainable land use.

It may be argued that it may be problematic to decide on what constitutes each value, especially in the benefits category. However, such judgment needs to be made in one form or another in general, regardless of this index model. And not the least if the production is supplemented with public resources, and in many cases the judgment is reasonably straight forward (large surplus, very long distances to market, or lack of given product and large impact on community or national economics).

After decision is made, the producer/landowner responds, continues with same practice, or changes his farming, in which case monitoring and revision of decision has to be made. The model is beneficial for land care and participatory approaches, it allows for comparisons locally or between areas and land use practices, and can be used for weighing and determining new land use approaches. This can also be tied into the Agro-Environmental measures of the EU.

This model has similarities to the DPSIR model (Driving forces, Pressures, State, Impacts and Response), but is more aimed for soil conservation and social involvement in form of incentives and alternatives. It has a feed-back loop as the DPSIR and takes into consideration that knowledge changes, and land use changes the condition of the land. It differs from the DPSIR based Environmental Sustainability Index as it is more solutions based, while both attempts to achieve single Sustainability Index. The model has relation to other conceptual models, such as one presented by Robertson and Swinton (2005), which emphasized ecosystems and their services.

Conclusions

The interests of agriculture and environment have often been at odds with each other. Is this changing? Conservation of soil resources and other measures to improve the environment have become central in the daily operations of land users throughout Europe. Hopefully, this signifies the long-awaited marriage of agricultural and environmental interests, bearing many fruitful opportunities for diverse lifestyles in the rural areas of Europe.

References

Arnalds, O. (2000). Desertification: an appeal for a broader perspective. In Arnalds, O. and Archer, S. (eds), Rangeland Desertification. Kluwer Academic Press, Dordrecht, the Netherlands. 5-15.

Arnalds, O. and Barkarsson, B. (2003). Soil erosion and land use policy in Iceland in relation to sheep grazing and government subsidies. Environmental Science and Policy 6,105-113.

Arnalds, O. Thorsson, J. and Thorarinsdottir, E.F. (2003). Land use and eco-friendly sheep procuction (Landnýting og vistvæn framleiðsla sauðfjárafurða). In Icelandic. Rala Report no 211, Agricultural Research Institute (Agricutlural Univeristy of Iceland), Reykjavik, Iceland.

Boardman, J., Poesen, J. and Evans, R. (2003). Socio-economic factors in soil erosion and conservation. Environmental Science & Policy 6,1-6.

Doran, J.W. and Jones, A.J. (1996). Methods for Assessing Soil Quality. SSSA Special Publication No 49, Soil Science Society of America, Madison, Wisconsin, USA.

Forse, B. (1989). The myth of the marching desert. New Scientist, February 4, 1989, 31-32.

Geeson, N.A., Brandt, C.J., and Thornes, J.B. (2002). Mediterranean Desertification. A Mosaic of Processes and Responses. Wiley, Chichester, England.

Gisladottir, G. and M. Stocking (2005). Land degradation control and its global environmental benefits. Land Degradation & Development 16, 99-112.

Huber, S. Syed, B., Freudenschuz, Ernsten, V, Loveland, P. (2001). Proposal for a European Soil Monitoring and Assessment Framework. European Environment Agency, Copenhagen, Denmark.

Hurni. H. and Meyer, K (Eds, 2002). A World Soils Agenda. Discussing International Actions for the Sustainable Use of Soils. Prepared with the support of an international group of specialists of the IASUS Working Group of the International Union of Soil Science (IUSS). Centre for Development and Environment, Berne, Switzerland.

Robertsson, G.P. and Swinton, S.M. (2005). Reconciling agricultural productivity and environmental integrity: a grand challenge for agriculture. Frontiers Ecol Environ 3:38-46.

Thorns, J.B. (2001). The evolving context of Mediterranean desertification. In (Geeson, N.A., Brandt, C.J. and Thorns, J.B, eds) Mediterranean Desertification. A mosaic of Processes and Responses. Wiley. Chichester, England, pp. 5-11.

Wynen, E. (2002). A UN Convention on soil health or what are the alternatives. Commissioned Report for the Danish Association for Organic Agriculture (LÖJ), Denmark.

Towards prevention and management of contaminated land

Joop Vegter

COMMON FORUM Network, Email: Joopvegter@mac.com

Introduction

The Millennium Ecosystem assessment (2005) stated that over the past 50 years, humans have changed ecosystems more rapidly and extensively than in any comparable period of time in human history. The services these ecosystems provide are likely to decline with direct and indirect effects on human health and welfare. Soil does play a central role in ecosystem services, soil formation is mentioned as a most important support function for many them.

Many threats to soil have been identified. In the EU Soil communication (2002) eight threats were considered important enough to undertake action: Erosion, Organic matter decline, Soil biodiversity loss, Contamination, Soil sealing, Soil compaction, Salinization and Floods and landslides. The soil communication was followed by a well-organized discussion with experts from the memberstates and stakeholder organisations. The reports of this discussion are now elaborated and will result in a new EU soil communication, a soil framework directive and an extended impact assessment of various policy options. Soil is now high on the political agenda of the EU and ought to be so in the rest of the world according to the Millennium ecosystem assessment. However compared to other areas of environmental policy soil protection policy has been developed only recently, much later in most countries than policies for water and air.

Concerning soil contamination, one of the major threats especially in industrialised countries, some concerns about the soil environment were already expressed in earlier centuries. In the Netherlands a book about human health published in 1869 by L. Ali Cohen, gives the following comment on the bad soil quality in urbanized areas: "The soil may be a safe resting place for the dead but becomes a dangerous dwelling for the living"! But most of the time, before 1970, the soil was generally considered as an environment with an almost infinite self-purifying capacity. One of the reasons for this misunderstanding is that effects of poor air and water quality are clearly visible, whereas effects of soil contamination only show up after a thorough investigation of soil and groundwater. Political attention to soil contamination problems had to await the major incidents of the 80's of the previous century, like Love Canal, New York State; Times Beach, Missouri; and Lekkerkerk, the Netherlands.

The status of soil and soil contamination

Contamination refers to the present or past introduction (either direct through leakages, spills and applications of contaminated products or indirect through atmospheric deposition or contaminated surface waters) of chemical substances in the soil system by human activities that may lead to adverse effects on soil uses and functions and/or adverse effects in other parts of the environment. Older publications used to make distinctions between contamination (concentration above background value) and pollution (concentration above background value with adverse effects on soil uses and functions or on other parts of the environment). Contamination and pollution are nowadays used more or less as synonyms.

The invisibility of soil contamination, the heterogeneity of soils, and the fact that land is often privately owned makes it very difficult to make systematic quantitative assessments of the status of contamination in soils in Europe or

worldwide. Real spatially representative information is lacking. Even in countries were a contaminated site remediation program is in place, only rough estimates exist about the number of sites that may need remediation. In view of the differences in national approaches even this number cannot be compared internationally.

The Working group contamination (Vegter et al., 2004), one of the technical working groups established under the EU Thematic strategy for soil protection, considered that a qualitative description of the status of soil contamination is possible, which is good enough to serve as a starting point for policy making. The working group considered the following broad categories of land uses:

1. Agricultural areas including areas with intensive forestry
2. Natural areas including recreational areas and areas with extensive forestry
3. Urban areas and infrastructures
4. Soils under surface waters or sediments.

The overall soil conditions with respect to contamination for each of these land use categories are described below.

1] Agricultural areas

Soils in agricultural areas are under pressure from atmospheric deposition (acidifying substances, persistent organic pollutants, heavy metals), direct input of pesticides, manure and other biowaste. These pressures may lead to the slow accumulation of heavy metals and persistent organic pollutants in topsoil and to accumulation of phosphates in areas with intensive animal farming.

The use of land for agriculture is only endangered in some problem areas because of safety of food crops. In general, agricultural soil is still fit for its use and for future land use changes for what concerns contamination, although a transition from eutrophic farmland to oligotrophic nature may take some time. It should be realised that also a natural succession towards mature terrestrial ecosystems will take its time.

2] Natural areas

Soils in natural areas share the same pressures from atmospheric deposition as agricultural soils. An additional concern in these areas is related to nitrogen deposition, which may lead to eutrophication and acidification. Soils in natural areas may slowly accumulate persistent organic pollutants and heavy metals but these soils are in general still in a reasonably good shape. Hence the quality of soil would not be a barrier for a change in land use.

3] Urban areas and infrastructures

Urban soils and soils close to infrastructures are generally polluted. The most important contaminants are polyaromatic hydrocarbons (PAH), lead, copper and zinc from powerlines and masts, cadmium from transport, herbicides in the vicinity of roads and railways, asbestos from demolished buildings and mineral oil. These soils are often unfit for sensitive uses like playgrounds and vegetable gardens as observed in many urban areas in countries with a longer tradition in contaminated sites inventories. Contaminated soil may lead to contaminated indoor dust and thus to an increased human exposure. Apart from heavily contaminated sites, the impacts on human health are generally low if the soil is not used for vegetable gardens or as playground for children.

4] Sediments

Sediments are the major sinks for water pollution. They still reflect the former large-scale pollution of surface waters (metals, mineral oil, PAH, polychlorinated biphenyls or PCBs, old pesticides). The quality of the surface water has much improved due to more stringent emission controls, but now the

sediments have become a threat for their ecological impacts in the cleaner waters. In many cases, sediments are generally unfit for use on land in agricultural and natural areas. Because river- and harbour- management often requires dredging, the polluted sediments are a big burden for society. In addition polluted sediments have impacts on terrestrial soils after flooding.

The general picture that emerges from the characterisations above is that soils in agricultural and natural areas are still in an acceptable state with respect to contamination but are under pressure. Taking into account average land use distributions in EU (fig 1), it may be generally concluded that approximately 70% of EU soils are still in reasonable shape, with the exclusion of problems occurring in localised areas. However if pressures continue at the current level, as it is already evident in some problem areas, impacts will start to occur on a larger scale. Because the negative effects on the quality of soils are hard to remediate, these pressures should be addressed in time. On the other hand many urban soils and sediments are already heavily affected. Prevention should stop further deterioration and the risks of the currently contaminated land should be adequately managed.

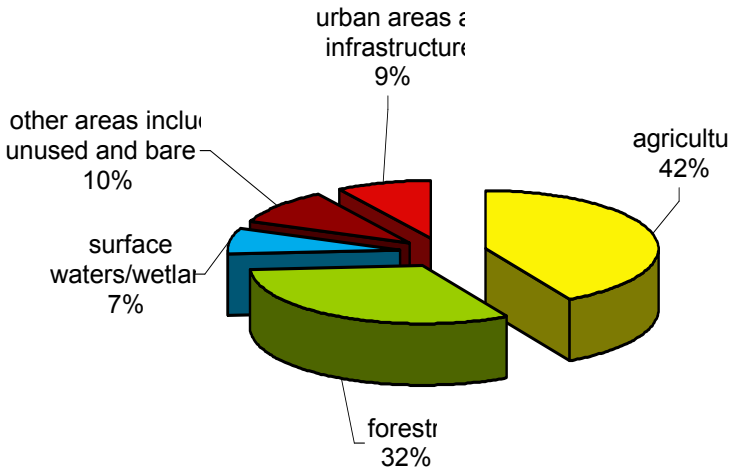


Figure 1. Use of land in the EU 15. Data elaborated from Eurostat, LUCAS survey 2003

Prevention of contamination and management of contaminated land

Although detailed information of the state of soils with respect to contamination is lacking there is enough sound scientific information about the socio-economic drivers, the pressures on landuse by human activities and the impacts of a bad soil status to justify the development of a soil protection policy. The EU soil thematic strategy is based on a state of the art assessment of the full DPSIR (Drivers, Pressures, State, Impact and Responses) causal chain. A few distinctive features that set soil apart from other areas of environmental policy are relevant for development of soil protection:

- Soil is a non-renewable resource with potentially rapid degradation rates and extremely slow formation and regeneration processes. Therefore, prevention and precaution should be at the core of soil protection policies.
- Since pollutants can exceed irreversibility thresholds unnoticed and become 'chemical time bombs' (Salomons and Stigliani 1995), it is

essential to have anticipatory policies based on monitoring and early warning systems to protect the environment and human health.

- Since soil is generally submitted to property rights, soil protection policy may make use of the environmental liability of landowners.
- Maintaining soils in good condition is an essential precondition for the long-term sustainability of our society.
- The complexity of local contamination is such that avoidance has to be 'key aim for the future'.
- Soil protection policies should have a strong in-built local element because of the geographically diverse nature of soils.

In view of the consideration mentioned above the working group proposed four specific policy strategies concerning respectively:

- Local sources of contamination,
- Agricultural soil uses,
- Management of contaminated land
- Large-scale diffuse pollution.

The strategies are related to the way the land is used and identify the owner/user of the land as the primarily responsible party for soil protection. The strategies can be linked to the DPSIR scheme (fig 2)

Contamination from local sources corresponds to activities where it is not necessary to put (contaminating) substances into the soil. Oil tanks do not necessarily leak, properly designed waste dumps do not need to have substantial emissions to groundwater and leaching in construction materials can be reduced without affecting their functionality. Soil is only used for support or to provide space for these activities. On the other hand activities like agriculture do address the soil as an ecosystem. Agriculture takes space but in addition modifies the ecological cycles of energy and matter to adjust them to agricultural use. Sustainable agriculture is not possible without some input of fertilisers. However, to keep the soil in good shape we must avoid accumulation and balance the inputs to the soil system with its normal outputs without adversely affecting other parts of the environment.

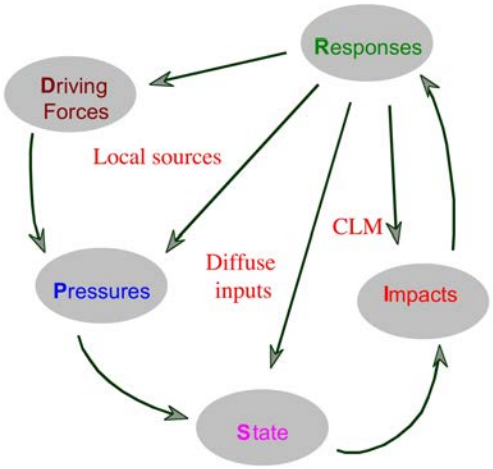


Fig 2. Soil policiy strategies (Responses) for contamination. Policies for local sources aim at avoiding pressures. For Diffuse inputs like agriculture the state of soil should be kept in balance. Contaminated land management. (CLM) aims at restoring or reducing impacts.

For contaminated land the owner of the land should be made responsible for managing and improving the situation, in the case that the polluter cannot be

legally addressed. In many contaminated land situations resulting from past industrial activities it may be impossible to apply the "polluters pay principle". Management and remediation of contaminated land can be based on risk-assessment and risk-management approaches described in the reports of the CARACAS (Ferguson et al 1998) and CLARINET (Vegter et al 2002) concerted actions.

A preventive policy approach for the still ongoing large scale diffuse pollution by atmospheric deposition and, in the case of sediments, water pollution, requires large scale integration of soil protection, air and water policies and land use policies. The Water framework directive (2000) provides opportunities for management of water quality and quantity at the river basin scale and may become an important vehicle for soil and sediment protection and further integration of environmental management. The abatement of large-scale diffuse contamination problems will for long be the task of public authorities and EU wide coordination is necessary due to the transboundary nature of the environmental problem and its economic repercussions. There is a need for more a proactive planning for the future uses of soil and water resources. Sound management of soil and water resources calls for harmonisation of spatial planning with the environment, so that land uses can be optimised with respect to soil quality and hydrological situation.

The four strategies are framed in terms of owner responsibilities and management of soil resources, recognizing of course that large-scale contamination from diffuse sources is beyond the control of the individual owner of the land. These must be brought under control at larger special scale by regional of national resource management policies. This policy model, which starts by addressing the responsibilities of the owner of the land could also be applied to other threats like erosion and organic matter decline, but for other threats like sealing and the loss of unique landscapes and geological structures (geodiversity) soil protection really needs stronger links with spatial planning and decision making by regional, national authorities or even the EU level.

Current developments in EU soil policy and related research

Around a year ago, the discussion in the technical working groups ended in Brussels with the meeting of the so-called Advisory Forum, with representatives from EU member states and European stakeholder organisations. The commission started to study the many recommendations of the working groups (van Camp et al 2004) and started to plan the next steps.

Meanwhile the former working group research teamed up with two EU funded research activities SCAPE (Soil Conservation and Protection for Europe) and JOINT (Joint Technical Approach for Decontamination of Soil and Groundwater) and organized a workshop in Vienna to focus the many research recommendations of the Working group research. The workshop produced a concise research agenda for all soil threats and justified the research needs in terms of sustainable management of soil and water resources and the competitiveness of the European economy. A booklet with the results of the Vienna workshop, "Scientific Basis for the Management of European Soil Resources - Research Agenda" (2004) was presented at the 'Vital Soil' conference, a policy conference organized by the Dutch EU presidency and the Commission in The Hague (NL), November 2004.

After this conference a few presentations in international meetings by policy staff members of the Commissions DG Environment provided indications about their plans. A new policy package will be proposed in 2005 which consists of:

- A Framework Directive for the protection of soil (SFD).

- A Communication laying down the way forward and addressing issues not tackled in the SFD
- An Extended Impact assessment (economic and environmental) based on the recommendations of the working groups

The directive will be about common principles and definitions and will be much less detailed compared to the Water Framework Directive. There are some interesting aspects in the plans of the commission concerning "contamination". Apart from a further specification of common principles and definitions for soil protection, a common definition of contamination (and as a logical consequence contaminated land) is likely to be proposed. Another interesting aspect is that the commission intends to define a "working unit" for EU soil policy. For regional soil threats like erosion, decline of organic matter, compaction, flood and landslides, the focal point of EU policy will be on so called "risk areas", which have to be identified by EU member states based on common criteria. For other threats like sealing (closely related to national and subnational spatial planning) and contamination (many national policies and contaminated land programs already in place), the working unit will be more on the national/ regional level. There is a need for more subsidiarity here, due to the stronger links of these policies with the national and regional public administrations. The overall strategy (framework directive and communication) is to be characterised as "light", which may be interpreted as finding common ground for cooperation between member states before resorting to hard "command and control"(Holling and Meffe, 1996) regulations at the EU level. The commission is currently consulting citizens and experts about the strategy and soil framework directive through internet (http://www.europa.eu.int/comm/environment/soil/index.htm).

The scientific discussion goes on as well. The EU funded project JOINT has published an analysis of the medium and long-term research needs for contaminated land management and related groundwater contamination (Risk based management of contamination and protection of the soil system in urban environments, 2005). In their view the knowledge about urban soil systems lacks behind, because most of our knowledge about soil systems stems from studies of relatively undisturbed agricultural and natural soils. This is traditionally seen as a threat: urbanisation is blocking water- and geochemical cycles. However, the soil system in urban environments can have positive functions, and it is important to understand these. The more so because the urban environment will expand very fast in the next 20 years as several EU development scenarios have shown, and some contamination associated with the urban environment is likely to persist, even if most of the severely contaminated sites will have been remediated.

Conclusions

Although there is no complete inventory of the status of soils with respects to contamination, the combined information about drivers, pressures, state and impact of soil contamination is at present good enough to formulate adequate responses. These responses start with addressing the responsabilities of the owner and users of the land for the protection of soil. However large-scale problems are beyond the control of individual landowners. Environmental policies should evolve towards system-oriented management approaches, integrating soil and water protection with air pollution control and spatial planning. Integrated management of soil and water is also important in environmental problems that are not caused by polluting substances. Overexploitation of the watercycle leads to soil problems like desertification and salinization.

It is also clear that the classical generic tools in environmental policies for contaminating substances like state-of–the-art emission reduction techniques and the setting of (eco) toxicological quality standards fall short in view of the larger

scale soil problems. For soil protection we need to put the uses and functions of the soil-(ground)water-sediment system upfront and not the individual contaminating substances.

In 1972 the Council of Europe already stressed the importance of spatial harmonization of landuses and functions, and the recent Millennium Ecosystem assessment found that a spatially diverse "Adapting Mosaic" scenario is best for improvement of ecosystem services. In this scenario, regional watershed-scale ecosystems are the focus of political and economic activity. Local institutions are strengthened and local ecosystem management strategies are common; societies develop a strongly proactive approach to the management of ecosystems. Policies for soil and water should move in that direction

References

Cohen, Levy Ali (1869). Handboek der openbare gezondheidsregeling en der geneeskundige politie met het oog op de behoeften en de wetgeving van Nederland Groningen : Wolters, 1869-1872. - 2 dl.

Council of Europe, 1972, European Soil Charter, Ref:B(72) 63, Strasbourg 1972.

EUROSTAT, 2003. 2003 results of the LUCAS survey and comparison with 2001 results. Eurostat document ASA/LAND/75, prepared for meeting of the Working group "Land use statistics" of the Agricultural Statistics Committee. December 2003.

Ferguson, C. C.; Darmendrail, D.; Freier, K.; Jensen, B. K.; Jensen, J.; Kasamas, H.; Urzelai, A. & Vegter, J. (1998), Risk Assessment for Contaminated Sites in Europe. Volume 1. Scientific Basis. CARACAS Final Publication. LQM Press, Nottingham, ISBN 0953309002.

Holling, C.S. and Meffe, G.K. (1996). Command and control and the pathology of natural resource management. Conservation Biology 10, 328-337.

Millennium Ecosystem Assessment, 2005. Ecosystems and Human Well-being: Synthesis. Island Press, Washington, DC.

Risk based management of contamination and protection of the soil system in urban environments, (2005). UW Umweltswirschaft GmbH Stuttgart ISBN 3-937750-01-0.

Salomons, W. and B. Stigliani, eds (1995), "Biogeodynamics of Pollutants in Soils and Sediments," Springer Publ. Co,

Scientific Basis for the Management of European Soil Resources - Research Agenda" (2004). Guthmann-Peterson Büchermacher und Verleger Wien. ISBN 3-900782-47-4.

Soil Communication EC(COM(2002) 179 final.

VAN-CAMP. L., BUJARRABAL, B., GENTILE, A-R., JONES, R.J.A., MONTANARELLA, L., OLAZABAL, C. AND SELVARADJOU, S-K. (2004). Reports of the Technical Working Groups Established under the Thematic Strategy for Soil Protection. EUR 21319 EN/4, 872 pp. Office for Official Publications of the European Communities, Luxembourg.

Vegter J. J., Lowe J., Kasamas H. (2002) Sustainable Management of Contaminated Land: An Overview. Austrian Federal Environment Agency,on behalf of CLARINET

Vegter, J.J., Huber, S., and Gentile, A.R. (2004). Report of the technical working group on soil contamination, EU soil strategy. CIRCA website EU soil policy library: http://forum.europa.eu.int/Public/irc/env/soil/library

Water Framework Directive. Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy.

Appendix 1 – Participant list

Abed, Sheila (Executive Director of the Paraguayan Environmental Law and Economics Institute (IDEA)/IUCN- Chair Environmental Law, PY)	Sheila.abed@idea.org.py
Arnalds, Andres (Soil Conservation Service of Iceland, IS)	andres.arnalds@land.is
Arnalds, Olafur (Agricultural University of Iceland, IS)	oa@libhi.is
Benjamin, Antonio Herman (Lawyers for a Green Planet Brazil, BR)	Planet-ben@uol.com.br
Benson, John (Botanic Gardens Trust Sydney, AU)	John.benson@rbgsyd.nsw.gov.au
Benyamini, Yoram (Ministry of Agriculture, IL)	benyay@mail.biu.ac.il
Berveling, Steven (Barrister, Sydney, AU)	berveling@mpchambers.net.au
Beste, Andrea (Institute for soil conservation and sustainable agriculture, Mainz, DE)	320029388147-0001@T-Online.de
Blüm, Winfried (President of ECSSS / University of Natural Resources and Applied Life Sciences (BOKU), AT)	herma.exner@boku.ac.at
Boer, Ben (University of Sydney, AU)	benboer@law.usyd.edu.au
Boix-Fayos, Carolina (CEBAS – CSIC Murcia, ES)	rn002@cebas.csic.es
Bork, Hans-Rudolf (University of Kiel, DE)	hrbork@ecolody.uni-kiel.de
Bouma, Nienke (Soil and water consultancy/ IBED-Physical Geography, University of Amsterdam, NL)	n.a.bouma@wanadoo.nl
Bouwmeester, Hein (Meander Advies & Onderzoek, NL	hb@solum.nl
Brandt, Jane (Desertlinks, UK)	jane@medalus.demon.co.uk
Briassoulis, Helen (University of Aegean, GR)	e.briassouli@aegean.gr
Crofts, Roger (Independent Environmental and Management Advisor, Edinburgh, UK)	roger@dodin.idps.co.uk
Curfs, Michiel (SCAPE, ES)	michielcurfs@gmail.com
De Vente, Joris (KU Leuven, BE)	Joris.deVente@geo.kuleuven.ac.be

Ditzler, Craig (United States Department of Agriculture, Natural Resources Conservation Service, USA)	Craig.ditzler@lin.usda.gov
Du, Qun (Member, IUCN Commission on Environmental Law Law / School of Wuhan University, CN)	qdu@whu.edu.cn
Fullen, Mike (University of Wolverhampton, UK)	m.fullen@wlv.ac.uk
Futrell, William (President, Sustainable Development Law Associates, USA)	Sdla2003@aol.com
Geeson, Nichola (Desertlinks, UK)	tnchgeeson@btinternet.com
Golden, Michael (Director of the Soil Survey Division, USDA, NRCS, USA)	Michael.golden@wdc.usda.gov
Grinlinton, David (University of Auckland, NZ)	d.grinlinton@auckland.ac.nz
Hannam, Ian (Asian Development Bank, AU)	ihannam@adb.org
Heuser, Irene (Landesvertretung Brandenburg, Berlin, DE)	Irene.heuser@lv-bb.brandenburg.de
Imeson, Anton (SCAPE Project Coordinator / University of Amsterdam, NL)	aimeson@science.uva.nl
Jungerius, Pim (Stichting Geomorfologie en Landschap, NL)	Juan.GenL@inter.nl.net
Kajetan Hetzer (SNS Bank, NL)	kajetan.hetzer@sns.nl
Kertész, Ádám (Geographical Research Institute Hungarian Academy of Sciences, HU)	kertesza@helka.iif.hu
Klaus Kuhn (University of Exeter, UK)	N.Kuhn@exeter.ac.uk
Lahmar, Rabah, (CIRAD, FR)	lahmar@cirad.fr
Maier, Bernhard (Stand Montafon- Forestry Service, AT)	bernhard.maier@stand-montafon.at
Margina, Carmen Alina (Associate Programme Officer, Facilitation Unit for Europe, UNCCD Secretariat, GE)	cmargina@unccd.int
Montanarella, Luca (Joint Research Centre, EC, IT)	luca.montanarella@jrc.it
Mortensen, Lis (Faroese Geological Survey, FO)	lis.mortensen@jfs.fo

Nortcliff, Stephen (Secretary General, International Union of Soil Sciences, University of Reading, UK)	S.Nortcliff@reading.ac.uk
Quaranta, Giovanni (University of Basilicata, IT)	quaranta@unibas.it
Roxo, Maria (University of Lisbon, PT)	mj.roxo@iol.pt
Rubio, Jose Luis (ESSC President, CIDE, Valencia, ES)	Jose.L.Rubio@uv.es
Runolfsson, Sveinn (Soil Conservation Service of Iceland, IS)	sveinn@land.is
Sabir, Mohamed (President ISCO 2006 / National School of Forest Engineers Salé, MA)	sabirenfi@wanadoo.net.ma
Sahota, Parminder Singh (Cranfield University, UK)	p.s.sahota@cranfield.ac.uk
Salvia, Rosanna (University of Basilicata, IT)	sr06agr@unibas.it
Sherif, Adel Omar (Member IUCN Sustainable Soils Working Group, EG)	sccourt@idsc.net.eg
Stocking, Michael (University of East Anglia, Norwich, UK)	m.stocking@uea.ac.uk
Van Asselen, Sanneke (University of Amsterdam, NL)	sasselen@science.uva.nl
Van den Ancker, Hanneke (Stichitng Geomorfologie en Landschap, NL)	Juan.GenL@inter.nl.net
Van Lynden, Godert (ISRIC World Soil Information, NL)	Godert.vanlynden@wur.nl
Vanheusden, Bernard (Hasselt University / University of Leuven, BE)	Bernard.vanheusden@luc.ac.be
Vegter, Joop (Technical Soil Protection Committee, NL)	joopvegter@mac.com
Waite, Andrew (Partner, Planning and Environment Department, Co-ordinator of the Environment Group Berwin Leighton Paisner, Solicitors, USA)	andrew.waite@blplaw.com
Wilcox Bradford (Texas A&M University Rangeland Ecology & Management Department, USA)	bwilcox@tamu.edu
Yeroyanni, Maria (EC DG Research, EU)	marie.yeroyanni@cec.eu.int
Zanolla, Sara (IT)	sara.zanolla@regione.fvg.it

Appendix - Programme

Day 1 – (14 September 2005)

8.30	Registration	
9.00	Welcome	Gudni Agustsson
9.10	Opening	Anton Imeson
I Introductory session: overview presentations		**Chair: Gudmundur B. Helgason**
9.30	State of the European soils	Luca Montanarella
9.50	Development and degradation of the soils of the world since the rise of agriculture	Hans-Rudolf Bork
10.10	*Coffee Break*	
10.40	Soil conservation: connecting the pieces	Roger Crofts
11.00	Sustainable land management: a global challenge with local solutions	Michael Stocking
11.20	The role of the World Conservation Union in the development of Soil Law and Policy	Sheila Abed
11.40	Questions and Discussion	
12.00	*Lunch*	
		Chair: Magnus Johannesson
13.00	National and International measures to protect soil	Ian Hannam and Ben Boer
13.30	Assessment and Monitoring of United States Soil Resources	Craig Ditzler and Michael Golden
13.50	Questions and Discussion	
14.10	Introduction Working Groups	
Iceland session		
14.20	Land degradation and desertification in Iceland	Olafur Arnalds
14.40	A century of soil conservation in Iceland	Sveinn Runolfssonn
15.00	Questions and Discussion	
15.15	Depart for visit to SCS headquarters at Gunnarsholt	
19.00	*Dinner at Gunnarsholt*	

Day 2 – (15 September 2005)

II Integrating soil into other issues		**Chair: Sveinn Runolfsson**
8.30	Globalisation, sustainability and resilience from the soil's point of view	Pim Jungerius
8.50	Geodiversity and Geoheritage within the framework of the Soil Strategy	Hanneke van den Ancker
9.10	Are sustainable soil management and increased food production mutually exclusive?	Stephen Nortcliff
9.30	The answer lies in the soil	Anton Imeson
9.40	Questions and Discussion	

10.10	*Coffee Break*	
III Law, legal management and solutions		**Chair: Ben Boer**
10.30	Contaminated land legislation and liability, and the impact of waste management legislation	Andrew Waite
10.50	Six Priority Forestry Programs and Legal Issues on Conservative Forestry Development in the PRC	Qun Du
11.10	Laws to promote sustainable soils in the United States	William Futrell
11.30	Soil and biodiversity protection in Brazilian Law	Antonio Benjamin
11.50	Questions and Discussion	
12.20	*Lunch*	
13.20	Legal methods and strategies to promote the sustainable use of soil: 'Integrated Environmental Management' in New Zealand	David Grinlinton
13.40	The Development of EU Soil Protection Law	Irene Heuser
14.00	Law and policy for soil protection in Egypt	Adel Omar Sherif
14.20	Legal issues regarding the sustainable management of contaminated soils with examples from Australia	Steven Berveling
14.40	Questions and Discussion	
15.10	*Coffee Break*	
15.30	Parallel Working Group sessions	
19.00	*Dinner Hotel Selfoss*	

DAY 3 (16 September 2005)

8.30	Depart for field excursion (see separate programme)	
19.00	*Dinner*	

DAY 4 (17 September 2005)

IV Research and case studies		**Chair: Arnold Arnoldussen**
8.30	Vegetation classification and assessment to improve the management of soil resources, New South Wales Australia	John Benson
8.50	Documentation and evaluation of case studies of soil and water protection using conservation tillage in Europe	Godert van Lynden
9.10	Traditional strategies for soil and water conservation in the Maghreb Mediterranean mountains	Mohamed Sabir
9.30	Results of SCAPE's Case Studies	Anton Imeson
9.50	Questions and Discussion	
10.30	*Coffee Break*	

10.50	Future research needs for the sustainable management of soil resources	Winfried Blüm
11.10	SCAPE's vision on research needs	Anton Imeson
11.30	Questions and Discussion	
12.00	*Lunch*	
V Strategies and policies		**Chair: Luca Montanarella**
13.00	European framework for sustainability: Quality indicators for soil as a multifunctional medium	Jose Luis Rubio
13.20	Socio economic drivers for degradation and soil protection	Helen Briassoulis
13.40	Barriers and incentives to landcare - experiences from Iceland	Andres Arnalds
14.00	Which Strategy and Policy is needed to establish a more Sustainable Land Management – a SCAPE vision	Arnold Arnoldussen
14.20	Questions and Discussion	
14.50	*Coffee Break*	
15.10	Combating desertification in Europe: NAP's and new Rural Development Programme	Giovanni Quaranta
15.30	Brownfield redevelopment	Bernard Vanheusden
15.50	Knowledge and Policy Making; Premises, Paradigms, and a Sustainability Index Model	Olafur Arnalds
16.10	Towards prevention and management of contaminated land	Joop Vegter
16.30	Questions and Discussion	
17.00	Parallel Working Group Sessions	
19.00	*Dinner*	

DAY 5 (17 September 2005)

Concluding Plenary

8.30	Report WG 1: Soil Protection in Europe, problems and policy
8.50	Report WG 2: Desertification; the road forward
9.10	Report WG 3: International environment law instrument for sustainable use of soil
9.30	Report WG 4: Iceland Statements on Soil Conservation
10.00	*Coffee Break*
10.30	Integration of WG outcomes
11.00	Formulation of one Concordat from information from all Working Groups
11.30	Closure and depart