a world soils agenda

Discussing International Actions for the Sustainable Use of Soils

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Contents

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Preparation of this publication was possible thanks to the dedicated help of several colleagues working at the Centre for Development and Environment (CDE): Andrea Wirth Stucki, Marlène Thibault, Anne Zimmermann, Hanspeter Liniger, Gudrun Schwilch and Ursula Gaemperli Krauer.

Berne, August 2002
Hans Hurni and Konrad Meyer

Preface

At the 16th World Congress of Soil Sciences (WCSS) in Montpellier in August 1998, the International Union of Soil Sciences (IUSS) decided to establish a working group whose task would be to examine emerging initiatives for a 'soil convention' at the global level. During a special session in Montpellier, a debate took place whether there was a need for such a special convention, or alternatively, whether the soil issue should be included more explicitly in existing treaties and conventions of the UN system. Clearly, the need for a global soils agenda was confirmed by all participants, as there is a general lack of recognition of soil-related matters among the general public and administrations.

Documents and agreements with particular reference to soils exist at the international level, e.g. the European Soil Charter (Council of Europe, 1972), the World Soil Charter (FAO, 1982) and the World Soils Policy (UNEP, 1982). Unfortunately, their non-binding nature deprives these documents of their relevance for effective action. In other agreements soils are mentioned marginally, as in the Stockholm Declaration on the Human Environment (UN, 1972), the World Conservation Strategy (IUCN, 1980) and the Rio Declaration and Agenda 21 (UN, 1992). The UN Convention to Combat Desertification (UNCCD, 1992) is the only multinational environmental agreement that partially includes elements of soil protection; however, its relevance is restricted to semi-arid areas.

At the 11th International Soil Conservation Organisation Conference held in Buenos Aires in October 2000, the working group 'Soil Convention' felt that its name focused too narrowly on the idea of a UN convention, disregarding other potentials at the global level in support of sustainable use of soils. The working group was thus renamed 'International Actions for the Sustainable Use of Soils (IASUS)'.

Symposium 61 at the 17th WCSS in Bangkok was a special opportunity for pro-active IASUS action-taking: specialists were invited to write papers relating to the theme, and an e-mail discussion forum took place from December 2001 to July 2002 in preparation of a world soils agenda. The present publication presents the state of the art of the current discussion and specialists' opinions in this field. It adds to the work of other groups such as the 'Tutzing Initiative for a Soil Convention' and a specialist working group of the Commission on Environmental Law of the World Conservation Union (IUCN).

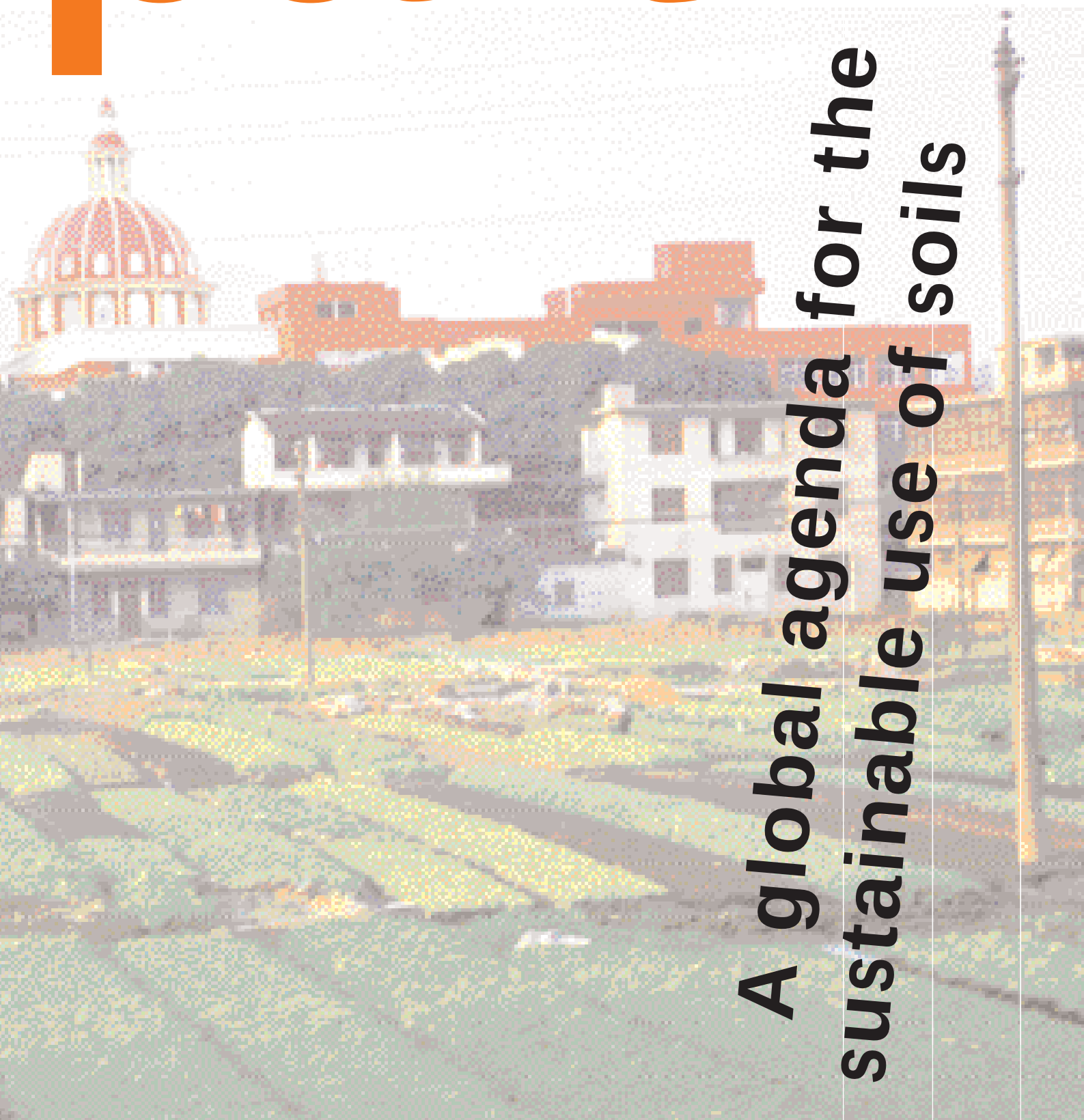
The IUSS and the scientific community associated with it have a special role in furthering sustainable use of soils at the global level. International agreements and treaties are a possible tool towards achieving this goal. The proposed Intergovernmental Panel on Land and Soil, also discussed here, would be an opportunity to provide science-based assessments and outline possible ways of mitigating the global threat of land and soil degradation.

Vienna, August 2002
Winfried E.H. Blum
Secretary General, IUSS

Based on a discussion forum summarised in Part II and the individual papers in Part III, nine agenda items are presented in the following pages as elements of a proposed world soils agenda. Tasks have been targeted to address institutions in the three major fields of science, policy making and implementation. International institutions, associations, working groups and UN agencies are the source bodies that should be mandated to realise this global agenda for the sustainable use of soils.

part I

A global agenda for the sustainable use of soils



A global agenda for the sustainable use of soils

1. Tasks for science, monitoring and evaluation

Agenda 1:
Assessing the status and trends of soil degradation at a global scale

The issue:
Despite efforts to provide a global assessment of soil degradation in the late 1980s, great uncertainty about the extent, severity and impact of the multiple forms of soil degradation still prevails. Moreover, there are only assumptions – no definite knowledge – about the trends of current processes, the thresholds that may be encountered, and the effects of future soil degradation on agriculture, ecology and life in general. In particular, although the Global Assessment of Human-induced Soil Degradation (GLASOD, 1990) provided a first appraisal and world map, the soil science community strongly argues that this expert-opinion assessment needs refinement and re-visiting at a larger scale.

Requirements:
A new, more detailed assessment of soil degradation can be based on the UN 'Millennium Ecosystem Assessment', using both scientific findings and specialist opinion. Policy makers and UN agencies should work in support of this aim so that national teams of specialists can be formed, who will in turn elaborate on existing information and expand the databases with additional research.

A new assessment based on such research would have the potential to answer many of the questions raised by the different stakeholders, possibly within the timeframe of one decade. National teams would have to be guided by task forces at the regional level, who in turn would answer to a core global supervising and advising team. A sound basis on which to build such an initiative could be the SOTER methodology developed by ISRIC; research teams in international research institutions such as IWMI-IBSRAM could be mandated to provide guidance.

Agenda 2:
Defining impact indicators and tools for monitoring and evaluation

The issue:
Current soil degradation has multiple impacts on the natural resource base, on agriculture, the economy, institutions and society at large. Defining indicators that make it possible to assess all the dimensions of these impacts would require monitoring and evaluating an unmanageable number and diversity of parameters. The challenge is therefore to find a smaller number of comprehensive, i.e. multi-dimensional, multi-scale and multi-functional indicators, the monitoring of which would make it possible to give an overview of how much sustainability is reduced by a given degradation process. Current action to reduce soil degradation faces a similar problem of multi-facetted impacts, and monitoring systems for mitigation also depend on a clear identification of multi-functional indicators.

Requirements:
National and international research and observation agencies need to be mandated by national governments to develop indicators and install soil monitoring systems at the national and sub-national levels. Indicators should allow for an assessment of all the dimensions of sustainability, not just the ecologically oriented and soil-focused aspects. Particular emphasis must be given to comprehensiveness, feasibility and long-term implementation of a monitoring system, while at the same time guaranteeing that the indicators under scrutiny produce significant evidence of anticipated changes observed over a given timeframe. International associations such as the IUSS, and more broadly, the ICSU community, would have the competence to support these initiatives at the national level. Some experience has been gained in international programmes such as IHDP and IGPB, although not specifically towards the IASUS goals.

Agenda 3:
Developing principles, technologies, approaches and enabling frameworks for sustainable land management

The issue:
In many parts of the world and for many land use systems, technologies for more sustainable management of soils have been developed and are being applied by farmers and land users. However, much of this knowledge is not documented and can therefore hardly be

Theme	No.	Agenda	Target institutions	Source bodies
Science, monitoring and evaluation	1	Status and trends of soil degradation	Policy makers, UN agencies, national agencies, NGOs	ISRIC, IWMI-IBSRAM
	2	Impact indicators and tools for monitoring	National and international research and observation agencies	IUSS, ISCU, IHDP, IGBP
	3	Principles, technologies and approaches to sustainable land management	Implementing ministries and agencies, decision-support networks, research institutes	IASUS; WASWC-WOCAT; UNDP; UNCCD

Abbreviations: see p.11

shared with other potential users. Also missing is a proper analysis of the multiple benefits and potential harms of a technology, as well as a multi-stakeholder appraisal of its validity in existing contexts and applicability to other situations in other parts of the world. Equally lacking is an analysis of the frame conditions that make it possible or impossible to use a technology. In particular, many technologies are suitable only under restricted ecological and climatic conditions, in particular farming systems, and in specific social, economic and political situations. Finally, implementation and spreading of new technologies depend on the approaches chosen to make them available. Much more research is needed here in particular, based on multi-disciplinary initiatives and using interdisciplinary and transdisciplinary, i.e. participatory, methodologies.

Requirements:
At the national level, ministries and agencies in various land-related development fields and research institutes associated with them should be mandated by national governments to jointly work towards sustainable land management. In particular, research, monitoring and evaluation should be directed towards developing and testing sustainable land management technologies, as well as their ecological suitability, economic viability, social acceptability and institutional feasibility. The WOCAT programme (pp. 16–17) offers a valid compilation and multi-disciplinary appraisal of current experiences in many countries. Much more is needed in addition, not only to apply the WOCAT programme more widely, but also in terms of research on new technologies, approaches and frame conditions, of testing their impacts on social, economic and ecological processes, and vice versa. Science and technology advisory panels from UNDP, UNCCD, the IASUS Working Group and the WASWC-WOCAT network could offer their experience and guidance to regional, national and sub-national groups in order to help standardise their work and make it comparable and competitive at the global level.

2. Tasks for policy guidance

Agenda 4: Identifying an international, multi-disciplinary network for soil issues

The issue:
The International Union of Soil Sciences (IUSS) is a powerful association of national soil science societies. Soil issues, however, require multiple disciplines beyond soil science. Agronomy, forestry, geography and other disciplines focusing on land issues have developed soil-related sub-disciplines. In recent years, sustainability of natural resource management has become a field of research involving economics, law and the social sciences. An international network for soil issues would have to include specialists from all soil and soil-related disciplines. Relating to soil resources, only few countries have national soil policies, and only a fraction of those countries effectively implement, monitor and fine-tune policies. National soil policies have the potential to address all the aspects

Theme	No.	Agenda	Target institutions	Source bodies
Policy guidance	4	International, multi-disciplinary network	IPLS, UNCCD, UNFCCC, UNCBD	IUSS, ICSU, ISCO
	5	Intergovernmental panel on soils	Societies, policy makers, UN agencies, national agencies, NGOs	UNCCD, UNEP, WBGU
	6	Guidance for national soil policies	National ministries of rural and urban development	IUCN-ELC

Abbreviations: see p.11

of soil degradation problems, from basic principles to multi-functional uses of soils and integration into spatial planning, agricultural production, development of built-up areas and biodiversity conservation.

Requirements:
Awareness raising among national policy makers, independent of their respective governance systems, is necessary to alert both the administration and the general public to the need to develop an integrated national soil (protection) policy and establish institutional structures for its implementation. Both national and international multi-disciplinary specialist teams and/or specialist institutions are offering their services and expertise to national policy makers, ensuring that national policies are internationally compatible. For this purpose, it will be necessary to establish an international network using associations and organisations such as the IUSS (for soil-related matters), ICSU (for broader scientific aspects) or ISCO (for sustainable land management expertise). A network of this kind could provide international panels such as the proposed IPLS (see Agenda 5) and existing advisory panels of the international conventions with specialist inputs.

Agenda 5: Establishing an intergovernmental panel on soils

The issue:
Land-related issues are increasingly becoming a central factor in sustainable development. While other natural resources such as climate, biodiversity, drylands, forests or water have received international recognition through special treaties, soil as a resource was always considered of secondary importance, not requiring attention in its own right. This is why an Intergovernmental Panel on Land and Soil (IPLS) became a subject of discussion as of the 4th Conference of Parties (COP) to the UNCCD in December 2000.

Requirements:
Societies, policy makers, UN agencies, national agencies and NGOs should be made aware of the benefits of an IPLS. The UNCCD has a strong need for such a scientific panel, the objectives of which would be comparable to the objectives of the Intergovernmental Panel on Climate Change (IPCC), which works towards the goals of the UNFCCC. Possible objectives should be:

a) to serve as a clearing house for soil and land-related issues of the UNCCD;
b) to synthesise relevant information at the global to local levels;
c) to provide information on the impacts of soil and land degradation;
d) to provide guidance to science for land and soil-related research, and
e) to assist in policymaking at all levels in order to achieve sustainable land management.

The original idea for an IPLS stemmed from WBGU, while UNEP took up the proposal and carried it into the UNCCD negotiations. In addition, IPLS activities would equally serve other conventions and treaties, and guide national research and action in all countries.

Agenda 6: Providing guidance to develop and implement national soil policies

The issue:
National soil policies need to be developed into more integrated instruments and applied in as many countries as possible. While these tasks are typically national efforts, following the principle of subsidiarity, it can nevertheless be a great advantage to achieve international harmonisation of national policies.

Requirements:
National ministries of rural and urban development are the major target group for developing national soil policies. Special task forces must be mandated within these institutions and consist of multiple disciplines and backgrounds with experience in soil and land-related matters. It will be particularly important to include legal advice and competence as part of such task forces. At the international level, the Environmental Law Centre (ELC) of the IUCN has developed special competence in this field, hence it could serve as a competence centre to be called upon for providing consultancy to national initiatives.

3. Tasks for support of implementation

Agenda 7:
Promoting initiatives for sustainable land management

The issue:
Watershed management and soil conservation programmes have been a main activity of many governments in the second half of the 20th century. During the last decade of the century, however, these programmes were increasingly questioned because of their exclusively ecological focus, i.e. their aim to minimise land degradation and its on- and off-site impacts. Calls for direct economic profitability of the implemented technologies were made. However, direct profitability is difficult to achieve. Farmers whose land management systems needed to become more sustainable usually had to make additional investments. When incentives were not provided to such land users, the additional labour and material investments disadvantaged them in relation to other production systems. This also applied to subsistence-based farming where other, mostly off-farm activities were more profitable than applying sustainable land management technologies. In affluent societies, on the other hand, subsidy systems were increasingly abandoned and partly replaced by direct governmental payments to farms for the societal and ecological services provided in addition to agricultural products.

Requirements:
Ministries of Agriculture in industrialised countries are taking the opportunity to replace their systems of subsidies on agricultural prices with payment systems compensating for additional investments or alternative production systems, particularly where the sustainability of resource use is an issue. Development cooperation agencies could follow the same philosophy by investing into sustainable land management technologies and approaches. This would replace the incentive-based conservation projects with a more economically focused investment programme for sustainable agricultural production systems. If additional costs for labour and material incurred by land users in developing countries were financed by OECD agencies, guided by the DAC, much more could be achieved, including for subsistence-based farming systems where households can hardly modify existing strategies in favour of more risk-taking income generation activities.

Theme	No.	Agenda	Target institutions	Source bodies
Implementation support	7	Programmes to support sustainable land management	Development cooperation agencies	OECD-DAC
	8	Inclusion of soil-related issues in development	Development cooperation agencies	IUSS, WASWC, ISCO
	9	Guidance for national and local action	National ministries, soil associations	UNCCD, UNEP, NRI

Abbreviations: see p.11

Agenda 8:
Ensuring inclusion of soil-related issues in development programmes

The issue:
Rural development programmes of the OECD family often did not include mechanisms capable of considering the effect of their programmes on sustainable land management. In an integrated approach to rural development, however, respective components would have to be built into programmes, or at least, the impact of these programmes on soils would have to be observed and reported at regular intervals.

Requirements:
Development cooperation agencies are invited to evaluate the impacts of their programmes on soil and land resources, and to make adaptations if necessary. For example, water development projects should include components of watershed protection; road construction projects would have to add components to mitigate off-site impacts and make sure biodiversity is not affected by roads; education programmes should ensure that sustainable management of natural resources is a compulsory theme, and so on. International networks such as the IUSS, WASWC and ISCO are willing to make specialists and/or task forces available to assist with such institutional efforts.

Agenda 9: Providing guidance for national and local action

The issue:
Local to national programmes in rural development often do not include soil-related considerations, nor do they assess the actual or potential impacts of these activities on land-related resources (soil, water, biodiversity). These programmes sometimes also lack specific capacity and/or competence in sustainable land management, although most human-induced development activities have an impact on land and particularly on soils. Hence national to local action should be guided by specialists, using scaled activities depending on the importance of these activities.

Requirements:
Guidance for land-related policies, projects and programmes at local to national levels needs to be provided at all stages of implementation, from planning, stakeholder negotiation and field activities to ex-post monitoring and impact assessment. Task forces could provide backstopping to implementing bodies such as national ministries or NGOs in partnership with the groups and specialists in charge of national and local action. National soil societies and national research institutes (NRI) constitute a most suitable pool of specialists and institutional capacity for forming such task forces. Experience is also available at the international level, not only at the global scale, but also in relation to specific regions and countries. Competence can be found within the networks of the UNCCD, UNEP, UNDP and IUSS.

Abbreviations

ASEAN	Association of South-East Asian Nations
CDE	Centre for Development and Environment, Berne
CEL	Commission on Environmental Law of IUCN
COP	Conference of Parties
DAC	Development Assistance Committee
ELC	Environmental Law Centre
FAO	Food and Agriculture Organisation of the United Nations
GEF	Global Environment Facility
GLASOD	Global Assessment of Soil Degradation
IASUS	International Actions for the Sustainable Use of Soils
IBSRAM	International Board for Soil Research and Management (1985–2001)
ICSU	International Council of Scientific Unions
IGBP	International Geosphere-Biosphere Programme
IHDP	International Human Dimensions Programme
IPCC	Intergovernmental Panel on Climate Change
IPLS	Intergovernmental Panel on Land and Soil (proposed)
ISCO	International Soil Conservation Organisation
ISRIC	International Soil Reference and Information Centre
IUCN	World Conservation Union
IUSS	International Union of Soil Sciences
IWMI	International Water Management Institute
LADA	Dryland Assessment of Land Degradation (UNEP-GEF-FAO)
NGO	Non-Governmental Organisation
NRI	National Research Institutes
OECD	Organisation for Economic Cooperation and Development
SOTER	Soil and Terrain Database
UN	United Nations
UNCBD	UN Convention on Biological Diversity
UNCCD	UN Convention to Combat Desertification
UNDP	UN Development Programme
UNEP	UN Environment Programme
UNFCCC	UN Framework Convention on Climate Change
WASWC	World Association of Soil and Water Conservation
WBGU	German Advisory Council on Global Change
WOCAT	World Overview of Conservation Approaches and Technologies

Sources of Part II

Part II is based on individual responses by specialists of the IUSS Working Group IASUS, submitted in an e-mail discussion forum between December 2001 and July 2002:

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Further information on the contributors is provided in the Annex.

Introduction to the specialist appraisal of issues relating to 'International Actions for the Sustainable Use of Soils' (IASUS) presented in Part II

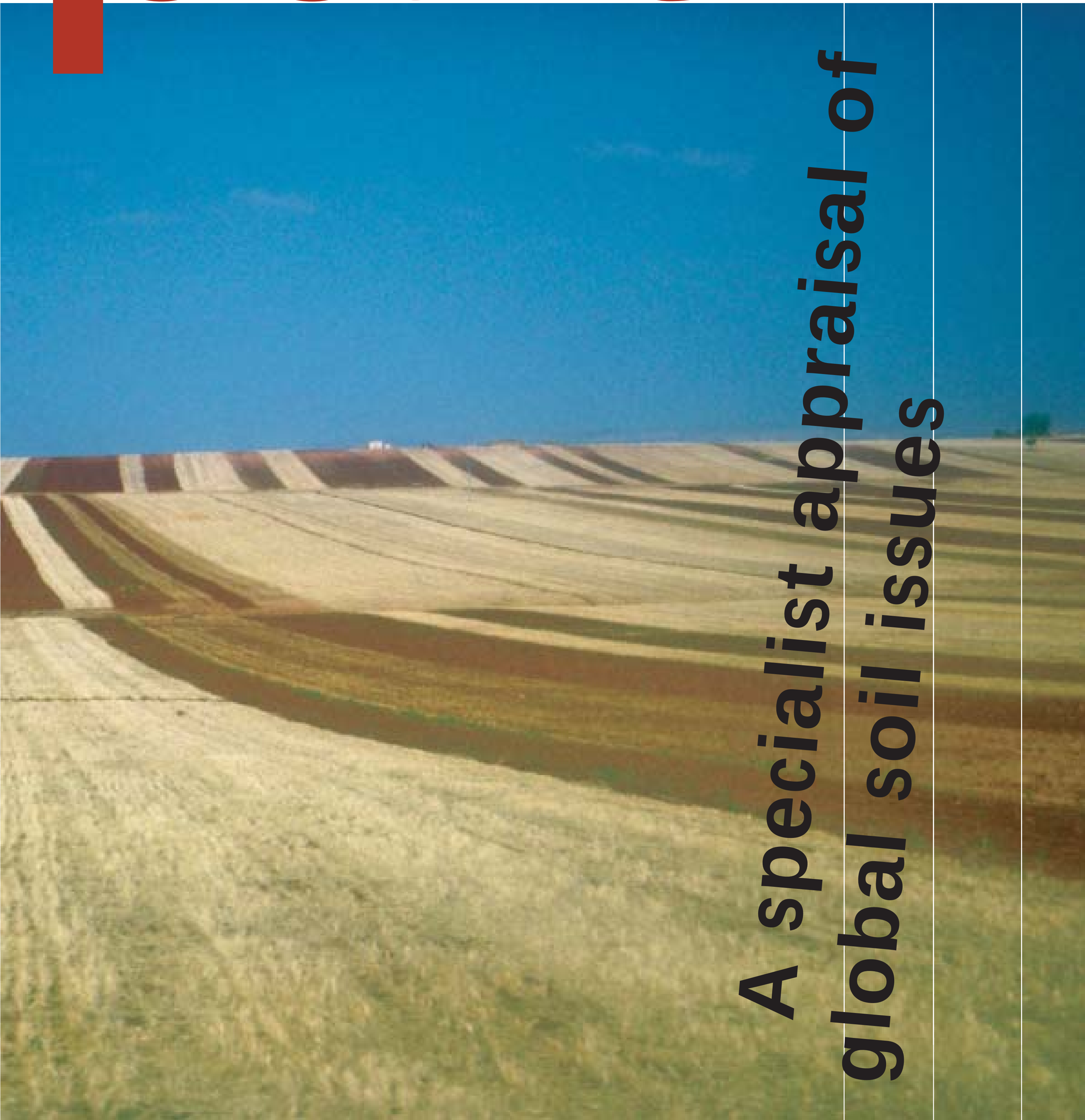
Despite much effort to promote sustainable forms of natural resource management, soil and land degradation remains an unsolved problem of global environmental change. An IUSS Working Group 'Soil Convention' was established after the 16th WCSS held in Montpellier in August 1998 in order to assess policy-related responses to global soil and land degradation.

At the 11th Conference of the International Soil Conservation Organisation held in Buenos Aires in October 2000, this working group was renamed 'International Actions for the Sustainable Use of Soils (IASUS)'. The group invited members from all continents and with a broad range of expertise related to soil science and land use to take part in a general discussion of issues related to IASUS. An e-mail forum was established between December 2001 and July 2002 to facilitate the discussion of five major IASUS issues.

Part II of this publication is a compilation of statements and findings from this discussion. The text presents a summary of the personal views and opinions of the IASUS forum group on various lines of action and initiatives aiming to more successfully address the causes and effects of soil and land degradation, particularly through actions at the international level.

part II

A specialist appraisal of global soil issues



Preparing the land with simple tillage tractor on the Loess plateau in China. Photo by Malcolm Douglas

"A study in East Africa (Kenya) and my own research in Tanzania have shown that densely populated communities actively undertake soil conservation measures. Thus, there is little evidence to make such a strong assertion that population growth is a primary cause of degradation." Alemneh Dejene

Appraising sustainability of the current uses of soil and land

1. How severe is soil degradation?

According to the specialists participating in the forum there is sufficient evidence to show that human-induced soil degradation is more than a local problem. The cumulative effect of all the innumerable occurrences of local damage worldwide was reported to result in global damage affecting one third of all agricultural land (GLASOD, 1990). Although the UN Millennium Report (2000) considers this to be an overestimation, it acknowledges at the same time that one third of the world's population suffer from human-induced soil degradation. The difficulty is 'how to measure soil degradation', and even more difficult, 'how to assess the effects of soil degradation'. Change may vary from being catastrophic at one end of the scale to benign or even positive at the other end. It is important to note that catastrophic change in soil degradation occurs alongside other aspects of change, particularly where human land use systems are unable to change and adapt to new situations. Benign or even positive change may occur where soil degradation induces change in technology, land use, cropping systems or use of labour towards more sustainable land management systems.

2. Soil degradation and desertification

Responding specialists see degrading soils as a major risk to sustainable development, and they believe that increasing attention is given in policy discussions to issues of soil and land management particularly in semi-arid environments. But the focus of political attention on desertification is seen as an insufficient approach for addressing land degradation at the global level. Desertification is land degradation in dryland areas. This, however, is no more (or less) important than degradation in more humid environments; the only difference is that in semi-arid areas local land users may be affected more directly than in humid areas, because in the former, water scarcity becomes more pronounced in degraded soils. Land degradation is a 'cross-cutting issue' that intersects with biodiversity, climate change, hazardous waste and other issues of global change. The politicisation of the desertification debate is now fortunately leading to efforts towards placing land degradation in its proper, i.e. interconnected position also in humid areas.

3. Is soil degradation linked to population growth?

Growing populations clearly mean more pressure on natural, human, economic and other resources, including soils. On the other hand, various studies indicate that food requirements can be met even if the world's population doubled; however, these studies do not necessarily include estimations on possible implications for global soil degradation and other environmental impacts. Soil degradation has been a major cause for food shortages in many places. Higher population pressure on land may thus have negative effects if no proper remediation measures are taken. Yet, higher pressure on land, i.e. overexploitation, may also be induced by intensification of agriculture in countries with little population growth. Population growth, development of innovation and the rational use of technology all go hand-in-hand and can lead to both positive and negative outcomes, depending on many other social, political, economic and environmental conditions. Food security is mainly an economic issue with strong linkages to global trade policies and local trade practices. Consequently, poverty alleviation is the main issue at stake, and masking food shortage by claiming soil degradation as the main cause can even weaken efforts towards poverty alleviation.

4. How effective are the existing soil conservation technologies?

Worldwide, a large array of soil conservation technologies and approaches are in use, as documented by the WOCAT database and decision-support system. Although the immediate causes and impacts of soil degradation are generally well understood, it is far too simplistic to say that this understanding automatically leads to the reverse of soil degradation. There are many reasons why soil degradation still occurs. An appraisal of different conservation technologies must therefore take into account not only the technological means involved, but also the approaches that are supposed to grant successful implementation of measures, the socio-economic environment, markets, infrastructure, extension and

Farming on very steep slopes, with steep down-slope drainage and across-slope conservation measures, Papua New Guinea. Photo by Godert van Lynden

other services, and the socio-cultural structures. Effective legislation is a part – most often a necessary part – of the approach. However, success can be achieved through applying technologies even without the support of legislation; this has often been the case thanks to local NGO activities, innovation by farmers or promotion by researchers or extension agents. Numerous examples are documented in many parts of the world, involving either historically grown or recently introduced conservation measures (see world map by WOCAT, pp. 16–17). Furthermore, legislation may not achieve anything in the long term if it is not accepted by the local people. Conservation issues are thus neither merely a technical matter, nor can they automatically be resolved through legislation. It is necessary to address also socio-economic aspects of land use and to link incentives to sound land use practices.

5. Which are the current levels of intervention?

Just as the cause of soil degradation can be sought at different levels ranging from single field to global economy, so can solutions. Efforts must be made at all levels, and their effects must be coordinated (see Figure). In some cases it may be appropriate to seek a solution solely at the household or community levels. In many other cases, however, solutions identified at the local level need to be matched by national and global policies and actions.

"Only now, at the global level, are we shaking off the desertification debacle of the 1980s."

Michael Stocking

6. Integrating the sustainable use of soil into land management systems

Effective means to manage soils more sustainably require an integrated land management approach that includes an array of technical and non-technical factors, aspects of society as well as of the biophysical environment, and solutions in the policy environment as well as technical, social and economic solutions. Soil is at the interface of many different processes and is a highly multi-functional medium. An integrated approach to soil protection could mean streamlining existing policies (concerning air, water, transport, agriculture, etc.) by incorporating a soil protection element into each of these policies. Only an integrated approach can lead to adequate solutions.

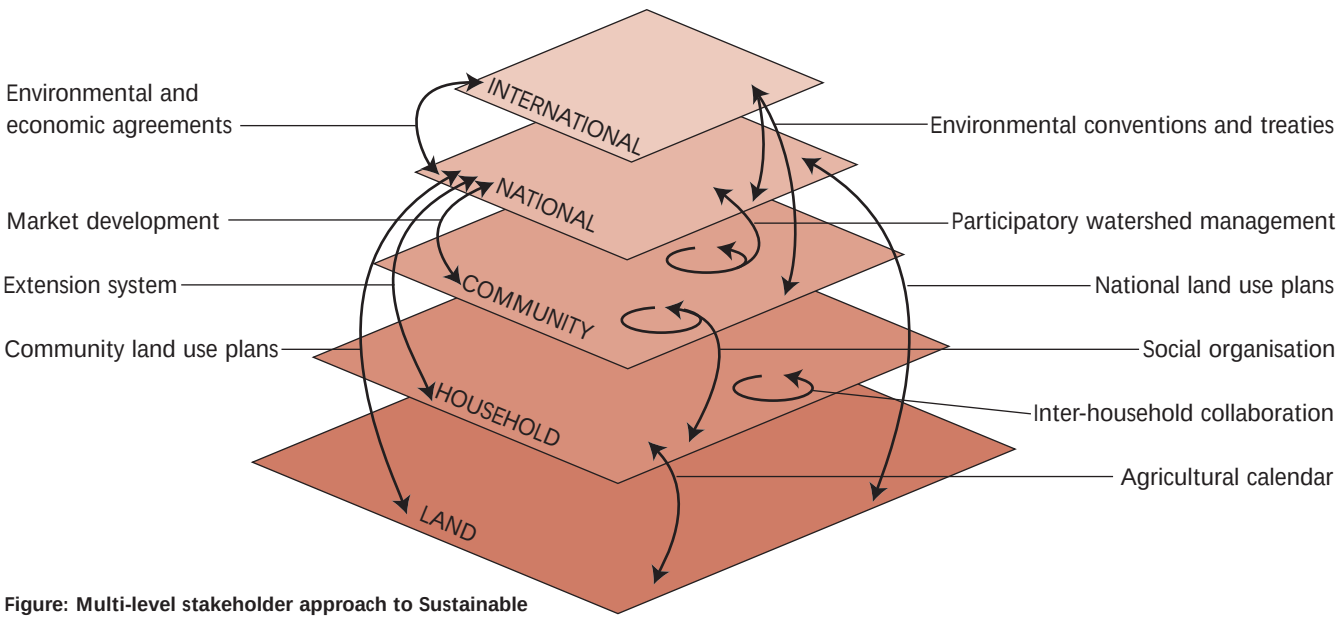


Figure: Multi-level stakeholder approach to Sustainable Land Management (SLM), from Hurni et al (1996).

Management measure:
Area closure: to the left, area of uncontrolled grazing, to the right, area closure excluding grazing in the first few years, followed by controlled grazing, Niger.
Photo by Hanspeter Liniger

Structural measure:
forward sloping stone bench terraces, Morocco.
Photo by Hanspeter Liniger

A world map of soil and water conservation achievements

A WOCAT initiative

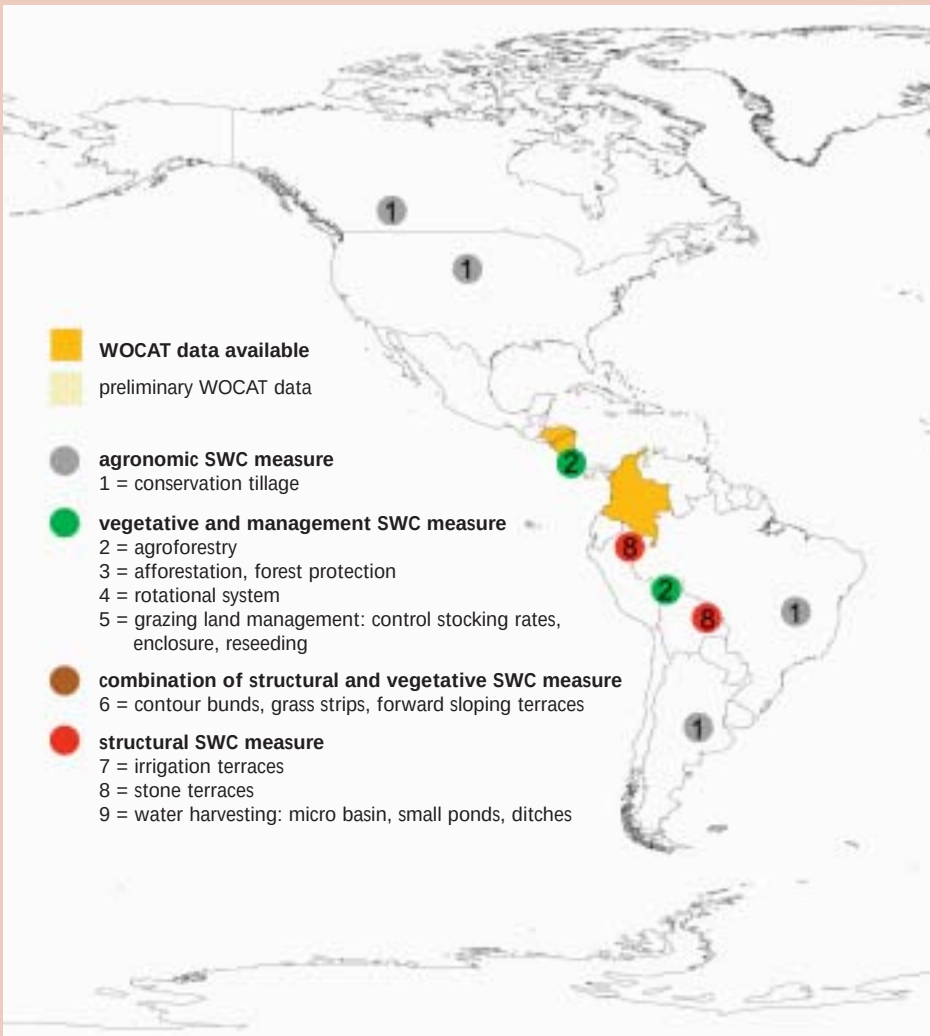
Over the past ten years, the World Overview of Conservation Approaches and Technologies (WOCAT) programme has been carried out by national and regional initiatives in countries interested in using the WOCAT tools for documentation, evaluation and exchange of knowledge on soil and water conservation (SWC) (see WOCAT Box p. 20). Recent requests, e.g. by the National Geographic Society, to present a global overview of achievements in prevention and combating of degradation show that there is a need to present the bright side of land management on the map of the world, and to show where water, soil and vegetation are used sustainably.

A global initiative launched by WOCAT to this purpose asks national soil and water conservation experts to provide information on the most important SWC technologies in their area of expertise. The request asks for short descriptions of the technologies, the types of conservation and degradation, the location and size of measures and the type of land use involved.

The aim of the new initiative is to create a world map at a scale of about 1:60 million, on which, for the first time, SWC achievements will be marked with symbols in different sizes indicating the area coverage, and colours and shapes showing land use, degradation and conservation type. Each of the main SWC types will be illustrated by photos and a brief text.

A preliminary version of the world map will be placed on the WOCAT web site, with the request to provide more information. The map will be updated regularly to show the progress of data collection and SWC achievements. Each of the countries that provided information will be listed.

The Map below is a first draft of how SWC achievements could be presented. It shows examples of SWC technologies in three main categories: agronomic (e.g. minimum tillage), vegetative/management (e.g. grass strips, agroforestry, enclosure) and structural measures (e.g. terraces). The map also illustrates where SWC technologies have already been presented in the WOCAT database (orange) and where preliminary data are available (yellow).

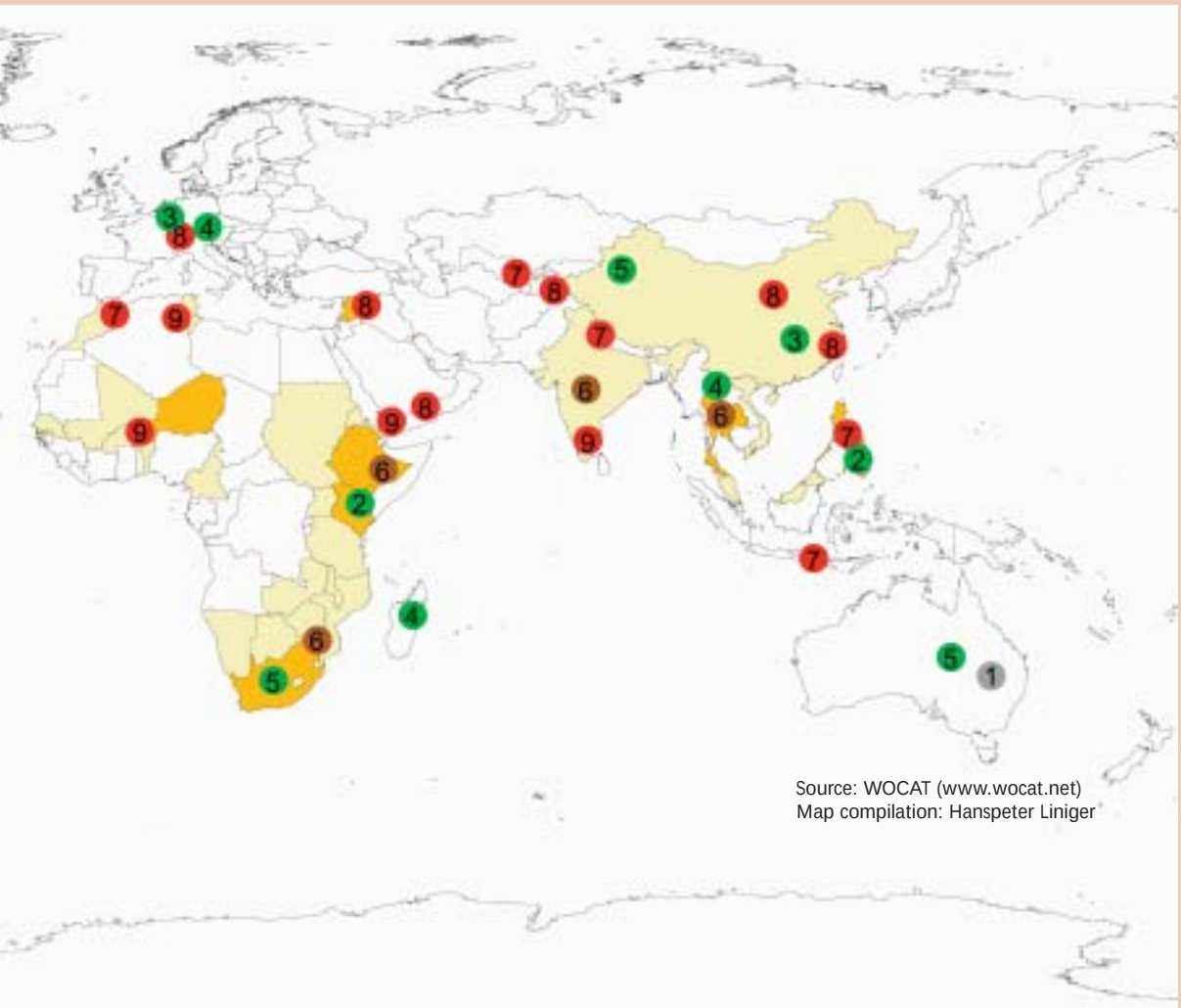


Combination of different measures: level bench terraces with fruit trees, grass strips on risers, and ridging for sweet potatoes. Fujian Province, China. Photo by Hanspeter Liniger

SWC specialists and experts are invited to provide the basic information mentioned above in order to contribute to the global coverage. For further details visit the WOCAT homepage http://www.wocat.net/worldmap.htm or contact us via e-mail at: wocat@giub.unibe.ch

Map: Global overview of soil and water conservation achievements (selected examples and WOCAT coverage)
Source: WOCAT database

Contact: www.wocat.net
wocat@giub.unibe.ch



Source: WOCAT (www.wocat.net)
Map compilation: Hanspeter Liniger

Soil sealing at a rate of nearly 1 m² per second in Switzerland. Photo by WWF

Finding appropriate indicators and monitoring systems

1. State of the art

A critical view concerning the ability of current monitoring systems to properly assess soil and land degradation predominates among the responding specialists. Most specialists agree that there is a genuine need to critically review and improve current approaches, while a minority only denies the ability of current monitoring systems to generate an adequate global picture of land degradation without more detailed and comparable information. None of the responding specialists, however, believes that a realistic global picture can be produced on the basis of existing monitoring programmes. Some voices express satisfaction with existing monitoring systems but question their widespread applicability for financial reasons. These various opinions show that there is a need for a set of global criteria or indicators as well as for specific regional monitoring systems. Some specialists have fundamental doubts about the benefits of current monitoring systems. A critical review is required in order to redefine the parameters that are to be monitored. Too much time has been spent on the assessment of the processes of soil degradation and not enough on its economic impacts; even less emphasis has been placed on positive measures to reverse and avoid soil and land degradation. Indicators focussing on chemo-physical parameters alone are unlikely to gain wide attention. In order to find interest and funding, indicators need to relate to a wider environment, including poverty alleviation and development. Hence, monitoring must address the impacts of degradation, how society is being affected by degradation and how society is adapting to it, including the dynamics of these processes in their social, economic and biophysical dimensions.

2. Limitations in realising adequate soil monitoring and evaluation systems

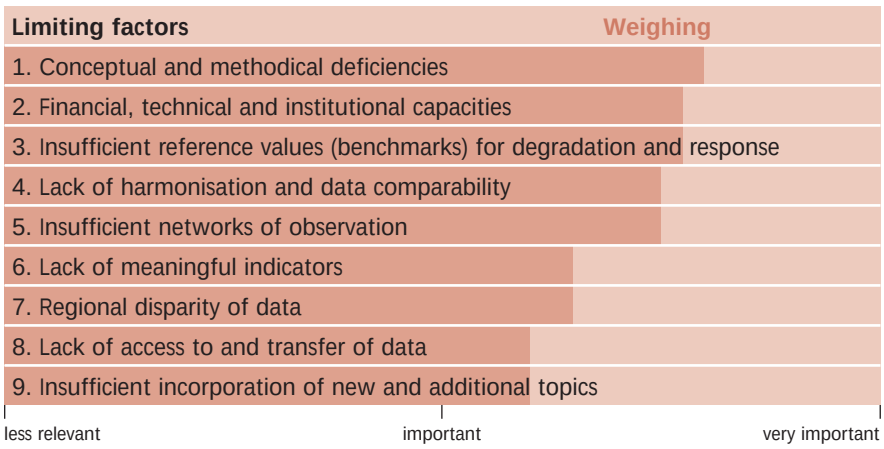


Figure 1:
Factors limiting adequate soil monitoring systems. Relative weighing of 9 limiting factors by responding specialists, from 3: very important; 2: important, to 1: less relevant.

There appears to be a clear differentiation in Figure 1 between the various limiting factors for an efficient soil monitoring system as elaborated by the responding specialists. Priority is given to 'conceptual deficiencies', followed by needs for 'capacity', 'benchmarking', 'harmonising' and 'networks'. Further importance is given to better 'indicators' and less 'regional disparity of data'. Least important but still rated important to very important are better 'access to data' and the need for 'incorporation of new topics' into monitoring systems.

Chemical degradation through application of pesticides in Switzerland. Photo by WWF

3. Challenges to overcome inadequate monitoring of soil changes at the global level

What is wrong with existing monitoring practices?

Some statements address conceptual and technical problems such as poor quality of data, inefficient coordination, high costs, lack of widespread application and lack of global perspectives. Furthermore, responding specialists criticise that monitoring does not necessarily lead to more measures to control or recover degraded lands. Some of the objections expressed also concern fundamental errors such as measuring wrong things, exaggerating or selectively choosing those data that get publicity; misunderstanding the science of, for example, erosion plots; and extrapolating data to large areas without justification.

What types of indicators are needed for effective monitoring?

Answers range from lists of specific indicators to statements either that indicators need to be adapted to each particular site and situation, or that a minimum set of common measurements should be used at all sites for comparability reasons. Indicators must be sensitive enough to indicate a change within a given timeframe, to assess and study on-site causes and consequences of soil and land degradation, and to identify improvements. Indicators will vary according to scale (global, regional, national and local) and the decisions to be made on the basis of the monitoring results.

List of possible indicators to monitor soil changes at the global level

Agro-ecosystem extent and change
- Extent and area intensity of agriculture (1 km^2 satellite data)
- Agricultural land use balance and trends (FAO STAT, 1999)
- Agro-climatic factors and generalised slope (AEZ zonation; global GEM)
- Percent and area of land equipped for irrigation
- General agricultural characterisation (extent, agro-climate, slope, etc.)

Food, feed and fibre
- Production and productivity (area of crops and pastures, yields)
- Intensity of input use (fertiliser, pesticides, labour, tractors)
- Value of agricultural production (total VoP; VoP/ha cropland)
- Nutrition value (calories, protein, fat/person)
- Employment and income (no. agric. workers; production/agric. worker)

Soil resource condition
- Inherent soil constraints (fertility)
- Status and change in soil quality (degree of degradation)
- Soil organic matter (organic C in top 1 m)
- Soil nutrient balance (kg NPK/ha)

Water services
- Water supply for rainfed agriculture (rainfall, growing season)
- Water use for irrigation (% in irrigation, irrigation applied, efficiency)
- Effects of agriculture on water supply (% watersheds in agriculture)
- Potential water quality effects (salinisation, fertilisation rates)

Biodiversity
- Conservation of natural habitat (% habitat in agriculture)
- Pressure on protected areas (% protected area in agriculture)
- Habitat quality in agricultural areas (% tree cover)
- Agro-biodiversity (species, modern germ plasm, transgenic crops)

Carbon services
- Vegetation carbon (live vegetation)
- Soil carbon (depth to 1 m)
- GHG emissions from agriculture (CO_2, CH_4)

Source: Wood et al, 2000. Quoted in: Dumanski J, Pieri C. (in prep.)

Flood and sediment loss after heavy rain in Varzob Valley, Tajikistan. Photo by Hanspeter Liniger

What additional topics should be added to a powerful monitoring system?

Monitoring practices should be based on an interdisciplinary and integrative approach. It is not helpful to focus on single aspects of the problem without analysing the whole situation that is involved in causing soil and land degradation. Monitoring should address topics that range from human causes (poverty, need for land, lack of knowledge or of adoption of appropriate practices) to environmental forces that can be managed or controlled to a certain extent (e.g. soil fertility maintenance, soil conservation practices, etc.). Efforts should be made to come up with reliable, up to date data on the status of global soil degradation, as this would assist with proper selection and justification of certain legal elements for a global instrument.

Which of the existing global monitoring systems and outputs can be regarded as particularly valuable, and why?

Programmes that have been named by responding specialists include GLASOD (1990) and WOCAT (see box), but others question whether there are any monitoring systems that serve the purpose of monitoring soil change. Global Terrestrial Observation System (GTOS) is seen as a possible system, but many specialists question its validity for that particular purpose. Present monitoring methods are considered too subjective still. The specialists call for more sites where environmental and economic factors are defined and critical factors measured. Only on such a basis may it be possible to develop meaningful, quantitative models serving the purpose of global observancy.

WOCAT: World Overview of Conservation Approaches and Technologies

Making local experience available at the global level

WOCAT's mission is to provide tools that allow soil and water conservation (SWC) specialists to share their valuable knowledge in soil and water management, that assist them in their search for appropriate SWC technologies and approaches, and that support them in making decisions in the field and at the planning level.

WOCAT is a network of soil and water conservation specialists from all over the world. It uses global knowledge for local improvements and offers contacts as well as opportunities to share experience around the globe. It provides SWC specialists with technical information about SWC technologies and approaches from their own and other regions. The same pool of knowledge and information can be used in the field and at the planning level. Through its services, WOCAT helps to ensure that existing knowledge and funds are used more efficiently for improved decision making and optimised land management.

WOCAT has developed tools to document, monitor and evaluate 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 help to document all relevant aspects of SWC technologies and approaches, including area coverage. WOCAT results and outputs are accessible via the Internet, in the form of books and maps, and on CD-ROM.

WOCAT is organised as a consortium of national and international institutions and operates in a decentralised manner. This means that it is carried out through initiatives at regional and national levels, with backstopping from experienced members of the consortium.

The WOCAT network is open to all individuals and organisations with a mandate or an interest in SWC. Everyone is invited to share and use the WOCAT knowledge base. More WOCAT initiatives are welcome! Contact the WOCAT secretariat and ask for the WOCAT brochure and CD-ROM.

WOCAT secretariat: Centre for Development and Environment (CDE), Steigerhubelstrasse 3, CH-3008 Berne, Switzerland, e-mail: wocat@giub.unibe.ch, web site: http://www.wocat.net

Physical degradation through soil compaction from heavy machinery. Photo by WWF

What type of institutional setting is required to improve monitoring at the global level?

Consensus and close collaboration are the prerequisites most frequently cited by responding specialists. A multi-institutional or multi-disciplinary team must be involved. Efforts that are limited to treating only one aspect of the problem will rarely yield any solutions because more often than not, land degradation derives from a complex interaction of multiple factors that are both human and environmental, biotic as well as abiotic.

Thus, only through multi-disciplinary action and participation, the topic will be properly addressed. The activities must be derived from collaboration with other institutions such as development agencies and social politics, and they need the support of the local community, the local and national government, and civil society. Policies must support the activities, but these must have backing by the local people involved in the monitoring schemes. Top down dictatorial approaches or institutional dominance over persons living in degraded areas is a recipe for disaster.

Furthermore, teams involved in monitoring must be united and must seek agreement on issues. They must be able to solve inter-personal differences, which often cause teams to break down and the efforts to be wasted. A cross-sectoral approach is needed, involving governments, international organisations, agricultural industry and civil society. There is no one-fits-all solution, but compatibility should be supported. A focus on well-known hot spots may suffice, hence there is no need of a global coverage. Networking among existing institutions can be an asset, based on good communication between the principal global organisations that have an interest in or mandate for monitoring. Examples are the principal international soil science organisations and institutes, and the principal user groups, such as social science organisations, funding agencies (e.g. GEF), the Commission on Sustainable Development, the secretariats of multilateral conventions (UNCCD, UNCBD), etc., and also prominent regional organisations (e.g. ASEAN). Cross-disciplinary monitoring systems that work in a truly participatory way with land users and other stakeholders, and which put emphasis on livelihoods and the socio-economic impact of soil and land degradation and rehabilitation, will be most successful according to responding specialists.

Measuring runoff and soil loss provides information on rates of soil degradation in Northern Thailand. Photo by Hans Hurni

Assessing the value of research

1. What does research have to offer?

The challenge of knowledge creation and management

Most responding specialists agree or partly agree that the problem is not lack of knowledge, but lack of access to knowledge and of willingness to share it. One disagreeing voice, however, finds it absurd to suggest that most of the viable research questions related to soil degradation have been answered. Furthermore, missing incentives and bureaucratic systems were mentioned as reasons why users do not benefit from available methods for avoiding and correcting land degradation. Those who agree that lack of knowledge is not a problem have strong reservations regarding the type of available knowledge and information. A major limitation is seen in the lack of access to appropriate knowledge or lack of knowledge in an appropriate form for certain types of land use decisionmaking. This could mean either that the knowledge that is widely disseminated is not relevant, or that not enough attention has been paid to 'uptake pathways' in the design of the research in the first place. Bridging the gap between science and society is seen as one of the major challenges for the future.

Limited scientific knowledge for practical use

Responding specialists felt that we are limited by the types of scientific knowledge we possess. They referred to the lack of knowledge in a form suitable to address the various types of land use situations; to the prevailing narrow disciplinary approach to study soil degradation; and to the little relevance of a great part of the available knowledge to policy making and to the needs of society. However, it was also mentioned that because science is responding to societal needs, its understanding of new concerns is always limited. Disagreement was expressed based on the view that everyone's knowledge is valuable and that a major limitation is the insufficient ability to understand and value other people's knowledge, rather than the type of scientific knowledge we have.

Accountability of research

Research must be made accountable for the lack of awareness and willingness to address soil degradation. Critical reactions by responding specialists dominate, with some agreement that it is not the scientific community alone that can be blamed, but also poor links and communication between researchers and the users of information – the policy makers, decision makers, law makers – and the inability of these communicational links to ensure that information is obtained in a form suitable for efficient integration with the non-research knowledge systems. Scientists must also be experts in public relations and advocate research. In doing so they must point out definable benefits of the research in terms of outcomes for the good of society. Moreover, it is claimed that in fact, investments in research have returns far in excess of expenditures. However, scientific findings may complicate previous knowledge on a subject matter, making it difficult to create effective awareness, or the economics of the issues may prove too costly for stimulating effective actions. Finally, sound findings and public relation and communication efforts may not be sufficient if they are ignored or if benefiting is avoided on other grounds.

> *"Neither research nor researchers should be held accountable for the lack of awareness and willingness to address soil degradation. It is those involved in the application of research who are failing in their task."*
>
> Dennis Greenland

Adequacy of current research

'Conventional' research is reported to be inadequate to tackle problems of global environmental change and to help solve soil problems at the global scale. Depending on how 'conventional' is interpreted, such research may well be inadequate for tackling soil problems at a global scale. It is still difficult to find truly interdisciplinary projects. So-called 'conventional' research is just one real-world view. It needs to be put alongside local people's knowledge and experimentation systems as well as research from other traditions. It was said that research needs to be better tailored toward new forms of environmental issues (adaptive research), but it was also claimed that research is by definition always changing and adapting to new problems.

"Research needs should never be an excuse for putting off action. We must act as a society based on our best science. At the same time we must be conducting new science to guide tomorrow's actions."

Mark Nearing

Validity of the syndrome approach for research

The German Advisory Council on Global Change (WBGU) argued in favour of a 'syndrome' approach to the analysis of soil degradation (WBGU, 1997). Some responding specialists see this approach as one of the few attempts to look beyond soil science in an integrated approach to soil degradation. Others view it more sceptically, suggesting that it merely claims to be a 'novel' approach, without actually offering any major reorientation of research. It is also judged to be too restrictive, too negative and too strongly led by formal science. Soil degradation problems need to be analysed from many perspectives – depending on the central issue of concern. One significant way to change the situation is to empower local communities by giving them some influence in the selection of research projects.

"Using the syndrome approach – and its enhanced framework of syndrome mitigation – is a true innovation adopted by research communities and in global networks such as the programme 'NCCR North-South' (2000), which operates in eight major regions of the world in partnership with local institutions."

Hans Hurni

Does research prevent action?

Responding specialists both agree and disagree that calling for more research simply puts off urgent action to prevent and mitigate global soil degradation. Agreement is based on the view that action is urgent but not necessarily in the interest of both the research and the policy-making communities. Knowledge about the major soil degradation processes is said to be so abundant that it is difficult to manage comprehensively in most circumstances. Political willingness is claimed to be the main determining agent to reversing the present situation. Researchers may well be to blame, but research should be much wider and more utilitarian than laborious collecting of data and rigorous analysis. There is no reason why much 'monitoring and evaluation' (M&E) should not be called 'research'. And M&E is in very short supply regarding the lessons from past actions and adjusting future actions. Calls for more research must first and foremost include a solid concept for cross-sectoral research and, even more important, for linkage to relevant policy processes (development, environment, poverty, globalisation).

Usefulness of global programmes

Responding specialists agree that GLASOD, SOTER and WOCAT have been set up with considerable success to overcome problems of knowledge management and diffusion. These programmes are seen as necessary steps on a longer road, but they are certainly not the end to the problem. GLASOD is said to be a great success in awareness building for soil degradation, while WOCAT is doing a similar thing for soil and water conservation. SOTER could be turned into a similar success if useful applications were demonstrated and if a wider global coverage were accomplished. WOCAT has considerably expanded particularly in recent years. Although these programmes may be biased by expert judgement, they are the only reference for any policy-making exercise on mitigating soil degradation at the global level. However, it is also alleged that there has been a tendency for these tools to be used beyond their levels of reliability and technological capability.

2. Which major directions should future research take?

Responding specialists were asked to give their rating to various strategic directions research should take, as well as to thematic issues that should be treated.

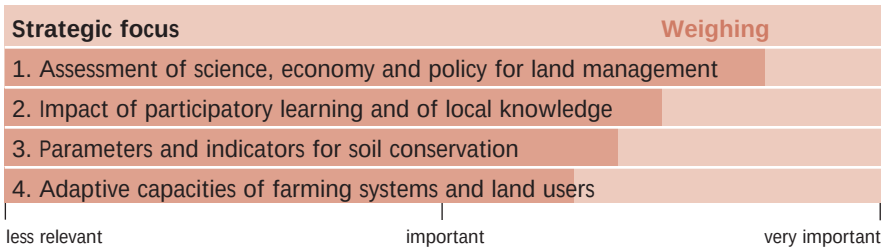


Figure 2a:
Strategic focus for future research in sustainable land and soil management. Relative weighing of 12 issues by responding specialists, from very important, important, to less relevant.

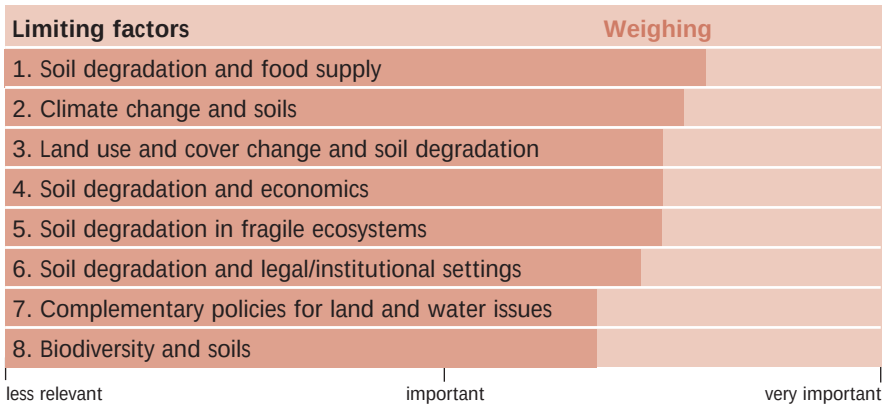


Figure 2b:
Thematic focus for future research in sustainable land and soil management. Legend: see 2a.

Of the four strategic approaches in Figure 2a, the 'assessment of science, economy and policy in regard to land use management' scores highest, followed by 'participatory learning' and 'strengthening of adaptive capacities'. Looking at the eight thematic issues in Figure 2b, the responding specialists rate 'soil degradation and food supply' highest, followed by 'climate change' and a cluster of four further issues, namely 'land use', 'fragile ecosystems', 'economics' and 'institutional settings'. 'Biodiversity' and 'policies' are given least importance, but are still taxed by many as very important. Suggested other issues included 'perceptions of soil and land degradation', 'soils and livelihoods of local people', 'soils for science: getting to know your funding sources' and 'learning to talk to, and help, people who will benefit from your research', as well as, on the technical side, 'non-point source pollution' and 'irrigation: water supply and environmental impact, how soils interact'.

Chemical soil degradation through deposition of air pollutants. Photo by WWF

Research approach \ Nature of research	Applied	Adaptive	Strategic	Generic	Ø
Transdisciplinarity	2.12	2.00	2.50	2.71	2.33
Interdisciplinarity	2.00	2.75	2.42	3.00	2.54
Disciplinarity	2.67	2.83	2.14	2.83	2.62
Ø	2.26	2.53	2.35	2.85	2.50

Figure 3:
Useful types of research. Averages of relative weighing, by responding specialists, of selected approaches and types of research in a matrix, from 1: most preferred, to 5: least preferred.

The differences in average scores within the matrix in Figure 3 are not very large, meaning that responding specialists share the conviction that approach and nature research have to be multiple in all aspects. Nevertheless, when looking at research approaches, 'participatory' approaches are prioritised over 'interdisciplinary' and 'disciplinary' approaches. This indicates that a strong involvement of land users and their knowledge is generally favoured. Relating to the nature of research, 'applied' ventures are favoured over 'strategic', 'adaptive' and 'generic' projects, in this sequence. This in turn indicates that the direct usefulness is highly valued, particularly in sectors where greatest needs are identified. Simply adapting technologies used elsewhere is less favoured, while inventive (i.e. generic) research is ranked lowest in usefulness.

The Loess plateau in China is both highly fertile and highly susceptible to soil erosion. Photo by Hanspeter Liniger

Potential legislation tools to attain more sustainable use of soils

1. Interventions at the global level

The benefits of an international soil instrument

All responding specialists recognise the benefits of introducing an international soil instrument to raise awareness of the serious situation of soil degradation, hence the need for ringing the bell is undisputed. More controversial is the question of what an international initiative should be like. Some prefer implementable conservation programmes and awareness campaigns on positive achievements. Others favour a high-level policy commitment to soil-related issues and argue that many funding countries would only take these issues seriously if they had signed such a legal instrument. But what instrument? The idea of a new soil convention is given little hope in light of the existing desertification convention and the general convention fatigue ten years after the earth summit in Rio. A legal instrument focusing purely on soil seems undesirable; strengthening soil-related aspects in existing agreements is more widely supported.

"Different countries have different degrees of soil degradation and to introduce such an instrument would help countries/regions come to terms with the magnitude of the danger the world is facing."

David Malinda

The need for national soil policies and legislation

Most responding specialists recognise the need to develop legal instruments and guidelines for individual nations to improve national soil laws. However, strengthening national soil legislation is supported only with some critical statements. Preference was expressed for guidelines rather than enforceable instruments, among others for the reason that talking about legislation and enforcement with regard to soil conservation/sustainable land management is a delicate matter particularly in developing countries. Generally, national legislation for soil has received less attention than that for other ecosystem components (e.g. water, vegetation, wetland); existing guidelines for individual nations to develop and reform national soil legislation are inadequate. Apparently there is some interest in a 'generic' soil law and accompanying operational guidelines in some regions (e.g. Southeast Asia, Central Asia). Reservations were made with regard to the term 'national soil law'. Soil is part of landscape ecology. To isolate it at the national level is seen as an invitation to ignore it. Integrating soil-related aspects in existing national legislation seems a better strategy.

"Clearly, and there is quite some national request for this type of activity!"

Jens Mackensen

Safeguarding ecological functions

All responding specialists agree that it is important to consider the ecological functions of soil for the conservation of biodiversity and the maintenance of human life in the development of legal instruments for the sustainable use of soil. This unanimous support can be interpreted in the sense that any legislative effort needs to take account of the multitude of functions soil has. Existing soil legislations generally tend to recognise the importance of soil in various processes, especially food production, but rarely pay proper attention to the complete range of ecological services soils provide or to the importance of their biodiversity. It seems essential that the ecological impacts of soil and land use be considered with meaningful indicators and operational guidelines in legal instruments that guide soil use both nationally and internationally. We need to move away from the traditional pedological approach that considers essentially agriculture-related aspects of soils as the main issue. A holistic approach to soil protection requires taking into account the soil's multi-functionality.

"This is the key, in my opinion. Without this, there will be no recognition, as we have seen for the past 100 years."

Julian Dumanski

"Too many initiatives start up with lots of gusto and then dwindle down to bare minimum or negligible impacts."

George Brown

"Soil is an ecological element and it is the ecosystem values of soil that need to be properly recognised and managed by legislation (as against the things that soil is used for, e.g. agriculture, which should be dependent upon its ecological characteristics."

Ian Hannam

Acknowledging institutional leadership

In general, the IUCN Commission on Environmental Law (CEL) is granted credibility in developing the legal and institutional frameworks for improving the legal mechanisms for soil conservation at the international and national levels. However, it is also suggested that such a task could be better performed through global mechanisms related to the Commission on Sustainable Development (CSD), in collaboration with UN institutions like FAO and UNEP.

2. Interventions at the international level

Current environmental legislation

Most responding specialists do not feel competent enough to give a firm judgement on the status of international environmental law. It is, however, confirmed that soil (degradation) is a poorly recognised environmental problem in current international environmental law, based on the findings of a recent detailed analysis of existing global environmental policy and binding as well as non-binding instruments by the IUCN Environmental Law Center (CEL). However, some objection is raised in the light of developments within the desertification convention where the angle for viewing land and soil degradation is more and more widened to a more global perspective of land degradation.

Lack of binding frameworks

The CEL assessment of international environmental law underlines that existing binding instruments are insufficient as frameworks for sustainable use of soils at the global level. There is no specific and binding instrument for soil. Soil is mentioned in some existing instruments (e.g. UNCCD and UNCBD), but without the legal elements that are necessary to recognise it as an ecological element in its own right or to make decisions directly in the interest of soil conservation. There are, however, some regional instruments (e.g. ASEAN convention, Soil Protection Protocol to the European Alpine Convention) with specific provisions for soil. The UN Convention to Combat Desertification is also seen as a starting point in this direction, although it remains questionable whether any such international agreement can ultimately be binding in the sense of national legislation. Global instruments are seen as necessary but insufficient because there is yet no proof of effective enforcement and litigation in case of non-compliance with provisions of such international instruments. Nevertheless, instruments like the UN conventions on climate change, biodiversity and desertification are seen as a step in the right direction that provide some good opportunities for the soil issue. A good example ist the decision taken at COP6 of the biodiversity convention (2002) to establish an 'International Initiative for the Conservation and Sustainable Use of Soil Biodiversity' within the programme of work on agricultural biodiversity. Criticism is expressed with respect to the apparent lack of involvement by those who are directly affected in the top down development of such instruments.

Are ecological functions acknowledged?

Existing non-binding instruments do not recognise the ecological role of soil. There are only few global 'non-binding instruments' related to soils, and those few – e.g. the UNEP World Soil Charter – are considered inadequate to cater for all aspects of soil conservation, particularly its ecological characteristics and needs. On the other hand, the interlinked role of soil is mentioned, for example, in operational programmes OP12, OP13 and the draft OP14 of the Global Environment Facility (GEF), and the EU Thematic Strategy on Soils is seen as an example of a new approach.

Do guidelines for national policies exist?

Current international environmental law regimes do not provide guidelines for national soil legislation. Apparently, only the UNEP World Soils Policy (1982) has national guidelines for soil conservation legislation, and these are claimed to be inadequate for the 21st century. However, the above statement is also questioned, for instance by the national action programmes to the desertification convention, which often include aspects of soil protection.

"There is a lack of democracy in the overall process of developing new legal instruments for environmental protection."

Luca Montanarella

"I find it difficult to get particularly excited about developing specific legislation and policy for soils. The link to policy is essential, even though much scientific work ignores this. But what policy? It must be about sustainable use, more equitable sharing of benefits, and conservation for future generations. The proper role for soils information in this is with other parts of the biophysical environment – water, plants, landscapes, fauna."

Michael Stocking

Are there any promising initiatives at the international level?

The responding specialists give examples, including the recent re-orientation of UNCCD towards land degradation, the Millennium Ecosystem Assessment, the UNEP-GEF-FAO Dryland Assessment of Land Degradation (LADA), and the UNEP Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (GPA). The Tutzing Soils Convention – a private initiative – was also mentioned, as well as the moves by WBGU and UNEP for an international panel on land and soils, and by IUSS for International Actions for the Sustainable Use of Soils (IASUS). Based on the analysis of existing global and regional instruments, the IUCN Commission on Environmental Law (CEL) has initiated work on the development of a draft instrument for soil.

3. Interventions at the national level

Inadequate soil instruments

Existing national soil legislations are inadequate: This is said to be the outcome of the extensive investigation by the CEL into around 200 individual national soil legislations. But the question was raised whether a national legislation or strategy can be adequate enough to be applied to the widely diverse situations of soil and land use and degradation found throughout the world.

"National soil legislation would be whistling into the wind. It must be part of a wider, more holistic legislation."

Michael Stocking

One-sided interest at the national levels

National legislation, if existent at all, is dominated by physical and not by ecological problems arising from land use. It is believed that the division of science into strictly physical, chemical or biological phenomena continues to limit the ability of humans to think ecologically and holistically, particularly concerning the interactions that occur in the environment and in the soil. If soil legislation is ever to become successful, the link with ecosystem and human health will have to be made.

Positive initiatives

Examples of positive moves on national soil legislation included the Australian Landcare and Soil Conservation, the CRC Issue Brief for Congress – A Soil and Water Conservation Issue in the USA in 2001, as well as the most recent reform work on national soil conservation law undertaken by Iceland, Thailand and the People's Republic of China. Good trends in policy in a broader context were registered in Ghana, which was mentioned for having adopted some excellent conservation policies. Examples on European ground included the new EU Thematic Strategy on Soils, and the recent German Federal Soil Protection Act.

4. International and national options

Instrument	Coverage			Type		Suitability
	Global	Regional	National	Binding	Non-binding	
Framework treaty to strengthen soil in existing treaties	×			×		1.89
National soil law			×	×		2.25
Generic soil law			×	×		2.63
Protocol to existing treaty	×			×		2.78
Special treaty	×			×		2.78
Regional framework treaty		×		×		3.00
Charter or declaration	×				×	3.94

Figure 4:
Suitable legal instruments. Averages of relative weighing of most suitable instruments by responding specialists, from 1: most preferred, to 5: least preferred. See box for categories of instruments.

State-directed campaigns were used for implementing soil and water conservation measures in Ethiopia in the 1980s. Photo by Hans Hurni

Categories of legal instruments for land and soils

a) A globally binding special treaty:
This would be a stand-alone complete instrument for soil. It should be viewed as a long-term goal, given the limited success in effective implementation of existing treaties and the likely reluctance of policy-making institutions to support an additional treaty. Until the general population and governments realise its value, it will be difficult to create a treaty only for soils.

b) A globally binding framework treaty:
This is a realistic option that would produce substantial benefits by linking and integrating soil issues into existing treaties. However, a separate binding instrument will be essential to give the soil issue more weight and adequate integration as a cross-cutting issue in the existing instruments.

c) A globally binding protocol to existing treaties:
This is also a politically more achievable option; however, 'soil' may become the subordinate element in the framework instrument.

d) A globally non-binding declaration:
This is perhaps the most realistic short-term option as it involves less politics than the above options. But, as a non-binding instrument, it would be severely limited compared to the binding instruments in scope and effectiveness. It could be viewed as the initial stage of a longer-term evolution towards a fully binding treaty. Unless a declaration is associated with a stronger, binding mechanism, a non-binding mode of action will not be successful.

e) A regionally binding framework treaty:
Such a regional instrument would set out a range of elements 'common' to the particular physical and institutional characteristics and needs of the region. Three regions already show some interest in such regional instruments: namely Southeast Asia, Central and Southern America, and Central Europe.

f) A nationally binding generic soil law:
There is already substantial justification for a national 'generic' legislation framework.

g) A nationally binding soil law:
This type of instrument would play a role similar to that of a regional instrument or agreement. It may be a very useful tool to address specific transboundary soil conservation issues (e.g. in Central Europe). It may also be applicable for pollution control of international waters, e.g. Pantanal or Mekong Delta.

In terms of the scores given by responding specialists in Figure 4, it is a new global 'framework treaty which identifies the soil elements in existing treaties and links them through a separate binding instrument' that ranks highest, followed by 'national legally binding agreements on soil and land conservation'. A 'nationally binding generic soil law', a 'globally binding special treaty' and a 'globally binding protocol to existing treaty' get average scores still below 3 (i.e. neither most nor least preferred), followed by the remaining instruments with least support. Hence a new specific international treaty on soil is ranked at a middle position, and an international charter or declaration for soil of non-binding character is by far the least preferred solution.

"In the end national legislation is the most effective type of legislation."

Jens Mackensen

'Tassa' planting pits for improving and conserving moisture in Niger. Photo by Will Critchley

Appraisal of approaches other than legislation

1. General observations

Effective actions against soil degradation require a much closer look into the economic benefits of soil and land use

Responding specialists agree that very little attention has yet been given to the economic valuation of soil functions and of land management. Principles such as the 'polluter pays principle' and the 'internalisation of external costs' have largely been overlooked, and the soil issue remains more or less ignored in discussions and methodologies on how to internalise external costs. The lack of progress towards a sound valuation of soils and land use is seen as a consequence of little collaboration between economists and soil scientists. There are said to be serious methodological difficulties to overcome. Many of the soil's functions are difficult to estimate, especially in developing countries where markets are weak, distorted or even totally absent. The effect of soil degradation on yields, for example, is difficult to estimate and to separate from other influencing factors. Therefore, economic valuations of soil functions often have to rely on rough estimates. While the internalisation of external costs is indispensable for a proper social cost-benefit analysis of land use, specialists questioned whether it is appropriate to apply the 'polluter pays principle' to farmers who are forced to adopt unsustainable practices. It is said that in situations where farmers overuse land to meet their imminent needs, additional costs would exceed their capacity.

"Soil scientists put far too much attention on the process of erosion, and very little on impact. This must change!"

Julian Dumanski

Imperfect market conditions and undesirable effects characterise the situation of land allocation

The following examples underline this statement:

a) Ecological functions and quality of soils are economically undervalued.

Responding specialists claim that these values are rarely calculated, and that they are not recognised by the markets. They admit that the valuation is tricky, often yielding variable results depending on the perspectives of the involved stakeholders. Furthermore, in places with no land market such as in many countries of the South, different land qualities are not at all reflected in different land prices.

b) Enhancing economic benefits from land use and land use changes is generally linked to ecological degradation of soils.

This statement is viewed rather sceptically, as responding specialists believe that it is possible to increase economic returns from land use and land use changes without compromising the quality of the affected soils. The opposite is also said to be true, namely in places which are heavily dependent on subsistence agriculture, where farming leads to serious degradation and forces farmers to use unsuitable land in order to survive. In such cases, land use changes would be crucial with regard to a sustainable land management system.

The question of land degradation and sustainable land management can thus not only be explained by economic factors.

c) Restoration measures on contaminated grounds impose additional costs on land developers.

There is no objection to this statement. It is seen as a sound measure which normally is not restrictive since the development costs are simply passed on to the customers. The implication, however, that uncontaminated grounds become economically more attractive for land developers, meaning that intact grounds will in turn be degraded, has not been raised in any response.

d) External costs of land degradation do not induce more sustainable land use practices.

Responding specialists agree, basically because external costs are not internalised. However, it is admitted that fixing a price to land degradation and deciding who should pay for it, is not a simple task. Moreover, it is said that in developing countries, the biggest share of the costs of land degradation is often not constituted by the external costs to society but by internal costs to the farming households through reduced production. Specialists conclude that a major focus would have to be put on land use practices that are (i) economically interesting, and (ii) ecologically sustainable. It is claimed that many technologies addressing land degradation were designed

Earth bunds with grass strips support the formation of agricultural terraces in Anjeni, Ethiopia. Photo by Martin Moll

from an exclusively ecological point of view (i.e. with a focus on reducing soil erosion), but not from an economic standpoint. Usually, a technology to address ecological degradation is characterised by high initial investment costs and a time lag between investments and benefits.

e) In conclusion, there is little economic incentive to keep soils undisturbed.

Responding specialists argue that not many convincing scientific or political concepts exist to address the economy of soil degradation. While increased pressure on undisturbed land for non-agricultural purposes can be seen as a serious problem particularly in industrialised and densely populated areas, the issue of soil degradation is less obvious from the perspective of a small-scale farmer. Forced to survive on a little plot, farmers have no interest in leaving the soil undisturbed. However, they do have an interest to produce enough to survive without destroying the soil's productive potential. The challenge lies in finding the proper balance.

"I have never met any land user willingly degrading the land he is depending on, but only out of necessity, lacking knowledge with regard to alternatives and lacking support."

Eva Ludi

2. Market-based approaches

There is a need for appropriate framework conditions to take care of external costs related to land use

Responding specialists agree that there is a need for proper analysis and valuation of true external costs from land use. This should also include issues like climate change. Such analysis is said to require some new lines of thinking and vision developed from different perspectives. It would have to encompass aspects such as markets for land, capital, inputs and outputs, and funding for research and extension. However, it is also said that in agriculture-based developing countries, the primordial question is to address the direct costs of soil degradation. Land use systems have to be developed which are both more productive and less degrading. At the same time the percen-tage of people depending entirely on agrarian production must be lowered.

Economic instruments need to be developed to stop the degradation of soils

There is a strategy whereby valuable soil ecosystems that are irreversibly lost through land use transformation need be protected and withdrawn from the land market by regulation. In cases where soil degradation is reversible, degraded lands need be restored on site. In cases of soil sealing, compensation requirements need be imposed on land users by economic instruments such as a levy on soil sealing. Responding specialists, however, show a mixed reaction to the above strategy. Although desirable, such a strategy seems premature without the necessary knowledge on how to deal with its socio-economic implications. For a start, specialists suggest to focus on areas that are at the same time highly vulnerable to land degradation, densely populated and economically vulnerable. Almost all land transformation is likely to cause degradation. The issue is not degradation, but the impacts of degradation. Hence, instruments are needed to estimate impacts. Regulatory measures to withdraw land resources from use are objected, and preference is expressed for market mechanisms that help to link environmental and economic benefits from land use. The emerging carbon dioxide market is given as an example of a win-win situation, and tax benefits in return for using sustainable land management techniques is another. The example of a tax on soil sealing, however, has been characterised as unenforceable. Such economic instruments, while welcomed as an interesting option for correcting undesirable land allocation in industrialised societies, are looked upon more sceptically in the context of developing countries. It is claimed that farmers do not willingly destroy their soil, but are forced to degrade it because otherwise they cannot produce

WOCAT training course in Dushanbe, Tajikistan. Photo by Hanspeter Liniger

enough to sustain their families. Here, it is suggested to first rather develop more intensive land management systems for suitable areas that would allow alleviating pressure on land in more fragile areas. If valuable soil ecosystems should be taken out of production, solutions must be found to compensate the land users. Although farmers are responsible for some external costs induced through their land use systems, they could equally produce many external benefits if they adopted a more sustainable system. Because such a change is not without costs, society has to find ways of sharing these costs among the different groups profiting from subsequent benefits.

3. Institutional approaches

An Intergovernmental Panel on Land and Soil (IPLS)?

Similar to the Intergovernmental Panel on Climate Change, such an IPLS (see box) has been proposed for the purpose of identifying priority issues and to provide institutions (such as the UNCCD) with advice on soil and land degradation and its linkages to other environmental issues and conventions. The IPLS was proposed by developing countries at the 5th Conference of the Parties to the UNCCD in October 2001 in Geneva. The idea of an IPLS is supported by most responding specialists; however, they are aware of the various obstacles involved. It is argued that such a panel would serve the objectives of several dozen environmental and agricultural agreements

Efforts to establish an Intergovernmental Panel on Land and Soil (IPLS)

Tasks of an IPLS:

- To serve as a clearing-house for assessing global land and soil degradation, its impact on soil and land resources, and to propose regulatory management strategies.
- To assess and synthesise globally the scientific, technical and socio-economic information relevant for the understanding of the risk of human-induced land and soil quality change.
- To address the variety of land use and soil management issues, including desertification, as related to environmentally sustainable development, food security, poverty alleviation and multilateral environmental agreements.
- To stimulate and involve the scientific community in advancing and developing the science of soils and sustainable land use in a multi-disciplinary context.
- To actively assist national, regional and global decision makers in developing policies to assess, monitor and mitigate negative impacts of land and soil use.

Possible set-up of an IPLS and integration of the UNCCD

A possible link of the IPLS to the UNCCD must recognise the central role of the UNCCD as the only direct and global instrument for soil conservation (though concentrated on drylands only) while allowing a flexible incorporation of scientific advisory processes for other multilateral environmental agreements which relate directly or indirectly to land/soil issues (e.g. UNCBD, UNFCCC).

Activities in favour of an IPLS

Support to an IPLS was expressed:

- by the Executive Director of UNEP, Prof. Dr. Klaus Töpfer, at the 4th Conference of the Parties to the Convention to Combat Desertification (UNCCD), and by a side event at this venue (December 2000);
- at the 21st session of the Governing Council of the United Nations Environment Programme (UNEP) and Global Ministerial Environment Forum (February 2001);
- at a meeting with leading German scientists organised by the Advisory Council for Soil Protection, the Federal Agency for the Environment (UBA) and the Federal Ministry for the Environment (BMU) (March 2001);
- at the 3rd International Conference on Land Degradation and meeting of the IUSS Subcommission on Soil and Water Conservation, held in Rio de Janeiro (September 2001);
- at a side event at the 5th Conference of the Parties to the Convention to Combat Desertification (UNCCD). G-77 and China came up with a draft decision for the establishment of an IPLS at this venue (October 2001);
- by the European Commission's attempt at establishing the thematic strategy for soil protection outlined in the 6th Environment Action Programme. (In the revised version of the EC Soil Communication the paragraph concerning the IPLS has been removed (December 2001).)

**Soil destruction through extraction and mining in Switzerland.
Photo by WWF**

if it addressed soil and land-related issues in an interlinked way. It would be a boost to international research and policy making. However, duplication of existing efforts and a resurrection of environmental crisis need to be avoided. It was also argued that setting up such panels would delay rather than further necessary actions to alleviate problems related to land use.

"We have panels, conventions, meetings, workshops, working groups, steering committees, etc. that keep the world busy talking and sending e-mails. Maybe it is time to act instead!"

Luca Montanarella

Programmes to advance technological improvements and the transfer of know-how, such as WOCAT and SOTER, need to be made more effective

Responding specialists widely acknowledge the merits of such programmes. However, they also argue that more could be achieved through more efficient partnering and information dissemination. They say that all such networking programmes suffer from lack of funds, and besides assembling information on technical measures, they claim that it is equally important to look if and how land users can adapt technologies to their circumstances. However, specialists also warn not to push specific approaches and programmes that provide only partial answers.

"It is this last phrase which is key, and which neither SOTER nor WOCAT have been successful at. They have generated lots of data, but it is now data in search of a use."

Michael Stocking

Some form of a financial mechanism is needed to enhance sustainable soil use and land management particularly in developing countries.

Like the example of the 'clean development mechanism' of the Kyoto Protocol, any financial mechanism to enhance sustainable land use needs to be based on appropriate international agreements on terrestrial resources such as the UNCBD, the UNCCD or a new convention on soils. Responding specialists broadly welcomed the idea, as financial compensation has to be made available for addressing soil degradation in poor developing countries, also for the sake of people in industrialised countries. But, without a framework comparable to the Kyoto Protocol with binding requirements for each country, specialists feel that a market-driven mechanism like the Clean Development Mechanism (CDM) is unlikely to work in the land use context. However, partnership and collaboration with existing international environmental treaties will help to improve the recognition of soil degradation and the importance of sustainable land use for shared benefits. These opportunities should be better exploited. Moreover, there are good arguments to promote investments in land as worthwhile investments in natural capital. Responding specialists also believe that the financial mechanism problem might be resolved to some extent after the GEF Assembly in Beijing in October 2002, where land degradation is predicted to become a focal area, if still 'only' cross-cutting to biodiversity. However, it needs to be ensured that the GEF operational strategy objectives are not undermined by proposals that run counter to (1) conservation, (2) sustainable use and (3) equitable sharing of benefits.

"How would one perceive an involvement of the private market in spending more money on measures for sustainable soil management in times of ever falling commodity prices for agricultural products?"

Jens Mackensen

"There is an urgent need to mobilise investors – private investors, governments – to invest in such natural capital as soils in developing countries! Benefits will be substantial not only for those directly profiting from such investments but also for the investors!"

Eva Ludi

4. Capacity-building approaches

Lacking or ineffective awareness-raising and lobbying activities must be made accountable for the currently insufficient concern for the sustainable use of soils and land

Responding specialists do not agree to the above statement. They do not consider communication activities responsible for insufficient actions to improve soils and land use. They rather believe that the lack of visionary concepts within the land/soil management community must be looked at. Critical evaluation and learning from lessons of the past are seen as important.

"The most obvious problem is that we normally target ourselves for awareness building rather than those with whom we should be partnering."

Julian Dumanski

More needs to be done to raise concern and understanding for directing resources to appropriate actions

Despite the above-mentioned insufficiency at the conceptual level, responding specialists see a great need for more effective awareness-raising programmes. However, soil degradation needs to be addressed in many ways. In a developing country where it is in part a result of lacking alternatives, soil degradation can be addressed through direct investments in improving land use and management systems, and through developing the second and third sectors of the economy, thereby lowering pressure on the land. What is necessary with regard to awareness raising and capacity building is to show that soil degradation cannot be dealt with by technical measures alone, but requires a more holistic approach addressing the different factors responsible for soil degradation and including the different stakeholders.

Activities required for awareness raising and lobbying

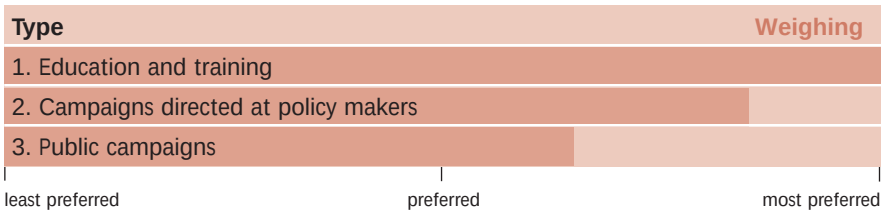


Figure 5a:
Types of capacity building. Relative weighing of selected factors by responding specialists, from most preferred to least preferred.

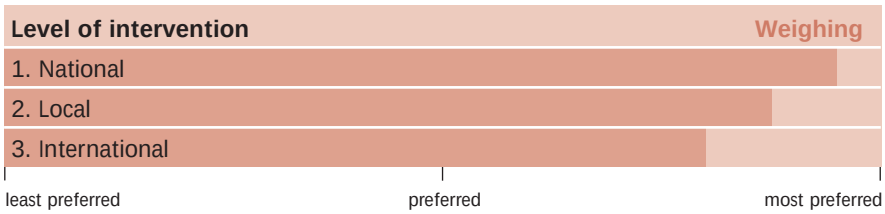


Figure 5b:
Levels of intervention in capacity building. Legend: see 5a.

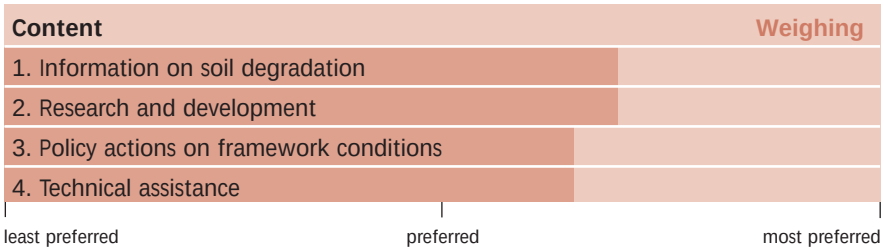


Figure 5c:
Types of contents for capacity building. Legend: see 5a.

Figure 5d:
Promoters of capacity building. Legend: see 5a.

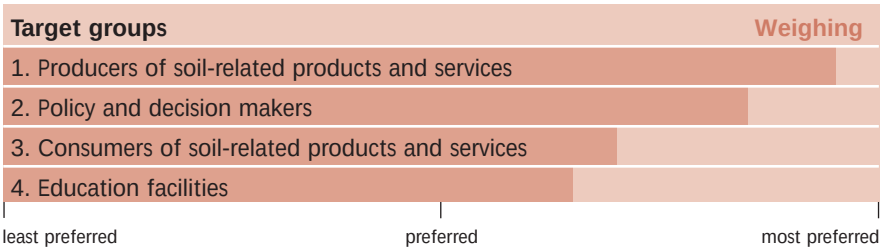


Figure 5e:
Target groups for capacity building. Legend: see 5a.

The average scores by responding specialists in Figure 5 give no distinctive indication of the direction of a particular programme to further awareness and actions to improve sustainable use and management of land resources. However, concerning the types of activities, a clear preference is given to education and training, over campaigns addressing policy makers and, finally, general public campaigns. The preferred level of intervention is the 'national' level, before 'local' and 'international' levels. Concerning content no particular preference is given, while 'land use organisations' have been marked as the most important proponents, before academic institutions, NGOs and governmental organisations. Relating to target groups, preference is given to producers of soil-based products and services, followed by policy makers, consumers and education facilities.

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Contents

part II

Individual contributions to a world soils agenda

A Preliminary Assessment of the Human Impact on Land Systems of the World

Hari Eswaran and Paul Reich

Abstract

Using a global assessment of land quality and an interpolated population density map, we show the spread of land impacted by human habitation and exploitation of natural resources. Land systems defined as 'pristine', 'minimal' and 'low' impact support about 4.3% of the world population (about 235 million people). These three zones occupy 24.4% of the land (31.8 million km^2) and are considered the non-threatened part of the world. However, human society has to be vigilant about these lands, and, wherever possible, revert some of the agricultural and grazing lands back to their natural condition as the earth's reserves. In contrast, the threatened part defined as 'moderate', 'high' and 'very high' impact land systems occupy 34% of the land surface (44 million km^2), and support 89% of the global population (4,900 million people). Countries where such lands dominate are the tension zones of the world. Not only has their environmental integrity been compromised to feed and clothe the people; the planet is also losing its genetic resources at an alarming rate.

1. Introduction

Agroecosystems (AESs) are disturbed environments where biodiversity and species regeneration by natural processes are significantly reduced or hampered by human-induced (anthropic) processes. In general, an AES is a change from a less manipulated, more or less undisturbed natural system to a carefully managed, controlled and manipulated system designed to maximise food and fibre production. Agroecosystems are sustainable to the extent humans make them sustainable. Conversion of natural ecosystems to AESs requires tradeoffs that are essential to the fundamental basis of maintaining, improving or sustaining the development of human resources for civilisations, societies or nations. The tradeoffs become critical when the limits of the land resource are reached and as populations approach or cross the threshold of the carrying capacity of the resource base (Eswaran et al, 1999).

These issues are overwhelming and perplexing. When the ratio of areas of natural to areas of human-changed ecosystems reaches critical levels, the fundamental question becomes: What proportion, or part or component, of biodiversity would society like to preserve in its original natural state? Probably a more important question is: How much biodiversity is required to sustain a healthy earth? Related concerns are the extent to which fragile ecosystems, such as wetlands and steep lands, should be preserved as biodiversity zones, and what price society is willing to pay in terms of reducing the net area for agriculture to maintain such set-aside lands for future generations. Debates on such questions (see Turner (ed.), 1990) have taken place in the United States and many developed countries, and appropriate laws are being implemented. However, such questions have received less attention in many developing countries.

The present study was initiated to obtain a preliminary assessment of global land resources and specifically the geographic areas where ecosystems have been impacted. The purpose of this analysis is to portray different manifestations of anthropic impacts on land. The disturbance of natural ecosystems, though largely for agricultural, grazing or even managed forestry purposes, also includes other activities such as urbanisation, recreational uses, mining and infrastructure to support societal functions. The latter set of human activities is collectively termed *resource consumption*. It destroys the land system almost permanently at the site and for significant distances around the site.

2. Method

The four driving variables characterising AESs are soil, climate, management system and time. Our assessment of land quality (Eswaran et al, 1999) combines the soil and climatic variables and how they influence agricultural productivity. Socio-economic and political factors, frequently more important determinants of the productivity of the land, are not considered in the land quality assessment due to location specificity. We use population density (the interpolated population density map developed by Tobler et al, 1995) as a default variable related to the effects of management and time. This is appropriate for a global or regional assessment but would not be reliable for more detailed or site-specific evaluations. As our intent is to demonstrate broad geographic patterns, population density serves as the proxy indicator for the impacts of land use during a long timeframe. Ehrlich and Holdren (1971) have attempted to distinguish the sources of human impact. Others have simplified the approach by merely relating population density to impact. As humans occupy and manage more than 95% of the earth's terrestrial ecosystems (Western, 1989), high human concentrations generally coincide with loss of biodiversity.

The analysis is necessarily empirical because there are few methods to assess and monitor quality of AESs. Consequently, there are no databases and the assessment has to be made using judgement and assumed relationships between population pressure and inherent quality of land. A digital global land quality map was overlaid on an interpolated population density map of the world. Details of the method are provided in the larger study that is currently being prepared (Eswaran and Reich, 2001).

3. Results and discussion

The basic assumption in the present analysis is that increasing human population density is strongly correlated to a geometric decrease in biodiversity. Through trial and error, humans have sought the most favourable soil and climatic resources for their agriculture. The population increases that erupted around the middle of the 20th century, particularly in developing countries, led to land clearing and exploitation of poorer soils or soils more susceptible to degradation and with a lesser resilience for recovery. Natural habitats became confined to lands not easily accessible to humans. These have specific ecosystem conditions permitting the evolution of species capable of adapting to these conditions. Species that had flourished on the better-endowed lands, now converted for agricultural or other uses for humans, became extinct or have been forced to survive in islands that have not been cultivated for various reasons.

Land system impact classes	Description
P Pristine	Lands undisturbed by humans are probably confined to inaccessible locations such as the very cold (tundra) or dry (deserts) or on mountain tops. These are included in the class designated as 'indeterminate'. There are areas that do not have major constraints for human habitation but are generally devoid of organised communities. The land may be used for hunting and gathering, but these are still of sufficiently low intensity so that habitat conditions do not show any major marks. Such lands are called 'pristine'. The largest contiguous extent of pristine lands is in the Amazon and the boreal forests. Smaller areas are distributed sporadically across the earth's land surface.
a) Minimal impact	Land that has been settled in the past 200 years. Although there has been land degradation, in some cases extensive in the initial period of colonisation, the introduction of some land management technology during the last 50 years has restored the quality of the land. Biodiversity is generally managed but threatened. Today, land is generally well managed; nevertheless, the threat of degradation is omnipresent.
b) Low impact	Land of generally good quality with low population densities. In the western countries there have been large investments in conservation technology. Much of the low impact land was settled during expansion of societies in the last 500 years. In Africa, it consists of a patchwork of agricultural lands interspersed with biodiversity zones. Land degradation risk is currently moderate, but the risk of degradation increases with population pressure, particularly in low-income situations.
c) Moderate impact	Land quality is moderate to high. Due to the relatively high productivity of the land, population pressure in developing countries has not completely degraded the land. However, natural vegetation is generally relegated to unattainable locations, and biodiversity is confined to lands unsuitable for agriculture. Generally, cultivation has been practised for long periods (500 to 1,000 years) in the Old World, and land degradation risk is high, while in the New World, although the duration of cultivation is comparatively short, conservation technology investments are high. Large forest areas of the humid tropics in Africa and Asia belong to this category.
d) High impact	Fully transformed land systems with only occasional pockets of natural vegetation. Biodiversity is almost completely destroyed. Only small areas exist in the New World, but in the Old World such lands are extensive. Under minimum inputs, soil productivity has sustained populations for a long time (>1,000 years). Land resilience is high and thus degradation is not generally felt even though land degradation has inflicted heavy damages to the system. Crop production reductions are rectified with heavy fertilisation, effectively masking impacts of land degradation. However, water pollution indicates the long-term consequences of such practices.
e) Very high impact	Lands with important constraints, colonised recently (<50 years) due to unavailability of other lands. Included are also the urban sprawls, cultivated sloping lands and irrigated drylands. Recent land degradation is generally rampant. Biodiversity is being rapidly reduced or totally destroyed. Urbanisation has consumed good agricultural land and permanently eliminated biodiversity. The 'edge effect' of urbanised areas has similar repercussions and strongly influences natural habitat conditions.
f) Indeterminate	Lands with major constraints (such as being too dry or too cold or too steep) for agricultural development, preventing the development of stable societies. There are large contiguous areas that are pristine. However, there are pockets of lands that have been indiscriminately used for deforestation, mining or other such activities without appropriate controls. Inherent biodiversity is generally maintained in large parts.

Table 1. Land system impact classes used to create the global anthropic land systems map.

3.1. A geography of despair

Figure 1 is a depiction of the state of the global land resources at the beginning of the new millennium. The impact of population concentrations is immediately evident in Fig. 1. Table 1 defines the classes, and Table 2 the areas of the different classes of land identified in Fig. 1. The pristine land system (note that the class designated as 'indeterminate' has large areas that are pristine) type replicates the least disturbed habitats and occupies about 7.9% of global land surface. These lands are in the boreal forests of Canada, the Amazon, desert fringes of Australia and the mountains of Scandinavia. The Amazon area, though evaluated as pristine in this study, is at the same time an example of the progressive and even severity of human impact on the environment of a region. There are many qualitative studies on the demise of plant and animal species such as those reported by Prance and Lovejoy (1985). A quantitative technical stocktaking is urgently needed to better appreciate the close relationship between such large forested areas and global climate change.

There are a few large contiguous areas of pristine land in Africa. However, the study suggests that the Congo Basin and central Kalimantan in Southeast Asia (two sites with the largest contiguous areas of tropical rainforest) are no longer pristine. Apart from the Amazon, the latter two were supposed to be the last vestiges of tropical rainforest. Deforestation and settlements have gradually reduced the pristine conditions of these two areas and have led to increasing degradation. In the states of Sarawak and Sabah of Malaysia on the island of

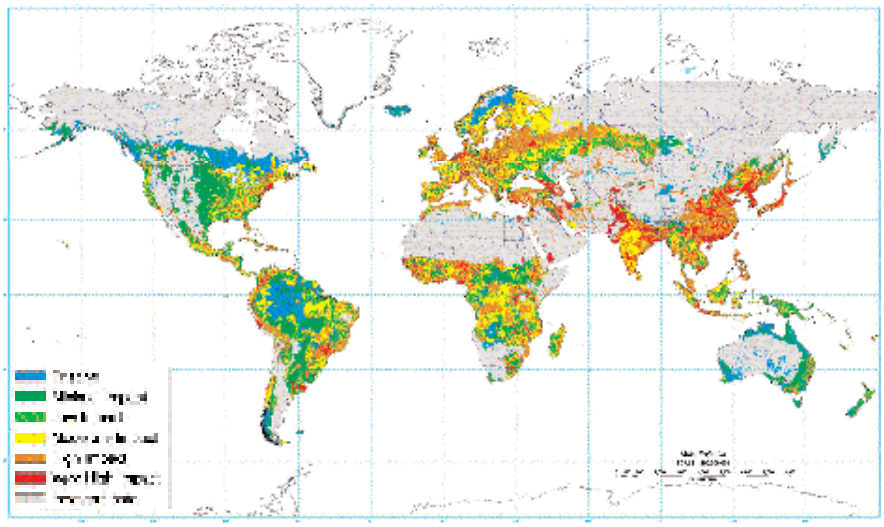

Figure 1: Anthropic systems. U.S. Dept. of Agriculture, Washington D.C., 2000.

Borneo, timber harvesting and conversion of forest to agricultural land since 1960 have significantly impacted the ecosystem (Brookfield et al, 1990). Unique animals, such as the orangutan, are losing their habitat and are becoming protected species sequestered in national parks. In East Africa, even the volcanic lands of Rwanda, Burundi, and Tanzania are being ravaged. The East African highlands, particularly around Lake Victoria, have one of the highest population densities in the world, and its negative impact on habitat conditions is evident today. What was forest just a few decades ago is now intensely used for agriculture or already degraded and abandoned or covered by settlements and towns (Lewis and Berry, 1988). The population-stress-induced agricultural land scarcity and the land-degradation-induced productivity decline have already triggered conflicts between communities and nations. Table 3 shows that, at the scale of the study, there is little pristine land in land quality classes (LQC) I through V, which comprise the better agricultural soils of the world. This analysis prompts two questions. First: Should there be an effort to set aside some LQC I through V lands as biodiversity reserves? Second: What would be the optimum proportion of each land quality class that should be set aside as biodiversity reserves?

Land classified here as 'minimal impact' occupies about 8.3% of the global land area and occurs mainly in the Americas and in Australia. There are probably two reasons for this distribution. Firstly, these areas comprise the New World, where colonisation has only existed for about 200 years, and secondly, population densities have not built up to threaten the land resources. Large areas of these lands have been cultivated and suffered severe degradation during the early years of cultivation. However, they could benefit from the latest conservation technologies and good land stewardship in the second half of the 20th century. Although they belong to LQC I through V, LQC I through III are some of the best soils of the world and have a high resilience. Minimal-impact lands dominate the above-mentioned regions.

Land system impact types	Area (m km²)	% global land area
Pristine	10.25	7.85
Minimal impact	10.84	8.30
Low impact	10.75	8.24
Moderate impact	17.98	13.77
High impact	19.93	15.26
Very high impact	5.87	4.50
Indeterminate	57.65	44.15
Total land area	130.58	100.00

Table 2.
Area occupied by different classes of anthropic impacts. Area with inadequate data is indicated as 'indeterminate'.

A large swath of low-impact zones stretches from the northern part of the Black Sea eastwards along the southern border of the Russian Steppes. Throughout Russian history, the Russian Plains have been the country's breadbasket. The Plains have a high population density and a long history of poor management and land exploitation, particularly during the socialist period. In the past 100 years, the expansion of the area under agricultural, urban and industrial use has progressively reduced biodiversity. The extent of human transformations varies across the Plains, due to variations in climate and soils in combination with population densities, and deserves a more detailed assessment.

In Fig. 1, a simplified pattern is presented. In South America and Southeast Asia, forest clearing for timber has accelerated during the past 50 years. Forest lands have been replaced by poorly managed pastures in the Amazon and by plantation crops in Southeast Asia. Thus, destruction of natural habitats was more rapid in the past 50 years than in any other period in human history. In the tropics, the lands classified as 'low impact' generally have some form of secondary forests. There are specific sites scattered across Asia where land management systems designed for the specific landscape conditions have been maintained for several centuries. Although the original biodiversity composition has changed, the stability of these systems suggests sustainability and opportunities for new habitat conditions; thus, they are considered as being of low impact. Low-impact zones occupy about 8.2% of the global land surface and occur in similar land quality classes as minimal-impact lands. In comparison to the latter, the low-impact zones show a higher density of human communities. The fragmentation of rainforests through the development of a mosaic of cultivated lands and communities is, according to Wuethrich (2000), reaching critical thresholds, above which the forest system may collapse.

Land quality class (LQC)	Antrophic land system impact types											
	Pristine		*Minimal*		*Low*		*Moderate*		*High*		*Very high*	
	area	%	area	%	area	%	area	%	area	%	area	%
I			2.44	59.54	0.97	23.79	0.68	16.65				
II			1.96	30.06	1.44	22.11	2.86	43.77	0.27	4.09		
III			2.93	49.74	1.48	25.09	1.02	17.32	0.46	7.83		
IV			0.83	16.24	1.19	23.23	1.61	31.55	1.49	29.06		
V			2.68	12.55	5.68	26.59	5.83	27.29	6.65	31.16	0.51	2.40
VI	4.53	26.29					5.98	34.71	5.40	31.35	1.32	7.67
VII	3.05	26.18							5.66	48.58	2.94	25.26
VIII											0.10	0.43
IX											1.00	2.73

Table 3.
Areas of land system impact types according to land quality classes in million km² and in percentages of the total area of each land quality class.

3.2. Land cover pattern

Table 4 shows that about 21% of the land surface is cultivated. Lands used for infrastructure, including urban lands, occupy about 0.5% of the global land surface. The remaining lands have been degraded to varying degrees. The proportions of the land cover classes are expressed as percentage within the impact class in Table 4. In the pristine class, the urban and cultivated lands constitute less than 10% of the class, while non-cultivated lands dominate the class. At the other extreme, in the 'very high impact' class, urban and cultivated lands make up more than 55% of the area.

The classes consisting of pristine, minimal-impact and low-impact lands are considered the unthreatened lands. They occupy about 40% of all degradation-susceptible lands (all lands except those considered as indeterminate). Not only large areas of land with natural vegetation, such as forests and shrubs, but also large areas of cultivated lands are threatened. The latter are situated mainly in developing countries in the tropics, where both the inherent quality and resilience of the soils are poor. The high proportion of threatened lands affects the global environmental situation, and the equally high proportion of threatened cultivated lands signals alarm for food security. The threatened lands that still retain some form of natural vegetation are the habitats that are at risk. Biodiversity is being challenged, as will be shown later.

4. Conclusion

At the dawn of the 21st century, the world's land systems bear the imprints of anthropic land use and, in many cases, land degradation. At one extreme, there are lands that have only recently been subjected to exploitation, but have also profited of a few decades of good conservation technology – minimal-impact lands. At the other extreme are the very-high-impact lands, which in general are permanently damaged. Between these two extremes, the land shows various degrees of use or misuse. Depending on the soil and climatic endowments, many of the lands have sufficient resilience to respond to appropriate conservation technologies. If the resilience and response of the various areas can be determined, it would be a good framework to develop national land use policies and enable sustainable agricultural strategies to be developed in those areas where they would be likely to succeed. We must accept the fact that some lands are so badly degraded that only a comprehensive rehabilitation programme and total elimination of human influence for sufficiently long periods can give them a chance to recover.

Planet Earth needs an affirmative action program with the full commitment of all countries and with the goal of attaining an appropriate balance between human needs and ecosystem conditions. The premise for this stems from the following facts:

- A substantial portion of nature is wounded and the healing process is urgent; the level of human impact is extensive and transcends national or regional boundaries.
- Disrupting natural processes has both on-site and off-site, and short-term as well as long-term impacts; we must be careful not to allow the need for land and development to destroy the very resources that can offer solutions to these problems.
- Forcing land resources to produce beyond their productivity leads to the collapse of ecosystems; the risk of habitat degradation and extinction of species increases with the duration of human occupation and with population density.

Land cover	Percentage in each anthropic land system impact class							
	Pristine	*Minimal*	*Low*	*Moderate*	*High*	*Very high*	*Indeterminate*	*Total*
Urban/developed	0.04	0.22	0.50	0.90	1.09	2.05	0.11	0.50
Cultivated	9.13	27.55	32.16	34.18	39.87	53.33	6.03	21.43
Grassland	4.59	10.90	5.53	2.55	7.49	5.52	11.69	8.50
Shrubland	9.46	5.24	4.09	3.51	5.38	9.19	22.98	13.09
Savanna	13.77	21.02	21.18	16.69	14.50	9.20	4.51	11.28
Forest	32.32	32.32	34.03	39.55	26.28	14.76	15.12	25.55
Wetland	23.20	0.20	0.15	0.22	0.29	0.37	1.97	0.99
Desert/barren	3.61	0.68	0.77	0.56	3.01	3.67	25.38	12.12
Tundra	2.21	0.48	0.29	0.31	0.72	0.70	11.12	5.23
Water	2.36	1.39	1.30	1.53	1.38	1.23	1.08	1.32
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table 4.
Land cover patterns as a function of anthropic impact on land.

- Sustainability means understanding and operating within the steady-state conditions of the ecosystem, where each land use type changes conditions to the point where they favour some species and select against others.
- Land is the most permanent measure of wealth of a nation. It is something to be cherished and protected.

Our planet is losing its genetic resources at an alarming rate. Human incursions into natural systems are probably initiating an accelerated process of extinction of species of greater dimensions than the disappearance of the dinosaurs. The core problem is, of course, the increasingly rapid growth of the human population. We must accept that in the threatened and critical zones, purely technological solutions may no longer be an option. We must not allow the pressures of poverty, greed and development to destroy the very resources that can offer solutions to the problem. Soil and water protection, preservation and conservation take on an urgency unprecedented in the history of human society.

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Current International Actions for Furthering the Sustainable Use of Soils[1]

Hans Hurni

Abstract

International actions for the sustainable use of soils are justified by the need to adjust the frame conditions under which local land users operate. The concept of sustainable development likewise provides ample justification to become active at the international level. Multi-level approaches to sustainable land management have been propagated for many years. Stakeholder negotiations must thus involve all levels, from local land users to national bodies and international delegations. At the global level, a number of actions have been taken, such as scientific and policy meetings, programmes to assess soil degradation, and programmes to develop suitable technologies and approaches. A number of working groups and panels have been established to address the need for globally binding agreements such as the newly proposed convention on soils. In addition, it will be instrumental, and maybe much more efficient, to better address the soil issue in existing international conventions, such as the UNCCD, the UNCBD or the UNFCCC. Another initiative is the International Panel on Land and Soil (IPLS), which appears to be a most promising approach with high potential impact on society and the land and soil resources alike. The present working groups of international organisations such as IUSS can provide supplementary inputs to the proposed IPLS, thereby enforcing this interdisciplinary expert body. Last but not least, scientific programmes will need to accompany this work by producing better understanding of the processes of land and soil degradation, and the measures needed to halt and reverse the negative trends now observed as a cumulative effect even at the global scale.

1. Introduction

The degradation of soils is one of the crucial issues of environmental change, not only at the local level, but particularly also at the global scale. Until today, however, soil degradation has been insufficiently tackled at all levels, compared with, for instance, global climatic change or the loss of biological diversity. The inherent risks of soil degradation for all other natural resources, such as water, biological diversity and food security for future generations call for a general framework of sustainable use of soils and their protection from overexploitation, pollution and destruction. Such a framework will have to include all stakeholders concerned, all land use types including nature conservation, and all scales from local action on a particular field to internationally binding agreements. Protective measures and actions are needed at different levels of intervention in order to ensure that local technology and regulative mechanisms complement each other in a long-lasting and sustainable manner. The ecological, economic, cultural and social functions of the soil should be maintained for present and future generations in all nations of the world.

A slogan often cited in the environmental movement of the 1980s and 1990s is *'think globally – act locally'*. While this is certainly still valid, experience has shown that in many cases projects to implement local action failed to achieve their set goals, particularly in soil and water conservation. Many projects have experienced an urgent need for substantial support to local land users wherever investments are necessary to achieve sustainable land management. An issue that has emerged in recent years is the question of incentives. Many projects realised that local land users were not interested in investing more than was directly necessary for the production of their crops unless they received financial, material or technical support (Sanders et al, 1999; Schrader, 2000; Ludi, 2002). Furthermore, a number of studies pointed out that the institutional frameworks around local farming were far from inducive to sustainable development, and that projects could be more successful if these conditions were changed (Pieri et al, 1995; Dumanski, 1997; Hurni, 1998). These considerations call for the creation of a new slogan, namely *'think locally – act globally'*!

The structure of this paper follows the latter slogan, focusing on the need for action at the global level. Based on the paradigm of sustainable development, various concepts to address soil degradation are outlined in a second section following below. A number of global actions, either recently introduced or potentially feasible, are discussed in a third section. Arguments for the feasibility of these different tools for action at the international level are listed in a fourth section, including an appraisal of their potential efficiency at the local level. The present paper thus follows a deductive methodology, proceeding from theory to possible tools, and is not based on empirical data. As sufficient evidence of the effect of global measures down to the local levels is not yet available, this is the only feasible methodology at present. Once various instruments will have been applied also at the global level, it should become possible to test their impact empirically.

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[1] This paper is an updated and enhanced version of a keynote prepared by H. Hurni, H.-P. Liniger and K. Meyer entitled 'Feasibility and potential impacts of international actions for the sustainable use of soils', orally presented by Hans-Peter Liniger at the 11th Conference of the International Soil Conservation Organisation (ISCO) on 28 October 2000 in Buenos Aires.

2. Concepts to address soil degradation

Sustainable development was defined in 1987 as development that 'meets the needs of the present without compromising the ability of future generations to meet their own needs' (WCED, 1987). This definition was universally accepted as a common goal at the UN Conference on Environment and Development (UNCED) in 1992. How does this concept relate to soil degradation?

Problems of land degradation can be documented in many parts of the world to various degrees with various impacts. The main natural resources affected are soils, water, natural vegetation, cultural plants and wildlife. Perceptions of the damaging effects of these natural resource problems, however, vary greatly not only between land users and other stakeholders but also within each of these groups and with time (Hurni, 2000). From an economic perspective, for example, an environmental problem might be assessed in terms of its short-term costs and benefits, disregarding long-term social and ecological impacts. The economic viability of environmentally friendly technologies may be assessed very differently at the household and societal levels. The social perspective of a community, a region or a country may take account of poverty issues, social differentiation of affected groups, or societal and political effects, but disregard economic considerations. The ecological perspective, finally, may consider only the effects of land degradation on nature, i.e. wildlife, vegetation and ecological processes, disregarding both social and economic problems.

Thus, the three dimensions of sustainable development – ecological, economic and social – may be highly contradictory and conflicting. Ensuring that actions undertaken have a positive effect in all three dimensions for all involved stakeholders is a challenge that may be difficult to meet in many instances.

Practical tools such as the Sustainable Development Appraisal (Hurni and Ludi, 2000) were developed to make this difficult task easier in real case applications. Integrated watershed management was also used as a landscape unit approach to sustainable land management in many countries such as, for instance, Kenya (Liniger et al, 1998).

The concept of 'Sustainable Land Management' (SLM) evolved in light of the above discussion on sustainability (cf. Dumanski, 1997). SLM can be defined as 'a system of technologies and/or planning that aims to integrate ecological with socio-economic and political principles in the management of land for agricultural and other purposes to achieve intra- and intergenerational equity' (H. Eswaran, personal communication, 1996). A central element of the approach used in the appraisal of sustainable land management is its multi-actor perspective (Hurni, 2000). In response to this concept, a 'multi-level stakeholder approach to sustainable land management' has been developed for finding feasible, acceptable, viable and ecologically sound solutions at the local scale (Hurni, 1998). Such an approach includes all levels from local to global.

For measures to be developed at the global level, however, it was considered more adequate to address a more clearly identifiable natural resource instead of 'land'. Therefore, 'soils' were placed at the centre of possible action despite the theoretical requirement to pursue a more holistic approach where 'land' would encompass multiple natural resources such as soil, water, vegetation and wildlife.

3. New approaches at the global level

3.1. Recent soil initiatives with worldwide effects

The series of conferences organised around the 'land' theme presents one example of an attempt to bring together experiences at the global level, and to learn from each other over large distances. Numerous workshops related to 'land' and 'soils' have been held at the global level since the 1970s, organised by organisations such as WASWC, IBSRAM (now IWMI), IUSS, ISRIC, FAO and others. A major attempt to look at problems of soil degradation at the global level was the 'Global Assessment of Human-induced Soil Degradation' (GLASOD), which showed that soil degradation damage in one form or another occurs in virtually all countries of the world (Oldeman et al, 1990). One third of the world's agricultural soils, or roughly 2 billion hectares of land, were reported as being affected by soil degradation. Water and wind erosion account for 84% of this observed damage, while other forms such as physical and chemical degradation are responsible for the rest. Industrialisation and urbanisation have caused specific forms of soil degradation. Most damage, however, is the result of inappropriate land management in the various farming systems from subsistence to mechanised farming.

The GLASOD data have provided a first scientific basis to assess soil degradation. However, the data are based on expert guesses and therefore need to be refined by collecting more quantified, empirical information showing the trends in global soil degradation. This may be achieved within the next 10–15 years by programmes such as the global and national 'Soil and Terrain Digital Database' programme, called SOTER (Oldeman, 1999). SOTER is a joint programme by ISRIC, FAO and UNEP.

A further initiative at the global level heading in the same direction was launched at the 7th ISCO Conference held in Sydney in 1992 – the programme WOCAT: 'World Overview of Conservation Approaches and Technolo-

gies' (see Box 1). WOCAT was designed to overcome the deficiency that on a global scale, little is done to document and make available information created by many specialists who assist local land users in improving soil and water productivity through Soil and Water Conservation (SWC) measures. WOCAT uses a standardised framework for the evaluation of soil and water conservation and makes the data available in various forms, including the Internet. Today, more than 25 countries have initiated WOCAT, are establishing national databases and are contributing to the global database (WOCAT, 2000). Complementary to GLASOD's and SOTER's assessments of soil degradation, WOCAT explicitly demonstrates what is done against this degradation.

3.2. A proposal for a Soil Convention (SC)

Chapters 10 to 14 of Agenda 21 of the UN Conference on Environment and Development of 1992 call for a responsible approach to soils. In order to make the recommendations of Agenda 21, supported by earlier texts such as the World Land Charter of FAO (1981), or the 'European Land Charter' of the European Council (1989) more effective, it may be necessary to develop internationally binding goals and rules for a lasting commitment to land and soil preservation. As an instrument for enforcing international rules, conventions on various global environmental problems have recently been developed by the UN and have been ratified by states and assigned to plans of action (e.g. the UNFCCC convention on climate, the UNCBD on biodiversity and the UNCCD on desertification).

Since the early 1990s, various experts and scientific bodies have recommended to develop a binding instrument on soils as an international framework for actions at all levels (Held, 2000). Based on these recommendations, the 'Tutzing Initiative for a Soil Convention' (TISC) was launched in 1997, proposing a 'Convention on the Sustainable Use of Soils' (Soil Convention). A draft was written with the support of experts and representatives from NGOs and from relevant disciplines (Tutzing Project "Time Eco-logy", 1998).

TISC underlines the importance of the UNCCD as a first step towards sustainable use of soils and land management. The proposal has been widely and controversially debated. Many persons and organisations, such as IUSS, WASWC and the Commission on Environmental Law (CEL) of IUCN actively support it, while others remain reserved. The feasibility of such a convention will thus have to be tested, both scientifically as well as in interactions with policy makers, country delegates of the UN system, national governments, administrations and NGOs.

Box 1:
World Overview of Conservation Approaches and Technologies (WOCAT)

WOCAT's mission is to provide tools that allow Soil and Water Conservation (SWC) specialists to share their valuable knowledge in soil and water management, that assist them in their search for appropriate SWC technologies and approaches, and that support them in making decisions in the field and at the planning level.

WOCAT was established as a global network of SWC specialists and institutions. It facilitates more efficient use of existing know-how and, consequently, of development funds. It thus helps to optimise the implementation of appropriate SWC and to avoid duplication of effort. WOCAT also contributes to the implementation of UN conventions, such as the UNCCD, the UNFCCC and the UNCBD.

Internet: http://www.wocat.net

3.3. A new IUSS working group: IASUS

In 1998, the International Union of Soil Sciences (IUSS) established an international working group, subsequently named 'International Actions for the Sustainable Use of Soils' (IASUS, see Box 2).

Since 1998, IASUS has started to appraise international tools to enhance sustainable use of soils, such as the World Soils Charter (UNESCO-FAO, 1980), programmes of the Global Environment Facility (GEF), and international conventions such as UNCCD, UNFCCC or UNCBD. A particular focus was placed on the appraisal of the impact of these current agreements in relation to sustainable soil management, particularly at the national and local levels. The work-

Box 2:
Goal of the IUSS Working Group 'International Actions for the Sustainable Use of Soils' (IASUS)

IASUS shall investigate the feasibility and possible impact of internationally coordinated activities for enhancing the sustainable use of soils, such as panels, conventions, monitoring systems, transfer mechanisms, approaches and technologies, and develop specific elements that are essential to induce and/or enhance such action. As a first step, IASUS has produced recommendations for the 17th World Congress of Soil Sciences of IUSS, to be held from 14–21 August 2002 in Bangkok (www.17wcss.ku.ac.th), on how to put soil degradation and sustainable use of soils on the international policy agenda and stimulate effective action.

Objectives of the IUSS Working Group IASUS:

a) To assess the instrument of a global soil convention with the help of stakeholders and decision makers
b) To elaborate arguments for its justification
c) To make a review on the feasibility of introducing an internationally binding agreement

ing group supports the global overview of soil degradation, GLASOD, and its current refinement methodologies, SOTER (ISRIC), as well as the WOCAT programme. IASUS further intends to develop and publish concepts, strategies and programmes to enhance coordinated action at the international level, and will provide support to national institutions and programmes. IASUS will present the intermediate results of its work at the current WCSS of IUSS in Bangkok to a broader group of soil scientists.

3.4. Activities of IUCN's Commission on Environmental Law (CEL)

In early 2000, the IUCN Commission on Environmental Law's Sustainable Soils Working Group (CELSSWG) was charged with the responsibility to further investigate the feasibility of introducing a convention for the sustainable use of soils. In particular, it was to develop specific elements that are essential to be included in the environmental law and policy for the sustainable use of soils (Hannam, 2000).

Furthermore, the CELSSWG shall examine existing legislation in relevant states with regard to soil conservation and associated policy material, with a view to assessing its adequacy to satisfactorily manage soil and land degradation problems and to enable sustainable management of soil. The CELSSWG will further develop the specific elements that may be used to formulate effective environmental law and policy to manage soil and land degradation, and prepare outlines of suitable legislation that may be adopted by the nations and states concerned. To assist this process, the group will prepare guidelines and explanatory materials to accompany the principles of legislation and policy, and possibly 'mode' legislation. The working group will also examine the TISC document as a possible format for a convention on sustainable use of soils, and advise the Environmental Law Centre (ELC) of IUCN concerning the most appropriate form that a possible convention for the sustainable use of soils should take (Hannam, 2000).

3.5. An Intergovernmental Panel on Land and Soil (IPLS)

In 2000, a new initiative was launched by the German Advisory Council on Global Change (Pilardeaux, 2000), arguing that an Intergovernmental – or alternatively, an International – Panel on Land and Soil is needed to ensure that the issue of soils is addressed at a global level. The difference between 'intergovernmental' and 'international' would be that the former is an expert group officially installed by national governments in fulfilment of an international convention, while the latter is a less formal body at the international level accountable neither to national governments nor to a specific UN convention.

The author takes the Intergovernmental Panel on Climate Change (IPCC) as an example, on the experience of which a panel on soils could be based. According to Pilardeaux (2000), the current lack of scientific advice on international soil protection policy has several reasons:

a) the UNCCD and other conventions need to be improved in terms of their implementation control by developing a basic set of global indicators (of both implementation and impact) related to specific resources and ecosystems;
b) in particular, global monitoring of soil degradation is insufficient and needs to be better coordinated and enhanced; and
c) the potential of soils and biological sources such as sinks for greenhouse gases needs to be better assessed.

A scientific body for soils would thus be required to provide independent scientific advice to one or more UN conventions. This body could evaluate their effects from the particular point of view of one major natural resource. An International or Intergovernmental Panel on Land and Soil (IPLS) could thus be created to deal with the scientific questions mentioned above in order to support the development of global strategies for soil protection. The specific task of an 'international' IPLS could be to provide information to the different Committees on Science and Technology of the various conventions, which would in turn include the scientific findings of the IPLS in their Conferences of the Parties.

4. Feasibility and potential impacts of international actions

International actions such as conferences, workshops, seminars or field tours of scientists, experts and practitioners are relatively easy to organise and have a learning effect for those participating. Impact beyond the involved actors, however, may be small. Proceedings from these meetings may help to broaden the range of possible learning effects to some extent. All in all, however, land users as the ultimate target group will benefit only marginally from these meetings.

Worldwide programmes such as GLASOD, SOTER and WOCAT are subject to limitations already at the implementation stage because of insufficient funding. It is hard today to find sufficient donors to help such large-scale, information-based, science-oriented programmes achieve global coverage within short periods of time. Consequently, these programmes are rather superficial and may contain improper information (like GLASOD), or their global spreading is very slow, as is the case with SOTER and WOCAT. The potential impact of the latter is coupled with the number of partner institutions that apply the programmes, hence the overall global impact has remained small despite many years of activity and efforts.

In relation to the Tutzing Initiative for a Soil Convention (TISC), much effort has been invested by many individuals and NGOs since 1997. Government administrations and political leaders of donor countries, however, have been strongly hesitating to adopt the idea. For example, the German Minister for the Environment, at the CSD annual conference in New York in April 2000, took a cautious position vis-à-vis initiating yet another international convention at a time when implementation of the present ones is rather difficult. He put emphasis on the inclusion of sustainable soil management in existing conventions and suggested they might be expanded if necessary. When seen from a political

point of view, the likelihood of governments endorsing and ratifying new internationally binding agreements appears to be relatively small at present. It seems the soil community has not been able to prove how vital a soil convention is to improving sustainable soil management. Feasibility assessments for international agreements will thus be needed both at the political and the scientific levels.

Nevertheless, as an internationally binding agreement a soil convention would provide clear benefits on several levels. For example, compensation mechanisms for internalising land damage caused by export products could be institutionalised, as could compensation mechanisms for globally beneficial measures relating to climate change and desertification, e.g. carbon sequestration in soils. Common norms and methodologies to monitor current soil degradation could be developed, and best suitable rehabilitation measures to be taken by governments of particular countries, as well as by individuals, could be proposed. Binding agreements could also stimulate national governments to better integrate soil and land issues in education, training and communication.

The practicability of the two major working groups concerned with international soil agreements, IASUS and CELSSWG, will depend on the funding made available to support their work. In view of the low interest of donor governments in such agreements, even a moderate budget for working group activities appears difficult to obtain. The potential impact of these working groups, however, may become considerable once they raise public interest in the problem of soil degradation and stimulate global action. Proper funding could place the working groups in a position to elaborate arguments for international action, to support international discussion on such action, and to review the political feasibility of appropriate measures. Although they would not have a direct impact to reduce soil degradation on the land, their indirect effect could nevertheless be considerable.

Finally, an 'international' (as opposed to an 'intergovernmental') International Panel on Land and Soil (IPLS) seems to have even a greater potential effect than the working groups, since it could be more widely acknowledged and its work more focused on international needs. Formally, an international panel would be much easier to create than an intergovernmental one, as this could be done by organisations such as UNEP or ICSU. The IPLS would be composed of multidisciplinary teams that would review scientific results. At the same time, they would also raise funding for international research programmes such as SOTER and WOCAT, and thereby directly address the problems of soil degradation at multiple levels and scales. The 'international' IPLS would feed the results back into communication channels to raise public awareness, and into science and technology committees of the UN conventions. It may prove difficult to obtain the necessary funding for such a panel, but hopefully the IPLS would be able to raise funding both for research and for implementation activities. Of all the different initiatives taken in the past by soil specialists and other scientists, an 'international' IPLS would thus be most promising. The 17th WCSS provides a unique opportunity to place IUSS among the key stakeholders of such an IPLS, as it is the most prominent organisation focusing on soils as a unique and vital resource on earth.

List of Abbreviations

CDE: Centre for Development and Environment, University of Berne, Switzerland
CEL: Commission on Environmental Law (of IUCN)
CELSSWG: Commission on Environmental Law Sustainable Soils Working Group
CSD: Commission on Sustainable Development (of the UN)
GLASOD: Global Assessment of Human-induced Soil Degradation, a programme by ISRIC and UNEP, http://www.isric.nl/GLASOD.htm
IASUS: International Actions for the Sustainable Use of Soils, a working group of the IUSS
IBSRAM: International Board for Soil Research and Management, now IWMI
IPCC: Intergovernmental Panel on Climate Change
IPLS: International (or Intergovernmental) Panel on Land and Soils
ISCO: International Soil Conservation Organisation
ISRIC: International Soil Reference and Information Centre, Wageningen, The Netherlands, http://www.isric.nl
IUCN: World Conservation Union, Gland, Switzerland
IUSS: International Union of Soil Sciences
IWMI: International Water Management Institute, Sri Lanka
SDA: Sustainable Development Appraisal – a methodological tool for participatory field work. CDE, Berne: www.cde.unibe.ch/programmes/africa/afr22.html
SLM: Sustainable Land Management
SOTER: Soil and Terrain Digital Database, a programme of ISRIC, FAO and UNEP
TISC: Tutzing Initiative for a Soil Convention
UNCBD: United Nations Convention on Biological Diversity
UNCCD: United Nations Convention to Combat Desertification
UNCED: United Nations Conference on Environment and Development, Rio de Janeiro, 1992
UNFCCC: United Nations Framework Convention on Climate Change
WASWC: World Association of Soil and Water Conservation

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International and National Law and Policy to Manage Soil Degradation

Ian Hannam

Abstract

Over the course of the 20th century, there has been an increased global consciousness to protect the environment, with a steady growth in international law focusing on the resolution of global environmental problems. During this time, new principles emerged concerning state responsibility for protection of the environment, and to encourage cooperation between states to deal with environmental problems. Since the 1992 United Nations Conference on Environment and Development (UNCED), more responsibilities have been placed on states to protect the local, regional and global environment, especially with regard to problems shared by the whole community, such as climate change, depletion of biodiversity, and soil degradation. This has brought a greater focus on the need for more effective implementation of international environmental law and policy for the sustainable use of soil. One of the challenges is to increase the level of implementation of international environmental law and policy through national soil legislation and policy. It is now well known that complex scientific, social, cultural and economic issues need to be taken into account when developing or strengthening these legal frameworks and to achieve the sustainable use of soils (Bridges et al, 2001).

1. Background

The seriousness of soil degradation problems identified by the scientific community in the decade since UNCED 1992 has motivated soil scientists into seeking better international and national legal instruments to manage soil. The challenge has now been taken up by the IUCN (the World Conservation Union), which, at its World Congress in Amman, Jordan, in October 2000, passed the Resolution:

Requesting the Environmental Law Programme, in its development of legal guidelines, explanatory material and investigation into a global legal instrument for the sustainable use of soils, to pay particular attention to the ecological needs of soils and their ecological functions for the conservation of biodiversity and the maintenance of human life.

The Commission on Environmental Law of the IUCN has established a specialist working group to implement the Resolution (Hannam, 2001a). The IUCN decision is enhanced by the Montevideo Programme III (the Programme for the Development and Periodic Review of Environmental Law for the First Decade of the Twenty-First Century), adopted by the Governing Council of the United Nations Environment Programme (UNEP) in February 2001. The specific Objective for Soils (Objective 12) as part of the strategic Environmental Law Programme advocates the development of international agreements, international guidelines, principles and standards, as well as the development of the capacity to formulate and implement these instruments and guidelines. Various aspects of the programme support a general initiative for soil legislation reform, including undertaking actions to improve the effectiveness of soil environmental law, improve the conservation and management of soil, and forge better links between soil environmental law and other fields of environmental law. Objective 12 promotes the review of domestic land use laws and change of land use laws and tenure systems, with the aim of achieving soil conservation and reclamation goals. It promotes the integration of soil conservation measures into relevant domestic laws, taking into account relevant international instruments such as the United Nations Convention to Combat Desertification.

2. Legal regimes

The 1980s and 1990s witnessed a growth in a broad range of environmental law at the international and national levels to manage the natural environment. However, law reform to control and manage the effects of soil degradation has featured rather poorly in this period. Legal and institutional frameworks in most countries treat soil degradation in a fragmented way (Khan, 1993; Hannam and Boer, 2001). The current degraded state of the world's soil resources clearly justifies a review of the effectiveness of the existing international and national legal framework as it relates to the control and management of soil degradation. In the past, the main type of legislation aimed at the control of soil degradation has been the 'soil conservation law' (Grossman and Brussaard, 1992; Khan, 1993). The legislation has a land utilisation focus which is no longer adequate to effectively protect and manage the world's soil. As the area of land affected by soil degradation has grown, practical soil conservation techniques have been developed and applied in conjunction with the expansion in agricultural activity (Hudson, 1995). The conservation capabilities of the legislation are overshadowed by the objective of agricultural production, price support schemes for domestic and export needs, land settlement and land development schemes. The general features of the legislation include provisions for: soil and land survey; land evaluation and land use allocation; soil erosion control projects; community advisory groups; project planning; and some compliance provisions (Hannam, 2001b). Soil conservation legislation was introduced in the early 1900s primarily to control the effects of soil erosion by wind and water and has been prominent in colonial Africa, Australia, New Zealand, the United States and some European and Asian nations. By the early 1970s it was stated that 'the general object of soil

conservation legislation is to induce those whose activities affect the soil to act in a manner that preserves its desired qualities to a greater extent than their normal manner of operation would do' (Christie, 1972; UNEP/FAO, 1999). Towards the end of the last century, and in pursuance of a sustainable land management goal, it was clearly acknowledged that a wide range of land management programmes, policies and educational initiatives, as well as better national and local laws are necessary if such a goal is to be successfully achieved (Hurni, 1996; El-Swaify, 1999).

3. Basic principles for the legal protection of soil

A number of basic principles are recognised as essential to consider in the preparation of legal instruments for soil. Soil has a fundamental role in the terrestrial ecosystem as a three-dimensional body performing a wide range of ecological functions. Alteration of soil processes leads to changes in the function of ecosystems, and many environmental problems which become apparent in other media, actually originate within the soil (Pimental and Sparks, 2000). It is essential that the *principal functions of soil,* which include its ecological functions, cultural functions and its land use functions, must strongly influence the structure of national and international legal frameworks for soil. The ecological functions, in particular, should be qualitatively and quantitatively safeguarded and preserved in the long term to conserve biodiversity and maintain human life.

4. Legal frameworks

Law makers face a challenge in developing effective legislation for soil given the volume of soil science knowledge, the inherent risks or uncertainty that characterise many actions involving the use of land resources, and the economic and social importance attached to soil and land. Well-designed legal frameworks are essential to guide this process, to prevent or minimise the risk of soil degradation, and to provide a basis for the sustainable use of soil. Legislation may be used to prohibit or restrict land use activities as well as to provide economic and practical incentives. It also has an important role in the establishment of institutional mechanisms to develop practical land management measures, ensure effective compliance, monitor the performance of land management programmes, and enable the necessary changes to the law so that it remains effective. Establishing efficient institutions, both internationally and nationally, is one of the most important roles of legislation, though it is often underestimated.

Experiences with national soil legislation indicate the type of elements necessary for a successful international regulatory framework to tackle the problem of soil degradation (Hannam, 2001b). The causes and effects are similar worldwide and the degree and severity of soil degradation present it as a global environmental problem. Moreover, the physical and social impacts of soil degradation do not stop at political boundaries. Isolated unilateral action by individual states can never be enough to address all activities and processes of soil degradation. Whatever the soil degradation problem, and at whatever level, the effective management of natural resources must be based on common objectives and agreed means and approaches, supported where appropriate by concerted bilateral, regional or global action (IUCN, 2000). An examination of existing national soil legislation indicates that a broad range of legal mechanisms have been used across the world over many decades to protect and manage land, including acts, decrees, resolutions, ordinances, codes regulations, circulars, decisions, orders, and by-laws (Hannam, 2001a). The actual number of individual laws far exceeds the number of countries which have some form of law as many countries have multiple mechanisms within their soil legal framework (i.e. a principal act accompanied by a code, regulation, ordinance, etc.). A few countries, like the UK, have up to 15 soil legislation mechanisms covering a broad range of items, including soil planning, access, organic farming practices, nitrate sensitive areas and soil restoration. Some countries with multiple states or provinces (e.g. United States of America, Australia, Italy, India) have a system of soil legislation that includes a form of federal soil law with each state or province having its own individual soil legislation and other supportive legal mechanisms (Bradsen, 1988; Tran et al, 1997; Krasnova, 2000).

The effects of the increase in human population of the world, especially the decline in food security, now underline the fact that soil has ecological limits. There is an increasing imbalance in the production of food due to the difference in the rate of deterioration of soils and their functions and the rate of their regeneration (Bridges et al, 2001). This situation requires an in-depth reconsideration of human attitudes to natural resources in general, but to soil in particular. This challenge has been taken up by the principal soil science organisations, and other important movements such as the global Soil Campaign of the Foundation Charles Léopold Mayer (Dosso et al, 1995) are attempting to create an awareness and knowledge of soil among all humans, with the main objective to:

- change the attitude of humans towards the vital importance of soils;
- raise the 'status' of soil by advising governments of the world of the way to manage their soil as a very slowly renewable resource; and
- build the foundations of an international front against soil deterioration.

5. Multilateral environmental treaties and agreements

The most logical way to approach an analysis of the international legislation for soil degradation management is to review the relevant instruments of the two broad categories of environmental law instruments (United Nations, 1999). Instruments within the two categories have various characteristics of timeliness, political acceptability, complexity of the ecological problems to be dealt with, the technical ability of developing nations to implement legal instruments, and the finances and resources required for effective implementation.

5.1. Non-binding instruments

Non-binding instruments, sometimes referred to as 'soft law', are resolutions adopted by intergovernmental bodies, and can take the form of recommendations, guidelines, programmes of action and declarations of principles. States can accept them as a guide for future action, even though they are not mandatory. Elements of 'soft law' may be included in binding instruments at a later stage, and thus become 'hard law'. This reflects the evolutionary character of international law on a particular subject. The main feature of non-binding instruments over binding instruments is that they can be achieved within a shorter timeframe because they are not mandatory and do not require ratification. A non-binding instrument can also be in the format of international guidelines and statements of 'best practice', perhaps in the form of a code of conduct. Examples of non-binding instruments relevant to soil include (see Hannam and Boer, 2001):

- Stockholm Declaration on the Human Environment (UN, 1972);
- European Soil Charter (Council of Europe, 1972);
- World Conservation Strategy (IUCN, 1980);
- World Charter for Nature (UNEP, 1982a);
- World Soil Charter (FAO, 1982) and World Soils Policy (UNEP, 1982b);
- Rio Declaration (United Nations, 1992a) and Agenda 21 (United Nations, 1992b).

5.2. Binding instruments

The generic term 'treaty' is regularly used to embrace instruments that are binding at the level of international law and are concluded between international entities, regardless of their formal designation. A treaty, in the generic sense, is also synonymous with the terms 'convention', 'agreement' and 'protocol', and is a binding instrument, where the contracting parties intended to create legal rights and duties, concluded by states or international organisations with treaty-making power, and governed by international law. A treaty is normally open for participation by the international community as a whole, or by a large number of states. Usually the instruments negotiated under the auspices of an international organisation are called conventions. The structure of a treaty can range from very formal to less formal, where the latter may be in the form of an agreement that deals with a narrower range of subject matter than the former. A treaty can also take the form of an instrument of a technical or administrative character, signed by the representatives of government departments, but not subject to ratification. Another structural form of treaty, referred to as a 'protocol', is a binding instrument that is subsidiary to an existing treaty, and drawn up by the same parties. Protocols can deal with ancillary matters, such as the interpretation of particular clauses of the existing treaty, formal clauses not inserted in the treaty, or the regulation of technical matters. They can establish additional rights and obligations to an existing treaty and can enable certain parties of the existing treaty to establish among themselves a framework of obligations that reach further than the general treaty and to which not all parties of the general treaty consent. There is also the option of an instrument with specific substantive obligations that implements the general objectives of a previous framework or umbrella treaty. This ensures a more simplified and accelerated treaty-making process. Finally, there are protocols that contain supplementary provisions to a previous treaty (United Nations, 1999). Examples of international binding instruments relevant to soils include:

- Convention to Combat Desertification (UNEP, 1994);
- Convention on Biological Diversity (UNEP, 1995a);
- Framework Convention on Climate Change (UNEP, 1995b);
- Kyoto Protocol (Climate Change Secretariat, 1997).

5.3. Relevant regional agreements

A number of regional binding instruments include provisions for the sustainable use of soil. These cover the South Pacific region, Central and Northern Africa, the Alpine area of Europe, Southeast Asia and the Mediterranean. Examples are:

- African Convention for the Conservation of Nature and Natural Resources, 1969;
- the ASEAN Agreement on the Conservation of Nature and Natural Resources, 1985;
- Convention Concerning the Protection of the Alps, 1991; and
- the Protocol for the Implementation of the Alpine Convention of 1991 in the area of Soil Protection, 1998.

5.4. Other international initiatives

In addition to the existing formal instruments of environmental law, a number of initiatives have been undertaken as attempts to introduce new environmental instruments with either broad-ranging or specific provisions important for the conservation of soil, including:

- the Forest Principles, 1992 (Tarasofsky, 1995);
- the Draft International Covenant on Environment and Development, 1995 (IUCN, 2000); and
- the Tutzing Proposal for a Soil Convention, 1997 (The Tutzing Project "Time Ecology", 1998).

6. Overview of the existing international regime

It is regarded that the current international environmental law regime is inadequate to cater for the principal international and national environmental law needs to manage soil degradation. The existing global binding instruments are insufficient as a framework and fall well short in including a sufficient range of legal elements that are needed to protect and manage land in a sustainable way. Although some current international non-binding instruments include general concepts relating to the control and prevention of soil degradation that are still relevant in the 21st century, they do not recognise soil as an important element of the terrestrial ecology. Finally, the existing international environmental law regime does not provide specific guidelines for states to approach the reform or development of national soil legislation. These inadequacies are particularly obvious when the current national and international situation is compared to the desired international position for soil legislation under the objectives of the IUCN Soils Resolution and the UNEP Montevideo Programme III objective for soils.

There are a number of global land resource management issues that have a major influence on the level to which international regulation can be effectively implemented. The uneven spatial and temporal distribution of populations and consumptive needs among nations creates an uneven distribution of capital available for soil protection. This is also affected by the uneven distribution of productive, unutilised, under-utilised or degrading soils, the substantial variation in the cropping systems and the occurrence of highly productive soils (Bridges et al, 2001). As the world's population continues to grow, the balance between surplus production and food deficit changes. What we have today is a substantial variation between nations with the opportunities to transfer knowledge on the sustainable use of soils, predicting and combating degradation threats and achieving sustainable land management, and those who have no such opportunities. This leads to a number of important soil scientific factors that need to be grappled with by both international and national environmental law:

- Soil degradation has a significant impact on the total environment.
- The amount, type, degree and severity of soil degradation vary between different landscapes.
- Soil degradation affects the global environment because it represents a loss of integral components of the land and systems of living organisms.
- Good quality soils used for agriculture are in danger of being lost to non-agricultural uses, being sealed by urbanisation, roads, etc.
- Soil degradation causes damage to the land resource by soil erosion, contamination, change of physical or chemical state (acidification, compaction, salinisation) 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 usage associated with agriculture.
- Losses of biodiversity are generally related to changes in land use, including deforestation, agricultural intensification and urban expansion, which are associated with soil degradation.
- Accelerated soil degradation is mostly human-induced and it occurs in all eco-regions of the world, irrespective of the social, economic and political conditions.
- Accelerated soil degradation exacerbates the scarcity of productive lands and is, therefore, a major threat to global food security.

7. An international legal framework for soil

A number of complex steps are involved to achieve a desired goal of sustainable use of soil, starting with the opportunity for input by all interest groups, including international environmental organisations, interested states, soil scientific institutions, private sector stakeholders and non-governmental organisations. Such a process is founded on building an adequate understanding of current soil degradation processes and issues (in particular severity and distribution) to enable a clear vision of what the benefits of an international sustainable soil legal framework might be. Some essential elements that should appear within an international legal framework for soil are:

- the fundamental biological principles for sustainable soil management;
- a consolidation of the relevant elements of existing international soil policies;
- guidelines on the legal, biological and policy requirements for the ecologically sustainable management of soil;
- links between an instrument on soils and other international environmental instruments;
- guidelines for states to legislate or reform legislation on soil, ensuring recognition of soil as a part of the biophysical environment;
- the promotion of public awareness of the need for soil conservation; and
- guidelines for soil environmental education and public participation programmes.

In considering which type of framework may be appropriate to re-evaluate the legal mechanisms to control and manage soil degradation, it is essential to view the elements that may be applied to achieve sustainable use of soil. The principal underlying ethic of an international framework is recognising the basic rights of the natural environment and of humans to a healthy environment, and the obligations on respective parties to observe these natural rights. The general expectation is that the world community as a whole, and respective states, will seek to protect and conserve soil resources for the benefit of present and future generations. There

will be circumstances where a state, exercising its rights and obligations, will require access to judicial and administrative proceedings, including redress and remedy. A state may seek to take legal action against another for the effects of soil degradation, arising from the transboundary effects of unsustainable soil use. Some of the elements considered as essential for a soil legislative framework at the national level include:

- the goals and objectives for an ecologically sustainable approach to soil management;
- obligations on government, landowners, managers and the community to cooperate on soil conservation;
- the development of soil policy, guidelines and ecological standards;
- promoting soil conservation through a mix of regulatory and non-regulatory means;
- mechanisms to enable soil to be conserved and managed on all classes of land; and
- promoting an integrated approach to the management of natural resources as a whole.

The basic societal obligations that need to be enshrined in the global regulatory framework to prevent and control soil degradation include:

- the ethic to conserve and protect soil, globally;
- the development and maintenance of up to date information on the ecological status of soil;
- the establishment and maintenance of ecological soil standards for the principal land uses;
- monitoring soil condition and informing the world community on a regular basis;
- preparing adequate soil knowledge for developing countries, and giving guidance as to how this knowledge may be effectively implemented in the developing countries;
- forging effective links between the existing international environmental instruments which have a role in soil degradation management; and
- outlining the procedures for the global community to take international judicial action against states who use their soils in an ecologically unsustainable manner.

8. Conclusions

This paper concludes that both the international and national legal regimes for soil can be substantially improved. Over the past five years or so, there has been an increasing realisation within the soil science community and related groups that a new, improved, international environmental law instrument is a critical component of the strategic plan for sustainable land management into the 21st century. This motivation is confirmed by the fact that over the last two years, no fewer than six major international soil conferences have been held where this issue has been a major discussion item, and that it is already on the agendas of the three major international soil conferences to be held in the world over the next twelve months, including the 3rd International Land Degradation Conference (Rio de Janeiro, Brazil, September 2001), the 12th International Soil Conservation Organisation Conference (Beijing, China, May 2002), and the 17th World Congress of Soil Sciences (Bangkok, Thailand, August 2002). It is also appearing on the agendas of regional soil science workshops (e.g. Soils and the Sustainable Development Strategy of the European Union, Agricultural University of Uppsala, Sweden, 23–24 April 2001; Soils Congress of Yugoslavia, Belgrade, October 2001).

Despite the complexities of the legal and physical aspects of soil, water and vegetation, there is a good range of options available within the scope of binding and non-binding environmental law instruments to develop a plan to improve the national and international legal position. The path selected by the community to achieve the environmental law necessary to more effectively manage soil should be cognisant of the following things:

- the poor recognition of soil in the current international environmental law, and the fact that national soil legislation is generally inadequate to manage the type and severity of soil degradation problems currently experienced around the world;
- the need to satisfy the current high level of recognition among the relevant disciplines of the benefits of developing an international regime which can 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 domestic law to protect and manage soil sustainably. Of particular concern is the continued high rate of expansion of soil degradation, the increase in degree and severity of individual soil degradation processes and the periodic emergence of new forms of soil degradation. The data clearly show that in the immediate future the world will be placing even greater pressure on its soils than it is today, in order to produce sufficient food to meet the ever-increasing food deficit;
- a general realisation that the world community must take action sooner rather than later to more adequately cater for the ecological 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;
- a realisation 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 potential. Some developed nations with a major leadership role in global environmental management are currently displaying an unsatisfactory attitude toward some of their principal domestic responsibilities;
- recognition of the existing available options to develop an international soil instrument, including: (1) binding stand-alone convention (treaty), (2) protocol to existing convention, (3) non-binding instrument, (4) updating and expanding existing soil charter, and declaration of principles.

It is essential that the plan to manage soils into the 21st century include a sound legal framework at international and national levels. A major public relations task is required to promote soil as an essential element of the environmental debate, and there is an urgent need to encourage dialogue between the disciplines to promote sustainable use of soils.

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Enhancing the Land and Soil Component in the Institutional Framework of Multilateral Environmental Agreements

Jens Mackensen and
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Abstract

Soil has an image problem. For many people, land and soil degradation remains a local rather than a global issue. They see it as a problem limited to poor developing countries, particularly African countries. In the absence of a strong political commitment to the issue, the international regime for land and soil conservation remains relatively weak and fragmented. Meanwhile, climate change, biodiversity, international waters, hazardous chemicals, wetlands and forests have more easily gained political standing as global environmental issues. Importantly, each of these issues contains a strong land and soil component.

Soil is degraded through a range of processes, including desertification, erosion, industrial contamination, land use change, overexploitation of marginal land, overuse of pesticides and fertilisers in mechanised agriculture, declining agro-biodiversity, urban sprawl and soil sealing, and the impacts of mining, tourism, and military and other human activities. As it can take hundreds or thousands of years to regenerate most soils, the damage occurring today is for all purposes irreversible.

As environmental policies and treaties must be science-driven, improving the scientific advice on land and soil issues would be the best way to establish a political perception of land and soil degradation as a global environmental issue. There are today over 50 advisory processes related to the environment. Three thousand and more experts are appointed to UN-sponsored processes alone, and many thousands of others directly contribute their expertise. Despite this, an earlier study by UNEP (2001) concluded that there were still problems with the availability of good-quality environmental data, the linkage between advisory processes, and the dissemination of knowledge.

In the specific field of land use and soil management, a great deal of scientific knowledge does indeed exist. But this knowledge is not well disseminated, particularly to economic or social experts and policy makers. Thus, the challenge is not necessarily to generate more data, but to integrate existing knowledge into policy processes. At the same time, data gaps must be identified and addressed, and improved indicators should be developed so that data generated in different forums are comparable.

There are at least several ways to move forward to a more effective assessment regime for land and soil degradation:

- Seek closer cooperation on land and soil issues among existing advisory bodies. Since land and soil issues are inherently interrelated, this approach might ensure the most comprehensive possible assessment.
- Mandate an existing advisory body to take the lead in encouraging collaboration. Such a body could facilitate networking and set up a clearing-house for scientific knowledge on land and soil management in order to strengthen synergies among conventions.
- Set up a new, independent advisory body. Such a body could, for example, be modelled on UNESCO's Intergovernmental Oceanographic Commission (IOC), or alternatively, an International Panel on Land and Soil could be created along the lines of the WMO/UNEP Intergovernmental Panel on Climate Change.

1. Land and soil in international environmental policy

On the occasion of the eighth session of the UN Commission on Sustainable Development (CSD), the Secretary-General, in his report on 'integrated planning and management of land resources', stated that land-related issues 'are likely to be the most important factor of global change in terrestrial ecosystems over the next few decades' (E/CN.17/2000/6, section II, paragraph 5). Furthermore, in the Millennium Report, soil degradation is addressed in its own section ('Defending the soil'), stating that 'nearly 2 billion hectares of land – an area about the combined size of Canada and the United States – is affected by human-induced degradation of soils, putting the livelihoods of nearly 1 billion people at risk. [...] Each year an additional 20 million hectares of agricultural land becomes too degraded for crop production, or is lost to urban sprawl' (United Nations, 2000, paragraphs 283–284).

Soil is degraded through a range of processes, including desertification, erosion, industrial contamination, land use change, overexploitation of marginal land, overuse of pesticides and fertilisers in mechanised agriculture, declining agro-biodiversity, urban sprawl and soil sealing, and the impacts of mining, tourism, military and other human activities. As it can take hundreds or thousands of years to regenerate most soils, the damage occurring today is in most cases irreversible for all purposes.

Soil has been ignored particularly because the risks facing it are diffuse and become apparent only in the long term (Bolte, 2000). Soil has been the victim of its own unassuming character: it is difficult to see as distinct from the other milieus, and its slow, complex process of deterioration has not aroused media or public interest (El-Swaify, 2000). Soil is

not subject to a sensational type of pollution or emergency situation, which are the only situations likely to elicit reactions from governments or public opinion (Pilardeaux, 2000).

Soil has an image problem, not least due to the above reasons. For many people, land and soil degradation remains a local rather than a global issue. They see it as a problem limited to poor developing countries, particularly African countries. In the absence of a strong political commitment to the issue, the international regime for land and soil conservation remains relatively weak and fragmented. Meanwhile, climate change, biodiversity, international waters, hazardous chemicals, wetlands and forests have more easily gained political standing as global environmental issues, resulting in a number of multilateral environmental agreements (MEAs). Importantly, however, each of these issues contains a strong land and soil component in most of the multilateral environmental agreements. Interlinkages between agreements can be identified and improved for the sake of better addressing land and soil degradation.

The MEAs negotiated since 1972 represent a remarkable achievement. However, these MEAs lack coherence with respect to a number of important new environmental policy issues, such as the precautionary principle and scientific uncertainty, inter- and intra-generational equity, life-cycle economy, common but differentiated responsibilities, and sustainable development. There is a need to review the existing institutional structures, instruments and arrangements, including the UN system, MEAs and available means for coordination and consultation (UNEP, 2000). This would make it possible to enhance implementation at the national level, especially through harmonisation of national reporting.

The challenge is basically to overcome fragmented concepts and institutionalisation and sectoral divides. Indeed, the existing machinery remains fragmented and is often equipped with vague mandates, inadequate resources and marginal political support. Weak support and poorly coordinated management have left institutions less effective than they could be, while demands on their resources continue to grow.

The many various institutional mechanisms designed to address specific environmental issues (as well as the interface between the economic, social and environmental aspects of development) were often created without due consideration of how they might interact with the overall system, and questions have increasingly arisen concerning the coordination of this multi-faceted institutional architecture. There is a global awareness that the international institutional architecture dealing with environmental issues must be strengthened.

Following up the views expressed by governments at UNEP's 21st Governing Council (GC) session in February 2001, UNEP has embarked on a process aimed at improving international environmental governance. In its decision 21/21, the GC called for a comprehensive policy-oriented assessment of existing institutional weaknesses as well as future needs and options for strengthened international environmental governance, including the financing of UNEP. There is a general agreement that the strengthening of international environmental governance should be pursued by taking an evolutionary approach that builds on existing structures and ensures improved coordination and coherence among the various global institutions and instruments involved.

2. Framework of conventional protection of land and soil

It is necessary to distinguish between environmental agreements which address land and soil issues directly (primary protection) and those that address these issues indirectly (secondary protection).

To date, the United Nations Convention to Combat Desertification is the globally most important instrument for primary protection of land and soil. The UNCCD defines desertification as 'degradation of land resources in arid, semi-arid, and dry sub-humid areas caused by different factors, including climatic variations and human activities', where arid, semi-arid and dry sub-humid areas means areas other than polar and subpolar regions, in which the ratio of annual precipitation to potential evapotranspiration falls within the range from 0.05 to 0.65. The objective of the UNCCD is to prevent and reduce land degradation, rehabilitate partly degraded land, and reclaim desertified land particularly in Africa and in countries that experience serious drought. As the geographic focus of 'desertification' excludes important climatic regions no less affected by severe land and soil degradation processes, the 4th UNCCD Conference of Parties (COP-4) adopted a regional annex for Central and Eastern Europe. This annex is considered to have opened the UNCCD to specific situations outside its initial scope.

Several MEAs relate directly to land and soil issues on a regional level. The African Convention on the Conservation of Nature and Natural Resources was adopted in 1968 under the auspices of the Organisation of African Unity by 43 parties, covering the northern and central African States. It addresses conservation, utilisation and development of natural resources including soil, which is recognised as a natural resource. Specifically, parties are obligated to conserve

and improve soil, combat soil erosion, and not misuse soil. Parties are required to establish land use plans based on relevant science, including ecological, pedological, economic and sociological factors. The Convention on Establishing a Permanent Inter-State Drought Control Committee addresses inter-state drought control as a major causal agent of soil degradation. The ASEAN Agreement on the Conservation of Nature and Natural Resources was signed in Kuala Lumpur in 1985 but is not yet in force. Parties are obligated to develop and coordinate national conservation strategies that include the role of soil in the functioning of natural ecosystems. Furthermore, they agreed to undertake soil conservation measures to rehabilitate eroded and degraded soils, establish soil policies, and control soil erosion and improve soil fertility.

The Alpine Convention was signed in 1991 and entered into force in 1995. Particularly relevant is the Alpine Convention Soil Protection Protocol, which was adopted in 1998 and is not yet in force. This Protocol is the only global agreement on the issue which is intended to create legal rights and obligations among parties. It contains various particularly relevant ecological concepts and principles. The ACSPP aims at reducing the quantitative and qualitative damage to soil through the use of appropriate agricultural and forestry land use methods. It encourages minimal interference with soil, soil erosion control, restrictions on the sealing of soil, and soil rehabilitation. The ACSPP states that the functions of soil (including natural functions, cultural functions and land use functions) should be safeguarded and preserved in order to maintain an ecological balance in the region and soil diversity for future generations. In addition, parties are obliged to a) take legal and administrative measures to protect soil which apply the precautionary principle, b) consider the objectives of the ACSPP in other policies – nature protection, agriculture, coordination of forestry, c) ensure cooperation between institutions and territorial authorities to develop synergies for soil protection, and d) support international cooperation among institutions concerned with soil research. Specific issues such as protection against impacts of tourism, soil pollution, and management of rehabilitation areas or specific ecosystems such as wetlands and moor lands are addressed also in the ACSPP.

Land and soil issues are indirectly addressed in the 'biodiversity' cluster through the promotion of conservation of landscapes, natural scenery, ecosystems and the habitats of plant and animal species.

The Convention on Biological Diversity (UNCBD) regulates the parties' responsibility for conserving biological diversity and for using biological resources in a sustainable manner. Biological diversity is defined as the variability among living organisms from all sources including, among others, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part. The UNCBD explicitly incorporates soils as a key habitat for many of the world's species, making them worthy of protection, conservation and sustainable use under the Convention. The Convention on Wetlands protects land and soil as a habitat as well, through 'conservation and wise use of wetlands by national action and international cooperation as a means to achieving sustainable development throughout the world'. The Convention on the Conservation of Migratory Species of Wild Animals is a global Convention that serves the conservation of migratory species and their habitats. On the regional level, MEAs relating to sustainable land and soil management and conservation include the Convention on Nature Protection and Wildlife Preservation in the Western Hemisphere, the Convention for the Protection of the Natural Resources and Environment of the South Pacific Region, the Convention on the Conservation of European Wildlife and Natural Habitats, and the Benelux Convention on Nature Conservation and Landscape Protection. Most of these MEAs require parties to cooperate in conservation, management and restoration of the natural environment. They are further required to cooperate for consistency in policy, exchange of information and training, and exchange of scientific results, and to coordinate execution of international agreements.

In the 'chemical' cluster, the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal addresses not only the transport of hazardous wastes but also their disposal. The Convention thus relates to important aspects of soil protection and soil rehabilitation by promoting and regulating the responsible treatment and disposal of hazardous wastes. The Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (PIC) relates primarily to trade of hazardous chemicals, focusing on commercial transaction aspects. Its intention is to foster the international flow of information on hazardous chemicals, guaranteeing better monitoring of trade in such substances. Its implementation is indirectly conducive for soil protection from chemical pollution. The Stockholm Convention on Persistent Organic Pollutants (POP) focuses on the protection of human health and the environment from the harmful impact of persistent organic pollutants (POPs), which contaminate soils and, subsequently, crop, food and water. Unlike the PIC Convention, POP is not of a purely preventive nature, but also covers measures to deal with actual contamination.

The UN Framework Convention on Climate Change (UNFCCC) seeks, in the 'atmospheric' cluster, to limit the greenhouse effect by reducing global greenhouse gas emissions, in particular CO_2, through promoting clean energy production and increased energy efficiencies. The not yet ratified Kyoto Protocol addresses soils and vegetation by virtue of their function as globally significant carbon pools, utilising their ability to temporarily sequester and release carbon. Land use, land use change and forestry obtained a significant role with regard to carbon dioxide and other greenhouse gases. The Convention on Long-Range Transboundary Air Pollution and its Sulphur Protocol aim to further reduce emissions of sulphur and other pollutants which endanger human life, harm living resources and ecosystems, and, in particular, cause land and soil acidification.

In addition, the 'indigenous and tribal peoples' cluster and the 'development and economic' cluster exhibit relevance to land and soil issues. The latter would include, for example, the 4th ACP-EEC Convention of Lomé (Contracts of Guarantee between State and European Investment Bank), in which member states agree that, among others, halting the deterioration of land and forests is one of their basic objectives.

3. Need for enhanced coherence between MEAs

With the recognition of co-dependency of ecosystems, scientific and technical cooperation has become a growing concern within the science and policy interface. Therefore, there is a need of more integrated scientific processes between MEAs, aimed to identify synergistic policies and exploit bio-geophysical relationships between MEAs.

Bringing the work of MEAs towards a more holistic approach represents a real challenge, especially when it comes to land and soil issues. Enabling an effective coherence of work between MEAs implies enhancing the knowledge available on land and soil degradation and improving assessments. Enhancing coherence between MEAs is in line with enhancing international environmental governance and calls for bringing together all the major actors to agree on the components that will support harmonised and coherent implementation of the conventions at the national level. The centrepiece of the synergy process is indeed the implementation of the conventions at the national level.

A number of initiatives in process aim at enhancing coordination between the secretariats of the MEAs. Enhanced efforts towards a more effective implementation of those conventions have been widely promoted and encouraged, such as UNGASS 19, resolution S/19-2, Programme for the Further Implementation of Agenda, SG recommendation (E/CN.17/1997/6) within CSD, Resolution VII/4 of COP 1999 Convention on Wetlands, Resolution 6.5 of COP 1999 Convention on Migratory Species, COP 2000 of CITES, decision V/19 of COP 2000 Convention on Biological Diversity. In particular, the Nairobi Declaration on the Role and Mandate of UNEP (1997) identifies as one of the core elements of the UNEP mandate the development of 'coherent interlinkages among existing international environmental conventions'. This and other parts of the UNEP mandate concerning a coherent approach towards environmental activities in the UN system give a clear mandate for UNEP to lead efforts to promote synergies. Initiatives already taken to enhance synergies among MEAs have touched different areas, particularly a) harmonising national reporting and b) implementation of joint work programmes under MoU/MoC.

The practice of national reporting requires an MEA party to provide a periodic report to the institutions established under the treaty or to other parties to that agreement. National reporting enables the governing bodies of those agreements to assess implementation and to make rational decisions on future priorities and needs.

As we have mentioned, a number of initiatives aimed at enhancing coherence between the secretariats are in process in the 'land and soil' cluster. Obstacles preventing further cooperation are a) differing constituencies of MEAs; b) fragmented responsibility for national land and soil information management; c) limited understanding of the link between reporting and efficient implementation of MEAs; d) limited resources for information management in MEA secretariats; and e) scientific uncertainty that makes true standards difficult to achieve.

In order to improve institutional interlinkages and to achieve the actions noted above and maintain their success, standing linkages between MEAs will be required in a number of areas, such as a) coherent scientific methodology, b) coherent use of nomenclature and definitions, and c) coherence of information management practices and technology.

4. Institutional cooperation between scientific and advisory bodies of land and soil-related MEAs

The unprecedented number of scientific panels set up to advise governments on various environmental issues is a general trend that can be witnessed in most MEAs. At present, there are more than 50 advisory processes in existence. Over 3,000 experts are currently appointed to UN-sponsored advisory processes alone, and many thousands of others directly contribute their expertise. Several million US dollars are spent on these panels every year. Generally, these individual scientific advisory processes are created separately and without reference to past experience. There is little overarching

debate about their roles and organisation. Because the scientific advisory processes have become an integral part of international environmental governance, there is a need to provide this advisory process structure with a more coherent framework making it possible to use the diversity of existing processes as a potential strength (Fritz, 2000).

The coordination between scientific advisory processes is characterised by the existence of several gaps (Fritz, 2000) that apply also to land and soil issues across the different clusters. The most relevant are the data gap, the linkages gap, the public access gap and the impact gap.

The 'data gap' was identified by Agenda 21 as the gap between the availability of quality data, e.g. on land and soil issues from around the world, and the needs of both national and international policy makers.

A 'linkages gap' exists between the increasing number of advisory processes being founded. Although it is increasingly recognised that environmental problems can only be solved holistically, only few ongoing collaborative efforts exist.

There is also a 'public access gap' between the production and synthesis of knowledge and its use by a broad readership. Each year, dozens of reports are prepared by external consultants and UN staff members at a great cost. They often reflect useful syntheses of current knowledge, and many are of high quality. However, once the official meetings for which the reports are intended are over, the reports are shelved. While most are available on the Internet, a user requires good knowledge of the UN system to search the numerous institutions potentially supporting similar activities. It would be useful to identify 'success stories' and 'best practices' relevant to various conventions.

An 'impact gap' exists between scientific advisory activities and efforts to support local and national-level capacity building. Advisory processes harness much knowledge that is sometimes only used for limited purposes. Located at the interface between scientific research and policy making, advisory processes can set priorities useful to UN scientific and research support activities. While there is much talk of capacity building, there are few examples of advisory processes that assist international scientific programmes in strengthening local and national capabilities to manage national activities – thus, ultimately improving support for implementing international agreements.

5. The structure of scientific and advisory processes

Generally, scientific and advisory processes are either created within the structure of an MEA or contribute to a wider process outside any specific forum.

Certain bodies are set up to provide scientific and technical advice to member parties within an MEA. These bodies are subsidiary bodies of the respective MEAs and remain dependent on the Conference of Parties (COP) set up specifically for the MEA. For instance, the Committee on Science and Technology (CST) within the UNCCD calls for and evaluates experts' scientific assessment at the specific request of the COP. In its capacity as a subsidiary body of the COP bound to COP instructions, the CST is thus closely linked to and dependent on the programme of UNCCD. Similar bodies are the Subsidiary Body on Scientific and Technical Advice (SBSTA) of UNFCCC and the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) of the UNCBD.

Other scientific and advisory bodies are set up independently of MEAs. The recommendations produced by those scientific and advisory bodies are accessible not only to member parties of all MEAs but also to the international community in general: the scientific knowledge provided by those bodies is meant to be used in intergovernmental processes and deliberations.

The IPCC, created by WMO and UNEP in 1988, provides scientific, technical and socio-economic advice to the world community, and in particular to the parties of the UNFCCC, through its periodic assessment reports on the state of knowledge on climate change, its potential impacts, and options for response strategies. The IPCC thus played an important role in establishing the Intergovernmental Negotiating Committee for a UN Framework Convention on Climate Change (UNFCCC) by the UN General Assembly.

6. Options to address identified needs

Clearly, there are at least several ways to move forward to a more effective assessment regime for land and soil degradation.

A first option is to seek closer coherence on land and soil issues among existing advisory bodies. Since land and soil issues are inherently cross-cutting, this approach might ensure the most comprehensive possible assessment of scientific knowledge. An improved dialogue would generate a more holistic understanding of the role of soil in the biosphere and in human socio-economic systems. It would also ensure a stronger and/or more complete consideration of land and soil aspects in global assessment processes such as the Millennium Ecosystem Assessment, the Pilot Analysis of Global Ecosystems, and the Land Degradation Assessment in Drylands.

Another approach would be to mandate an existing advisory body to take the lead in encouraging collaboration between MEAs and their advisory bodies. Such a body could facilitate networking and set up a clearing-house for scientific knowledge on land and soil management in order to strengthen synergies among conventions. The Global Terrestrial Observing System (GTOS), for

example, could serve as a global platform if its mandate, composition and funding mechanism were appropriately altered. Another candidate might be the UNCCD Committee on Science and Technology. The CST advises parties on the scientific and technological aspects of desertification and drought and serves as a liaison between governments and the scientific community. It could well be placed in a position to embrace more responsibilities for global land and soil issues. During the 5th Conference of the Parties (COP-5) to the UNCCD, which took place in Geneva, Switzerland from 1 to 13 October 2001, negotiations addressed the question of improving efficiency and effectiveness of the CST. In its Decision ICCD/COP(5)/L.7/Rev.1, the COP decided to adopt ways and means to improve CST efficiency and effectiveness, including the establishment of a group of experts under the CST to provide scientific input.

Finally, there is the option to set up a new, independent advisory body. Such a body could, for example, be modelled on UNESCO's Intergovernmental Oceanographic Commission (IOC). Composed of government representatives, the IOC facilitates international research, education and training programmes and observing systems. Alternatively, an International Panel on Land and Soil could be created along the lines of the WMO/UNEP Intergovernmental Panel on Climate Change. Such a panel would be able to:

- assess and synthesise the scientific, technical and socio-economic information relevant for the understanding of the risk of human-induced land quality changes,
- stimulate and involve the scientific community to develop the science of land degradation and desertification,
- assist national, regional and global decision makers in developing policies to assess, monitor and mitigate negative impacts on land and soil,
- channel and render accessible the available knowledge about land degradation and desertification.

List of Abbreviations

ACP:	African, Caribbean and Pacific Group of States
ACSPP:	Alpine Convention Soil Protection Protocol
ASEAN:	Association of Southeast Asian Nations
CSD:	UN Commission on Sustainable Development
CST:	UNCCD Committee on Science and Technology
EEC:	European Economic Community
GTOS:	Global Terrestrial Observing System
IOC:	UNESCO Intergovernmental Oceanographic Commission
IPCC:	Intergovernmental Panel on Climate Change
PIC:	Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade
POP:	Stockholm Convention on Persistent Organic Pollutants
UNCBD:	United Nations Convention on Biological Diversity
UNCCD:	United Nations Convention to Combat Desertification
UNFCCC:	United Nations Framework Convention on Climate Change
UNEP:	United Nations Environment Programme
UNESCO:	United Nations Educational, Scientific and Cultural Organization
WMO:	World Meteorological Organization

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Legends for photos (cover and title pages of Parts I, II and II):

Cover: 'Tassa' planting pits for improving soil and conserving moisture in Niger. (Photo by Will Critchley)

Part I: Irrigation of gardens in the outskirts of Fuzhou, China. (Photo by Hanspeter Liniger)

Part II: Wheat production in Syria near Aleppo. (Photo by Hanspeter Liniger)

Part III: Soil terracing on marginal lands in Nepal. (Photo by Tej Partap)