Criteria and indicators for land quality and sustainable land management

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ABSTRACT

Sustainable land management (SLM) requires the integration of technologies, policies and activities in the rural sector, particularly agriculture, in such a way as to enhance economic performance while maintaining the quality and environmental functions of the natural resource base. Five criteria to evaluate progress towards SLM were identified: productivity, security, protection, viability and acceptability. The definition and pillars are the basic principles and the foundation on which sustainable land management is being developed, and these have been examined and debated by many over the past seven years. Through this process, the concepts of land use resilience and social equity have been added, but otherwise the definition and pillars have stood up to the test. The concept of sustainable land management, like the concept of sustainable development on which it is founded, is gaining momentum in rural as well as in urban constituencies. This is due as much to its psychologic appeal as to the flexibility of the definition. Much progress has been made in identifying criteria and indicators for SLM. To date, international agreement has been achieved on the following land quality indicators: (1) five sets of indicators that can be developed in the short term, ie, nutrient balance, yield trends and variability, land use intensity, land use diversity and land cover; (2) three sets of indicators, requiring longer-term research, on the themes soil quality, land degradation and agro-biodiversity; and (3) four sets of indicators that are being developed by other working groups, ie, water quality, forest land quality, rangeland quality and land contamination/pollution. These are the land quality components of SLM and still must be complemented with indicators of the other pillars—economic viability, system resilience, and social equity and acceptability. In these last areas, agreement has been reached only on the indicators: net farm profitability and use of soil conservation practices. Although these are still general themes rather than specific indicators, they provide effective and practical direction on the criteria and requirements for sustainable land management and they channel the research effort. Identifying indicators, however, is only one of several important steps. The next major initiative has to be on procedures to implement SLM at local, national and international levels. Advances in SLM will not be achieved on the basis of technologic and scientific advances alone; changes in institutional and economic structures will also have to be part of the solution. For example, soil conservation technologies and programmes, which were originally designed for rehabilitating degraded areas, must move more into programmes of preventative maintenance; rural land use planning must move away from a prescriptive approach and take on the role of facilitator in order to ensure that the local concerns of farmers and others are given equal hearing with other vested interests. Farmers and other land users are the custodians of rural land resources, and their collective decisions will ultimately determine the sustainability of land use systems.

The concept of sustainable land management (SLM) grew out of a workshop in Chiang Rai, Thailand, 1991. This workshop recommended that an international working group of the International Society of Soil Science (ISSS) be formed to refine the concept, develop a definition and recommend a procedure to monitor and evaluate our progress towards sustainable land use systems. A second workshop (Lethbridge, Canada, 1993) emphasized the development of indicators of sustainable land management as instruments for monitoring and evaluation. The results of these experiences were presented at the 15th Congress of Soil Science, Acapulco, 1994. Subsequent international workshops (Cali, Colombia, 1995; Nairobi, Kenya, 1995; Washington DC, 1996; Naurod, Germany, 1997) focused on indicators of land quality as part of the suite of required SLM indicators. The workshop held in Enschede in 1997 set the stage for the next steps in the development and application of sustainable land management.

The definition of sustainable land management calls for integrating technologies, policies and activities in the rural sector, particularly agriculture, in such a way as to enhance economic performance while maintaining the quality and environmental functions of the natural resource base. Five criteria, called the pillars of SLM, were identified: productivity, security, protection, viability and acceptability. The definition and pillars are the basic principles and the foundation on which sustainable land management is being developed, and these have been examined and debated by many over the past seven years. This process of debate and refinement has indicated that the concepts of land use resilience and social equity should be added to the criteria, but otherwise the definition and pillars have stood up to the test. The concept of sustainable land management, like the concept of sustainable development on which it is founded, is gaining momentum in rural as well as in urban constituencies, and at local, national and international levels. This is due as much to the flexibility of its definition as to its obvious psychologic appeal.

The lack of a comprehensive, quantifiable definition for sustainable land management is sometimes considered to be a serious deficiency. Yet, as argued by Gallopin [4], a research model for sustainability has to be more flexible than a research model for chemistry, physics or classical agronomy, and is therefore less easy to quantify. Such a research model must be designed around an evaluation process (rather than within a thematic context), because it is intended to test the likelihood of certain events taking place and the aggregate impacts of these events, rather than the specifics of various null hypotheses or the impacts of certain inputs or land management interventions. Essentially, the research model must include a goal statement, a conceptual framework, a set of procedures, and criteria (indicators) for diagnosis. One main objective of such a research model is to evaluate the impacts of uncertain events, but the process of evaluation is guided by scientifically defined protocols.

Does the lack of a quantifiable definition, *ie*, specific sustainability targets, prevent good research on sustain-

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ability, or is it a better reflection of what is required? Personal observations from various case studies show that the unquantified definition adds flexibility to the approach, and this contributes directly to the resilience of the concept. Because of this, the concept of sustainable land management can be applied at different levels and different scales to resolve different issues, while still providing firm guidance on the scientific standards and protocols to be followed in the evaluation (Figure 1). For example, the original concept of sustainable land management was technologies that contributed to sustainable agriculture, but Traeger *et al* [9] interpreted this concept as part of the broader concept of natural resources management. These are two scales of interpretation and both are correct because each views the problem from a different perspective and with a different set of criteria. The concept of sustainable land management, like the concepts of truth, justice and humility, are best expressed as objectives to be attained, rather than ones that can be measured. For practical reasons, simply estimating whether we are tracking towards or away from sustainability is often as useful as attaining specific (sustainability) targets. This is not unlike monitoring economic performance, where interest lies more often in the direction and rate of change than in specific economic goals. The concept of sustainable land management is being increasingly applied in land management decisions, and this flexibility in the definition does not detract from the value or the quality of the evaluation. The necessary refinements, however, in the form of more practical guidelines and indicators for application at different scales, are being identified through field testing, evaluation and experimentation.

CRITERIA FOR SUSTAINABLE LAND MANAGEMENT

The objective of sustainable land management is to harmonize the complementary goals of providing environmental, economic and social opportunities for the benefit of present and future generations, while maintaining and enhancing the quality of the land (soil, water and air) resource [7]. Land provides an environment for agricultural production, but it is also an essential condition for improved environmental management (source/sink functions for greenhouse gases, recycling nutrients, ameliorating and filtering pollutants, transmitting and purifying water as part of the hydrologic cycle, etc).

Experiences gained from testing the concept in field projects in developing and developed countries have identified a series of principles and criteria for sustainable land management, and these can be used as general guidelines for development projects [1, 2, 10]. These criteria are particularly important in assessing the impacts of agricultural management in rural landscapes. Agriculture is unlike other resource-based industries in that it involves millions of small-scale entrepreneurs who make individual decisions on the management of their (natural) resources and on the investment of their capital. Although the land use decisions of any individual farmer may seem insignificant, these decisions are repeated over and over again in the landscape, and collectively can achieve major regional and even global significance. Agriculture is often cited as being part of the environmental problem, and it is recognized that agricultural land use systems are often significant contributors to non-point pollution and environmental degradation. The most useful of these criteria (lessons learned) are summarized below.

GLOBAL CONCERNS FOR SUSTAINABILITY

Sustainability can be achieved only through the collective efforts of those immediately responsible for managing resources. This requires a policy environment where farmers and other local decision makers are not only able to reap the benefits for good land use decisions, but are also held responsible for inappropriate land uses. However, environmental problems do not recognize land ownership boundaries or geopolitical spheres of influence. Land degradation affects the

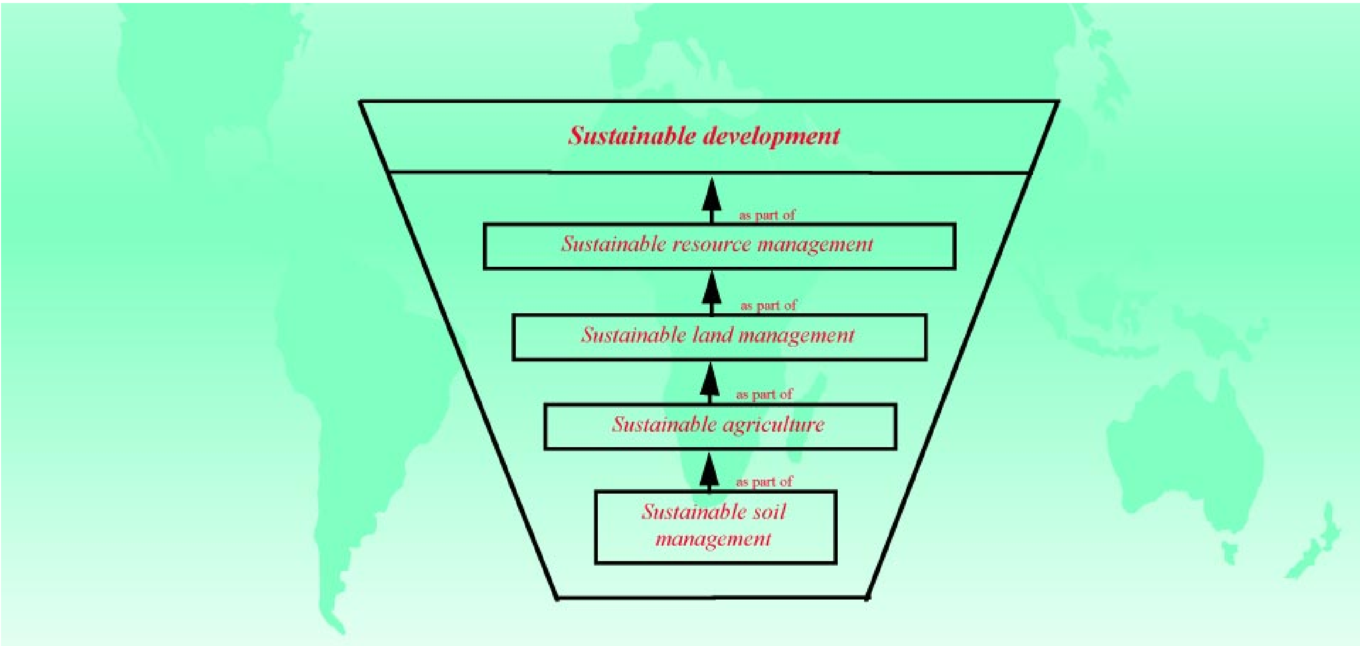

FIGURE 1 Relationships among sustainable development, sustainable agriculture and sustainable land management

yields obtained by the farmer, but the larger impacts are often off-site, *eg*, degradation of water quality, loss of habitat, loss of biodiversity, etc. Although the concerns for sustainability are global, the required actions must be local and national.

The comprehensive integration of economic and environmental interests is necessary to achieve the objectives of sustainable land management. This requires that environmental concerns be given equal importance with economic performance in evaluating the impacts of development projects, and that reliable indicators of environmental performance be developed. Without this, the integration of environmental concerns into economic decision making is an appealing concept, but one rarely applied.

There is urgent need to resolve the global challenge to produce more food to feed the rapidly rising world population, while at the same time preserving the biologic production potential and the environmental maintenance systems of the land. This is necessary to achieve orderliness in the policy environments of developing countries and in the lending objectives of donors. Sustainable land management, if properly designed and implemented, will ensure that agriculture becomes part of the environmental solution, rather than remaining an environmental problem.

SUSTAINABLE AGRICULTURE

More ecologically balanced land management can achieve both economic and environmental benefits, and this must be the foundation (linchpin) for further rural interventions (investments). Without good land management, other investments in the rural sector are likely to be disappointing. (Sustainable land management requires a long-term commitment to maintain the quality of the land resource; unfortunately, short-term economics often promote technologies that exploit and degrade the land.) At the same time, arguing for the continued maintenance of agriculture without reference to environmental sustainability is increasingly difficult. Indicators of land quality are needed to guide us along the way.

Agricultural intensification is often necessary to achieve more sustainable systems. This requires shifts to higher value production, or higher yields with more inputs per unit of production and higher standards of management (more knowledge-intensive). However, sustainable agriculture has to work within the bounds of nature, not against them. This means matching land uses to the constraints of local environments, planning production within biologic potentials, and carefully limiting the use of fertilizers, pesticides and other inputs in order to ensure they do not exceed the capacity of the environment to absorb and filter any excess. When working with nature, many yield improvements can be achieved by optimizing rather than maximizing external inputs.

The importance of off-farm income, *eg*, to supplement cash flow on the farm, generate an investment environment for improved land management, and reduce (production) pressures on land, should not be underestimated.

SHARING RESPONSIBILITIES FOR SUSTAINABILITY

Although farmers and land managers directly affect how the land is managed, sustainable land management is the responsibility of all segments of society. Governments must ensure that their policies and programmes do not create negative environmental impacts; society needs to define requirements for land maintenance and develop a "social" discount rate for future land use options; and farmers and land managers must expand their knowledge of sustainable technologies and implement improved procedures of land stewardship. The preferred option is not to tell the farmer what to do (command and control legislation), but to create a policy environment where farmers are more empowered but also held accountable for achieving the objectives of sustainable land management. Many rural societies in developing countries, however, are poorly equipped to resolve these issues on their own.

Concerns for sustainable land management go beyond agriculture to include the legitimate interests of other aspects of land stewardship, including wildlife, waterfowl and biodiversity management. There is increasing evidence that society is demanding that farmers become stewards of rural landscapes, and that agriculture become more than simply putting food on the table. Many of society's environmental values may not represent economic gains for farmers, however, and farmers cannot shoulder all the costs of environmental maintenance.

RELATIONSHIPS AMONG SOIL QUALITY, LAND QUALITY AND SUSTAINABLE LAND MANAGEMENT

New concepts of soil and land quality are emerging, and often these are used interchangeably. These concepts of "quality" are based on the essential characteristics of soil and land that fulfil human land use requirements, *eg*, agriculture, forestry, conservation and maintenance of environmental functions. Natural land quality comes from the suitability of land for specific uses, and is not uniform over the landscape; human interventions (land management) can degrade or enhance land quality; changes in land quality are assessed in relation to benchmarks, such as changes from an undisturbed state. These concepts and their relationships are summarized below, to the extent that some consensus is available on how these should be applied.

Soil quality is the capacity of a specific soil to function within natural or managed ecosystem boundaries to sustain plant and animal production, maintain or enhance water quality, and support human health and habitation [8].

Land quality is the condition, state or "health" of the land relative to human requirements, including agricultural production, forestry, conservation, and environmental management [6].

Sustainable land management combines technologies, policies and activities that are aimed at integrating socio-economic principles with environmental concerns so as to simultaneously maintain or enhance production, reduce the level of production risk, protect the potential of natural resources and prevent (buffer against) soil and water degradation, be economically viable, and be socially acceptable [7].

These concepts span the scales of detail, application and levels of integration with socio-economic data. Soil quality is the most restrictive, followed by land quality and then sustainable land management. Soil quality is effectively a condition of a site, and it can be studied using only soil data. Land quality requires the integration of soil data with other biophysical information, such as climate, geology and land use. Land quality is a condition of the landscape, *ie*, it is a biophysical property, but includes the impacts of human interventions (land use) on the landscape. Sustainable land management requires the integration of these biophysical conditions, *ie*, land quality, with economic and social demands. It is an assessment of the impacts of human habitation, and a condition of sustainable development.

These are more than simple differences in semantics; the concepts differ according to the kinds and scales of the processes being described, the data used for input, and the amount and kinds of integration with other disciplines [3]. However, the concepts form a continuum over the landscape, and they apply for different types and scales of land use.

INDICATORS OF LAND QUALITY

THE BIOPHYSICAL COMPONENT OF SUSTAINABLE LAND MANAGEMENT

Indicators are instruments to help us monitor whether we are on the path towards or away from sustainable land use systems. Many attempts have been made to define sets of soil and land quality indicators; most, however, have involved *a priori* indicator selection and long lists of soil properties (rather than indicators of change) but little thorough analysis of the important cause-effect relationships defining the impacts of human interventions on the landscape. Also, there have been few attempts to coordinate the various indicator programmes.

The World Bank, along with LINEP, UNDP, FAO, the CGIAR and various bilateral agencies, is spearheading a programme to develop land quality indicators (LQIs). These indicators are intended as criteria for not only project development but also environmental impact assessment and monitoring progress towards sustainable land management.

A research strategy for the land quality programme was developed during a two-day research planning meeting sponsored by the World Bank, which was held from 21 to 22 October 1996 in Washington DC. A panel of internationally acclaimed scientists and administrators established the objectives and priorities for the research, defined the strategic alliances to be developed with ongoing national and international programmes, and identified potential sources of funding. They also achieved international agreement on a core set of strategic land quality indicators. The highlights of the research plan are summarized below.

Defining and testing *cause-effect relationships among land quality, land use and rural poverty* is the primary research objective of the LQI research programme. Associated research issues are:

- how to integrate socio-economic (land management) data with biophysical information in the definition and development of LQIs
- how to scale and aggregate indicators from local to regional (AEZ), national and global scales
- how to transform and scale data for application at various hierarchic levels.

The pressure-state-response framework was adopted as the operative framework for indicator development [6].

A two-stream research plan was developed for the programme, involving:

- *Stream 1:* Core LQIs as international reference standards, to be initiated in the short term and based primarily on data already available.
- *Stream 2:* National and subnational LQIs for monitoring and evaluating at project and programme levels, to be implemented contemporaneously with stream 1 but involving more in-depth and longer-term research. Some new data will be generated in this stream to supplement data already available.

Stream 1 research is a short-term programme of data analysis, testing and refinement to develop "core LQIs as international reference standards". Core LQIs are those where sufficient research has already been conducted to establish a sound theoretical base, where sufficient data are already available, or where development procedures have been tested and are available (*eg*, remote sensing). To a great extext, stream 1 research will be exploratory, based primarily on census data and including other (*eg*, remote sensing) data as necessary. This phase will be "piggybacked" on programmes already in place.

International agreement has been achieved on the core LQIs recommended for stream 1 research. These include five sets of LQIs to be developed for managed ecosystems (agriculture and forestry) in the major agroecologic zones (AEZs) of tropical, subtropical and temperate environments:

(1) Nutrient balance: describes nutrient stocks and flows as related to different land management systems used by farmers in specific AEZs and specific countries.

(2) Yield trends and yield gaps: describes current yields, yield trends and actual:potential farm-level yields for the major food crops in different countries.

(3) Land use intensity: describes the impacts of agricultural intensification on land quality. Intensification may involve increased cropping, more value-added production, and increased amounts and frequency of inputs; emphasis is on the management practices adopted by farmers in the transition to intensification.

(4) Land use diversity (agrodiversity): describes the degree of diversification of production systems over the landscape, including livestock and agroforestry systems; it reflects the degree of flexibility (and resilience) of regional farming systems, and their capacity to absorb shocks and respond to opportunities.

(5) Land cover: describes the extent, duration and timing of vegetative cover on the land during major erosive periods of the year. It is a surrogate for erosion and, along with land use intensity and diversity, it will increase understanding on the issues of desertification.

Stream 2 research is a longer-term programme intended for more thorough analyses of the cause-effect relationships between land use and land quality change. The basis of this programme is that robust LQIs can be developed only through thorough analysis and understanding of the cause-effect relationships of human interventions on rural landscapes. *A priori* selection of LQIs is not recommended, although some brainstorming is essential at the outset in order to develop a shortlist of potential LQIs for testing and to better design the research programme.

No only will this programme test the LQIs identified in the first stream, it will also promote new research and, in particular, identify new LQIs related to impacts of land management practices. It will involve the analysis of available data, as well as field studies, modelling and model calibration in selected AEZs. Consequently, research in the second stream will be longer-term and more detailed and structured so as to ensure that indicators are sufficiently robust to withstand scientific scrutiny.

LQIs recommended for stream 2 research are those that require further development of their theoretical base or lack adequate data for development. Only general indicator themes (rather than specific indicators) have been identified so far, along with some preliminary criteria. These include:

- soil quality: likely to be based on soil organic matter turnover, particularly the dynamic (microbiologic) carbon pool, most affected by environmental conditions and land use change.
- land degradation (erosion, salinization, compaction, organic matter loss): these processes have been much researched and have a strong scientific base, but reliable data on extent and impacts are often lacking.
- agrobiodiversity: involves managing natural habitats and the coexistence of native species in agricultural areas, maintaining natural soil micro-/meso-biodiversity, and managing the gene pools utilized in crop and animal production.

Other indicators, *eg*, for land resilience, may be added in the future as required.

In addition to the indicators identified in the stream 1 and stream 2 programmes, the following four sets of indicators were identified as core LQIs:

- water quality
- forest land quality
- rangeland quality
- land contamination/pollution.

These, however, were recommended not for additional research but rather to be developed through collaboration with the respective authoritative disciplines.

The above are the biophysical components of sustainable land management. Although useful in their own right, they must still be complemented with indicators of the other pillars of sustainable land management, *ie*, economic viability, system resilience, and social equity and acceptability. So far, agreement has been reached in these last areas only over the two indicators [1]:

- net farm profitability
- use of soil conservation practices.

Considerable additional work is required to develop these pillars to the same level of detail as the land resource (biophysical) pillars.

Although this collection of indicators is still a collection of general themes as well as specific quantitative indicators, this list provides effective and practical direction on the criteria and requirements for sustainable land management. Achieving this degree of international agreement channels the research effort, and it will ensure quicker, more cost-effective indicators.

NEXT STEPS

APPLYING SUSTAINABLE LAND MANAGEMENT IN THE FIELD

Indicators as instruments for monitoring and assessment are only one of several important steps in the evolution of the sustainable land management programme. The next major initiative has to be on procedures to implement sustainable land management at local, national and international levels. This process is more complex, because it requires not only technologic and scientific advances, but also changes in institutional structures and economic evaluation procedures.

The objectives of sustainable land management will not be achieved unless local issues and constraints to improved rural land management are addressed from the outset. Farmers and other land users are the custodians of rural land resources, and their collective decisions will ultimately determine the sustainability of land use systems. To achieve this, emphasis has to be on technologies and programmes that simultaneously contribute to improving the economic and social welfare of the farmer, while maintaining and enhancing the quality of the natural resource base on which production depends. Sustainable land management technologies will not be adopted by farmers unless they contribute first to improved economic viability.

There are no easy recipes on how this can be achieved, but some guidelines are emerging. It is becoming increasingly clear that the emphasis will have to shift from top-down policy making, land use planning and extension services to more flexible procedures and mechanisms that accommodate local requirements—from strengthening traditional institutions based on top-down delivery to transforming them into institutions capable of delivering bottom-up initiatives. For example, soil conservation technologies and programmes, which were originally designed to rehabilitate degraded areas, must move more into the area of preventative maintenance; rural land use planning must move away from a prescriptive approach (*ie*, identifying “optimal” solutions for local land users) and take on the role of facilitator in order to ensure that the local concerns of farmers and others are given equal hearing with other vested interests. Sustainable land management requires local solutions and it can only be achieved when farmers and land users are able to choose the most efficient options for themselves without being hampered by distorting policy, market and government programmes, *ie*, when they have the authority to make the best choices and also take responsibility for these decisions. Farmers and other land users will have to be made true partners in technology innovation and application, with both *authority and responsibility* for their decisions.

Most rural societies, particularly those in developing countries, are poorly equipped to address these issues on their own. Strong partnerships with governments, the scientific community, as well as NGOs and, increasingly, agri-business will be required. Further advances on sustainable land management will depend to a large extent on a sympathetic policy environment and the promotion of local, farmer-led soil conservation associations (similar to community-led natural resource management groups). Such associations are often a signal that the local farming community is committed to maintaining the land resource and to resolving its own problems. However, the importance of farmer-led innovations as a strategic component of sustainable land management and of the role of farmer-led soil conservation associations as the empowerment mechanism to ensure continuance of sustainable land management in the future must be recognized. This is not likely to happen on its own because it disenfranchises many existing bureaucratic institutions. It will require commitment from national governments towards decentralized responsibility, and collective action from international institutions to catalyze the change.

The emphasis on sustainable land management at the local level can have considerable impact on global environmental management. Although land management decisions in rural areas are made by millions of small-scale entrepreneurs (farmers) with individual objectives and aspirations, experience has shown that local farmer-led innovations demonstrated at the farm level are rapidly repeated in many similar environments. This results in the patterns of land use that are commonly observed over large spatial areas. The collective impacts of these patterns can be considerable on such global environmental issues as desertification, land degradation, loss of biodiversity, and carbon sequestration. The challenges are considerable, but much can be achieved by empowering conservation-oriented farmer associations to take the lead in these programmes, thereby demonstrating willingness and commitment to their land use choices.

Agenda 21, in particular Chapter 10, provided an important international opportunity for sustainable land management, but it has been criticized for the lack of effective action. The failure, however, lies not with Agenda 21, which is only a framework for action, but rather in the inability of national and international communities to collectively mobilize and develop practical actions that can be implemented (*ie*, pushing the transformation from top-down prescriptive approaches to bottom-up programme delivery). It is time that our current delivery procedures were seriously reconsidered. It is time to mobilize the global community towards the view that protecting soil resources is equal in importance to protecting the planet's climate, water and biodiversity, and to recognize the soil as a strategic component of global life support systems. This was a major recommendation from the 9th international ISCO conference [5] and needs to be fully endorsed and promoted.

CONCLUSIONS

Apart from some minor adjustments, the framework and definition for sustainable land management have stood up to peer review. Consequently, further refinement of these concepts is more academic than practical at this point in time. However, considerable very useful work remains to be done to develop the indicators for monitoring our efforts towards sustainability, and to test and apply these in field studies in developing and developed countries. A high degree of international agreement on the required set of biophysical (land quality) indicators has already been achieved, but a similar effort is required for the economic and social indicators.

Another major challenge is how to effectively implement sustainable land management in the field. Farmers and other land users are the custodians of rural land resources, and their collective decisions will ultimately determine the sustainability of land use systems. Many approaches to land use planning, land evaluation and traditional rural extension have been tried, but these have enjoyed mixed success at best. It is becoming clear that the direct involvement of farmers and other members of rural societies is necessary to effect on-the-ground delivery of these concepts and, increasingly, this involves transferring principles, criteria and knowledge rather than technologic packages (as was the tendency in the past). Often, if farmers understand the principles and criteria involved, they will figure out the solution(s). In fact, experience in several parts of the world has demonstrated that farmer-led innovation, farmer empowerment with authority and responsibility for decisions, and bottom-up planning and delivery of programmes are essential for achieving sustainable land management, but these must be supported by technologic and institutional backstopping from research and extension.

Sustainable land management provides improved options for both agricultural production and environmental maintenance. Soil is a strategic component of global life support systems, and protecting global soil resources is equal in importance to protecting the planet's climate, water and biodiversity. A new international convention on soil resources is necessary to create the social and political awareness and the national and international implementation strategies to ensure the maintenance of the ecologic functions and the quality of the soil.

REFERENCES

1 Dumanski, J. 1994. Proceedings of the International Workshop on Sustainable Land Management for the 21st Century. Organizing Comm, internatl workshop on sustainable land management, Agri Inst of Canada, Ottawa.

2 Dumanski, J. 1997. Planning for sustainability in agricultural development projects. GTZ, Agriculture and Rural Dev 1/97, pp 15-18.

3 Dumanski, J, W W Pettapiece and R J Macgregor. 1997. Relevance of Scale Dependent Approaches for Integrating Biophysical and Socioeconomic Information and Development of Agroecological Indicators. Kluwer Acad Publ (in press).

4 Gallopin, G C. 1995. The potential of agroecosystem health as a guiding concept for agricultural research. Ecosystem Health 1, 3, pp 129-139.

5 ISCO. 1996. Towards sustainable land use: furthering cooperation between people and institutions. 9th ISCO conf, Ministry of the Environment, Nature Conservation and Nuclear Safety, Bonn, Germany.

6 Pieri, C, J Dumanski, A S Hamblin and A Young. 1995. Land Quality Indicators. World Bank Discussion Paper 315, World Bank, Washington DC.

7 Smyth, A J and J Dumanski. 1993. FESLM: An International Framework for Evaluating Sustainable Land Management. World Soil Resources Rep 73, FAO, Rome.

8 SSSA (Soil Science Society of America). 1995. SSSA statement on soil quality. Agronomy News, June 1995, SSSA, Madison, Wisconsin.

9 Traeger, H, K Steiner and A Herring. 1997. Indicators of Sustainable Land Management. A Literature Review. GTZ, Farming Systems Research, Eschbom, Germany.

10 World Bank. 1997. Expanding the Measure of Wealth. Indicators of Environmentally Sustainable Development. World Bank, Washington DC.

RESUME

Une gestion durable des terres (SLM) exige l'intégration de technologies, de politiques et d'activités dans le secteur rural, particulièrement dans l'agriculture, de manière à amplifier la performance économique tout en maintenant la qualité et les fonctions environnementales de la base naturelle de ressources. On a identifié cinq critères d'évaluation de progrès vers SLM: la productivité, la sécurité, la protection, la viabilité et l'acceptabilité. La définition et les piliers sont les principes de base et la fondation sur lesquelles une gestion durable des terres est développée; beaucoup ont examiné et débattu là-dessus durant ces sept dernières années. Au cours de ce processus, les concepts de souplesse d'utilisation des terres et d'équité sociale ont été ajoutés mais autrement la définition et les piliers ont résisté au test. Le concept de gestion durable des terres, de même que celui de développement durable, sur lequel il est fondé, prend de l'importance aussi bien dans les circonscriptions rurales que urbaines. Ceci est dû à son attrait psychologique ainsi qu'à la flexibilité de sa définition. On a fait beaucoup de progrès pour identifier les critères et les indicateurs de SLM. A ce jour, un accord international a été obtenu sur les indicateurs suivants de qualité des terres: (1) cinq séries d'indicateurs pouvant être développés à court terme, c-à-d équilibre nutritionnel, tendances de récolte et variabilité, intensité d'utilisation des terres et diversité de culture; (2) trois séries d'indicateurs, requérant une recherche à long terme, sur les thèmes de qualité de sol, de dégradation des terres et d'agro-biodiversité; (3) quatre séries d'indicateurs que d'autres groupes de travail développent actuellement, c-à-d, qualité de l'eau, des terres forestières, des pâturages ainsi que la contamination et la pollution du sol. Ceux-ci sont les composants de la qualité du sol d'un SLM et doivent, cependant être complétés avec des indicateurs des autres piliers—viabilité économique, élasticité du système, et équité sociale et acceptabilité. Dans ces derniers domaines, on est seulement arrivé à une entente sur les indicateurs: profitabilité nette de la ferme et pratiques d'utilisation et de conservation de sol. Bien qu'il ne s'agisse encore que de thèmes généraux plutôt que d'indicateurs spécifiques, ils donnent une direction efficace et pratique sur les critères et les exigences pour une gestion durable des terres et ils canalisent l'effort de recherche. L'identification des indicateurs n'est cependant qu'une seule de plusieurs étapes importantes. L'initiative majeure importante suivante doit porter sur les procédures pour l'implantation d'un SLM aux niveaux local, national et international. On n'avancera pas en SLM sur la base d'avancées technologiques et scientifiques seulement; des changements dans les structures institutionnelles et économiques feront également partie de la solution. Par exemple, les technologies et les programmes de conservation des sols, qui étaient à l'origine seulement créés pour la réhabilitation de zones dégradées, doivent maintenant être déplacés dans des programmes de maintenance préventive; la planification d'utilisation de terres rurales doit aller d'une approche prescriptive et prendre le rôle de facilitateur dans le but d'assurer que l'on portera autant d'écoute aux intérêts locaux des fermiers et autres concernant les droits acquis. Les fermiers et autres utilisateurs des terres sont les gardiens des ressources rurales, et leurs décisions collectives détermineront en dernier, la durabilité des systèmes d'utilisation des terres.

RESUMEN

El manejo sostenible de las tierras (SLM) requiere la integración de tecnologías, políticas y actividades en el sector rural, en particular en la agricultura, de manera a aumentar el rendimiento económico mientras que se mantengan la calidad y las funciones ambientales de la base de recursos naturales. Se identificaron cinco criterios para evaluar el progreso hacia el SLM: la productividad, la seguridad, la protección, la viabilidad y la aceptabilidad. La definición y los pilares son los principios básicos y los cimientos sobre los cuales se está desarrollando el manejo sostenible de las tierras, y estos han sido examinados y discutidos por muchas personas en los últimos siete años. A través de este proceso, se han agregado los conceptos de resiliencia del uso de las tierras y de equidad social, pero por lo demás la definición y los pilares han resistido a las pruebas. El concepto de manejo sostenible de las tierras, como el concepto de desarrollo sostenible en el cual está fundado, está tomando impulso tanto en distritos rurales como urbanos. Esto se debe tanto a su atracción psycológica como a la flexibilidad de la definición. Se han hecho muchos progresos en identificar criterios e indicadores de SLM. Hasta ahora, se ha logrado un acuerdo internacional sobre los siguientes indicadores de la calidad de las tierras: (1) cinco grupos de indicadores que pueden ser desarrollados a corto plazo, incluyendo balance de nutrientes, tendencias y variabilidad de los rendimientos de cultivos, intensidad del uso de las tierras, diversidad del uso de las tierras, y cobertura de las tierras; (2) tres grupos de indicadores, que requieren investigación a largo plazo, sobre los temas de calidad del suelo, degradación de las tierras y agrobiodiversidad; y (3) cuatro grupos de indicadores que están siendo desarrollados por otros grupos de trabajo, incluyendo calidad de las aguas, calidad de las tierras forestales, calidad de los pastizales naturales, y contaminación/polución de las tierras. Estos son los componentes de la calidad de las tierras en el SLM, que todavía necesitan ser complementados con los indicadores de los otros pilares—viabilidad económica, resiliencia del sistema, y aceptabilidad y equidad social. En estas últimas áreas, se ha logrado acuerdo solamente con respecto a los dos indicadores: la ganancia neta de la finca y el uso de prácticas para la conservación de suelos. Aunque estos son todavía temas generales en vez de indicadores específicos, los mismos proveen una dirección efectiva y práctica sobre los criterios y requerimientos para el manejo sostenible de las tierras y canalizan el esfuerzo de investigación. La identificación de indicadores es, sin embargo, solamente uno de los varios pasos importantes. La próxima iniciativa mayor tiene que concentrarse en los procedimientos para implementar el SLM a nivel local, nacional e internacional. No se lograrán adelantos en el SLM solamente en base a progresos tecnológicos y científicos; cambios en las estructuras institucionales y económicas también tendrán que ser parte de la solución. Por ejemplo, tecnologías y programas para la conservación de los suelos, que originalmente fueron diseñados para rehabilitar áreas degradadas, deben moverse más hacia programas de mantenimiento preventivo; la planificación del uso rural de las tierras debe apartarse del enfoque prescriptivo para desempeñar el papel de facilitador, con el objeto de asegurar que los intereses locales de los agricultores y de otros habitantes reciban la misma atención que otros intereses creados. Los agricultores y demás usuarios de las tierras son los guardianes de los recursos de tierras rurales, y sus decisiones colectivas determinarán en último término la sostenibilidad de los sistemas de uso de las tierras.