# Planning sustainable land management: the hierarchy of user needs

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## ABSTRACT

There is a need to move from a prescriptive approach towards an integrated approach to the physical land use planning and the social and institutional dimensions of land management. This paper examines issues of land use planning and land management in the rural environments of developing countries. The paper describes different approaches to assessing the needs and perceptions of land users. Based on a long series of trials and errors, it is well recognized that the most serious problems to achieving the integration of land use planning and land management are not technical, but related to the human factor. First, in rural areas individual farmers, men and women, and farmer groups should be the engine of this integration. But farmers or herders are not the only users, and at district, subnational and national levels, different stakeholders may have conflicting views about the best land management practices to achieve sustainable land management (SLM). Consequently, conflict resolution techniques are part of this process of integration. Second, the nature of information required is further discussed, emphasizing the fact that robust information available in a timely manner is often more important for the improvement of the decision making process than comprehensiveness. While information collection and management is costly, all efforts should be made to address the issue of the lack of coordination between information collectors and suppliers (national institutions, ministries, NGOs, bilateral and international aid organizations) and to develop decentralized systems of data management. The value of collected data can be increased dramatically if more consistent standards and formats are adopted that will allow temporal and spatial trends to be documented and explored. Finally, the challenge today is to transform information into knowledge. With the extraordinary and rapid development of information technology, the present trend is towards the development of a knowledge management system (KMS), recognizing that knowledge is a complex process, made up of information, expertise, experience and intuition, meaning that knowledge is never final and always evolving.

The planning of sustainable land management (SLM) is becoming an urgent necessity at the dawn of the 21st century. Expanding human population and economic activities are placing ever-increasing pressures on land, creating competition and conflicts to access and to use this finite life-supporting resource.

However, a "land use planning approach", which refers to spatial planning of physical land resources in a top-down setting, is no longer appropriate or adequate to address the issue of optimizing land management for the satisfaction of conflicting human needs, including maximum sustainable production and the preservation of a safe and healthy environment. There is the need to move from a prescriptive approach towards an integrated approach to the physical land use planning and the social and institutional dimensions of land management.

This paper examines issues of land use planning and land management in rural environments for developing countries. In these regions, development of sustainable land management practices is central to the issues of food security, poverty alleviation and protection of the environment.

Based on a long series of trials and errors in both the developed and developing countries, it is well recognized that the most serious problems in achieving the integration of land use planning and land management are not technical but related to the human factor. It is also acknowledged that this integration should be developed at the lowest possible level (following the principle of "subsidiarity"), using demand-based approaches and involving all stakeholders in decision making. For example, in rural areas individual farmers, men and women, and farmer groups should be the engine of this integration. But farmers or herders are not the only users, and at district, subnational and national levels different stakeholders may have conflicting views about the best land management practices to achieve SLM. How to identify these user needs, and how to establish a hierarchy of often conflicting views among stakeholders on the use of land resources are some of the questions that are discussed in this paper. Further, considering all the possible user needs, which are the most useful (cost-effective) sets of data and information to enable the ultimate land user, *ie*, the individual farmer or herder, to implement sustainable land management practices? Often the most useful information is conditioned or limited by the availability and relevance of existing data; yet a few data locally known, such as tillage practices and crop residues management, must be more systematically georeferenced and incorporated into current agricultural census and surveys.

## ASSESSING THE NEEDS AND PERCEPTIONS OF LAND USERS

The assessment of land user needs is not a trivial question, because it raises issues of the hierarchy of human needs, of methodology and of information management.

### HIERARCHY OF HUMAN NEEDS

The concept of a hierarchy of needs was developed by Maslow, an American psychologist, to better understand the behaviour and motivations of individuals. Winsemius *et al* [16] adapted this concept to the environmental hierarchy of human needs for sustainable development, following five basic steps in the human decision-making process. These include first the satisfaction of basic physiologic needs (for food, energy and shelter), second and third the prevention of aggression which may threaten directly or indirectly the human health for any person or member of society. The fourth

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step relates to an increasing level of awareness and the recognition of collective responsibility to society on environmental issues. Finally, the fifth step is reached when all the stakeholders acknowledge the necessity of a full internalization of the "environment", accepting that environmental challenges are an integral part of one's responsibilities and translating this acceptance into everyday behaviour. The key point made by Maslow is that any individual, or human group, can only move to a higher level when they have satisfied their needs at the lower levels.

This concept of hierarchy of needs is also useful to land use planning and land use management. For example, it helps us to understand why farmers or farmer groups will not embrace a new set of sustainable land management practices unless these fulfil first necessities of life; there are no direct or indirect threats to family welfare; and they improve economic return. However, although this concept facilitates the categorization of generic human needs, it has to be complemented by an approach to operationalize the identification and assessment of the land user needs in the perspective of practical implementation of SLM.

## USERS AND USER NEEDS ASSESSMENT

There are many categories or types of land user in addition to the farmer, and all these must be identified to establish the respective hierarchy of needs. These users vary from place to place, but collectively they make up the major stakeholders in the process of land use planning and land use management. In a recent review of partnerships for sustainable agriculture, Thrupp [15] identified several categories of stakeholder, including:

- farmers and farmer groups
- non-governmental organizations of local and/or international origin
- national public and private agricultural extension agencies, including private agribusiness salesmen
- national public and private agricultural research institutions, including private agribusiness distributors, educational and social institutions
- international, regional agricultural research institutions, including public and private research organizations from developed countries
- development agencies, transnational companies, northern and international policy-oriented organizations.

With such a diverse group, each stakeholder group is likely to have different views and opinions about the best way to use and manage the land. Although it could be useful to identify the major needs of each group, there is probably little to gain by refining these evolving needs. For example, in many countries farmers have encroached on steeply sloping areas [3], using slash-and-burn techniques, while "land use planners" want them to adopt more environmentally friendly land management practices or even to relocate to other places. This may raise new issues of land rights and land use security. The point is that identifying user needs is not a static and intellectual exercise, but involves a dynamic conflict resolution process among actual and potential stakeholders.

Each group of stakeholders assess their needs on the basis of their perceptions and understanding of the land use issues and the availability of information. Consequently, identification and critical information, including users' perceptions of this information, are essential to establish a useful hierarchy of user needs and for a successful negotiation process between the major stakeholders.

## APPROACHES TO USER NEEDS ASSESSMENT

Two approaches can be used to identify and prioritize user needs (Figure 1), following the conventional and a more innovative and interactive transfer of technology model [15].

The first approach is a public research and extension-driven model, characterized by a high degree of centralization of both technology and knowledge. This approach is a technology- and information-centered approach and it functions well in homogeneous production areas with high potential productivity, and where a limited number of research and development sites are

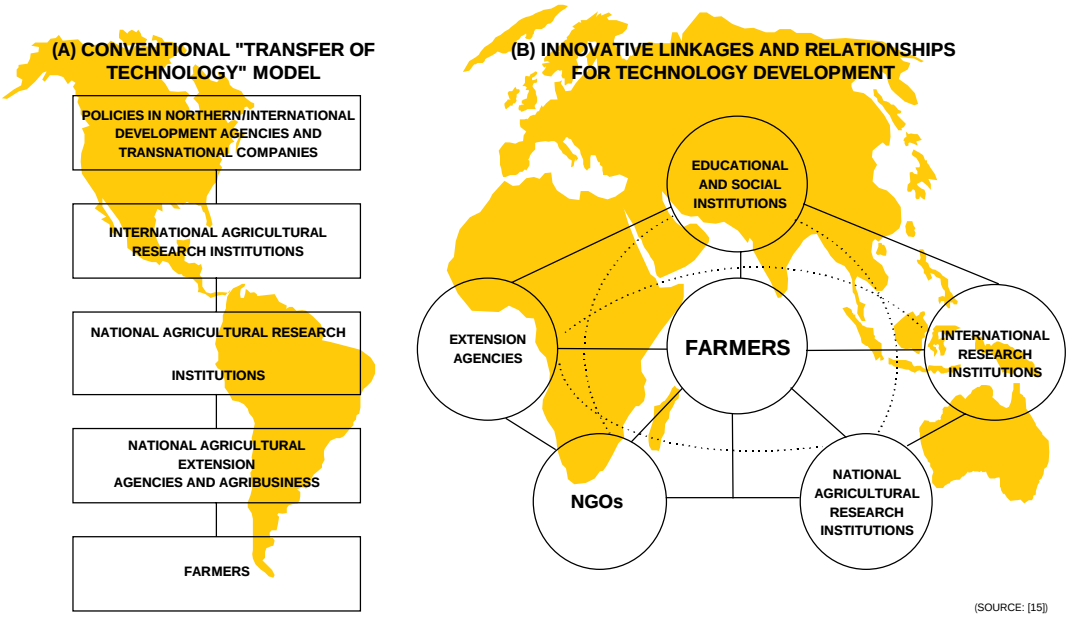


**FIGURE 1** Institutional relationships for agricultural technology development: conventional versus alternative modes

representative of large areas. The green revolution epitomizes the effectiveness and limitations of this approach. Because of the centralized top-down methodology, however, this approach has significant weaknesses in dealing with areas with diverse production systems, with a high level of biologic interaction as well as a high level of social integration [6].

The second approach relies on building partnerships for the development and delivery of innovative technologies, drawing upon an interactive establishment of major stakeholders' needs that stem from their perceptions and priorities of land use issues. This option is a people-centered process for creating awareness and ownership among land users aiming at the adoption of SLM. This approach requires that indigenous, or community-based knowledge and actions be prioritized in relation to new knowledge and technology entering from outside. Outside sources may still be needed for solving specific problems (*eg*, soil nutrient deficiencies, pest control, etc), or for understanding the basic process at the root of SLM at field and/or watershed scale and beyond (*eg*, soil erosion, agrobiodiversity management, etc). This approach requires a high level of social infrastructure and networking, which includes the participation and empowerment of farmers and communities, the development of partnerships among institutions, and policy and political support. Although this approach is particularly well adapted to lower productivity areas with high levels of agroecological and social integration, it also has high potential for application in high productivity regions.

Finally, it is likely that a combination of the two approaches will be used, depending of the circumstances—as currently illustrated in the Cerrados zones of Brazil (the first approach is initially favoured in areas under new development with commercial farmers, whereas in areas with less recent settlement an interactive and participative approach to land use planning and management is favoured).

## THE NEED FOR APPROPRIATE INFORMATION

It is commonly believed that the basic human needs of each category of land user will be better addressed if they have access to the right information, meaning the information which is consistent with SLM. Although the decision process is far more complex, it is true that, in parallel to the hierarchy of user needs, there is a related "hierarchy" of information needs. For example, what are the basic information needs to develop appropriate strategies to increase soil productivity, to generate more incomes and to increase rural welfare?

FAO and UNEP [4] recently identified the required information needed to facilitate the implementation of an improved approach to sustainable land management, catalyzed by the preparation of action plans consistent with Chapter 10 of Agenda 21 issued by the United Nations Conference on Environment and Development (UNCED, June 1992).

Four sets of information were recommended:

- the land resources, including the biophysical aspects on soils, climate, flora and fauna
- the combined needs of all stakeholders, including cultivated and grazing land, water supplies, firewood, building material, etc,
- the economic, social, legal and institutional framework within which negotiation would take place and actions would be delivered
- the technologic options and other opportunities to improve the productivity of land resources, including the change from farming to non-farming land use.

Such a comprehensive list infers that a broad array of data and information are required for setting the stage for SLM. In reality, however, only critical information, *ie*, information that most directly (efficiently) relates to the issue in hand, is needed, although other information might be potentially useful. The idea is to give a decision maker only essential information, but that in a timely manner. A related point concerns the cost of collecting, validating and using data and information, a condition that in the real world imposes strong limitations on the quantity of information that can be made available and monitored. For example, in some World Bank financed projects focused on SLM (*eg*, the projects "Natural resource management in Tunisia" (300,000 ha) or "Sustainable rural development in marginal indigenous areas in Mexico" (about 2,300,000 ha)), the funds available for monitoring and evaluating land use options amount to US$ 2 to 5/ha/year, or 1 or 2 percent of the total project cost. With such limited funding, it is very important to identify the critical data and information requirements, unless some additional source of funds is available.

Finally, it should be emphasized that the choice of a preferred approach to assess land user needs is not independent of the information requirement. Very often, the top-down option tends to generate a selection and hierarchy of information needs based on top-level decision and preconceived scale of users hierarchy, which eventually result in a more comprehensive collection of data and quantitative information. Usually, the information gathered is strongly focused on biophysical factors, and includes some detailed socio-economic and farm surveys. For example, this option considers the collection of a full set of soil information leading to the establishment of a comprehensive soil map—potentially useful for SLM but often not critical.

On the other hand, the second option, more oriented to consensus building and conflict resolution, leads to a more selective set of required information. It tends to focus on qualitative and semi-quantitative data and information, in particular socio-economic data and environmental indicators or surrogates and proxies derived from local knowledge. This option, while assessing user needs, identifies the major land issues perceived by the local land users, the indicators and/or surrogates of these issues, and the alternatives for overcoming or mitigating the impact of these land issues. From this point of view, farmers are not seen as an "object of research" but as providers of critical information.

While discussion on the kind and cost of information to be collected goes beyond the scope of this paper, it is important that these two approaches to information gathering are seen not as competitive but as complementary, and implemented within the broader framework of a comprehensive and decentralized information system on land related issues. While earlier work on information management featured basic data and comprehensiveness, particularly in the domain of land related information, the new orientation is on timely and demand-driven information to facilitate knowledge-sharing and action-oriented programmes.

## NEW PRIORITIES

New priorities and actions are required for an interactive and people-centered approach to land use planning and management. Some are reviewed below in relation to specific constraints related to information gathering and management at local, subnational and national levels.

### ENHANCING THE ASSESSMENT OF FARMERS' NEEDS

While participatory rural assessment is becoming popular in many rural projects, a frequent observation is that the initial prioritization of major land issues, which is one product of the so-called rapid rural appraisal (RRA) methodology, is often too general or too weak to establish a solid and appropriate strategy for SLM. This means that RRA should be followed by enhanced thematic appraisal focused on land-related issues [4]. This complementary assessment needs to be built into the preparation phase of any rural development project.

More specifically, RRA might be enhanced as follows:

(1) Many examples from existing projects show that a better technical and scientific diagnosis of land issues should be based on a clear understanding of the driving forces and the direct and indirect causes of land-related problems. For example, it was rightly but incompletely estimated that one of the key issues of limited crop yields (soya, upland rice) in the Cerrados zone in Brazil was soil aluminum toxicity and the uneven distribution of rain at the beginning of the rainy season. A significant amount of funding was allocated to soil pH management, including the use of gypsum for deep placement of calcium, and to selecting drought-resistant varieties. However, more detailed field observations indicated that soil compaction was also among the key soil constraints, as was soil erosion [12, 13]. These processes were induced by heavy use of disc harrows. Without proper diagnosis of the problem, no significant soil productivity increases would have been achieved. Currently, under the development of no-till practices and comprehensive soil fertility management, the Cerrado zone has experienced double-yield increase, while no-till has expanded from a few hectares in the '80s to 2.2 million ha in 1996.

(2) Another requirement for RRA enhancement is to ensure that all segments of farming communities, including traditional, professional and commercial farmers, as well as male and female social groups, are part of the assessment of user needs with respect to SLM. Farmers and farming communities are diverse in terms of needs, perceptions of land-related problems, access to resources, etc. For example, in sub-Saharan Africa, women farmers are particularly concerned about fuelwood shortage and water-borne diseases, whereas in the same environment male farmers are principally motivated by market conditions and economic incentives. Priorities differ widely—not only at district level but even at village level—with respect to soil fertility and access to inputs [7]. Moreover, in any given situation, some farmers are doing better than others; these are also the farmers who require the most (diverse) information. Therefore, by interacting with these farmers, one can quickly identify the most useful set of information needs.

(3) Finally, those who are directly engaged in information collection should be trained in techniques of conflict resolution, which have to be considered an integral part of the land use planning exercise.

### CAPTURING FARMERS' KNOWLEDGE INTO AN INFORMATION BASE

A key objective of the people-centered approach to assessing the needs and perceptions of land users is to capture and store local farmer knowledge. Different experiences are now available and documented [14, 10, 5], showing that this objective is attainable in a quantitative and cost-effective manner. Also software is available to spatially register and use the information. Data collection can be semi-automated; using GPS and photographs and photomosaics, simple information such as field boundaries, farmers' appreciation of soil productivity or constraints (using, *eg*, indigenous classification of soils), land use rights, etc, can be quickly collected and registered. This is currently being done in Côte d'Ivoire (Projet de Gestion des Terroirs Ruraux) and the procedure is an extraordinary tool for promoting communication among land users and resolving land use conflicts in areas such as the district of Soubre (southern Côte d'Ivoire), known for its highly politicized conflicts between customary rights and "modern" land tenure rights. Compared with the social costs of these conflicts, the cost-efficiency of two GPS and the associated training was deemed to be a very good investment by the national decision makers involved in land use planning. Further, methods for collecting information from local farmers and using a computer system to store geo-information are readily available. For example, Lawas and Luning [9] demonstrated that farmers' knowledge can be quantified and systematically organized using a GIS. GIS software is becoming increasingly affordable and these technologies are being increasingly used in many developing countries.

### AGGREGATING INFORMATION

Project managers and national policy makers are another important set of users, but they require information at broader levels of organization. Their information needs are different, raising different kinds of issues, *eg*,

- the integration of data generated by different disciplines and sources (human and biophysical sciences), farmers' knowledge and remote sensing into a common georeferenced base
- the scaling of data and information to make them accessible and relevant to project managers and national policy makers [2].

While information technologies are available to address most of these issues, including the modelling approach, some basic questions still have to be resolved, such as the congruence between socio-biophysical boundaries (the *terroirs* or resource management domains (RMDs)) and administrative boundaries [1]. Land management decisions most often relate to socio-territorial units (human settlements x natural landscape units), while most agricultural census data, as well as legal regulations and policy decisions, relate to administrative units. These data can be transformed using GIS-based technologies, in which case analyses of the census can be done for units more familiar to soil scientists. However, the census is often deficient in land manage-

ment data and must be enhanced with information on crop residues management, tillage methods, machinery used and SLM indicators [11].

### FROM INFORMATION MANAGEMENT TOWARDS KNOWLEDGE MANAGEMENT

Although much data are already available and more could be done with accessible information and knowledge, new information will always be required from the evolving key research questions, such as:

- relationships between needs and perceptions of land users
- relationships between land productivity and land quality
- relationships between land use and poverty in rural areas
- management of land use issues at the interface rural/urban environments.

While research, such as the project "Land use/land cover change science/research plan" [8], has to be developed, it is important to make the best use of the available knowledge.

With the extraordinary and rapid development of information technology and the present trend towards developing a knowledge management system (KMS), the challenge today is to transform information into knowledge.

The World Bank is currently addressing this issue (drawing on, and adapting to its mission the experience of giant multinational private organizations such as AT&T or IBM) by creating knowledge nodes in major thematic areas, including land and water management. This is a definite move to enable users to find data and information across organizational boundaries or entities, and to enhance the knowledge-generation process. Such knowledge nodes require that technology platforms be built along the lines of highly decentralized and transparent information systems. One implication, particularly relevant to information related to SLM, is the need for common standards and formats to accumulate and organize the appropriate information over time and space. However, a KMS requires that, in addition to creating, organizing and applying knowledge, such systems identify the gaps—and research needs to fill these gaps. It basically recognizes that knowledge is a complex process, made up of information, expertise, experience and intuition, *ie*, knowledge is never final but always evolving. A KMS is focused also on quality, friendliness and timely information.

The endeavour to adapt geo-information development to sustainable land management should be inspired by a similar approach, leading to a highly decentralized KMS that creates knowledge through a demand-driven approach and provides robust information in a timely manner. The objective is not comprehensiveness, but better decisions and measurable results.

## CONCLUSIONS

To achieve SLM at local, national and global levels in the broader context of sustainable rural development will require a major effort to truly integrate the physical, social and institutional dimensions of land use planning and land management. Improved information dissemination among all the stakeholders has the potential to contribute significantly to resolve the farmer's conflicting needs for short-term productivity/income gains and longer-term environmental protection. However, the immediate cost of information acquisition is often high, particularly for developing countries facing pressing financial constraints. In this context, three main themes should be kept in mind.

(1) While considerable effort is currently made in each country to collect information and data, the lack of coordination between information collectors and suppliers (national institutions, ministries, NGOs, bilateral and international aid organizations) has a high cost and does not lead to efficient use of these data and information. Decentralized systems of data collection are certainly the best, but they should be systematically interconnected within some common network(s) to improve opportunities to share and compare data among users. While biophysical data are increasingly georeferenced, there is still ample opportunity to further develop the use of low-cost tools, such as GPS, to spatially reference all physical and social information. The value of collected data can be increased dramatically if more consistent standards and formats are adopted that will allow temporal and spatial trends to be documented and explored.

(2) It was emphasized that SLM is predominantly a conflict resolution issue among the major stakeholders. Techniques are already being developed to address this issue and should be more widely disseminated—also among scientists with a biophysical science background. In the context of preparing rural development projects or programmes, however, an ex ante analysis of who will lose and who will benefit from the planned actions is always very useful. In the long run, SLM is best assured when the impacts on the "losing group" are minimized, and this is often only achievable by either modifying or adapting some of the initially planned actions or by adding some component that will compensate the potential losers. World Bank financed projects in Egypt (Mathru resource management project) and in Brazil (land management projects in Paraná, Santa Catarina, Rio Grande do Sul, etc) provide good examples of such an approach: although farmers are not participating fully in the projects, non-participating farmers are indirectly benefiting through their neighbours' soil erosion control, improved water quality, better flood control, and improved market access through road network improvements, etc. As a result of creating this broad base of beneficiaries, political commitment to these projects remains high, even where elections have meant changes in government.

Finally, each land user requires only a limited amount of relevant and timely information, *ie*, information which improves the user's ability to make the right decision in a very specific environment and often at very short notice. Questions that arise are often terrain-specific or seek information that must be frequently updated (*eg*, variation in market prices, labour and/or cash availability, rainfall fluctuation, etc). SLM calls for flexible responses to perpetually changing problems. In other words, one might consider the integration of land use planning and land management in the broader context of sustainable rural development to be best served by the dissemination of some basic agroecologic and environmental-economic principles in a clear and adapted language.

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## RESUME


Il est nécessaire d'aller d'une approche traditionnelle vers une approche intégrée de planification d'utilisation physique des terres et des dimensions sociales et institutionnelles de gestion des terres. Dans cet article, on examine les résultats d'une planification et d'une gestion des terres dans l'environnement rural de pays en voie de développement. On décrit différentes approches pour l'évaluation des besoins et des perceptions des utilisateurs des terres. Une longue série d'essais et d'erreurs ont bien montré que les problèmes les plus sérieux pour réussir une intégration de planification d'utilisation des terres ne sont pas d'ordre technique, mais relatifs au facteur humain. Premièrement, en zone rurale les fermiers individuels, femmes et hommes, et les groupes de fermiers devraient être le moteur de cette intégration. Mais les fermiers ou les pasteurs ne sont pas les seuls utilisateurs, et au niveau régional, départemental et national, différents intéressés peuvent avoir des avis conflictuels sur les meilleures pratiques pour réussir une gestion durable des terres (SLM). En conséquence, les techniques pour résoudre ces conflits font partie du processus d'intégration. Deuxièmement, la nature de l'information demandée est ensuite discutée, s'appuyant sur le fait qu'une solide information disponible en temps opportun est souvent plus importante que sa portée pour le processus de prise de décision. Etant donné que l'acquisition et la gestion d'information est coûteuse, tous les efforts devraient être faits pour aborder le résultat de ce manque de coordination entre les demandeurs et les fournisseurs d'information (institutions nationales, ministères, ING, organisations d'aide bilatérale et internationale) et pour développer des systèmes décentralisés de gestion de données. La valeur des données acquises peut être considérablement augmentée si des normes et des formats plus conséquents sont adoptés qui permettront de documenter et explorer des tendances temporelles et spatiales. Finalement, le défi d'aujourd'hui est celui de transformer l'information en savoir. Avec le développement extraordinaire et rapide de la technologie d'information, on tend maintenant vers le développement d'un système de gestion du savoir (KMS), en reconnaissant que le savoir est un procédé complexe composé d'information, d'expertise, d'expérience et d'intuition, ce qui signifie que le savoir n'est jamais définitif et toujours en évolution.


## RESUMEN


Hay una necesidad de pasar de un enfoque prescriptivo a un enfoque integrado entre la planificación física del uso de las tierras y las dimensiones sociales e institucionales del manejo de las tierras. Este artículo examina temas de planificación del uso y manejo de las tierras en los medios rurales de los países en vía de desarrollo. El artículo describe diferentes enfoques para evaluar las necesidades y las percepciones de los usuarios de las tierras. En base a una larga serie de ensayos y errores, se reconoce claramente que los problemas más serios para realizar la integración de la planificación del uso de las tierras y del manejo de las mismas no son técnicos, pero están relacionados al factor humano. En primer lugar, los agricultores individuales, hombres y mujeres, y los grupos de agricultores deberían formar el motor de esta integración en áreas rurales. Pero los agricultores o los pastores no son los únicos usuarios, y a los niveles de distrito, subnacional y nacional, los diferentes participantes pueden tener opiniones contradictorias en cuanto a las mejores prácticas de manejo de las tierras para lograr un manejo sostenible de las tierras (SLM). Por lo tanto, las técnicas para la resolución de conflictos hacen parte de este proceso de integración. En segundo lugar, se discute la naturaleza de la información requerida, dando énfasis al hecho que una información robusta, disponible en forma oportuna, es frecuentemente más importante que una información exhaustiva para el mejoramiento del proceso de toma de decisión. Mientras que la colección y el manejo de la información son costosos, todos los esfuerzos deberían dedicarse al problema de la falta de coordinación entre colectores y suministradores de información (instituciones nacionales, ministerios, ONGs, organizaciones de ayuda bilaterales e internacionales) y para desarrollar sistemas decentralizados de manejo de los datos. Se puede aumentar considerablemente el valor de los datos colectados, si se adoptan normas y formatos más consistentes, que permitirán documentar y explorar tendencias temporales y espaciales. Finalmente, el desafío hoy en día es el de transformar información en conocimiento. Con el extraordinario y rápido desarrollo de la tecnología de información, la tendencia presente es hacia el desarrollo de un sistema de manejo del conocimiento (KMS), reconociendo que el conocimiento es un proceso complejo, hecho de información, experticia, experiencia e intuición, lo cual significa que el conocimiento nunca es final y siempre evoluciona.