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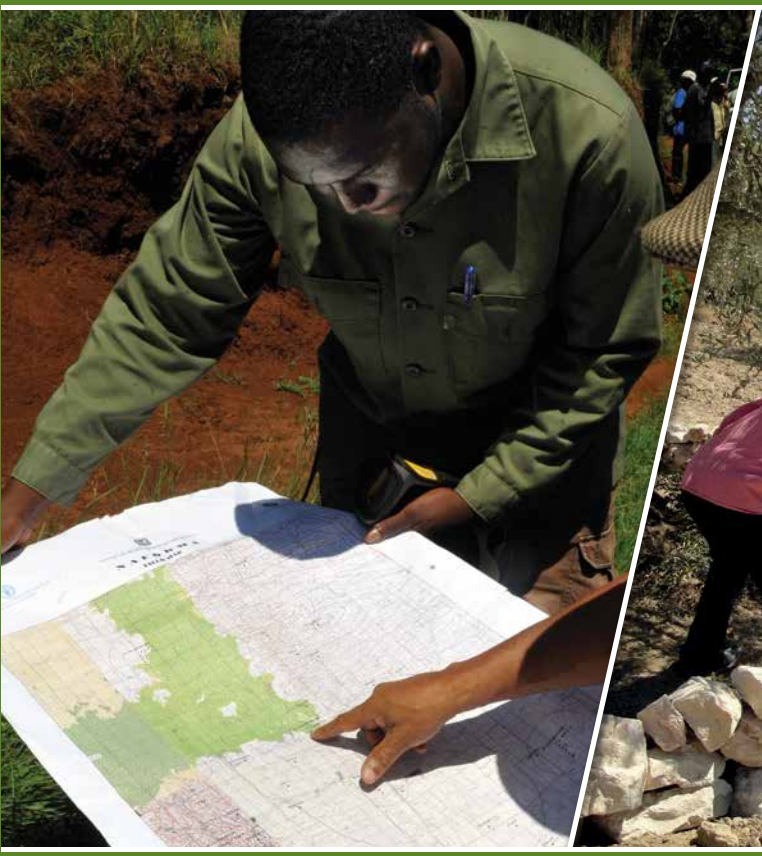

Land resource planning for sustainable land management

Current and emerging needs in land resource planning for food security, sustainable livelihoods, integrated landscape management and restoration

14 | LAND AND WATER DIVISION
WORKING PAPER

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A review of needs at various scales for tools and processes that can help countries and stakeholders meet emerging challenges, address increasing degradation of and competition for resources, support the sustainable use and restoration of land and water resources, and ensure resilient ecosystems

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Glossary

Biodiversity
The 2015 FAO Global Forest Resources Assessment and the Convention on Biological Diversity uses the following definition: "The variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, among species and of ecosystems."

Ecosystem services
The benefits people obtain from ecosystems. These include provisioning services such as food and water; regulating services such as flood and disease control; cultural services such as spiritual, recreational and cultural benefits; and supporting services such as nutrient cycling that maintain the conditions for life on Earth (Millennium Ecosystem Assessment, 2005).

Integrated landscape management
Ensures that by managing the underpinning natural resource base and ecosystem services through a coordinated process across sectors and stakeholders, the range of societal needs can be met in the short and long terms. Diverse landscape management approaches have been developed from different entry points but aimed at realizing multiple outcomes simultaneously. Commonalities include: generating an agreed vision among stakeholders of long-term and wide-scale landscape goals; adopting a mosaic of practices that achieve multiple objectives; devising strategies to manage spatial interactions across different land uses and users; establishing institutions for stakeholder dialogue, negotiation and action; and shaping markets and policies to support desired outcomes. These process, technical, socioeconomic, market and policy dimensions are mutually reinforcing (Landscapes for People, Food and Nature, 2015).

Land
A delineable area of the Earth's terrestrial surface, encompassing all attributes of the biosphere immediately above or below this surface, including those of the near-surface climate, the soil and terrain forms, the surface hydrology (including shallow lakes, rivers, marshes and swamps), the near-surface sedimentary layers and associated groundwater reserve, the plant and animal populations, the human settlement pattern and the physical results of past and present human activity, such as terracing,

water storage and drainage structures, infrastructure and buildings (United Nations, 1995).

Landscape
An area of land containing a mosaic of ecosystems, including human-dominated ecosystems. The term cultural landscape is often used when referring to landscapes containing significant human populations. (Millennium Ecosystem Assessment, 2003).

Land use planning
this is the systematic assessment of land potential and alternatives for optimal land uses and improved economic and social conditions through participatory processes that are multisectoral, multistakeholder and scale-dependent. The purpose of land-use planning is to support decision-makers and land users in selecting and putting into practice those land uses that will best meet the needs of people while safeguarding natural resources and ecosystem services for current and future generations. Tools and methods for land-use planning at appropriate scales should encourage and assist the diverse and often competing users of land resources in selecting land-use and management options that increase their productivity, support sustainable agriculture and food systems, promote governance over land and water resources and meet the needs of society (adapted from FAO, 1993).

Land resource planning
This is similar to land-use planning but, in this paper, the term is used in a broader sense. Thus, land resource planning encompasses land evaluation and land-use planning and addresses the biophysical, socio-economic and negotiatory domains.

Acronyms & abbreviations

CBL	Land and Water Division of FAO
FAO	Food and Agriculture Organization of the United Nations
GIS	Geographic information system
INDC	Intended nationally determined contribution
ISRIC	International Soil Reference and Information Centre
LADA	Land Degradation Assessment in Dryland Areas
LRP	Land resource planning
NDC	Nationally determined contribution
SDG	Sustainable Development Goal
SLM	Sustainable land management
WOCAT	World Overview of Conservation Approaches and Technologies

Executive summary

This working paper provides an overview of the historic development and status of implementation of land evaluation and land-use planning concepts and tools for land resource and landscape management, and it proposes recommendations for future actions. The increasing and juxtaposed challenges of population growth, demands on limited resources by diverse actors, land degradation, biodiversity loss and climate change require the rational use of resources to sustain and enhance productivity and maintain resilient ecosystems. Land-use planning and, more broadly, land resource planning (LRP), are tools for achieving the sustainable and efficient use of resources, taking into account biophysical and socio-economic dimensions. The availability of suitable tools and information to support and satisfy the needs of decision-makers at different scales, across sectors and among stakeholders is limited, however. The needs of decision-makers to address the challenges and drivers of change and promote effective and sustainable responses calls for an updated set of tools and approaches for participatory LRP. Such a set of tools should take into account biophysical, economic, socio-cultural and governance dimensions, and it should promote integrated landscape management as a means to satisfy the needs of multiple stakeholders and implement diverse national strategies and commitments. It is proposed that a consultation process involving a wide range of stakeholders operating at different scales be undertaken to bring together lessons and experiences in tools and approaches for LRP and to identify the main gaps and opportunities. This consultation process should lead to the formulation, with partners, of a strategy for the development, testing and validation of updated LRP tools in pilot countries with stakeholders and decision-makers, from the scale of local landscapes to the subnational, national and transboundary scales.

To initiate such a process, the Land and Water Division of FAO conducted a survey among stakeholders operating at different scales and in different sectors and regions to compile lessons and experiences from users of LRP tools and approaches and to identify challenges in the use of such tools, the need for and gaps in LRP tools, and possible future actions. The survey provided useful perspectives among professionals on the gaps and bottlenecks in LRP tools and opportunities for future development.

It is clear that many disciplines need better LRP, and the various actors and sectors need to be brought together in planning processes. In developing

future actions, more emphasis on LRP will be required at the national and subnational levels. A key principle is to ensure the balanced involvement of all stakeholders in the planning process. It is also important to enhance the visibility of user-identified tools, approaches and databases. In all cases, capacity building in the use of specialized tools and databases is necessary. A balanced mix is required of user-friendly computer tools and printed materials. Interventions in different regions to develop LRP tools should recognize region-specific needs and priorities.

The FAO survey identified a serious knowledge gap in the LRP community about the tools and approaches available for guiding LRP processes. To address this gap, an inventory of existing tools and approaches was compiled and the Land Resources Planning Toolbox was established. The Toolbox lists the available tools and describes their capabilities, limitations and suitability for various LRP stakeholders, professionals, regions and scales. The Toolbox distinguishes between tools in the biophysical and socio-economic domains and those that integrate both domains, and it can be searched according to several criteria. LRP tools can help decision-makers and land users put sustainable land management into practice.

Background

Land-use planning and sustainable resource management

Since the approval of the World Soil Charter in 1981 by FAO member countries and the convening of the UN Conference on Environment and Development in 1992, land-use planning has been promoted as an important tool for the sustainable use and management of land resources. A fundamental part of land-use planning is a systematic land evaluation/assessment process, which has been used widely for determining the suitability of land for various uses (e.g. rainfed and irrigated agriculture; rangelands; livestock; fisheries and aquaculture; forestry and agroforestry; and non-agricultural uses), thus increasing the efficiency and effectiveness of decision-making processes on land use, management and governance.

Approaches developed to support rational land-use decisions

The discipline of land evaluation was invented in Germany and applied in the former Soviet Union (the Bonitet system) before the Second World War with the aim of determining fertility values for soils and translating those into production estimates. The discipline was reinvented to help in determining the best (agricultural) uses of newly opened land, mainly in colonized tropical countries. In some western countries, land evaluation was used after the Second World War to determine the value of land that needed to be exchanged to form unique plots in the process of land consolidation. Countries actively used land-use planning in the 1980s and 1990s at a range of scales. Users included land authorities in national development plans and specific sectors; government authorities and technical sectors in subnational planning; and a range of concerned local stakeholders in landscape planning.[1] Land-use planning proved valuable for developing and developed countries with substantial areas of underexploited land in guiding coordinated efforts to put economic development plans into effect.

There has been a loss of interest in the discipline of land-use planning in recent decades, largely because little unused and unexplored land remains; moreover, scientists have realized that the relationship between land productivity and ecological/edaphic factors is dependent not only on land or soil potential but also on social and economic factors. On the other hand, management and inputs are still dependent on natural resources such as soil quality, water availability, biodiversity and climate, as well as on infrastructure, access to services and labour, and knowledge. For example, less-healthy or less-suitable soils involve a higher cost (e.g. in terms of soil and water conservation measures, irrigation, fertilizers and adapted seeds or

[1] In this paper, "local" means the scale of a village, community or landscape.

Land suitability has evolved to consider biophysical and socio-economic conditions

other germplasm) to attain the same yield as suitable soils, where suitability involves the ability not only to produce but also to store, process and sell surplus products. Consequently, suitability evaluations that address only land resource potential have declined in importance, while the matching of management options (technologies and approaches) with land uses and socio-economic determinants (e.g. knowledge, inputs, costs and benefits) – as proposed, for example, in Land Degradation Assessment in Dryland Areas (LADA) and the World Overview of Conservation Approaches and Technologies (WOCAT) – have gained in importance.

Modern approaches to land-use planning not only determine appropriate land-use types but also provide decision-makers with sustainable land resource management scenarios that improve productivity and sustainability. The scarcity of land and water increases competition for these resources and forces users to intensify production to meet escalating demand. Decision-makers need assistance in determining and putting into practice the best land-use management options for sustaining production. In most cases, management options are under continuous development. Broad consideration of natural resources and ecosystems is required in the planning process to identify and promote the most suitable and sustainable production systems over time.

Scenarios to inform the decision-makers

Another issue is that land value has less to do with land quality than with the value attached to specific land uses by stakeholders, often driven by socio-economic factors. This is unfortunate, because environmental considerations (e.g. the ecosystem services provided by land) and resilience in the face of climate change, climate variability and other shocks (such as natural disasters and market volatility) are often undervalued or underestimated. This points to how land resource planning (LRP) can be a valuable tool for sharing information on economically, socially and environmentally sound options, developing alternative scenarios for meeting the goals and aspirations of land users and water users, and building consensus among stakeholders through informed decision-making processes.

From top-down to participatory, people-centred approaches

The term "land-use planning" has often been interpreted as "central" or top-down planning; it is often forgotten, however, that land users – notably farmers, herders and fishers – are primary land-use planners and that those who exploit forest, energy or mineral resources or who use land for settlements, industry, recreation or tourism must also be taken into account in planning processes. Therefore, a participatory negotiation process is needed among stakeholders in planning the use of land and water resources and ecosystems. Such a process may involve modelling optimization techniques; land evaluation; dialogue and consensus building among divergent groups; and the development of regulations, laws and other governance mechanisms.

Current and emerging needs

The demand for food is escalating, and so is the pressure on natural resources. Significant changes are required to address current trends and to move instead towards sustainable food production and agriculture. FAO (2014) identified five interconnected principles for the transition toward sustainable food and agriculture (Figure 1): 1) improving efficiency in the use of resources; 2) natural resource conservation; 3) improving rural livelihoods; 4) enhancing resilience; and 5) governance. FAO recognizes that the adoption of sustainable land-use and land management practices is important for achieving sustainability in its Strategic Objective 2: "Producers and natural resource managers adopt practices that increase and improve the provision of goods and services in agricultural sector production systems in a sustainable manner". A new approach to LRP is needed to implement the five principles for the transition to sustainable food and agriculture and to integrate the three dimensions of sustainability – ecological, social and economic (Figure 2) – at various scales and among the competing uses of natural resources.

Principles for transitioning to sustainable food and agriculture

FAO has been a key player in LRP for many years. In the last few decades, [2]a wide range of tools and methods has been developed and applied in participatory LRP adapted to various contexts and scales of decision-making. Successes have been achieved at the local-to-national scales, but countries are reporting increasing constraints and difficulties, due mainly to new and emerging economic, social and environmental conditions. There are many examples of notable disasters resulting from a lack of LRP, such as building factories on vertisols (which are unstable as they expand and shrink with changes in moisture), and implementing irrigation development programmes on saline soils prone to further salinization and an associated loss of productivity.

Difficulties in planning for emerging issues

The International Conference on Agrarian Reform and Rural Development, held in 2006, adopted a declaration, vision and principles for the appropriate use of land resources (FAO, 2006). Recently, however,

[2] For example, FAO led a "participatory land-use planning development project" in Bosnia and Herzegovina in 2000–2008 that highlighted the importance and effectiveness of decentralized participatory approaches as part of a multisectoral planning process.

FIGURE 1
The principles of sustainable food and agriculture

1. Improving efficiency in the use of resources is crucial to sustainable agriculture
2. Sustainability requires direct action to conserve, protect and enhance natural resources
3. Agriculture that fails to protect and improve rural livelihoods, equity and social well-being is unsustainable
4. Enhanced resilience of people, communities and ecosystems is key to sustainable agriculture
5. Sustainable food and agriculture requires responsible and effective governance mechanisms

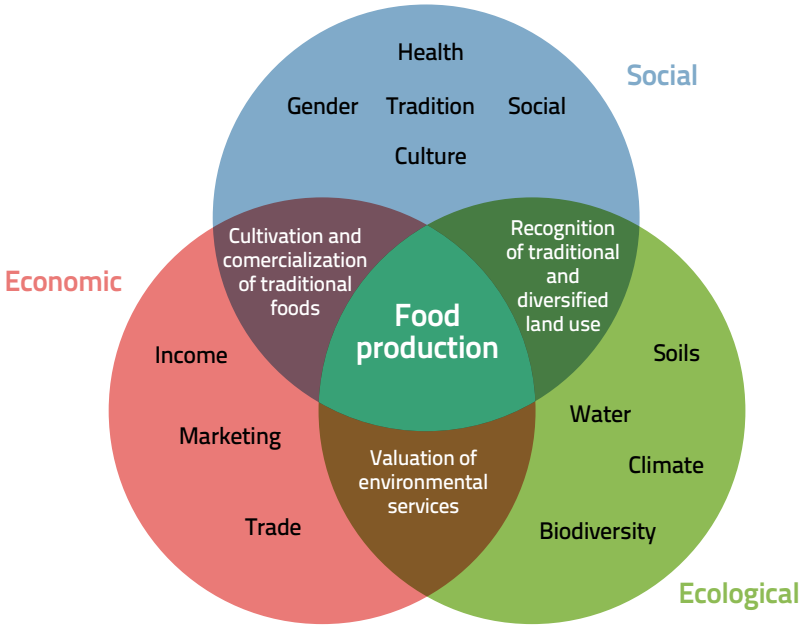
Doubts on the adequacy of planning tools at various scales

despite huge technological advances in geospatial tools, data management and communications, FAO and many partner institutions have recognized that developments in LRP have not kept pace with new challenges and increased demand for and pressure on land and water resources. There are doubts that adequate planning and analytical tools, knowledge and skills that compare scenarios, review trade-offs and identify win–win options are available to decision-makers at various scales. Yet such tools, knowledge and skills are crucial for facilitating and supporting effective LRP that addresses conflicts, meets competing local, national and global demands for land and water resources, and enhances governance over resources at all scales.

Integrated planning at the national, subnational and local levels

The outcome document of the United Nations Conference on Sustainable Development in 2012, "The Future We Want" (United Nations, 2012), stresses (in paragraph 101) the need for more coherent and integrated planning and decision-making at the national, subnational and local levels, as appropriate. It calls on countries to strengthen national, subnational and local institutions and relevant multistakeholder bodies and processes (as appropriate) that deal with sustainable development. The human

FIGURE 2
The three dimensions of sustainability



Source: IAASTD, 2009.

and biophysical interlinkages, and the impacts of land-use and land management practices on ecosystem resilience and sustainability, are complex, multiscalar and time-dependent. It is an increasing challenge to meet the needs and interests of individual land users and those of urban and rural populations and societies at large, taking into account the dynamics of population growth and migration.

Reinforcing land-use planning in the Forest and Landscape Restoration Mechanism

The FAO Committee on Forestry achieved progress in this regard in 2014, creating the Forest and Landscape Restoration Mechanism to, among other things, strengthen LRP and its components. FAO has engaged consistently with the Global Partnership on Forest and Landscape Restoration, and it has supported member countries through its field programmes and assisted them in developing capacity in intersectoral planning, institutional development and the implementation of integrated approaches.

LRP is also a basis for scaling up sustainable land management (SLM) practices by supporting investment and development plans; this has been happening in Africa, for example, through country strategic investment

programmes and plans developed under the TerrAfrica partnership programme for sub-Saharan Africa and the Great Green Wall for the Sahara and the Sahel Initiative. Good LRP requires adherence to guidelines such as the FAO Principles for Responsible Investment in Agriculture and Food Systems (FAO, 2014), the Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security (FAO, 2012b), and the Voluntary Guidelines for Sustainable Soil Management (FAO, 2017a).

Land-use planning for scaling up SLM practices

Globally, FAO targets food security, nutrition and sustainable agriculture as key elements for achieving the Sustainable Development Goals (SDGs) by 2030. There is increasing recognition that this requires the availability of up-to-date, user-friendly and harmonized tools that can improve knowledge and understanding and support well-informed decisions. LRP involves, among other things, elements of good governance and the analysis of trade-offs among uses to enable the effective development and implementation of land-use plans that optimize resource use and minimize conflicts among competing users and thereby conserve resources for future generations. Box 1 presents the SDGs that are most relevant to and would benefit from LRP at various scales.

Up-to-date tools for achieving the SDGs

Governance and trade-offs for sustainable development

In some situations, climate change and climate variability have major implications for land resources and use and will require effective land-use and water-use planning for mitigating and adapting to climate change. Land evaluation can help in matching the existing biophysical and socio-economic contexts with the most sustainable options or changes to land-use systems to support the climate resilience agenda. For example, land evaluation can be used to formulate, through participatory processes, scenarios for the use and management of land and water resources based on projected changes, which can be used to support decision-making.

Planning to support the climate resilience agenda

Negotiations at the 21st Conference of the Parties to the United Nations Framework Convention on Climate Change concluded with the landmark Paris Agreement on climate change. The Agreement requests countries to develop and implement nationally determined contributions (NDCs) and to report on their progress. Many countries have identified priority actions for the agriculture and land-use sectors in their intended NDCs (INDCs). In the Asia and Pacific region, for example, priority INDCs are seen to be well aligned with FAO's Country Programming Framework priorities and its Strategic Objectives. Improved land-use planning – as part of an integrated approach – was identified as one of the tools that can help countries mitigate and adapt to climate change (Damen, 2016).

Planning to support the implementation of NDCs

The impact of land degradation on land productivity is an impediment to achieving food security and reducing hunger. The degradation of

BOX 1

Sustainable Development Goals of relevance to land resource planning

1.4 By 2030, ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including microfinance.

2.3 By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment.

2.4 By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.

11.3 By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries.

11.a Support positive economic, social and environmental links between urban, peri-urban and rural areas by strengthening national and regional development planning.

12.2 By 2030, achieve the sustainable management and efficient use of natural resources.

13.2 Integrate climate change measures into national policies, strategies and planning.

13.b Promote mechanisms for raising capacity for effective climate change-related planning and management in least developed countries and small island developing States, including focusing on women, youth and local and marginalized communities.

15.3 By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world.

15.9 By 2020, integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts.

16.7 Ensure responsive, inclusive, participatory and representative decision-making at all levels.

Direct actions to combat land degradation

agro-ecosystems directly affects the food supply and income of the poor, increasing their vulnerability and creating a vicious cycle of poverty, further degradation and hunger (United Nations, 2012). Therefore, direct actions are required at all scales to conserve, protect and enhance natural resource management and combat land degradation. FAO is developing options to avoid further degradation and restore already-degraded lands. This effort is supported by SLM policies and practices, including assessment, planning and management tools. The aim of such efforts – supported by participatory scaling-up strategies and policies – is to reduce the transformation of currently productive and forested lands into unproductive or degraded lands and, where such transformations occur, to reverse them. Experiences and lessons learned on the role of SLM in combating land degradation are numerous at the national, regional and global scales.

Land resource planning and integrated land resource management

LRP – which encompasses land evaluation and land-use planning – is the systematic assessment of land potential and alternatives for optimal land use and improved economic and social conditions through participatory processes that are multisectoral, multistakeholder and scale-dependent. FAO promotes the use of SLM across the range of land-use systems – cropping, livestock and forestry – by, on the one hand, reducing further land degradation and, on the other, restoring and rehabilitating degraded lands. LRP is part of the integrated land resource management continuum, which involves a land assessment (i.e. land evaluation), the identification of needs and challenges, the selection and implementation of optimum SLM options and decision-support systems at the farm, landscape and national scales, and the monitoring and assessment of impacts to inform decision-makers and stakeholders. LRP is an approach for selecting and putting into practice the optimum SLM options within an integrated landscape management context, supported by the policy and institutional set-up (Figure 3). The implementation of management plans, involving all stakeholders, must be monitored using participatory processes, and the results and impacts should inform decision-making and planning in a cyclical process.

Integrated land resource management

Assessment, planning, implementation and monitoring

Inform decision-makers and stakeholders

The integrated land resource management process is scale-dependent, and it integrates multiple stakeholders and sectors. The guiding principles are that people and participatory approaches should be at the centre of the process and that governance and enabling policies and institutions should support the achievement of land-use plans. Policies and institutional support are crucial at all scales to match national and subnational economic, social and environmental goals with the needs of stakeholders (public and private-sector) and to manage trade-offs and inequalities between sectors and actors.

People's participation

Governance

Enabling policies and institutions

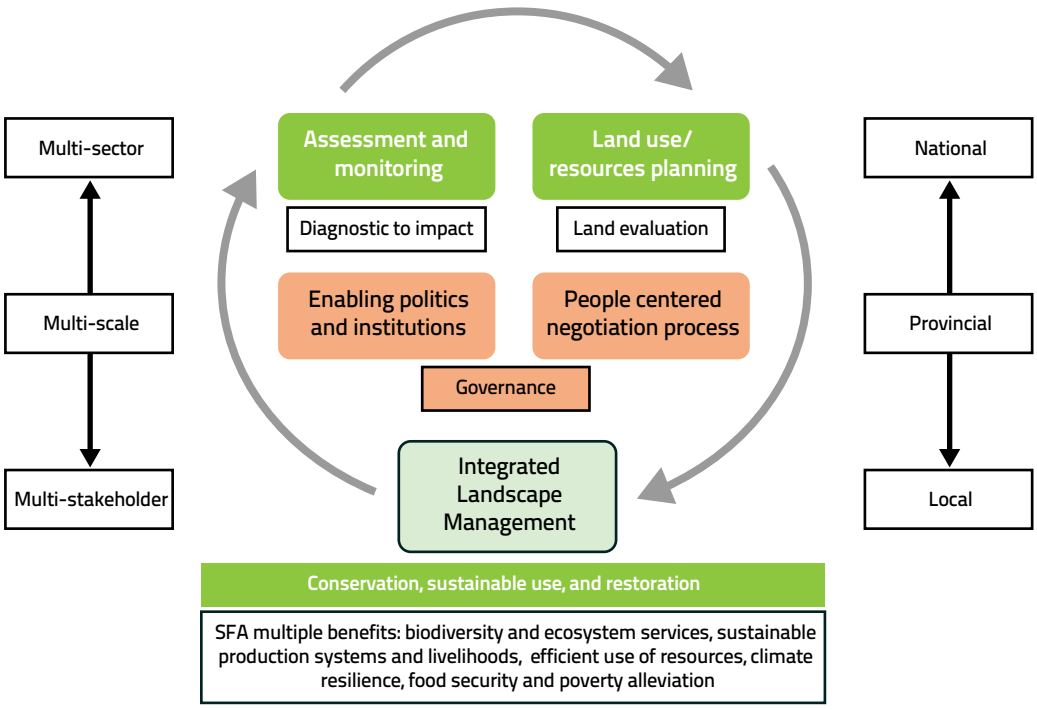
Land suitability evaluation is a tool to support decision-makers in the LRP process (see Box 2 for an example of the role of land suitability assessment to strengthen rural development planning in Rodrigues). Land suitability

Land suitability evaluation provides viable land-use options

assessment provides decision-makers with viable land-use options, based on the biophysical potential of resources and socio-economic conditions. These options support the land-use decision-making process in fulfilling the needs of different sectors operating in a landscape while optimizing and sustaining resource use.

FIGURE 3

Land resource planning as part of an integrated land resource decision-making process



Integrating landscape elements to optimize resource use

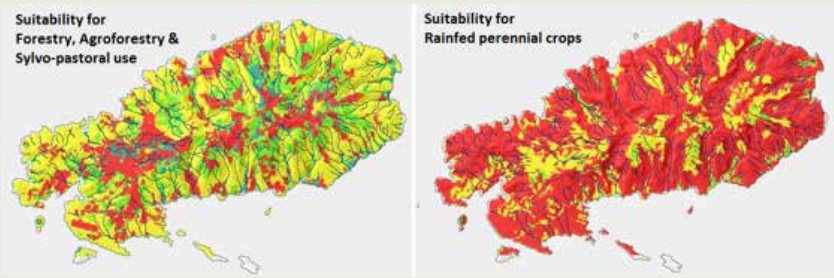
LRP has an important role to play in integrating the various elements of landscapes and in constructing a comprehensive view of landscape activities and sectors. Opportunities for expanding the area of agricultural land are limited, due to two factors. First, much of the available land is unsuitable for agriculture, and transforming such land into agricultural production would involve high economic, social and ecological costs (FAO, 2014). Second, competition among sectors within landscapes leaves less land for agricultural production. Food security should be achieved by increasing (and then maintaining) production on already-existing agricultural land to meet the demands of growing populations (FAO, 2011). LRP provides tools for using land resources in the most efficient way and promotes SLM practices to maintain productive landscapes.

BOX 2

Assessing land suitability to strengthen rural development planning in Rodrigues

Agriculture has a key role to play in the economy of Rodrigues, but the capacity to feed the population is constrained by the island's limited natural resource base. The island provides a typical example of a situation in which several sectors compete to make the best use of resources in a confined landscape.

Land suitability assessment, based on criteria determined through a multistakeholder consultation process, helped raise awareness among decision-makers in Rodrigues about the value of suitability mapping to optimize resource use among competing sectors in the landscape.



Examples of suitability evaluation results for two of seven potential uses.

Local stakeholders will establish and maintain a natural resource information system to support development planning and to promote more inclusive, participatory land resource planning that considers competing sectors in the landscape.

Land resource planning and sustainable land management

SLM for the restoration of degraded natural resources and ecosystem functions

SLM is "the use of land resources, including soils, water, animals and plants, for the production of goods to meet changing human needs, while simultaneously ensuring the long-term productive potential of these resources and the maintenance of their environmental functions" (United Nations, 1992). It includes a range of complementary measures adapted to the biophysical and socio-economic context for the protection, conservation and sustainable use of resources (e.g. soil, water and biodiversity) and the restoration or rehabilitation of degraded natural resources and their ecosystem functions. Promising SLM options are available to sustain various productive land uses in landscapes. Crucial elements for guiding an SLM programme include knowledge management, capacity development and the coherence and alignment of policies and investments through integrated LRP strategies. More than 2 billion hectares worldwide offer opportunities for restoration through forest and landscape restoration (UNCCD, 2013), and SLM tools and practices can support this task (WRI, 2014). WOCAT has shown that SLM has the potential to increase yields by 30–170 percent, water-use efficiency by up to 100 percent, and soil organic carbon by 1 percent in degraded soils and by 2–3 percent in non-degraded soils (WOCAT, 2007; CDE, 2010).

SLM can increase yields by 30–170 percent, water-use efficiency by 100 percent and soil organic carbon by 1–3 percent

Unfavourable climate and mismanagement

↓

Degradation

Favourable human activities/proper land use

↓

Sustainability

SLM practices provide options for managing soil, water and plants and the ways these interact under a given set of biophysical and socio-economic conditions. Unfavourable climatic conditions (e.g. those imposed by climate change and climate variability), coupled with the mismanagement or misuse of resources, can increase degradation and vulnerability to change. On the other hand, the adoption of favourable practices, such as selecting proper land uses (based on land suitability evaluation) and implementing SLM, will enhance sustainability and resilience in the face of change (Figure 4). Understanding which part of the land resource is under threat is vital for selecting and putting into practice the most efficient and affordable solutions. The use of LRP in choosing land uses and adopting SLM, therefore, is an entry point to help decision-makers and communities increase the resilience of land-use systems. Selecting the

most appropriate land uses and implementing SLM (favourable human activities) will enhance sustainability and the efficiency of resource use. LRP tools help decision-makers adopt appropriate options for the use of land resources based on their natural potential, thereby avoiding unsustainable exploitation and minimizing the risk of further degradation. LRP should also help land users in selecting and putting into practice SLM options that support land and soil restoration in degraded areas (FAO, 2017b; FAO, 2017c).

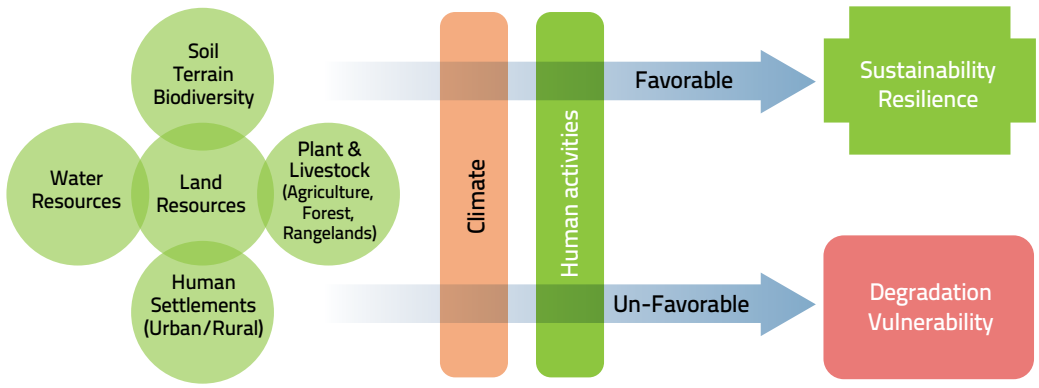
Economic, political, ecological and social land-use decisions

A comprehensive land-based approach would involve identifying and prioritizing target areas where certain options have high potential for success; selecting the most appropriate SLM regime; and disseminating SLM practices, supported by proper policies, financial mechanisms and continuous monitoring to maintain adaptability in the face of climatic and socio-economic change. The needs and wishes of farmers should be at the centre of sustainable land development processes (Mediterra, 2016; Ziadat *et al.*, 2015).

The multiuse nature of land involves various trade-offs that favour one use at the expense of others. Decisions that lead to changes in land use are often made on economic or political rather than ecological or social grounds. This can lead to the inappropriate use or management of land resources, with many potential negative impacts, such as the degradation of soil, water and biological resources; the loss of ecosystem functions and associated services; urbanization on productive soils; the use of poor-quality water or inadequate water for irrigation, leading to salinization; and the disturbance of fragile coastal ecosystems accompanied by biodiversity losses and ecological disruption (Mediterra, 2016).

FIGURE 4

Human activities and land use determine the sustainability of land resources



Source: FAO, 2017b.

Integrated landscape management

Integrated landscape management is the basis of natural resource management; it ensures that, by managing the underpinning natural resource base and ecosystem services through a coordinated process across sectors and stakeholders, the full range of societal needs can be met in the short and long terms. Land evaluation, land-use planning, negotiated territorial development and SLM are all tools that support LRP and integrated landscape management.

Features of land resource planning tools

The following principles and features are essential to consider in the process of updating LRP tools:

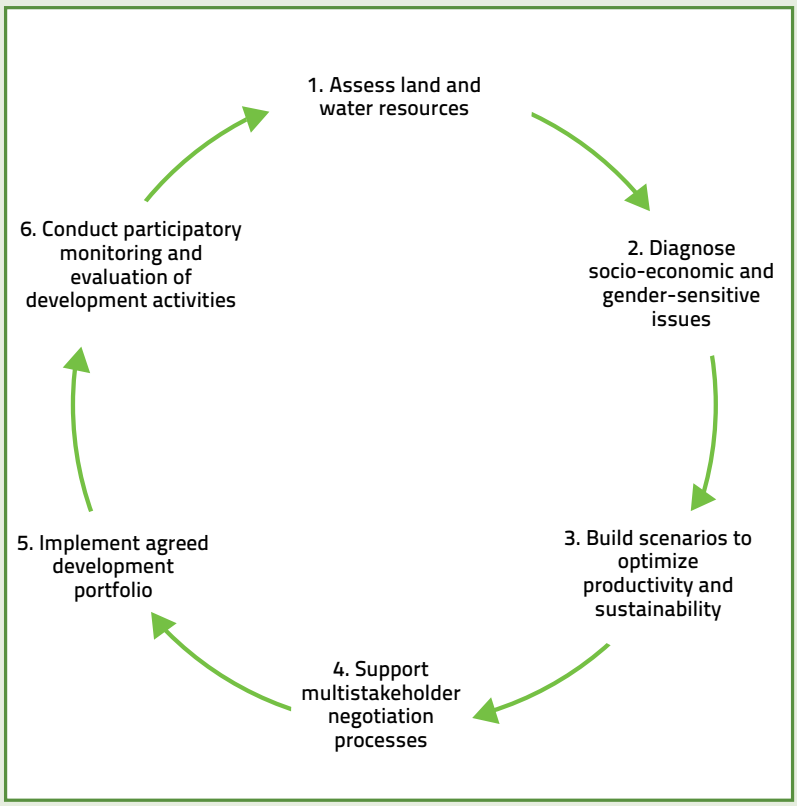
- The discipline should go beyond agricultural uses to include all involved sectors, focus on evaluating the range of ecosystem services generated, and involve some form of environmental accounting and land valuation.
- Modern techniques (e.g. remote sensing, precision farming, modelling, the use of apps, and geographic information systems – GIS) are essential parts of the package to be discussed.
- An informal system for matching SLM technologies and land-use systems can be developed (building on the work of LADA and WOCAT). In most cases and for various economic and social reasons, changing existing land uses is difficult. It is desirable, therefore, to introduce SLM practices to help land users in managing existing land uses in more sustainable and productive ways.
- Consider people at the centre of the process and adopt negotiatory processes based on the needs of the various users and taking into account power asymmetries, competing demands on resources and ecosystems, the land potential and the socio-economic context. Box 3 provides an example of the multiphase approach proposed for the implementation of participatory resource planning in the Near East.
- To be beneficial for decision-making, LRP should be designed to provide information at the scale at which it is needed. At the national scale, a national development plan is needed to identify major land-use systems; this will be used mainly to inform national policies (Figure 5), and it has a different level of generality to what is needed at the district scale, where planning should consider specific district-level problems and opportunities and inform district policies and priorities. At the local scale, consideration should be given to the specific problems of land users as well as their needs and capacities, and a detailed land-use plan should be formulated for the specific land uses and associated management options. The three scales are interrelated, and a two-way information flow should be maintained

Features of LRP: go beyond agriculture; use technology; introduce SLM practices; people-centred; multiscalar

to ensure that national policies are in harmony with and are being informed by district-level and local planning. Also, changes at the district and local levels should be adequately reflected in national policies and planning.

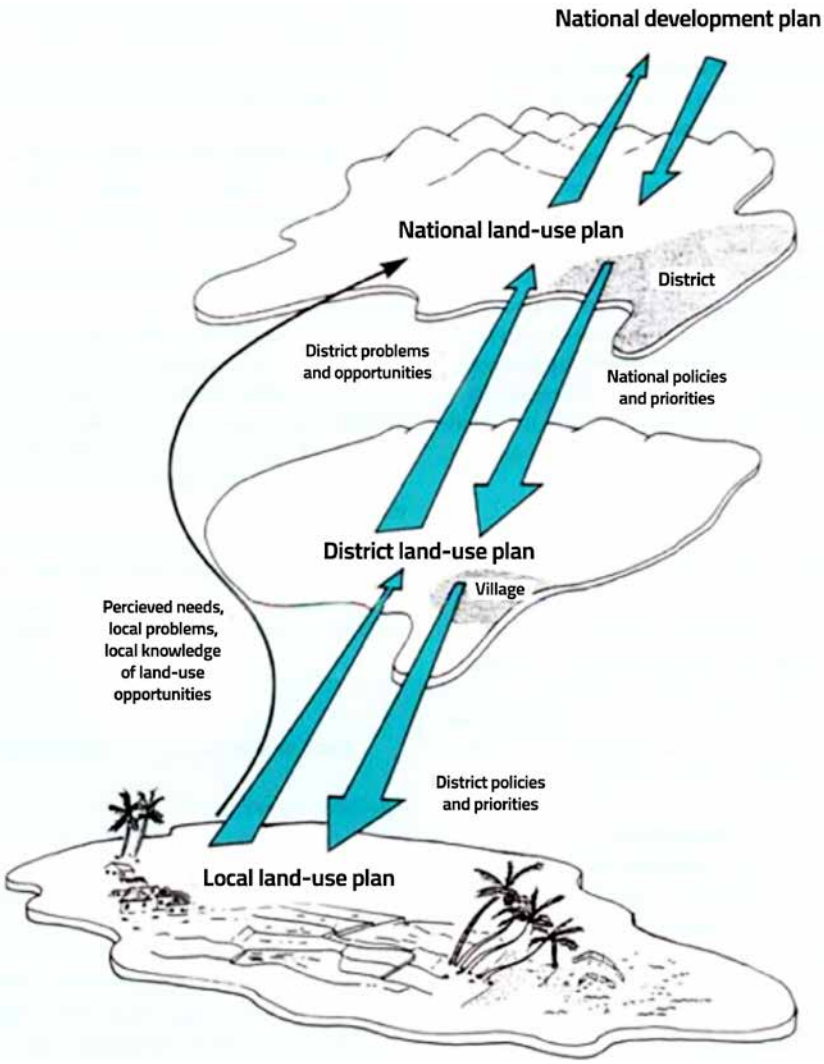
BOX 3

Negotiated territorial development in a multistakeholder participatory resource planning approach



Source: FAO, 2016b.

FIGURE 5
Land-use planning at three scales



Source: FAO, 1993

Stocktake of needs and emerging issues for updating land resource planning tools and approaches

Stocktake of LRP tools

FAO Strategic Objectives

FAO proposes a stocktaking exercise to link LRP and its various dimensions with ongoing processes for achieving sustainable food and agriculture, the SDGs, land degradation and land restoration targets and other processes in which FAO members and partners are engaged. Such an exercise would contribute directly to FAO Strategic Objective 2 (sustainable increases in agriculture, fisheries and forestry production) and Strategic Objective 5 (enhanced resilience to shocks) by promoting the optimal use of land and water resources and ecosystems, reducing risks from natural disasters, promoting integrated landscape management, and prioritizing sustainable food and agricultural systems that generate economic, social and environmental benefits in the short and long terms.

Tools to support policies and SLM

Consideration should be given to the crucial role and function of LRP at the intersection of policy and practice and to the increased knowledge and improved tools available. Land evaluation and land-use planning (i.e. LRP) are tools to support integrated landscape management and restoration; they consider interactions among the various components of a landscape and help decision-makers put SLM into practice.

A holistic view of all sectors is indispensable

Recent developments and challenges in the planning process necessitate a closer look at the entire cyclical process: evaluation, planning, management, monitoring and assessment. The complexity of using and managing natural resources sustainably given increasing pressures and demands requires a holistic consideration of the various sectors, stakeholders and scales and the interactions among these. Planning the sustainable use and management of natural resources requires an understanding of interactions between land, soil, water, natural vegetation, rangelands, arable land (rainfed and irrigated), genetic resources, livestock, fisheries

and aquaculture, forests and mountains, and of the overarching socio-economic setup, including governance, gender, enabling environments and markets. Changing the existing land-use system may not be necessary; there may be feasible options for intensifying or diversifying production, improving user rights, enhancing governance mechanisms and integrating effective SLM technologies in landscape management approaches.

Tools to improve data on land resources

Modern tools that increase the availability of information on land resources should be used to support the development of new planning approaches and methods and to improve the integrated land resource planning and management process. This calls for reviewing the concepts and toolset and for the design of an up-to-date participatory LRP process involving the full range of expertise (e.g. land-use planners, decision-makers, scientists and other specialists) and aiming to provide practical guidance for the full range of stakeholders (e.g. policy-makers, development planners, private-sector investors, and land users).

Governance of land and water resources

The governance of land and water resources is another driving factor that should be reviewed as an integral part of the LRP process to ensure that proper decisions on land use and management are taken, implemented and (if necessary) enforced. Mechanisms for building trust and allowing fair and honest negotiations between stakeholders with different capacities and power and at various scales (i.e. local to national, and even transboundary) are also needed.

Capacity development

Land-use plans should be dynamic instruments that allow for the frequent assessment of implementation and results and which can be adjusted and updated to meet goals and address emerging issues. The capacity of stakeholders to prepare and revise land-use plans must be developed to ensure the continuous fine-tuning of plans in response to challenges and uncertainties.

What needs to be done?

Important questions to be answered include the following:

- Is LRP and its component tools, methods and stakeholder processes still valid today in light of challenges such as sustainable development, climate change, land degradation and biodiversity loss?
- What changes are required in the process?
- How can a renewed LRP process be re-launched most effectively to address such challenges?

LRP stakeholder survey

To answer these questions, FAO initiated a wide-ranging consultation process involving professionals and stakeholders in LRP through an online survey probing their opinions and uses of tools and approaches to planning, as well as gaps and needs. The survey and its outcomes are summarized in the next section.

Survey on participatory land resource planning tools

Fitting tools to needs is challenging

LRP is a process for achieving sustainable and efficient resource use, taking into account biophysical and socio-economic dimensions. From the early top-down (and simplistic) approach to land-use planning, LRP has evolved into a set of approaches, guidelines, methods, datasets and specialist support tools covering biophysical, economic, socio-cultural and governance dimensions, which, for convenience, we label as "tools". The aim of such tools is to address the needs of advisors and decision-makers in adopting appropriate options for the use of land resources based on natural potential and hence avoiding unsustainable exploitation and preventing further degradation. The diversity of LRP tools, however, makes it challenging to target them at those stakeholder groups that would benefit most from them. The solution to this challenge is to collate an inventory of existing tools and approaches and develop an updated toolbox (hereafter called the LRP Toolbox) in support of participatory LRP.

Stocktaking of gaps and opportunities

To initiate such a process, the Land and Water Division of FAO conducted a survey among stakeholders operating at different scales and in various sectors and regions to compile experiences and lessons learned among users of LRP tools and approaches. The specific goals of the survey were to: 1) identify stakeholders in LRP; 2) inventory the use of available LRP tools and identify challenges in their use, as well as needs and gaps; 3) support LRP by sharing experiences among users and other stakeholders; and 4) identify possible actions and strategic partners in the targeted development of LRP tools.

The survey was designed by a team in the Land and Water Division and tested (in English) among a 35-member core group of respondents in FAO and key partner institutions working on LRP. Following this validation phase, the survey was distributed to a worldwide target group in the six FAO working languages (Arabic, Chinese, English, French, Russian and Spanish) in late 2016 and announced through several external networks.

LRP stakeholder survey

In its final form, the survey was returned by 747 respondents (454 in English, 88 in Spanish, 79 in French, 71 in Russian, 51 in Arabic and four in Chinese); Annex 1 presents the questions included in the survey, and the survey methods, results and key messages are documented in an unpublished report (FAO, 2017d).

Characteristics of survey participants and their organizations

Institutional coverage

A wide variety of institutions involved in LRP responded to the survey, including in academic, research, governmental, intergovernmental, international and non-governmental organizations. The good institutional coverage suggests that the gaps and opportunities identified by respondents are comprehensive.

The main support provided by the organizations and networks of respondents were advisory services, training and education, and policy support; a smaller number provided support for development, implementation, execution, facilitation, concept-based studies, investment and technical project development. This indicates that there was a diverse base among respondents in terms of the organizational support provided to LRP processes but that there was less support for investment, technical project development and financing. Thus, there may be opportunities to increase the use of LRP tools in development, implementation and execution to guide LRP processes and generate more impact.

Multidisciplinary

Survey respondents came from a wide range of disciplines, including LRP, soil and water management and conservation, and environmental management/ecosystem services. The diversity of disciplines captured in the survey suggests that LRP is needed in many disciplines and that the results of the survey are comprehensive in identifying the needs of those disciplines. It also directs attention to the need to bring together all actors and sectors in the planning process.

Taking into consideration that respondents may have multiple roles in LRP, it is striking that about half the respondents considered themselves in the roles of either technical specialists or scientific advisors. Modellers and other stakeholders were less well represented; policy-makers and facilitators were strongly represented.

The majority of respondents operating in FAO regions worked in Africa, followed by Europe and Central Asia; the other continents were also well represented. The regions in which respondents operated were used to

Regional coverage

disaggregate certain questions to gain a better understanding of needs in terms of tools, approaches and data for specific regions. This was helpful in deriving key messages to guide proposed actions to address gaps at the global level (i.e. those held in common worldwide), and those that are region-specific.

Level of operation

Respondents worked mostly at the subnational or national scales. "Land users" and "local/community/village" were particularly well represented, and a substantial number of respondents covered several scales ("multiscalar"). Fewer respondents were working at the regional, transboundary or global levels, implying that, in developing future actions, the emphasis should be at the national and subnational scales.

Multistakeholder approaches

Farmers and other land users, scientists, representatives of farmer groups, non-governmental organizations, women's groups and foresters were all actively involved in LRP processes. The passive involvement of city inhabitants and local industries indicated by respondents may point to competition between sectors. These results, with a clear differentiation between more- and less-active stakeholder groups, indicate a need to consider the balanced involvement of all stakeholders in planning processes through the adoption of participatory planning at different scales.

Characteristics and perceptions of the tools and data used in land resource planning

Decision-support tools

The most frequently used tools by respondents were those that provided direct biophysical decision-support outputs, such as land evaluation, suitability and similarity analysis; land capability classification; and agro-ecological zoning. Of approaches with a strong socio-economic component, the most commonly used (by 30 percent of respondents) were rapid rural appraisal and guidelines for participatory land-use planning/negotiated territorial planning. There was widespread agreement (70 percent of respondents) on the need for more or better decision-support tools for LRP at all scales, although a slightly higher need was indicated for decision-support tools at the local scale. These are important considerations for guiding the development of tools that are helpful to various users.

About 20 percent of respondents indicated that they used tools not featured in the survey, such as customized land-use decision models; participatory land-use planning; participatory tools at the local scale; GIS-based modelling approaches; and models and databases for decision support.

Integrated approaches

These results are important for the future development and dissemination of integrated tools to support LRP. In their responses to other questions, respondents indicated the need for integrated approaches – which, to a large extent, they were already using; it was clear that demand for integrated LRP tools is high and that future actions should foster greater use of integrated approaches. Incorporating other user-identified tools and approaches into the LRP Toolbox should be a priority as a way of increasing their visibility and to enable more users to explore the utility of such tools for their own planning purposes.

Many respondents reported frequently using databases of soils, agricultural statistics, land degradation, soil conservation and climate. Surprisingly, the

crop requirement databases ECOCROP and GAEZ were not frequently used, although policy-makers consulted them. This could be explained by the fact that most respondents were operating at subnational scales and that the information provided by these two databases is too general for effective use at those scales. There is a need to explore ways of increasing usage of these databases, given their importance to sound LRP. A relatively high percentage (21.5 percent) of databases used by respondents were not listed in the survey, including custom databases (based on satellite image analysis, field surveys and United Nations databases) at the regional-to-local scales containing data on soils, climate, population and land-use patterns. These custom databases were developed to serve various objectives, and they should be included in the LRP Toolbox to increase their exposure to other potential users.

Customized tools

The list of additional support tools provided by respondents is an important means of enriching the LRP Toolbox and promoting the sharing of tools among users across regions and scales of operation and to satisfy different interests in the planning process.

A common remark by respondents was that it is essential to ensure that tools can be adapted to local conditions. Some respondents mentioned the failure of powerful tools in environments for which they were not designed or for which local data had to be generated through inference rather than observation. Preference was expressed for participatory community- and stakeholder-led planning tools, including gender-sensitive tools, because these better reflect the need to negotiate between interests in the real world and therefore have a greater chance of success.

Adapting tools to local conditions

An important result was that the use of tools is often not the most crucial step in the LRP process; rather, it is what happens after diagnostic studies have been conducted and land-use and land management plans have been prepared. Key bottlenecks include shortcomings in legislative frameworks and the lack of procedures for an effective transition from approved plans to budgeted projects and programmes.

Effective implementation of plans

The most common shortcomings are low spatial or temporal resolution, resulting in variable data quality and necessitating the use of more general information than is appropriate for a particular scale of operation. To overcome this limitation, several respondents indicated that they were developing their own georeferenced local-level datasets, using GIS and remote sensing inputs.

Most respondents viewed easy access to useful information as paramount, and “facilitating easy access to information” was considered the most useful property of a tool. The criteria for integrated holistic approaches

Data accessibility

were considered very important, and a large majority of respondents recognized gaps in support tools in the three domains (i.e. biophysical, socio-economic and negotiatory). Notably, appropriate tools are missing in the socio-economic domain; most (80 percent) respondents indicated a lack of tools for integrating biophysical/environmental and socio-economic information. Responses strongly emphasized integration at different scales of planning, the integration of the perspectives of all stakeholders, and the need for holistic approaches.

Hard-copy material

Capacity development

A substantial majority of respondents recognized gaps in the availability of user-friendly computer tools and hard-copy guidelines and manuals. The 61 percent of responses emphasizing a gap in the availability of hard-copy guidelines and manuals is relatively high given the general trend towards electronic and computer-based tools. This shows that there remains a need to provide hard-copy material to increase access to tools, especially where computer facilities are unavailable. An important consideration in developing future tools and approaches, therefore, is avoiding an overreliance on electronic and computer-based tools. An overwhelming majority of respondents recognized gaps in technical capacity in the use of LRP tools.

Eliciting ideas for further tool development

Desirable features of future tools

There is a need for more or better decision-support tools for LRP; as a general principle, such tools should offer easy access to information with practical utility. New tools are needed at all scales, although respondents indicated a slightly higher need for decision-support tools at the local level. The demand is highest for tools that integrate the biophysical and socio-economic domains, with "integration" a recurring key theme among respondents for further tool development. It implies "inclusiveness" – the need to link different scales of planning, including the perspectives of all stakeholders, to combine biophysical, socio-economic and negotiatory approaches, and to adapt tools to local conditions. Not all tool development should rely on digital platforms: there is surprisingly high demand for hard-copy guidelines and manuals.

It is clear, therefore, that tool development needs to take these pathways. Future actions should foster the integration of biophysical, socio-economic and negotiatory approaches. Respondents expressed preference for participatory, community- and stakeholder-led, gender-sensitive planning tools because these reflect the need to negotiate among interests in the real world. Nevertheless, the biophysical potential of land resources is the basis for participatory and negotiatory processes. It is also important to enhance the visibility of other user-identified tools, approaches and databases. In all cases, capacity building is needed in the use of specialized tools and databases.

Regional accents

The following are nuances in regional perceptions of the gaps in tools and necessary actions.

Africa

In **Africa**, the main bottlenecks are related to the availability of data on local land resources; awareness among stakeholders and decision-makers about the importance of LRP; limited access to computer hardware and software; and feelings of isolation and loss of interest among extension staff due to the physical distance and limited internet connectivity of their workplaces.

Solutions to such bottlenecks could involve developing tools that can generate useful datasets based on simplified land evaluation criteria and minimal field work; the design of participatory approaches that pay adequate attention to continuous dialogue with national decision-makers; stimulating the devolution of responsibilities and budgets to adequately equipped, decentralized planning teams in regions and districts; and creating virtual spaces for exchanging experiences among peers and experts, perhaps through specially developed smartphone apps.

Asia

By and large, **Asia** experiences similar challenges in land-use planning to Africa, such as including stakeholders in planning processes; holistic planning to increase the productivity of farming systems while enhancing ecosystem services and mitigating climate change; and enhancing capacity in the use of LRP tools. Because the institutionalization of LRP is generally more advanced in Asia, the region also faces the challenge of combining top-down and bottom-up LRP processes when local-level planning decisions run counter to national planning directives.

Such issues can only be resolved through the establishment of permanent mechanisms to ensure continuing dialogue between decision-makers at different levels. Given rapid development in much of the region, new LRP tools will be needed to monitor crucial development indicators such as market signals in response to policy initiatives.

Latin America

In **Latin America**, integrated landscape management approaches – although widely perceived as desirable – are hampered by factors such as the highest inequality in land distribution worldwide and, in many cases, the absence of a legal and policy framework, especially related to the land rights of indigenous peoples. Within these region-specific limitations, efforts are

being made to implement novel and authentic visions for the indigenous management of territories based on the accepted principles of income generation through the sustainable use of natural resources, biodiversity conservation and adaptation to climate change.

To contribute to decision-making within a territorial management framework, tools are needed that enabled detailed analyses at the local scale while remaining economically feasible. Capacity building is essential and should focus on understanding the intervention points at which tools can be integrated into the LRP process and on advancing collaboration and information-sharing among stakeholders, both nationally and subnationally.

Europe

Approaches to integrated planning are most advanced in **Europe**, where all sectoral interests (e.g. the natural environment, rural–urban habitats, industry and infrastructure) are taken into account, with a well-defined planning horizon and from the perspective of sustainable development. Development plans follow established procedures and are supported by well-functioning legal frameworks.

Central Asia

The situation is very different in **Central Asia**. The process of transforming the region's formerly centrally planned economies into market economies is ongoing, and there remain a generally high level of poverty, a dependence on agriculture and natural resources for livelihoods and national incomes, and a challenging environmental context.

Before deciding which tools are most suitable in Central Asia, an in-depth study is needed on the ways in which land-use planning is done in the region and how to move from top-down, centrally coordinated land-use planning to participatory, decentralized LRP approaches.

Near East

Respondents in the **Near East** agreed on the urgency of integrated and inclusive LRP at the national, subnational and local scales because, in the region, land-use planning is a mostly theoretical concept that is rarely applied in practice. Respondents also agreed on the need for guidelines because the principles of LRP are insufficiently recognized – and therefore not supported – by decision-makers. International support may be needed, including through targeted projects for capacity building among decision-makers and other stakeholders.

It is recognized that guidelines cannot cater for all possible planning situations; rather, they should be designed in ways that provide essential skills for preparing participatory land-use plans at the local scale, adapted to representative situations. The integration of biophysical and socio-economic information should consider the dimensions of farming and other production systems, agro-ecological conditions, and projections of climate change.

The Land Resources Planning Toolbox

Tools to support LRP

The importance of LRP in the sustainable management of increasingly scarce natural resources is bound to increase, given continued population growth and the expected impacts of climate change. Assisting the LRP process is a growing suite of approaches, guidelines, methods, datasets and specialist support tools covering biophysical, economic, socio-cultural and governance dimensions. The rising demands on decision-makers at the national, subnational and local scales to address emerging challenges and promote effective and sustainable responses call for an updated set of tools and approaches to support participatory LRP processes.

Visibility of LRP tools

The LRP survey described above provided evidence that, even within the LRP target group, there is considerable ignorance on the range of tools, approaches and databases now available for LRP. On the other hand, many survey respondents indicated that they use tools not featured in the survey, some of which were developed locally.

Inventory of tools

To address this serious knowledge gap, a stocktaking exercise was undertaken to build an inventory of existing tools and approaches and to establish a regularly updated toolbox to support participatory LRP. Such a toolbox, it was considered, should be capable of providing answers to questions such as: What tools are available? What are their capabilities and limitations? Which tools best suit which stakeholders and LRP professionals? And for which regions and scales of planning are they suitable? The toolbox should be maintained over time, with new tools added as they become available. Adequate attention should be paid to tools identified by external agents to enhance their visibility and enable more users to explore the utility of such tools in meeting their own planning objectives.

The LRP survey identified a particular need for decision-support tools that offer easy access to information of practical use; cater particularly to the needs of local planning; deal with themes in all domains but especially the socio-economic domain; and, most importantly, integrate both the biophysical and socio-economic domains.

LRP Toolbox

FAO subsequently developed the LRP Toolbox[3] as a web-based dissemination platform for the LRP community. The Toolbox provides a comprehensive inventory of available tools, databases and support tools for facilitating LRP. The Toolbox, which is hosted on the FAO website, will be maintained and updated over time.

Provide guidance to multiple users

The LRP Toolbox is expected to play a crucial role by filling a major knowledge gap in the community of LRP practitioners and stakeholders. It contains over 100 records (and growing) of LRP tools, including descriptions (Annex 2). The Toolbox makes a distinction between tools in the biophysical and socio-economic domains and those that integrate the two domains. The Toolbox can be searched by several criteria (Box 3).

BOX 3

The Land Resources Planning Toolbox

The Land Resources Planning Toolbox is a web-based dissemination platform that allows users to extract information on land resource planning tools and databases from a centrally maintained database. The database has a hierarchical structure, whereby individual tools can be searched using free text or according to the following five criteria: 1) main category; 2) subcategory; 3) thematic area; 4) type of tool; and 5) scale/level of applicability (Figure 6).

The subcategories depend on the selected main category (Figure 7), and multiple selections can be entered into the other search fields (i.e. thematic area, type of tool and scale of applicability). The Toolbox database contains a short description of each tool, including its objectives, the scale(s) for which it was developed and can be used, the target user groups that would benefit from its use, and the regions in which it has been used; links to websites and case studies are provided, where available.

More work is needed to review the main constraints on, and opportunities for, evidence-based decision-making at various scales and among the full range of stakeholders. The need for integrated information systems and simple, rigorous methods of analysis and planning should be reviewed as a way of informing land-use decisions and investments and bringing about a transformation from unsustainable to sustainable development in support of the SDGs.

[3] www.fao.org/land-water/land/land-governance/land-resources-planning-toolbox/en

FIGURE 6
Homepage of the LRP Toolbox

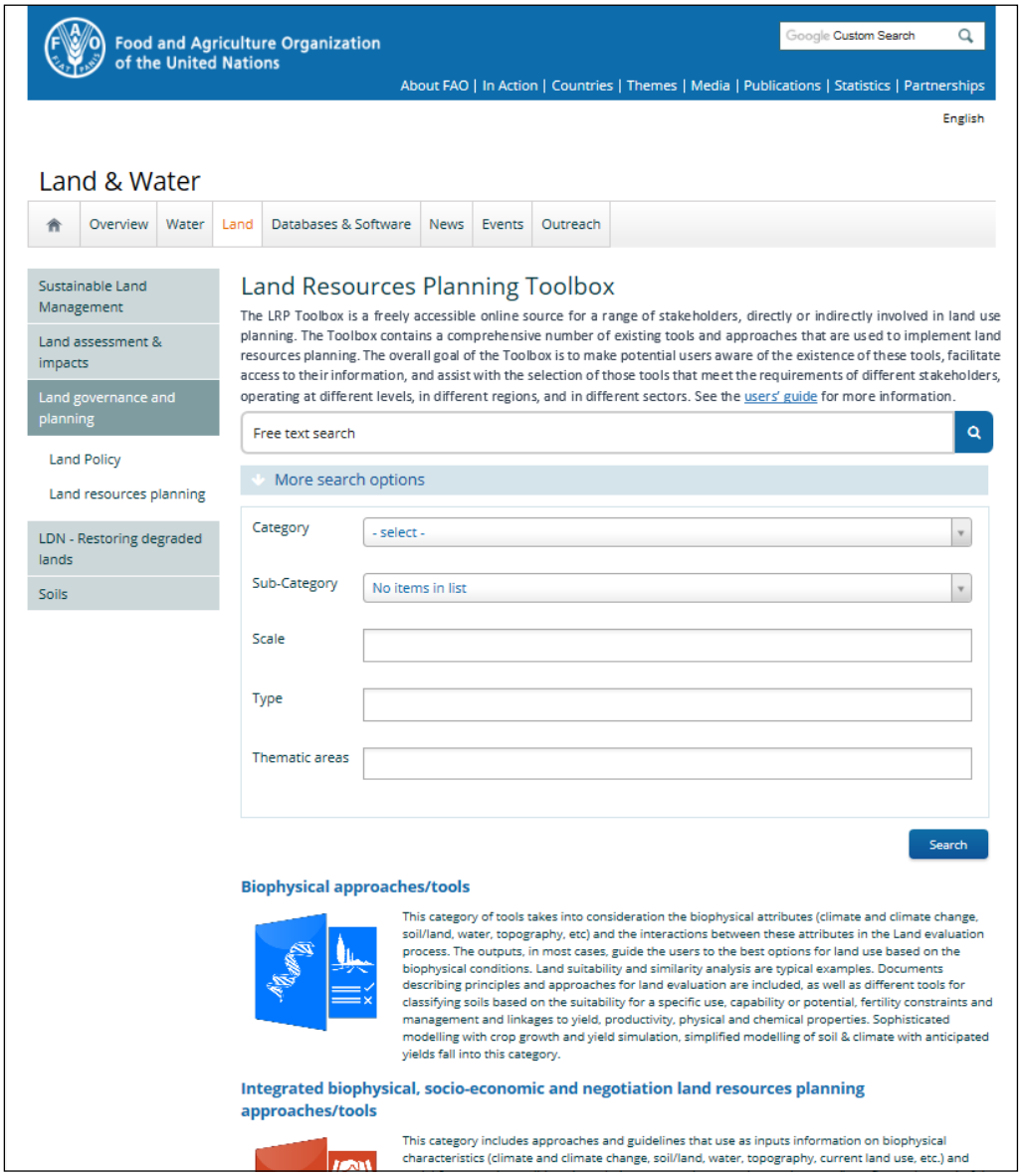
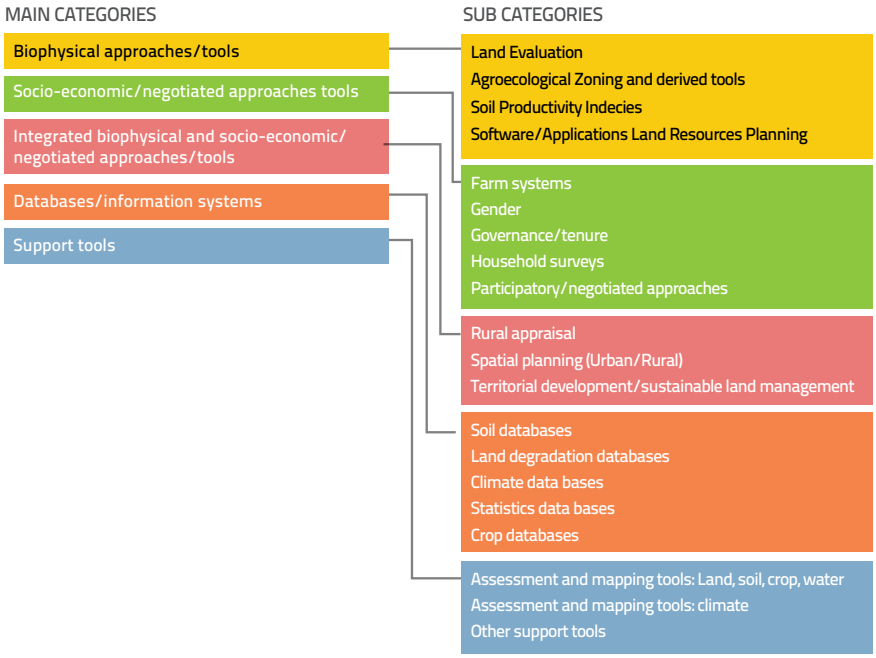


FIGURE 7

Search criteria and options for the Land Resources Planning Toolbox



THEMATIC AREAS

- Agriculture, statistics
- Agriculture, productivity
- Cadaster
- Climate
- Crops, distribution
- Crops, productivity
- Crops, suitability
- Economy, statistics
- Environment, the distichs
- Farming systems
- Food, statistics
- forestry, statistics
- General
- Land degradation
- Land evaluation
- Land management/planning
- Land/water rights
- Land/cover
- Population, distribution
- Population, statistics
- Remote sensing
- Social participatory approaches
- Social, statistics
- Soils, distribution and properties
- soils, management and conservation
- Water, productivity
- Water, statistics

TYPE OF TOOL

- Data
- Documentation/manuals
- Educational materials
- Framework/guidelines
- Maps/GIS
- Model
- Questionnaire/survey
- Software

SCALE OF APPLICABILITY

- Global
- Regional
- National
- Subnational/province/district
- Watershed/basin/landscape
- Locality/farm/site

A communication and knowledge platform should be established (or existing platforms adapted) for sharing experiences and results in the use of up-to-date, participatory LRP tools and approaches for addressing conflicts and competition over resources and achieving a balanced economic, social and environmental development process.

Up-to-date LRP tools have great potential to support integrated landscape management and land restoration processes. Field programmes should be designed and implemented in a range of countries to validate the utility of updated tools and to fine-tune them to ensure that user needs are fully reflected and tools are in place to support land-use decisions at the national-to-local scales.

State-of-the-art LRP guidance, tools and methods are needed to support informed decision-making for the development of national land-use strategies and action plans across sectors (e.g. agriculture, environment, forest, energy, land, water, finance and planning).

A strategy should be formulated for generating a new paradigm of participatory, multistakeholder LRP to meet the current and emerging needs of countries at various scales (e.g. local, subnational, national and transboundary), paying attention to livelihoods and socio-economic benefits as well as to the maintenance of the natural resource base and sustainable production systems.

References

BMZ. 2012. *Land use planning concept, tools and applications.* German Federal Ministry for Economic Cooperation and Development (BMZ) (available at www.giz.de/expertise/downloads/Fachexpertise/giz2012-en-land-use-planning-manual.pdf).

CDE. 2010. *Coping with degradation through SLWM.* SOLAW Background Thematic Report 12. Centre for Development and Environment (CDE). Rome, FAO (available at www.fao.org/nr/solaw).

Damen, B. 2016. Paris Agreement & FAO-AP. Using nationally determined contributions (NDCs) for country programming in Asia and the Pacific. Presentation at FAO headquarters, Rome, 7 March 2016.

EcoAgriculture Partners. 2017. *Landscapes for People, Food and Nature Initiative.* Webpage (available at www.peoplefoodandnature.org).

FAO. 1976. *Framework for land evaluation.* Rome.

FAO. 1993. *Guidelines for land use planning.* Rome (available at www.fao.org/docrep/t0715e/t0715e00.htm).

FAO. 1997. *Africover land cover classification.* Remote Sensing Centre Series 70. Rome.

FAO. 2004. *Participatory land use development in the municipalities of Bosnia and Herzegovina. Guidelines.* Rome (available at www.fao.org/fileadmin/templates/nr/images/resources/pdf_documents/PLUD_Guidelines_final_eng_1_.pdf).

FAO. 2006. Final declaration, ICARRD – International Conference on Agrarian Reform and Rural Development (available at www.nyeleni.org/IMG/pdf/2006_03_FinalDeclaration_FAO_Conference_En-1-3.pdf).

FAO. 2007. *Land evaluation: towards a revised framework* Land and water. Discussion Paper 6. Rome (available at www.fao.org/3/a-a1080e.pdf).

FAO. 2011. *The State of the World's Land and Water Resources for Food and Agriculture: Managing systems at risk.* Rome.

FAO. 2012a. *Towards the future we want: end hunger and make the transition to sustainable agricultural and food systems.* Rome.

FAO. 2012b. *Voluntary guidelines on the responsible governance of tenure of land, fisheries and forests in the context of national food security.* Rome.

FAO. 2013b. *Sustainable land management.* Webpage (available at www.fao.org/nr/land/sustainable-land-management/en/).

FAO. 2014. *Building a common vision for sustainable food and agriculture, principles and approaches.* Rome.

FAO. 2016a. *Land use planning and policy.* Webpage (available at www.fao.org/nr/land/land-policy-and-planning/en/).

FAO. 2016b. *Negotiated territorial development in a multi-stakeholders participatory resource planning approach: an initial sustainable framework for the Near East region.* Land and Water Division Working Paper No. 15. Rome.

FAO. 2016c. *Agriculture and the 2030 Agenda for Sustainable Development.* 25th Session of the Committee on Agriculture, 26–30 September 2016. Rome.

FAO. 2016d. *FAO's role in monitoring the Sustainable Development Goals.* Unpublished report.

FAO. 2017a. *Voluntary guidelines for sustainable soil management.* Rome.

FAO. 2017b. *Climate-smart agriculture sourcebook.* Module B.7 Sustainable soil/land management for climate-smart agriculture. Rome.

FAO. 2017c. *Landscapes for life: guidance document on integrated landscape management.* (In preparation.) Rome.

FAO. 2017d. *Review and evaluation of participatory land use/resource planning tools.* Unpublished report.

FAO, IFAD & WFP. 2013. *The State of Food Insecurity in the World 2013: The multiple dimensions of food security.* Rome, FAO, International Fund for Agricultural Development (IFAD) and World Food Programme (WFP).

IAASTD. 2009. *Agriculture at a crossroad.* International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD).

LandPotential.org. 2016. *Land potential knowledge system* (LandPKS). Webpage (available at http://landpotential.org).

Landscapes for People, Food and Nature. 2015. *Landscape partnerships for sustainable development: achieving the SDGs through integrated landscape management. A white paper to discuss the benefits of using ILM as a key means of implementation of the Sustainable Development Goals.* Presented at the Global Landscapes Forum, Paris, December 2015 (available at http://peoplefoodandnature.org/wp-content/uploads/2015/12/LPFN_WhitePaper_112415c_lowres.pdf).

Millennium Ecosystem Assessment. 2003. *Ecosystems and human well-being: a framework for assessment.* Washington, DC, Island Press.

Millennium Ecosystem Assessment. 2005. E*cosystems and human well-being: synthesis.* Washington, DC, Island Press.

United Nations. 1995. *Chapter 40: Information for decision-making and Earthwatch.* Commission on Sustainable Development, Economic and Social Council E/CN.17/1995/7, February 1995. United Nations, New York.

UNCCD. 2013. *Desertification, land degradation & drought (DLDD): some global facts and figures.* United Nations Convention to Combat Desertification (UNCCD).

United Nations. 1992. *Agenda 21: the United Nations Programme of Action from Rio.* New York, USA.

United Nations. 2012. *The future we want. Rio+20 outcome document.* Resolution A/RES/66/288 adopted by the General Assembly on 27 July 2012 (available at www.un.org/disabilities/documents/rio20_outcome_document_complete.pdf).

WOCAT. 2007. *Where the land is greener: case studies and analysis of soil and water conservation worldwide*, edited by H.P. Liniger & W. Critchley. World Overview of Conservation Approaches and Technologies (WOCAT).

WRI. 2014. *Atlas of forest and landscape restoration opportunities.* Washington, DC, World Resources Institute (WRI).

Zdruli, P., Ziadat, F., Nerilli, E., D'Agostino, D., Lahmer, F. & Bunning, S. 2016. *Sustainable development of land resources. In Zero waste in the Mediterranean*, Chapter 4. Paris, Presses de Sciences Po.

Ziadat, F., Berrahmouni, N., Grewer, U., Bunning, S., Bockel, L. & Oweis, T. 2015. *Reversing land degradation in the drylands: scaling out and monitoring proven sustainable land management options.* In Griffiths, J., ed. Living land, pp. 14–17. United Nations Convention to Combat Desertification (available at www.unccd.int/Lists/SiteDocumentLibrary/Publications/Living_Land_ENG.pdf).

Annex 1.
Survey questions

1. What is your affiliation?

Answer options:

- Individual Farmer/ Land user
- Farmers' organization/group
- Private firm
- Governmental
- Intergovernmental/ International
- Non-governmental
- Academic/ Research
- Other

2. Which type of support is provided by your organization? Multiple answers possible.

Answer options:

- Advisory services
- Financial support
- Facilitation
- Development, implementation and/or execution of land-use plans
- Training and education
- Concept/desk-based study
- Investment and technical project development
- Policy support
- Combination of above or other

3. What is the main focus of your activities? (Multiple answers possible).

Answer options:

- Land-use planning/Land evaluation
- Soil/Land management
- Water management
- Basin/Watershed/Landscape management

- Horticulture
- Environment management and ecosystem services
- Forestry/ Agroforestry
- Soil and water conservation
- Fishery/Aquaculture
- Agronomy
- GIS / remote sensing applications
- Wildlife / wetlands/ drylands management
- Rangeland management
- Crop management/ protection
- Irrigation management
- Livestock/ pasture management
- Socio-cultural aspects
- Economic aspects
- Legal aspects
- Gender equality
- Land resources assessments
- Coastal zone/area management
- Territorial development/planning
- Land tenure/common property management
- Mountain/highland development
- Multifunctional agriculture
- Climate-smart agriculture
- Urban-rural linkages and peri-urban agriculture
- Agricultural heritage systems/ landscapes
- Agricultural biodiversity conservation and sustainable use
- Biodiversity management (in protected areas etc.)
- Sustainable energy and bioenergy development
- Combination of the above or other

4. What are your specific roles within the process of land-use planning? More than one answer possible.

Answer options:

- Technical specialist
- Modeler
- Policy-maker
- Facilitator

- Scientific advisor
- Stakeholder (beneficiary/affected)
- Other

5. In which region do you operate?

Answer options:

- Africa
- Asia and the Pacific
- Near East and North Africa
- Latin America and the Caribbean
- Europe and Central Asia
- Global
- Other

6. At what scale/level do you operate?

Answer options:

- Land users (farmer, entrepreneur)
- Local/community/village
- District/Province
- Urban/Peri-urban area
- Sub-national
- National
- Multi-scale
- Transboundary (across neighbouring countries)
- Regional
- Global
- Combination of above or other

7. Please choose all potential stakeholders that are directly or indirectly affected by a change of land-use (related to your initiative).

Answer options:

- Farmers/Land-users
- Representatives of farmer's groups
- Non-governmental organizations
- Women's groups
- Youth's groups
- City inhabitants

- Local industry
- Foresters
- Politicians
- Scientists
- Indigenous people
- Other

8. Please describe the level of involvement of following stakeholders in the land-use planning process (related to your initiative).

Answer options:

- Farmers/Land-users
- Representatives of farmer's groups
- Non-governmental organizations
- Women's groups
- Youth's groups
- City inhabitants
- Local industry
- Foresters
- Politicians
- Scientists
- Indigenous people
- Other (please specify)

9. Did you/do you use tools (software, frameworks, guidelines, databases/inputs, case-studies) in order to support your decision-making in land evaluation and land-use planning?(In case you choose NO, you will skip all questions of this category).

Answer options:

- Yes
- No

10. Which of the following biophysical and/or socio-economic and/or negotiation approaches do/did you use?

Answer options:

- Land Evaluation, Similarity and Suitability Analysis- Examples
- Land Capability Classification
- Land Potential Knowledge System (LandPKS)
- Agro-Ecological Zoning and derived tools (GAEZ, AEZ-WIN)

- Soil Potential Ratings & Storie Index, Fertility Capability Classification, Soil Productivity Index
- Automated Land Evaluation System (ALES)
- Decision Support System for Agrotechnology Transfer (DSSAT), Land Resources Information Management System (LRIMS)
- Framework for Evaluating Sustainable Land Management (FESLM)
- Guidelines for Participatory Land Use Planning/ Negotiated Territorial Planning
- Land Evaluation and Site Assessment (LESA), Planning for Sustainable Use of Land Resources
- Participatory and Negotiated Territorial Development (PNTD)
- Improving Gender Equality in Territorial Issues (IGETI)
- Rapid Rural Appraisal (RRA)
- Voluntary Guidelines on Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security (VGGT)
- Other

11. Which of the following databases/inputs do/did you use?

Answer options:

- Soil Databases: SOTER, HWSD, DSMW, SISLAC, AFSIS, European Soil Database and Soil Properties, Soil Grids, EuDASM
- Land Degradation databases: LADA, GLADA, GLADIS, GLASOD
- Sub-national crop maps: Agro-MAPS
- Conservation Approaches and Technologies: WOCAT
- Climatic Databases: FAOCLIM, CFSR, CMIP3
- Agricultural Statistics: FAOSTAT, CountrySTAT, AQUASTAT
- Crop suitability databases: Ecocrop 1, Ecocrop 2, GAEZ
- Other

12. Which of the following supporting tools do/did you use?

Answer options:

- LADA tools
- SLEEP
- AQUACROP
- CROPWAT
- EX-ACT

- SHARP
- LPFN
- Climate tools: CM Box, LocClim, New_LocClim, AgroMetShell, CLIMWAT, ETo calculator
- Other Supporting tools: LCCS, TerrAfrica, WOFOST, HORTIVAR, WISDOM, WINDISP, ADDATI
- Other

13. Overall, how satisfied are you with the support the following tools provided?

Answer options:

Choose one opinion
Very dissatisfied / Somewhat dissatisfied/ Neither satisfied nor dissatisfied/ Somewhat satisfied / Very satisfied

About tool:

- Land Evaluation, Similarity and Suitability Analysis- Examples
- Land Capability Classification
- LandPKS
- Agro-Ecological Zoning and derived tools (GAEZ, AEZ-WIN)
- Soil Potential Ratings & Storie Index, Fertility Capability Classification, Soil Productivity Index
- ALES
- DSSAT, LRIMS
- FESLM
- Guidelines for Participatory Land Use Planning/ Negotiated Territorial Planning
- LESA
- PNTD
- IGETI
- RRA
- VGGT
- Other

14. Please explain why these tools did or did not meet your needs.

15. How satisfied are you with the support of your land-use planning activities by following databases/inputs?

Answer options:

Choose one opinion

Very dissatisfied / Somewhat dissatisfied/ Neither satisfied nor dissatisfied/ Somewhat satisfied / Very satisfied

About database:

- Soil Databases: SOTER, HWSD, DSMW, SISLAC, AFSIS, European Soil Database and Soil Properties, Soil Grids, EuDASM
- LADA, GLADA, GLADIS, GLASOD
- Agro-MAPS
- WOCAT
- Climatic Databases: FAOCLIM, CFSR, CMIP3
- FAOSTAT, CountrySTAT, AQUASTAT
- Ecocrop 1, Ecocrop 2, GAEZ
- Other

16. Please explain why these databases/inputs did or did not meet your needs.

17. How satisfied are you with the support of your land-use planning activities by following supporting tools?

Answer options:

Choose one opinion

Very dissatisfied / Somewhat dissatisfied/ Neither satisfied nor dissatisfied/ Somewhat satisfied / Very satisfied

About support tool:

- LADA tools
- SLEEP
- AQUACROP
- CROPWAT
- EX-ACT
- SHARP
- LPFN
- Climate tools: CM Box, LocClim, New_LocClim, AgroMetShell, CLIMWAT, ETo calculator
- Other Supporting tools: LCCS, TerrAfrica, WOFOST, HORTIVAR, WISDOM, WINDISP, ADDATI
- Other

18. Please explain why these supporting tools did or did not meet your needs.

19. Please select the most important criteria that makes a tool useful to meet your needs.

Answer options:

- Facilitates easy access to information
- Facilitates integration of different scales and levels of planning
- Facilitates integration of all stakeholders' perspectives
- Provides a holistic approach
- Is very specific (dealing with a single issue)
- Is very practical
- Other

20. Which of the following would support your decision-making in the land-use planning process? Multiple answers possible.

Answer options:

- Diagnostic/Assessment tools
- Land-use plans
- Maps/GIS
- Suitability analysis and maps
- Multi-stakeholder dialogue
- Community-based participatory approach
- Land/ natural resources management plans
- Case studies (e.g. using WOCAT tools)
- Training materials
- Policy advice/briefs
- Project design/ development
- Other

21. At which scale do you see more gaps in land-use planning decision-support tools?

Answer options:

- National/ Sub-national
- Watershed/ Landscape
- Local level (Village/ Community)

22. For which focus do you recognize more gaps in the land-use planning decision-support tools?

Answer options:

- Biophysical (environmental) approaches
- Socio-economic (people centered) approaches
- Integration of these two

23. For which of the following sectors do you recognize more gaps in the land-use planning decision tools?

Answer options:

- Forestry
- Rangeland
- Urban
- Irrigated
- Rainfed
- Mountains
- Integration of above sectors

24. For which of the data below do you recognize more gaps in the land-use planning decision tools?

Answer options:

- Biophysical data (soil, current land use, climate, topography, water, resources, etc.)
- Socio-economic data (population, tenure, demography, market, cost/benefit, gender etc.)

25. Do you recognize more gaps in the land-use planning decision-support tools regarding:

Answer options:

- Availability of user friendly computer tools
- Availability of hard-copy guidelines and manuals

26. Do you recognize gaps regarding the capacity of technical staff and decision-makers on the selection, updating and use of land-use planning tools?

Answer options:

- Yes
- No
- Not applicable

27. Are there any additional gaps in the land-use planning decision-support tools? If so, please name them.

28. Please share your experience and provide any other comments or remarks that may be relevant.

29. If you are interested in the results of the survey, please leave your email address.

30. We would like to know more about you, please provide the following information (OPTIONAL).

Answer options:

- First Name and Last Name
- Organisation
- City/Town
- Country:
- Email Address

Annex 2.
Tools in the Land Resources Planning Toolbox

The tools described below are featured in the Land Resources Planning Toolbox developed by FAO (www.fao.org/land-water/land/land-governance/land-resources-planning-toolbox).

Abbreviation	What?	Learn more about it through these links
ADDATI	A Package for Exploratory Data Analysis	http://www.fao.org/nr/climpag/aw_6_en.asp
AEZ	Agro-ecological Zoning. Guidelines	ftp://ftp.fao.org/agl/agll/prosoil/docs/S521.pdf
AEZ-WIN	AEZ (Agro-Ecological Zones) for Windows	http://pure.iiasa.ac.at/5825/
AFSIS	Africa Soil Information Service	http://africasoils.net/
Agro-Maps	Global Spatial Database of Agricultural Land-Use Statistics	http://kids.fao.org/agromaps/
AgroMetShell	Software for crop yield forecasting	http://www.hoefsloot.com/agrometshell.htm
ALES	Automated Land Evaluation System	http://www.css.cornell.edu/faculty/dgr2/research/ales/alesprog.htm
AQUACROP	Crop-Water Productivity Model of FAO	http://www.fao.org/land-water/databases-and-software/aquacrop/en/
AQUASTAT	Global Water Information System of FAO	http://www.fao.org/nr/water/aquastat/main/index.stm
CANSIS	Canadian Soil Information Service	http://sis.agr.gc.ca/cansis/
CFSR	Climate Forecast System Reanalysis	https://climatedataguide.ucar.edu/climate-data/climate-forecast-system-reanalysis-cfsr
CLIMWAT	Climatic Database to be used with CROPWAT	http://www.fao.org/land-water/databases-and-software/climwat-for-cropwat/en/
CM_Box	Crop Monitoring Box	http://www.hoefsloot.com/wiki/index.php?title=Main_Page

CMIP3	Coupled Model Intercomparison Project	http://cmip-pcmdi.llnl.gov/cmip3_overview.html
COMAP	Community mapping. A tool for community organizing	http://www.wateraid.org/~/media/Publications/community-mapping-programme-partner-guidelines.pdf
Country_STAT	Country Statistics on Food and Agriculture	https://www.countrystat.org/default.aspx
CPSZ	Crop Production Systems Zones of the IGAD Sub-region	http://www.paolosantacroce.net/Publications/Entries/1995/1/1_Crop_Production_System_Zones_of_the_IGADD_Sub-Region.html
CROPWAT	Crop Water and Irrigation Requirements Program of FAO	http://www.fao.org/land-water/databases-and-software/cropwat/en/
DIMITRA	Dimitra Clubs	http://www.fao.org/dimitra/dimitra-clubs/en/
DSMW	FAO Digital Soil Map of the World	http://www.fao.org/geonetwork/srv/en/metadata.show?id=14116
DSSAT	Decision-Support System for Agrotechnology Transfer	https://en.wikipedia.org/wiki/DSSAT
DTR	Desarrollo territorial rural	http://www.fao.org/3/a-a1253s.pdf
ECOCROP	Crop Ecological Requirements Database	http://ecocrop.fao.org/ecocrop/srv/en/home
ECOSYS	Ecosystem Classification	http://www.ecosystems.ws/ecosystem_classification_systems.htm
ELMO	Evaluation of Land Management Options	https://wle.cgiar.org/evaluating-land-management-options-elmo
ETO Calculator	Potential Evapotranspiration Calculation Program of FAO	http://www.fao.org/land-water/databases-and-software/eto-calculator/en/
EuDASM	European Digital Archive of Soil Maps	http://esdac.jrc.ec.europa.eu/resource-type/national-soil-maps-eudasm
EX-ACT	Ex-Ante Carbon Balance Tool	http://www.fao.org/tc/exact/ex-act-home/en/
FAOCLIM	World-wide Agroclimatic Data of FAO	http://www.fao.org/nr/climpag/pub/en1102_en.asp
FAOSTAT	Global Food and Agriculture Statistics of FAO	http://www.fao.org/faostat/en/#home
FARMDESIGN	Bio-economic farm and landscape models, FarmDESIGN and LandscapeIMAGES	http://www.farmdesign.net/
FCC	Fertility Capability Classification	http://gisweb.ciat.cgiar.org/RTBMaps/Docs/fcc_doc.pdf

FERTIREC	Online fertilizer recommendations	http://stcr.gov.in/Farmer/index.aspx
FESLM	Framework for Evaluating Sustainable Land Management	http://www.fao.org/docrep/T1079E/T1079E00.htm
FLE	Framework for Land Evaluation	http://www.fao.org/docrep/x5310e/x5310e00.htm
FSP	Farming systems and poverty	http://www.fao.org/docrep/003/y1860e/y1860e00.htm
FUTURE_LAND	The Future of Our Land. Guidelines for Integrated Planning for Sustainable Management of Land Resources	http://www.fao.org/docrep/004/x3810e/x3810e00.htm
GAEZ	Global Agro-Ecological Zones	http://www.fao.org/nr/gaez/en/
GLADA	Global Assessment of Land Degradation and Improvement	http://www.isric.org/projects/global-assessment-land-degradation-and-improvement-glada
GLADIS	Global Land Degradation Information System of FAO	http://www.fao.org/land-water/databases-and-software/gladis/en/
GLASOD	Global Assessment of Human-induced Soil Degradation	http://www.isric.org/projects/global-assessment-human-induced-soil-degradation-glasod
GlobCover	GlobCover land Cover Maps	http://due.esrin.esa.int/page_globcover.php
GLRDB	FAO Gender and Land Rights Database	http://www.fao.org/gender-landrights-database/en/
GNTD	Toolkit for the application of Green Negotiated Territorial Development	http://www.fao.org/documents/card/en/c/7ec0cee1-e1c7-41cb-863e-c519238538b9/
GRASS	Grassland Regeneration and Sustainability Standard	http://www.fao.org/nr/sustainability/grassland/best-practices/projects-detail/en/c/237687/
Guide_LUP	Guidelines for Land Use Planning	https://www.mpl.ird.fr/crea/taller-colombia/FAO/AGLL/pdfdocs/guidelup.pdf
HORTIVAR	Horticulture Cultivars Performance Database	http://www.fao.org/hortivar/
HWSD	Harmonized World Soil Database	http://webarchive.iiasa.ac.at/Research/LUC/External-World-soil-database/HTML/index.html?sb=1
IDE_MINAGRI	Gestionamos informacion geografica para la agricultura nacional	http://ide.minagri.gob.cl/geoweb/
IG_UTP	International Guidelines on Urban and Territorial Planning	https://unhabitat.org/books/international-guidelines-on-urban-and-territorial-planning/

IGETI	Improving Gender Equality in Territorial Issues	www.fao.org/docrep/016/me282e/me282e.pdf
KEITA	Approche territoriale du projet Keita	http://www.fao.org/docrep/x5306f/x5306f08.htm
LADA_Tools	Land Degradation Assessment in Drylands: the tools include (i) Methodology and results, (ii) maps of land-use systems at global and regional scales, (iii) a questionnaire for mapping land degradation and sustainable land management	http://www.fao.org/3/a-i3241e.pdf ; http://www.fao.org/docrep/017/i3242e/i3242e.pdf ; http://www.fao.org/docrep/017/i3240e/i3240e.pdf
LAND_HEALTH	Land Health Surveillance, Land Health decisions, Stochastic Impact Evaluation	http://www.worldagroforestry.org/landhealth
LandPKS	Land Potential Knowledge System	https://www.landpotential.org/index.html
LASUME	Land Survey Methods and Training in Participatory Land-use Planning and Land Allocation	http://www.mekonginfo.org/assets/midocs/0001841-planning-cadastre-land-survey-methods-and-training-in-participatory-land-use-planning-and-land-allocation.pdf
LCC	Land Capability Classification	https://www.nrcs.usda.gov/Internet/FSE.../nrcs142p2_052290.pdf
LCCS	Land Cover Classification System	http://www.fao.org/docrep/003/x0596e/x0596e00.HTM
LE_Rev	Land evaluation: towards a revised framework	http://www.fao.org/nr/lman/docs/lman_070601_en.pdf
LEAP	Landscape Ecological Assessment Planning (LEAP)	http://leap.silvacom.com/
LEFSA	Land Evaluation and Farming Systems Analysis for Land-use Planning	http://edepot.wur.nl/297638
LESA	Land Evaluation and Site Assessment	https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/?cid=nrcs143_008438
LocClim	Local Climate Estimator	http://www.fao.org/nr/climpag/pub/en0201_en.asp
LPFN	Landscapes for People, Food and Nature	http://peoplefoodandnature.org/
LRIMS	Land Record Information Management System	https://www.geospatialworld.net/article/lrims-for-better-administration/
LSMS	Living Standards Measurement Study (LSMS)	http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTRESEARCH/EXTLSMS/0,,contentMDK:21610833~pagePK:64168427~piPK:64168435~theSitePK:3358997,00.html

LSRS_Can	Land Suitability Rating System for Agricultural Crops	http://sis.agr.gc.ca/cansis/publications/manuals/1995-lsrs/index.html
LUDAS	Land-use Dynamics Simulator (LUDAS)	http://www.sciencedirect.com/science/article/pii/S1574954110000208
LUPC_TAJ	The land-use planning (LUP) Catalogue of Tajikistan	http://www.naturalresources-centralasia.org/flermoneca/assets/files/The%20land%20use%20planning%20(LUP%20)%20Catalogue%20of%20Tajikistan_EN_small.pdf
LUWES	Land-use planning for Low Emission Development Strategy	http://www.worldagroforestry.org/sea/Publications/files/booklet/BL0040-12.pdf
MIRCA2000	Global data set of monthly irrigated and rainfed crop areas around the year 2000	https://www.uni-frankfurt.de/45218023/MIRCA
MIREPLA	Micro-regional planning	http://www.fao.org/fileadmin/user_upload/Europe/documents/Publications/Mrp_en.pdf
NELAWU	Negotiating land and water use: participatory planning of resource management	http://www.fao.org/docrep/019/mi371e/mi371e.pdf
New_LocClim	Local Climate Estimator	http://www.fao.org/nr/climpag/pub/en3_051002_en.asp
NTD_NE	Negotiated territorial development in a multi-stakeholders participatory resource planning approach. An initial sustainable framework for the Near East region	http://www.fao.org/3/a-i6133e.pdf
ORTEMU_BOL	Ordenamiento territorial municipal. Una experiencia en el Departamento de Santa Cruz, Bolivia	http://www.fao.org/forestry/11741-0aeb23101258b35f4fa711fa453afb5e.pdf
ORTEMU_CHI	Ordenamiento Territorial en el Municipio. Una guía metodológica	http://www.fao.org/3/a-i3755s.pdf
PI	Soil productivity index based upon predicted water depletion and growth	http://library.wur.nl/WebQuery/clc/195121
PLASULARE	Planning for sustainable use of land resources	http://www.fao.org/docrep/v8047e/v8047e00.htm
PLUP	Participatory Land-use Planning	http://www.fao.org/docrep/019/mi375e/mi375e.pdf
PMAP_ECOS	Participatory Mapping of Ecosystem Services in Multiuse Agricultural Landscapes	http://www.fao.org/nr/climpag/aw_6_en.asp
PNTD	Participatory and Negotiated Territorial Development	http://www.fao.org/3/a-i4592e.pdf

PTP_PHI	Participatory territorial planning. The farming systems development approach in community planning in the Philippines	http://www.fao.org/docrep/005/y8999t/y8999t06.htm
PVIDEO	Participatory Video	http://blog.ciat.cgiar.org/filming-for-change-when-farmers-get-behind-the-camera/
RRA	Rapid Rural Appraisal	http://www.fao.org/docrep/w3241e/w3241e09.htm
SEDLAC	Socio-Economic Database for Latin America and the Caribbean	http://sedlac.econo.unlp.edu.ar/eng/dynamics-searches.php
SEEA	System of Environmental-Economic Accounting	https://unstats.un.org/unsd/envaccounting/seea.asp
SHARP	Self-evaluation and Holistic Assessment of Climate Resilience of Farmers and Pastoralists	http://www.fao.org/in-action/sharp/en/
SISLAC	Sistema de Informacion de Suelos de Latinoamerica	http://www.fao.org/soils-portal/soil-survey/soil-maps-and-databases/soil-profile-databases/en/
SIT_CONAF	Sistema de Informacion Territorial	http://sit.conaf.cl/
SLEEP	Soil Landscape Estimation and Evaluation Program	https://ijabe.org/index.php/ijabe/article/view/1270
SOIL_GRIDS	Soil grids	http://www.soilgrids.org/
SOTER	Soil and Terrain Databases	http://www.isric.org/explore/soter
SPI	Soil Potential Index	https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_054225
SPMLI	Spatial Planning and Monitoring of Landscape Interventions: Maps to Link People with their Landscapes: A Users' Guide	http://ecoagriculture.org/wp-content/uploads/2014/11/SpatialPlanningGuide_10November2014.pdf
SPR	Soil Potential Ratings	https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_054225
SSA	Similarity and Suitability Assessment	https://apps.icarda.org/wsInternet/wsInternet.asmx/DownloadFileToLocal?filePath=Water_management_series/Water_benchmarks_11.pdf&fileName=Water_benchmarks_11.pdf
STCR	Soil Test Crop Response (STCR) database	https://sites.google.com/a/tnau.ac.in/soilscience/home/research/stcr
STORIE	Storie Index	http://anrcatalog.ucanr.edu/pdf/3203.pdf

STORIE_rev	Revised Storie Index for use with digital soil information	http://anrcatalog.ucanr.edu/pdf/8335.pdf
SWAT	Soil and Water Assessment Tool	http://swat.tamu.edu/
TerrAfrica	Regional Sustainable Land and Water Management	http://terrafrica.org/about/
TPLD_IN	A Handbook for trainers on Participatory Local Development. The Panchayati Raj model in India	ftp://ftp.fao.org/docrep/fao/006/ad346e/ad346e00.pdf
VGGT	Voluntary Guidelines on Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security	http://www.fao.org/cfs/home/activities/vggt/en/
WEPP	Water Erosion Prediction Project (WEPP)	https://www.ars.usda.gov/midwest-area/west-lafayette-in/national-soil-erosion-research/docs/wepp/research/
WINDISP	Map and Image Display and Analysis Software	ftp://ftp.fao.org/Public/GIEWS/windisp/.../Windisp35en.pdf
WISDOM	Woodfuel Integrated Supply/Demand Overview Mapping	http://www.fao.org/docrep/009/j8027e/j8027e00.htm
WOCAT	World Overview of Conservation Approaches and Technologies	https://www.wocat.net/
WOFOST	World Food Studies Simulation Model	http://www.wur.nl/en/Expertise-Services/Research-Institutes/Environmental-Research/Facilities-Products/Software-and-models/WOFOST.htm

Land resource planning for sustainable land management

Current and emerging needs in land resource planning for food security, sustainable livelihoods, integrated landscape management and restoration

This working paper provides an overview of the historic development and status of implementation of land evaluation and land-use planning concepts and tools for land resource and landscape management, and it proposes recommendations for future actions. The increasing and juxtaposed challenges of population growth, demands on limited resources by diverse actors, land degradation, biodiversity loss and climate change require the rational use of resources to sustain and enhance productivity and maintain resilient ecosystems. Land-use planning and, more broadly, land resource planning (LRP), are tools for achieving the sustainable and efficient use of resources, taking into account biophysical and socio-economic dimensions. The availability of suitable tools and information to support and satisfy the needs of decision-makers at different scales, across sectors and among stakeholders is limited, however. The needs of decision-makers to address the challenges and drivers of change and promote effective and sustainable responses calls for an updated set of tools and approaches for participatory LRP. Such a set of tools should take into account biophysical, economic, socio-cultural and governance dimensions, and it should promote integrated landscape management as a means to satisfy the needs of multiple stakeholders and implement diverse national strategies and commitments. It is proposed that a consultation process involving a wide range of stakeholders operating at different scales be undertaken to bring together lessons and experiences in tools and approaches for LRP and to identify the main gaps and opportunities. This consultation process should lead to the formulation, with partners, of a strategy for the development, testing and validation of updated LRP tools in pilot countries with stakeholders and decision-makers, from the scale of local landscapes to the subnational, national and transboundary scales.

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