

Land Use Planning: A Key to Sustainable Agriculture

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Abstract

Sustainable use of the soil is a form of land management which retains the natural fertility of the soil and allows for the production of food and fiber supplies and renewable natural resources on a long-term basis. It implies that the natural environment should be treated and managed in such a way that the cycles and energy fluxes among the soil, bodies of water and atmosphere are considered, preserved or restored. To this respect, the term “sustainable land use” is more comprehensive than the term “sustainable soil use”. Land, commonly, stands for a section of the earth’s surface with all the physical, chemical and biological features that influence the use of the resource. It refers to soil, spatial variability of landscape, climate, hydrology, vegetation and fauna, and also includes improvements in land management, such as drainage schemes, terraces and other agro-biological and mechanical measures. The term “land use” encompasses not only land use for agricultural and forestry purposes, but also use of the land for settlements, industrial sites, roads and other human activities. Land use, in this meaning, can be termed sustainable only if it achieves such a spatial distribution or configuration of the different uses, as to guarantee biodiversity and preserve the eco-balance of the whole system. Rational land use planning is fundamental to this process. With reference to the aforesaid issues, the paper describes the main physical, social and economic features of land use planning projects, along with their environmental impacts and constraints to sustainable development. The importance and role of institutional strengthening, sound financial and managerial frameworks, availability of human resources involved, research thrust, technology transfer and networking improvement are also analyzed.

Key-words: Land use planning, sustainable agriculture, networking system.

Introduction

The world’s population is expected to grow from 6 billion today to at least 8 billion in the year 2025. It is, therefore, clear that achieving food security and improving the quality of life, while preserving the environment, will continue to pose major challenges to scientists, decision-makers and technicians in the years to come. The main activity of agriculture is the production of food, so increasing agricultural development in a sustainable manner will be crucial in responding to these challenges.

In the past, demand for growth in food has been met by expanding agricultural land. Nowadays, the availability of new land is limited; moreover, the more or less uncontrolled growth in agricultural production, during the past few decades, in industrial as well as developing countries, has pushed agricultural production to and, in many cases, over the edge of sustainability. This means that the traditional ways to increase production are facing a new challenge: to find a new balance between agricultural development and the conservation of the natural resources.

Agricultural engineering has been applying scientific principles for the optimal use and management of natural resources for centuries, and its role is increasing with the dawn of the new millennium. There are, at least, two reasons for this growing significance. First, it is well understood that the wise use of land resources will play a role of paramount importance in the provision of food for future generations. Second, the demand for different land uses is increasing tremendously, especially in the developed world. The land demands for cropping, grazing, forestry, wildlife, infrastructure, outdoor recreation, landscape and industrial and urban development are greater than the land resources available. To this end, rational land use planning will help to find a balance among these different demands and assure agricultural production, while conserving the natural environment.

With reference to the afore-mentioned issues, the paper, firstly, describes the main physical, social and economic features of the land use planning process, along with its environmental impacts and constraints to sustainable agricultural development. Finally, the importance and role of institutional strengthening, sound financial and managerial frameworks, availability of human resources involved, research thrust, technology transfer and networking improvement are analyzed.

The Concept of Sustainable Land Use

To meet future challenges of food security, further development of agriculture is necessary. This development has to guarantee both the growth in agricultural output and the conservation of natural resources. The conservation of the natural resources is important because of the dependence of agriculture on these resources. This means that the natural environment should be treated and managed in such a way that food production is secured now and in the future. So, food security is not only a matter of quantity, but also of continuity. Agriculture, thus, is forced to find a balance between development and conservation. In this process the responsible use of natural resources plays a role of paramount importance. Among the basic natural resources, upon which life depends, is the soil.

The responsible use of the soil can be described in terms of sustainability or sustainable development. Sustainability has been defined in many different ways and there is no single, universally accepted definition. According to the Brundtland Commission "sustainable development is a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development and institutional changes are all in harmony and enhance both current and future potential, to meet human needs and aspiration". This process implies long-term perspective for planning and integrated policies for implementation. FAO has formulated its own definition of sustainability, specifically in the context of agriculture, forestry and fisheries: "sustainable development is the management and conservation of the natural resource base and the orientation of technological and institutional change in such a manner as to ensure the attainment and continued satisfaction of human needs for the present and future generations. Such sustainable development conserves land, water, plant and animal genetic resources, is environmentally non-degrading, technically appropriate, economically viable and socially acceptable".

Scarcity of suitable soil is a major constraint for further agricultural development in many countries of the world. Therefore, as the demand for soil continues to increase, it is imperative that this limited resource be used efficiently for agricultural and other uses.

Sustainable use of the soil is a form of land management which retains the natural fertility of the soil and allows for the production of high quality of foodstuffs and renewable natural resources on a long-term basis. This means that the natural environment should be treated and managed in such a way, as to preserve or restore the cycles and energy fluxes among soil, bodies of water and atmosphere.

The term “sustainable land use” is more comprehensive than the term “sustainable soil use”. Land, commonly, stands for a section of the earth’s surface, with all the physical, chemical and biological features that influence the use of the resource. It refers to soil, spatial variability of landscape, climate, hydrology, vegetation and fauna, and also includes improvements in land management, such as drainage schemes, terraces and other agrobiological and mechanical measures. The term “land use” encompasses not only land use for agricultural and forestry purposes, but also land uses for settlements, industrial sites, roads and so on. Land use, in this sense, can be termed sustainable if, and only if, is achieved such a spatial distribution or configuration of the different uses, as to guarantee biodiversity and preserve the eco-balance of the whole system. In other words, land use that limits the interactions among soil, water and atmosphere and degrades the habitat standards vital to biological diversity of flora and fauna cannot be defined sustainable. In this respect, the term “sustainable land use” combines technology, policies and activities aimed at integrating socio-economic principles with environmental concerns. The term bears more dimensions or meanings:

- Sustainable use in the meaning of husbandry. In this sense, it is related to concepts such as continuity, durability and equity in the exploitation of natural resources over long periods of time. The dimension refers to methods by which land is managed – crop rotation procedures, tillage systems and so on – all striving to preserve or restore the quality and fertility of the soil. This meaning is strongly related to the long-term physical and economic sustainability.
- Sustainable use in term of interdependence. This meaning is related to the spatial dimension of sustainability. It involves such aspects as fragmentation and relations among different land uses. On this facet of sustainability are, nowadays, focusing many land use planning studies, due to the fact that there is still a great lack of knowledge and uncertainty.
- Sustainable use in terms of ethical obligations to future generations. This refers to the losses and depletions of natural resources in combination with the expected increase in population. Land is not a simple commodity that can be stored and replaced, destroyed and remade, or even recycled in exactly the same way as manufactured goods. It is a complex and biological system, built up over long periods of time. The land could have lost its suitability for cropping or other uses by means of natural or anthropogenic causes. To restore its capacity for beneficial use, while protecting the environment, methods of reclamation have to be tailored to the specific problems at hand. In this field much needs to be done to ensure the future of mankind.

Any assessment of sustainability would be incomplete if it did not address all the dimensions previously described.

Clearly, there are conflicts among these goals. More equity may mean less efficiency. In the short term it may not be possible to meet the needs or demands of even the present generations, let alone the future ones, if these needs or demands are greater than what the environment can afford. Furthermore, degrading the natural resources will reduce their capacity to meet future needs, whatever those needs will be. So, demand management and degradation prevention play a basic role in the process of sustainable use and development of land. Decision – makers have to consider and agree upon a trade-off among different goals but, if the ecosystem as a whole is to survive, the use of natural assets must be compensated by the development of human or physical assets of equal or greater worth. In this regard, good and reliable information is essential, that is, information on the people’s needs, land resources and on the economic, social and environmental consequences of alternative decisions. To this end, the task of the land-use planners is to ensure that decisions are made on the basis of consensus, to avoid disagreements on the ways and directions the natural resources should be exploited. Wise land use planning will help to reduce the trade-off costs and resolve conflicts by involving the community in the decision process.

Land Use Planning: A Tool to Achieve Sustainability

Land use planning is the systematic assessment of land and water potential, alternatives for land use and economic and social conditions in order to select and adopt the best land use options. Its purpose is to select and put into practice those land uses that will best meet the needs of the people while safeguarding resources for the future. The driving force in planning is the need for change, the need for improved management or the need for a quite different pattern of land use dictated by changing circumstances. In the process all kinds of land use are involved: agriculture, forestry, wildlife conservation, urban and industrial expansions, tourism and amenities. Planning also provides guidance in case of conflicts among manifold alternatives, by indicating which areas are most valuable for any particular land use. Land use planning can be viewed as an iterative and continuous process, whose aim is to make the best use of land resources by:

- assessing present and future needs and evaluating the land's availability to meet them;
- identifying and resolving conflicts among competing uses and needs;
- devising alternative options and choosing those that best fit identified targets;
- learning from experience.

At every stage, as better information is available, the process may have to be changed to take account of it.

Goals are important elements in the planning process. They define what is meant by the best use of the land and they have to be specified at the outset of every planning project. Goals, normally, are divided into objects and targets.

Objectives are the general aims within the planning process. They allow the judging of different solutions of a concrete problem in the planning area, and lead to suitable propositions and projects for the use of the land. The targets are the most detailed aims of land use planning. They lead to the design of actual measures that have to be taken and carried out in an area to solve the problems at hand.

The objectives and targets identify the best use of the land. If two different forms of land use bring forth exactly the same profit (economically and socially), the objectives will determine which of the two land uses should be implemented, while the targets will indicate which procedures should be followed.

The goals, as a whole, may be grouped under three main headings: efficiency, equity and acceptability and sustainability.

- Efficiency refers to the economic viability of the land use plan.
The plan should yield more than it costs. So one goal of planning development is to make efficient and productive use of the land. In general terms, for any particular land use, certain areas are better suited than others. Efficiency is achieved by matching different land uses with the areas that will yield the greatest benefit at the least cost. However, it is not always clear which land use is the most profitable one; this depends on the point of view. The point of view of individuals, for instance, focuses on the greatest return on capital and labour invested or on the greatest benefit from the area available. Government's point of view is more complex: it may include improving the foreign exchange situation by producing for export or for import substitution.
- Equity and acceptability represent the social features of land use planning.

The plan must be accepted by the local population, otherwise the proposed changes will not take place. Equity refers to the levelling of the living standards of the residents. People living in the planning area are expected to gain from the land use plan, even if they do not own the land. Living standards may include levels of income, food security and housing. Planning to achieve these standards then involves the allocation of land for specific uses as well as the allocation of financial and other resources.

- Sustainability, as stated before, refers to a development in land use planning that meets the needs of the present while conserving resources for future generations. This requires a combination of production and conservation: the production of the goods needed by the people now, combined with the conservation of the natural resources on which the production depends. So, land use to be sustainable, has to be planned for the community as a whole, because the conservation of soil, water and other land resources is often beyond the means of individual land users.

Research and Development

International and national research, nowadays, needs to be focused more effectively than in the past on problems of land use planning and management. This is the only way to provide land users and planners with suitable and tested technologies for targeted measures to increase agricultural production while protecting the natural resources. The lack of research, application of research findings and access to new and advanced technology in this field is seen as one of the main reasons for the problems that plague the sector: poor land use efficiency, environmental degradation, high costs and lack of responsiveness to beneficiaries.

Successful research thrust on sustainable land use planning should include the following actions:

- Data base improvement;
- Adaptive research;
- Institutional strengthening;
- Socio-economic analysis;
- Environmental protection and conservation;
- Technology transfer and infrastructure.
- Data base improvement.

Availability of reliable hydro-climatic and other associated natural resource data is an essential prerequisite for sustainable land use planning development. As long as adequate and reliable data are not available, planning, design and management of land use programs will continue to remain guesswork, use of other natural resources haphazard and wasteful, and the development process unsustainable. Many land use projects were conceived and designed on a medium – to long-term basis, on the assumption that future climatic conditions will not be different from the past ones. This will not be so in the years to come, due to the global warming and greenhouse effect. Therefore, land use planning designers and managers should begin a systematic re-examination of engineering design criteria, operating rules, contingency plans and land allocation policies. Demand management and adaptation are essential components for increasing project flexibility to meet uncertainties of climate change. On the whole, land use planning programs can only be soundly formulated on the basis of adequate data on soil and its production capacity, potentially available water resources, performance of existing land use projects and other related factors.

- Adaptive research.

A wide variety of techniques or methods are used in land use planning. They are taken from the natural sciences (climatology, hydrology, soil science, ecology), from technology (agriculture, forestry, irrigation and drainage engineering) and from the social science (economics, sociology). Research for land use planning requires enhanced field investigations and a large variety of tools such as: Information Management, System Analysis, Decision Support Systems, Multicriteria Analysis, Geographic Information Systems, Remote Sensing, Computer Image Analysis, Sensors, Modeling Technique, Neural Network Technology, Land Evaluation. All these tools have to be considered under a broad and integrated approach related to food and other agricultural commodity production, rational land use planning, water saving, resource conservation, environmental impacts and socio-economic effects. Current research thrust needs to be reoriented by recognizing the complex role of the land resources in agricultural development, and by following a broad-based holistic approach. To this end, adaptive research programs must be directed to investigate the actual and real problems associated with the planning, design, implementation and management of land use projects. It is important that the resulting methodology be technically feasible, environmentally and economically viable and socially acceptable.

- Institutional strengthening.

The importance of a functional and coherent institutional framework aiming to promote, at both national and international levels, sustainable land use planning development, has been fully recognized at present. The solution may not always require the creation of new and enlarged institutions and establishment of larger governmental services. An important criterion in reorganizing and/or establishing new institutions should be the ability of such institutions to address successfully the multi-dimensional problems that are generally faced by the land users at both local and national levels. Such institutions should be capable of undertaking, regulating, stimulating and facilitating the roles and the tasks carried out by the land users. These institutional frameworks need to be strengthened or restructured to meet more efficiently the land users' requirements and to promote sustainable land use planning development. Principal institutions should have effective linkages with all other related frameworks, so as to optimize the use of physical, financial and human resources involved.

Concluding Remarks

- Sustainable land use planning is a process that aims to integrate ecological with socio-economic, and political with ethical principles in the management of land, for productive and other functions, to achieve intra – and inter – generational equity.
- For formulating and implementing policies and strategies for land use planning it is essential to collect, process and disseminate timely and reliable information and utilize modern land assessment and evaluation technologies, to create sound scientific knowledge for proper decision support.
- The challenging, but widely acceptable concept of sustainable land use planning calls for new approaches on development and, therefore, on land use and management. To this respect, new perspectives are required to manage the land and its associated resources. This is not only a question of allocating and controlling the use of the land, but of combining the knowledge of pressure influencing the resources themselves, with the relations among users and human and social objectives, the technologies available to improve and enhance the land use planning process, and the maintenance of both the biodiversity and the natural equilibrium.

- The lessons learned demonstrate that it is necessary to make a decisive break from past policies to embrace a new holistic approach in land use planning and management, that is comprehensive, participatory and environmentally sustainable.
- There is an urgent need for adequately trained professionals who can work in the multi-sectorial environment of integrated natural resource management.
- Finally, to achieve a sustainable land use planning development, objectives and goals, policies and regulations should be grounded in local realities, traditions and natural resource management strategies. The environmental and socio-economic impacts of such policies and regulations should be assessed before they are implemented.

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