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Planning for sustainable use of land resources

Towards a new approach

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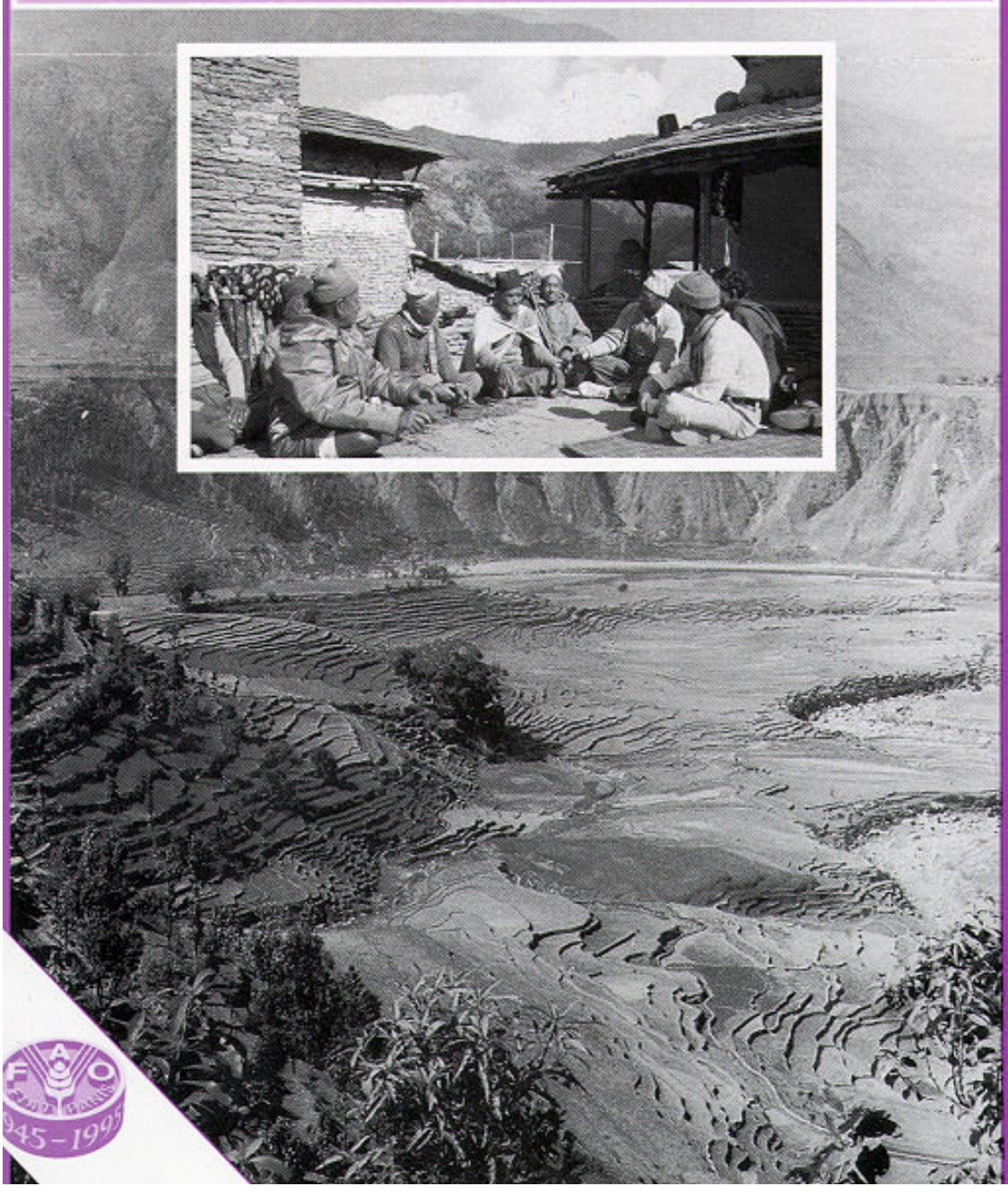

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This publication clarifies issues and emerging concepts relating to a new integrated and holistic approach to land use planning in line with the needs of Chapter 10 (Integrated Approach to the Planning and Management of Land Resources) of Agenda 21 of the United Nations Conference on Environment and Development (UNCED). Definitions of land, natural resources and the various types of planning are presented and discussed. The paper introduced elements to be considered, such as land tenure issues, stakeholders, land qualities and sustainability indicators, together with the relationship between rural and urban planning. A planning sequence is briefly outlined; it begins with definition of objectives and includes the development of a framework for decision-making, the development of information databases and tools and multiple goal analysis. Finally the institutional aspects of planning and implementation are briefly discussed.

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Background paper to FAO's Task Managership
for Chapter 10 of Agenda 21 of the
United Nations Conference on Environment
and Development (UNCED)

prepared by the
Land and Water Development Division
and approved by FAO's Interdepartmental
Working Group on Land Use Planning

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Preface

The increasing human population in developing countries is putting pressure on their finite land resources and causing land degradation. Sectoral approaches to planning for the alleviation of this situation have frequently not been effective, and an integrated approach is required that involves all stakeholders from the outset, accommodates the qualities and limitations of each land unit component, and produces viable land use options. Concepts and definitions relating to such a holistic approach are given, in support of the overriding need to create negotiating platforms for decision making at all levels of planning.

Current land use issues, which require a resolution formulated with the aid of this approach in the rural and peri-urban spheres, are frequently derived from environmental versus developmental conflicts. Those discussed include decision making on whether it is preferable to use scarce resources to rehabilitate degraded land or to improve prime agricultural land, whether smallholder settlements or large-scale mechanized farming will better support the expanding population, the encroachment of urban development onto high quality agricultural land, the correct uses of scarce water resources, and the particular requirement for integrated as opposed to sectoral planning of coastal zones.

The execution of the integrated approach, as described in Agenda 21, will depend on policies that support planning for the use and sustainable management of land resources, on the strengthening of implementing institutions and on ensuring the active involvement and participation of stakeholders in the decision-making process. These actions will in turn be supported by a variety of databases on natural resources and their uses, which are combined through the use of a geographical information system. Social and economic tools are also described, which when used will ensure the inclusion of the contributions from stakeholders in land use negotiations.

The text of this Bulletin was first published in the form of a discussion paper which was intended to amplify and provide a background to FAO's draft report as Task Manager for the UN System for the implementation of Chapter 10 (Integrated Planning and Management of Land Resources) of Agenda 21. An extract from the final report on the review of Chapter 10 at the Third Session of the Commission on Sustainable Development in April 1995, is reproduced as Appendix I of the present document. The United Nations Environment Programme has since provided funds for a workshop in June 1995 which is intended to result in a first version of a new integrated approach.

The original discussion paper provided part of the basis for discussion at the International Workshop on Chapter 10 issues held at Wageningen, The Netherlands, on 20 to 22 February 1995. The conclusions and recommendations of that meeting are also included here as Appendix II.

Acknowledgements

The present text was prepared by W.G. Sombroek and D. Sims, with inputs by a wide range of specialists with FAO and from cooperating UN agencies and several NGOs.

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Chapter 1

Introduction

"people are entitled to a healthy and productive life in harmony with nature"
(Rio declaration)

An integrated approach to planning the use and management of land resources entails the involvement of all stakeholders in the process of decision making on the future of the land, and the identification and evaluation of all biophysical and socio-economic attributes of land units. This requires the identification and establishment of a use or non-use of each land unit that is technically appropriate, economically viable, socially acceptable and environmentally non-degrading.

A purely sectoral approach to the planning of land resources should be avoided, as this may lead to their irreversible degradation. Concern about the environment has been highlighted by the recent rapid growth of the world's human population, the increasing socio-economic interdependence of countries and regions, the growing awareness of the value of natural ecosystems, and the perception that current land use practices may influence the global climatic system. An integrated rather than sectoral approach is a means to prevent or resolve conflicts related to land and water use, as it optimizes the planning process and creates an enabling environment for mediation between, and decision making by, all stakeholders at early stages.

The medium, or most likely, projection of population growth implies a near doubling of world population to about 10 thousand million by the year 2050 (UNFPA, 1992). Most experts agree that through full and judicious application of modern agricultural technology, the world's land resources can, in theory, provide sufficient food, fibre, animal feed, biofuel and timber for such a doubling. In practice, there will be acute land shortages in many countries, especially many developing ones.

A recent FAO study (Alexandratos, 1995) estimates that 92% of the 1800 million ha of land in developing countries (excluding China) with rainfed crop potential, but not yet used for this purpose, is in Sub-Saharan Africa (44%) and in Latin America and the Caribbean (48%). Two-thirds of these 1800 million ha are concentrated in a small number of countries, e.g. 27% in Brazil, 9% in Zaire and 30% in 12 other countries. A good part of this land "reserve" is, however, under forest (at least 45%), or in protected areas, and should therefore not be considered as a readily-available reserve for agricultural production. A significant part (72% in Sub-Saharan Africa and Latin America) suffers from soil and terrain constraints.

Overall some 50% of the 1800 million ha of land "reserve" is classified in the categories "humid" (i.e. too wet for most crops and rather unhealthy for human settlement) or as "marginally suitable for crop production". The possibilities for expansion of land for crop production are therefore limited. Consequently, much of the perceived increased need for food, etc. will have to come from intensification of production with high-yielding crop varieties in high-potential areas. These are lands with good soil and terrain conditions, with favourable temperature and rainfall conditions or a supply of irrigation water, and with easy access to mineral or organic fertilizers.

FAO estimates (Yudelman, 1994) that, though arable land may expand by 90 million ha by the year 2010, the harvested area could increase by 124 million ha because cropping intensities would rise, with irrigated land in developing countries expanding by 23.5 million ha from the present 186 million ha.

More detailed studies are under way on the irrigation potential in developing countries, and Africa in particular. These focus on areas combining suitable soil and terrain conditions that are under command, and with surface and groundwater freshwater resources that can be harnessed without excessive costs or damage to environmental values. At the same time FAO is cooperating with a number of UN Agencies and the Stockholm Environmental Institute in assessing the global freshwater resources, with the aim of identifying where water crises may be imminent.

As the result of intensification of land use in areas that are naturally well-endowed, or can be made so by economically-viable human interventions such as irrigation and drainage development, there will in the near future be a significant decrease in the land per rural household. *Per caput* availability of arable land in developing countries is projected by FAO to nearly halve between the late 1980s and 2010, from 0.65 to about 0.4 ha. This figure is likely to become even smaller toward 2050.

In contrast to this sketched situation in developing countries, the *per caput* amount of arable land may increase in developed countries with their stagnant population growth. This could lead to the more marginal arable lands being taken out of production as "set-aside" lands for nature "development", cultural landscape conservation or recreational purposes (Van de Klundert, *et al*., 1994). The situation in countries-in-transition is more difficult to project because of the current process of transfer of state-owned arable land to private ownership.

The FAO predictions are limited in time scale to 2010, when any global climatic change is expected to be still of negligible influence. This may be different by the year 2050 or beyond. The consensus among climate change modellers is that in developing countries the effects on food security may be negative rather than positive (Norse and Sombroek, 1995).

The above discussion has concentrated on the amount of land available for the production of food and fibre. Land has, however, many functions (see also ESCAP, 1994):

- It is the basis for many life support systems, through the production of biomass that provides food, fodder, fibre, fuel, timber and other biotic materials for human use, either directly or through animal husbandry including aquaculture and inland and coastal fishery (the *production function*).

- Land is the basis of terrestrial biodiversity by providing the biological habitats and gene reserves for plants, animals and micro-organisms, above and below ground (the *biotic environmental function*).

- Land and its use are a source and sink of greenhouse gases and form a co-determinant of the global energy balance - reflection, absorption and transformation of radiative energy of the sun, and of the global hydrological cycle (the *climate regulative function*).

- Land regulates the storage and flow of surface and groundwater resources, and influences their quality (the *hydrologic function*)

- Land is a storehouse of raw materials and minerals for human use (the *storage function*).

- Land has a receptive, filtering, buffering and transforming function of hazardous compounds (the *waste and pollution control function*).

- Land provides the physical basis for human settlements, industrial plants and social activities such as sports and recreation (the *living space function*).

- Land is a medium to store and protect the evidence of the cultural history of mankind, and a source of information on past climatic conditions and past land uses (the *archive or heritage function*).

- Land provides space for the transport of people, inputs and produce, and for the movement of plants and animals between discrete areas of natural ecosystems (the *connective space function*).

The suitability of the land for these functions varies greatly over the world. Landscape units, as natural resources units, have a dynamism of their own, but human influences affect this dynamism to a great extent, in space and time. The qualities of the land for one or more functions may be improved (for instance, through erosion control measures), but more often than not the land has been or is being degraded by human action.

Human-induced land degradation has taken place all through history, such as during the Mediterranean and Middle East civilizations, around or before O AD, and during the time of European expansion in the Americas, Australia, Asia and Africa. During this century, however, land degradation, including desertification, has increased enormously in extent and severity, by direct action of a strongly growing world population and its increased livelihood expectations and demands (ISRIC, 1990).

The rate of land degradation may continue unabated or even increase under conditions of any human-induced global climatic changes, but this cannot be automatically assumed. Land degradation can be controlled, redressed or even reversed if the land is used wisely, if all the functions of the land are taken into account, and if short-term vested interests of privileged groups are replaced by long-term enlightened interests of all segments of humankind, globally, nationally and locally.

Land degradation has been exacerbated where there has been an absence of any land use planning, or of its orderly execution, or the existence of financial or legal incentives that have led to the wrong land use decisions, or one-sided central planning leading to over-utilization of the land resources + for instance for immediate production at all costs. As a consequence the result has often been misery for large segments of the local population and destruction of valuable ecosystems. Such narrow approaches should be replaced by a technique for the planning and management of land resources that is integrated and holistic and where land users are central. This will ensure the long-term quality of the land for human use, the prevention or resolution of social conflicts related to land use, and the conservation of ecosystems of high biodiversity value.

Chapter 2

Concepts, definitions and links

The integrated approach to the planning and management of land resources has been identified as a separate programme area of UNCED's Agenda 21 (UNCED, 1993). The relevant text (Chapter 10) is quite short and will benefit from elaboration, to ensure appropriate action is taken by governments and international organizations such as the UN specialized agencies, of which FAO is assigned as Task Manager.

The responsibilities of the Task Manager for each chapter are firstly to prepare periodic reports for the UN Commission on Sustainable Development (CSD) on progress towards implementation. Secondly, the Task Manager will work with UN Agencies, national governments and NGOs, to develop a more effective and combined approach to the problems identified in the chapter.

This background paper to the Task Manager's report is intended to provide a basis for a more in-depth discussion on these issues, considering that there have not been major preparatory conferences as in the case of desertification (Chapter 12), forests (Chapter 11), sustainable agricultural development (Chapter 14) and water resources (Chapter 18). In a sense, the present text endeavours to provide a commentary on Chapter 10, supported by explanations of a number of definitions, examples of issues to be solved through an integrated approach, and tools available when planning the use and management of land resources.

The text of Chapter 10 deals with *the reorganization and strengthening of decision-making structures* and not with the operational aspects of planning and management. The latter figure more prominently as detailed sectoral plans in other programme areas[1] of Agenda 21. Thus this paper concentrates on concepts, principles and decision making within an overall framework for sustainable land management. However, as the discussion develops, it may not be possible to avoid some reference to operational or implementation aspects.

The need for a separate programme area is brought out in the following extracts from the text (paragraph. 10.1): "the ever-increasing pressures on land resources, creating competition and conflicts and resulting in sub-optimal use of both land and land resources". "Integrated physical and land use planning and management is an eminently practical way to achieve" the resolving of such conflicts and "to move towards more effective and efficient use of the land and its natural resources". Also (paragraph. 10.3), "It is recognized that such integration should take place at two levels, considering on the one hand all environmental, social and

[1] For instance, paragraphs 5.16-5.66, 7.27-7.29, 12.28-12.29, 13.13-13.17, 14.34-14.38, 14.44-14.47, 18.6-18.12, 18.76. Since Chapter 10 does not deal with the actual management of land, a more appropriate title might be "An integrated approach to planning the use and management of land resources" - denoting the guiding, and in a way overarching, principles for the more sectoral-oriented management of land as discussed in the other chapters.

economic factors and on the other all environmental and resources components together (i.e. air, water, biota, land and geological and natural resources)".

As shown by these quotations, Chapter 10 makes distinctions between land and land resources, between land use planning and physical planning, between environmental, geological and natural resources, and between planning and management. For each of these, detailed definitions are required.

LAND AND LAND RESOURCES

As stated in the introduction of Chapter 10, the definition of *land* used to be: "a physical entity in terms of its topography and spatial nature"; this is often associated with an economic value, expressed in price per hectare at ownership transfer. The broader, integrative or holistic view takes into account the physio-biotic and socio-economic resources of the physical entity as well, and this is obviously the guiding principle of Chapter 10 as a whole. A complete definition[2] may therefore be the following one (already used in the documentation for the Convention to Combat Desertification) (UN, 1994):

> *"Land is 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 physical results of past and present human activity (terracing, water storage or drainage structures, roads, buildings, etc.)."*

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[2] (1) This definition conforms to *land system units, landscape-ecological units* or *unites de terroir*, as building blocks of a watershed (catchment area) or a phytogeographic unit (biome). The repeated reference to _land and land resources_ of Chapter 10 may be taken to mean: land as well as its individual land components.

(2) The definition of a *natural* land unit as defined above is distinctive from an *administrative* unit of land (*territoire*) which can be of any size (individual holding, municipality, province, state, etc.) and which normally encompasses a number of natural units or parts of them.

(3) The components of the natural land unit can be termed land resources, including physical, biotic, environmental, infrastructural, social and economic components, inasmuch as they are fixed to the land unit.

(4) Included in the land resources are surface and near-surface freshwater resources. Part of these move through successive land units, but then the local flow characteristics can be considered as part of the land unit. The linkages between water and land are so intimate at the management level that the water element cannot be excluded (land as a unit *intermixed* with water, with its land use in part *depending* on access to that water, and the unit at the same time *affecting* the quality and quantity of the passing water). Only the freshwater harnessed in major reservoirs outside the natural land unit, or pumped from rivers at upstream sites, can be considered as a separate resource.

(5) Underground geological resources (oil, gas, ores, precious metals), and deeper geohydrological resources that normally bear no relation to the surface topography such as confined aquifers, are excluded from the group of components of the natural land unit, although it is recognized that some countries consider them as part of individual land ownership (and hence with rights to exploit or sell them).

In this holistic approach, a natural unit of land has both a vertical aspect – from atmospheric climate down to groundwater resources, and a horizontal aspect – an identifiable repetitive sequence of soil, terrain, hydrological, and vegetative or land use elements.

ENVIRONMENTAL RESOURCES AND NATURAL RESOURCES

Natural resources, in the context of "land" as defined above, are taken to be those components of land units that are of direct economic use for human population groups living in the area, or expected to move into the area: near-surface climatic conditions; soil and terrain conditions; freshwater conditions; and vegetational and animal conditions in so far as they provide produce. To a large degree, these resources can be quantified in economic terms. This can be done irrespective of their location (intrinsic value) or in relation to their proximity to human settlements (situational value).

Environmental resources are taken to be those components of the land that have an intrinsic value of their own, or are of value for the longer-term sustainability of the use of the land by human populations, either *in loco* or regional and global. They include biodiversity of plant and animal populations; scenic, educational or research value of landscapes; protective value of vegetation in relation to soil and water resources either *in loco* or downstream; the functions of the vegetation as a regulator of the local and regional climate and of the composition of the atmosphere; water and soil conditions as regulators of nutrient cycles (C, N, P, K, S), as influencing human health and as a long-term buffer against extreme weather events; occurrence of vectors of human or animal diseases (mosquitoes, tsetse flies, blackflies, etc.). Environmental resources are to a large degree "non-tangible" in strictly economic terms.

In the framework of an integrated, holistic approach to land use planning, the distinction is somewhat artificial, as environmental resources *are* part of the set of natural resources. However, it still serves to group the tangible from the non-tangible components, and the directly beneficial at local level from the indirectly beneficial components of human life support systems. In the context of Chapter 10, both groups should receive equal attention.

Accepting the broad definition of land as including "human settlement patterns", a third important set of resources has to be taken into account. The set *of social or human resources* should be defined in terms of density of population groups, their occupational activities, their land rights, their sources of income, the standard of living of households, gender aspects, etc.

LAND USE PLANNING AND PHYSICAL PLANNING

For the purposes of this discussion *physical planning* is the designing of the optimal physical infrastructure of an administrative land unit, such as transport facilities – roads, railways, airports, harbours; industrial plants and storage of produce; mining and power generation, and facilities for towns and other human settlements – in anticipation of population increase and socio-economic development, and taking into account the outcome of land use zoning and planning. It has both rural and urban development aspects, though the latter usually predominates.

Physical planning is normally carried out by the state, or by local government organizations for the general good of the community. The purpose is to take a more nearly holistic or

overall view of the development of an area than can or would be taken by individuals. Physical planning has two main functions: to develop a rational infrastructure, and to restrain the excesses of individuals in the interests of the community as a whole. This latter function usually leads to physical planning being associated with a system of laws and regulations.

Land use planning should be a decision-making process that "facilitates the allocation of land to the uses that provide the greatest sustainable benefits" (Agenda 21, paragraph 10.5). It is based on the socio-economic conditions and expected developments of the population in and around a natural land unit. These are matched through a multiple goal analysis and assessment of the intrinsic value of the various environmental and natural resources of the land unit. The result is an indication of a preferred future land use, or combination of uses. Through a negotiation process with all stakeholders, the outcome is decisions on the concrete allocation of land for specific uses (or non-uses) through legal and administrative measures, which will lead eventually to implementation of the plan.

As considered in Chapter 10, land use planning is mainly related to rural areas, concentrating on the use of the land in the broadest agricultural context (crop production, animal husbandry, forest management/silviculture, inland fisheries, safeguarding of protective vegetation and biodiversity values). However, peri-urban areas are also included where they directly impinge on rural areas, through expansion of building construction onto valuable agricultural land and the consequent modification of land uses in the adjoining rural areas.

PLANNING AND MANAGEMENT

As stated before, land resources *planning* is the process of evaluation of options and subsequent decision-making which precedes implementation of a decision or plan.

Land resources *management*, in its narrow sense is the actual practice of using the land by the local human population, which should be sustainable (FAO/Netherlands, 1991; see Box 1). The detailed operational aspects of such sustainable management are dealt within other chapters of Agenda 21: Chapters 7, 12, 13, 14, 18, etc.

In a broader sense – as obviously meant in Chapter 10 – land resources management is the implementation of land use planning, as agreed between and with the direct participation of stakeholders. It is achieved through political decisions; legal, administrative and institutional execution; demarcation on the ground; inspection and control of adherence to the decisions; solving of land tenure issues; settling of water rights; issuing of concessions for plant and animal extraction (timber, fuel wood, charcoal and peat, non-wood products, hunting); promotion of the role of women and other disadvantaged groups in agriculture and rural development in the area, and the safeguarding of traditional rights of early indigenous peoples.

ZONING, RESOURCE MANAGEMENT DOMAINS, ALLOCATION

The term "zoning" is not mentioned in Chapter 10, yet it is one of the products of land resources planning used in the Task Manager's Report as well as in a number of national approaches. It therefore warrants a definition.

Sustainable agriculture and rural development has been defined by FAO as "....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 present and future generations. Such sustainable development (in agriculture, forestry and fisheries sectors) conserves land, water, plant and animal genetic resources, is environmentally non-degrading, technically appropriate, economically viable, and socially acceptable".

Box 1: Definition of sustainability (FAO/Netherlands Den Bosch Conference (1991)

For many years zoning has been used for ensuring land use control in urban and peri-urban areas. More recently it has also become associated with delineation of rural ecological units, as in FAO's Agro-Ecological Zones (AEZ) Project (see Box 2).

In the urban planning sphere the word is commonly used in a prescriptive sense; for example, the allocation of peri-urban land for specific uses such as housing, light industry, recreation, horticulture or animal bio-industry, in each case with the appropriate legal restrictions to land markets.

In the original agro-ecologic zoning concept the word denotes an earlier stage of rural planning. It is a subdivision of the rural lands on the basis of physical and biological characteristics (climate, soils, terrain forms, land cover, and to a degree the water resources), and is used as a tool for agricultural land use planning. At regional inter-country level, it was one of the tools to assess the potential human population supporting (or "carrying") capacity of a country. This is inasmuch as it depends on the producing capacity of the land at different levels of input and technology, discounting industrial, trade or mining activities. In this sense also the zoning was adopted by the CGIAR system of international agricultural research for its new ecoregional approach.

The AEZ methodology has been refined by FAO for within-country level zoning applications (Mozambique, Bangladesh, Kenya, Nigeria, and currently China and the Amazon region), where socio-economic conditions have also been taken into account. These conditions figure even more prominently in the programmes for (agro-)Ecological and (socio-)Economic Zoning - EEZ - of whole and mainly natural ecosystems, such as the Amazon forest region or "biome" (Sombroek, 1994). In these latter two cases, the zoning *sensu strictu* is a delineation of areas of rural lands, which could be earmarked for one or another use or non-use, based on identical physio-biotic conditions and prevailing socio-economic infrastructure. The resulting units can be defined as Resource Management Domains, RMDs, defined as areas within a broad physio-biotic zone that have at present the same socio-economic conditions.

The above zoning does not include legal or administrative decisions on future land use, which is the subject of land use *allocation*. It consists of a series of processes that take place after the zoning *sensu strictu*. Important procedures will involve political decisions connected with choosing between alternative options presented in a plan after negotiation with all stakeholders; identification of land rights and solving any resulting conflicts; legal, administrative and institutional execution; demarcation on the ground; and effective control of adherence to the decisions taken.

From very early times, for example in China, and in the nineteenth century in several European countries land owners were taxed on the value of their land, based upon its productivity and agricultural value. This value was assessed on the basis of experience, which in turn was based on such factors as quantity and distribution of rainfall, slope, and depth and type of soil. In 1961 the US Department of Agriculture published the Land Capability Classification, which divides land into eight Classes on the basis of soil and climatic limitations. Suitability in this case meant that the land could be safely used for the purposes listed without permanent damage. The system was widely adopted in many countries for land evaluation purposes.

In 1976 FAO published A Framework For Land Evaluation. The Framework defines land units in terms of their characteristics (measurable factors such as slope, soil texture, rainfall, etc.), and qualities (effects such as temperature regime, moisture availability, which result from a combination of characteristics), matches them with potential uses defined in terms of the *requirements* of such uses, and then rates the land in terms of suitability for the use. A use could not be rated as suitable unless it was sustainable. The Framework, and a number of subsequent publications, provide fairly exhaustive lists of land characteristics and land qualities.

The initial Agro-Ecological Zones project and population supporting capacity study was carried out between 1978 and 1982, and covered Africa, Asia, and South America. Since then the method has been considerably developed, and applied at country level, for example in Kenya and China. Training workshops have recently been arranged in Nigeria, Syria and Thailand.

The first step in the AEZ procedure is the preparation of a digitized land resources map on which is superimposed agroclimatic information, in particular rainfall, temperature and potential evapo-transpiration. The combined data is then used to identify individual land/climate units on basis of length of growing season determined by moisture availability. Potential yields for crops are then calculated, taking into account temperature, day length, and other climatic limitations, and site and soil limitations, at different levels of input. The result is predicted yield as a percentage of potential yield.

The method has been elaborated to cover a wide range of crops, tree and grass species, and animal production types, using different production systems. Predicted soil loss has been modelled for each use and production system combination. Human population supporting capacities of the land, on the basis of different food security scenarios and levels of input, are also calculated. AEZ has recently been linked to CAPPA, a computerized system for agricultural planning and policy analysis.

All of the above systems represent progressively more systematic attempts to predict the performance of different types or units of land under different crops and production systems, or to calculate potential output and human carrying capacity under different policy and management scenarios.

Box 2: Land evaluation; a brief historical perspective.

LINKS BETWEEN RURAL, PERI-URBAN AND URBAN LAND USE PLANNING

Having established that Chapter 10 focuses on rural land use planning, it should be realized that there are important links with human settlements in general and the needs of urban centres in particular. For example, these are apparent in the seven programme areas of Chapter 7 of Agenda 21, for which UNCHS (Habitat) is the Task Manager for UN System involvement. Synergies need to be developed between urban and rural land use planning and apparent antagonisms need to be resolved through platforms for decision making. These will be wherever stakeholders in urban and rural development can meet and resolve their

URBAN needs	RURAL needs	
Prevention of mass-influx of rural poor	Availability of labour for agricultural activities (cropping, forestry, fisheries)	Potentially synergistic: socio-economic support mechanisms for stable and equitable income of rural population
Affordable food, especially for the poorer segments of the urban population	Substantial and stable market for agricultural produce, at above-cost prices	Antagonistic: food aid from outside the country Synergistic: promotion of credit and markets for locally produced food
Good access/communications with the hinterland (transport of raw materials; tourism)	Good access/communication with the urban centres (transport of agricultural inputs and outputs)	Synergistic
Energy from water reservoirs	Rural water resources for irrigation, agricultural produce processing	Antagonistic: flooding of agricultural or forest land by reservoirs Synergistic: water storage for both energy and irrigation
Steady and good quality water supply for human and industrial use	As above, and disposal of agricultural drainage water (salinity; some excess fertilizer input, pesticides, etc.)	Antagonistic: limitation of water quantity for upstream rural use; degradation of water quality for downstream urban use Synergistic: afforestation; more efficient agricultural inputs use
Household fuel (charcoal) and wood-based shelter materials (timber)	Vegetative protection of upper catchments and river banks to prevent degradation of agricultural land	Antagonistic, unless effective land market control Synergistic: afforestation and protection of vulnerable ecosystems
Disposal of solid and liquid waste and storm water	Protection of valuable natural ecosystems; replenishment of plant nutrients stock	Antagonistic: degradation of down-stream agro-ecosystems Synergistic: reuse of treated waste on peri-urban agricultural lands
Expansion of settlement and industrial area and (peri) urban infrastructure (harbours, airports) and associated free land markets	Protection of prime agricultural land and safe agricultural land tenure in peri-urban areas	Antagonistic, unless effective land market control

Box 3: Antagonism and synergism between urban and rural land resources use.

differences for the benefit of the common welfare. A listing of synergies and antagonisms between urban and rural land resources use is given in Box 3.

Environmental health planning as specified in Chapter 6 of Agenda 21, with WHO as Task Manager within the UN system, can and should be fully interlinked with rural land use planning. The elimination of vector-borne diseases should go hand in hand with rural

The Onchocerciasis Control Programme (OCP) has, over a period of 20 years, successfully eliminated the transmission of *Onchocerca volvulus*, causing river blindness over an area of 764 000 km^2 in West Africa, thereby protecting a population of 20 million. During the programme's implementation, the coverage was extended to 1.3 million km^2, and efforts to eliminate transmission among an additional 10 million people are well underway. The main strategy of OCP continues to be control of the vector, the blackfly *Simulium damnosum*, by applying environment-friendly insecticides to rapids and other white water sites (the breeding places of the vector) in some 50 000 km of rivers. This strategy is, since the late 1980s, complemented by the use of ivermectin, a drug that kills the microfilarial state of the parasite.

Prior to the start of OCP, river blindness was a major obstacle to agricultural development of large extents of fertile river valleys. Opening these lands for development was and continues to be a major objective of the programme. On completion of OCP operations in 1997, some 25 million hectares of riverine land will be available for resettlement and cultivation.

This creates a unique opportunity to put into practice the principles of an integrated approach to the planning and management of land resources, as contained in Chapter 10 of Agenda 21. In anticipation, the World Bank convened a conference in Paris in March 1994, where high-level delegation from the OCP countries (including some heads of State and ministers) met together with representatives of the four sponsoring UN agencies (UNDP, World Bank, FAO and WHO) and of bilateral agencies. The elements of a strategy for the sustainable resettlement and development of OCP areas were agreed upon and have been presented to the Joint Programme Committee of OCP at its XVth session in Yamoussoukro, 28 November-1 December 1994.

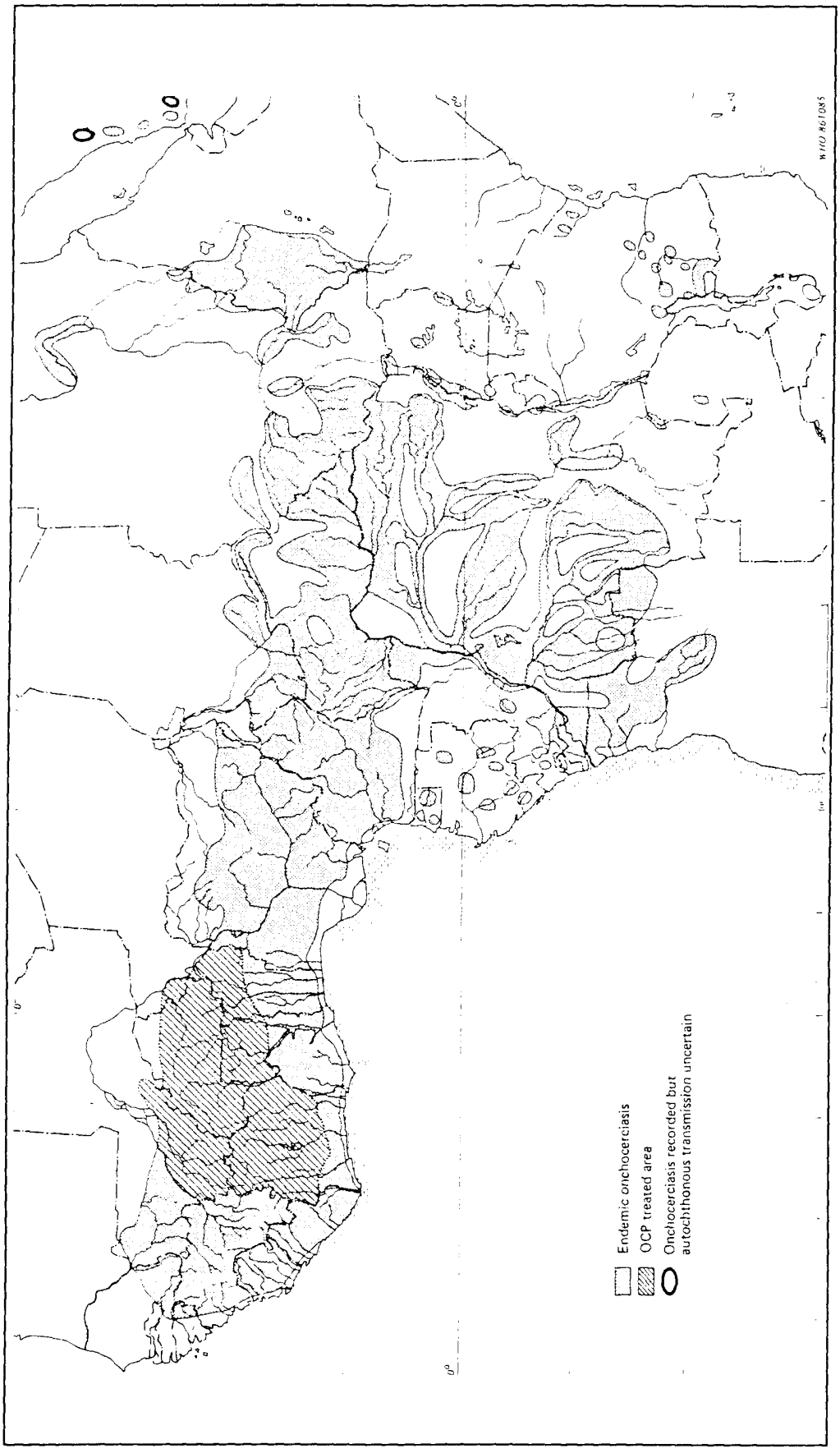
Box 4: The Onchocerciasis Control Programme In West Africa

development and in many cases precede it. The occurrence of such diseases is still prevalent in many developing countries of the tropics and subtropics and has been mapped in a major publication of WHO (WHO, 1989).

Malaria control is an essential pre-requisite for a healthy rural community anywhere in the world. Sustainable development of rural communities in sub-Saharan Africa has been hampered by infestations such as the tsetse fly, causing sleeping sickness in humans and domestic animals, and the blackfly causing river blindness (see box 5). There are new and promising biological methods of eradicating tsetse fly infestations, and the blackfly has been eliminated in large parts of West Africa by concentrated efforts of an international consortium led by the World Bank, in close collaboration with the Governments that are directly concerned (see box 4). Such disease control measures now provide unique opportunities for national planning agencies, supported by international institutions and donor countries, to carry out integrated approaches to land resources planning in these hitherto sparsely populated areas.

The control of vector-borne diseases in general is being promoted internationally by a WHO-FAO-UNEP-Habitat Joint Panel of Experts on Environmental Management for Vector Control (PEEM), established in 1981. The many publications and other activities implemented by PEEM share as an essential element the intersectoral approach to environmental health issues associated with natural resources development in both rural, per-urban and urban spheres.

Box 5. Map showing geographical distribution of Onchocerciasis in Africa and the Arabian Peninsula



FAO runs major programmes in collaboration with member countries concerned with the control of diseases and pests in managed ecosystems such as the Integrated Pest Management (IPM) programme in rice growing areas, the control of locust swarms in North Africa and the Near East, and the eradication of diseases including foot and mouth and screw worm in animal herds (EMPRES).

AN INTEGRATED APPROACH

Integration, or "the act of combining or adding parts to make a unified whole" (Collins English dictionary) refers to all parts that make up a land unit as defined before. In combination with the word "approach", it should also refer to participatory and comprehensive cooperation between all institutions and groups at national, provincial and local levels – all "parts", partners or stakeholders – that relate to and deal with land resources planning and the management of such planning.

Chapter 10 of Agenda 21 calls for mechanisms aiming to promote a constructive and productive dialogue between the full range of stakeholders. These include ministries, provincial and municipal government departments and their policy development entities, research and resources data base development institutes such as a topographic service or statistics institutes, parastatal organizations in the executive sphere such as national irrigation boards or town water supply companies, and public-interest organizations (NGOs) at both national and local level, such as nature conservation societies, farmers' associations and community groups.

This implies the need to create an enabling environment in the legislative and administrative sphere, leading to *negotiation platforms for decision making* at all relevant levels, to solve conflicting demands on the use of the land, or components of it, such as freshwater resources. These platforms should both be horizontal between ministries, provincial or municipal governing bodies, and vertical between governing bodies and local, actual or potential users of the land resources, all together linking in both top-down and bottom-up directions.

It should be realized that such integrative platforms, to be successful, require much time, patience and goodwill. Only with these attributes will they overcome bureaucracy and the historical barriers that have been erected between sectoral institutions that may be blinkered by tunnel vision. A fully integrated approach may be worth the effort only if the conflicting demands on the land concerned are seemingly intractable, as exemplified in Chapter 4 of this paper. If the optimal and sustainable land use is readily apparent, for instance forest conservation in upper river catchments, established national parks or indigenous reserves, then overmuch time need not be spent on ensuring full integration of all interested parties, in order to make good use of human resources.

Chapter 3

Elements to be considered

The process of land use planning and its implementation, which is land use management as defined above, hinges on three elements: the stakeholders, the quality or limitations of each component of the land unit, and the viable land use options in the area. In a more technical sense the factors of planning are: the amount of land available and its tenure; the quality, potential productivity and suitability of the land; the level of technology used to exploit the land resources, the population density, and the needs and standards of living of the people. Each of these factors interacts with the others.

LAND TENURE, LAND RIGHTS AND LAND MARKETS

In the real world there are many actual or potential conflicts with respect to land among different owners, claimants, actual land users and otherwise affected persons and communities. Clarification and security of land rights are essential for the success of an integrated approach to the planning and management of land resources. Settling these rights reduces conflicts between stakeholders, increases the confidence required for sustainable land use practices by the actual land cultivators or protectors, determines the respective responsibilities, and provides the basis for a fair and environmentally-sound allocation of incentives, subsidies or taxes.

Land tenure has many forms:

- legal ownership, as confirmed in cadastral ledgers and title deeds, without actual use of the land ("absentee" land holding purely for investment purposes);
- legal ownership with use, or the requirement to use the land in a specified or prescribed way;
- legal ownership by a physical person or an institutional body but with agreed use by other person(s), providing usufructuary rights;
- state land with defined use or non-use such as national parks or nature reserves;
- state land with "squatters" rights, i.e. the right to own a defined area of land after new occupants have been earning their living on parts of the land during a number of years;
- state lands with formal concessions to persons or companies to extract biotic or mineral resources (e.g. logging, mining) whether or not with the requirement to restore the land cover or land surface conditions;

- state, provincial or municipal land with archaeological or cultural heritage value, needing full-scale protection or limitations on its use;
- communal lands, vested in traditional rights of indigenous groups or early occupants of the land, such as hunters or gatherers of products of non-allocated lands;
- communal lands with traditional agreements between the settled population and transhumance groups about the seasonal use of the land, or portions of it (dry season rights for nomadic herdsmen; right of crossing); and
- lands with rights of intergenerational transfer of ownership or lease holdership, and a degree of freedom in subdividing the land rights among sons and daughters, such as to first-born only or to all children, following a land succession system.

As stated before, "land" in the context of Chapter 10 includes the local, unharnessed water resources. Especially in dryland situations there are many water use-related land rights. These include access to water for drinking water supply and sanitation, for use in irrigated agriculture including water harvesting and for the watering of cattle. In both dryland and humid environments there are moreover fishing rights, as well as entitlements to use water for the processing of primary agricultural produce, such as coffee, kenaf, sisal, jute, hides and skins. If well organized, such rights are linked to duties to avoid pollution of the water resources, as these would be detrimental to their subsequent use by other stakeholders in the same land unit or downstream.

All rights have to be taken into account in a judicious manner during execution of any land resources plan. They first have to be carefully inventoried, checked against their fairness and their consistency in relation to the overall policy on land tenure of the national or provincial government. These policies are laid down in Agrarian Reform Laws, Land Tenure Acts, Land Acquisition Acts, Land Titling Acts, Freehold Leases and Customary laws and regulations in communal tenure. The latter are often at village level and include the joint ownership of natural forests, individual stands of trees, water bodies and watering points. They often go with well-defined regulations and social controls, which seek to protect local natural resources and to avoid a monopoly by individuals at the expense of the community.

Efficient natural resources tenure (NRT) systems have to be developed, which can solve the often conflicting though not necessarily exclusive objectives of economic growth (output), equity (fair access to all, including gender equality), tenure security, and land resources improvement and conservation.

A comprehensive assessment of land tenure and land rights should also include an inventory of *land markets* (Amani *et al.*, 1994). This entails the socio-economic characteristics of the buyers and the sellers of land, and the geographic distribution of land markets. It will examine what rights are being involved precisely; for what purpose is buying done (productive, speculations, hedge against inflation, residential purposes); for what reason are people selling (emergency, immediate survival, moving, cash-in on an investment, compulsion); and how the land markets influence land-use patterns, land productivity, land scarcity and conditions of fragile environments.

National, provincial and local governments may want to levy fees on certain land allocation mechanisms, including formal or informal land market transactions in rural or peri-urban areas. Alternatively, they may place limitations on the leasing, owning, buying or selling of land by non-nationals or foreign companies, if this is perceived to be detrimental to equitable land use or conservation. They may also provide incentives, such as subsidies or infrastructural works, to ensure more equitable, productive or conservational use of the land. Existing incentives may be abolished if they have been proven to be detrimental to such use. An example of this is subsidies for "valorization" of forest land, by converting it into pasture land.

For the sake of completeness it should be mentioned that in many societies certain land and open-water bodies also have cultural, historical or even religious values. Such values are difficult to quantify in economic terms, but cannot be discarded in any harmonious decision-making process seeking to determine the future use or non-use of the land concerned.

LAND USERS AND OTHER STAKEHOLDERS

The stakeholders, or *interested parties*, are individuals, communities or governments that have a traditional, current or future right to co-decide on the use of the land. A listing of stakeholders is given below, with each of them having its own goals and priorities.

- *Regional intergovernmental cooperation entities*, such as the Amazon Cooperation Treaty system. They are intended to ensure a harmonious conservation and development of, for example, an international river basin or a phytogeographic region.
- *National or federal governments*. They have strategic interests such as physical security over the land through ensuring natural human occupation of the whole of their sovereign territory; promotion of commodities for export or internal food security; energy development; settlement of excess population from other parts of the country; control of precious minerals or drug production and trafficking.
- *State or provincial governments*, as well as district or municipal authorities. They have a direct responsibility for the well-being of the human population within their administrative boundaries; they may either want to stimulate or to dissuade human settlements in rural areas (e.g. produce versus ecotourism), but in general will need to raise revenues for part of their administrative functions.
- *Non-governmental organizations (NGOs)*, promoting one or more specific goals. They may be public interest goals, such as the green movements that care about the maintenance of ecological or historical values; business-interest NGOs, such as mining companies, energy-generating companies or the fertilizer industry; scientific-interest NGOs that study the long-term effects of land cover and land-use changes; grass-roots NGOs that strive for socially-equitable sustainable development of their own local community or environmental conservation areas; and religion-inspired NGOs that are concerned about spiritual and social well-being of rural or peri-urban population groups or the conservation of holy places.

- *Individual title deed or concession holders* of large tracts of the land using it for productive or conservational purposes.
- *Long-existing rural communities*, with communal or individual ownership of land that is or should be of sufficient size to ensure basic livelihood.
- *Landless people and autonomous groups of migrants* that seek to eke out a living, permanently or temporarily, on as yet unoccupied or under-utilized land (squatters, forest product gatherers, fishermen, small-scale miners) or who wish to be hired as labourers in rural or peri-urban enterprises.
- *Urban communities in the area, or tourists*, seeking rural recreational facilities.
- *Any original inhabitants of the region*, wishing to conserve their traditional ways of living and land-holding rights, and to use their legalized or claimed territorial rights on their own terms.

To those who have access to it, land is a resource used to satisfy needs. The immediate priorities of a peasant farmer may be to produce food and income. His or her land use decisions will be taken in such a way so as to optimize achievement of these objectives. When making decisions the farmers take into account the characteristics of the land, their available resources, and economic factors such as the availability of markets.

The objectives of the individual farmer, fisherman or forester's family, particularly if poor, and even those of commercial farmers, tend to be short-term in nature. Future benefits tend to have a low priority, though secure ownership and associated emotional identification with the land resource will stretch the priority horizon. To be successfully adopted, agricultural development programmes must meet families' objectives, and must include procedures to take full account of the social and economic factors of the environment within which they make their decisions. An enabling environment for such decisions to be sustainable in its use by future generations includes many factors, with the first and foremost being the existence of secure land tenure of an adequate size to provide intergenerational family livelihood.

The wider community up to national level is also a land user in the sense that land is required for urban use, for all kinds of facilities, for industry, and for recreation. At this level primary goals may be to raise standards of living and feed the population. The objectives of the nation tend to be long-term; to preserve natural resources for the future. There is therefore frequently a basic dichotomy of interest between the objectives of the actual land user and those of the community to which he or she belongs. The community – be it local, provincial or national – will frequently try to influence the way land is used, either by extension programmes, subsidies or laws. However, most land use decisions are made by millions of individual land users. The art of the land use planner or agricultural development expert is to identity improved and sustainable land uses which optimize the objectives of the individual land user as well as those of the community.

It is worth noting that governments and populations in neighbouring and other countries, or in the world as a whole, may also have an interest in how land is used. This is the case where pollution or other harmful effects are exported from one country to another, or where

activities in one country, or a group of countries or regions, are affecting global systems to the detriment of us all.

QUALITIES AND LIMITATIONS OF LAND FOR DIFFERENT USES

The evaluation of the land and planning for different actual or potential uses requires a series of steps, as follows:

(i) in collaboration with the stakeholders, the establishment of achievable goals and objectives, framed within an enabling policy environment for sustainable land use;

(ii) the identification and delineation of land, on the basis of comparable physio-biotic characteristics (climate, elevation, landforms, soils, hydrology), into natural land units or zones;

(iii) the assessment of the inherent land qualities, and their constraints and opportunities, of the identified land units, of which Box 6 gives examples;

(iv) the identification and characterization of the present forms of land cover or land use per land unit or land zone;

(v) the identification of prospective land utilization types or production systems in accordance with the wishes of the stakeholders;

(vi) the identification of the physio-biotic and socio-economic requirements of the agreed land utilization types;

(vii) the matching of the inherent land qualities of (iii) with the requirements of the utilization types of (vi);

(viii) the formulation of alternative land uses or non-use per land unit or zone as a result of (vii);

(ix) the assessment of the alternative land uses against the needs and aspirations of all population groups (to be) involved and affected, through the use of platforms for negotiation and decision making that include all stakeholders;

(x) the decision to proceed with one acceptable and recommended land use; and

(xi) the identification of policies, strategies and measures to be taken to move from the current to the recommended land use and with the active participation of all stakeholders.

It is noted that a distinction is made between *land cover* and *land use*. The former is the observed cover of the land as seen on the ground or by remote sensing; it comprises the vegetation (natural or planted) and any human constructions which occur on the earth's surface. Open water bodies, ice, bare rock, mobile sands and similar surfaces are included.

A. ATMOSPHERIC QUALITIES

A1 Atmospheric moisture supply: *rainfall*, length of growing season, evaporation, dew formation.
A2 Atmospheric energy for photosynthesis: *temperature*, daylength, sunshine conditions.
A3 Atmospheric conditions for crop ripening, harvesting and land preparation: *occurrence of dry spells.*

C. COVER QUALITIES

C1 Value of the standing vegetation as "crop", such as timber.
C2 Value of the standing vegetation as germ plasm: *biodiversity value* (intra-specific variability and number of species).
C3 Value of standing vegetation as *protection against degradation of soils and catchment area*.
C4 Value of the standing vegetation as regulator of local and regional climatic conditions.
C5 Regeneration capacity of the vegetation after complete removal.
C6 Value of the standing vegetation as *shelter* for crops and cattle against adverse atmospheric influences.
C7 Hindrance of vegetation at introduction of crops and pastures: *the land "development" costs*.
C8 Incidence of above ground pests and vectors of diseases: *health risks* to humans and animals.

T. LAND SURFACE AND TERRAIN QUALITIES

T1 Surface receptivity as seedbed: the *tilth condition*.
T2 Surface treadability: the *bearing capacity* for cattle, machinery, etc.
T3 Surface limitations for the use of implements (stoniness, stickiness, *the arability.*
T4 Spatial regularity of soil and terrain pattern, determining size and shape of fields with a *capacity for uniform management.*
T5 Surface liability to deformation: the occurrence or hazard of *wind and water erosion.*
T6 Accessibility of the land: the degree of remoteness from means of transport.
T7 Surface *water storage capacity of the terrain*: the presence or potential of ponds, on-farm reservoirs, bunds, etc.
T8 Surface propensity to yield runoff water, for local *water harvesting* or downstream water supply.
T9 Accumulation position of the land: degree of *fertility renewal or crop damage* by overflow or overblow.

S SOIL PROFILE QUALITIES

S1 Physical soil fertility: the net *moisture storage capacity* in the rootable zone.
S2 Physical soil toxicity: the presence or hazard of *waterlogging* in the rootable zone or the absence of oxygen.
S3 Chemical soil fertility: *the availability of plant nutrients.*
S4 Chemical soil toxicity: *salinity* or salinization hazard; *excess of exchangeable sodium.*
S5 Biological soil fertility: the *N-fixation capacity* of the soil biomass; and its capacity for *soil organic matter turnover.*
S6 Biological soil toxicity: the presence or hazard of *soil-borne pests and diseases.*

U. SUBSTRATUM OR UNDERGROUND QUALITIES

U1 *Groundwater level and quality* in relation to (irrigated) land use.
U2 Substratum *potential for water storage* (local use) and conductance (downstream use).
U3 Presence of unconfined freshwater *aquifers*.
U4 Substratum (and soil profile) *suitability for foundation works* (buildings, roads, canals, etc.).
U5 Substratum (and soil profile) as *source of construction materials.*
U6 Substratum (and soil profile) as *source of minerals.*

Box 6: Land Qualities in the Agricultural Sphere

Land use concerns the function or purpose for which land is used by the local human population and can be defined as "the human activities which are directly related to land, making use of its resources or having an impact on them". Data on the sequence and type of activities, the inputs (labour, capital, water, fertilizer, etc.), and resulting outputs (type of produce, and length of the cropping cycle) permit precise definitions of a land use, economic and environmental impact analysis, and modelling of the effects of modification of the land use, or its substitution by another land use.[3]

Another distinction to be made is between *land characteristics*, *land properties and land qualities*.

Land characteristics are those attributes of the land that help in identifying natural land units. Land properties are single attributes of the land that connote a certain behaviour. A land quality is a complex or compound attribute of the land which acts in a manner distinct, and largely independent, from the actions of other land qualities in its influence on the suitability of land for a specified kind of use (FAO, 1976). Note should be made though that in recent American literature _land quality_ is being used as a single indicator of the overall value of land, such as high-quality vs. low-quality land. Land qualities can also be defined in negative terms, as "land limitations". An illustrative listing of potentially relevant land qualities is given in Box 6. This listing is mainly referring to the vertical components of land units. One should still add land qualities or limitations that are the consequence of the horizontal pattern of landscape elements.

In order to define the degree of suitability, the requirements of potential uses need to be defined in the same terms. For example, an important land quality may be soil moisture storage capacity. Potential uses would then be defined in terms of their soil moisture requirements, in terms of amount, distribution, etc. Rapid evaluations may be carried out qualitatively, or on the basis of suitability classes. However, increasing use is being made of mathematical models, in particular for crop yield predictions and land degradation assessments, in support of quantitative land evaluations.

SUSTAINABILITY INDICATORS

All land use planning should result in local land uses that are sustainable. The systematic assessment of sustainability of current or planned land uses is in its infancy. Many groups of researchers are trying to define *sustainability indicators* and to devise methods to monitor them in field conditions. The latter could be done on the basis of a system of periodic observation at representative sites of local, national or even global level, with remote sensing techniques to extrapolate the findings over the whole of the land cover or land use system or type. The latter is the aim of a proposed Global Terrestrial Observing System (GTOS), at present in the planning phase by FAO, ICSU/IGBP, UNEP, UNESCO and WMO.

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[3] FAO, in collaboration with ITC in The Netherlands, has developed, and tested in the field, software designed to collect and analyse this information. FAO and UNEP, in cooperation with several specialized institutes, are developing manuals for the inventory and characterization of actual land use, applying an international framework for its classification (Table 1).

TABLE 1
An initial approach to an international framework for classification of land uses

Level I Degree of modification of the ecosystem	Level II Functional land use	Level III Biophysical land use
Uses based on natural ecosystems	Not used	
	Conservation Total conservation Partial conservation	
	Collection	Plant products Animal products Plant and animal products
Uses based on mixed natural and managed ecosystems	Agrosilvopastoralism	Forest products, cropping, livestock and aquaculture on same holding
Uses based on managed ecosystems	Production forestry	Management of natural forests Management of planted forests
	Livestock production	Nomadic grazing Extensive grazing Intensive livestock production Confined livestock production
	Arable cropping	Shifting cultivation Sedentary cultivation, temporary cropping Sedentary cultivation, permanent cropping Wetland cultivation Covered crop production
	Mixed livestock and crop production	
	Fisheries production	Fishing Aquaculture
Settlement and related uses	Recreation	
	Mineral extraction	Mining Quarrying
	Settlement	Residential Commercial Industrial Infrastructure
	Uses restricted by security	

Note: with land use phases on irrigated land use, type and sequence of crops, intensity of inputs, etc.

Sustainability indicators can be of many kinds: physio-biotic or socio-economic. Depending on the type of land use or non-use, and analogous to the listing of land qualities, physio-biotic indicators can be mainly land cover related (constancy of the natural vegetation structure or of its biodiversity), land surface related (absence of wind or water erosion, constancy of runoff), soil quality related (absence of human-induced salinization, acidification, compaction or loss of soil biologic activity) and substratum related (absence of human-induced waterlogging or pollution, constancy of depth and quality of groundwater).

Among the socio-economic sustainability indicators one can use the absence of rural migrations to urban centres, the stability or increase in rural labour opportunities for all of working age, the constancy or increase in primary school attendance, the maintenance of food sufficiency and well-balanced diets, stable herd structures in grazing areas, the absence or decrease of unhealthy conditions within rural population groups, harmonious relations between different land users over use issues, or simply the constancy or increase of *per caput* produce from the land as recorded in agricultural statistics per village, district, province or country (though this may mask unsustainability in parts of the area concerned). Ecoregional differentiation of the set of useful sustainability indicators, as under development by the World Bank and CGIAR centres and other specialized institutions, is probably a feasible approach.

A Working Group that has devised a framework for evaluating sustainable land management (FESLM) (FAO, 1993a) has identified useful indicators of sustainable agriculture. They are those that reflect environmental changes important to the continuing success of specific forms of land use, show steady responses to environmental change, are a clear measure of a cause having a well understood effect, and can be measured and expressed in numerical terms.

Chapter 4

Some important issues to be resolved through an integrated approach

ISSUES IN THE RURAL SPHERE

Recuperation of degraded marginal lands versus conservation and improvement of prime agricultural land

Land, in the holistic sense as described above, is not a fully "renewable" resource; in many ways it is finite. Components of the land may degrade in their intrinsic quality, or direct economic value, by direct or indirect human action or natural processes such as climate variability. Degradation of one component, such as through deforestation, may negatively influence one or more of the other components such as soil, water flow or microclimate.

Degradation of soil conditions is probably the most widespread and pernicious form of deterioration, because it affects a major life-supporting system and because its natural recuperation may take centuries. Artificial soil rehabilitation or amelioration is often very expensive. If seriously degraded soils are located in zones of marginal climatic conditions or other low-potential areas, it may instead be preferable to conserve and improve areas of prime agricultural land through judicious intensification. This is valid where such lands are available and accessible to the country. For social reasons, however, such as keeping already-settled population groups on marginal land, this alternative may not be a feasible option.

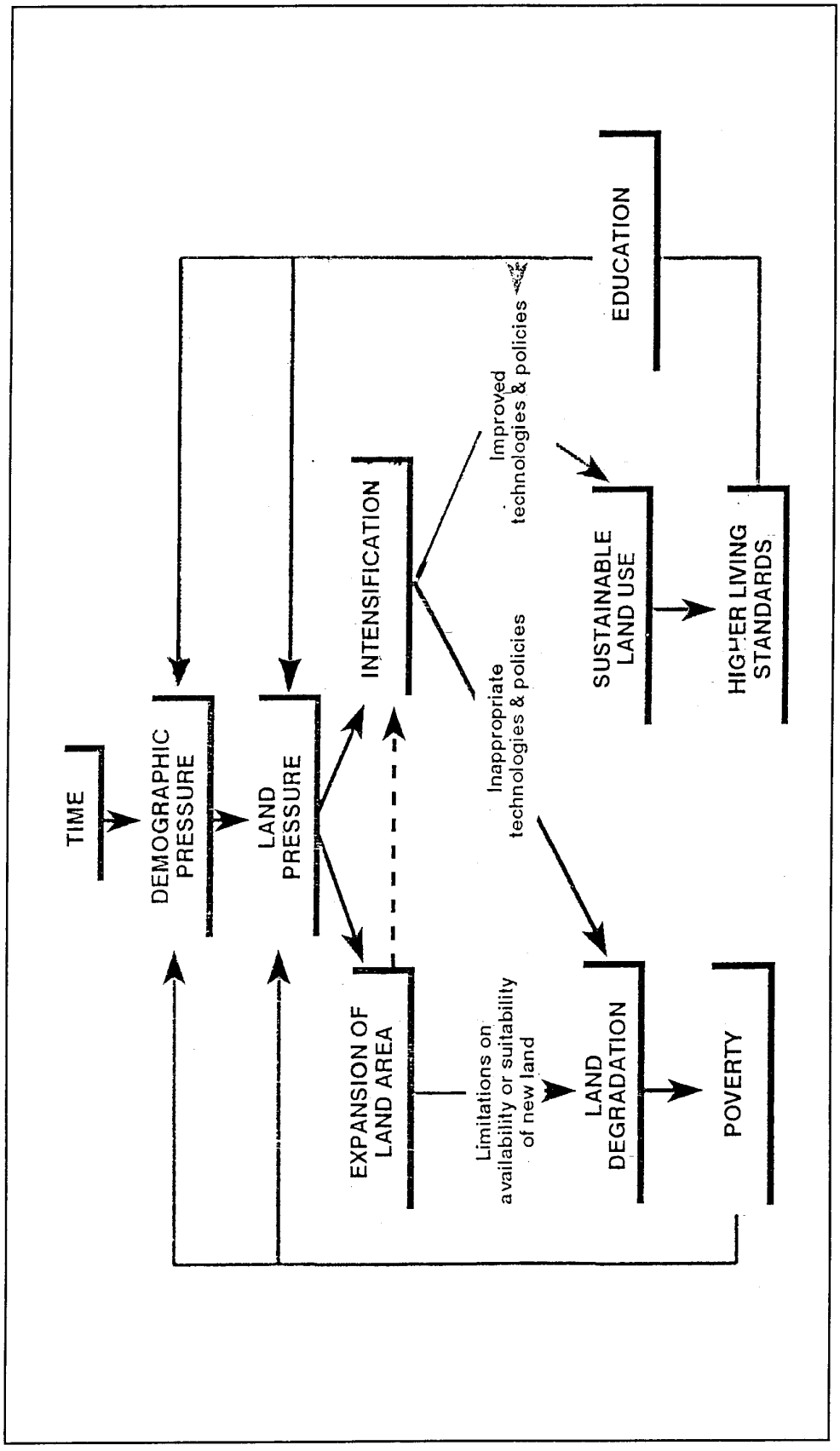
It should be mentioned that increased rural population in marginal areas does not necessarily lead to land degradation so long as improved technologies and policies are introduced (see Box 7). If basic production facilities and primary education, availability of rural credit for integrated soil-water-nutrient conservation, plus access to a nearby market for agricultural produce are improved, then higher population densities may naturally lead to intensified land use in a sustainable form (Tiffin *et al.*, 1994).

Protection of ecological values versus the need for food and other produce

Especially since UNCED, there is worldwide concern for the dwindling areas occupied by natural vegetation, and a positive reappraisal of their intrinsic values as sources and sinks of greenhouse gases, for biodiversity as *in situ* gene banks, for catchment protection, and as regulators of local climatic conditions.

On the other hand, there is the need for provision of an adequate quantity and quality of food, fodder, bio-fuel, fibres and timber for a rapidly increasing human population, especially in

Box 7. Land degradation versus sustainable land use in developing countries



developing countries. This requires a policy to stimulate extra produce to ensure food security. If food self-sufficiency is not possible then there may be the need for the generation of cash from land-based export commodities so that food can be acquired from elsewhere. This in turn may entail the clearing of natural vegetation, drainage of wetlands, intensification of grazing, etc.

A case in point is the drainage of wetlands for food production in resource-poor countries with high population pressures such as Rwanda, as opposed to their conservation as areas of high biodiversity value and large fish-stocks. It implies the need to assess whether such wetlands are all of different kinds, or have basically the same characteristics. In the latter case a number of individual wetland areas can be changed into agricultural land without impinging upon essential biodiversity values.

Governments in general, and in particular those developing countries that are signatories to the various UNCED initiatives – Framework Convention on Biodiversity; Framework Convention on Climate Change; Convention on Desertification Control; Declaration on Forest Principles – will soon be confronted with decisions to be made. These include the demarcation and control of nature reserves, buffer zones and corridors against the needs for extra agricultural land. Unless carefully handled, the resolution of such land use issues will cause conflict at policy and strategy levels. The prior application of systematic land use planning procedures that are presented here will greatly assist decision-makers in resolving potential conflicts of interest.

Smallholder settlement versus large-scale mechanized farming

High-level policy decisions may be needed to stimulate smallholder settlements with individual title deeds, especially in those developing countries with a rapid rate of population increase and a basically rural economy. This will be despite the recognition that such policies may not result in maximum sustainable productivity of the land, because of low external input conditions.

If acute food deficiencies loom, and when there is still a reserve of non-allocated land, then one may want to stimulate or allow large-scale farming which maximizes production through the fullest use of inputs such as machinery, fertilizers, irrigation, etc., though it has a low labour intensity per unit of land. The latter would, however, generate or strengthen an already existing trend of the movement of rural population from the land to urban centres, with *bidonvilles* (peri-urban shanty towns) and social unrest as likely consequences. A move to large-scale farming also implies a hidden impoverishment of biodiversity values on land that is to be put to such a use, with the loss of land races and traditional cultivars, and the impoverishment of soil flora, fauna and organic matter.

In developed countries with low population growth, the tendency to move from small-scale to large-scale farming is an automatic trend. It creates possibilities for sizeable areas of "set-aside lands" that in due course may develop into valuable semi-natural conservation areas. In such situations, special attention may be given to the creation of connective space (linkage corridors) between discrete areas of semi-natural ecosystems systems, including inland aquatic spaces linking stretches of open water and woodlands linked by hedgerows, to ensure free movement of flora and fauna and thereby avoid loss of their habitat (Ministry of Agriculture, Netherlands, 1990).

Small island states have specific problems (FAO, 1994). Land and water scarcity may be particularly acute, and in some cases likely to be aggravated by a surmised future sea level rise because of global climatic change. The trade-off between local food-sufficiency and tourist development should also here be of prime consideration when an integrated land use planning process is underway.

Forestry and silviculture versus animal husbandry and fisheries versus arable cropping and integrated uses of the land

Within the broad category of "agricultural land", policy decisions will have to be made about the allocation or reallocation of land between possible uses and users, and about the practicalities of implementation through focused subsidies, etc. In the past, many "land capability" assessments had an in-built bias towards arable cropping, rainfed or irrigated. Grazing-based animal husbandry was accorded second place, forestry development, the creation of conservation areas and national parks were placed low in priority ratings, and inland fisheries were often disregarded completely.

This cropping-centred approach is particularly being challenged by the forestry sector. The value of trees is being reassessed, whether in the form of planted forests, woodlots/strips and individual trees in farming land as a bio-fuel supply, regulators of the water supply and flow in catchment areas, erosion control measures, sinks of atmospheric carbon (in the biomass and in the soil) or an improvement of soil fertility (N fixation; deep nutrient cycling).

In many countries the forestry sector has traditionally developed in isolation, and has been seen as encroaching upon crop and animal production, and *vice versa*. There is a definite need to integrate forestry development in closer association with crop and animal husbandry, and especially in ecologically-fragile regions. Areas where integration can be effectively pursued are in the maintenance of a mosaic of endemic vegetation reserves across a country, the development of farmers' timber supplies through woodlots on pasture lands, the maintenance of scattered individual trees of known usefulness in cropland, tree-lining and hedging of field boundaries for the protection of biodiversity and for the attenuation of adverse weather conditions.

Animal protein production by grazing or the use of fodder may be of lower human nutritive value per land unit in densely populated areas, or those with high population growth, than plant protein production. A consequential changeover in dietary habits may, however, meet with strong social resistance in countries with a long tradition of meat-based consumption patterns, such as in many parts of South America. In the drier parts of Africa and the Near East, cattle herders have traditional rights to the use of the land resources, partly as a dry season transhumance activity. With an increasingly settled farming population, and the confining of herdsmen within national territories, this system may break down with adverse social consequences, unless integrated land use planning procedures are implemented.

The value of inland fisheries as protein suppliers, whether on natural lakes or rivers, or through on-farm water storage with aquaculture, has to be reassessed as well.

Combinations of forestry, animal husbandry, arable cropping and aquaculture, on individual farms as agroforestry and agro-silvi-pastoral practices, can have a synergistic effect on the productivity of the land and its resilience to degradation.

The use of water for irrigated cropping of annuals or perennials may constitute a maximum utilization of that particular "land" resource for increasing food production and other by-products, especially in areas with insufficient or uncertain rainfall conditions. However, irrigation requires large investments, may result in forced social changes, especially when large schemes are involved, and may cause degradation of the land through salinization and waterlogging. Long established indigenous irrigation practices have been proven to be efficient, such as those found in the Asian wet-foot rice-growing schemes.

The relative impact of the various forms of agricultural production on the emission of greenhouse gases will have to be taken into account. This is because of current intergovernmental negotiations on climate change control, involving country-level methane emissions by ruminant animals and wet-foot crops in comparison to such emissions in natural wetlands and by wildlife, and involving emissions of nitrous oxide by nitrogenous fertilizer use or biomass burning in rangelands. In this context it is noted that the capacity of well-managed rangelands and pastures to conserve soil organic matter and to fix carbon from the atmosphere is higher than that of mechanically-tilled arable land.

The trade-offs of each of the above agricultural practices can only be objectively assessed through an integrated approach to land use planning.

Rights of indigenous groups versus the need for resettlement of excess population from elsewhere in the country

The rights of indigenous groups, such as the remaining Amerindians, to exclusive occupation and management of their traditional lands have been given scant attention in the past. This situation is changing for the better, largely through activities of a number of NGOs, but at the same time it may create a problem. Any settlement on such lands of large numbers of people from over-exploited areas elsewhere in a country, carrying with them land use practices that may not be suitable for the new region, complicates the issue. This is a social and ethical problem rather than a macro-economic one and may give rise to serious civil strife, with environmental degradation as an added complication. It can be anticipated and managed through participatory approaches to land use negotiations at the local level that are most appropriate to the needs of the indigenous groups of people.

ISSUES IN THE PERI-URBAN AND COASTAL SPHERE

Prime agricultural land versus urbanization

Many urban settlements arose in the past on prime agricultural land, when the subsistence needs of urban dwellers had to be met from locally-obtained food supplies. With the continuing advancement of further urbanization, especially in developing countries, such valuable agricultural land as remains is being used for buildings, industry, transport facilities including airports, recreational parks, etc.

Especially when such prime land is scarce within a country, a government may need to develop policies to safeguard it for intensive cropping, and to stimulate peri-urban agriculture by needy people, especially women. Treatment of waste and sewage sludge for its reuse to maintain and improve the fertility of such agricultural land should be an essential policy

element of central or local government authorities. They should also take into account the detrimental effects on the quality of agricultural land of air-borne and water-borne pollution as the result of urbanization, industrial development and processing of mining ore, fossil fuel and primary agricultural produce. A legal and economic framework is needed to establish which persons or entities are responsible for cleaning up such pollution. Such a framework can be one of the products of an integrated approach to peri-urban land use planning.

Irrigation development versus apportioning of water resources for urban settlement and industrial developments

Urban settlements and associated industrial enterprises need large and reliable supplies of fresh water, for direct consumption as drinking water, for commercial purposes and sanitation, and to generate hydropower. In the latter case reservoir and spillway water can still be used for irrigation development, but the optimum size and siting of a dam for hydropower purposes may be different if the water is to be stored primarily for agricultural purposes, and with regard to the commandability of irrigable lands, or to the avoidance of the flooding of valuable rainfed agricultural land or natural ecosystems that would be taken up by the reservoir.

Conversely, urban water requirements may be put in jeopardy by the needs of rural areas upstream. Takeoff of surface or groundwater resources for rural agricultural uses, with their potential for pollution of the resulting drainage water and effluent, may harm any urban drinking water supplies that are dependent on them unless adequate wastewater treatment is first ensured. A *modus vivendi* between the two conflicting uses has to be reached, through an integrated and participatory approach (see Chapter 18A of Agenda 21, "Integrated water resources development and management" for details).

Disposal versus reuse of urban waste in peri-urban and rural areas

Many larger towns and cities, especially those in coastal zones, dispose of their solid and liquid waste and storm water directly into lakes, river estuaries or the sea – often with detrimental environmental effects on coastal ecosystems, such as coral reefs, mangroves or tidal flats.

Both the water and the plant nutrient resources contained in these urban wastes can be used, after appropriate treatment, to water and fertilize neighbouring rural and peri-urban agricultural land. In the latter areas, in particular, they could help the poor in urban fringes to maintain a living by food production and the sale of fruit and vegetables to urban dwellers.

The extra cost of waste processing for reuse will have to be compared with the benefits of improvement of agricultural lands and the safeguarding of environmental values downstream through an integrated approach (see Agenda 21, Chapters 7 and 18 for details).

Coastal zones planning

Traditional resource-based activities, such as coastal fisheries and aquaculture, forestry and agriculture, are frequently found side-by-side in coastal areas with activities such as industry, tourism, minerals extraction and shipping. These different activities are frequently in competition for scarce coastal resources, particularly land and water. In addition, due to their proximity, growth or intensification, one or more of these activities may have impacts on

others. The economic opportunities frequently offered by coastal areas present many of them with high population growth rates and consequent increasing demands for employment, housing and services. As well as their key economic role, coastal areas are also important ecologically, providing a number of environmental goods and services. Coastal ecosystems are also important for the mitigation of the effects of natural disasters and play an essential role in natural processes such as land accretion and countering of coastal erosion.

Many tropical coastal plains and river deltas contain significant proportions of actually or potentially acid sulphate soils. Where there are sizeable and expanding human populations dependent on the land in the neighbourhood, these areas are under considerable social and economic pressures to be reclaimed and developed. Careful decisions need to be taken as to how best each area of acid sulphate soils should be used or conserved.

Mangrove forests are under pressure to be exploited for their wood resources and for the land beneath them that can also be drained and reclaimed for development from the sea. They extend along many reaches of less active tropical coastlines, providing protection from marine erosion for the coasts behind and valuable habitats for the wide variety of fisheries, birds and aquatic resources that live within them. Brackish water aquaculture and small-scale fisheries in these mangrove environments, and in lagoons and estuaries, are of considerable economic importance and also need to be considered. Levels of sustainable uses of mangroves are required to be devised, as part of management guidelines within integrated planning strategies for coastal zones that contain them.

Changing land uses immediately behind coasts can also impact on the coastal and marine resources. Deforestation and unprotected soil cultivation on coastal plains and hills lead to eroded material silting rivers and being deposited in estuaries and on coral reefs offshore. Removal of sand near river mouths for construction can alter the flow patterns of the water downstream and consequent longshore drift of material. Urban expansion on coastlines can use valuable freshwater that formerly flushed out brackish water lagoons, and can replace it with untreated wastewater and sewage. Physical infrastructures built as coastal protection schemes can transfer erosion and deposition to unprotected areas. The whole zone can be subject to a wide variety of overlapping legislation and under the responsibilities of different agencies that operate in isolation from each other.

The common occurrence of trans-sectoral impacts in coastal areas and the multi-faceted aspects of coastal management issues mean that the conventional sectoral planning approach is inadequate by itself. It has to be replaced by an holistic approach to management in which linkages between sectors are understood, the need for trade-offs is recognized, benefits and costs of different development options are critically assessed, appropriate management interventions are identified and implemented, and the necessary institutional and organizational arrangements are devised and put in place. This is the essence of integrated coastal zone management.

ISSUES IN THE INTERNATIONAL SPHERE

Capital investment in infrastructure versus capital investment in land quality improvement

Many loans from national and international development banks are earmarked for improving the physical infrastructure of a country, with the anticipation in part that they will lead to

sustainable agricultural and rural development through a trickle-down process. This approach is in contrast with the bottom-up long-term capital investment policy that aims to improve the inherent qualities of agricultural lands in general and soil qualities in particular; a policy that is gaining sympathy in World Bank circles.

Implementation of such a policy would entail the conscious enlargement, in a fully participatory approach with the agricultural communities concerned, of the stock of soil organic matter, the use of rock-phosphates and lime to overcome the large phosphorous fixation/occlusion and high aluminium content of many tropical soils, and the use of mineral and organic fertilizers to build up chemical soil fertility – all for the benefit of an inter-generational sustainable use of the land by a growing rural population.

Primary agricultural production versus bio-industrial processing

At present, many developing countries export primary agricultural produce, including cassava, soybeans, chincona, palm oil, latex, cocoa butter, coconuts and raw timber, to developed countries. There it is processed for ready food, finished products or as feed for stall-fed cattle, pigs, chickens, etc.

The latter use in particular creates problems at both ends of the marketing chain: through the production of excess bio-industrial waste in the processing country, including excess manure, and through the depletion of major soil nutrients in the developing country together with the impoverishment of soil-biological life in general. A conscious effort to redress this situation, and international agreements on trade and subsidies, will be needed, taking into account the social implications for the rural populations in both developing and developed countries.

For example, it has been estimated that eighty percent of the land used to grow the crops used by the Dutch agricultural processing industry, the second largest in the world in terms of exports, is actually outside Holland. Such agro-industrial countries have the moral responsibility to assist in the good husbandry of the land from which the primary produce is derived, and in the gradual transfer of processing facilities to those developing countries whenever feasible.

Production of medicinal or addicting drugs versus local food production

A number of medicinal drugs such as kinin are traditionally grown in developing countries for the international market. They provide cash for the primary growers, enabling them to acquire food and other essential supplies in the local markets. Their replacement with artificial medicinal products may cause disruptions to the existing land use patterns and fragile environments on which they depend.

A special, multifaceted problem requiring international cooperation is the control or eradication of the production, refining and illegal trafficking of highly priced drugs for psychic stimulation and addiction, and their replacement by beneficial agricultural land uses. These drugs are often grown on small plots in fragile lands on mountain slopes and in tropical forests. Any replacement food production in the same areas, usually involving much larger tracts of land, is often economically non-viable and can be environmentally damaging. Special national and international incentives are then needed to ensure the sustainability of alternative land uses at the site, and to stimulate agricultural expansion elsewhere in the country where it is needed and feasible.

Chapter 5

Objectives and execution of the integrated approach

OBJECTIVES

These are clearly described in paragraph 10.5 of Chapter 10 of Agenda 21:

- *To review and develop policies to support the best possible use of the land and the sustainable management of land resources.* As stated earlier, land use decisions are made on the basis of perceptions relating to the maximization of benefits, to the immediate land user, and to the community. Those perceptions are related to the social, economic and legal environment. The policies and programmes of governments influence that environment.

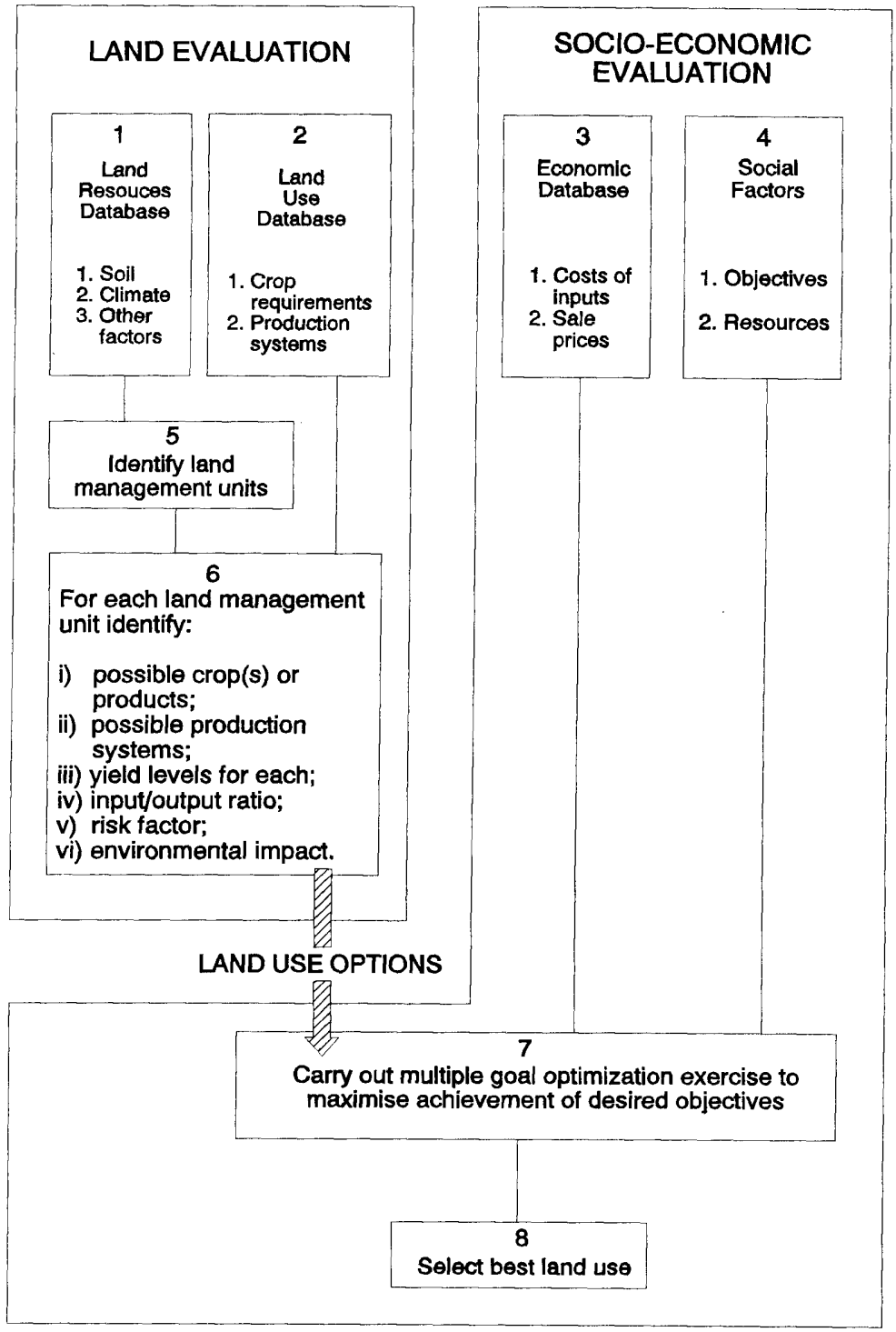
- *To improve and strengthen planning, management and evaluation systems for land and land resources.* These systems relate to the collection and evaluation of relevant information to permit the decision-maker, whether it be a farmer or a government, to optimize the achievement of objectives.

- *To strengthen institutions and coordinating mechanisms for land and land resources*, so that they are fully able to implement policies and systems. The interaction with land users at all levels is essential, to produce necessary quantities of food, raise living standards to acceptable levels, manage ecosystems in a sustainable manner and preserve biodiversity.

- *To create mechanisms which will ensure the active involvement and participation of all concerned* (the stakeholders), particularly communities and people at the local level, in decisions on land use and management.

To be successful such a programme requires two major components. One is a methodology consisting of a set of reproducible procedures undertaken in sequence, which results in the transformation of information on physical, economic, and social factors into higher incomes based on sustainable land use.

The second component is an institutional framework which is structured and staffed in such a way that it is able to implement these procedures successfully. The world's problems in relation to food requirements for a population expected to double in the next half century, and the impact which intensified use of land resources is already having on the environment, are



Box 8. Decision support system for land use planning

so serious that, though no two countries are exactly alike, the only possibility for their solution is a generic approach which is simple in outline, so that the main principles can be easily understood and applied worldwide.

In the past, the application of such a integrated holistic approach to negotiating sustainable land uses was laborious and time-consuming. In recent years a number of technical and socio-economic tools have become available in support of the system. They are described in the following sections.

DEVELOPMENT OF A FRAMEWORK FOR DECISION MAKING

In operational terms a basic decision support system could take the form shown in Box 8. The diagram shows four databases (sub-boxes 1-4), and an evaluation procedure that produces information under six headings for each land use option (sub-box 6), and a final exercise to select the best options for each land unit (sub-box 8).

After definition of the land mapping/land management units (sub-box 5) that are to be evaluated, each is compared in turn with the environmental requirements of the possible crops, products, or benefits that could be produced from it. A "crop" is anything that can be consumed or sold, and includes not only plant and animal products, but also the benefits from uses such as tourism or nature conservation, which have a financial or social value.

The production systems, land utilization types, or land management units are next defined, as these affect and control the outputs and yields of the "crops". For example, higher yields will be anticipated from production systems that include applications of fertilizer or irrigation water. For those "crops" which can be produced on the land unit being evaluated, potential outputs or yields are then calculated. The result of the exercise is a list (sub-box 6), which contains the land use *options* or choices for any particular land management unit.

To compare potential benefits from each option it is necessary to calculate production costs. Information on labour requirements and management levels will also be needed, which is derived from the necessary basic data that are contained in the production systems and costs of inputs databases. It is also necessary to assess what impacts each of the land uses is likely to have on the environment. Effects on the physical environment could include erosion and pollution, but economic or social effects could also be important.

Thus at the end of the evaluation process the output would include, for each possible product or land use and depending on the scale at which the exercise is being carried out, information on product, production system, yield, risk, financial profit and environmental impact.

The final stage is to select the best combination of land uses in the light of the agreed objectives. Note that "best" is a subjective term and can only be defined to the extent that objectives have been correctly identified.

Operationally, as can be seen from the diagram, the decision support system for land use planning is a two-stage approach, with the output from the physical scientists as the land use options becoming an input to the socio-economic appraisal.

It needs to be emphasized that the conceptual or organizational approach illustrated in Box 8 does not imply that there must be only one design of database or only one method of calculating yields, or carrying out an economic analysis, economic impact study or multiple goal optimization exercise. On the contrary, different methods will be appropriate depending on the scale of the exercise, the amount of accuracy required, and the type of data and level of expertise available.

Thus the basic framework is scale-independent, and can be used at national or farm level, or any in between. This is possible, first because it reflects the natural decision-making process, and secondly because the objective of the exercise is not built into the model, but is independently defined. The model itself is neutral.

DEVELOPMENT OF STATISTICAL AND GEOREFERENCED DATABASES ON ALL LAND RESOURCES, ON ACTUAL LAND USES AND FUNCTIONS AND ON SOCIO-ECONOMIC CONDITIONS

FAO (1993b) and Dalal-Clayton and Dent (1993) provide extensive introductions to databases relevant to the management of land resources and to land use planning.

(i) ***Climate databases***

All countries have a network of meteorological stations, to observe and document climate and weather conditions. In areas of difficult access, such as tropical forest, mountain or desert ecosystems, these stations may be wide apart, with a limited number of recording years or time gaps in the recording, or incompleteness in the range of attributes needed. Much interpolation is then needed and specialized UN Agencies such as WMO and FAO can assist in addressing the limitations.

One of many climate databases is METEO, which FAO has developed with software available in English. It is designed either for direct typed input of agroclimatic data or the acceptance of digitized input from, for example, CLICOM. This is the WMO database that is now used by the meteorological services in many countries. METEO also includes some utilities which, for example, calculate potential and actual evapotranspiration rates.

(ii) ***Databases on soil and terrain conditions***

Nearly every country has made an inventory of its soil resources, but the level of detail, the classification criteria and the naming of soils has varied, making correlations between classifications and countries difficult. Often, there was no link between soil and terrain conditions within a overall landscape-ecological framework, which is a prerequisite for a holistic approach to land use planning.

To remedy this, FAO and UNESCO undertook the preparation of a Soil Map of the World in the 1960s and 1970s. FAO is now in the process of updating this global information using the soil databases developed since then by national institutions. In

support of its field programme, in 1989 FAO developed the FAO/ISRIC Soil (profile) Database. Its function is to store, classify and output standard soil survey data covering site and profile descriptions and analytical data.

FAO, UNEP, ISSS and ISRIC are cooperating in developing the World Soils and Terrain Digital Database (SOTER) (FAO, 1993c). This provides a methodology for describing land and soil components of the landscape, which has been applied on pilot areas covering parts of several countries in Latin America, North America and West Africa. A detailed manual and software are available for users of SOTER. A soil and terrain database should also include information on geological hazards of land (flooding, landslides, ashfalls) as well as geochemical hazards (toxic substances, radiological properties). The surficial occurrences of minerals or construction materials should be inventoried, evaluated and stored, either in the soil and terrain database or in a separate georeferenced database.

In general, the establishment of soil and terrain databases is nowadays facilitated by remote sensing and global positioning system technology. Supported by this, a number of countries have started national assessments of the various forms of land and soil degradation, building on the methodology developed for the UNEP/ISRIC Global Assessment of Soil Degradation (GLASOD) (ISRIC, 1990).

(iii) ***Water resources databases***

With the exception of developed countries and those in dryland environments, the development of databases on water resources and their use has lagged behind those on soils and terrain. It requires analysis of the relevant data of meteorological stations, the repeated measurement of stream flows, the assessment of groundwater reserves through borehole analysis, and the amount and types of actual uses being made of the water resources. WMO, UNESCO, FAO and UNEP are active in supporting data collation at national, regional and global levels. In the case of FAO the data is used in the AQUASTAT program and in the inland fisheries documentation programme.

(iv) ***Land cover and biodiversity databases***

All countries have maps of the various forms of land cover, including forests, savannahs and wetland vegetation, but georeferenced information on the floral and faunal diversity and its value is often sparse within countries. UNESCO, FAO and a host of international specialized centres are striving to remedy this in support of national and regional entities such as the Amazon Countries Cooperation Treaty. In the case of forests, FAO has carried out global forest resources inventories in 1980 and 1990 respectively, and is supporting national Tropical Forestry Action Programmes. It has also commenced a systematic inventory of all land cover types, in close cooperation with national centres, starting with those in Africa through the AFRICOVER project.

Areas of known or inferred archaeological value, or reflecting typical past land use systems, can be included in the land cover database or be treated separately.

(v) ***Databases on land uses, crop and production systems***

All countries compile information on actual land uses, but this is often only statistical and consolidated at district level rather than being fully georeferenced. The lack of some practical, simple and widely accepted method of describing land uses and production systems is a serious constraint to the effective management of land resources. FAO has proposed a terminology for the components of land use types and production systems. It has now embarked on supporting national institutions in improving their georeferenced databases on actual land uses. Each identified land use should also be assessed on its inherent sustainability, on the basis of a set of sustainability indicators as noted in Chapter 3.

Many countries have basic information on the environmental requirements – climatic conditions, soil and terrain conditions, water quality – of their traditional food crops, their export crops, plantation of trees, domestic animals and consumable fish spheres. Many new cultivars or races are becoming available through biotechnological breeding or horizontal selection and much information on their requirements has already been collected by the CGIAR system of international agricultural research.

FAO uses such information for the development of a two-level general database on crop-environmental requirements. The first level, ECOCROP 1, currently covers 1200 species and will output information on candidate crops for defined environments and uses, and on the soil and climatic limits within which these crops can be successfully grown. ECOCROP 2, as the second level database, is under development to model data on crop processes by different growth stages.

(vi) ***Databases on social and related conditions***

The database containing information on social factors must identify the objectives, resources and constraints of each community, class or group in the area being developed. This may be obtained through a farming systems approach. An essential element of the social database is information on current systems of land tenure and registration, land rights, land markets and forms of incentive and taxation in the area under consideration, as detailed in Chapter 3, as well as an assessment of their fairness and adequacy for sustainable development (Bruce, 1994).

The database should also contain information on the aspirations and felt needs of the different groups of land users, the expected increase in local populations, the trends of inward or outward migration, permanently or seasonally, and off-farm or off-region labour income. Information on the level of capacity building, the degree of extension services, and the availability of credit for farmers' activities and other local enterprises should also be included in the database. Finally, rural health conditions should be inventoried, including the occurrence of vector-borne diseases and pests on the various land units under consideration.

(vii) ***Databases on economic aspects***

Costs of inputs and current sale prices for outputs are required to define options and to select the best mix of options to achieve objectives. The information may be obtainable from published information, and the design of the database is straightforward.

It should however be noted that the economy of inputs and outputs is liable to strong variability, in relation to the priorities of the central government, the occurrence of major droughts, floods or other natural hazards, and the emergence of civil strife. International developments in the sphere of trade, employment opportunities, tourism, the flow of credits or aid arrangements in relation to structural adjustment programmes, and the changes in power block composition, all reflect on economies and social conditions, from the level of central government institutions down to village community level.

Whilst biophysical databases may have a usable lifetime of 20 to 30 years, economic and social databases will normally have to be revised every 5 to 10 years.

DEVELOPMENT OF TOOLS FOR UNITING THE DATABASES IN A UNIFIED SYSTEM AND FOR INCORPORATING TEMPORAL AND SPATIAL CHANGES

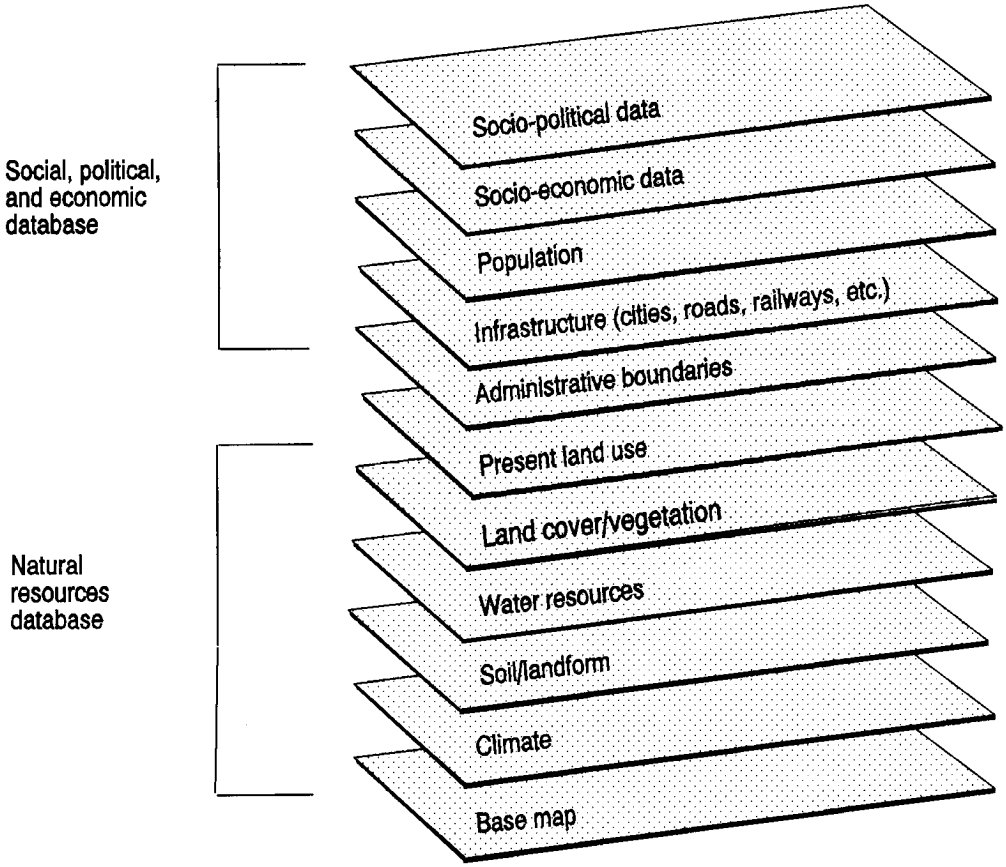
The delineation of an area to be covered by a land use plan can be made either on the basis of administrative boundaries – provinces, districts, municipalities, etc., or of natural land unit boundaries – whole river catchments, phytogeographic units, sub-catchments, landscape ecological units etc., or on the basis of combinations of these.

The data to be incorporated into the databases are available in the form of maps, statistics and tables, though these have often been compiled at different formats and scales. Such spatial inconsistencies have made their integration for the decision-making process of resource management difficult and time-consuming, especially if the basic landscape-ecological units were not taken as a starting point.

With the continuous developments of computer hardware and software, and their availability at fair prices by national, district or municipal planning entities, this condition is improving dramatically. In particular, the development of Land Information Systems (LIS) (Meyerinck *et al.*, 1988) and Geographic Information Systems (GIS) software has enabled the available georeferenced databases to be harnessed with relative ease into multiple-layer digital form. Each thematic layer is analogous to a map, but it can be both displayed and printed separately, and overlaid to produce a multi-theme map at any scale or orientation.

This construction of a GIS/LIS database is illustrated in Box 9. Multidisciplinary natural resources teams are required to make GIS/LIS systems an effective tool in support of land use planning. They will include physical geographers, agronomists and climate-soil-crop modellers, geostatisticians, computer programmers, economists and social scientists, and also data extensionists to ensure that the system and its products are transparent to the occasional users such as policy-makers and stakeholders at every level.

There remain a number of technical and organizational limitations to the effective utilization of GIS technology, especially in the smaller developing countries (Sombroek and Antoine, 1994). Four important constraints are: (i) the inadequate analysis of real-life problems as they occur in complex land management and sustainability issues at the household level, and as



In a modern computerized GIS each separate piece of data or information stored in a database is georeferenced. This means that its exact geographical location is also entered into the database, either as a point reference or as a polygon or mapping unit. The GIS system has the capability to retrieve all the information and a given subject or theme and display it, or hold it as a separate thematic layer. A thematic layer can be overlaid, and either viewed or printed out as paper maps.

Box 9. Digitized Geographical Information Systems (GIS)

they involve the integration of biophysical, socio-economic and political considerations in a truly holistic manner; (ii) the limitation in data availability and data quality at all scales, especially those that require substantial ground truthing; (iii) the lack of common data exchange formats and protocol; and (iv) the inadequate communication means between computer systems, data suppliers and users due, for instance, to poor local telephone networks.

In general, the current situation is that digital information technology is developing at a rate faster than the speed of production of information by natural resources institutions in developing countries.

MULTIPLE GOAL ANALYSIS AND OPTIMIZATION TECHNIQUES OF THE HARNESSED DATA

There is usually more than one objective when negotiations are underway for land resources management. They may be to a greater or lesser extent incompatible, but they can often be ranked in order of priority. Objectives must be identified before "best" or "optimum" can be defined in relation to land use. Objectives and their relative importance can alter over time. This reduces the value of printed suitability maps as interim outputs, and enhances the value of a computerized system which can rapidly access, combine, and reclassify the basic data as required.

It is possible to conduct local level land use or farm planning by ranking objectives in order of priority, but true multiple objective maximization can only be done subjectively or through linear programming or other mathematical methods. Some software programs have been developed for the purpose.

Once a first estimate of the goals and objectives of the government and the land users is available, the land productivity database together with other results of agro-ecological zoning can be used to estimate what land use distribution would meet or optimally approach those goals. Linear programming methods have been used to provide a land use optimization procedure on the basis of AEZ information for Kenya (FAO/IIASA, 1994). This program, or related non-linear programming or multi-objective methods, can be used to support government planners, land users and other stakeholders in the land use negotiation and decision-making processes. It will provide successive land use distributions in response to successively discussed sets of objectives and constraints, until a decision can be taken on the selection of ones that will most nearly meet the objectives.

The calculation of land productivity for the full range of current and envisaged uses provides quantitative support, to be estimated by land users and other experts, on the possible viability of new land uses on specific kinds of land, in comparison with the existing uses.

SOCIAL, ECONOMIC AND POLITICAL TOOLS FOR DECISION MAKING ON LAND USE

Land use decisions are rarely made by an individual or authority in isolation. In almost all cases, land use negotiations precede, and lead to, decisions. Consensus may be achieved, or compromise reached, or decisions may be imposed to a greater or lesser extent.

In a properly integrated approach, the partners or stakeholders in the land use negotiations have available technical support provided by three legs:

- a common *technical language,* the terms of which are understood by all partners in a similar way;
- a common *information knowledge base*, including land and water resources, vegetation and crop resources, infrastructure (roads, markets of produce and inputs, etc.) and initial indications of the main objectives of the different partners;

- a "what-if engine", a *land use scenario programme*, which will provide a succession of maps of land use distribution and other interpreted information on the basis of objectives and specifications stipulated by participants at various points during the negotiations.

The collection of biophysical and socio-economic databases, their storage in GIS/LIS systems and their multiple goal analysis, and the resulting optimization of land use utilization type per (agro-)ecological subzone, socio-economic resource management domain or natural land unit, will remain a theoretical exercise if the stakeholders are not fully involved. Their first participation is in the decision, by the relevant governmental bodies, to start integrated land resources planning for a defined area (country, province, district, municipality or village). A second phase of contact between planners and stakeholders is during the characterization of present forms of land cover or land use and the identification of desired and viable future land utilization types. This is conducted by means of surveys, interviews and public hearings, as itemized in the steps given in the section beginning on page 19.

The most intensive participation of all stakeholders is to take place in the step numbered (ix). Here the recommended land uses per land unit, as the result of optimization techniques applied to the data sets of the biophysical and socio-economic GIS, are to be compared with the claims, needs, concerns and aspirations of the various stakeholders. These are often conflicting and require appropriate *platforms for negotiation* (Röling, 1994) and decision taking, at the level concerned. There are many forms of platforms at village level, from informal consultations between village elders, through elected village land use committees, to district planning committees and national development and conservation planning fora.

For a specific land use planning activity at district, or provincial ("meso") level, an ad hoc Planning Group of stakeholder and planning specialists can be established, with an independent chairman and a well-equipped secretariat. For details on the functioning of such an *ad hoc* Planning Group see the Issues Paper of the International Workshop on Chapter 10, Wageningen, 20-22 February, 1995.

The people's participation in the land use planning process has two complementary forms. First, at the institutional level, technical support can be provided to the people to assist them in refining a need that they have already declared. Secondly, land use plans devised externally from the people can be adapted and refined by them, in the light of their own knowledge and the technical support provided.

The negotiation and decision-making process is often long drawn-out; in part because of conflicting needs and demands for land and in part because, through the process itself, land use options and opportunities, as well as constraints, become clearer to participants. To strengthen and speed up common understanding, the result of each successive optimization run should be available to planners and land users in response to the successive sets of objectives and constraints which they wish to explore, until a consensus or compromise plan is achieved.

This network system approach to planning, rather than a hierarchical procedure, is the only means of devising a land use plan that will have the fullest cooperation of all sectors of the society in its implementation and hence has the best chance of being successful.

In a number of countries land tenure reform, including access for women to land registration projects and land privatization, is a national priority. In such situations the establishment of a "Land Regularization Task Force" (LRTF), side-by-side with land use planning institutions, may be appropriate. It would deal with land consolidation, land administration and the creation or decentralization of effective land tenure control institutions, stimulating land privatization and administration processes in collaboration with legal institutional structures.

As an example of the need to employ all the available tools in support of land use decision-making, the integration of water resources in land use planning is an essential pre-requisite in drought-prone regions (ISAWIP, 1994). FAO, in co-operation with WHO, UNESCO and UNEP, is promoting this integration through stressing the linkages between land, in a narrow sense, and water, and country-level action plans on Water and Sustainable Agricultural Development (WASAD). When international river basins are concerned, such as the Nile, Tigris/Euphrates or Mekong basins, then subregional intergovernmental development committees are essential for solving water apportionment conflicts and integrating the needs of all stakeholders.

IMPLEMENTATION OF THE AGREED LAND RESOURCES DEVELOPMENT PLAN

Once a consensus has been reached through negotiation on the contents of a land use plan, its execution involves a number of actions. These are the re-definition of overall policies and strategies of land use planning, maybe in the form of a "Covenant" (a set of principles on the ethics of land and water use); the preparation of projects for legislation; political decisions to proceed with the identification and acquisition of the required funds (from taxation, from local, national or international donations, from loans of development banks, etc.); the legal, administrative and institutional execution; demarcation on the ground; and finally the inspection, monitoring and control of adherence to the decisions taken.

A degree of updating and adaptation of the plan at various phases of its execution will be required. This is because of the appearance of practical problems, in one or more aspects, and the emergence of new technologies in the production or processing of yields from the land or in limiting or overcoming any environmental damage. Socio-economic changes at national and international levels during the execution of the plan will also require careful steering of any land development activities taking place over large areas.

Chapter 6

Institutional aspects

It would clearly be a waste of time and effort to create systems and programmes if they cannot be efficiently implemented. Applying a mixture of a systems approach, and experience in many countries over a long period, the following institutional components appear to be necessary at the three most common levels of land use planning.

(i) National level:

- ***National resource planning committee***. A permanent inter-ministerial, inter-departmental technical committee should be convened, chaired by a senior civil servant. Its functions are to identify priorities and requirements, allocate resources, approve plans and monitor implementation. Decisions of the committee should be in the form of recommendations to the cabinet, governing council or other ultimate decision-making body of the country. In this way it should possess the three necessary qualities – technical knowledge, access to resources, and authority.

- ***Natural resources conservation board or commission***. A legally independent body should be charged with enforcement of laws and policies designed to conserve or properly manage national resources, to propose new laws and policies where needed, and to monitor environmental conditions, including atmospheric pollution, pollution of water bodies, vegetation and animal resources, and land resources.

- ***Ministries and departments***. Their basic functions are to provide information, to recommend, and to implement. The proliferation of specialized and semi-autonomous bodies or institutes is undesirable. The overlapping or poorly-defined responsibilities of different government and parastatal agencies are major causes of inefficiency, and of inept use and management of scarce resources.

The institutional priorities at national level differ between countries. Three groups of countries can be distinguished (SADC/SACCAR, 1994).

- countries where the institutional set-up is in its infancy: newly-independent countries or countries recuperating from major civil strife where re-settlement and land titling issues dominate land use policy;

- countries where land use planning responsibilities are at present divided among many different units with overlapping or competing tasks, needing institutional linkages or coordination and clear definition of responsibilities; and

- countries where land use decisions are undertaken by one specialized government department, needing effective cooperation from other institutions – on data gathering, data processing, land evaluation, land use planning extension – as well as the development of appropriate platforms for negotiations between all stakeholders ("creation of an enabling environment for decision-making and adherence to the execution of a land use plan once agreed").

(ii) Regional or district level:

Provincial or district land use planning or development groups. The basic functions of these groups are to identify priorities, allocate resources, make or approve sub-national plans, monitor implementation, and make bye-laws. They should also be responsible for the establishment of long-term development plans and zoning systems for their areas. Membership may be drawn partly from the community and partly from government. Expertise can be provided by a cadre of directly employed staff, or through subject-matter specialists who are members of government departments, delegated to assist the local land use planning group and operationally under its control.

(iii) Village or community level:

It would be counterproductive to impose any form of standardization on the innumerable social linkages and special interest groups which exist or can form at grass roots community level for different purposes, with different types of organization, priorities and objectives. It is essential to bear in mind that at this level *freedom* to organize, to debate, and to contribute are essential prerequisites.

At the level of the village, ward, or population as a whole it is necessary to create the capacity to coordinate activities and decide on priorities. This is in order to deal with the overall and long-term interests of the community as a whole, with problems or natural systems that extend over comparatively large areas, such as river basins, and with the necessary coordination and collaboration with neighbouring communities.

At village or ward level the level of power, resources and necessary expertise needed is commensurate with the size and importance of the area and population. At this level the required resources and expertise will probably be provided partly by the community and partly by the government on an *ad hoc* basis.

Chapter 7

Conclusion

The goal of a new integrated approach to planning the use and management of land resources is to make optimal and informed choices on the future uses of the land. It will be achieved through interactions and negotiations between planners, stakeholders and decision-makers at national, provincial and local levels. It will be on the basis of efficient, comprehensive data gathering and processing in a appropriate storage and retrieval system, through a network of nodal institutions. The smooth flow of the resulting evaluation of the data will be output in an understandable, user-friendly format. The plan will enable all stakeholders to co-decide on the sustainable, equitable and economic use of the land and follow it through to successful implementation.

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Appendix I

Extract from the final report on the review of Chapter 10 at the Third Session of the Commission on Sustainable Development[4]

8. The Commission notes with great concern that an estimated one-sixth of the total arable land surface of the globe has been damaged by human-induced soil degradation. A global partnership is required to protect and restore the health of the Earth's terrestrial ecosystems.

9. The Commission notes with concern the convergence of poverty, hunger and degradation of terrestrial resources in environmentally more fragile marginal lands, where the large majority of poor smallholder farmers are increasingly located. The Commission calls upon Governments, bilateral donors, multilateral financial institutions, technical specialized agencies, and NGOs to give high priority to rural development in these lower potential areas, particularly through enhancing the productivity of farmers on a sustainable basis.

10. The Commission stresses that the integrated approach to the planning and management of land and water resources is central to the implementation of recommendations of Agenda 21 concerning land, desertification, mountains, forests and biodiversity. Land needs to be considered as a finite resource relative to many and varied needs. Its allocation must aim to satisfy these needs in the most equitable and sustainable way.

11. An integrated and multi-disciplinary approach to the planning, development and management of land resources is a process which methodically identifies human and environmental needs, the potential and options for change and improvement, identifies and evaluates all relevant physical, social, economic and policy factors, and develops a series of actions necessary to permit and facilitate change. The process needs to address an array of cross sectoral issues such as the creation of productive employment, the eradication of poverty and responses to pressures on the land caused by poverty, unsustainable consumption and production, population growth, and changing demographic patterns. Clarification and security of land rights, possible involving land tenure and ownership reforms, are central to the solution of these problems. A holistic approach to the management of land resources requires the integration of land and issues of water resources as they relate to land use. A mismanagement of land and water often leads to land degradation through erosion, flooding, waterlogging and salinity and the depletion of groundwater resources. The demands by rural and urban communities for land and its associated water resources will often conflict if not properly managed.

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[4] Held in New York, 11-28 April 1995.

12. The Commission notes that soil and water degradation through contamination by agricultural, urban and industrial effluents is of increasing importance in developed and developing countries. The Commission invites Governments, international organizations and groups to increase their efforts in this field.

13. A people-oriented approach, adapted to suit local circumstances, is central to the sustainable development of land resources. All stakeholders, especially women, farmers, indigenous peoples, landless labourers and other major groups, should participate in the planning and management of land resources, in identifying problems and proposing solutions, as well as in the consensus building process. For this process, the intermediate level is important. Governments should encourage the participation of all stakeholders at that level. The empowerment of people and communities, the creation of social equity and an enabling environment, as well as the strengthening of capacities and the building of awareness at all levels, are important elements in this multi-stakeholder approach. Security of tenure and the existence of equitable and efficient legal and fiscal systems are important management ingredients to ensure increased productivity and secure conservation efforts.

14. The Commission notes with appreciation the outcome of the International Workshop on Agenda 21 – Chapter 10, Integrated Planning and Management of Land Resources, organized by the Government of the Netherlands and FAO, and hosted by the Government of the Netherlands (Wageningen, 20-22 February 1995). The Commission invites the Government of the Netherlands and FAO to give the report of the workshop and its recommendations the widest possible dissemination.

15. The Commission stresses the importance of the collection and processing and dissemination of timely and reliable information and the utilization of modern land assessment and evaluation technologies, together with those for resource characterization, as essential for the planning and management of land resources. The development and use of appropriate indicators, including performance indicators, on the basis of sound scientific knowledge, tailored to meet local requirements and circumstances, is essential for formulating and implementing policies and monitoring of results. There is a need to ensure that information of a technical nature is fully linked with social and economic aspects at the local, regional and national levels. The Commission also takes note with appreciation of the report of the Panel on Science and Technology for Integrated Land Management of the Commission on Science and Technology for Development, which adds an important dimension in furthering the implementation of Chapter 10.

16. The Commission notes with concern the uneven pace of progress in implementing the objectives and recommendations contained in Chapter 10 of Agenda 21 especially with regard to existing institutional structures which are largely sector oriented, leading to an overlapping of governmental responsibilities, and the need for community driven approaches.

17. The Commission urges Governments to take all necessary steps to achieve the objectives set out in Chapter 10 within the agreed time-frame. At the international level priority should be given to the development of a holistic and integrated framework to put in place social and economic conditions which will facilitate sustainable production and the conservation of biodiversity. Technical and infrastructural support, which can be applied in any country with

appropriate modifications according to local needs and conditions, will be desirable in many cases.

18. The Commission urges Governments, in line with their respective needs and priorities, to develop national and/or local land use planning systems containing a statement of objectives and a detailed timetable for implementation spread over a period of years. These should aim to remove constraints and provide incentives, enhancing the involvement and empowerment of peoples, develop information and management systems and modify institutions and establish suitable linkages among them. It also urges them to exchange views on their programmes for integrated land management, involving all sectors of the community and all stakeholder groups, developed and implemented at the appropriate level.

19. The Commission requests the Secretary-General to strengthen coordination and cooperation among the organizations of the United Nations system through the development and implementation of joint approaches and collaborative programmes. FAO, in partnership with UNEP, UNDP, other international agencies and Governments, with the appropriate contributions of NGOs, should develop tools and recommend actions for integrated land management. Such action should be carried forward to the CSD through the exchange of knowledge and experiences in an open and transparent manner, with the full and effective participation of developing countries, reflecting their specific conditions and needs.

20. The Commission urges Governments, with the cooperation and support of the institutions, and organizations of the United Nations system, as appropriate, to pay particular attention to:

a. establishing stable land use systems in areas where important ecosystems or ecoregions are being endangered by human activities;

b. applying integrated planning and development approaches in regions which are becoming open to intensified settlement and agricultural production;

c. bringing about integrated approaches to capacity building.

21. For the effective implementation of Chapter 10 of Agenda 21, the Commission reaffirms the commitments contained in Chapters 33 and 34 of Agenda 21.

Appendix II

Conclusions and recommendations of the International Workshop on Agenda 21 - Chapter 10[5]

PART ONE: INTRODUCTION

The International workshop on Agenda 21 – Chapter 10: Integrated Planning and Management of Land Resources was held in Wageningen, The Netherlands, from 20 to 22 February 1995. The objectives of the workshop, for which initiative was jointly taken by FAO and the Government of the Netherlands, were:

(i) to formulate recommendations and policy options on the implementation of Chapter 10 to be submitted to the Commission on Sustainable Development (CSD) for consideration at its third session in April 1995, and

(ii) to exchange knowledge and experience on the planning and management of land resources.

The workshop was attended by more than 80 senior officials from 32 countries from all regions, 6 intergovernmental organizations and 6 non-governmental organizations.

Chapter 10 calls for an integrated approach to the planning and management of land resources through re-organizing and, where necessary, strengthening of decision-making structures, including policies and planning and management structures. Such an approach recognized the need for participation of all stakeholders in land use decision making, and bridges the gap between the production and income objectives of land users and the long-term objective of preserving natural resources, Chapter 10 has an umbrella function for the other land-related chapters which deal with forests, mountains, desertification and sustainable agriculture and rural development as more specific forms of land use. It has, therefore, many linkages with the other chapters, but clearly has its own objectives for the integrated process of planning and management of land resources, as set out in para. 10.5:

(i) to review and develop policies to support the best possible use of land the sustainable management of land resources, by not later than 1996;

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[5] International Workshop on Agenda 21 – Chapter 10: Integrated Planning and Management of Land Resources, held 20 to 22 February 1995 at the International Agricultural Centre, Wageningen, The Netherlands.

(ii) to improve and strengthen planning, management and evaluation systems for land and land resources, by not later than 2000;

(iii) to strengthen institutions and coordinating mechanisms for land resources, by not later than 1998;

(iv) to create mechanisms to facilitate the active involvement and participation of all concerned, particularly communities and people at the local level, in decision making on land use and management, by not later than 1996.

The workshop had selected the following three themes for discussion:

(i) the integration of objectives and policy formulation for planning and management of land resources in rural areas;

(ii) managing a planning process for the use of land resources in rural areas with all stakeholders; and

(iii) possibilities for sustainable economic development in rural areas, with emphasis on non-traditional uses of land.

These were also the subjects of the keynote addresses and of the working groups and were elaborated on in the Issues Paper prepared by the Winand Staring Centre for Integrated Land, Soil and Water Research in Wageningen. The workshop took the "meso-level" (intermediate between central government and local community) as a starting point for analysis of the possibilities of integration of goals. During the discussions it was recognized that, given the specific characteristics of regions, a ranking of goals (ecological, economic, social) has to be made.

The workshop had before it the Issues Paper mentioned earlier and the background paper Planning for Sustainable Use of Land Resources: Towards a New Approach, prepared by FAO. Furthermore, 31 completed questionnaires on a specific national case of intermediate-level planning and management of land resources were returned by participants, of which a summary was presented and made available to the workshop. These cases showed the progress achieved by individual countries in the implementation of Chapter 10. The full report of the workshop will contain an extensive summary of the cases. It is planned to also prepare a more extensive study on the cases. Both activities can be regarded as a contribution to the fulfilment of the requirements set forth in para. 10.12.d.

The workshop actively discussed, especially in the working groups, many items relating to the integrated approach to planning and management of land resources and agreed upon a set of conclusions and recommendations. The country cases submitted by the participants turned out to be a valuable source of information for additional recommendations on the implementation of Chapter 10. A number of recommendations are already included in the text of Chapter 10 or other Chapters of the land cluster. The outcome of the discussions emphasized the importance of many of these recommendations, but these are not repeated in the present document. The other recommendations that were formulated by the meeting are either a

further specification of existing points in Chapter 10, or are new and additional points; these are included in the present document.

Discussions were held in the spirit of global partnership to conserve, protect and restore the health and integrity of the Earth's terrestrial ecosystems. Referring to principle 7 of the Rio declaration it was recognized that States have common but differentiated responsibilities. The developed countries acknowledge the responsibility that they bear for the international pursuit of sustainable development in view of the technologies and financial resources they command. Concerning the latter aspect reference was also made to Chapter 33, paragraphs 33.13 and 33.14.

The Government of the Netherlands will present the conclusions and recommendations of the workshop to the Intersessional Meeting on Sectorial Subjects in March 1995 and to the third session of the CSD in April 1995, and will request that this document be considered as an official document for these meetings.

PART TWO: RECOMMENDATIONS

The participants of the workshop submit the following recommendations to the Commission on Sustainable Development. In this regard they recognize that recommendations should be tailored to the particular situation within countries. National integrated land resources planning strategies must recognize differences relating to:

- rural vs. urban needs;
- regular vs. emergency situations;
- variations in preparedness in terms of the state of development of legislation, policies, institutions, and public participation in planning and decision making.

All countries are committed to the timetable for Chapter 10 but various constraints mean that some countries will take longer to meet the objectives fully and will have to intensify efforts to achieve them.

1. INTEGRATION OF OBJECTIVES AND POLICY FORMULATION FOR LAND USE PLANNING AND MANAGEMENT OF LAND RESOURCES IN RURAL AREAS

Under this theme the workshop participants recommend that:

1.1 Governments develop a framework or guidance to implementing agencies for integrated land use planning and management including explicit aims and taking into account what has been achieved so far.

1.2 Governments review land tenure arrangements or legislation with the objective of providing long-term security on the land, taking into account the needs of all stakeholders,

especially the farmers and all those that are effectively involved in the agricultural sector, both men and women.

1.3 Governments review economic policies and revise economic instruments to reinforce the positive consequences and decrease the negative consequences of public and private activities for sustainable management of land resources.

1.4 To provide the investment in rural areas that is needed to implement Agenda 21, governments assess and, if necessary, redress the balance of resource flows between rural and urban areas.

1.5 For targetting common sustainable development goals and an integrated approach, governments not only review the mandates of institutions but also pool budgets of sectors.

1.6 To cope with emergency situations beyond the normal planning scenario, governments provide for a rapid alert and response capability.

1.7 Government formulate and adopt legal and technical adjustment mechanisms for the effective promotion of and the support to the stability of agricultural land use and for sustaining competition and complementarity, in economic terms, of agriculture and other forms of land use.

1.8 Governments design land valuation systems and standards for agriculture that will quantify the social, economic, environmental and demographic impacts associated with the transfer of productive arable land to other uses.

1.9 Governments and international organizations cooperate in identifying national and international sustained sources of funding to carry out integrated land use planning and management with full stakeholder participation.

1.10 The various forms and degrees of land degradation, their socio-economic causes and effects, particularly poverty, need to be given prominence in all programmes for integrated planning and management of land and water resources, taking into account the linkages with the aims of other relevant Chapters of Agenda 21, such as 11, 12, 13, 14, 15 and 18.

2. MANAGING A PLANNING PROCESS FOR THE USE OF LAND RESOURCES OF RURAL AREAS WITH ALL STAKEHOLDERS

Under this theme the workshop participants recommend that:

2.1 Governments promote capacity building, including leadership skills, so that communities and people's organizations, with special attention to women and youth, can participate in, or initiate, local land use planning.Funding for upgrading of technical skills and training will be needed.

2.2 Governments focus on financial support for a catalytic approach to start community participation processes at all levels. This should include capacity building of grassroot-level and voluntary associations. Financial support can be more effective if it addresses causes instead of symptoms.

2.3 Governments incorporate indigenous knowledge and methods of land resources management into their policies and development programmes and assist people's organizations to do likewise. Research will be needed to uncover this knowledge and incorporate it into formal databases and planning procedures.

2.4 Governments develop criteria and performance indicators for sustainable land use, allowing flexibility for sub-national and local variations.

2.5 Governments establish and strengthen conflict resolution mechanisms, in particular at the local level.

2.6 If land reforms are considered necessary, these should be introduced in a gradual and progressive manner so as to maintain a minimum support of all stakeholders.

2.7 Governments cooperate on funding, training and technical support involving multilateral, regional, UN, NGO, farmers' organizations and bilateral external support agencies.

2.8 No set planning procedure is applicable in all situations. International and national organizations should develop modular planning tools so that specific combinations of modules can be applied to individual situations. Workshops for land use planning should be conducted to familiarize policy makers and technical specialists with these new tools.

2.9 Stakeholders at the meso level should be informed by their national authorities about the framework within which they participate in the planning process and about the extent to which they can influence the framework itself as well as the outcome of the planning process.

2.10 Public authorities should enter into partnerships with stakeholders to produce local plans and action strategies for development, for the security of individuals, and for the alleviation of poverty; they should provide the link between broader land use and sectoral planning, bringing together the resources necessary to achieve optimal results.

2.11 Governments and organizations recognize differences in interests of stakeholders and their representative NGOs and, in particular, to ensure incorporation of legitimate concerns and participation by land users including women.

3. POSSIBILITIES FOR SUSTAINABLE ECONOMIC DEVELOPMENT IN RURAL AREAS

Under this theme the workshop participants recommend that:

3.1 Governments provide a national framework to assess the costs and benefits of different land use options or developments.

3.2 For any public intervention or expenditure (a tax, a subsidy, a regulation, a programme of activities, an investment project), governments select at least one performance indicator and monitor it.

3.3 Governments follow sound macro-economic and effective poverty reduction policies as a necessary condition for more sustainable management of land resources. An enabling legal framework is also required.

3.4 Governments use economic instruments to express environmental costs and benefits in market prices, whereby all land resource users will be enabled to take account of environmental costs and benefits in their decision making.

3.5 Where environmental costs and benefits cannot be fully captured in taxes, subsidies or other economic instruments, governments provide incentives for voluntary action by land resource users, or use regulations to enable land resource users to take account of environmental costs and benefits in their decision making, with due consideration for the administrative costs of these regulations.

3.6 Economic instruments will be necessary but are, often, insufficient to promote improved land use. When complementary measures are required, projects should be designed accordingly, including activities such as formation and promotion of groups of land users, technology dissemination, field demonstrations, capacity building of user groups and of government support services and adaptive research institutions.

3.7 Where new economic "carriers" are considered necessary for sustainable development of rural areas, projects should be designed to include activities such as ecotourism, joint wildlife management with local communities, joint forest management with local communities, watershed management (with upstream conservation funded by downstream beneficiaries of more regular flows, reduced silt load, and improved water quality), and nature reserves and parks (with employment generated by the policing function). More generally, governments promote labour-intensive growth throughout the economy, and reverse discrimination against rural areas in the allocation of public expenditure to health, education and infrastructure.