

Terminology for Integrated Resources Planning and Management

February 1998

compiled and edited by

Keya Choudhury and Louisa J.M. Jansen



Food and Agriculture Organization of the United Nations

Preface

An integrated approach to the planning and management of land resources has been developed by FAO since its appointment as Task Manager for the implementation of Agenda 21/Chapter 10 (UN, 1992).

The new approach emphasizes two main characteristics:

- the active participation of stakeholders at national, provincial and local levels in the process of planning and decision making; and
- the integration of technical, institutional, legal and socio-economic aspects.

To achieve the implementation of land-use planning and land management cooperation among experts from the disciplines involved and integration of the respective results are required in order to identify and evaluate all biophysical, socio-economic and legal attributes of the land.

The glossary aims to contribute to the development of a common technical language in land resources planning and management. The terms, methods and concepts used by the different sectors involved should be understood by all partners in an identical way, independent from their backgrounds and professional experiences.

The terms and definitions which are included in this glossary encompass conservation and management of soil, (fresh-) water and vegetation; climate; farming systems; crop production, livestock and fish production; land tenure and sustainable development.

The comments and suggestions received on the two previous drafts which were circulated in-house have been an important support to the release of a first version of the glossary.

Any further proposals are most welcome, to be directed to:

Chief, Soil Resources, Management and Conservation Service (AGLS)
FAO, Viale delle Terme di Caracalla, 00100 Rome, Italy

Acknowledgements

The idea to start with the compilation of a glossary covering terms related to new developments in land-use planning was raised by Denis Sims, Soil Resources, Management and Conservation Service (AGLS), thereby referring to an earlier initiative of the Interdepartmental Working Group on Land Use Planning – Subgroup on Methodology Development of which he was Secretary.

The encouragement, critical review and valuable suggestions by many people within FAO have helped to attain the present version of this glossary. All these contributions are gratefully acknowledged.

Main contributions came from Peter Griffee, Stephen Reynolds and Eric Kueneman of the Crop and Grassland Service (AGPC). Uwe Barg and Kausik Rana, Fisheries Department, contributed to the integration of fisheries and aquaculture. Numerous terms related to livestock were delivered by Simon Mack, Animal Production Service (AGAP). Glossaries being basic sources for many environmental terms were provided by Nadia Scialabba and Jeff Tschirley, Environment and Natural Resources Service (SDRN), and Klaus Janz, Forest Resources Development Service (FORM). The farming systems part has been reviewed and supported by Martin Maurer and Anselm Duchrow, Farm Management and Production Economics Service (AGSP). Terms related to irrigation, drainage, water resources and water management have been reviewed by Martin Smith and Arumugam Kandiah, Water Resources, Development and Management Service (AGLW). Other suggestions and contributions resulted from email discussions with Jan Slingenbergh, Jim Riddell, Narain Pratap, Susan Braatz and Paul Vantomme.

The colleagues of the Soil Resources, Management and Conservation Service (AGLS) supported the development of the glossary throughout the whole period of development.

Keya Choudhury
Louisa J.M. Jansen

Contents

1. GLOSSARY.....	7
2. INDEX	62
3. REFERENCES	66

Abbreviations

AEC	agro-ecological cell
AEZ	agro-ecological zoning
ASA	American Society of Agronomy
CSSS	Canadian Society of Soil Science
EC	Electrical Conductivity
EIA	environmental impact assessment
FAO	Food and Agriculture Organization of the United Nations
FGDC	Federal Geographic Data Committee
FRA	forest resources assessment
FSA	farming systems analysis
FSD	farming systems approach to development
GIS	geographical information system
GP	Growing Period
HP	Humid Period
IBPGR	International Board of Plant Genetic Resources
ICID	International Commission on Irrigation and Drainage
IDWG/LUP	Interdepartmental Working Group on Land Use Planning Subgroup 1: Methodology.
IER	income equivalent ratio
ISO	International Organization for Standardization
ISSS	International Society of Soil Science
ITC	International Institute for Aerospace Surveys and Earth Sciences
IUCN	World Conservation Union
LER	land equivalent ratio
LGP	length of growing period
LU	livestock unit
NWGS	non-wood goods and services
PET	potential evapotranspiration
ppt	parts per thousand
SCSA	Soil Conservation Society of America
TDS	Total Dissolved Solids
UNDP	United Nations Development Programme
UN-ECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNIDO	United Nations Industrial Development Organization
USDA	United States Department of Agriculture
USP	University of the South Pacific
WAU	University of Wageningen
WHO	World Health Organization
WMO	World Meteorological Organization

Introduction to the glossary

All terms defined and explained in the glossary are included in an alphabetical list. An index helps to find a particular term easily and gives an overview of the terms included.

Very often descriptive text, related terms, synonyms and antonyms are given in addition to the proper definition to help the reader to understand the term in its context and practical use.

Sources have been specified for all the definitions or different parts of a definition and the descriptive text.

The definition given is the one preferred and commonly used by FAO. Whenever useful or necessary, a general or basic definition has been added to a term which is defined for the purpose of integrated resource planning and management or related subjects.

Where no agreement has been yet reached or definitions vary significantly from each other, more than one definition has been listed.

1. Glossary

A

a-posteriori classification systems

Classes are defined after clustering similarity or dissimilarity of samples (FAO, 1997a).

The advantage of this type of classification is its flexibility compared to the implicit rigidity of the *a-priori classification*. On the other hand, because the a-posteriori classification depends on the area described, it is unable to define standardized classes other than for the area concerned.

a-priori classification systems

Classes are defined before actual data collection takes place.

This means that all possible combinations of diagnostic criteria must be dealt with in the classification. Basically in the field each sample plot is identified and labelled according to the classification adopted. This method is used extensively in plant taxonomy and soil science. The main advantage is that classes are standardized independent of the area and the means used for classification (FAO, 1997a).

See also *classification systems*

abiotic

non-living (Lawrence, 1995).

agricultural area

Land used primarily for the production or collection of farm *commodities* (Schwarz, Thor & Elsner, 1976).

According to the land uses a distinction is made between *arable land*, *land under protective cover*, *land under permanent crops in open air*, *land under permanent meadows and pastures* both naturally grown or cultivated (FAO, 1995a).

agricultural climatology

Climatology as applied to the effect of climate on crops. It includes especially the length of the growing period, the relation of growth rate and crop yields to the various climatic factors and the optimum and limiting climates for any given crop, the value of irrigation, and the effect of climatic and weather conditions on the development and spread of crop diseases (WMO, 1990).

agricultural holding

Economic unit of agricultural production under single management comprising all livestock kept and all land used wholly or partly for agricultural production purposes, without regard to title, legal form or size (FAO, 1995a).

See also **agricultural land**, see *agricultural area*

agricultural meteorology

This is concerned with the interactions between meteorological and hydrological factors, on the one hand, and agriculture in the widest sense, including horticulture, animal husbandry and forestry, on the other hand (WMO, 1990).

agricultural production

Measured in total output of a crop (FAO, 1984b).

See also *yield*

agricultural region

Any geographical area in which there is a clearly defined and predominant agricultural structure producing broadly similar types of farming, such as the Mediterranean region, the prairie provinces of Canada and areas of wet-rice cultivation in southeast Asia (IDWG/LUP, 1994).

The delimitation of agricultural regions is closely linked to the classification of *Farming Systems*.

agriculture

A broad class of resource uses which includes all forms of *land use* for the production of *biotic* crops - whether animal or plant (Schwarz, Thor & Elsner, 1976).

agroclimatic zone

A land unit defined in terms of *major climate* and *growing period*, which is climatically the homogeneous response of a crop or a farming system (IDWG/LUP, 1994, modified).

agro-ecological zone

A land resource mapping unit, defined in terms of climate, land form and soils, and/or land cover, and having a specific range of potentials and constraints for land use (FAO, 1996a).

Essential elements in defining an agro-ecological zone are the *growing period*, the temperature regime and the soil units.

agro-ecological zoning (AEZ)

The division of an area of land into smaller units, which have similar characteristics related to *land suitability*, potential production and *environmental impact* (FAO, 1996a).

agro-ecological cell (AEC)

An area or point with a unique combination of land, soil and climate characteristics. The agro-ecological cell is the basic processing unit for physical analysis in an AEZ (*agro-ecological zoning*) study (FAO, 1996a).

agro-ecological region

This term was used exclusively to describe agro-ecological zones in Bangladesh taking into account the physiographic aspect. The regions coincide with the 34 major physiographic units or their subunits which have been recognized in Bangladesh. Subdivisions of these regions to indicate areas where significant differences in soils and/or depth of seasonal flooding occur within the region are termed agro-ecological subregions (Brammer *et al.*, 1988).

agro-economic zones

Zones which are defined in terms of common features from an agricultural point of view.

For different purposes these features will differ but may involve such dimensions as climate, soil resources, land use, ethnic groupings and market access (FAO, 1985a).

See also *Farming System Zones*

agroforestry

Agroforestry is a collective name for land-use systems and technologies where woody perennials (trees, shrubs, palms, bamboos, etc.) are deliberately used on the same land management unit as agricultural crops and/or animals, in some form of spatial arrangement or temporal sequence (Lundgren & Raintree, 1982).

In agroforestry systems there are both ecological and economic interactions between the different components (Lundgren & Raintree, 1982).

annual plants

Plant species that complete their life-cycle within 12 months from the date of germination (IBPGR, 1991).

aquaculture

Aquaculture is defined according to the definition currently used by FAO for statistical purposes:

Aquaculture is the farming of aquatic organisms including fish, molluscs, crustaceans and aquatic plants. Farming implies some sort of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators. Farming also implies individual or corporate ownership of the stock being cultivated. For statistical purposes, aquatic organisms which are harvested by an individual or corporate body which has owned them throughout their rearing period contribute to aquaculture while aquatic organisms which are exploitable by the public as a common property resource, with or without appropriate licences, are the harvest of fisheries.

See also *Culture-based Capture Fisheries*

arable land

1. Land which is ploughed, and on which crops are cultivated; agriculture based on the production of field crops, such as sorghum, millet, maize and vegetables (Timberlake & van der Poel, 1979).
2. Arable land includes all land used in most years for growing temporary crops and which is lying fallow or has not been sown due to unforeseen circumstances.

Arable land does not include land under permanent crops or land under protective cover. It is not meant to indicate land that is potentially cultivable but is not normally cultivated (FAO, 1995a).

See also *agricultural area*

arid climate

Generally extremely dry climate (WMO, 1990).

W. Koeppen and others have applied the name desert climate for similar conditions of extreme aridity (WMO, 1990).

artificial water bodies

Areas which are covered by water due to the construction of artifacts such as reservoirs, canals and artificial lakes. Without these structures the area would not be covered by water (FAO, 1997a).

B

bare rock

Area dominated by rock outcrops. The remainder may be covered by shallow soils or isolated pockets filled with soil or sand or a mixture of both. This rock surface is continuous except for a few cracks (CSSS, 1972).

As defined in the FAO Land Cover Classification (FAO, 1997a) this includes areas where rock is surfacing over more than 60 percent of the area.

basin In the context of hydrology and related subjects this includes a drainage area of a stream, river or lake (UNESCO/WMO, 1992).

biennial

Plant species that complete their life-cycles from seed germination to fruiting in two years (IBPGR, 1991).

See also *annual*

See also *perennial*

biodiversity

For the following definition a consensus was reached by the Council on Environmental Quality, the US Office of Technology Assessment, The National Academy of Sciences and the United Nations Environment Programme (Biodiversity, Internet):

The variety and variability among living organisms and the environment in which they occur. The richness of the mix of elements and the connections between those elements that sustain the system as a whole.

biomass

In the broad sense the total weight of living or recently living matter, derived from animals and plants. Often referring to plant biomass which includes all the components of plants - stems, leaves, bark, flowers, etc. (Roetheli *et al.* In: Arntzen & Ritter, 1994).

Usually expressed as dry weight per area (Roetheli *et al.* In: Arntzen & Ritter, 1994).

Biomass should not be confused with *productivity*, the actual rate at which organic matter is created. For example, a redwood forest has a large biomass and small productivity while phytoplankton have a low biomass (because they are continually consumed by predators) but high productivity (FAO, 1997b, slightly modified).

biome

Ecological regions as a result of complex interactions of climate, geology, soil type, water resources and latitude. These components together determine what types of plant and animal life exist in different places (Lean & Hinrichsen, 1992).

UNESCO has designated fourteen major biomes (Lean & Hinrichsen, 1992).

biosphere The portion of earth and its atmosphere that can support life (UNEP, pers. com., modified by Tschirley, FAO, 1997). Generally the transition zone between earth and atmosphere, where most forms of terrestrial life are commonly found (WMO, 1990).

biotic

Live and living organisms (Lawrence, 1995).

boundary conditions

Economic, social, and physical conditions associated with a *land-use system* or production system. These may be the result, in part or completely, of the presence of these conditions, or some or all of these conditions may be a consequence of the particular land-use or production system.

brackish, see *water salinity*

broadleaved

All trees and shrubs classified botanically as Angiospermae (Ford-Robertson, 1971).

They are sometimes referred to as non-coniferous or hardwoods (UN-ECE/FAO, 1997).

Predominantly broadleaved includes forest/other wooded land on which more than 75 percent of the tree crown cover consists of broadleaved species (UN-ECE/FAO, 1997).

brushland, see *shrubland*

The term "brushland" is used in the Forest Resources assessment 1990 (FAO, 1995b).

buffer zone

Working definition as used and developed at the Buffer Zone Management Workshop, Uganda, 5-11, October 1990:

An area inside or adjacent to a protected area where a harmonious relationship between the natural environment and people is promoted (Brown *et al.*, 1992).

See also *buffer zone management*

buffer zone management (BZM)

A process with the objective of optimizing the political, economic, social, cultural, ecological and intrinsic value of resources. The objective is reached through active, adaptive management, with fairness to all groups, and by allowing for changing values over time (Brown *et al.*, 1992).

built-up area

Areas which are characterized by an artificial cover which replaces the original (semi-) natural cover (FAO, 1997a).

This term includes industrial areas, *urban areas*, transportation, communication and energy utilities.

See also *construction works*

See also *non-built-up area*

C

canopy cover, see *vegetation cover*

carrying capacity

Represents the point of balance between reproduction potential and environmental resistance, that is the maximum population of a species that a specific ecosystem can support indefinitely without deterioration of the character and quality of the resource, i.e., vegetation or soil (FAO, 1997b).

It is expressed by numbers of livestock, numbers of certain wild animals, numbers of tourist visits, etc., per unit area (ISSS, 1996).

catchment areas see *watershed*

classification

Classification is described as “ the ordering or arrangement of objects into groups or sets on the basis of their relationships” (Sokal, 1974 in: FAO, 1997a).

In terms of methodology development classification is an abstract representation of the situation in the field using well-defined diagnostic criteria.

A classification is 1) scale independent and 2) independent of the means used to collect information (FAO, 1997a).

See also *classification system*

classification system

Describes the names of the classes and the criteria used to distinguish them (FAO, 1997a).

See also *a-priori classification systems*

See also *a-posteriori classification systems*

classifier, see *classification*

climate

Fluctuating aggregate of atmospheric conditions characterized by the states and developments of the weather of a given area (WMO, 1990).

climatic classification

The division of the earth's climates into a worldwide system of contiguous regions, each one of which is defined by relative homogeneity of the climatic elements (WMO, 1990).

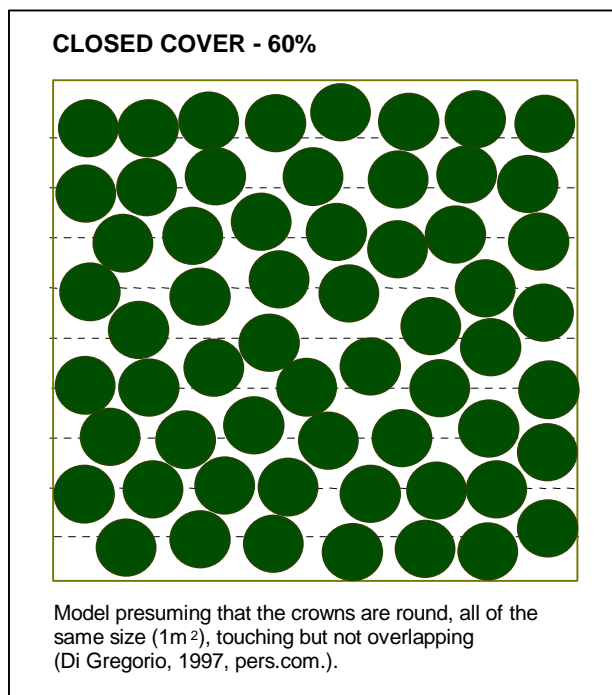
It is often referred to by the classifications of a) W. Koeppen (1918) which is based upon annual and seasonal temperature and precipitation values and b) C.W. Thornwaite (1931) where a moisture index shows amounts and periods of water surplus and deficiency (WMO, 1990).

closed vegetation cover

In the case of a closed cover being composed of trees or shrubs the crowns interlock, touch or are very slightly separated. In the latter case the distance between two perimeters is at least 1/6 of the crown average diameter (Eiten, 1968).

The percentage of closed cover varies with different approaches:

1. More than 60-70 percent of a defined area is covered by a certain vegetation layer (according to Eiten, 1968; adopted in the land cover classification, FAO, 1997a). A forest is defined with a closed layer of trees.
2. In the forest resources assessment (FAO, 1995b) the land cover class "Closed Forest" is defined with more than 40 percent canopy coverage.



commodity = product

Goods and services which are the result of production processes normally intended for sale on the market at a price that is designed to cover their cost of production (FAO, 1996c).

Agricultural context: A commodity may be sold directly off the farm, for example wheat, wool, or apples, or may be produced as an input to another production system, for example straw or hay which are fed to animals being sold afterwards. Thus a commodity in this sense includes not only conventional agricultural crops, but also trees, fish or any other product of the land which has value and is produced or gathered for consumption or sale (IDWG/LUP, 1994).

See also *Produce*

common property resources

Resources collectively owned and managed by a well-defined group of users (IDWG/LUP, 1994).

Irrigation systems and upland pastures are common examples. Ideally common property resources are governed by a common property regime (i.e., a system of rights and duties which prevents over-exploitation). Many traditional societies have institutional arrangements to manage common resources in a sustainable manner. In some cases punishment for violating the rules is severe. In the absence of fear of punishment, sustainable management of common property depends basically on mutual trust among members of the user group. That is, each person will adhere to his or her duties and responsibilities with the expectation that others will do the same. But in the face of rapid population growth and poverty, many common property resource management institutions have broken down. The result may be that common property resources are converted to *open access resources* (IDWG/LUP, 1994).

communal land

Non-registered, untitled land under the control of local communities and commonly associated with uncontrolled free access (Mack, personal communication).

compact plantation

This includes plants, trees and shrubs planted in a regular and systematic manner. Plants, trees or shrubs forming an irregular pattern but dense enough to permit data collection of area planted, are also considered compact plantation (FAO, 1996a).

coniferous, = needleleaved

All trees classified botanically as Gymnospermae (Ford-Robertson, 1971) carrying the typical needle-shaped leaves (Kuechler & Zonneveld, 1988).

They are sometimes referred to as softwoods (UN-ECE/FAO, 1997).

Predominantly coniferous include forest/other wooded land on which more than 75 percent of the tree crown cover consists of coniferous species (UN-ECE/FAO, 1997).

conservation**~ of natural resources**

The protection, improvement and use of natural resources according to principles that will assure their highest economic or social benefits for humans and their environment now and into the future (SCSA, 1982).

Very detailed explanations of conservation concepts for land, soil and land use are stated in the terminology for soil erosion and conservation (ISSS, 1996).

See also *natural resources*

consolidated surface

Consolidated surfaces are characterized by solid and firm consistency of their surface, or by the presence of coarse fragments with these properties. These surfaces are impenetrable with a spade or a hoe (Soil Resources, Management and Conservation Service, FAO, 1997).

construction works

Collective term including earthworks, landscape engineering, road construction, construction of waste disposal sites and backfilling of excavated sites or mines (ISO, 1996).

In the FAO Land Cover Classification (FAO, 1997a) the term „artificial cover“ is used. A distinction is made between built-up area and non-built-up area.

See also *built-up areas*

See also *non-built-up areas*

consumptive use

Quantity of surface and groundwater absorbed by crops and transpired or used directly in the building of plant tissue, together with that evaporated from the cropped area, expressed in units of volume per unit area (WMO, 1990).

cover, see *vegetation cover, land cover, earth cover*

crop

Harvested products of plants grown or gathered for food and materials; the produce of the field, either while growing or when gathered (Crop and Grassland Service, FAO, 1997); products can further derive from living aquatic resources i.e. *capture fisheries* and *aquaculture* (Inland Water Resources and Aquaculture Service, FAO, 1997).

See also *agriculture*

crop by-products

The residues left over from the processing of grain and pulses, i.e., bran, oilseed cakes, etc. (Mack, FAO, personal communication).

crop calendar

A list of the standard crops of a region in the form of a calendar giving the dates of sowing and the agricultural operations, and various stages of their growth in years of normal weather (WMO, 1990).

crop growth requirements

Needs of an individual crop or cultivar for an appropriate development and yield. Plant growth requires a reasonable moisture and nutrient supply, linked to a sufficient rooting depth and to a proper energy regime for photosynthesis and biomass production (Verheye, 1996).

crop residues

The residues left after the crop has been harvested (i.e., straw, stover, haulm, bunches, roots etc.). May be stored for later use or consumed *in situ* (i.e., stubble grazing) (Mack, personal communication).

crop rotation

The repetitive cultivation of an ordered succession of crops (or crops and fallow) on the same land. One cycle often takes several years to complete (ASA, 1976).

crop yield, see *yield***cropland**

Land used for the production of adapted crops (Lipton, 1995).

Cropland includes all *arable land* plus *land under permanent crops* (FAO, 1995a).

See also *agricultural area*

cropping index

The number of crops grown per annum on a given area of land multiplied by 100 (ASA, 1976).

cropping pattern

The yearly sequence and spatial arrangement of the crops or of crops and fallow on a given area (ASA, 1976; FAO, 1996a).

cropping system

The *cropping patterns* used on a farm and their interaction with farm resources, other farm enterprises, and available technology which determine their cultivation (ASA, 1976).

The cropping system is subsystem of a *farming system* (FAO, 1996a).

cultivar

A variety of plant species produced by selected breeding (King, 1974).

culture-based capture fisheries

Culture-based capture fisheries are often taken to mean capture fisheries which are maintained by stocking with material raised within aquaculture installations. However, this definition is too narrow to cover the range of management practices collectively known as enhancements, and for the purposes of this document the following working definition for culture-based fisheries is given as (Inland Water Resources and Aquaculture Service, FAO, 1997):

Activities aimed at supplementing or sustaining the recruitment of one or more aquatic species and raising the total production or the production of selected elements of a fishery beyond a level which is sustainable through natural processes. In this sense culture-based fisheries include enhancement measures which may take the form of: introduction of new species; stocking natural and artificial water bodies; fertilization; environmental engineering including habitat improvements and modification of water bodies; altering species composition including elimination of undesirable species, or constituting an artificial fauna of selected species; genetic modification of introduced species (Inland Water Resources and Aquaculture Service, FAO, 1997).

See also *aquaculture*

D

deciduous

The phenology of perennial plants which are leafless for a certain period during the year (Ford-Robertson, 1971). The leaf shedding usually takes place simultaneously in connection with the unfavourable season (UNESCO, 1973).

In the FAO Land Cover Classification this describes a class where more than 75 percent of the life form is deciduous.

desertification

Land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities (UNEP, 1995).

See also *land degradation*

dominance

The extent to which a given species or life form predominates in a community because of its size, abundance, cover or aggression, and affects the fitness of associated species (FGDC, 1997).

drainage

1. The natural or artificial removal of surplus ground- and surface water and dissolved salts from any area in order to enhance crop growth.

In the case of natural drainage the excess waters flow from fields to lakes, swamps, streams and rivers. In an artificial system surplus ground- or surface water is removed by means of subsurface or surface conduits, artificial or natural (ICID, 1975; FAO, 1996d). Used as an instrument to control salinity, ponding and waterlogging (FAO, 1996d).

2. Drainage is the removal of excess water from the land surface and/or the upper soil layer to make non-productive wet land productive and wet land more productive (FAO, 1995a)

drainage area, see *watershed*

drainage basin, see *watershed*

drought

A period of abnormally dry weather sufficiently prolonged for the lack of water to cause a serious hydrologic imbalance (i.e., crop damage) in the affected area. Drought severity depends upon the degree of moisture deficiency, the duration and (to a lesser extent) the size of the affected area (WMO, 1990).

drought, agricultural

Agricultural drought occurs when rainfall amounts and distribution, soil water reserves and evaporation losses combine to cause crop or livestock yields to diminish markedly (WMO, 1990).

dry period

The time over the year which is characterized by the precipitation being lower than half the evapotranspiration and which therefore does not belong to the *growing period*. (FAO, 1996a).

See also *concept of growing period*

See also *potential evapotranspiration*

dryland farming

Crop production without supplementary irrigation in semi-arid regions and therefore dependent on precipitation (Stewart, in: Arntzen & Ritter, 1994).

Dryland farming requires the capture and efficient use of precipitation. The farming activities should be focused on retaining precipitation, reducing evaporation and utilizing drought-tolerant crops (Stewart, in: Arntzen & Ritter, 1994).

Rainfed farming includes dryland farming, though these terms are not interchangeable. Both systems exclude irrigation, but rainfed agriculture can emphasize, i.e., the disposal of excess water (Stewart, in: Arntzen & Ritter, 1994).

dwarf shrubs

Multi-stemmed woody plants with a life form at a height of less than 0.5 m due to genetic or environmental constraints (FAO, 1997a).

E

ecological zone

A land area, generally smaller than a region but considerably larger than a farm, with a definable combination of climate, relief, altitude, edaphic conditions and natural vegetation (IDWG/LUP, 1994).

ecological-economic zoning

A kind of zoning which integrates physical land resources elements with socio-economic factors and a wider range of land uses in zone definitions (FAO, 1996a).

ecosystem

A natural entity populated by a definable group of organisms interacting with a definable abiotic environment (Hart, in: Arntzen & Ritter, 1994).

ecotype

A crop cultivar adapted to a particular range of climatic or soil conditions (FAO, 1996a).

See also *cultivar*

edaphic requirement.

A requirement of the crop for a particular condition or range of conditions in the soil environment (FAO, 1996a).

electrical conductivity (EC)

A measure of the concentration of salts, defined as the conductance of a cubic centimetre of water at a standard temperature of 25° C (FAO, 1996d).

Electrical conductivity is expressed in deciSiemens per metre (dS/m) (FAO, 1996d).

emission

The discharge of radiation, heat, smell, noise, fluid, gas or smoke from natural or anthropogenic sources into the atmosphere (Sykes, 1989, modified).

Anthropogenic sources include smokestacks, other vents, and surface areas of commercial or industrial facilities; from residential chimneys; and from motor vehicle, locomotive, or aircraft exhausts (UNEP, pers. com., modified by Tschirley, FAO, 1997).

Natural emissions may originate from marine or inland water, soil, vegetation, volcanoes or biomass burning (Bates *et al.*, 1992).

environment

The combined external conditions affecting the life, development and survival of an organism or an *ecosystem* (UNEP, pers. com., modified by Tschirley, FAO, 1997).

environmental impact assessment (EIA)

An analytical process designed to identify and predict the impacts of a proposed action on the biogeophysical environment and on human health and well-being and further to interpret and communicate information about the significance of the impacts, including mitigation measures that are likely to eliminate the risks (UNEP, pers. com., modified by Tschirley, FAO, 1997; FAO, 1997).

In many countries, organizations planning new projects are required by law to conduct EIA. (UNEP, pers. com., modified by Tschirley, FAO, 1997; FAO, 1997).

erosion

Types of erosion comprise the wearing away of the land by running water, rainfall, wind, ice or other geological agents, including such processes as detachment, entrainment, suspension, transportation and mass movement (ISSS, 1996).

A further distinction can be made according to the source (Roose, 1996): Geologically, erosion is defined as the process that slowly shapes hillsides, allowing the formation of soil cover from the weathering of rocks and from alluvial and colluvial deposits. Erosion due to human activities as an effect of careless exploitation of the environment results in increasing *runoff* and declining arable layers.

evaporation, actual**= effective evaporation**

Quantity of emitted water vapour from an open water surface or from the ground at a temperature below boiling point (WMO, 1990, modified).

evapotranspiration

Amount of water transferred into the atmosphere by evaporation from the soil surface and by plant transpiration (WMO, 1990).

See also *potential evapotranspiration*

evergreen

This term as such means the phenology of perennial plants that are never entirely without green foliage (Ford-Robertson, 1971).

In the FAO Land Cover Classification this describes a class where more than 75 percent of the life form is evergreen (FAO, 1997a).

F

fallow system

An agricultural system with an alternation between a cropping period of several years and a fallow period with natural fallow vegetation. The intensity of rotation, expressed as R , is between 33 and 66 percent (Ruthenberg *et al.*, 1980).

R is calculated as the years of cultivation multiplied by 100 and divided by the length of the cycle of land utilization. This indicates that between 33 and 66 percent of the area, which is available for farming, is under cultivation. In other words the land is cultivated between 33 and 66 percent of the years (Ruthenberg *et al.*, 1980).

See also *land cultivation systems*

farm commodity, see *commodity*

farm-household system

The principal system and focus of the *farming systems approach to development* (FSD).

The farm-household system consists of three basic subsystems that are closely linked and interactive, namely (USP/FAO, 1997):

- the *household*, constituting the decision-making unit and determining the objectives, mobilizing resources, influencing the transformation process, deciding on the disposal of resulting products.
- the *farm*, on which crop and livestock (and fishing) activities are implemented, providing employment, food, and cash for the farm household;
- *off-farm employment*, which can complement or compete with the farm for resources (labour, capital) and provides supplemental income.

See also *farming system*

farming system

Unit of analysis of agricultural production, defined by the components and boundaries and by the types of interactions among the components and with the environments outside the boundaries. Farming systems include all activities, both agricultural and non-agricultural, under the control of farm household units (Caldwell in: Arntzen & Ritter, 1994).

A decision-making unit, comprising a farm household, cropping, *livestock systems* and fish production systems, that produces crop and animal products for consumption and sale (FAO, 1996a).

farming systems classification

1. In the classification according to Ruthenberg *et al.* (1980), a distinction is made between agriculture and pasture management systems. The criteria which form the basis for classification are land use, the type and intensity of rotation, use of water, cultivation technique and forms of livestock.

Main Farming Systems according to Ruthenberg <i>et al.</i> (1980)
1) shifting cultivation
2) fallow systems
3) ley and dairy systems
4) systems with permanent upland cultivation
5) systems with arable irrigation farming
6) systems with perennial crops
7) grazing systems

2. Doppler (1997) classifies the farming systems according to criteria for decision making and behaviour which results in several levels of differentiation:

- first level: degree of orientation to the market
- second level: shortage of land
- third level: various criteria

farming system zones

Similar entities of *farm-household systems*. They represent areas for possible development interventions. Due to dynamic aspects, farming system zones tend to change over time (FAO, 1990).

Note: Farming system zones can be subdivisions of agro-ecological zones, in some cases they can even be synonymous (FAO, 1990).

Main Farming Systems according to Doppler (1997)

- A. Subsistence orientated
- 1) migrating/unlimited availability of land
 - nomadism
 - migrant farming
 - 2) non-migrating/limited availability of land
 - traditional fallow systems
 - traditional irrigated farms
- B. Subsistence and market orientated
- 1) scarcity of land using livestock
 - transhumance
 - non-migrating systems
 - 2) scarcity of land with particular use of labour
 - fallow systems
 - permanent cropping
 - 3) scarcity of land with particular use of water
 - own source of water
 - water from outside the farm
- C. Market orientated
- 1) intensive specialized farms
 - intensive cultivation
 - intensive dairy production
 - 2) large-scale farms with paid labour
 - ranches
 - plantations

farming systems approach to development (FSD)

An approach to develop *farm-household systems* and *rural communities* on an equitable, sustainable and participatory basis (USP/FAO, 1997).

The FSD approach consists of two stages, both of which involve intensive interaction with farmers:

- farming systems analysis (FSA);
- farming systems testing, planning, monitoring and evaluation

Furthermore, zoning is required to facilitate the planning and implementation process.

See also *farming system zones*

feed

Any non-injurious edible material having nutrient value. May be harvest forage, range or artificial pasture forage, grain, or other processed feed for livestock or game animals. (Am. Soc. of Range Management, 1964)

field capacity

The amount of water held in the soil after the excess gravitational water has drained away and after the rate of downward movement of water has materially decreased (ICID, 1975).

fodder

Coarse grasses such as maize and sorghum harvested with the seed and leaves green or live, cured and fed in their entirety as forage (Reynolds, 1995)

forage

All browse and herbaceous food that is available to livestock or game animals. Material such as pasture, hay, silage and green feed in contrast to the less digestible plant material known as "roughage". As a verb, to search for or consume forage (Reynolds, 1995; Ibrahim, 1975).

forbs

All broad-leaved herbaceous plants in the common sense, e.g. sunflower, clover etc. and all non-graminoid herbaceous plants (UNESCO, 1973).

forest

1. Land with tree crown cover (or equivalent stocking level) of more than 10 percent and area of more than 0.5 ha. The trees should be able to reach a minimum height of 5 m at maturity *in situ*. May consist either of closed forest formations where trees of various storeys and undergrowth cover a high proportion of the ground or of open forest formations with a continuous vegetation cover in which tree crown cover exceeds 10 percent. Young natural stands and all plantations established for forestry purposes which have yet to reach a crown density of 10 percent or tree height of 5 m are included under forest, as are areas normally forming part of the forest area which are temporarily unstocked as a result of human intervention or natural causes but which are expected to revert to forest (UN-ECE/FAO, 1997).

Includes: Forest nurseries and seed orchards that constitute an integral part of the forest; forest roads, cleared tracts, firebreaks and other small open areas within the forest; forest in national parks, nature reserves and other protected areas such as those of special environmental, scientific, historical, cultural or spiritual interest; windbreaks and shelterbelts of trees with an area of more than 0.5 ha and a width of more than 20 m. Rubberwood plantations and cork oak stands are included.

Excludes: Land predominantly used for agricultural practices.

See also *other wooded land*

2. In other disciplines forests are defined as a large tract of land with a fairly dense growth of trees. This differs in degree from woodland, which tends to refer to more open forest (Timberlake & van der Poel, 1979, modified).

Example: In the FAO Land Cover Classification a range of 60-70 percent crown cover determines a closed even or uneven canopy.

See also *closed vegetation cover*

forest not available for wood supply

Forest where legal, economic or specific environmental restrictions prevent any significant supply of wood (UN-ECE/FAO, 1997).

Includes: (a) forest with legal restrictions or restrictions resulting from other political decisions which totally exclude or severely limit wood supply, *inter alia* for reasons of environmental or biodiversity conservation, e.g., protection forest, national parks, nature reserves and other protected areas, such as those of special environmental, scientific, historical, cultural or spiritual interest; (b) forest where physical productivity or wood quality is too low or harvesting and transport costs are too high to warrant wood harvesting, apart from occasional cuttings for auto-consumption.

forest plantation

Forest stands established by planting or/and seeding in the process of afforestation or reforestation. They are either:

- of introduced species (all planted stands); or
- intensively managed stands of indigenous species which meet all the following criteria: one or two species at plantation, even age class, regular spacing.

Excludes: stands which were established as plantations but which have been without intensive management for a significant period of time. These should be considered semi-natural.

forest resources assessment (FRA)

Collection, compilation in a database and evaluation of statistical, digital, mapped or other (quantitative and descriptive) information on status and changes of forest resources, including their wood production components and non-wood goods and services (NWGS), at national, regional and global levels, with reference to a specified reference period or reference year (UN-ECE/FAO, 1997).

formation

A group of vegetation communities in a single geographical region or continent, of similar physiognomy and existing under related climatic and environmental conditions (Collins, 1990 in: IDWG/LUP, 1994).

For example, the tropical rain forest of the Indo-Malayan archipelago is a formation within which are found detailed local and regional formations called associations (Collins, 1990 in: IDWG/LUP, 1994).

freshwater see *water salinity*

G

game

All wild, free living species although commonly restricted to the Ungulates (= deer, antelope etc.) (Mack, personal communication).

game cropping

The sustainable culling of wild game species (Mack, personal communication).

game farming

Game species raised and managed under extensive production systems, usually on commercial ranches (Mack, personal communication).

genetic resources

Germplasm of plants, animals or other organisms containing useful characters of actual or potential value. In a domesticated species, it is the sum of all the genetic combinations produced in the process of evolution (IBPGR, 1991).

geo-referencing

Defining the location of an entity object by registering its coordinates in a specific coordinate system.

geographical information system (GIS).

A system for capturing, storing, checking, integrating, manipulating, analysing and displaying data which is spatially referenced to the earth (FAO, 1996a).

global radiation

The total of direct solar radiation and diffuse sky radiation received by a unit horizontal surface (WMO, 1990).

graminoids

All herbaceous grasses and other narrowleaf grass-like plants which are not grasses according to the taxonomic definition (Kuechler & Zonneveld, 1988), e.g., sedges and rushes.

grassland

A plant community in which grasses are dominant, shrubs are rare and trees absent (Skerman & Riveros, 1990)

grazing area

The land available for grazing animals; specifically may refer to the land area for the animals of a particular stockowner or community herd (Reynolds, 1997).

Stocking rate can be calculated from the number and size of the animals and the land area and, if the nature of the herbage cover is known, grazing pressure can be calculated (Reynolds, 1997).

grazing pressure

The actual number of grazing animals on a unit of land at a specific time (Whiteman, 1980).

Usually expressed as hectares/livestock unit (ha/LU) (Whiteman, 1980).

See also *livestock unit*

gross margin

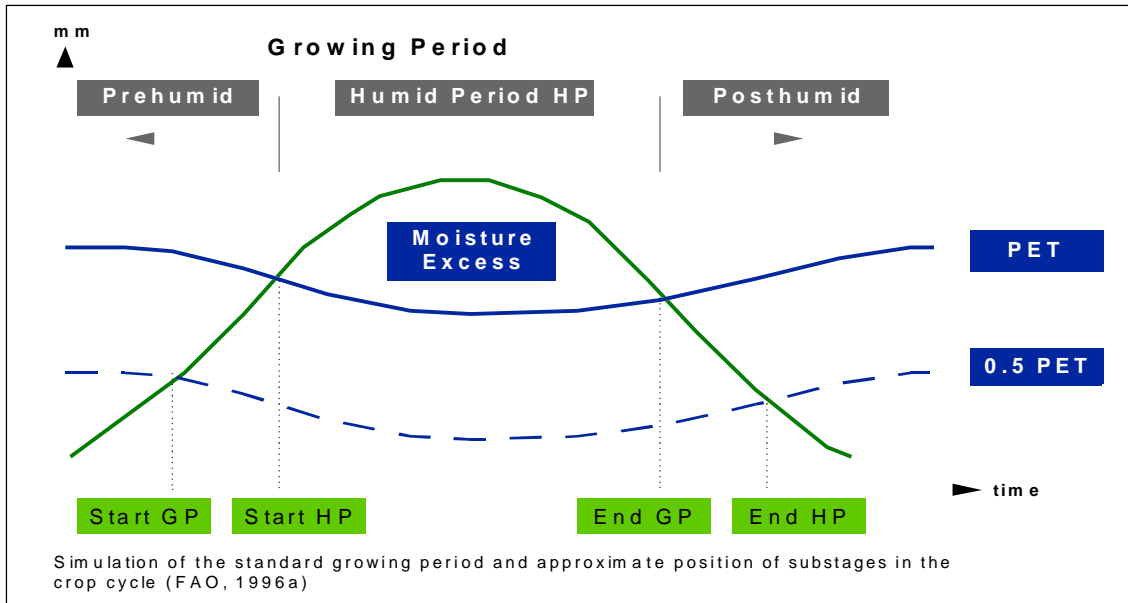
The revenue from an enterprise minus the variable costs (FAO, 1983, slightly modified)

groundwater

Water in soil beneath the soil surface, usually under conditions where the pressure in the water is greater than the atmospheric pressure, and the soil voids are substantially filled with the water (USDA, 1954).

growing period

The period of the year when both moisture and temperature conditions are suitable for crop production (FAO, 1996a).



Concept of growing period:

The estimation of the growing period is based on a water balance model which compares rainfall (P = precipitation) with *potential evapotranspiration* (PET). In the model 0.5 PET indicates that the effectiveness of early rains on seed germination and initial crop growth increases considerably once the precipitation is equal to or exceeds 0.5 PET. If the growing period is not limited by temperature, the ratio of P/ET determines the start, end and type of growing period.

The definition of the growing period has been developed for a standard model. The four generalized types of growing period and the different growing period patterns are described in detail in FAO (1996a).

See also *length of growing period*

growing season

Used in a general way, not as a technical term, to refer to the period of the year when most crops are grown, e.g., the rainy season (FAO, 1983).

growth cycle

1. See *life cycle, plant development cycle*
2. The period required for an annual crop to complete its annual cycle of establishment, growth and production of harvested part. Growth cycle refers to the ecophysiological needs of the crop, *growing season* or *growing period* refers to the land or environment (FAO, 1983).

growth form

The shape or appearance of a plant; it primarily reflects the influence of growing conditions (FGDC, 1997). A classification of plants based upon their size, morphology, habit, life span and woodiness.

H

habitat

The place or type of site where species and communities normally live or grow, usually characterized by a relatively uniform portion of the physical features or by consistent plant forms. Deserts, lakes and forests are all habitats (FAO, 1997b).

habitat/species management area

Protected area managed mainly for conservation through management intervention.

See also *IUCN protection status categories*

harvest index

The ratio of economic yield of a crop and total dry matter at harvest (Evans, 1972).

hazard

- 1) Property of a substance or material, which may cause an adverse effect on the original functions of the material (ISO, 1996, modified).
- 2) Situations or events that may lead to loss or damage (Nash & Nash, 1995).

hazard analysis

Applied to: (1) identify potential sources of release of hazardous materials from fixed facilities or transportation accidents; (2) determine the vulnerability of a geographical area to a release of hazardous materials; and, (3) compare hazards to determine which present greater or lesser risks to a community (UNEP, pers. com., modified by Tschirley, FAO, 1997).

height

The height of a certain *layer* is measured from the ground to the average top of the life form which is examined (Kuechler & Zonneveld, 1988).

The fact that single plants of one synusia differ from the average height can be ignored apart from the fact that they can form an own layer, e.g. the emergents of a rainforest which tower above the rest (Kuechler & Zonneveld, 1988).

herbaceous plants

Plants without persistent stem or shoots above ground and lacking definite firm structure (Scoggan, 1978).

Depending on the physiognomy a distinction is made between *graminoids* and *forbs* (Kuechler & Zonneveld, 1988; UNESCO, 1973).

herbs, see *herbaceous plants*

holder

A civil or judicial person who exercises management control over the agricultural holding operation and takes major decisions regarding resource use. The holder has technical and economic responsibility for the holding and may undertake all responsibilities directly, or delegate responsibilities related to day-to-day work management to a hired manager (FAO, 1995a).

holding

One or more parcels of forest and other wooded land which constitute a single unit from the point of view of management or utilization. For State-owned forest and other wooded land a holding may be defined as the area forming a major management unit administered by a senior official, .e.g. a Regional Forestry Officer. For forest and other wooded land that is owned publicly, other than by the State, or by large-scale forest owners, e.g. forest industries, a holding may constitute a number of separated properties which are, however, managed according to one corporate strategy. Under any category of ownership, other than State-owned, one holding may be the property of one or several owners (UN-ECE/FAO, 1997).

See also *agricultural holding*

hydrological cycle

The sun constantly evaporates water into the atmosphere, part of which is returned on land as rain and snow. Part of that precipitation is rapidly evaporated back into the atmosphere. Some drains into lakes and rivers to commence a journey back to the sea. Part infiltrates into the soil to become soil moisture or groundwater. Under natural conditions, the groundwater gradually works its way back into surface waters and makes up the main source of dependable river flow. Plants incorporate some of the soil moisture and groundwater into their tissues, and release some into the atmosphere in the process of transpiration (WMO, 1997).

income equivalent ratio (IER)

The ratio of the area under sole cropping needed to produce the same gross income as one hectare of intercropping at the same management level (ASA, 1976).

IER is the conversion of the land equivalent ratio (LER) into economic terms (ASA, 1976).

indicators

Signals - of processes, inputs, outputs, effects, results, outcomes, impacts, etc. - that enable such phenomena to be judged or measured (UNEP, pers. com., modified by Tschirley, FAO, 1997).

Both qualitative and quantitative indicators are needed for management learning, policy review, monitoring and evaluation.

In biology, an organism, species or community with characteristics that show the presence of specific environmental conditions, good or bad (UNEP, pers. com., modified by Tschirley, FAO, 1997).

In plant breeding an indicator gene is one which is expressed phenotypically to help identify the gene presence in a cross (e.g. flower colour).

infiltration rate

The volume of water entering a specified cross-sectional area of soil per unit time; expressed in m/s or m/day (Arntzen & Ritter, 1994).

infrastructure

Permanent installations and facilities that provide services to a community, such as roads, irrigation or drainage works, schools, hospitals and communication systems (Arntzen & Ritter, 1994).

inland water

The *surface water* existing inland including lakes, ponds, streams, rivers, natural or artificial watercourses and reservoirs, and coastal lagoons and artificial water bodies (Riemer, 1984, modified, Lo, 1992).

See also *water salinity*

integrated coastal area management (ICAM)

Integrated coastal area management is a dynamic process by which actions are taken for the use, development and protection of coastal resources and areas to achieve national goals established in cooperation with user groups and regional and local authorities (FAO, 1997b).

In this definition, integrated management refers to the management of sectoral components as parts of a functional whole with explicit recognition that it is the users of resources, not the stocks of natural resources, which are the focus of management. For the purpose of integrated management, the boundaries of a coastal area should be defined according to the problems to be resolved. The definition thus implies a pragmatic approach to the defining of coastal areas in which the area under consideration might change over time as additional problems are addressed which require resolution over a wider geographical area (FAO, 1997b).

intercropping

The growing of two or more crops on the same field per year (FAO, 1985b; ASA, 1976), either simultaneously or - in the case of relay intercropping - with an overlapping period.

Simultaneous systems refer to the cultivation of two or more crops either intermingled or with distinct row or strip arrangement.

Ruthenberg *et al.* (1980) made a further distinction as follows:

- Intercropping of crops with similar vegetation cycles.
Example: Mixed annual crops are cultivated on one piece of land. Components often found are legumes combined with non-legumes.
- Intercropping through interplanting in medium- or long-term arable crops.
Example: Perennial crops (trees and shrubs) are inter-planted through cash crops during the period of establishment of the main crop. At a later stage the inter-planted crops might be replaced by cover crops (Euroconsult & Ministerie van Landbouw , 1989).

intermittently flooded

Substrate is usually exposed, but surface water can be present for variable periods without detectable seasonal periodicity. Inundation is not predictable in a given season and is dependent upon highly localized rain storms (FGDC, 1997).

This modifier can be applied to both wetland and non-wetland situations (FGDC, 1997).

Equivalent to Cowardin's Intermittently Flooded Modifier (Cowardin *et al.*,1976).

inundated land

Land covered with or subject to overflows of water, such as from floods, tides (ICID, 1975).

irrigation

Water artificially applied to soils. This does not include precipitation (ICID, 1975).

A distinction is made between surface irrigation (basin, border, furrow irrigation), localized irrigation (umbrella term for other irrigation systems such as trickle, drip, drop, daily flow and micro (FAO, 1989) and overhead irrigation (sprinkler irrigation).

irrigated land

Areas artificially provided with water, other than rain, for improving pastures or crop production (FAO, 1995a).

Uncontrolled land flooding by overflowing of rivers or streams is not considered irrigation (FAO, 1995a).

IUCN (World Conservation Union) protection status categories

- I. See *Strict nature reserve/wilderness area*
- II. See *National park*
- III. See *Natural monument*
- IV. See *Habitat/species management area*
- V. See *Protected landscape/seascape*
- VI. See *Managed resource protection area*

L

land

A delineable area of the earth's terrestrial surface, embracing 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 and geohydrological reserves, 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.) (IDWG/LUP, 1994).

land area

Total area excluding area under inland water bodies (FAO Production Yearbook).

See also *total area*

land cover

Land cover is the observed (bio)physical cover on the earth's surface (FAO, 1997a).

When considering land cover in a very pure and strict sense it should be confined to describe the vegetation and the man-made features. Consequently, areas where the surface consists of bare rock or bare soil are describing *land* itself rather than land cover. Also water surfaces can be disputed as being real *land* cover. However, in practice the scientific community is used to describe those aspects under the term land cover (FAO, 1997a).

Land cover is not to be confused with *land use*.

Example: *woodland* or *forest* are land covers, but the land use may be hunting or rubber tapping.

land degradation

Land which due to natural processes or human activity is no longer able to sustain properly an economic function and/or the original natural ecological function (ISO, 1996).

See also *soil degradation*

land equivalent ratio (LER).

The ratio of the area needed under sole cropping to the area under intercropping at the same management level to give an equal amount of yield. LER is the sum of the fractions of the yields of the intercrops relative to their sole crop yields (ASA, 1976; FAO, 1996a).

land evaluation.

The assessment of land performance when used for a specified purpose, involving the execution and interpretation of surveys and studies of land forms, soils, vegetation, climate and other aspects of land in order to identify and make a comparison of promising kinds of land use in terms applicable to the objectives of the evaluation (FAO, 1976).

land facet

A *land unit* with climate, land forms, soils and vegetation characteristics which for most practical purposes may be considered as uniform.

A subdivision of a *land system* (FAO, 1983). Land units usually contain several land facets, and a number of Land Units are usually contained in a Land System (IDWG/LUP, 1994).

land husbandry

The concept of husbandry is widely understood when applied to crops and animals. As a concept of signifying understanding, management and improvement, it is equally applicable to land.

Land husbandry is the care and management of the land for productive purposes in order to sustain and enhance the land's productive potential (Hudson *et al.*, 1993). Land husbandry aims primarily at a significant increase in yields, and this requires stabilization of the environment (Roose, 1996).

land management units *Land units* suitable for the same type of use, with insufficient variation to warrant division into smaller units.

Sometimes a subdivision of an *agro-ecosystem*. Differs from *recommendation domain* in that it covers physical factors only.

land mapping unit

An area of land demarcated on a map and possessing specified land characteristics and/or qualities (FAO, 1976).

land potentially productive

Uncultivated land which is either producing some kind of utilizable vegetable product, such as seeds and rushes for matting and bedding for livestock, wild berries, plants and fruit, or land which could be brought into crop production with little more effort in addition to that required in common cultivation practices (FAO, 1984a).

land quality

A complex attribute of land which acts in a distinct way in its influence on the suitability of land for a specified use (FAO, 1996a).

land suitability

The applicability of a given type of land for a specific kind of land use (Verheye, 1996).

land suitability classification

An appraisal or grouping of specific types of land in terms of an absolute or relative suitability for a specified kind of use (Verheye, 1996).

land system

A *land unit* with relatively uniform climate and with a repeating pattern of land forms, soils and vegetation (FAO, 1983).

A land system may be divided into *land facets* (FAO, 1983).

land temporarily fallow

Land resting for a period of time before it is planted again. If the land remains fallow too long, it might acquire certain characteristics requiring it to be reclassified, such as "permanent meadows and pastures" or "woodland or forest" or "all other land" if it becomes wasteland. A maximum idle period should be specified: probably less than five years (FAO, 1984a).

Land is not considered temporarily fallow unless it has been, or is intended to be, kept at rest for at least one agricultural year. Land temporarily fallow should be distinguished from land abandoned by shifting cultivation; the former is part of the holding whereas the latter is not (FAO, 1996a).

See also *fallow system*

land tenure

1. Land tenure refers to arrangements or rights under which the *holder* holds or uses land. Land rented out is not considered to be part of the holding. A holding may be operated under one or more tenure forms, with each parcel normally operated under one tenure form. All data regarding land tenure should be collected for the same time reference (FAO, 1995a).

This definition is used for land belonging to an *agricultural holding*.

2. Land tenure refers to the arrangement or right that allows a person or a community to use specific pieces of land and associated resources (e.g. water, trees, etc.) in a certain period of time and for particular purposes (Riddell, 1997, pers. com.).

There are many land tenure systems that allow people to use the same property for different purposes. For example, the farming rights can belong to one person, while the trees to another and the fruit of the trees to someone else.

Leasing and renting are kinds of land tenure, just as is share-cropping. Thus, there exists a hierarchy of land tenure interests in the same parcel.

Example: One person holds the right to use a specific resource, another may hold the allocation rights and finally someone else holds the alienation rights (that is the person who can sell the land).

land type

A recognizable and definable landscape i.e., combination of land forms, topography and vegetation, possessing a particular climate, and usually characterized by one type of soil or parent material and a type of land use practised over a long period (IDWG/LUP, 1994).

land under permanent crops

Land cultivated with long-term crops which do not have to be replanted for several years after each harvest including cultivation under cover; land under trees and shrubs producing flowers, such as roses and jasmine and nurseries except those for forest trees, which should be classified under "woodland or forest" (FAO,1984).

See also *agricultural area*

See also *permanent cultivation*

land under permanent meadows and pastures

Land used permanently (five years or more) for herbaceous forage crops, either cultivated or growing wild (wild prairie or grazing land). Permanent meadows and pastures on which trees and shrubs are grown should be recorded under this heading only if the growing of forage crops is the most important use of the area (FAO,1984).

See also *agricultural area*

See also *permanent pasture*

land under protective cover

Land under protective structures with protective roof of glass, plastic or other material. Such land may be used for both temporary and permanent crops (FAO,1984).

See also *agricultural area*

See also *permanent cultivation*

land under temporary crops

Land used for crops with an under-one-year growing cycle, which must be newly sown or planted for further production after the harvest (FAO, 1984a).

Crops remaining in the field more than one year should also be considered temporary crops if harvesting destroys the plant, for example cassava and yams.

Crops grown in rotation and destroyed when the land is ploughed, for example alfalfa, clover and grasses, should be considered as temporary crops.

Vegetables, flowers, bulbs and kitchen and market gardens, should also be included in this category. Asparagus, strawberries, pineapples, bananas and sugar cane, for example, are sometimes grown as permanent, biennial or annual crops; the respective areas should be classified under temporary or permanent crops accordingly (FAO, 1984a).

land under temporary meadows and pastures

Land temporarily cultivated with herbaceous forage crops for mowing or pasture. A period of less than five years should be considered as temporary (FAO, 1984a).

Belonging to *arable land*.

land unit

An area of land defined in terms of land qualities and characteristics which may be demarcated on a map. A hierarchy of land units might consist of land provinces, land systems, land forms and terrain units (IDWG/LUP, 1994).

A general term used in soil surveys, land suitability classification and land-use planning.

See also *land management units*

land use

Land use is characterized by the arrangements, activities and inputs people undertake in a certain land cover type to produce, change or maintain it (FAO, 1997a). Land use defined in this way establishes a direct link between land cover and the actions of people in their environment.

Not to be confused with land cover. A crop is not a land use.

Recreation area is a land use term that may be applicable for different land cover types: for instance sandy surfaces like a beach, a built up area like a lunapark, a forest, etc.

land-use planning

The systematic assessment of land and water potential, alternative patterns of land use and other physical, social and economic conditions, for the purpose of selecting and adopting land-use options which are most beneficial to land users without degrading the resources or the environment, together with the selection of measures most likely to encourage such land uses.

land-use potential

A theoretical application for land use in a specific area as the result of the land suitability assessment (bio-physical) and the human and capital resources assessment (socio-economic potentials) (Verheye, personal communication).

The physical resources refer to climatic conditions, land form patterns and soil and moisture properties which are relatively stable over time, whereas human and capital resources are much more variable (Verheye, personal communication).

land-use system

A specified *land utilization type* practised on a given land unit, and associated with inputs, outputs and possibly land improvements (FAO, 1976).

A new definition is still under discussion.

land utilization type (LUT)

A use of land defined in terms of a product, or products, the inputs and operations required to produce these products, and the socio-economic setting in which production is carried out (FAO, 1976).

In the context of rainfed agriculture referring to a crop, crop combination or cropping system with a specified technical and socio-economic setting.

In the strict meaning of the term, describes a synthetic, simplified, representative land-use type, for the purpose of land suitability evaluation.

It is necessary to distinguish between the LUT, as described above, and an actual, or real land use observed and described in the field.

leaching

The removal of soluble salts by water percolating through the soil (FAO, 1996d).

leaf area index

The total area of green leaves per unit area of ground covered. Usually expressed as a ratio (WMO, 1990).

This concept was first introduced as leaf area divided by area of ground per plant (Evans, 1972).

legend

Application of a classification system in a particular area using a defined mapping scale and a particular data set. Therefore, a legend may contain only a proportion, or sub-set, of all possible classes of the classification (FAO, 1997a).

Thus, a legend is:

- scale and cartographic representation dependent, e.g. occurrence of mixed classes,
- data and mapping methodology dependent, and
- different legends which do not have a common reference classification system cannot be compared and correlated.

length of growing period (LGP)

The continuous period of the year when precipitation exceeds half of Penman evapotranspiration plus a period required to evapotranspire an assumed soil moisture reserve *and* when mean daily temperature exceeds 6.5 degrees Celsius (FAO, 1996a).

See also *growing period*

See also *potential evapotranspiration*

ley pasture

A sown pasture used for a specific period of time and which is alternated with crops (Mack & Reynolds, personal communications).

Opposite of *permanent pasture*

ley system, see *ley pasture*

life cycle

Successive series of changes through which an organism passes in the course of its development (Abifarin, 1984).

See also *plant development cycle*

life form A life form is a group of plants having certain morphological features in common (Kuechler & Zonneveld, 1988).

See also *growth form*

livestock

Refers to all animals kept or reared, mainly for agricultural purposes (FAO, 1996b).

Includes *aquaculture* for fish production.

livestock unit (LU)

A standard liveweight unit for all grazing animals based on their respective liveweight.

A common LU is 500 kg with adult cattle representing 1.0 LU, and an adult sheep representing 0.1 LU (Mack, personal communication).

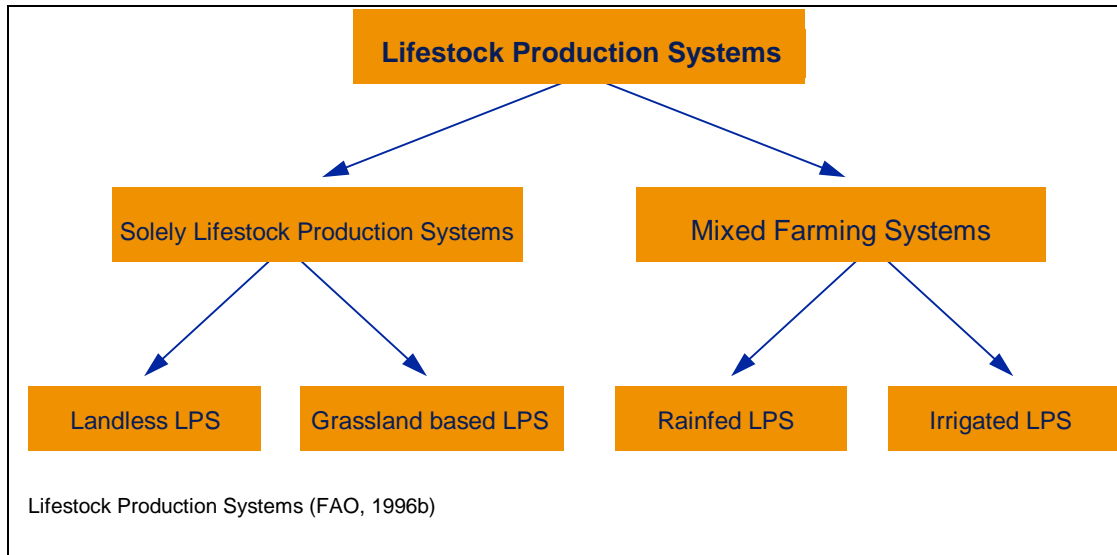
See also *tropical livestock unit*

livestock systems

A subset of *farming systems*, including cases in which livestock contribute more than 10 percent to total farm output in value terms or where intermediate contributions such as animal traction or manure represent more than 10 percent of the total value of purchased inputs (FAO, 1996b).

A first-level distinction is made between solely livestock production and mixed farming systems.

The world livestock production systems are classified as follows, based on integration with crops, relation to land, agro-ecological zone, intensity of production and type of product:



M

macroclimate

The general large-scale climate of a geographic region, i.e., continental, Mediterranean or tropical climate, as distinguished from the *mesoclimate* and *microclimate* (WMO, 1990).

macropattern = spatial distribution

Macropattern is concerned with the horizontal dispersion of the vegetation (Feoli & Orlochi, 1991).

major climate

A broad climatic division, defined in terms of monthly temperatures, seasonality of rainfall and temperature regime (FAO, 1983).

major land use

A major subdivision of rural land use, such as rainfed agriculture, irrigated agriculture, grassland, forestry, recreation, aquaculture and fisheries (FAO, 1983).

managed resource protection area

Protected area managed for the sustainable use of natural ecosystems (UN-ECE/FAO, 1997).

See also *IUCN protection status categories*

mapping unit, see *land mapping unit*

= map unit

marginal land

Land which is not suitable, economical or productive in most circumstances for a generalized type of land use (agriculture, forestry, intensive grazing) due to the presence of climatic, soil-associated or geographic constraints. Land which therefore requires extensive remedial action of one or more biophysical constraints to make its general productive use possible and protect it from degradation (Soil Resources, Management and Conservation Service, FAO, 1997).

mesoclimate

The climate of small areas of the earth's surface which may not be representative of the general climate of the district (WMO, 1990).

microclimate

Climate of the air space which extends from the very surface of the earth to a height where the effects of the immediate character of the underlying surface can no longer be distinguished from the general local climate (WMO, 1990).

Currently the most studied broad types are: the urban microclimate, the vegetation microclimate and the microclimate of confined spaces, i.e., greenhouses.

mixed cropping

As defined by Ruthenberg *et al.* (1980), this includes the growth of two or more crops simultaneously on one plot

Usually involves relay planting.

This term is therefore closely linked to multiple cropping.

mixed farming

Farming involving crops, livestock and/or trees (ASA, 1976).

In particular this includes livestock systems in which more than 10 percent of the dry matter fed to animals comes from crop by-products/stubble **or** more than 10 percent of the total value of production comes from non-livestock farming activities (FAO, 1996b).

mixed sward

A pasture comprising both grass and legumes species (Mack, personal communication).

A sward is defined as a population of herbaceous plants characterized by a relatively short growth habit and relatively continuous ground cover. Therefore a mixed sward is comprised of various herbaceous plants which may include both grass and legumes (Reynolds, personal communication).

monoculture

The repetitive growing of the same sole crop on the same land (ASA, 1976).

multiple cropping

Cultivation of two or more crops on the same field in a year (ASA, 1976).

The concept of multiple cropping includes cropping practices where sole or mixed crops are growing in sequence, simultaneously, or with an overlapping period (Andrews and Kassam, in ASA, 1976, modified).

A distinction is made between *sequential cropping* and *intercropping*. Both can be further subdivided into the major multiple cropping patterns (Sanchez, in ASA, 1976).

Sequential cropping:

- growing two/three/four crops a year in sequence,
- ratoon cropping.

Intercropping:

- mixed/row/strip intercropping (simultaneously),
- relay intercropping (overlapping).

N

national park

Protected area managed mainly for ecosystem protection and recreation (UN-ECE/FAO, 1997).

See also *IUCN protection status categories*

natural monument

Protected area managed mainly for conservation of specific natural features (UN-ECE/FAO, 1997).

See also *IUCN protection status categories*

natural resources

Any portion of the natural environment, such as air, water, soil, botanical and zoological resources, and minerals (FAO, 1997b).

A subdivision is often made into *renewable* and *non-renewable* natural resources.

natural vegetation

Natural vegetation areas are defined as areas where the vegetative cover is in balance with abiotic and biotic forces of its biotope (FAO Land Cover Classification). Areas dominated by native or naturalized vegetation that has not been cultivated or treated with any annual management or manipulation regime.

In cases where it cannot be assessed whether the vegetation was planted or cultivated by humans, the vegetation is considered "natural/semi-natural." (FGDC, 1997).

natural/semi-natural - areas

See also *natural vegetation*

See also *semi--natural vegetation*

needle-leaved = coniferous

net farm income

The combined *gross margins* from enterprises on a farm, minus the fixed costs (FAO, 1983)

nomadism

1. Systems in which animal owners do not have a permanent place of residence. As they are not practising regular cultivation they move with their herds (Ruthenberg *et al.*, 1980).
2. A livestock production system where animals migrate continually in search of grazing (Mack, personal communication).

Non built-up area

Areas which are characterized by the lack of a fixed definable cover though a preliminary removal of vegetation took place. This includes waste dumps and extraction sites.

See also *construction works*

See also *built-up area*

non-renewable resources

Resources that may eventually be replaced by natural processes (such as coal, oil and fossil water), but these occur over long periods of geologic time rather than within the time frame of current civilization, and their consumption necessarily involves their depletion (FAO, 1997b).

non-tidal water regime

According to Cowardin *et al.* (1979), a distinction is made as follows:

a) permanently flooded; b) intermittently flooded; c) semi-permanently flooded; d) seasonally flooded; e) saturated; f) temporarily flooded; g) intermittently flooded; h) artificially flooded.

See also *tidal water regime*

non-vegetated

Areas which have a total vegetation cover of less than four percent during at least ten months of the year (FAO, 1997a).

non-wood forest products

The term “non-wood forest products” (NWFP) and the similar terms “minor-”, “secondary-”, and “non-timber-” forest products have emerged as umbrella expressions for the vast array of both animal and plant resources other than wood (or timber in the case of “non-timber-”) derived from forests or forest tree species. NWFP may be gathered from the wild, produced as (semi-) domesticated plants in plantations or in agroforestry schemes, or produced in intermediate production systems of varying degrees of domestication. Their wild or semi-domesticated status distinguishes them from well-established agricultural crops such as oilpalm, cocoa, coconut, rubber or coffee (Vantomme, personal communication).

O

open access resources

Any natural resource that does not have a barrier or obstacle to its use or exploitation; sometimes also referred to as non-property resources (IDWG/LUP, 1994).

Examples are many types of fisheries, the ocean, certain freshwater resources, including great lakes and, in the absence of regulation or control, many upland forests resources. Because these resources are available free or at minimum cost, they are frequently overexploited, leading to degradation, pollution or exhaustion (IDWG/LUP, 1994).

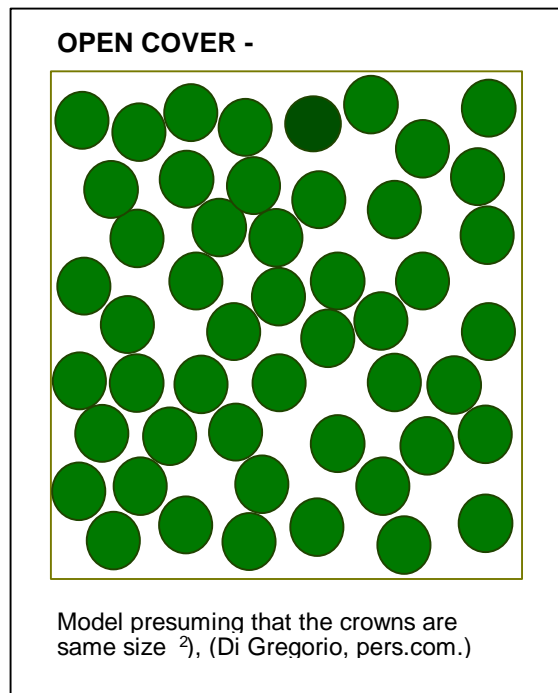
open vegetation cover

In the case of trees and shrubs the crowns are usually no longer interlocking. The distance between the perimeters can range from very slight up to twice the average diameter (Eiten, 1968).

The percentage of open cover varies with different approaches:

1. Between 70-60 percent and 20-10 percent of a defined area is covered by a certain vegetation layer (according to Eiten, 1968; adopted in the land cover classification, FAO, 1997a). Woodland is defined with an open layer of trees.
2. In the forest resources assessment (FAO, 1995b) the land cover class "open forest" is defined with a canopy coverage of 10 to 40 percent.

See also *vegetation cover*



other wooded land

Land either with a tree crown cover (or equivalent stocking level) of 5-10 percent of trees able to reach a height of 5 m at maturity *in situ*; or a crown cover (or equivalent stocking level) of more than 10 percent of trees not able to reach a height of 5 m at maturity *in situ* (e.g. dwarf or stunted trees) and shrub or bush cover practices (UN-ECE/FAO, 1997).

Excludes: Areas having the tree, shrub or bush cover specified above but of less than 0.5 ha and width of 20 m, which are classed under "other land" ; land predominantly used for agricultural practices (UN-ECE/FAO, 1997).

See also *forest*

overlapping cropping system see *relay intercropping*

This only refers to crops with briefly overlapping growing periods as described under *relay intercropping*. An overlap which lasts for the whole cultivation period, e.g. if annual or biennial plants are planted into a stand of perennial plants it is considered under *intercropping* (=simultaneous cropping).

P

parcel

A contiguous piece of land with identical uniform tenure and physical characteristics. It is entirely surrounded by land with other tenure and/or physical characteristics, or by infrastructure, e.g. roads or water. A parcel may consist of one or two fields adjacent to each other (FAO, 1995a).

pastoral territories

Land traditionally exploited for livestock production by herders and managed under extensive grazing systems (Batello, 1997, personal communication).

percolation

A qualitative term applying to the downward movement of water through soil which is saturated or nearly so at hydraulic gradients of one or less (USDA, 1954).

Percolation is the movement of water within the soil body whereas *infiltration* is the movement of the water through the soil surface into the soil body (ICID, 1975).

perennial plants

Plant species with a life-cycle that characteristically lasts more than two years. The plants may flower annually (IBPGR, 1991).

See also *annual plants*

See also *biennial plants*

permaculture

Permaculture is a concept to create and maintain sustainable human environments. It involves elements like plants, animals, buildings and infrastructure (water, energy, communications). In a broader perspective permaculture concerns the relationships between these elements and the way they are placed in the landscape. The aim is to create systems that are ecologically sound and economically viable, which provide for their own needs, do not exploit or pollute, and are therefore sustainable in the long term (Mollison, 1991).

permanent cropping, see *land under permanent crops*

permanent cultivation

Farming systems in which fallows or leys are rare and for a short term, interpolated between the cultivation of arable crops. The intensity of rotation, expressed as *R*, is more than 66 percent years (Ruthenberg *et al.*, 1980).

R is calculated as the years of cultivation multiplied by 100 and divided by the length of the cycle of land utilization. This indicates that more than 66 percent of the area which is available for farming is under cultivation. In other words, the land is cultivated more than 66 percent of the years (Ruthenberg *et al.*, 1980).

Permanent cultivation systems are characterized by:

- a permanent division within the holding between *arable land* and *grassland*;
- clearly demarked fields;
- the dominance of *annual* or *biennial* crops.

See also *land cultivation systems*

permanent pasture

Long established pasture that is not renewed on a regular basis (Mack, personal communication).

See also *land under permanent meadows and pastures*

permanent wilting point

The permanent wilting point of a soil is the amount of moisture present when plants first become permanently wilted; that is, when they wilt and do not regain turgidity unless water is added to the soil (WMO, 1990).

permanently flooded

Water covers the land surface at all times of the year in all years (Cowardin *et al.*, 1979).

See also *non-tidal water regimes*

phenological requirement

A plant (crop) requirement for certain environmental conditions to occur at times which are related to the plant (crop) growth cycle (FAO, 1996a, modified).

plant community

Any collection of plants living and growing together and which possesses a certain unity and individuality. The community comprises a typical species composition that has resulted from the interaction of populations over time (IDWG/LUP, 1994).

plant development cycle

Agronomically this encompasses all the growth stages of a particular plant (crop) from germination to maturity. The growth cycle is dependent on the genotype of the plant and the environment in which the plant is grown. The plant passes from one state to another in an organized manner via a number of processes (Soffe, 1995).

See also *life cycle*

plant growth stage, see *plant phenology*, *plant development cycle*

plant phenology

Periodic biological phenomena in relation to environmental conditions and the *plant development cycle*. The different phenological events describe the stages of plant growth (WMO, 1990, modified).

plantation, see *forest plantation*, *compact plantation*

planted/cultivated areas

Areas where the natural vegetation has been removed or modified and replaced by different types of vegetative cover resulting from anthropic activities. This vegetation is artificial and requires human activities to be maintained over the long term. In between the human activities or before starting crop cultivation, the surface can be temporarily without vegetative cover. Its seasonal phenological appearance can be regularly modified by humans (e.g. irrigation). All vegetation that is planted or cultivated with the intent to harvest is included in this class (e.g. wheat fields, orchards, rubber and teak plantations) (FAO, 1997a).

potential evapotranspiration (PET)

Maximum quantity of water capable of being lost, as water vapour, in a given climate, by a continuous stretch of vegetation covering the whole ground and well supplied with water. It thus includes evaporation from the soil and transpiration from the vegetation from a specific region in a given time interval (WMO, 1990).

Reference crop evapotranspiration calculated according to the Penman method:

$$\text{PET} = C [\text{WR}_n + (1-W) f(u) (e_a - e_d)] \quad [\text{mm/day}]$$

- W: temperature related weighting factor
R_n: net radiation in equivalent evaporation [mm/day]
f(u): wind-related function
(e_a-e_d): water saturation deficit, difference between the saturation vapour pressure at mean air temperature and the mean actual vapour pressure of the air [hPa]
C: adjustment factor to compensate for the effect of day and night weather conditions

See also *reference evapotranspiration (ET_o)*

potential yield.

The maximum realizable yield that can be achieved by a given crop cultivar in a given area, based on radiation and temperature (FAO, 1996a).

In terms of **fish production**, the sustainable yield that can be achieved (a) from a given water body (e.g. lakes, reservoirs, rivers, lagoons, etc.), based on its natural productivity, through capture fisheries including enhancement measures, or (b) through aquaculture practices on land (using ponds, tanks, etc.) or in water bodies (using cages, pens, rafts, etc.) (Inland Water Resources and Aquaculture Service, FAO, 1997)

precipitation

Aggregate of aqueous particles, liquid or solid, crystallized or amorphous, which fall from a cloud or group of clouds and reach the ground (WMO, 1990).

produce

Products (e.g., crops, livestock, fish products, timber), services (e.g. recreational facilities, military training facilities) or other benefits (e.g. wildlife conservation) resulting from the use of land (FAO, 1976).

This wider concept of a crop is absolutely necessary in land-use planning, agricultural development, or extension, where the optimum defined in terms of farmer or government objectives sustainable land use for a given combination of physical, social and economic conditions must be identified. When present or traditional land use is becoming uneconomic or is causing environmental degradation and alternative land use needs to be identified, the possibilities must not be restricted to the same type or class of use.

product, see *commodity*

production system.

A particular series of activities (the management system) carried out to produce a defined set of commodities or benefits (produce) (FAO, 1996a).

productivity The rate of energy accumulation of a system, e.g. soil, land, agriculture (Stocking, 1984).

The productive agricultural potential is measured as *biomass*.

Soil productivity is expressed as the accumulation of energy in the form of vegetation (FAO, 1984b).

Biomass productivity is the amount produced in an area during a given period of time (Roetheli *et al.*, in Arntzen & Ritter, 1994).

protected area

A geographically defined area which is designed and managed to achieve specific conservation objectives (FAO, 1997b).

See also *conservation*

protected landscape/seascape

Protected areas managed mainly for landscape/seascape conservation and recreation.

See also *IUCN protection status categories*

See also *protected area*

R

rainfed cultivation

The crop establishment and development are completely sustained by rainfall (Euroconsult & Ministerie van Landbouw , 1988, modified).

ranching

Commercial raising of grazing animals, mainly for meat, under extensive production systems usually with controlled boundaries and paddocks (Mack, personal communication).

ratoon cropping

Two or more crops are taken consecutively from a stand (Ruthenberg *et al.*, 1980).

Significant ratoon crops are sugarcane or sorghum.

Ratoon cropping is a form of *sequential cropping*.

recommendation domain, see *agro-ecological zoning*

reference evapotranspiration (ET_o)

The FAO expert consultation (FAO, 1991), reached unanimous agreement in recommending the Penman-Monteith approach as the best performing method to estimate evapotranspiration of a reference crop and adopted the estimates for bulk surface and aerodynamic resistance as elaborated by Allen *et al.* (1989) as standard values for the reference crop.

The adoption of fixed values for crop surface resistance and crop height required an adjustment of the concept of reference evapotranspiration which was redefined as follows:

Reference evapotranspiration is the rate of evapotranspiration from a hypothetical reference crop with an assumed crop height (12 cm), a fixed crop surface resistance (70 s m⁻¹) and albedo (0.23), closely resembling the evapotranspiration from an extensive surface of green grass cover of uniform height, actively growing, completely shading the ground and with adequate water.

Thus defined, the Penman-Monteith equation used for 24-hour calculations of reference evapotranspiration and using daily or monthly mean data can be simplified as follows:

$$ET_o = \frac{0.408 \Delta (R_n - G) + g \frac{900}{T + 273} U_2 (e_a - e_d)}{\Delta + g(1 + 0.34 U_2)}$$

where:

ET _o	:	reference crop evapotranspiration [mm d ⁻¹]
R _n	:	net radiation at the crop surface [MJ m ⁻² d ⁻¹]
G	:	soil heat flux [MJ m ⁻² d ⁻¹]
T	:	average air temperature [°C]
U ₂	:	wind speed measured at 2 m height [m s ⁻¹]
(e _a -e _d)	:	vapour pressure deficit [kPa]
*	:	slope of the vapour pressure curve [kPa °C ⁻¹]
*	:	psychrometric constant [kPa °C ⁻¹]
900	:	conversion factor

Full details of the FAO Penman-Monteith method and procedures for determining the various parameters, algorithms, recommended values and units are included in the proceedings of the consultation (FAO, 1991), and in the ICID Bulletin Vol. 43, no 2 (Allen *et al.*, 1994a; 1994b).

regeneration

Re-establishment of a forest stand by natural or artificial means following the removal of the previous crop by felling or as a result of natural causes, e.g. storm or fire (UN-ECE/FAO, 1997).

relay intercropping, = relay planting

A special form of *intercropping* with an *overlapping* period of each one's life cycle (acc. to ASA, 1976).

In practice a maturing crop is interplanted with seeds or seedlings of the following crop (Ruthenberg *et al.*, 1980). The first crop is interplanted after it has reached its reproductive stage of growth but before it is ready for harvest.

renewable resources

A resource that can potentially last indefinitely (provided stocks are not overexploited) without reducing the available supply because it is replaced through natural processes (either because it recycles quite rapidly, such as water, or because it is alive and can propagate itself or be propagated, such as organisms and ecosystems) (FAO, 1997b).

resources, see *natural resources*

resource management domains

Regions designated for identical treatments, i.e., land development plans or nature conservation programmes, and classified on the basis of ecological-economic zoning (FAO, 1996a).

risk

Risk, as a technical term, is defined as the product:

risk = magnitude of hazard x probability of occurrence (Nash & Nash, 1995).

This is a measure of the probability that damage to life, health, property and/or the environment will occur as a result of a given hazard (UNEP, pers. com., modified by Tschirley, FAO, 1997) and the magnitude of the consequences of the effect occurring (ISO, 1996).

See also *hazard*

risk assessment

Component of risk management which comprises all processes concerned with identification, estimation and qualitative and quantitative evaluation of risks. Risk assessment consists of hazard identification, hazard assessment, risk estimation and risk reduction (ISO, 1996).

The terms risk management and risk assessment are used in many different ways, in different contexts and jurisdictions and by different professions. There is often little consistency of use even within one country (ISO, 1996) It is therefore recommended that these terms are explained in the context in which they are intended to apply.

Example: In the environmental context the risk is posed to human health and/or the environment by the actual or potential presence and/or use of specific pollutants (UNEP, pers. com., modified by Tschirley, FAO, 1997).

See also *risk management*

risk management

The process of evaluating and selecting regulatory and non-regulatory responses to risk. The selection process necessarily requires the consideration of legal, economic and behavioural factors (UNEP, pers. com., modified by Tschirley, FAO, 1997).

The terms risk management and risk assessment are used in many different ways, in different contexts and jurisdictions and by different professions. There is often little consistency of use even within one country (ISO, 1996) It is therefore recommended that these terms are explained in the context in which they are intended to apply.

See also *risk assessment*

river basin, see *watershed, basin*

rotational grazing

A system in which animals are rotated through a series of fenced paddocks resulting in high grazing intensities over short periods of time (Mack, personal communication).

runoff

Portion of total precipitation from a given area that appears in natural or artificial surface streams (ICID, 1975).

rural communities

Systems which comprise many farm- and non-farm-households, both of which can be further subdivided and interactive (FAO, 1990).

See also *farming systems approach to development*

S

salinity

The relative concentration of salts, usually sodium chloride, in a given soil or water (ICID, 1975, modified).

See also *electrical conductivity*

See also *water salinity*

salinization

The accumulation of soluble salts at the surface or at some point below the surface of the soil profile (ICID, 1975) to levels that have negative effects on plant growth and/or on soils (FAO, 1996d). This occurs due to water evaporation leaving behind salts that were dissolved in water (WMO, 1997).

savanna

Savanna vegetation is characterized by a continuous graminoid stratum, more or less interrupted by trees or shrubs. The climate associated with savanna lands is always seasonal wet, warm to hot summers alternating with more or less dry, warm to cool winters (Tothill & Mott, 1985).

The use of the word *savanna* differs according to the cultural and scientific background. Thus a precise definition is lacking though the term *savanna* is useful in identifying, by structure and function, some unity of vegetation types determined by environmental controls such as climate, soils and fire and providing humans with a particular type of agronomic and pastoral resource (Tothill & Mott, 1985).

scrub, see *shrubland*

semi-natural vegetation

Semi-natural vegetation is defined as vegetation not planted by humans but influenced by human actions. These may result from grazing, possibly overgrazing the natural phytocenoses, or else from practices such as selective logging in a natural forest whereby the floristic composition has been changed; also previously cultivated areas which have been abandoned and where vegetation is regenerating are included. A further example is the secondary vegetation developing during the fallow period of the shifting cultivation practice. The human disturbance may be deliberate or inadvertent. Semi-natural vegetation thus includes, vegetation due to human influences but which has recovered to such an extent that species composition and environmental and ecological processes are indistinguishable from, or in a process of achieving, its undisturbed state (FAO, 1997a).

sequential cropping

A multiple cropping pattern which is characterized by two or more crops in sequence growing on the same field within a year. The succeeding crop is planted after the preceding one has been harvested. In other words, the farmer manages only one crop at a time in the same field. There is no intercrop competition (ASA, 1976).

See also *multiple cropping*

See also *ratoon cropping is a special form of sequential cropping*.

set stocking

A system where the grazing animals remain throughout the season on the same area of land resulting in lower, but continuous, grazing pressure (Mack, personal communication).

See also *grazing pressure*

shifting cultivation

The growing of crops for a few years on selected and cleared plots alternating with a lengthy period of vegetative fallow when the soil is rested. Cultivation consequently shifts within an area that is otherwise covered by natural vegetation. The intensity of rotation, expressed as *R*, is less than 33 percent (Ruthenberg *et al.*, 1980).

R is calculated as the years of cultivation multiplied by 100 and divided by the length of the cycle of land utilization. This indicates that less than 33 percent of the area which is available for farming, is under cultivation. In other words, the land is cultivated for less than 33 percent of the years (Ruthenberg *et al.*, 1980).

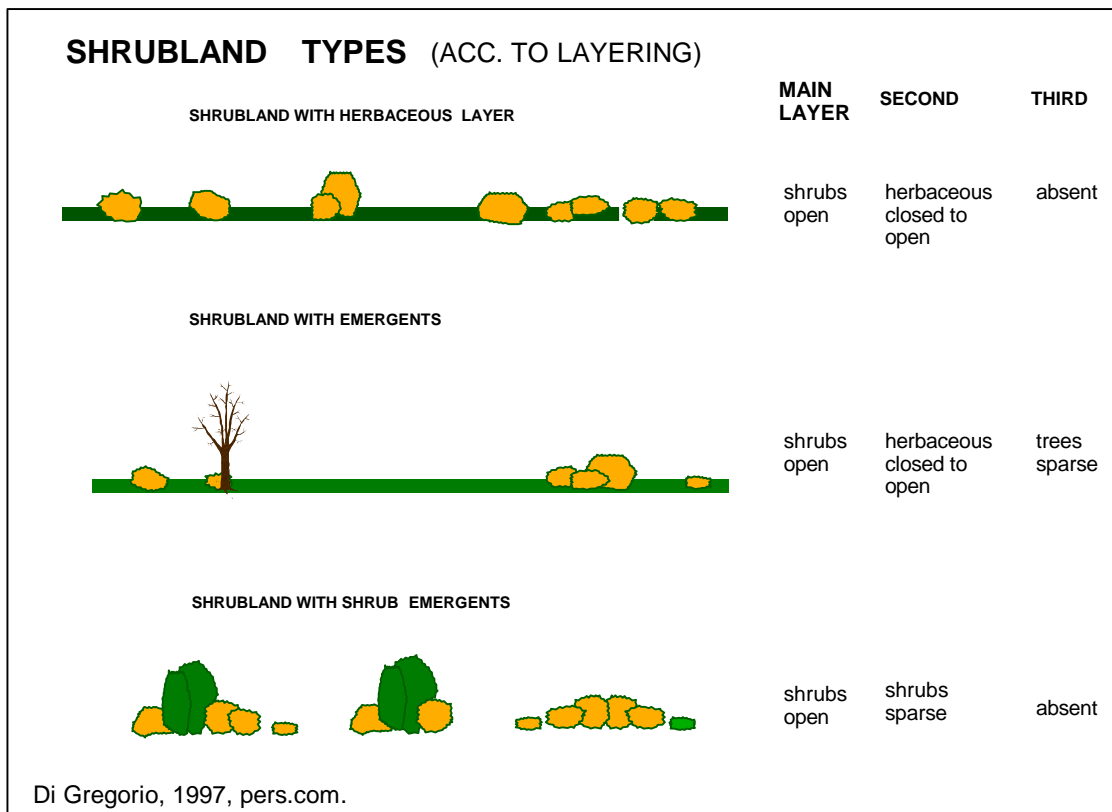
See also *land cultivation systems*

short-cycle species

Animal species with a short reproductive cycle and a short generation interval (i.e., sheep, goats, pigs and poultry).

shrubland = scrub, brushland

Areas covered with woody vegetation mainly composed of shrubs (generally more than 0.5 m and less than 5 m tall) with most of the individual shrubs not touching each other (UNESCO, 73).



shrubs

Woody perennial plants with persistent and woody stems and without any defined main stem (Ford-Robertson, 1971), and generally of more than 0.5 m and less than 5 m height.

simultaneous cropping system

See also *intercropping*

single cropping

Cultivation system in which a single crop species covers a plot of land, i.e., a monocultural cropping system (Euroconsult & Ministerie van Landbouw, 1989).

The cover duration is limited to the harvest stage.

Opposite of *Intercropping*

See also *monoculture*

soil

The upper layer of the earth's crust composed of mineral parts, organic substance, water, air and living matter. Soils are the result of interactions between the inherent nature of parent material, the prevailing environmental conditions and human activities (ISO, 1996).

soil and water conservation concepts

A distinction is made between two concepts of soil and water conservation (Roose, 1993, in De Graaf, 1996). One focuses the runoff with its increasing erosive energy that needs to be checked by mechanical measures, whereas the other estimates the impact of raindrops that needs to be minimized through adequate vegetative cover.

soil conservation, see *conservation, soil and water conservation concepts*

soil conservation measures

Comprises any set of measures intended to control or prevent soil erosion or to maintain fertility (Stocking *et al.*, 1989, in De Graaf, 1996).

soil conservation practices

Practices of land management, cultivation systems, land management and small construction works for correcting, preventing or reducing soil degradation (ISSS, 1996).

soil degradation

Decline in soil qualities commonly caused through improper use by humans (ISSS, 1996).

This includes physical, chemical and/or biological deterioration. Examples are loss of organic matter, decline in soil fertility, decline in structural condition, erosion, adverse changes in salinity, acidity or alkalinity, and the effects of toxic chemicals, pollutants or excessive flooding (Houghton & Charman, 1986, in ISSS, 1996).

See also *land degradation*

soil moisture content

The percentage of water in the soil (ICID, 1975).

Water in the soil available to plants. It is normally taken as the water amount in the soil between wilting point and field capacity (WMO, 1990).

soil structure

The arrangement of soil particles (sand, silt, clay, organic matter) into aggregates which occur in a variety of recognized shapes and sizes (ICID, 1975).

The soil structure has an impact on the *infiltration rate* (FAO, 1985c).

A favourable soil structure can be obtained by cultural practices like ploughing, mulching, ridging etc. (FAO, 1985c).

soil texture

Characterization of soil in respect to its particle size (FAO, 1985c).

A distinction is made as follows:

a) coarse textured soils with sand predominating; b) medium textured soils with silt predominating; c) fine textured soils with clay predominating.

The soil texture has an impact on the *infiltration rate*.

soil type.

A specific unit of soil with definable ranges of characteristics. May correspond to the lowest hierarchical unit of a soil classification system, including specification of phase (FAO, 1996a).

soil water

Water available in the root zone from earlier rain, snow or irrigation which partly or fully meets the requirements of a crop (FAO, 1989). The water is suspended in the uppermost belt of the zone of aeration. It is lying near enough to the surface to be discharged into the atmosphere by the transpiration of plants or by evaporation from the soil (ICID, 1975).

soil water content

The water lost from the soil upon drying to constant mass at 105°C (Kirkham, in Arntzen & Ritter, 1994).

This is expressed either in units of water per unit mass of dry soil (kg/kg) or in volume of water per unit volume of soil (m^3/m^3) (Kirkham, in Arntzen & Ritter, 1994).

sole cropping see *single cropping*

solely livestock production

Livestock systems in which more than 90 percent of dry matter fed to animals comes from rangelands, pastures, annual forages and purchased feeds **and** less than 10 percent of the total value of production comes from non-livestock farming activities (FAO, 1996b).

sparse vegetation cover

The distance between two perimeters of a *life form* is more than twice the average perimeter diameter (Eiten, 1968).

In many cases a sparse life form might be associated with another life form of a greater cover continuity, e.g. savannas are characterized by sparse trees standing out from a herbaceous closed or open layer.

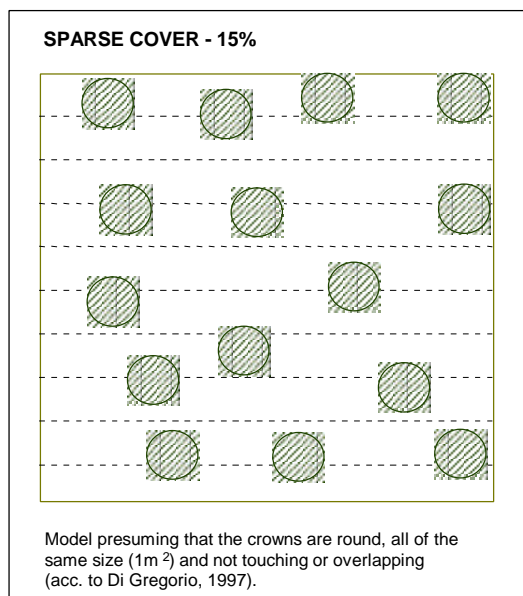
Percentage of sparse cover:

between 20-10 percent and 1 percent of a defined area is covered by a certain vegetation layer (according to Eiten, 1968; adopted in the land cover classification, FAO, 1997a).

spatial distribution, see *macropattern*

stakeholders

A large group of individuals and groups of individuals (including governmental and non-governmental institutions, traditional communities, universities, research institutions, development agencies and banks, donors, etc.) with an interest or claim (whether stated or implied) which has the potential of having an impact on a given project and its objectives. Stakeholder groups that have a direct or indirect "stake" can be at the household, community, local, regional, national or international levels (FAO, 1997b).



steppe

Term usually applied to areas with rainfall of < 500-600 mm per year and a dry season of 8-9 months. Open herbaceous formations, perennial graminæ often widely spaced generally not exceeding 80 cm in height with annuals interspaced (Reynolds, 1997; Pandeya & Jain, 1979).

Term originally applied to areas in Siberia and SE Europe. Distinguished from Savannah by less dense grass cover and by xeromorphic character and annual nature of many species. Woody plants are often thorny or succulent. Different types may be recognized according to the character of the woody layer, e.g. grass steppe, dwarf-shrub steppe etc. (Reynolds, 1997, pers. com.; Pandeya & Jain, 1979).

stocking rate

The number of grazing animals per unit of land. Usually given as a recommendation and expressed as hectares/livestock unit (ha/LU) (Reynolds, 1995).

In more intensive systems it is expressed as LU/ha. This will vary according to production objectives (Reynolds, 1995).

See also *overstocking*

stratification

In vegetation science stratification describes the vertical layering of vegetation (FAO, 1997a).

strict nature reserve/wilderness area

Protected area managed mainly for science or wilderness protection (UN-ECE/FAO, 1997).

See also *IUCN protection status categories*

subsistence farming

Farming system emphasizing production for use rather than for sale (Lipton, 1995).

surface water

- a) All waters on the surface of the earth, including fresh and salt water, ice and snow, as distinguished from subterranean water; oceans, lakes, rivers etc. (Lo, 1992).
- b) The runoff from paved or unpaved land, or from buildings, as distinct from sewage (Lo, 1992).

sustainable development = Sustainable Agriculture and Rural Development (SARD)

The management and conservation of the natural resource base, and the orientation of the 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 the agriculture, forestry and fishery sectors concerns land, water, plant and animal genetic resources, is environmentally non-degrading, technically appropriate, economically viable and socially.

synusia

An association of plant species with a similar life form and similar ecological requirements occurring together in the same habitat; sometimes called a "union". Most habitats are occupied by several synusiae, which may grow above each other in layers, beside each other, or in mixture; for example, an open tree synusia or layer over a grass-dominated synusia or layer (FGDC, 1997).

T

temporarily fallow, see *land temporarily fallow*, *fallow systems*

temporary arable cropping, see *land under temporary crops*

tidal water regime

The water regimes are determined by oceanic tides. This includes different relations between water cover and substrate exposition (Cowardin *et al.*, 1979): a) the substrate is permanently flooded with tidal water (subtidal), b) the land surface is exposed by tides less often than daily (irregularly exposed), c) tidal water alternately floods and exposes the land surface at least once daily (regularly flooded), d) Tidal water floods the land surface less often than daily (irregularly flooded).

See also *non-tidal water regime*

tied ridge

Placing bunds or ridges along the contour, connected at intervals by ridges along the slope (ISSS, 1996).

The aim is to reduce runoff and increase infiltration and water storage (ISSS, 1996).

top soil

The upper part of a soil, with the lower limit set at 30 cm or shallower. The soil depth may be limited by a root growth inhibiting layer which can be hard rock, a pedogenetically indurated layer, a chemically unfavourable layer, or a strongly contrasting layer (FAO, 1995d).

topography

Refers to the differences in elevation of the land surface on a broad scale. It is derived from the most representative or characteristic slope gradient of the area around the site (FAO, 1990).

total area

Area of a country, including area under inland water bodies, but excluding offshore territorial waters (UN-ECE/FAO, 1997).

See also *land area*

toxicity

Reaction of plants due to certain constituents in the soil or water which are taken up by the plants and accumulated to high concentration. This results in plant damage or reduced yields of crops. The degree of plant damage depends on the uptake and the crop sensitivity (FAO, 1989).

trade-off

The value of something which has to be given up in order to get something else which is desired (e.g., the environmental cost incurred to obtain economic development).

Sustainability can be evaluated by the sum of the various social, economic and natural resources where the degree of use, exchange and trading among resources will vary according to the values given to each.

Trade-off patterns are determined by the different properties of a system, and their importance to different groups. The understanding of social dynamics and resource-use systems and the evaluation of related trade-offs, in terms of equity, productivity, resilience, and environmental stability, are useful to envision alternative development scenarios.

See also *sustainable development*

transhumance

1. Farmers with a permanent place of residence send their herds, tended by herdsmen, for long periods of time to distant grazing areas (Ruthenberg *et al.*, 1980).
2. A livestock production system where animals leave their home base for part of the year and migrate in search of grazing (Mack, personal communication).

transpiration

Process by which water from vegetation is transferred into the atmosphere in the form of vapour (WMO, 1990).

trees

A woody perennial plant with a single well defined stem or, in the case of coppice, with several stems, carrying a more or less defined crown (Ford-Robertson, 1971, modified).

Includes: a) bamboos, palms meeting the above criterion (UN-ECE/FAO, b) trees as described above being at least 3 m tall (FAO Land Cover Classification), c) woody plants without a tree-like appearance but being more than 5 m tall (FAO Land Cover Classification)

tropical livestock unit (TLU)

A LU based on 250 kg livestock which more accurately reflects the mature weight of adult cattle in developing countries (Mack, personal communication).

See also *livestock unit*

U

unconsolidated

A defined area is covered with more than 80 percent of unconsolidated material (FAO, 1997a). The surface can be penetrated by a spade or a hoe.

under-utilized crops

Species which are wild or semi-domesticated and are considered as “minor” and have been accepted by a community as an integral part of their diet or materials. They often mitigate seasonal shortages of major staples and provide rural income. They require little input as they are adapted to the local environment and are tolerant of many *biotic* and *abiotic* stresses (Griffiee, FAO, pers.com.).

unstocked forest

Forest on which tree crown cover (stand density) has been reduced to less than 10 percent or has been removed as a result of human intervention or natural causes, e.g. by felling or burning, but which is expected to revert to stocked forest (UN-ECE/FAO, 1997).

urban area

Areas used for or covered with built-up elements of the residential, commercial, industrial or institutional sector. Transportation or communication elements can be part of the urban area (acc. to Vesterby and Buist, in Arntzen & Ritter, 1994).

See also *construction works*

urban vegetated area

Areas which are enclosed by any kind of urban construction. These areas form isolated patches within the urban area (FAO, 1997a).

See also *construction works*

See also *urban area*

V

variety

A subdivision of a species which is genetically uniform due to its artificial propagation in the laboratory or in agriculture (King, 1974).

vegetated areas

Areas which have a total vegetation cover of more than four percent during at least 10 months of the year (FAO, 1997a).

vegetation cover

The vegetation cover can be considered as the proportion of a particular area of the ground, substrate or water surface covered by a layer of plants considered at the greatest horizontal perimeter level of each plant in the layer (Eiten, 68).

Cover densities commonly used are closed, open, sparse vegetation cover.

W

water

A solid, liquid or gaseous component of the lithosphere, atmosphere and hydrosphere constituting rain, ice and snow, surface water and groundwater. Other solid, liquid or gaseous materials may be dissolved or suspended (Lo, 1992).

water areas potentially productive

Under-utilized water bodies which are likely to be capable to sustain or to increase fish production through capture fisheries, aquaculture or enhancement measures (Inland Water Resources and Aquaculture Service, FAO, 1997).

water balance

Balance of inflow and outflow of water per unit area or unit volume and unit time taking into account net changes of storage (WMO, 1990).

water content

See also *soil water content*

water deficit

The *precipitation* is smaller than the *potential evapotranspiration* during a certain period of time (WMO, 1990, modified).

water infiltration rate, see *infiltration rate*

water quality = water suitability

- 1) The chemical, physical and biological characteristics of water in respect to its suitability for a particular purpose (Lo, 1992).
- 2) Applicability of water for irrigation. This is determined by the amount and the type of salt. To determine the water quality the potential of *salinity*, *water infiltration rate* and *toxicity* are taken into account (FAO, 1989).

water requirement

The quantity of water regardless of its source, required by a crop or diversified pattern of crops in a given period of time, for its normal growth under field conditions (ICID, 1975).

It includes evaporation and other economically unavoidable wastes. It may also be expressed as equal to seasonal consumptive use plus percolation as this may be unavoidable. It is usually expressed in water depth units per unit area (ICID, 1975).

water resources

Analogous to *natural resources* ; a distinction is made between renewable and non-renewable water resources.

Non-renewable water resources are not replenished at all or for a very long time by nature. This includes the so-called fossil waters. Renewable water resources are rechargeable due to the hydrological cycle unless they are not overexploited, comprising groundwater aquifers and surface water like rivers and lakes (WMO, 1997).

Internal renewable water resources comprise the average annual flow of rivers and groundwater generated from endogenous precipitation (FAO, 1995c).

water salinity

According to the US Geological Survey classification:

Fresh Water: less than 1000 ppm of Total Dissolved Solids (TDS).

Slightly saline: 1 000 - 3 000 TDS

Moderately saline: 3 000 - 10 000 TDS

Very saline: 10 000 - 35 000 TDS

Brine: more than 35 000 TDS; water saturated or nearly so with salt.

The use of the term “salinity” (and its determination) can vary among hydrologists, geologists, limnologists, oceanographers, marine biologists and experts in aquatic chemistry. There are significant variations in composition of constituents and their concentrations in natural waters. Bicarbonates and calcium predominate in freshwaters, while chlorides, sodium, and sulphate prevail in marine waters. As a general rule, **inland waters** (less than 1 ppt) can be distinguished from **brackish** (from 1 to 34 ppt) and **marine** waters (35 ppt). The distinction between **inland** and **coastal waters** is important given the many wetlands, lagoons, estuaries, etc. in the coastal zone. There are saline inland waters which may have values for “salinity” higher than marine waters (Inland Water Resources and Aquaculture Service, FAO, 1997).

water table

The upper boundary for groundwater at which the pressure in the groundwater is equal to atmospheric pressure (USDA, 1954). The body of groundwater is not confined by an overlying impermeable formation (ICID, 1975).

Not to confuse with *water surface* which in permeable material, in general, is above the water table (ICID, 1975).

water use

The withdrawal of water for domestic, industrial and agricultural (including fish culture) purposes (WMO, 1997), power production, transportation and recreation.

The main part of water withdrawn by industries is returned to lakes and rivers after being used, often degraded in quality. Water for agricultural purposes (irrigation) is partly consumed by crops, and partly required to flush salts out of the soil (WMO, 1997).

waterlogging

State of and in which the subsoil *water table* is located at or near the surface (ICID, 1975). In other words access water is accumulated in the root zone of the soil (FAO, 1996d).

If the land is cultivated this results in a reduced yield of crops commonly grown. Uncultivated land is limited in its use because of the high subsoil water table (ICID, 1975).

watershed, = catchment, catchment area, drainage area, drainage basin, river basin (UNESCO/WMO, 1992; ISSS, 1996)

The area which supplies water by surface and subsurface flow from rain to a given point in the drainage system (ISSS, 1996).

See also *basin*

wetland

Land where saturation with water is the dominant factor determining the nature of soil development and the types of plant and animal communities living in the soil and on its surface. The single feature that most wetlands share is soil or substrate that is at least periodically saturated with or covered by water. The water creates severe physiological problems for all plants and animals except those that are adapted for life in water or in saturated soil (Cowardin *et al.*, 1979).

woodland

Characterized by an open, even or uneven tree layer. A herbaceous layer and/or sparse or open shrub layer can be present or not, but the trees are definitely dominant in the total vegetation aspect (Eiten, 1968).

woody plants

Perennial plants with stems and branches from which buds and shoots develop (Ford-Robertson, 1971).

woody grassland

A plant community in which grasses are dominant with an open or discontinuous woody (tree) stratum (Reynolds, pers. com., 1997).

Y

yield

Amount of production per unit area over a given time. A measure of agricultural production (FAO, 1984b).

2. Index

A

abiotic	8
agricultural area	8
agricultural climatology	8
agricultural holding	8
agricultural land	8
agricultural meteorology	8
agricultural production	8
agricultural region	9
agriculture	9
agroclimatic zone	9
agro-ecological cell (AEC)	9
agro-ecological region	9
agro-ecological zone	9
agro-ecological zoning (AEZ)	9
agro-economic Zones	9
agroforestry	9
annual plants	9
a-posteriori classification systems	8
a-priori classification systems	8
aquaculture	10
arable land	10
arid climate	10
artificial water bodies	10

B

bare rock	11
basin	11
biennial	11
biodiversity	11
biomass	11
biome	11
biosphere	11
biotic	11
boundary conditions	12
brackish	<i>See Water Salinity</i>
broadleaved	12
brushland	<i>See shrubland</i>
buffer Zone	12
buffer zone management (BZM)	12
built-up area	12

C

canopy cover	<i>see vegetation cover</i>
carrying capacity	13
catchment areas	<i>See watershed</i>
classification	13

classification system	13
classifier	<i>See classification</i>
climate	13
climatic classification	13
closed vegetation cover	14
commodity	14
common property resources	14
communal land	14
compact plantation	15
coniferous	15
conservation	
~of natural resources	15
consolidated surface	15
construction works	15
consumptive use	15
cover	15
crop	15
crop by-products	15
crop calendar	16
crop growth requirements	16
crop residues	16
crop rotation	16
crop yield	<i>See yield</i>
cropland	16
cropping index	16
cropping pattern.	16
cropping system.	16
cultivar	16
culture-based capture fisheries	16

D

deciduous	17
desertification	17
dominance	17
drainage	17
drainage area	<i>See watershed</i>
drainage basin	<i>See watershed</i>
drought	17
~, agricultural	17
dry period	17
dwarf shrubs	18

E

ecological zone	19
ecological-economic zoning	19
ecosystem	19
ecotype	19
edaphic requirement.	19
electrical conductivity (EC)	19

emission	19
environment	19
environmental impact assessment (EIA)	19
erosion	20
evaporation	
~, actual	20
evapotranspiration	20
evergreen	20

F

fallow System	21
farm commodity	<i>See</i> Commodity
farm-household system	21
farming system	21
farming system zones	22
farming systems approach to development (FSD)	22
feed	22
field capacity	22
fodder	22
forage	22
forbs	22
forest	23
~ not available for wood supply	23
forest plantation	23
forest resources assessment (FRA)	23
formation	24
freshwater	24

G

game	25
game cropping	25
game farming	25
geographical information system (GIS).	25
geo-referencing	25
global radiation	25
graminoids	25
grassland	25
grazing area	25
grazing pressure	25
gross margin	25
groundwater	26
growing period	26
growing season	26
growth cycle	26
growth form	26

H

habitat	27
habitat/species management area	27
harvest index	27
hazard	27
hazards analysis	27
height	27
herbaceous plants	27
herbs	<i>See</i> herbaceous plants
holder	27
holding	28

hydrological cycle	28
--------------------	----

I

income equivalent ratio (IER)	29
indicators	29
infiltration rate	29
infrastructure	29
inland water	29
integrated coastal area management (ICAM)	29
intercropping	30
intermittently flooded	30
inundated land	30
irrigated land	30
irrigation	30
IUCN (World Conservation Union) protection status categories	30

L

land	31
~ Potentially Productive	32
~ Temporarily Fallow	32
~ under permanent crops	33
~ Under permanent Meadows and Pastures	33
Under Temporary Meadows and Pastures	34
Land	
~ Under Protective Cover	33
~ Under Temporary Crops	34
land area	31
land cover	31
land degradation	31
land equivalent ratio (LER).	31
land evaluation.	31
land facet	31
land husbandry	32
land management units	32
land mapping unit	32
land quality	32
land suitability	32
land suitability classification	32
land system	32
land tenure	33
land type	33
land unit	34
land use	34
~ Planning	34
~ Potential	34
~System	34
land utilization type	35
leaching	35
leaf area index	35
legend	35
length of growing period	35
ley pasture	35
ley system	35
life form	35
livestock	36
livestock systems	
~ Classification	36
livestock unit	36

M

macroclimate	37
macropattern	37
major climate	37
major land use	37
managed resource protection area	37
mapping unit	<i>See</i> land mapping unit
marginal land	37
mesoclimate	37
microclimate	37
mixed cropping	37
mixed farming systems	37
mixed sward	38
monoculture	38
multiple crop	38

N

national park	39
natural monument	39
natural resources	39
Non-renewable	39
renewable	47
natural vegetation	39
natural/semi-natural - areas	<i>See</i> natural vegetation, seminatural vegetation
needle-leaved	<i>See</i> coniferous
net farm income	39
nomadism	39
non built-up area	39
non-tidal water regime	40
non-vegetated	40
non-wood forest products	40

O

open access resources	41
open vegetation cover	41
other wooded land	41
overlapping cropping system	41

P

parcel	42
pastoral territories	42
percolation	42
perennial plants	42
permaculture	42
permanent cropping	<i>See</i> land under permanent crops
permanent cultivation	42
permanent pasture	42
permanent wilting point	43
permanently flooded	43
phenological requirement	43
plant community	43
plant development cycle	43
plant growth stage	<i>See</i> plant phenology
plant phenology	43

plantation	<i>See</i> forest plantation. <i>See</i> compact plantation
planted/cultivated areas	43
potential evapotranspiration (PET)	44
potential yield.	44
precipitation	44
produce	44
product	<i>See</i> Commodity
production system.	44
productivity	<i>See</i> Biomass
protected area	45
protected landscape/seascape	45

R

rained cultivation	46
ranching	46
ratoon cropping	46
recommendation domain	<i>See</i> agro-ecological zoning
reference evapotranspiration	46
regeneration	47
relay intercropping	47
resource management domains	47
resources	<i>See</i> natural resources
risk	47
risk assessment	47
risk management	47
river basin	48. <i>See</i> watershed
rotational grazing	48
runoff	48
rural communities	48

S

salinity	49
salinization	49
savanna	49
scrub	<i>See</i> Shrubland
semi-natural vegetation	49
sequential cropping	49
set stocking	49
shifting cultivation	50
short-cycle species	50
shrubland	50
shrubs	50
simultaneous cropping system	50
single cropping	51
soil	51
soil and water conservation concepts	51
soil conservation	51
soil conservation measures	51
soil conservation practices	51
soil degradation	51
soil moisture content	51
soil structure	51
soil texture	51
soil type.	52
soil water	52
soil water content	52
sole cropping	52
solely livestock production	52

sparse	
~Vegetation Cover	52
spatial distribution	<i>See</i> Macropattern
stakeholders	52
steppe	53
stocking rate	53
stratification	53
strict nature reserve/wilderness area	53
subsistence farming	53
surface water	53
sustainable development	53
synusia	53

T

temporarily fallow	54. <i>See</i> land temporarily fallow
temporary arable cropping	<i>See</i> land under temporary crops
tidal water regime	54
tied ridge	54
top soil	54
topography	54
total area	54
toxicity	54
trade-off	54
transhumance	55
transpiration	55
trees	55
tropical livestock unit (TLU)	55

U

unconsolidated	56
under- utilized crops	56
unstocked forest	56
urban area	56

urban vegetated area	56
-----------------------------	----

V

variety	57
vegetated	57
vegetation cover	57

W

water	58
water areas potentially productive	58
water balance	58
water content	<i>See</i> Soil Water Content
water deficit	58
water infiltration rate	<i>See</i> infiltration rate
water quality	58
water requirement	58
water resources	
~ internal renewable	58
water salinity	59
water table	59
water use	59
waterlogging	59
watershed	59
wetland	59
woodland	59
woody grassland	60
woody plants	60

Y

yield	61
--------------	----

3. References

- Abifarin, A.O. 1984. A dictionary of commonly used terms in crop improvement with particular reference to rice. International Institute of Tropical Agriculture. Ibadan, Nigeria.
- Allen, R.G., Jensen, M.E. Wright, J.L. and R.D. Burman 1989. Operational estimates of reference evapotranspiration. *Agron. J.* 81:650-662. In: FAO. 1991. Report on the Expert Consultation for the Revision of FAO methodologies for crop water requirements. FAO, Rome.
- Allen, R.G., Smith, M. Perrier, A. and L.S. Pereira 1994a. An Update for the Definition and Calculation of Reference Evapotranspiration. *ICID Bulletin* 43(2):34-92. In: FAO. 1991. Report on the Expert Consultation for the Revision of FAO methodologies for crop water requirements. FAO, Rome.
- Allen, R.G., Smith, M. Perrier, A. and L.S. Pereira 1994b. An Update for the Calculation of Reference Evapotranspiration. *ICID Bulletin*. 43(2):35-92. In: FAO. 1991. Report on the Expert Consultation for the Revision of FAO methodologies for crop water requirements. FAO, Rome.
- American Society of Range Management, 1964. A Glossary of terms used in range management. 32 pp.
- ASA. 1976. Multiple Cropping. ASA Special Publication No. 27. Participating agencies: Crop Science Society of America. Soil Science Society of America. American Society of Agronomy, Madison, USA.
- Arntzen, C.J. and Ritter, E.M. (eds) 1994. Encyclopedia of Agricultural Science Vol.1. Academic Press, San Diego, Colorado, USA.
- Bates, T.S., Lamb, B.K., Guenther, A., Dignon, J. & Stoiber, R.E. 1992. Sulfur emissions to the atmosphere from natural sources. *Journal of Atmospheric Chemistry* 14: 315-337.
- Brammer, H., Antoine, J., Kassam, A.H. & van Velthuizen, H.T. 1988. Land resources appraisal of Bangladesh for agricultural development. Technical Reports 1-7. FAO/UNDP Project BGD/81/035, "Agricultural Development Advice". Dhaka, Bangladesh.
- Brown, M., Buckley, R., Singer, A. & Dawson, L. 1992. Buffer Zone Management in Africa. Workshop organized by the PVO-NGO/NRMS Project. 5-11 October 1990, Kampala, Uganda.
- Collins 1990. Collins Reference Dictionary of Environmental Science in: IDWG/LUP. 1994. Glossary of Land Use Terms. Working Paper, Draft. Interdepartmental Working Group on Land Use Planning Subgroup 1: Methodology. FAO, Rome.
- Cowardin, L.M., Carter, V., Golet, F.C. and LaRoe, E.T. 1979. Classification of Wetlands and Deepwater Habitats of the United States. Fish and Wildlife Service. US Department of the Interior, Washington, D.C.
- CSSS. 1972. Canadian Society of Soil Science. Canada Department of Agriculture. Publication 1459. Glossary of Terms in Soil Science. Ottawa, Canada.
- De Graaf, J. 1996. The price of soil erosion: an economic evaluation of soil conservation and watershed development. *Tropical Resource Management Papers* No. 14. Wageningen Agricultural University, Wageningen, The Netherlands.
- Di Gregorio, A. & Jansen, L.J.M. 1996. FAO Land Cover Classification: A Dichotomous, Modular-Hierarchical Approach. Paper presented at the Federal Geographic Data Committee (FGDC) Meeting, Vegetation Subcommittee and Earth Cover Working Group - Washington, D.C., 15-17 October 1996. FAO, Rome.
- Doppler, W. 1997. Farming Systems under Tropical Conditions. In preparation. University of Hohenheim, Germany.
- Eiten, G. 1968. Vegetation Forms. *Boletim do Instituto de Botanica* No.4. Instituto de Botanica, Sao Paulo, Brazil.

- Euroconsult & Ministerie van Landbouw en Visserij 1989. Agricultural Compendium for Rural Development in the Tropics and Subtropics. 3rd ed. Elsevier, The Hague, Amsterdam, The Netherlands.
- Evans, G.C. 1972. The quantitative Analysis of Plant Growth. Studies in Ecology Vol. 1. University of California Press, Berkeley and Los Angeles, USA.
- FAO. 1976. A framework for land evaluation. FAO Soils Bulletin 32. FAO, Rome.
- FAO, 1983. Guidelines: land evaluation for rainfed agriculture. FAO Soils Bulletin 52. FAO, Rome.
- FAO. 1984a. Programme of the 1990 World Census of Agriculture. FAO Statistical Development Series 2. FAO, Rome.
- FAO, 1984b. Erosion and soil productivity: a review. Stocking, M., Consultants' Working Paper No.1. Soil Resources, Management and Conservation Service, FAO, Rome.
- FAO. 1985a. Farm management glossary. FAO Agricultural Services Bulletin 63. FAO, Rome.
- FAO. 1985b. Guidelines: land evaluation for irrigated agriculture. FAO Soils Bulletin 55. FAO, Rome.
- FAO. 1985c. Introduction to irrigation. By C. Brouwer, A. Goffeau & M. Heibloem. Irrigation Water Management Training Manual 1. FAO, Rome.
- FAO. 1989. Water quality for agriculture. By R.S. Ayers & D.W. Westcot, Irrigation and Drainage Paper 29 Rev.1, FAO, Rome.
- FAO. 1990. Guidelines for the conduct of a training course in farming systems development. FAO Farm Systems Management Series. FAO, Rome.
- FAO. 1991. Report on the Expert Consultation for the Revision of FAO methodologies for crop water requirements. By M. Smith, R. Allen, J.L. Monteith, L.A. Pereira, A. Perrier and A. Segeren. FAO, Rome.
- FAO. 1995a. Programme for the World Census of Agriculture 2000. FAO Statistical Development Series No.5. FAO, Rome.
- FAO. 1995b. Forest Resources Assessment 1990. Global Synthesis. FAO Forestry Paper 124. FAO, Rome.
- FAO. 1995c. Irrigation in Africa in figures. Water Report 7. FAO, Rome.
- FAO. 1995d. Topsoil Characterization for Sustainable Land Management. Revised Draft. Soil Resources, Management and Conservation Service, FAO, Rome.
- FAO. 1996a. Agro-ecological zoning. Guidelines. FAO Soils Bulletin 73. FAO, Rome.
- FAO. 1996b. World livestock production systems. Current status, issues and trends. Seré, C., Steinfeld, H. & Groenewold, J.. FAO Animal Production And Health Paper 127, FAO, Rome.
- FAO. 1996c. A system of economic accounts for food and agriculture. FAO Statistical Development Series 8. FAO, Rome.
- FAO. 1996d. Drainage of irrigated lands. By H.P. Ritzema, R.A.L. Kselik & F. Chanduvi. Irrigation Water Management Training Manual 9. FAO, Rome.
- FAO. 1997a. Africover land cover classification. FAO, Rome.
- FAO. 1997b. Agriculture, Forestry and Fisheries and Integrated Coastal Area Management (in preparation). FAO, Rome.
- Feoli, E. and Orloci, L. 1991 (eds.). Handbook of Vegetation Science. 11. Computer Assisted Vegetation Analysis. Kluwer Academic Publishers, Dordrech, The Netherlands.
- FGDC. 1997. Glossary on Vegetation Classification. Draft. Federal Geographic Data Committee, Vegetation Subcommittee. Washington, D.C.
- Ford-Robertson, F.C. (ed.) 1971. Terminology of Forest Science, Technology Practice and Products. Society of American Foresters, Washington D.C.

- Gray, P. 1970. Encyclopedia of the biological sciences. 2nd edition. Van Nostrand Reinhold Company, New York.
- Houghton & Charman, 1986. Glossary of Terms used in Soil Conservation, in: *Terminology for Soil Erosion and Conservation*. ISSS. 1996. P. 225 International Society of Soil Science, Vienna.
- Hudson, N., Cheatle, R., Wood, A. & Gichuki, F. (eds.) 1993. Working with Farmers for Better Land Husbandry. Intermediate Technology Publications. London.
- IBPGR. 1991. Elsevier's Dictionary of Plant Genetic Resources. International Board of Plant Genetic Resources, Rome.
- Ibrahim, K. 1975. Glossary of Terms used in Pasture and Range Survey Research, Ecology and Management, FAO, Rome. 153 p.
- ICID. 1975. International Commission on Irrigation and Drainage. Dictionary on Irrigation and Drainage, New Delhi.
- IDWG/LUP. 1994. Glossary of Land Use Terms. Working Paper, Draft. Interdepartmental Working Group on Land Use Planning Subgroup 1: Methodology. FAO, Rome.
- Internet, Biodiversity. <http://versar.com/biodivms/biooo2.htm>. June 1997.
- ISO. 1996. Requirements for characterization of excavated soil and other soil materials for re-use. CD 15176 ISO/TC 190/SC 7/ Soil and Site Assessment/ WG1/N 2. rev.3.
- ISSS. 1996. Terminology for Soil Erosion and Conservation. Bergsma, E., Charman, P., Gibbons, F., Hurni, H., Moldenhauer, W.C. & Panichapong, S. International Society of Soil Science, Vienna.
- King, R.C. 1974. A Dictionary of Genetics. 2nd Edition revised. University Press, Oxford, UK.
- Kuechler, A.W. and Zonneveld, I.S. (eds.) 1988. Handbook of Vegetation Science. 10. Vegetation Mapping. Kluwer Academic Publishers, Dordrech, Netherlands.
- Lawrence, E. (ed.) 1995. Henderson's dictionary of biological terms. 11th ed. John Wiley & Sons Inc., New York &
- Lean, G. & Hinrichsen, D. 1992. Atlas of the environment. 2nd ed. Corporate author: World Wide Fund for Nature, Morges (Switzerland). Helicon, Oxford, UK.
- Lipton, K.L. 1995. Dictionary of Agriculture. Lynne Rienner Publishers, Boulder, Colorado, USA.
- Lo, S. 1992. Glossary of Hydrology. Water Resources Publications, Littleton, Colorado, USA.
- Lundgren, B.O. & Raintree, J.B. 1982. Sustained agroforestry. In: Nestel B. (ed.). Agricultural Research for Development: Potentials and Challenges in Asia, ISNAR, The Hague, The Netherlands. pp. 37-49.
- Mollison, B. 1991. Introduction to Permaculture. Tutorial Press, Harare.
- Nash, J.C. & Nash, M.M. 1995. Managing Risks. Chance, Vol. 8, No.4. Springer Verlag, New York.
- Pandeya, S.C. & Jain, H.K. 1979. Tropical grazing land ecosystems of India. A state of knowledge report. Natural Resources Research No.16. UNESCO, Paris.
- Reynolds, S.G. 1995. Pasture-cattle-coconut systems. RAPA Publication 1995/7. FAO, Rome. 682 p.
- Riemer, D.N. 1984. Introduction to Freshwater Vegetation. AVI Publishing, Westport, Connecticut, USA.
- Roose, E. 1996. Land husbandry, components and strategy. FAO Soils Bulletin 70. FAO, Rome.
- Ruthenberg, H., MacArthur, J.D., Zandstra, H.D. & Collinson, M.P. 1980. Farming Systems in the Tropics. 3rd ed. Clarendon Press, Oxford, UK.
- Schwarz, C.F., Thor, E.C. & Elsner, G.H. 1976. Wildland Planning Glossary. USDA Forest Service, General Technical Report PSW-13/1976. Washington D.C.
- Scoggan, H.J. 1978. The Flora of Canada. National Museums of Canada, Ottawa.

- SCSA. 1982. Resource Conservation Glossary. 3rd ed. Soil Conservation Society of America, Ankeny, IA, USA.
- Skerman, P.J. & Riveros, F. 1990. Tropical Grasses. FAO Plant Production and Protection Series 23. FAO, Rome. 852 p.
- Soffe, R.J., (ed.) 1995. The Agricultural Notebook. 19th ed. Blackwell Science Oxford, UK .
- Sokal, 1974. In: Di Gregorio, A. & Jansen, L.J.M., 1996. FAO Land Cover Classification: A Dichotomous, Modular-Hierarchical Approach. Paper presented at the Federal Geographic Committee (FGDC) Meeting - Vegetation Subcommittee and Earth Cover Working Group - Washington, 15-17 October 1996. FAO, Rome.
- Sykes, J.B. (ed.) 1989. The Concise Oxford Dictionary of Current English. 7th ed. Oxford University Press, Oxford, UK.
- Timberlake and van der Poel, 1979. Glossary of terms used in range ecology, soil conservation, soil science, and land use planning.
- Tothill, J.C. & Mott, J.J., (eds.) 1985. Ecology and management of the world's savannas. (Proceedings) International Savanna Symposium 1984. Brisbane (Australia). 28-31 May 1984. Australian Academy of Science. Canberra, Australia.
- UN. 1992. Earth Summit. Agenda 21: Programme of Action for Sustainable Development. Rio Declaration on Environment and Development. Statement of forest principles. The final text of agreements negotiated by Governments at the United Nations Conference on Environment and Development (UNCED), 3-14 June 1992, Rio de Janeiro, Brazil. UN, New York, USA.
- UN-ECE/FAO, 1997. Temperate and Boreal Forest Resources Assessment 2000. United Nations Economic Commission for Europe, UN, New York and Geneva and FAO, Rome. In preparation.
- UNEP. 1995. United Nations Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, particularly in Africa. UNEP, Geneva.
- UNESCO. 1973. International Classification and Mapping of Vegetation. UNESCO, Paris.
- UNESCO/WMO. 1992. International Glossary of Hydrology 2nd ed. UNESCO, Paris & WMO, Geneva.
- USDA. 1954. Diagnosis and improvement of saline and alkali soils. Agriculture Handbook No. 60. United States Department of Agriculture, Washington, D.C.
- USP/FAO. 1997. An Introduction to the farming Systems Approach to Development (FSD) for the South Pacific. Special Issue of FAO Farm Systems Management Series. University of the South Pacific, Institute for Research, Extension and Training in Agriculture (IRETA) and FAO, Rome. University of the South Pacific, Western Samoa.
- Verheye, W.H. 1996. Advanced Course on Land Evaluation and Land Use Planning. Sierra Leone, 4-16 July 1996. FAO & Government of Sierra Leone Land Use Committee. FAO, Rome.
- Whiteman, P.C. 1980. Tropical Pasture Science, Oxford University Press, Oxford, UK. 392 p.
- WMO, 1990. Glossary of Terms Used in Agrometeorology. CAgM No. 40. WMO/TD-No. 391. WMO, Geneva.
- WMO. 1997. Comprehensive Assessment of the Freshwater Resources of the World. Participating agencies: UNDP, UNEP, FAO, UNESCO, World Bank, WHO, UNIDO. WMO, Geneva.