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Environmental management — Guidelines for establishing good practices for combating land degradation and desertification —

Part 1: **Good practices framework**

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Foreword

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The committee responsible for this document is Technical Committee ISO/TC 207, *Environmental management*, *Combat of land degradation and desertification*.

ISO 14055 consists of the following parts,

ISO 14055-1 Guidelines for establishing good practices for combating land degradation and desertification - Part 1 Good practices framework

ISO 14055-2 Guidelines for establishing good practices for combating land degradation and desertification — Part 2: Regional case study examples

The purpose of ISO 14055-1 is to provide guidelines for developing good practices to combat land degradation and desertification in arid and non-arid regions. ISO 14055-2 provides regional case studies illustrating application of the Part 1 framework to a range of land degradation cases.

Introduction

Land degradation and desertification are fundamental and persistent problems that have long been recognised. They are caused by climate variability (e.g. drought and floods), and unsustainable human activities, such as over-cultivation, overgrazing, deforestation, over extraction of water and inappropriate irrigation practices. These activities can lead to loss of vegetation and biodiversity, declining water supply and water quality, soil erosion, loss of soil fertility and soil structure, and soil. The consequences in the medium to long term are loss of agricultural and economic productivity, loss of soil health and function and loss of ecosystem services, including biodiversity loss, and adverse social impacts.

Land degradation is estimated to affect up to 20% of the world's drylands (Millennium Ecosystem Assessment, 2005), and 25% of cropland, pasture, forests and woodlands globally (FAO, 2011). In addition, one third of the earth's population, i.e. 2 billion people, are potential victims of the increasing effects of desertification (UNEP, 2007). Land degradation is both a significant driver of climate change through emissions of carbon dioxide to the atmosphere and change in surface characteristics affecting solar reflectance (albedo) and is predicted to be exacerbated by climate change. Degradation and desertification greatly reduce ecosystem resilience to climate change.

Land degradation affects productivity, and impacts directly on the livelihood and health and, in extreme cases, causes loss of life. Societies suffer from decreased access to adequate supplies of clean water, deterioration in air quality, threats to food security and declining economic status. These effects can be felt at all scales from the local to the global and all people but especially the poor and the vulnerable.

Recognising the significance of land degradation leading to desertification in dryland areas, the United Nations Convention to Combat Desertification (UNCCD) was developed to combat desertification and mitigate the effects of drought in dryland regions, particularly in sub-Saharan Africa. The UNCCD recognises desertification as a social and economic issue as much as an environmental concern. Therefore, it has a major focus on fighting poverty and promoting sustainable development in areas at risk of desertification. Parties to the UNCCD agreed to implement national, regional and sub-regional action programmes, and to seek to address causes of land degradation, such as unsustainable land management. This part of ISO 14055 is intended to complement and support the activities of the UNCCD by providing guidance to land managers on the establishment of good management practices that, when implemented, will reduce the risk of land degradation and desertification and assist in rehabilitation of lands affected by degradation. Land managers expected to benefit from the standard include and users, technical experts, private and public organisations, and policy makers involved in the management of land resources for ecological, productivity, economic or social objectives.

The purpose of ISO 14055-1 is to provide guidelines for developing good practices to combat land degradation and desertification in arid and non-arid regions. The scope of ISO 14055-1 seeks to extend the guidance of UNCCD to non-arid lands and provides a framework for the identification of good practices in land management relevant to all land types and climate zones, and for monitoring and reporting the implementation of good practices at the local level. ISO 14055-1 refers to actions or interventions undertaken with the purpose of preventing or minimising degradation of land or, where land is already degraded, to recovery of degraded land to improved productivity and ecosystem health.

ISO 14055-1 seeks to provide a flexible approach to the implementation of good practices to combat land degradation and desertification by allowing for different types and scales of activities so that the guidance in this part of ISO 14055 can be applied to all activities and be relevant to public and private use. It aims to be applicable to the range of geographical, climatic, cultural and other circumstances. Figure 1 illustrates the relationship between the guidelines for developing good practices presented under this part of ISO 14055 with Environmental Management Systems and Good Practice programs as they apply to land management. Annex C provides a list of relevant references for sources of additional information on good practices for combating land degradation and desertification.

Combating land degradation is critical to achieving sustainable development and sustainability and hence good practices programs must seek to attain a balance between environmental, social and economic goals. These goals are interdependent and should be mutually reinforcing. For example, the capacity of individual land managers and communities to implement good practices for combating land degradation can be limited by immediate needs of poverty and hunger. Conversely, combating land degradation will contribute to greater socio-economic as well as environmental resilience[1].

[1]ISO 14055-1 has referenced ISO Guide 82 in addressing sustainability in developing guidance for good practices to combat land degradation and desertification.

Provision of guidance on establishing good practices for managing land degradation and desertification benefits both land users and the wider community and can assist in increasing their resilience to climate change. It can also complement government policies to combat land degradation and desertification and contribute to objectives of parties to the UNCCD.

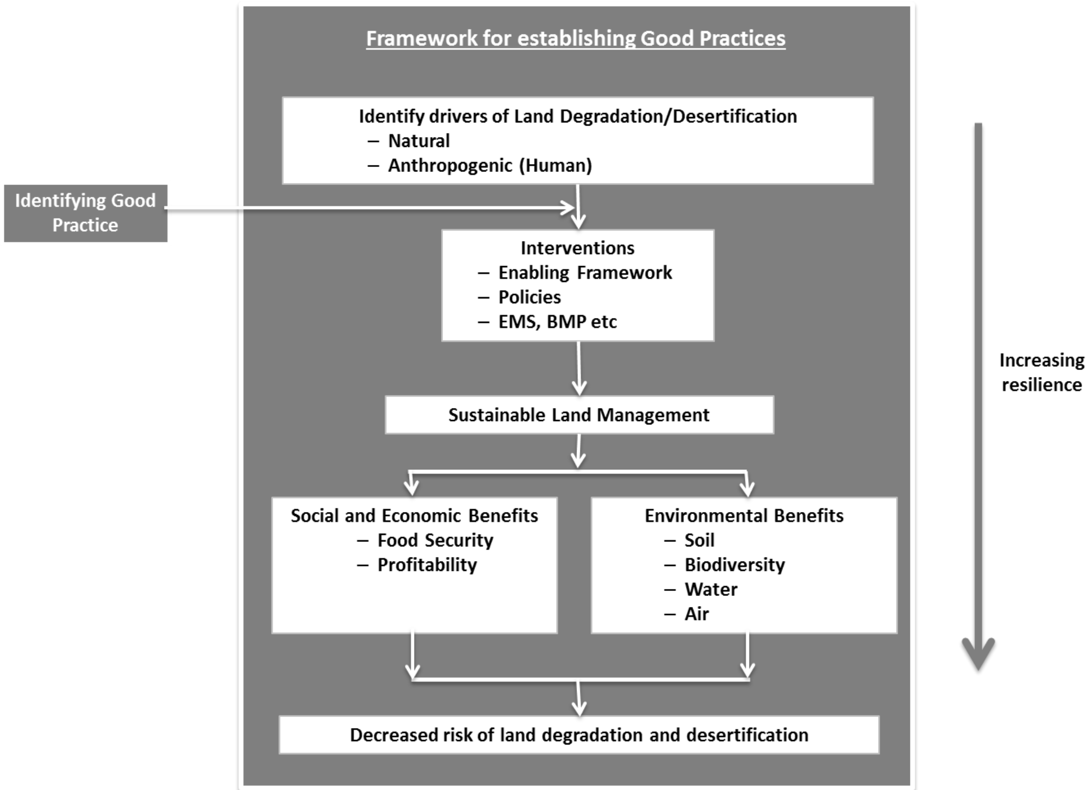

Figure 1 – Framework for establishing good practices for combating land degradation and desertification.

(EMS: Environmental Management System; BMP: Best Management Practice)

Environmental management - Guidelines for establishing good practices for combating land degradation and desertification - Part 1 - Good practices framework

1 Scope

ISO 14055-1 provides guidelines for establishing good practices in land management to prevent or minimize land degradation and desertification. It does not include management of coastal wetlands.

ISO 14055-1 defines a framework for identifying good practices in land management, based on assessment of the drivers of land degradation and risks associated with current and past practices. Guidance on monitoring and reporting implementation of good practices is also provided.

ISO 14055-1 is intended for use by private and public sector organizations with responsibility for land management and will allow an organization to communicate implementation of good practices.

2 Normative references

There are no normative references.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply. Annex A describes the methodology used to develop the terms and definition vocabulary.

3.1 General terms related to combating land degradation and desertification

3.1.1
ecosystem
dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit

[SOURCE: Convention on Biological Diversity - CBD, Article 2.]

3.1.1.1
ecosystem services
ecosystem services are the benefits people obtain from ecosystems. These include provisioning services such as food and water; regulating services such as flood and disease control; cultural services such as spiritual, recreational, and cultural benefits; and supporting services, such as nutrient cycling, that maintain the conditions for life on Earth.

[SOURCE : United Nations Environment Programme - UNEP]

3.1.1.2
agroecosystem
a biological and natural resource system managed by humans for the primary purpose of producing food as well as other socially valuable non-food goods and environmental services

[SOURCE: International Food Policy Research Institute - IFPRI and World Resources Institute - WRI study on “Pilot Analysis of Global Ecosystems”]

3.1.2
environment
surroundings in which an organization operates including air, water, land, natural resources, flora, fauna, humans and their interrelationships

Note 1 to entry: Surroundings can extend from within an organization to the local, regional and global system.

Note 2 to entry: Surroundings can be described in terms of biodiversity, ecosystems, climate or other characteristics.

[SOURCE: ISO 14001:2015 – 3.2.1]

3.1.2.1
sustainability
goal of sustainable development which encompasses environmental, social and economic aspects, in which the needs of the present are met without compromising the ability of future generations to meet their needs

Note 1 to entry: Environmental, social and economic aspects interact and are interdependent. They are referred to as the three pillars of sustainability.

Note 2 to entry: Sustainability is a comparative concept, not a state or absolute value.

[SOURCE: ISO FDIS 13065]

3.1.2.2
bio-productive capacity
the capacity of ecosystems to produce biological materials and to absorb waste materials

Note 1 to entry: Alternative terms for bio-productive capacity are bio capacity and biological capacity

[SOURCE: Adapted from Global Footprint Network]

http://www.footprintnetwork.org/en/index.php/GFN/page/glossary

3.1.3
biodiversity
variability among living organisms from all sources including, among others, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part

Note 1 to entry: Biodiversity includes diversity within species, between species and of ecosystems.

[SOURCE: Convention on Biological Diversity - CBD, Article 2.]

3.1.4
habitat
place or type of site where an organism or population naturally occurs

[SOURCE: Convention on Biological Diversity - CBD, Article 2.]

3.1.5
capacity building
specifically, capacity building encompasses the country’s human, scientific, technological, organizational, institutional and resource capabilities

[SOURCE: Agenda 21, Chapter 37, United Nations Conference on Environment and Development - UNCED, 1992]

3.1.6
off-site impact
impact on the environment that occurs away from the site of the immediate intervention on an ecosystem

EXAMPLE: Sediment loads into coastal marine systems due to land degradation at the source of a stream or river.

Note 1 to entry: The concept of off-site effect may also be used to describe impacts in the future of a current intervention.

[SOURCE: ISO/TC 207/WG9, 2015]

3.1.7
environmental degradation
the deterioration in environmental quality from ambient concentrations of pollutants and other activities and processes such as improper land use and natural disasters

Note 1 to entry: environmental degradation frequently involves overexploitation of resources generated by an ecosystem.

[SOURCE: Organization for Economic Co-operation and Development - OECD]

3.1.8
forest
forest land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ, not including land that is predominantly under agricultural or urban land use

NOTE: Forest can be (further) defined in legislation, where definitions can differ between countries. In case no legal definition for forest applies, the further detailing by the Food and Agriculture Organization of the United Nations (FAO) (see source) applies. According to FAO stands in agricultural production systems, such as fruit tree plantations, oil palm plantations and agroforestry systems when crops are grown under tree cover, are excluded.

[SOURCE: Food and Agriculture Organization of the United Nations – FRA 2015 – Terms and Definitions – Forest Resources Assessment Working Paper 180]

3.1.9
deforestation
direct human-induced conversion of forest land to non-forest land

[SOURCE: United Nations Framework Convention on Climate Change - UNFCCC, 2006]

3.1.10
desert
dry, barren and often sandy region with sparse vegetation that receives less than 250 mm of sporadic rainfall annually

[SOURCE: Adapted from Commission for Controlling the Desert Locust in the Central Region - CRC, FAO, 2009, TRG (A16.22) / KCCM, FAO, 2009]

3.1.11
salinization
soil degradation brought about by the increase of salts in the soil

Note 1 to entry: is also known as salination.

[SOURCE: Food and Agriculture Organization of the United Nations - FAO, 1994]

3.1.12
drought
naturally occurring phenomenon that exists when precipitation has been significantly below normal recorded levels, causing serious hydrological imbalances that adversely affect land resource production systems

Note 1 to entry: Droughts may be worse due to climatic changes as result of human unsustainable activities.

[SOURCE: United Nations Convention to Combat Desertification - UNCCD]

3.1.13
desertification
land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities

Note 1 to entry: Land is degraded when it can no longer support the same plant growth it had in the past, and the change is permanent on a human time scale.

[SOURCE: United Nations Convention to Combat Desertification - UNCCD, Article 1a.]

3.1.14
arid, semi-arid and dry sub-humid areas
means areas, other than polar and sub-polar regions, in which the ratio of annual precipitation to potential evapotranspiration falls within the range from 0.05 to 0.65

[SOURCE: United Nations Convention to Combat Desertification - UNCCD, Article 1g.]

3.2 Terms related to land

3.2.1
land
terrestrial bio-productive system

Note 1 to entry: The bio-productive system comprises soil, plant cover, other biota, and the ecological and hydrological processes that operate within the system.

[SOURCE: Adapted from United Nations Convention to Combat Desertification/Land Degradation and Desertification (UNCCD/LDD), 1994.]

3.2.1.1
rangeland
grassland and open woodland suitable for grazing

Note 1 to entry: Rangeland includes land on which the indigenous vegetation is predominately grasses, forbs (small species of flowering plants) and shrubs and is managed as a natural ecosystem.

[SOURCE: Adapted from United Nations Convention to Combat Desertification/Land Degradation and Desertification (UNCCD/LDD), 1994]

3.2.1.2
wetland
land inundated with water, whether natural or artificial, permanent or temporary, that is static or flowing, brackish or salt

Note 1 to entry: Examples of wetlands included in this standard are marsh, fen, peatland and pans.

[SOURCE: Adapted from Ramsar Convention on Wetlands, Art.1]

3.2.1.3
arable land
land under temporary agricultural crop, temporary meadows for mowing or pasture, land under market and kitchen gardens and land temporarily fallow

[SOURCE: Adapted from FAOSTAT, Food and Agriculture Organization of the United Nations Glossary]

3.2.1.4
peatland
wetlands with a thick water-logged organic soil layer (peat) made up of dead and decaying plant material. Peatlands include moors, bogs, mires, peat swamp forests and permafrost tundra

[SOURCE: Wetlands International]

3.2.1.5
grazing management plan
strategy that a land manager uses to ensure that rangeland is being used sustainably

[SOURCE: Sustainable Ranch Management Assessment Guidebook, 2011]

3.2.1.6
grazing pressure
the demand/supply ratio between dry matter requirements of livestock and the quantity of forage available in a pasture at a specific time

[SOURCE: The National Drought Mitigation centre, USA, 2015]
http://drought.unl.edu/

3.2.2
soil organic matter
carbon-containing material in the soil that is derived from living organisms

[SOURCE: Environmental Indicators for Agriculture – Vol. 3: Methods and Results, OECD, 2001, glossary, pages 389-391]

3.2.3
soil quality
capacity of a soil to function, sustain plant and animal productivity, maintain or enhance water and air quality, and support human health

[SOURCE: Adapted from United States Department of Agriculture - USDA]

3.2.4
soil fertility
the quality of a soil that enables it to provide nutrients in adequate amounts and in proper balance for the growth of specified plants or crops

[SOURCE: Glossary of Soil Science Terms, Soil Science Society of America]

3.2.5

soil structure

the combination or arrangement of primary soil particles into secondary units or peds

[SOURCE: FAO - Soil science society of America]

3.2.6

crust

surface layer of the soil, ranging in thickness from a few millimetres to a few centimetres, which is much more compact than the material beneath

Note 1 to entry: Soil crusting is also associated with biological and chemical factors.

Note 2 to entry: A biological crust is a living community of lichen, cyanobacteria, algae, and moss growing on the soil surface that bind the soil together.

Note 3 to entry: A precipitated, chemical crust can develop on soils with high salt content.

[SOURCE: Adapted from Bulletin 69, FAO, 1993]

3.2.7

land degradation

any form of deterioration of the natural potential of land that affects ecosystem integrity either in terms of reducing its sustainable ecological productivity or in terms of its native biologica l richness and maintenance of resilience

Note 1 to entry: FAO describes land degradation as having a wider scope than both soil erosion and soil degradation, covering all negative changes in the capacity of the ecosystem to provide goods and services (including biological and water related goods and services)

[SOURCE: Global Environment Facility – GEF]

3.2.8

soil erosion

wearing away of fields top soil by the natural physical forces of water and wind or through forces associated with anthropogenic activities such as farming or clearing of vegetation

Note 1 to entry: Soil erosion cab be a slow process that continues relatively unnoticed or at an alarming rate causing serious loss of top soil

[SOURCE: Adapted and Modified from OMAFRA Factsheet, Soil Erosion – Causes and Effects, 2012]

3.2.9

soil degradation

a change in the soil health status resulting in a diminished capacity of the ecosystem to provide goods and services

[SOURCE: Adapted from Food and Agriculture Organization of the United Nations - FAO]

3.2.10

land management

the process of managing the use and development of land resources

[SOURCE: FAO Land Tenure Manuals, No 2, FAO, 2006]

3.2.10.1
good practice
a practice that has been proven to work well and produce good results, and is therefore recommend as a model. It is a successful experience, which has been tested and validated, in the broad sense, which has been repeated and deserves to be shared so that a greater number of people can adopt it

[SOURCE: Good practices template, July 2015. Food and Agriculture Organization of the United Nations - FAO]

3.2.10.2
risk assessment
overall process of risk identification, risk analysis and risk evaluation

[SOURCE: Adapted from ISO Guide 73:2009, definition 3.4.1]

3.2.10.3
sustainable development
development that meets the needs of the present without compromising the ability of future generations to meet their own needs

[SOURCE: World Commission on Environment and Development, 1987]

3.2.10.4
sustainable use
use of resources such that they are not harvested beyond the natural replenishment capacity of the ecosystem

Note 1 to entry: Sustainable use of a particular resource is at a rate that will not impair the ability of future generation to meet their needs

[SOURCE: Adapted from Australian Institute of Marine Science.]

3.2.10.5
interested party
person or organization that can affect, be affected by, or perceive itself to be affected by a decision or activity

Example: Customers, communities, suppliers, regulators, non-governmental organizations, investors and employees.

Note 1 to entry: To “perceive itself to be affected” means the perception has been made known to the organization.

[SOURCE: ISO 14001:2015, 3.1.6]

3.2.11
water table
upper surface of groundwater, below which soil is saturated with water

Note 1 to entry: Water fills all voids and interstices where the pressure of water in the soil equals the atmospheric pressure

[SOURCE: Adapted from http://www.businessdictionary.com]

3.2.12
watershed
area of land where all of the water that is under it or drains off of it goes into the same place

Note 1 to entry: Catchment is another term for watershed

[SOURCE: United Nations Environmental Protection Agency - water.epa.gov]

4 Principles

4.1 General

The following principles are the basis for the guidance in this part of ISO 14055 and for its application.

The overall objective of the guidance provided in ISO 14055-1 is to develop good practices programs for combating land degradation and desertification to maintain or improve productivity, biodiversity and other ecosystem services and aid sustainable land management. Respect for the principles set out in this clause will assist in developing and implementing good practices that is consistent with the needs of interested parties and their economic, social, cultural and spiritual values for the land on which they live.

4.2 Sustainable development

Good practices for combating land degradation and desertification contribute to sustainable development by balancing economic, social, and environmental development within the limits of the earth's natural resources and seeking to manage land for productivity and ecosystem services while avoiding burden shifting to other regions or future generations.

4.3 Transparency

In developing good practices for combating land degradation and desertification there is a need for openness about decisions and activities that affect society, the economy and the environment and willingness to communicate these in a clear, accurate, timely, honest and complete manner to its interested parties to make decisions on use of the good practices with reasonable confidence

4.4 Social responsibility

In developing good practices for land management to combat land degradation and desertification, it is important to take account of the impacts of decisions and actions on society and the environment through behaviour that recognises:

- the rights of land users to derive economic benefit and food security from their land.
- the expectations of interested parties e.g. land managers, small scale farmers and indigenous communities
- environmental sustainability of the ecosystem
- applicable law and consistent with relevant international agreements.

A good practices framework for prevention or minimization of land degradation should be developed in consultation with interested parties and should be responsive to the views and needs of all participants, including indigenous peoples, local communities and vulnerable groups. Participation in developing a good practices framework should be encouraged.

Adapted from ISO 26000

4.5 Partnership

Good practices should allow opportunities for interested parties to cooperate in partnerships to enhance their efforts in combating land degradation and desertification

4.6 Scientifically based preferences

4.6.1 Scientifically based

When making decisions on good practices to combat land degradation and desertification, preference should be given to knowledge based on natural science (physics, chemistry, biology) and social and economic sciences. Examples of applications of natural science include, but are not restricted to, remote sensing, direct measurement of physical and chemical properties of soils, water resources, and ecosystem characteristics (See A.2.1).

4.6.2 Second preference

If scientific evidence is not available, reference may be made to expert opinion and traditional land management knowledge, relevant and valid within the geographical scope of the land being considered. Bringing together traditional or local knowledge with scientific understanding in “hybrid knowledge” can provide strength in addressing sustainable development issues.

4.6.3 Third preference

Decisions on good practices for combating land degradation and desertification based on value choices, should only be used if neither a scientific basis exists nor a justification based on other scientific approaches or international conventions is possible, and disclosed.

NOTE Value-choices in good practices for combating land degradation and desertification can relate to selection of data sources, land management practices, and other elements of establishing good practices.

4.7 Good governance

Good practices should take into consideration good governance including:

- taking account of availability of resources (human and economic) for implementing good practices to combat land degradation and desertification;
- making provision for measuring, monitoring and reporting on good practices implementation;
- developing a mechanism for review of implementation of good practices and recommendations for improvement; and
- ensuring accountability and transparency.

4.8 Alignment with national, regional and international initiatives

Good practices for combating land degradation and desertification should be aligned with national, regional and international initiatives guidance and frameworks.

4.9 Respect for human rights

In developing good practices for land management recognition of both the importance and the universality of human rights should be taken into consideration. Examples would include, but are not restricted to:

— The rights of indigenous people, vulnerable groups and local communities.

— The rights of people to continue to derive a livelihood from the land they occupy.

5 Identification of good practices to combat land degradation and desertification

5.1 General

Those in public and private sector organizations with responsibility for land management and for implementing good practices for combating land degradation and desertification should take information provided in this section into account for identifying good practices. This will ensure that these are effective, practical and consistent with sustainable development.

5.2 Drivers of land degradation and desertification

5.2.1 Overview of natural and anthropogenic factors affecting the function of ecosystems

The following diagram illustrates major natural factors and human activities that affect ecosystem function in a way that could lead to land degradation and desertification. Factors contributing to land degradation and desertification are highly variable and it is not intended to include all contributing factors in the range of ecosystems and circumstances subject to land degradation and desertification.

Factors affecting ecosystem function or structure

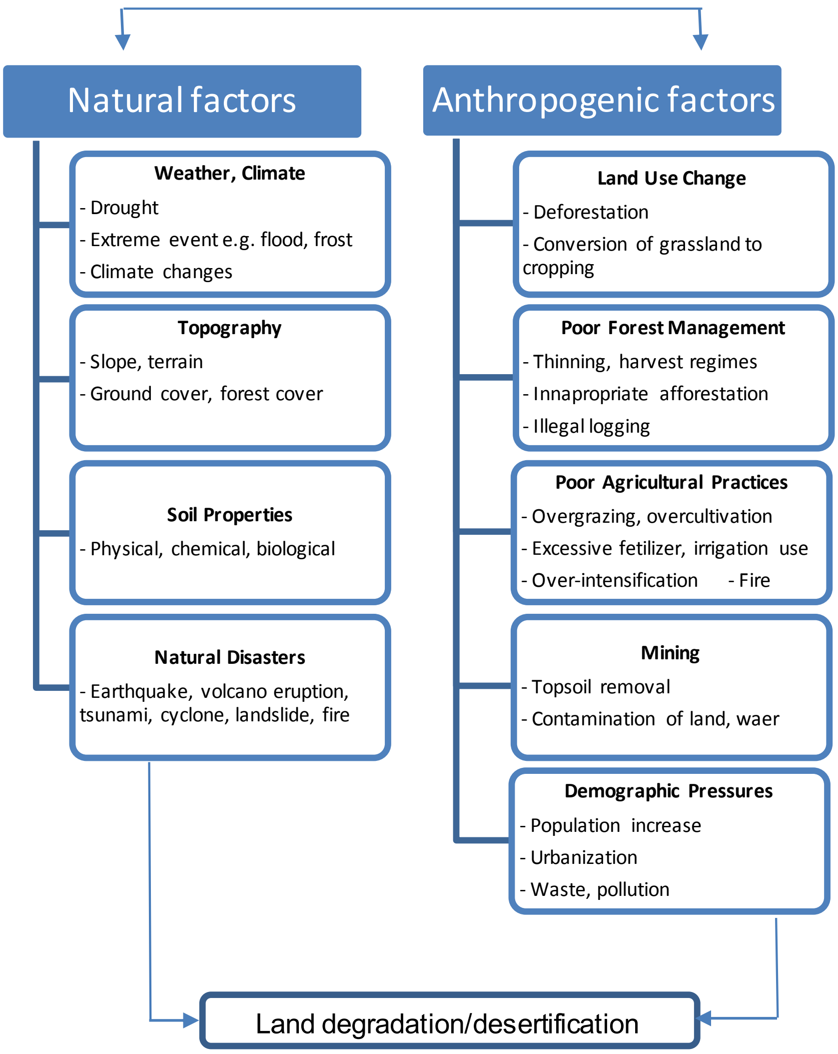

Figure 2 — Examples of major natural and anthropogenic factors that may lead to land degradation and desertification.

5.2.2 Examples of natural drivers of land degradation and desertification

5.2.2.1 General

Identification of natural drivers of land degradation requires observations and understanding of landscape characteristics that increase the vulnerability to loss of productivity and ecosystem functionality when combined with human activities. The following examples illustrate some natural drivers of land degradation and desertification but contributing factors vary between regions and circumstances.

NOTE Annex A provides more information on natural factors that contribute to land degradation and desertification.

5.2.2.2 Weather and climate

Variability in weather, climate, and extreme weather events are underlying drivers of land degradation and desertification. Elements to be considered in developing good practices to reduce the risk of land degradation and desertification include the risks of droughts, floods and extreme rainfall events, high solar radiation, extreme temperatures and wind. The threat of land degradation is likely to be exacerbated by climate change due to increasing variability and more frequent and severe extreme events.

5.2.2.3 Topography

Slope and terrain affect run-off and the permeability of the soil and can increase vulnerability of soils to water erosion. Examples of degradation influenced by slope and terrain include landslides, loss of fertile topsoil and soil organic matter, run-off of nutrients and agricultural chemicals and gullying on hill slopes.

5.2.2.4 Soil properties

Soil physical, chemical and biological characteristics including poor soil structure compaction, low organic matter, high salt content, reduced microbial activity affect vulnerability to degradation processes including erosion, loss of structure, poor infiltration rate, water retention capacity and nutrient run-down.

5.2.2.5 Natural disasters

Natural disasters such as wildfires, earthquakes, volcanoes, tsunamis and cyclones can result in changes to soil and vegetation characteristics of ecosystems and lead to biodiversity loss, habitat loss and decline in productivity and other forms of land degradation.

5.2.3 Examples of anthropogenic factors that contribute to land degradation and desertification

5.2.3.1 General

Identification of anthropogenic drivers of land degradation and desertification requires understanding of the impacts of human activities in combination with natural factors that increase the vulnerability of land to loss of productivity and ecosystem function.

NOTE Annex B provides more information on anthropogenic factors that contribute to land degradation and desertification.

5.2.3.2 Land use change

Land use change, including deforestation for agriculture or urban expansion and infrastructure, and conversion of permanent pastures to cropping may lead to loss of aboveground and belowground biodiversity, increase in invasive species, loss of soil carbon, decline in soil health, change in landscape hydrology and vulnerability to erosion.

5.2.3.3 Unsustainable forest management

Unsustainable forest management practices or afforestation that does not take into consideration suitability to local conditions and communities can result in loss of biodiversity, changes in catchment hydrology, increased risk of wildfire, changes in natural fire regimes, increased risk of water or wind erosion following harvest and long-term negative socio-economic outcomes.

5.2.3.4 Unsustainable agricultural practices

Agricultural practices that are unsustainable and contribute to land degradation and desertification includes:

— over-cultivation, which can cause decline in soil structure, depletion of nutrients, loss of soil carbon and decline in water holding capacity;

— overstocking and overgrazing by domestic livestock, especially in arid and semi-arid rangelands and during drought or dry periods, can result in loss of ground cover, vulnerability to erosion and loss of natural perennial species;

— inappropriate agricultural practices in both irrigated and dryland farming areas where there is risk of that can lead to a build-up of salts in the soil and lead to decline in chemical and physical properties and loss of soil microbial activity;

— excessive use of chemical fertilisers on crops or pasture can result in nutrient run-off and leaching, causing eutrophication and loss of water quality in freshwater or coastal systems, and emissions of nitrous oxide, which is a strong greenhouse gas; and

— over-intensification of agriculture and inappropriate farming systems can lead to decline in soil nutrients and soil health and increases in organic deposition and nutrient concentrations in adjacent water sources.

NOTE Thresholds for defining overgrazing, over-cultivation and risk of will vary regionally and with local conditions.

5.2.3.5 Mining and other industrial activities

Mining and other industrial activities may lead to land degradation due to alteration of soil structure through excavation, removal of top soil and aggregates, and dumping of mined soil and contaminated waste. This may lead to the loss of soil fertility, loss of biodiversity and contamination of ground and surface water.

5.2.3.6 Demographic pressures

Demographic pressures, including infrastructure development and urbanisation, contribute to land degradation through loss of arable lands, changes in hydrology and impacts of human waste and pollution. These pressures will increase with increasing population and competition for land resources and may result in further encroachment on natural ecosystems, forests and agricultural lands.

5.2.3.7 Unsustainable energy consumption

Use of firewood, crop residues and cow dung as an energy source in a way, which reduces vegetation and forest cover, and affects the rainfall patterns will contribute to land degradation

5.3 Forms of land degradation

5.3.1 Soil erosion

5.3.1.1 Soil erosion by water

Types of water erosion include:

— Surface wash or sheet/inter-rill erosion removes topsoil with loss of nutrients and soil organic matter, soil fertility and decrease in infiltration capacity of the soil and accelerated runoff.

— Gully erosion or gullying results in the development of deep incisions, down to the subsoil, due to concentrated runoff.

— Landslides, mudflows or mass movements of soil occur locally but often cause serious damage.

— Riverbank erosion occurs with lateral erosion of rivers cutting into riverbanks.

Offsite degradation effects of water erosion include deposition of sediments and nutrients, downstream flooding, siltation of reservoirs, waterways and lagoons, and pollution of water bodies with eroded sediments.

5.3.1.2 Soil erosion by wind

Loss of topsoil by wind action is most common in arid and semi-arid climates, but may also occur in regions that are more humid. Wind erosion is nearly always preceded by a decrease in the vegetative cover of the soil.

Offsite degradation caused by wind erosion include covering of terrain with windborne particles from distant sources, which may contain contaminants from mining activities e.g. mining dust, asbestos.

NOTE In arid and semi-arid climates, natural wind erosion is often difficult to distinguish from human-induced wind erosion; natural wind erosion is often exacerbated by human activities, such as cultivation or overgrazing.

5.3.2 Deterioration of soil chemical properties

5.3.2.1 Fertility decline

Fertility decline and reduced organic matter content may occur due to "soil mining" when nutrient removals through harvesting, burning, leaching, etc. are not sufficiently compensated by inputs of nutrients and organic matter through addition of manure, crop residues and other organic amendments, chemical fertilizers, or via flooding. This type of degradation may also include nutrient oxidation and volatilisation.

5.3.2.2 Acidification

Acidification is a process of decrease in soil pH over time. It can occur under natural conditions over thousands of years in high rainfall areas but rapid acidification can occur under intensive agricultural practices.

Practices that accelerate acidification include applying ammonium-based nitrogen fertilisers to naturally acid soils at rates in excess of plant requirements, leaching of nitrate nitrogen from ammonium-based fertilizers out of the root zone, and continual removal of plant and animal produce and waste products from fields.

5.3.2.3 Salinization and alkalinization

Salinization is due to a net increase of the salts content.

Salinization is the accumulation of salts in soil and water to levels that affect human and natural assets (e.g. plants, animals, aquatic ecosystems, water supplies, agriculture and infrastructure). Dryland salinity occurs where salt in the landscape is mobilised and redistributed closer to the soil surface and/or into waterways by rising groundwater, which may be caused by removal of deep-rooted trees, shrubs and grasses, and replacing with shallow-rooted species. Irrigation salinity occurs due to increased rates of leakage and groundwater recharge causing the water table to rise bringing salts into the plant root zone.

Alkalinisation occurs when a net increase in exchangeable sodium takes place.

The main human cause of alkinization of soils is the use of surface or ground water for irrigation that contains relatively high proportions of sodium bicarbonates and less calcium and magnesium. Alkaline soils have low agricultural productivity due to the low infiltration capacity and frequent waterlogging.

5.3.2.4 Soil pollution

Soil pollution may occur due to contamination of the soil with toxic materials from local (e.g. waste dumps, untreated industrial discharges) or diffuse sources (atmospheric deposition).

5.3.3 Deterioration of soil physical properties

5.3.3.1 Compaction

Compaction due to trampling or the weight and/or frequent use of machinery causes deterioration of the soil structure and changes of the proportion of sizes or loss amount of pores and consequently, infiltration rate and water holding capacity.

5.3.3.2 Sealing and crusting

Sealing or crusting is the clogging of pores with fine soil material and development of a thin impervious layer at the soil surface obstructing the infiltration of rainwater.

5.3.3.3 Waterlogging

Waterlogging occurs when the soil pores are filled with water, limiting availability of oxygen to plant roots and microorganisms, and affecting soil chemical processes.

5.3.3.4 Subsidence

Subsidence or downward movement of soils may occur naturally, for example if caves collapse, or as a result of activities such as mining. Subsidence of organic soils may occur due to drainage of peatlands or low-lying heavy soils.

5.3.4 Degradation of soil biological properties

Loss of bio-productive capacity of soils may occur due to activities such as excessive use of agrochemicals, construction and mining that decrease soil microbial biomass and potential for agricultural productivity.

5.3.5 Degradation of soil water properties

5.3.5.1 Aridification

Aridification (long-term drying) which is often measured as a reduction of average soil moisture content may be caused by changes in water balance, lowering of water tables or reduced ground cover resulting in reduced agricultural production, soil degradation, ecosystem changes and decreased water catchment runoff.

5.3.5.2 Change in surface water quantity or quality

Change in the quantity of surface water such as altered flow regimes, drying up of rivers and lakes or decline of surface water quality due to increased sediments and pollutants in fresh water bodies affect ecosystem function and agricultural productivity.

5.3.5.3 Change in groundwater level or quality

Change in groundwater and aquifer level such as lowering of groundwater table due to over-exploitation or reduced recharge of groundwater, or increase of groundwater table, e.g. due to excessive irrigation waterlogging and/or or decline in ground water quality due to pollutants infiltrating into the aquifers change water cycling and recharge of surface water.

5.3.5.4 Wetland area buffering capacity

Reduction of the buffering capacity of wetland areas decreases the resilience of ecosystems to flooding, run-off, droughts and pollution.

5.3.6 Degradation of ecosystem structure and biodiversity

5.3.6.1 Reduction of vegetation cover

Reduction in vegetative cover to establish settlements or for agricultural use decreases habitats and biodiversity and increases the area of bare or unprotected soil with potential for erosion.

5.3.6.2 Loss of habitats

Loss of natural habitats occurs due to decreasing vegetation diversity in forest and agricultural lands and results in a decline in biodiversity.

5.3.6.3 Decline in biomass

Replacement of forest after clear felling with secondary forest of reduced productivity results in lower biomass often with reduction in species diversity and reduced carbon stocks on that land.

5.3.6.4 Change in fire regimes

Wildfires or prescribed burning affect forest (e.g. by slash and burn), bush, grazing and cropland (e.g. by burning of residues) can result in decline in aboveground biodiversity through loss of native species, including palatable perennial grasses, spread of invasive species and diseases and decline in belowground species including earthworms and termites and microorganisms such as bacteria and fungi.

6 Guidelines for establishing good practices and monitoring their implementation

6.1 Objectives for good practices to combat land degradation and desertification

6.1.1 General

When developing a framework for identification of good practices the objectives should be clearly defined to ensure that efforts to combat land degradation and desertification will be practical and effective and will avoid the risk of adverse effects on sustainability locally or in other regions.

6.1.2 Objectives to consider when developing good practices

6.1.2.1 Maintain or improve productivity

Good practices should prevent further loss of productivity and improve yields in land that is already degraded. Long-term food productivity and future food security are threatened by soil degradation, loss of prime agricultural land to non-farm uses and other elements of land degradation.

NOTE Approximately 16 per cent of global agricultural land already has reduced yields due to degradation (World Meteorological Organization – WMO, 2005).

6.1.2.2 Decrease vulnerability to climate variability

A framework for identifying good practices should consider ways to increase resilience of ecosystems and communities to climate variability, especially drought and extreme weather events that are recognized as major factors contributing to land degradation. Land degradation and desertification may increase vulnerability of ecosystems to climate extremes thus exacerbating the risk of further degradation.

6.1.2.3 Increase resilience to climate change

A framework for identifying good practices to combat land degradation should consider ways to increase resilience to the impacts of climate change and to mitigate the threat of future climate change. Climate change will add an additional pressure on natural and managed ecosystems, including agricultural, forestry and protected areas, that is predicted to exacerbate the risk of land degradation. Combating land degradation and desertification will contribute to climate change mitigation by decreasing carbon dioxide emissions because of loss of biogenic carbon.

6.1.2.4 Maintain or improve ecosystem services

A framework for identifying good practices should recognise ecological functionality in different ecosystems, value ecosystem services and protect or restore vulnerable natural and managed ecosystems. Land degradation and desertification cause a decline in the many goods and services provided by ecosystems including cultural values, productivity for food and fibre, carbon sequestration potential, air quality and hydrological function.

6.2 Identifying applicable good practices

6.2.1 Identify regionally relevant land degradation and desertification drivers

Identify natural and anthropogenic drivers contributing to land degradation and desertification affecting the region (see Clause 4). These drivers may be associated with past, current or potential natural factors and human activities.

6.2.2. Identifying legality and restrictions in the land use

6.2.2.1 Legal requirements and land use restrictions

Identify legal requirements and land use restrictions applicable to the land use as appropriate, according to each national and local area

6.2.2.2 Non legal land use measures

Set internal performance criteria e.g. limitations on the amount of sediments discharged to rivers flowing into sensitive ecosystems, fisheries or reservoirs for human water supply and restricting human activities within a certain range of a watershed.

6.2.3 Criteria for good practices to combat land degradation and desertification

6.2.3.1 Basis for good practices

Using the principles set out in Clause 5, good practices should be developed to address drivers of land degradation and desertification identified in 5.2. These good practices should act to minimize the risk of land degradation and desertification and assist recovery of any existing land degradation by contributing to measures that are sustainable and maintain or improve the productive potential of the land, ecosystem structure and function and the quality of ecosystem services.

6.2.3.2 Criteria for good practices

Good practices should act to combat land degradation and desertification by:

- Preserving and increasing the productive characteristics and qualities of the soil;
- Conserving biodiversity within natural ecosystems, agricultural lands, and plantation forests including protecting endangered species;
- Conserving the integrity of waterways, watersheds and the quality of water;
- Managing the impacts of anthropogenic activities such as mining or urbanisation.

6.3 Framework for planning and implementation of good practices

A framework for implementing good practices to combat land degradation and desertification consists of a cycle of action through:

a) Develop a good practices action plan

b) Implement the good practices action plan

c) Monitor the impact of the action plan

d) Periodically review the results and iteratively refine the action plan

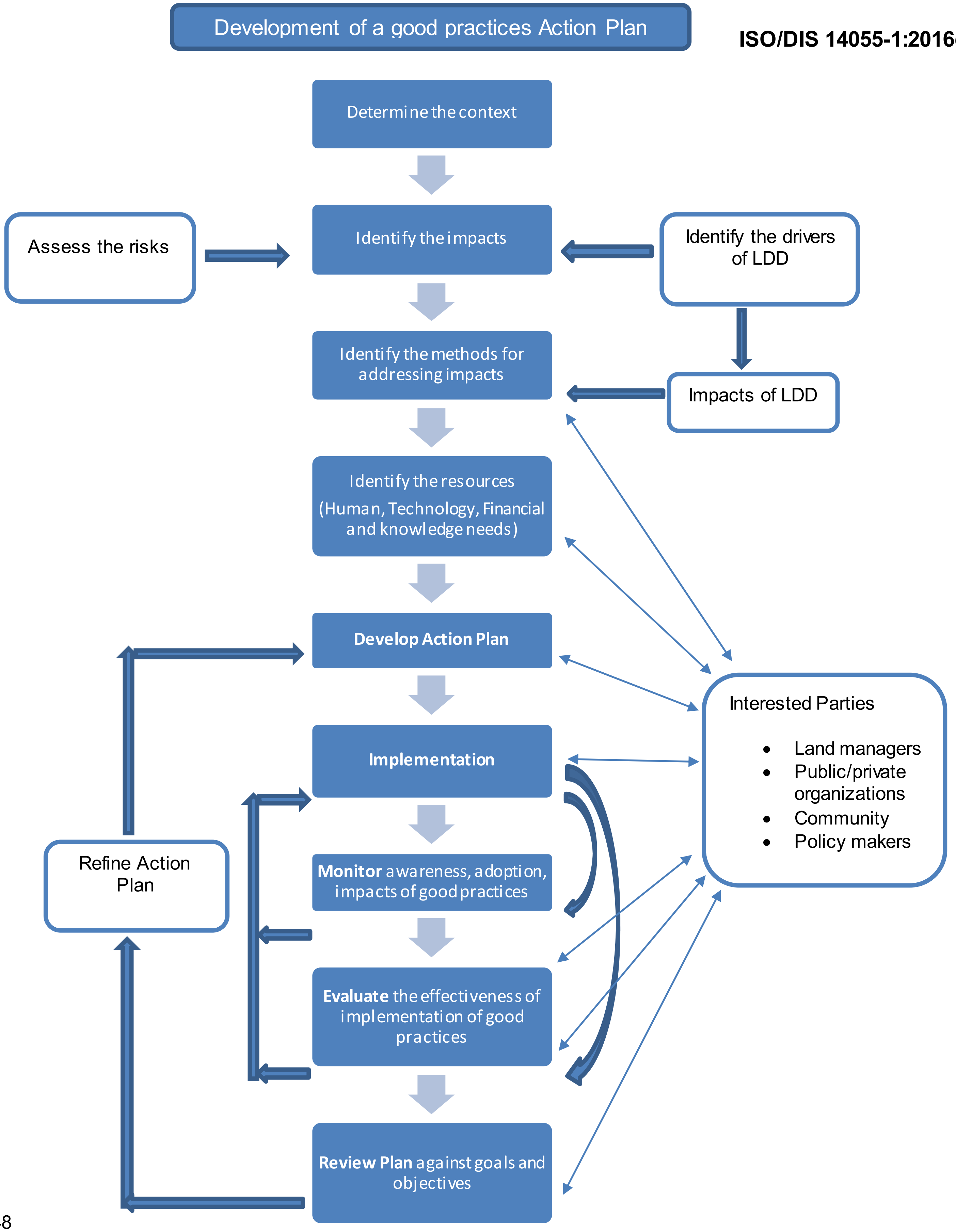
Development of a good practices Action Plan
Determine the context
Assess the risks
Identify the impacts
Identify the drivers of LDD
Identify the methods for addressing impacts
Impacts of LDD
Identify the resources
(Human, Technology, Financial and knowledge needs)
Develop Action Plan
Interested Parties
Land managers
Public/private organizations
Community
Policy makers
Implementation
Refine Action Plan
Monitor awareness, adoption, impacts of good practices
Evaluate the effectiveness of implementation of good practices
Review Plan against goals and objectives

Figure 3 – Development of a good practices Action Plan

6.3.1 Developing a good practices action plan

1) Determine the context in which the land degradation has occurred/may occur, including the needs and expectations of the relevant interested parties;

2) Identify the land degradation problem which may be related to past or current practices;

3) Identify the drivers of land degradation including the impact of past/current practices;

4) Assess the risk of future land degradation under projected changes, i.g. climate change, demographic change;

5) Assess the impact of the degradation on sustainability and the interested parties;

6) Identify methods to address the significant impacts, including good practices based on the situation and location; method selection should include cost-benefit analysis;

7) Identify what is to be monitored and the monitoring cycle necessary to determine the effectiveness of the methods selected;

8) Identify the resources needed and those actually available;

9) Develop an action plan to implement the methods and monitor the results within the resources available.

6.3.2 Implementing the action plan for good practices

6.3.2.1 General

Implementation of the action plan for good practices to combat land degradation and desertification should include active and ongoing cooperation between interested parties at all levels of responsibility.

6.3.2.2 Interested parties with regional responsibility

Those with regional responsibility should:

- Communicate good practices to land users and other stakeholders
- Encourage development of partnerships and collaborative activities
- Monitor availability of economic and human resources
- Where necessary, provide appropriate training and capacity building

6.3.2.3 Interested parties with responsibility for local land use

Those with direct responsibility for local land use should:

- Implement good practices appropriate to their land based on the plan
- Work cooperatively with other land users and local community within the region

6.3.3 Monitoring the impact of the implementation of action plan

6.3.3.1 General

The awareness and adoption of good practices can normally be measured within a shorter period than outcomes of the actions e.g. a decrease in the extent or severity of land degradation or desertification. Some outcomes of the implementation of good practices may take considerable time (e.g. decades) before being evident or fully effective. The outcomes may also result in changes off-site. Awareness and implementation of good practices and changes in land condition should be monitored.

6.3.3.2 Monitoring awareness and adoption of good practices

Relevant techniques for monitoring awareness and implementation of good practices may include:

- Land holder surveys across the region
- Verbal reporting
- Other discussions or records as part of regular on-going communication

6.3.3.3 Monitoring impacts of implementation of good practices for land degradation

Data should be collected at suitable and practical time intervals to monitor land, soil, water and biodiversity condition indicators appropriate to the local circumstances. Indicators of land degradation and desertification should be applicable to the local conditions. Where available indicators of land degradation defined by authoritative organisations such as UNCCD should be used and may be appended to this part of ISO 14055. Guidance for indicators of land degradation in non-arid lands may also be developed from these indicators or from other appropriate authoritative sources. Monitoring techniques may include:

- Direct reporting by land users.
- Use of remote sensing data for land cover e.g. using aerial or satellite imaging.
- Direct monitoring and measurement of indicators such as sediment loads or forest density.
- Review of critical incidents such as chemical spillages or landslides.

NOTE For forms of land degradation, see 5.3.

6.3.4 Reviewing and refining the good practices action plan

Based on the findings of the monitoring and measurement programme, the suitability, adequacy and effectiveness of the good practices should be evaluated as part of continual improvement. The programme of periodic review should be appropriate to the objectives, regulatory requirements and regional circumstances e.g. annual review. The results of the review should form the basis of iterative improvement in the good practices action plan and its implementation, noting that improvements in land condition may take several years to become apparent and that available resources may change over time.

6.4 Communication

Communication should include the exchange of information relevant to the interested parties and purpose. Characteristics of an effective communication strategy include:

- Direct communication with local groups and other relevant interested parties, e.g. workshops, drama/plays, media

- Appropriate language and methods of communication e.g. face to face meetings
- Ensuring opportunities for informal two way conversations
- Utilizing existing networks
- Timeliness
- Inclusiveness by ensuring all interested parties are consulted
- Reinforcement of messages
- Maintaining contact and being responsive
- Providing opportunities for sharing of experiences and lessons learnt to build collective knowledge
- Gathering and responding to feedback
- Recording outcomes of consultation
- Publication in reports or technical journals

Annex A
(informative)

Natural factors contributing to land degradation

A.1 General

A range of natural factors can make landscapes more vulnerable to degradation and when combined with human activities this risk can result in varying degrees of land degradation and desertification from which recovery is very slow or impossible. Climate and extreme weather events exerts a strong influence over vegetation type, biomass and diversity. Precipitation and temperature determine the potential distribution of terrestrial vegetation and constitute the principal factors in the genesis and evolution of soil. Precipitation also influences vegetation production. In wet climates, precipitation supports growth of rich forests but if these are cleared, intense precipitation can lead to landslides and water erosion. In dryer environments, precipitation controls the spatial and temporal use of land for grazing and when precipitation is very low favours the nomadic lifestyle.

Vegetation cover becomes progressively thinner and less continuous with decreasing annual rainfall. Dryland plants and animals display a variety of physiological, anatomical and behavioural adaptations to moisture and temperature stresses brought about by large diurnal and seasonal variations in temperature, rainfall and soil moisture. The generally high temperatures and low precipitation in the dry lands lead to poor organic matter production and rapid oxidation. Low organic matter leads to poor aggregation and low aggregate stability leading to a high potential for wind erosion. The severity, frequency, and extent of e rosion are likely to be altered by changes in rainfall amount and intensity and changes in wind.

Changes in vegetation cover are likely to result from short-term changes in weather and climate change. In turn, this will likely affect SOM dynamics and vulnerability to erosion. Volcanic eruptions can cause local land degradation due to the deposition of lava and change in surface soil structure, permeability, and damage to vegetation. In the longer term, volcanic soils can become highly fertile.

A.2 Weather and climatic factors

A.2.1 Climate variability and change

Weather and climate are underlying drivers of land degradation, in both arid/ semi-arid regions and non-arid regions. Climatic stresses include high soil temperature, seasonal excess water, short duration low temperatures, seasonal moisture stress and extended moisture stress. Drought is a natural event originating from a deficiency of precipitation that result in a water shortage for some activities or groups. It is the consequence of a reduction in the amount of precipitation over an extended period of time, usually a season or more in length, often associated with other climatic factors - such as high temperatures, high winds and low relative humidity - that can aggravate the severity of the event. Flooding resulting from high seasonal rainfall is also a major driver of land degradation, especially in combination with topographical features such as slope and poor soil structure. Elements to be considered in developing good practices to reduce the risk of land degradation and desertification include intense or extreme rainfall events, floods, droughts, dust (storms, hazards e.g. health, transport effects), ecological productivity brought about by changes in climatic and weather factors such as temperature, rainfall, wind speed, solar radiation, evaporation and environmental change including climate change.

Changes in weather and climate factors, in particular temperature and rainfall has profound impacts on the bio-functionality of land and/or soil quality. These are manifested by changes during the cropping season (planting date), frost incidence (cold spells), reduced soil microbial activity, reducing vegetation cover, limited water resources as well as changes in land-use practices (e.g. conversion of lands into other uses) and depletion of soil nutrients. For instance, in drylands, a shift in the onset of planting dates due to climate change has been reported. Erosional features due to loss of biomass and vegetative cover are a consequence of erratic and highly variable rainfall. Similarly, changes in the river flow regime will impact on potential stream sediment loading and the availability of water for irrigation. Ecosystems integrity and services are therefore negatively impacted leading to overall loss in environmental quality.

A.2.2 Extreme rainfall events

Rainfall events that can generally give rise to serious episodic events (e.g. overland flow and runoff) involve intensity of precipitation; duration of precipitation; the wetness of the ground and the response of the rainfall catchment. Runoff water loses will result in limited water availability to plants.

A.2.2.1 Drought

Higher evapotranspiration and more sunshine hours (solar radiation) increase the occurrence/prevalence of droughts in many ecological settings. For example, highly variable and seasonal precipitation and dry spells bring about limited water resources to sustain crops, with subsequent effects on poverty and reduced fibre production and consequently the livelihoods of most communities.

A.2.2.2 Floods and storms

Floods emanate from intense rainfall events, whereby the soil infiltration capacity is exceeded. Land use change which denudes cover may lead to soil surface crusting, poor soil structure and hence less infiltration. Floods can lead to water erosion, landslides, damage of property, infrastructure and general well-being. Some floods are associated with storms like hurricanes, sea rises and other extreme events. Globally, such events are predicted to increase with climate change. It is not only human security that is impacted, but living conditions in low lands subject to periodic flooding are also adversely affected. In drylands, the shift to intense rainstorms from generally well-spread rains is causing degradation in terms of direct loss of agricultural production as well as moisture stress and crop failures. Health related challenges exist e.g., fever, malaria and other related water borne diseases; as well as provision of adequate sanitation.

A.2.3 Extreme temperature events

A.2.3.1 Heat waves

Heatwaves are predicted to increase globally due to the effects of climate variability and change (IPCC 2007), as well as urbanisation e.g. urban heat islands. The confined urban setting has a lot of waste energy in the form of heat; as well as the closing of the atmospheric windows by greenhouse gases, lead to a net heating of the globe. Some of the indicators of climate change are temperature increase, with adverse impacts on people, their living environment, biodiversity as well as water resources use. Heatwaves have led to several deaths, especially of the elderly. In addition, heatwaves put a huge pressure on electricity consumption (hence has high carbon output). Heatwaves, as one of the extreme events under climate change, pose challenges in many spheres of life. High temperatures negatively affect daily livelihood activities (e.g. productivity decline due to inability to work under extreme day temperatures). This then leads to food insecurity and decreased livelihood assets such as low yields, poverty, malnutrition, diseases

A.2.3.2 Frosts and cold spells

Cold spells generally caused by weather systems typified by cold air masses, which may occur especially during the winter season. These cold air masses negatively affect ecosystem goods and services; For example, frost heaves affects agricultural productivity leading to crop failure and mortality of livestock in particular their young ones (e.g. calves, lambs, kids). In the Polar and Arctic regions, extreme cold can lead to loss of human life. Similarly, in some cold regions provision of services (e.g. frozen water pipes, transport) is retarded. In colder climates, cold spells leads to increased cost of maintenance of daily living cost and provision of services (e.g. increased use of energy consumption, clearing snow from roads. The cold spells in some regions leads to most people homeless and often fatalities due to hypothermia disease.

A.3 Topography

Slope is a major driver of land degradation where land management practices for agriculture, urban development and mining disturb natural ecosystem stability, particularly in high rainfall regions (World Bank 2008). Good forest management practices can protect against land degradation through land slippage or landslides on steep slopes. Retaining forest ecosystems on slopes can also play a key role in adaptation to climate change through their greater stability and resilience to extreme weather events such as heavy rainfall. For example, landslides occur most frequently in areas of steep slopes, deep highly erodible soils, weathered and jointed bedrock, usually after periods of intense and prolonged rainfall. Earthquakes can trigger them. In addition to deforestation and removal of vegetation cover, undercutting during infrastructure development and the weight of large buildings can increase the risk of landslides.

A.4 Soil properties

The vulnerability of soil to degradation, including erosion, depends on physical, chemical and biological properties, including:

a) Soil physical properties

— Soil texture.

— Soil structure.

— Water holding capacity

— Soil bulk density and porosity

— Permeability and hydraulic conductivity

— Drainage properties

— Electrical conductivity

b) Soil Chemical properties

— Soil fertility (nutrients)

— Cation exchange capacity

— Soil acidity

— Soil Salinity

— Soil alkalinity

c) Soil biological properties

— Soil microorganisms

— Soil flora and fauna

— Soil organic matter (soil carbon)

— Ground cover

A.5 Natural disasters

A.5.1 Wildfires

Wildfires, which may be caused naturally or by humans, with impacts on natural environments and loses to both property and lives. For example, the burning veldt is direct loss of vegetation, with implications on land use and resources availability. These directly contribute to loss and damage, land use change and forestry. Fires tend to occur in seasonally distinct climates, e.g. wet followed by dry, resulting in aerosols (smoke) which may be chemically loaded (pollution). The meteorological conditions and vegetation type/state (e.g. fuel load) may contribute to the intensity of the fires, which then influences nutrient and population dynamics and the resulting ecosystem.

A.5.2 Volcanic eruptions

Volcanoes are perforations in the earth's crust through which molten rock and gases escape to the surface. Volcanic hazards originated from two classes of eruptions namely explosive and effusive.

Explosive eruptions originate in the rapid dissolution and expansion of gas from the molten rock as it nears the earth's surface. Explosions pose a risk by scattering rock blocks, fragments, and lava at varying distances from the source.

Effusive eruptions refer to material flow rather than explosions are the major hazard. Flows vary in nature (mud, ash, lava) and quantity and may originate from multiple sources. Flows are governed by gravity, surrounding topography, and material viscosity.

Hazards associated with volcanic eruptions include lava flows, falling ash and projectiles, mudflows, and toxic gases. Volcanic activity may also trigger other natural hazardous events including local tsunamis, deformation of the landscape; floods when lakes, streams and rivers are dammed, and create landslides.

Annex B
(informative)

Anthropogenic factors contributing to land degradation

B.1 General

Urbanisation, infrastructure development such as roads and replacement of vegetation with hard surfaces and buildings, and agriculture all affect the resilience of landscapes and ecosystems to degradation. Agriculture occupies more land area than any other land use and has caused varying degrees of land degradation problems in many regions of the world. The change of land use from forest, savannah or grassland ecosystems has changed the integrity and functioning of ecosystems. Agriculture has brought removal of vegetation, tillage and cultivation, burning, the introduction of new plant and animal species, and the excessive use of agrochemicals to the ecosystems. In arid and semi-arid regions, natural factors (See Annex B) often make the regions vulnerable to degradation when human activities disturb the fine balance in ecosystems. In regions that are more productive, farming systems focused on developing high yielding varieties of crops, intensive tillage, and use of chemical pesticides and herbicides have caused problems including:

- Excessive disturbance through mechanical tillage
- Declining stocks of soil carbon
- Degradation of soil biological health and soil microbial populations
- Reduced soil moisture storage
- Overreliance on mineral fertilisers
- Poor water infiltration and increased runoff
- Compaction and poorly developed root systems
- Unsustainable levels of nutrient loss.

Interaction between natural and anthropogenic drivers of land degradation is complex, involving biophysical, social and economic factors. Poorer people, for whom food production is often an immediate need, are likely to be farming the steeper land, shallower soils, less fertile soils and in areas of lower rainfall (World Bank 2003). These fragile environments are more susceptible to land degradation and the poorer people have less capacity to adopt long-term sustainable land management practices and can be caught in a cycle of land degradation, poverty and decreasing food security (ODG 2006).

B.2 Land Use Change

Loss of forest cover commonly results in loss of other native plants and animals and consequently degradation of the health and integrity of regional ecosystems with downstream effects on ecosystem services, e.g. in the situation where forests along waterways are removed. The amount of forest cleared per year since 2000 remains high at 13 million ha per year on average with the net area of primary forests having decreased by 40 million ha since 2000 as the pressure for land other uses increases (FRA 2010). The main driver of forest loss globally is expansion of agricultural land, which occurs from small-scale farmers to large multinational companies. Other drivers of deforestation include expansion of infrastructure and mining. Deforestation can have broad environmental impacts, including increase of greenhouse gas emissions, loss of biodiversity, soil erosion and hydrology changes. Conversion of natural grasslands or permanent pasture to cultivation also results in a net loss of soil organic carbon in rangelands.

B.2.1 Deforestation

Loss of forestland leads to exposure of soil to agents of land degradation such as surface run off that could lead to soil and nutrient loss. Deforestation results in a net loss of terrestrial carbon stocks to the atmosphere as carbon dioxide and soil carbon stocks. A particular case is the clearing of forests and draining of peatlands affecting the large stocks of carbon and increasing greenhouse gas emissions directly and indirectly through increase in wildfires.

B.3 Poor Forest management

Incorrect choice of plant species for afforestation could lead to ecosystem imbalance such as ground water mining by deep-rooted trees and loss in habitat of certain flora and fauna. Improper schedule of felling and poor management of resulting litter may lead to unsustainable production. Forest degradation often has driving forces related to land use and management, including unsustainable and illegal logging, over-harvest of fuel wood and non-timber forest products, overgrazing, human- induced fires, and poor management of shifting cultivation. In contrast, bush encroachment resulting from abandonment of over-used land leads to re-colonisation of an area by less desirable plant species. Increase in invasive species that compete with native species can result in depletion of soil nutrients and loss of biodiversity.

B.4 Poor Agricultural Practices

B.4.1 Overgrazing

Overgrazing removes the vegetation cover that protects the soil and acts to bind soil aggregates to conserve moisture. Thus, overgrazing predisposes soil to wind and water as agents of erosion. The combination of overgrazing and a variable climate increases the risks of land degradation, particularly in arid and semi-arid regions. However, climate variability also makes it difficult to define good practices such as managing a safe carrying capacity for livestock, because of the dependency of pasture growth on drought and other climate factors. When droughts affect livelihoods, the options available to poor farmers and herders for adoption of more good land management practices, such as conservative stocking, is limited and over-grazing is more likely to cause degradation at a time when the landscape is most vulnerable.

B.4.2 Over cultivation

The area of crop production globally is 0.23ha/person but in low-income countries is 0.17ha/person, in middle-income countries 0.23ha/person and in high-income countries 0.37ha/person (FAO 2011). The pressure on land is higher in the poor income countries even though they are more dependent on the land for the food security. High production and more intense land use can cause environmental degradation through loss of biodiversity, soil erosion and pollution of the ecosystems including water resources. The practice of frequently cultivating and growing crops more rapidly than the soil can recuperate, leading to a decline in soil quality and productivity. Ploughing is frequently considered necessary to loosen the soil to improve aeration and infiltration through it, yet all too often the effect is just the reverse. The weight of the tractors causes the soil to become compact thus reducing water infiltration, which makes the soil more susceptible to erosion. In turn, nutrient decline is a potentially serious outcome from soil erosion, and although this can be overcome by adding in nutrients, this can be expensive and requires good land management practices.

A cycle can be developed in crop production where there is already poor quality of soil (possibly already degraded by over-cultivation), resulting in diminishing access to land and water. There is then, pressure to intensify use of soils with low fertility or expansion of land use onto soils with poor quality, which degrades the soil and water resources and sets up a reinforcing cycle of degradation.

B.4.3

Poor irrigation practices lead to accumulation of salts in the root zone thus causing toxicity and deprivation of soil moisture to plants. Poor land drainage can lead to ground water table encroachment into the root zone.

B.4.4 Burning biomass

Burning in slash-and-burn agriculture may lead to uncontrolled veld fires. Practices such as prescribed fires for control of pest and weeds in rangeland can lead to wild fire. Wildfires directly affect upland ecosystem services through damage caused to the vegetation, peat and soils, which results in loss of valuable habitat and associated wildlife alongside carbon release.

B.5 Mining

Mining is a profitable business and it creates employment opportunities. It benefits everyone including the government and that is why the mining industry is widely supported. However, there are several negative effects of mining for the environment.

Exploration, mine development and dumping of barren waste degrade habitats of flora and fauna and prohibit alternative land use such as forestry, agriculture or leisure. Pollution from heavy metals or reagents used in mining operations is a land degradation risk for significant areas, particularly in developing countries. Mining also leads to depletion and degradation of surface water, ground water and aquifers due to drilling.

Mining and its following activities have been found to degrade the land to a substantial extent. Overburden removal from the mine area results in a very significant loss of rain forest and the rich top soil. Overburden removal is normally done by the process of blasting or using excavators, which results in generation of large volume of waste (soil, debris and other material). This is impractical for the industry and is normally just stored in large piles within the mine area, and occasionally, on public land. The bigger the scale of the mine, greater is the quantum of waste generated. Opencast mines are therefore more pollution intensive as they generate much higher quantities of waste compared to the underground.

Though most mining wastes, such as overburden, are inert solid materials, the industry also generates waste that is toxic in nature. Some of these toxic are inherently present in the ore, for example, heavy metals such as mercury, arsenic, lead, zinc, cadmium, etc. These heavy metals leach out of the stored waste piles, contaminating the local environment. However, some toxic chemicals are also found in waste, as they are added purposely during extraction and processing.

B.6 Demographic changes

Demographic trends such as population growth and urban expansion into better quality lands and socio-economic circumstances that result in growing demand for food and fibre can increase the pressure towards unsustainable land management. Population pressures exacerbate the risk of climate change in increasing the vulnerability of landscapes to climate change, both directly through changes in weather patterns and extreme events, and indirectly through limiting alternative food supplies for vulnerable peoples. Increase in population leads to over exploitation of natural resources such as water, flora and fauna and soil. Pollution also may also results from the livelihood activities of population. Inappropriate agriculture and human settlement policies and inappropriate implementation of well-formulated policies lead to land degradation. War, refugee and nomadic population dynamics can lead to local dense populations leading to over-exploitation of vulnerable ecosystems.

Annex C
(informative)
Key sources of additional relevant information

C.1 International conventions and guidance

United Nations Convention to Combat Desertification – UNCCD Dryland Champions Program - UNCCD

National Action Plans of UNCCD Parties

C.2 Examples of national guidance and documents

National standard /guidelines from China

National standard/guidelines from Egypt

NOTE Examples of national standards for countries are illustrative only and do not reflect the relative value over other country standards

C.3 Reports and technical papers

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