Land degradation

SOLAW Background Thematic Report 3

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Acronyms and abbreviations

LADA	Land Degradation Assessment in Drylands
GEF	Global Environmental Facility
UNEP	United Nations Environment Programme
FAO	Food and Agriculture Organization of the United Nations
GLADIS	Global Land Degradation Information System
HDI	Human Development Index
FRA	
UNDP	United Nations Development Programme
WOCAT	World Overview of Conservation Approaches and Technologies
UNCCD	United Nations Convention to Combat Desertification
H–E	Human–Environment
MDG	Milliennium Development Goals
LDI	Land Degradation Index

Executive summary

Global assessments of soil and land degradation began more than 35 years ago, but have only recently achieved a clear answer as to where land degradation takes place, the effect it has on the population and what the cost would be to governments and land users if the decline in soil, water and vegetation resources continued unabated. Although institutional, socio-economic and biophysical causes of land degradation have been identified locally in many case studies, these have not been inventoried systematically at district, national or regional level. The Land Degradation Assessment in Drylands (LADA) project was launched by the Global Environmental Facility (GEF) to remedy this situation. The project was implemented by the United Nations Environment Programme (UNEP) and executed by the Food and Agriculture Organization of the United Nations (FAO). Many of the findings discussed in this report are outputs of this project.

GLADIS (Global Land Degradation Information System) is based on an assessment of the status and the trends of ecosystem goods and services:

- Status: a representation of the situation as it is, a "snapshot" of the capacity of the land to provide ecosystem service, taken in a given moment in time. It can be used as a baseline information.

- Trend: a description of the direction of the actual or potential changes that are on-going or potential in a given piece of land. It gives an indication of the stability or sustainability of the status. Trends can be either negative (degradation) or positive (improvement).

The combination of the two gives an idea of the overall level of land degradation, allowing for some preliminary analysis of the main causes and also to define a rough prioritization for interventions.

GLADIS summarizes findings in radar diagrams that cover the status and trends of each of the major ecosystem goods and services (biomass, soil health, water quantity and quality, biodiversity, economics, social and cultural). Results are available for each area of the globe, per country or per land-use system within a country. Figure 1 gives an example of this result in the form of a radar diagram.

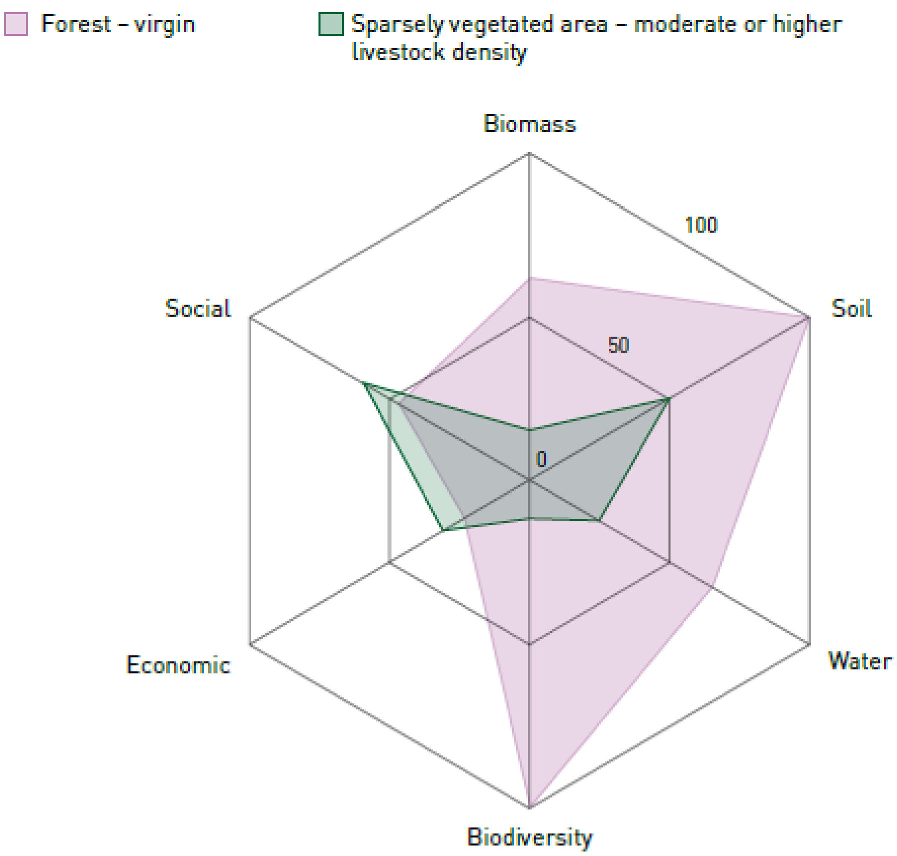


Figure 1 Capacity of the ecosystem to provide services under two different land uses
Source: GLADIS

Status of ecosystem services

Biomass – land cover has been inventoried and assessed because it is the main natural protection against degradation. Countries that are particularly well protected by dense biomass are those that are forest-rich. Countries that are particularly poor in land cover include all countries having large areas of drylands and deserts

Soil health – has been assessed against present prevailing land-cover/use. Soil is generally not a limiting factor for livestock or in forestry areas. It is cropping that sets significant demands on the soil. Poor soils under cropped agriculture are therefore rated more severely than soils richer in nutrients. This particularly concerns the countries in the Sahel, the Savannah belt in Africa, the central United States and some countries in Northwest Europe. Poor soils under agriculture also occur in the eastern areas of Brazil and India.

Water resources – there is a wide range in water availability worldwide. Countries that receive high rainfall and are well endowed with rivers score highly for water availability. Dryland countries on the other hand have an extremely limited water resource.

Biodiversity – its status has been assessed as a function of the land use, as such it reflects a decrease in biodiversity that goes from wetter to drier climes and from forestry-based, over livestock-based to crop-based agriculture where biodiversity often has the lowest status.

Economic productivity – Countries with highly intensive agriculture and commercial forests have ecosystems that produce high economic rural outputs. At the other end of the scale many dryland countries have low input agriculture, pastoral systems and little forest cover, which results in low rural economic output.

Social and cultural services – social provisioning has been estimated using accessibility, tourism and the presence of protected areas. The integrated index shows that all Europe, large parts of the United States and South America, with the exception of the Amazon, have high accessibility in addition to a high attraction value for landscapes and cultural provisions. Rainforests, polar and desert regions are less accessible, while civil strife may make some countries less able to provide social and cultural services.

Processes: Land degradation and improvement

Biomass health trends – Results from NDVI analysis and deforestation statistics indicate that over the last 20 years, the Sahel, Western Europe, large parts of India and the United States have slightly increased biomass and biomass health, while most of Central and South America (Amazon), Central and Eastern Africa and Southeast Asia have shown a relatively small decline. Note, these analysis are done on global datasets and therefore may mask dramatic changes locally.

Soil health trends – Soil health changes are determined by major degradation processes taking place in the soil. The results combining all soil factor trends are most severe for countries dominated by steep lands, often in combination with low input agriculture. The worst situation occurs in mountain ranges such as the Himalayas, Andes, Rockies, and the Alps and is associated with agricultural areas that are under-managed as in most of Africa, with the exception of South Africa, or over-managed as in most of Western Europe because of soil or groundwater pollution.

Water availability trends - Water scarcity is dynamic and varies in time as a result of natural hydrological variability and as a function of prevailing economic policy, planning and management approaches. In GLADIS, the variation of pressures on water resources over time has been computed by comparing the level of water resources withdrawn in 2003 with the level of 1983. In addition to this withdrawal pressure, the aridity index, expressed as the ratio of precipitation over potential evapo-transpiration (P/PET), has been analyzed in terms of historical trends over the period 1980-2000. In general, water processes are positive in countries with known positive water balances, such as those at the east of the Black Sea, as well as in many humid tropical and northern countries. On the contrary and not surprisingly, many dryland countries have negative processes. It has to be noted however that the process is quite linked with the extent of the irrigation system in a given area. So, areas where irrigation has expanded result in a decrease of water availability, and the contrary if the other way around, which explains the improving situation in southern Russia.

Biodiversity trends – To classify the risk to global biodiversity the anticipated threat from human-induced climate and land-use change was considered. The work is based on 'conservation risk areas', which are subject to past or future land-cover transformation and reduced for currently protected areas. According to the methodology, biodiversity threats are lowest in dryland countries and highest in the Mediterranean, in western India and in a corridor in South America in Brazil and Argentina.

Changes in (rural) economic output – The economic implications of the provisioning of goods and services by ecosystems are as important as the biophysical provisioning services themselves,. Non-industrial economic provisioning status and trends are not easily determined because one has to rely on country statistics of sometimes dubious accuracy. Apart from countries that are well known for their agricultural expansion over the last decade, for instance Brazil, China and Vietnam, a number of less expected countries occur on top of the list such as countries in the Sahel, which have started from a very low base level and have consequently shown a high growth rate.

There are little or no data available on the evolution and trends of those socially relevant data used for assessing the status of the social ecosystem provisions. Tests have been made for the utilization of the Human Development Index as calculated by the United Nations Development Program (UNDP), but those tests did not provide reliable and consistent results, so this approach has been dropped. Hence, no assessment of trends in social provisions is given. In order to keep the system consistent, the social axis is still present, but its value has been fixed at 50 (neutral/no change) for all pixels.

Analysis of results

A first conclusion is that most developing countries, particularly in dryland Africa, have a particularly fragile resource base as far as ecosystem provisioning services are concerned (Figure 2).

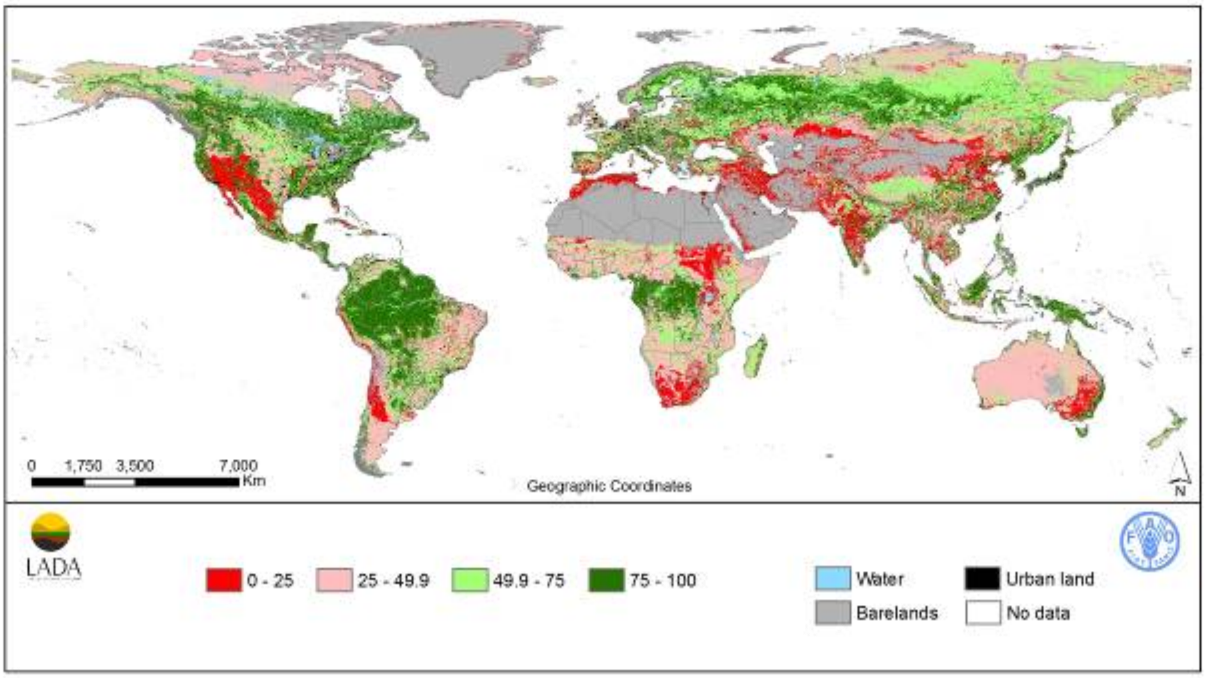
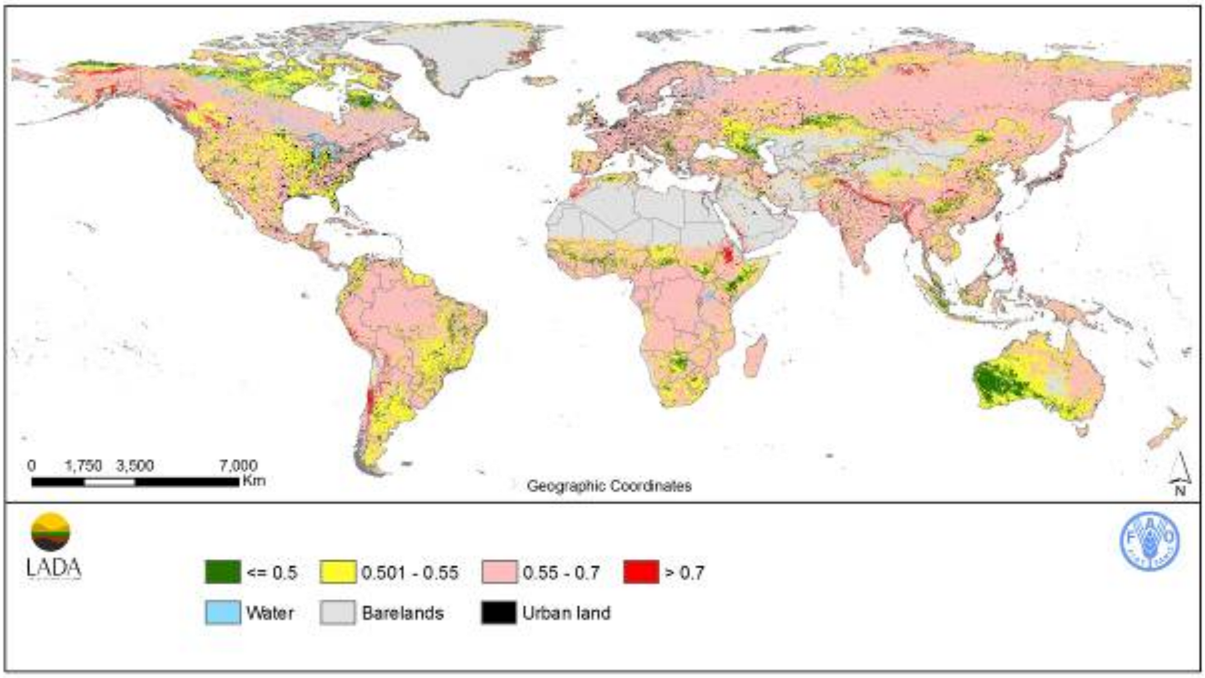


Figure 2 Status of the land' (Capacity of ecosystems to provide services)

Land degradation processes are on-going over large part of the Earth land surface (Figure 3). Most of the degradation is due to soil erosion and biodiversity loss in the less populated areas, while water shortage, soil depletion and soil pollution are most common in the most agricultural areas.

Many semi-arid areas appears to be less degrading, or are even improving (yellow and green areas in the map), often due to the fact that they start from a lower baselevel, and also in certain cases due to an increase in rainfall and an improvement in their rural economic performance in the period of analysis.



'Figure 3 Degrading land' (Trends in ecosystems services 1990-2005)

Land degradation classes

Biophysical land degradation classes are identified by the combination of the overall status in provisioning biophysical ecosystem services and the trend of these services (Biomass, Soil, Water and Biodiversity) as described above. The combined reclassification is shown in the following map and table (Figures 4 and 5).

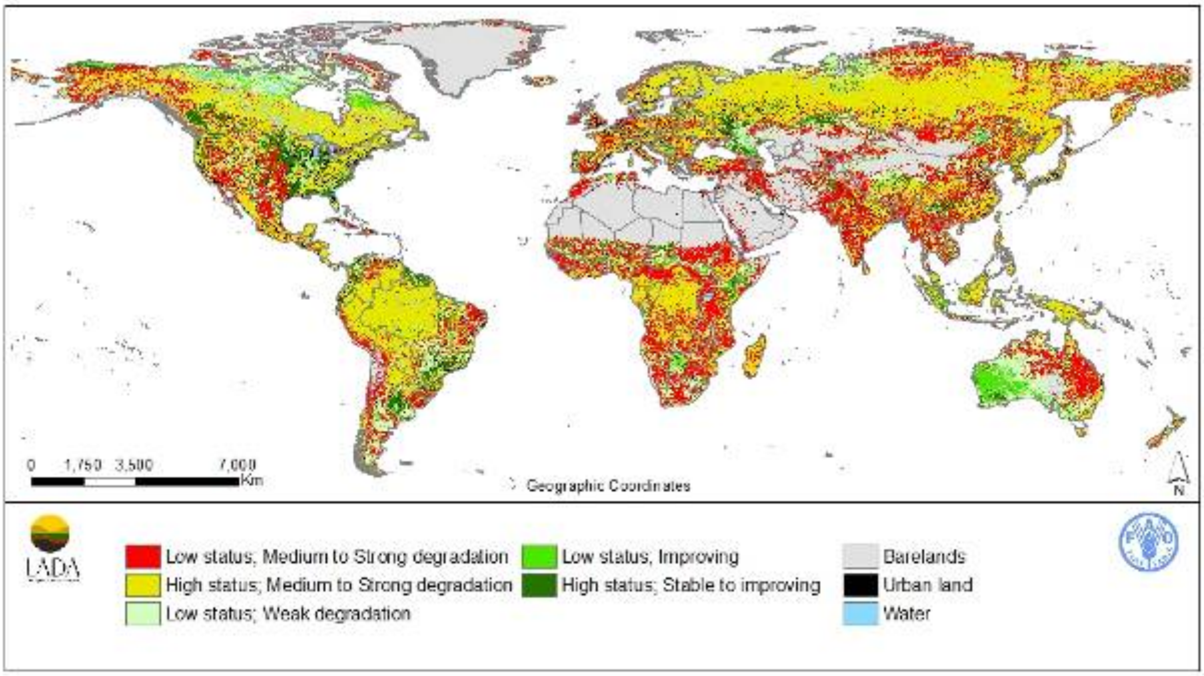


Figure 4: Land degradation classes

		Status			
		<=25 bad	**25-49.99**	**50-75**	**>75 good**
Process	**>0.7 high LD process**	Low status; Medium to Strong degradation	Low status; Medium to Strong degradation	High status; Medium to Strong degradation	High status; Medium to Strong degradation
	0.5-0.7	Low status; Medium to Strong degradation	Low status; Medium to Strong degradation	High status; Medium to Strong degradation	High status; Medium to Strong degradation
	0.5-0.55	Low status; Weak degradation	Low status; Weak degradation	High status; Stable to improving	High status; Stable to improving
	<= 0.5 low LD process	Low status; Improving	Low status; Improving	High status; Stable to improving	High status; Stable to improving

Figure 5: Combination of the Biophysical status index with the Biophysical degradation index

The global extent of the classes of biophysical degraded lands and intervention options are given in Figure 6. Figure 7 illustrates that stronger land degradation is associated with higher poverty levels.

Typology of degradation of ecosystem benefits	Intervention options
Type 1 – High degradation trend or highly degraded lands	Rehabilitate if economically feasible; mitigate where degrading trends are high
Type 2 – Moderate degradation trend in slightly or moderately degraded land	Introduce measure to mitigate degradation
Type 3 – Stable land, slightly or moderately degraded	Preventive interventions
Type 4 – Improving lands	Reinforcement of enabling conditions which foster SLM

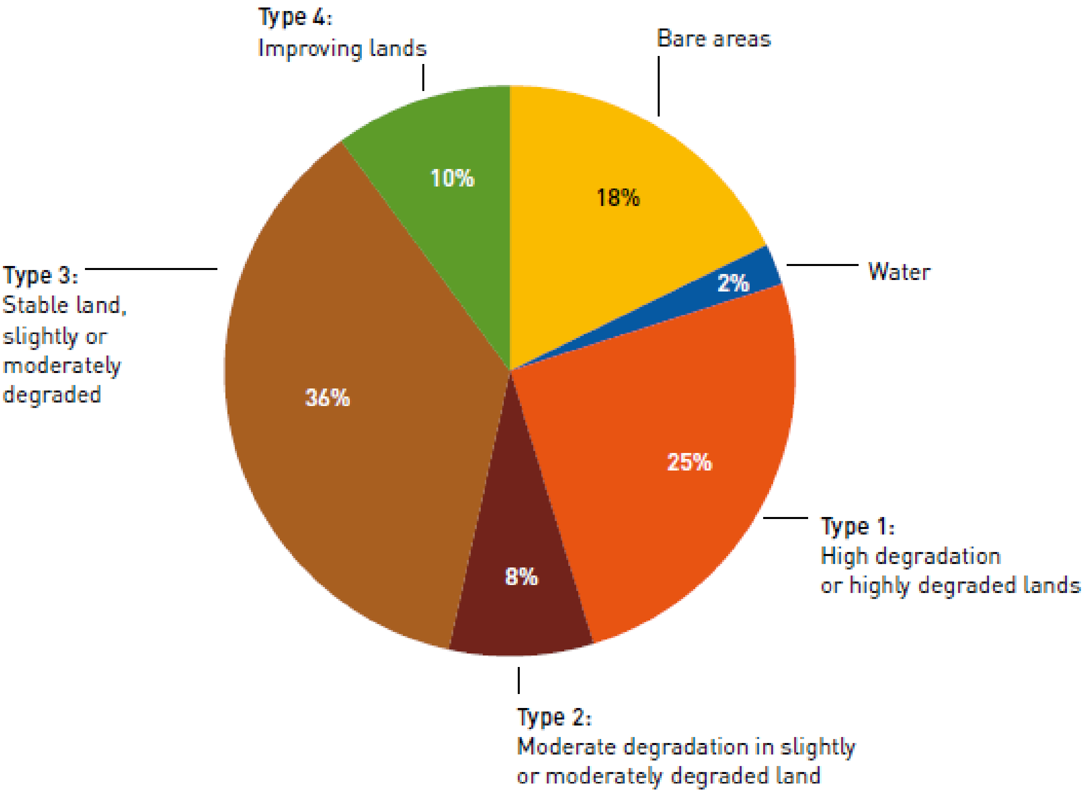
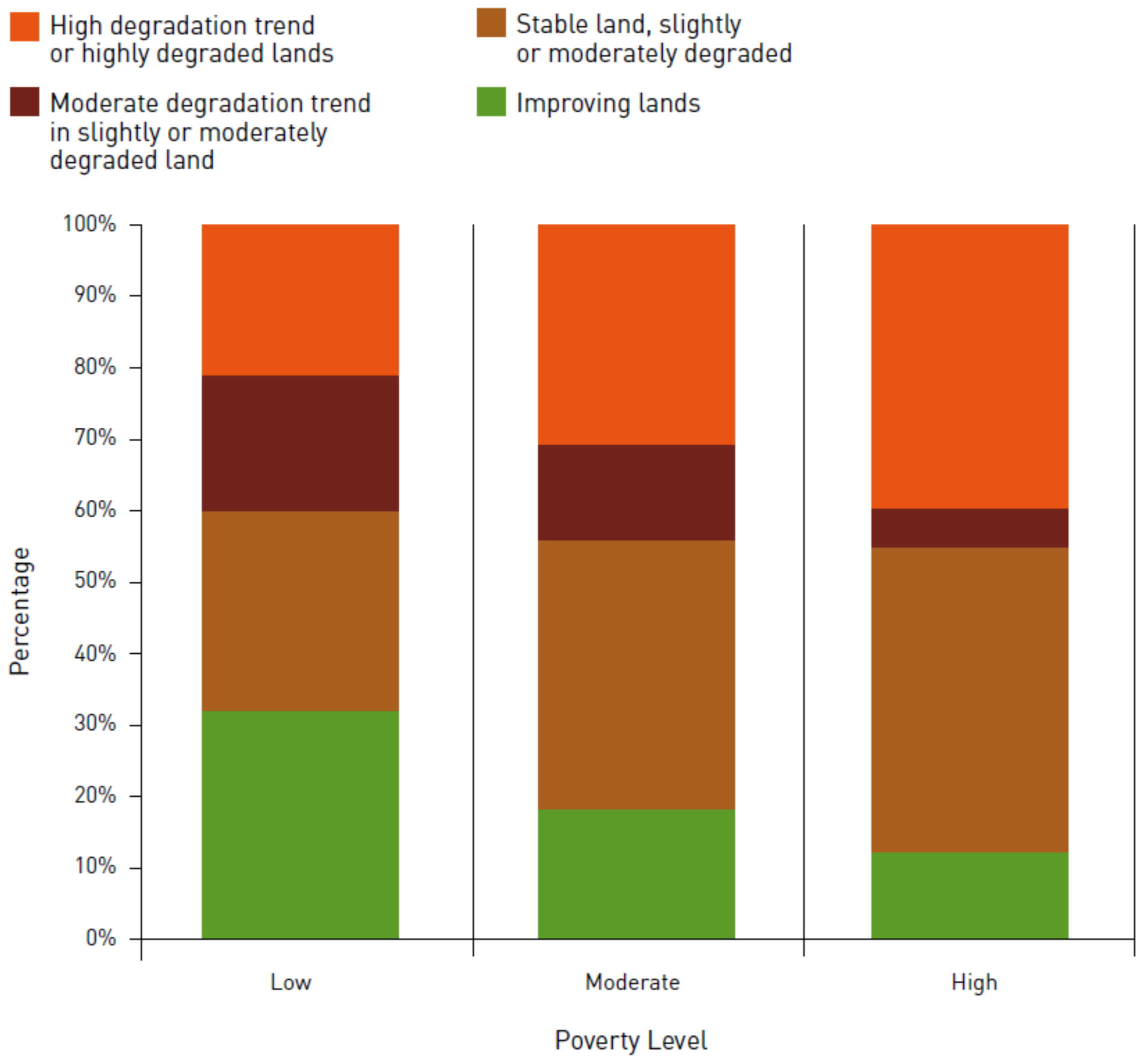


Figure 6: Status and trends in global land degradation



'Figure 7 Relation between land degradation and poverty

National and local land degradation studies: indicators and monitoring

There is a plethora of methods, indicators and recent studies concerning specific aspects of land degradation at local and national levels. An inventory carried out by the United Nations Convention to Combat Desertification (UNCCD) revealed more than 900 different land degradation indicators used in a sample of UNCCD countries. Efforts for harmonization are on-going. Eleven indicators have been provisionally defined by the UNCCD, and 22 metrics have been selected to be tested for their measurement. Practical monitoring may use any of the following:

(1) The LADA/WOCAT participatory assessment methodology can be used at sub-national level. The main parameters describe the state, cause and impact of degradation. At the same time, the type and extent of sustainable land management interventions are inventoried.

(2) The coupled Human – Environment (H-E) promotes the integrated consideration of biophysical and socio-economic parameters linking institutional and policy considerations with land degradation. These consider threshold tipping points beyond which systems can no longer be restored.

(3) Remote sensing approaches – have the significant advantage that data are continuously collected objectively and as such are ideally suited for monitoring purposes. Reliability issues and capacity needs remain as weakness points.

(4) Local sampling techniques and surveys are objective and the most detailed of all, but are more costly and quite time consuming.

The causes of land degradation

Natural causes – they often determine the inherent capacity of the ecosystem to provide goods and services. These include those that are climatic that determine the capacity to generate biomass and provide ground cover, water quantities and biodiversity. Some natural causes such as slope and soil vulnerability to water and wind erosion also influence the degradation processes.

Human-induced causes – of land degradation processes are largely determined by land use and land-use change, economic factors related to the possibility of investing in the land and access to markets; and social factors that assure the availability of infrastructure, and farmers' accessibility to land that allows them to produce at maximum capacity. A number of direct causes may seem natural but have human causes wholly, partly, or indirectly behind them such as bush invasion, forest fires, floods, landslides and droughts. Behind the directly obvious causes of human induced land degradation there are often other more deeply rooted drivers that have to do with population pressure, poverty, lack of markets and infrastructure, poor governance and weak institutional frameworks and inadequate education.

Although undoubtedly correct, it is difficult to prove the relationship of cause and effect for these in a statistically significant way. Most relationships are based on a few local studies that have little value outside the study area. Ecosystems produce a range of services and goods including those that are economic and social and the same cause that affects one service negatively may well affect another positively. Therefore, sensible trade-offs between social and economic advantages should be weighted against negative effects on biophysical characteristics and vice versa. The views of the stakeholders should always be taken into account when these trade-offs are negotiated.

The cost of land degradation

Most studies that focus on the cost of land degradation have estimated the costs of soil erosion, not of land degradation, which may be magnitudes higher when one considers biomass, water and biodiversity. Moreover, the studies are largely limited to productivity losses for which there is an overall problem of the lack of consistent relations between soil losses and productivity. Unless the environmental costs such as loss of carbon, decline in water resources, loss of cultural services, is correctly valued, it is obvious that the results of economic valuation will largely underestimate the costs.

Unfortunately, there is no widespread agreement on how to value ecosystem goods and services and therefore, until this is achieved, no progress will be made in accurately estimating the real global or national cost of land degradation. In addition, new economic options for use of degraded land, for instance for growing biofuel crops, or for carbon sequestration and carbon trading, will have additional spin-off environmental benefits. Scenarios are uncertain in this respect however, in the face of volatile and uncertain markets and the absence of internationally binding agreements.

Messages

Land degradation is more than an environmental problem alone and should be considered holistically, taking into account different ecosystem goods and services, biophysical as well as socio-economic. Results should be referred to a given time period and solutions require full consultation with stakeholders and imply trade-offs between environmental and socio-economic ecosystem services.

Degraded land, based on the capacity of the globe's ecosystem to deliver goods and services are highly variable. Degraded land mostly occurs in drylands and steep lands, which deserve special attention. The capacity to deliver ecosystem services is significantly less in developing countries as compared with industrial nations.

Degradation takes many forms and affects soils, biomass, water, biodiversity and economics and social services derived from the ecosystem. This decline (degradation) appears to be proportional with the present capacity of the system. In other words ecosystems with lower **capacit**ies decline less than ecosystems with **greater capacities.**

The impact of this degradation is most felt in areas with a high incidence of poverty. This implies that even when starting from a low resource base, the lower rate of degradation in these areas has a much greater impact, compared to ecosystems with a high capacity, with a higher rate of degradation, but fewer poor people.

Agricultural lands used for cropping and livestock rearing are more susceptible to degradation than non-agricultural lands. Land use, and associated inputs and management, are indeed the main direct causes of land degradation. Land use in itself is determined by natural conditions and cultural and socio-economic aspects including institutional settings, infrastructure, education and market availability.

At sub-national level, there is a harmonized and tested survey methodology, which was developed by WOCAT and LADA. It has been tested with positive results for the production of the UNCCD indicators for country reporting on the impact of land degradation. At the local level various approaches have been promoted, but those developed and based on integrated Human–Environment considerations and those given by LADA that use simplified sampling and socio-economic surveys appear to be most promising. Remote sensing techniques have a definite role to play, particularly in monitoring land degradation because they provide high resolution information in a continuous time scale. In addition, they are ideal to follow land cover changes linked to land use changes that are the main causes of degradation.

The cost of land degradation has been hotly debated since the publication of the first global inventory. However, in spite of the difficulties of providing precise figures, it can be said that land degradation has a significant economic impact in most developing countries. This is due, among others, to the fact that they have significantly less capacity of generating ecosystem goods and services than the developed ones.

An overall observation concerning the global level assessment is that quantitative reliable data is insufficient, particularly that for available water resources and their trends, and on economic factors that are often based on statistics of dubious quality. Therefore, apart from the complexity in interpretation highlighted above, the overall reliability of the input data remains another concern.

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