INTRODUCTION

Land is an essential building block of civilization, it is essential for growing most of the food that the world's ever-growing population needs, and yet its contribution to our quality of life is perceived and valued in starkly different and often incompatible ways. A minority has grown rich from the unsustainable use and large scale exploitation of land resources, with related conflicts intensifying in many countries. The world has reached a point where we must reconcile these differences and rethink the way in which we plan, use, and manage the land.

While, land degradation is a global problem, it takes place locally and requires local solutions. Greater commitment and more effective cooperation at the local level are necessary to stop land degradation and loss of biodiversity. Our ability to manage trade-offs at a landscape scale will ultimately decide the future of land resources – soil, water, and biodiversity and determine success or failure in delivering poverty reduction, food and water security, and climate change mitigation and adaptation. Indeed, integrated land and water management is recognized as an accelerator for achieving most important Sustainable Development Goals (SDGs). Further agricultural expansion, one of the main causes of land degradation, could be limited by increasing yields on existing farmland, shifting to plant-based diets, consuming animal proteins from sustainable sources, and reducing food loss and waste.

Moreover, we are at a critical occasion, fast approaching and in some cases surpassing planetary boundaries, the evidence presented in this first edition of the Global Land Outlook 2017 (GLO) demonstrates that informed and responsible decision making, improved land management policies and practices, and simple changes in our everyday lives, can, if widely adopted, help to reverse the current worrying trends in the state of our land resources.

Bringing together a diverse group of international experts and partners, the GLO provides the first in-depth analysis of the multiple functions of the land viewed from a wide range of interrelated sectors and thematic areas, such as the food-water-land interactions, as well as less obvious drivers of land use, notably the nature of economic growth, consumer choices and global trade patterns. It addresses the future challenges and opportunities for the management and restoration of land resources in the context of sustainable development, including:

- Food, water and energy security
- Climate change and biodiversity conservation
- Urban, peri-urban and infrastructure development

- Land tenure, governance and gender
- Migration, conflict and human security

Land degradation and its types

The term land, as employed in land evaluation, land use planning, etc., has a wider meaning than just soil. It refers to all natural resources which contribute to agricultural production, including livestock production and forestry. Land thus covers climate and water resources, landform, soils and vegetation, including both grassland resources and forests.

Land degradation

It is the temporary or permanent lowering of the productive capacity of land. It thus covers the various forms of soil degradation, adverse human impacts on water resources, deforestation, and lowering of the productive capacity of rangelands.

This study takes the degradation of soil resources as its focus. This includes soil erosion by water and wind, deterioration in soil physical, chemical and biological properties, waterlogging, and the build-up of toxicities, particularly salts, in the soil. Since soil productivity is intimately connected with water availability, lowering of the groundwater table is also noted. Since deforestation is being treated in detail in a current FAO study, it is here considered primarily as a cause of soil degradation, particularly erosion.

Land degradation has both on-site and off-site effects. On-site effects are the lowering of the productive capacity of the land, causing either reduced outputs (crop yields, livestock yields) or the need for increased inputs. Off-site effects of water erosion occur through changes in the water regime, including decline in river water quality, and sedimentation of river beds and reservoirs. The main off-site effect of wind erosion is overblowing, or sand deposition.

Types of land degradation assessed

For the purpose of this study, the many and varied processes of land degradation have been grouped into six classes: water erosion, wind erosion, soil fertility decline, salinization, waterlogging, and lowering of the water table.

Water erosion covers all forms of soil erosion by water, including sheet and rill erosion and gullying. Human-induced intensification of land sliding, caused by vegetation clearance, road construction, etc., is also included.

Wind erosion refers to loss of soil by wind, occurring primarily in dry regions.

Soil fertility decline is used as a short term to refer to what is more precisely described as deterioration in soil physical, chemical and biological properties. Whilst decline in fertility is indeed a major effect of erosion, the term is used here of cover effects of processes other than erosion. The main processes involved are:

- Lowering of soil organic master, with associated decline in soil biological activity;
- degradation of soil physical properties (structure, aeration, water holding capacity), as brought about by reduced organic master;
- Adverse changes in soil nutrient resources, including reduction in availability of the major nutrients (nitrogen, phosphorus, potassium), onset of micronutrient deficiencies, and development of nutrient imbalances.
- Buildup of toxicities, primarily acidification through incorrect fertilizer use.

Waterlogging is the lowering in land productivity through the rise in groundwater close to the soil surface. Also included under this heading is the severe form, termed ponding, where the water table rises above the surface. Waterlogging is linked with salinization, both being brought about by incorrect irrigation management.

Salinization is used in its broad sense, to refer to all types of soil degradation brought about by the increase of salts in the soil. It thus covers both salinization in its strict sense, the buildup of free salts; and codification (also called alkalization), the development of dominance of the exchange complex by sodium. As human-induced processes, these occur mainly through incorrect planning and management of irrigation schemes. Also covered is saline intrusion, the incursion of sea water into coastal soils arising from over-abstraction of groundwater.

Lowering of the water table is a self-explanatory form of land degradation, brought about through tubewell pumping of groundwater for irrigation exceeding the natural recharge capacity. This occurs in areas of non-saline ('sweet') groundwater. Pumping for urban and industrial use is a further cause.

Other types of degradation included

Other types of land degradation are treated briefly, treated as causes, or excluded from this review. This is because they are localized or of small extent on a regional scale, or because they are more fully treated elsewhere.

Four further classes are recognized as types of land degradation, and as having considerable importance in the region. One case, deforestation, has been treated by reference to an external

review. The two other types are considered in more generalized terms.

Deforestation The occurrence of deforestation is widespread and extremely serious in the region. It is not independently assessed here, in view of more detailed treatment in the current FAO Forest resources assessment 1990 project. Deforestation is also discussed as a cause of erosion.

Forest degradation This is the reduction of biotic resources and lowering of productive capacity of forests through human activities. It is under review in a current survey (Banerjee and Grimes, in preparation).

Rangeland degradation This is the lowering of the productive capacity of rangelands. It is considered in generalized terms, but no quantitative data have been identified.

Types of degradation excluded from the study

Other types of degradation are excluded from this study, either because they are of small extent on a regional scale, or they are more fully treated elsewhere. These are:

- **Acid sulphate formation**, a serious but localized form of degradation, which may occur on drainage of coastal swamps.
- **Soil pollution**, from industrial or mining effluents, to the atmosphere, rivers or groundwater. This is an important concern in the region, but is strongly localized.
- **Soil destruction through mining and quarrying activities**, the failure to restore soil after extraction. The same remarks apply as for soil pollution.
- **Urban and industrial encroachment onto agricultural land**. With the projected increase in urbanization, this will continue to be a substantial cause of loss of agricultural land, but it is a different problem from land degradation.
- **Effects of war**. Land degradation on a substantial scale through effects of war has been reported from Iran (western borderlands) and Afghanistan, in the latter case including the destruction of irrigation schemes.
- **Potential effects of global climatic change**. It is beyond question that the composition of the world's atmosphere is being substantially altered as a result of human activities. A small but significant global warming has already been observed and is projected to continue. It is possible that this may lead to modifications to the general atmospheric circulation with consequent changes in rainfall.

These changes could be beneficial or adverse to land productivity or human welfare: specifically, in semi-arid regions, rainfall might become higher or longer, more reliable or less, or with longer

or higher incidence of droughts. There is, however, no firm evidence of what such changes may tee.

If adverse changes occur in some areas, then these will certainly constitute a most serious form of human-induced degradation of natural resources. It is accepted that, for a range of reasons, action should be taken to reduce emissions of 'greenhouse gases'. However, until there is clearer evidence, its potential effects upon climate must remain a master of research, and these will not be further considered.

Problems of the natural environment

Aridity and drought are problems of the natural environment in semi-arid and aria areas. In the subsequent amplifications of the terms of reference it is clear that degradation, namely human-induced adverse environmental changes, is the intended focus. Therefore aridity and drought would only properly be included if it could be shown that rainfall had been reduced, or drought spells made more frequent, as a result of man's activities. This has not been established.

Problem soils. Soils which present special difficulties for agriculture may be called problem soils. They include saline soils, sandy soils, cracking clays, strongly acid soils, shallow soils, and soils on steeply sloping or poorly drained land.

To the extent that these are problems of the natural environment, problem soils do not constitute land degradation. However, land degradation frequently leads to an increase in the extent or severity of problem soils, for example, erosion causes shallow soils. A clear case is that of saline soils: these occur naturally, in which case they are problem soils, but their extent has been greatly increased by human-induced salinization.

Reversible degradation and land reclamation

The effects of water and wind erosion are largely irreversible. Although plant nutrients and soil organic master may be replaced, to replace the actual loss of soil material would require taking the soil out of use for many thousands of years, an impractical course of action.

In other cases, land degradation is reversible: soils with reduced organic master can be restored by additions of plant residues, degraded pastures may recover under improved range management. Salinized soils can be restored to productive use, although at a high cost, through salinity control and reclamation projects.

Land reclamation frequently requires inputs which are costly, labor-demanding or both. The reclamation projects in salinized and waterlogged irrigated areas demonstrate this fact clearly. In

other cases, the land can only be restored by taking it out of productive use for some years, as in reclamation forestry. The cost of reclamation, or restoration to productive use, of degraded soils is invariably less than the cost of preventing degradation before it occurs.