

## Sustainability dimensions

### Introduction

With 30 percent of the earth's land used for growing crops and pastureland, another 30 percent covered by forests, and a full 70 percent of abstracted fresh water used by agriculture, there is no question that agriculture must be at the centre of any discussion of natural resource management and global environmental objectives. Ensuring adequate food and water for all while at the same time achieving sustainable rural development and livelihoods for current and future generations hinge upon the responsible management of natural resources. Agriculture, though, has a complex relationship with natural resources and the environment.

While agriculture is a major user of land and water it must also maintain the quantity and quality of those resources in order to stay viable. Despite efforts to conserve and recycle natural resources, the agriculture sector generates waste and pollution that can negatively impact landscapes and wildlife habitats. For instance, as the largest consumer of water, agriculture is the main source of nitrate and ammonia pollution in both ground and surface water. It is a major contributor to the phosphate pollution of waterways and the release of powerful greenhouse gases (methane and nitrous oxide) into the atmosphere.

Increasingly, however, agriculture and forestry are recognized as having potentially positive externalities, such as the provision of environmental services and amenities

through water storage and purification, carbon sequestration and the maintenance of rural landscapes. Moreover, research-driven intensification is saving vast areas of natural forest and grassland that would have been developed in the absence of higher crop, meat and milk yields. But conversely, intensification has in some instances contributed to air and water pollution that has led to reduced productivity growth.

Both new and traditional demands for produce are putting intense pressure on scarce agricultural resources. While the sector will be forced to compete for land and water with mushrooming urban settlements and industrial zones, it will also be required to serve on another major front: to meet the increasing demands of the emerging bio-based economy, especially bioenergy and markets for renewable and sustainable industrial products.

## Key Resources

### The State of the World's Forests (SOFO)

The State of the World's Forests reports on the status of forests, recent major policy and institutional developments and key issues concerning the forest sector. It makes current, reliable and policy-relevant information widely available to facilitate informed discussion and decision-making with regard to the world's forests.

SOFO 2011 considers the theme 'Changing pathways, changing lives: forests as multiple pathways to sustainable development.' It takes a holistic view of the multiple ways in which forests support livelihoods. The chapters include regional trends on forest resources, the development of sustainable forest industries, climate change mitigation and adaptation, and the local value of forests.

2011: Changing pathways, changing lives: forests as multiple pathways to sustainable development

2009: Society, forests and forestry: adapting for the future

Publication cycle: Biennial

Webpage:

<http://www.fao.org/forestry/sofo/en/>



## The State of the World's Land and Water Resources for Food and Agriculture (SOLAW)

The State of the World's Land and Water Resources for Food and Agriculture analyses a variety of options for overcoming constraints and improving resource management in these areas of heightened risk.

By 2050, food production is projected to increase by about 70 percent globally and nearly 100 percent in developing countries. This incremental demand for food, together with demand from other competing uses, will place unprecedented pressure on many agricultural production systems across the world. These “systems at risk” are facing growing competition for land and water resources and they are often constrained by unsustainable agricultural practices. They therefore require particular attention and specific remedial action.

2011: Managing systems at risk.

Webpage:

<http://www.fao.org/nr/solaw/en/>



## Land

As populations and economies grow, productive lands in some countries are being displaced by urban and industrial development, roads and reservoirs. This is because, for sound historic and strategic reasons, many urban areas and industrial zones are situated on flat coastal plains or river valleys with fertile soils. Where land cannot be viably expanded, the loss of prime-quality cropland has put additional pressure on agriculture to perform, especially through intensification.

Changes in **landcover** have caused the most pressing environmental issue in recent decades. Deforestation and land use intensification, especially its impact on soil degradation, are at the heart of the issue. But, in much of the world, the current picture of landcover change shows a continuing slowdown of converting forests to areas for crop or livestock production and the steady growth of protected areas.

The latest estimate of the world's total **forest area** is at over four billion hectares, corresponding to 31 percent of total land area or an average of 0.6 hectares per capita. The five most forest-rich countries (the Russian Federation, Brazil, Canada, the United States of America and China) presently account for more than half of the planet's total forest area. Ten countries or areas have no forest at all, and an additional 54 have forest on less than 10 percent of their total land area. While the rate of **deforestation** and loss of forest from natural causes is still high, it is slowing down. At the global level, it has decreased from an estimated 16 million hectares per year in the 1990s to around 13 million hectares per year in the last decade.

At the same time, afforestation and natural expansion of forests in some countries and areas have significantly reduced the net loss of forest area at the global level. The net change in forest area over the period 2000–10 was estimated at -5.2 million hectares per year, down by 35 percent per year in the prior decade. However, most of the loss of forest continued to take place in countries and areas in the tropical regions, while most of the gain took place in the temperate and boreal zones and in some emerging economies.

On the positive side, close to 75 percent of the world's forests were covered by a national forest programme – a participatory process for the development and implementation of forest-related policies and international commitments at the national level.

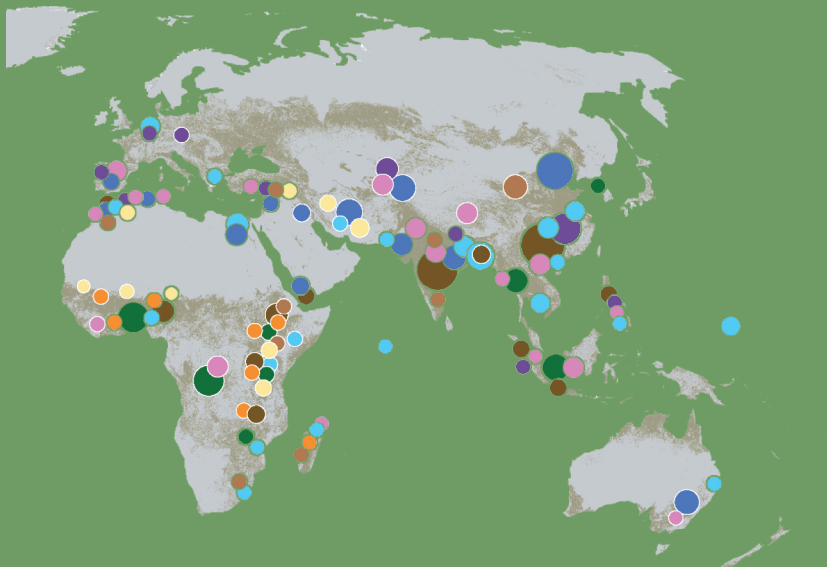
Map 54:



Source: FAO, Land and Water Division

Metalink: P4.ENV.FAO.FOR.LCF.SOLAW, p. 348

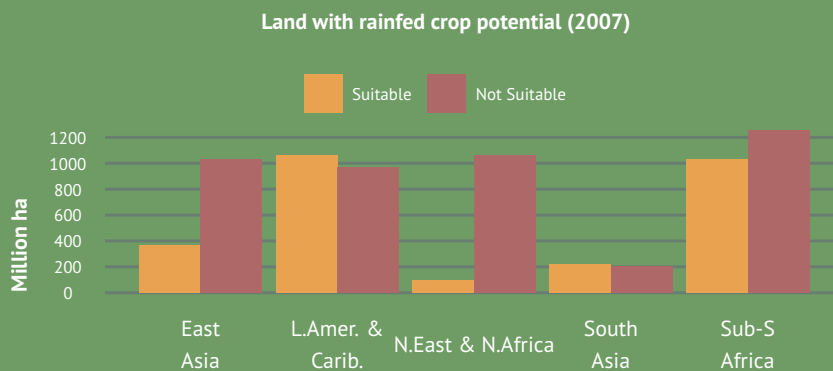
- Land and water are indispensable for agricultural production
- Many production systems are increasingly constrained by low availability of and access to these key resources
- Unsustainable practises, growing socio-economic pressures and climate change represent additional pressures



Global distribution of risks associated with main agricultural production systems

- Pollution
  - Desertification/droughts
- Deforestation
  - Loss/low soil fertility
- Loss of biodiversity
  - Erosion
- Land scarcity
  - Cropland

Chart 98: Land surface in many regions is unable to sustain crop cultivation, leading to environmental pressure from the intensification of existing cropland



Source: FAO, Statistics Division  
 Metalink: P4.ENV.LND.SUIT, p. 350

Historically, production of wood and wood products has been the main objective of forest management and other functions were not explicitly accounted for. However, there has been a shift towards assigning a higher priority to the environmental and social functions of forests.

Currently, more than 1.6 billion people depend on forests for their livelihoods, with some 300 million living in them. Forests provide habitats to about two-thirds of all species on earth. In addition, forests serve as carbon reservoirs by storing large amounts of carbon in trees and soil. When forests are cleared or degraded, their sink potential is reduced and they can become a substantial source of CO<sub>2</sub>.

Overall, forests contain just over half of the **carbon** in terrestrial vegetation and soil, amounting to 1200 Gt of carbon. Boreal (coniferous) forests account for more carbon than any other terrestrial ecosystem (26 percent), while tropical and temperate forests account for 20 and 7 percent respectively. The Intergovernmental Panel on Climate Change (IPCC) has estimated that, globally, carbon sequestration from reduced deforestation, forest regeneration and plantation development could equal approximately 15 percent of the total carbon dioxide emissions generated by fossil fuels.

Crop intensification has the potential to structurally lower crop productivity through land degradation. This term refers to the reduction of the land's capacity to provide an ecosystem functioning over a period of time for the beneficiaries of these functions, namely farming.

According to the Land Degradation Assessment in Drylands (LADA) initiative, **land degradation** costs an estimated US\$40 billion annually worldwide, without taking into account the hidden costs incurred by increased fertilizer use and loss of biodiversity and unique landscapes. The consequences of land degradation include reduced land productivity and socio-economic problems such as uncertainty in food security, migration, limited economic development and damage to ecosystems. Reclamation of degraded land is costly and, if severely degraded, impractical.

Map 55:



Source: FAO, Statistics Division

Metalink: [P4.ENV.FAO.FOR.LCF.SQ, p. 348](#) 

- Carbon content in topsoil is a good measure of soil fertility, but when removed, soil depletion results, leading to poor crop yields
- Depletion arises owing to excessively intense cultivation and inadequate soil management
- Sub-Saharan Africa and parts of Asia suffer from inherently low soil fertility

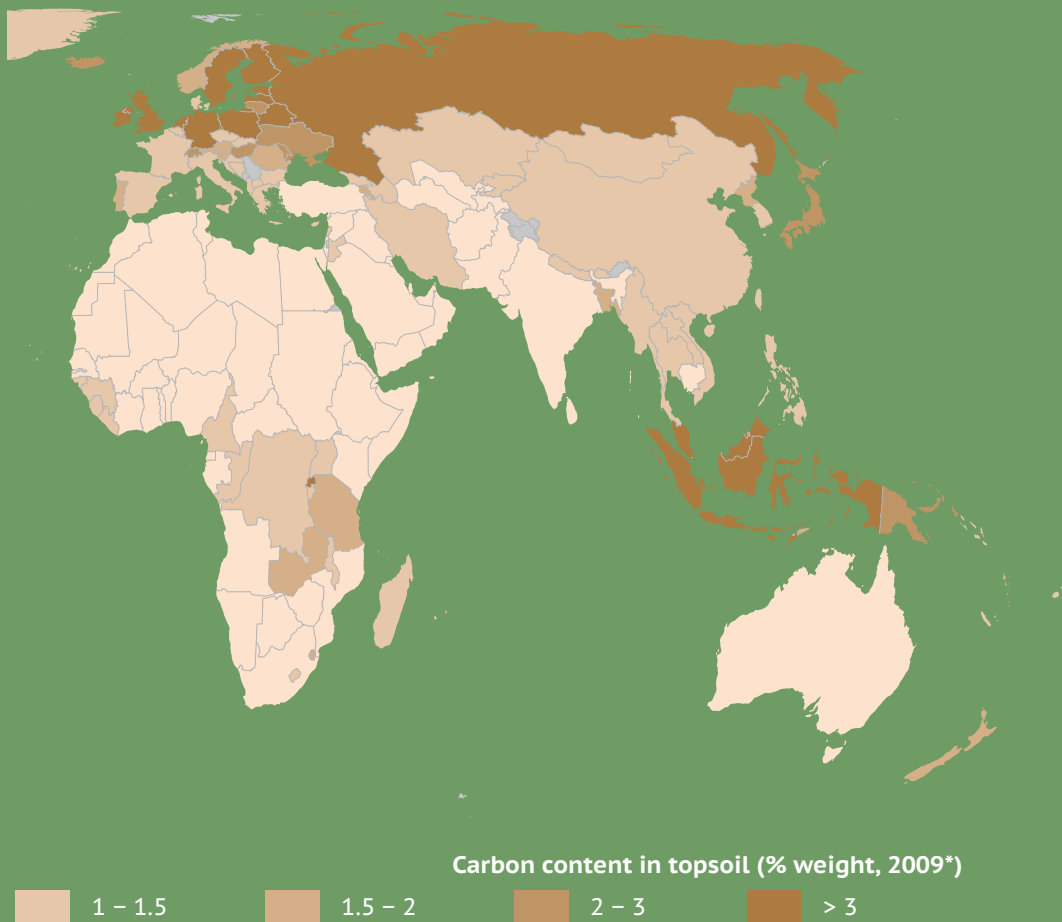
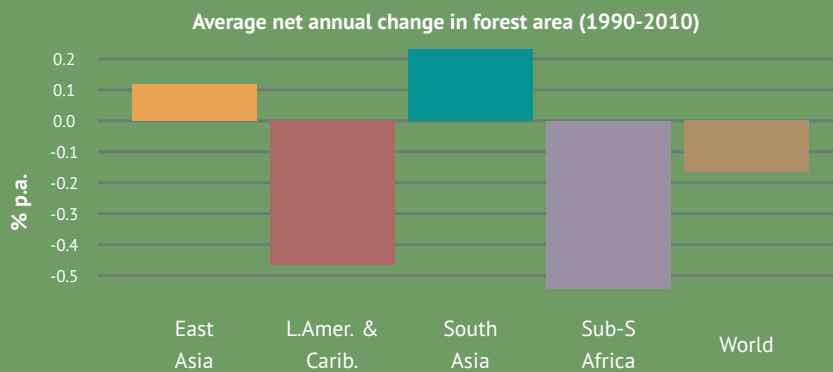


Chart 99: Rates of annual net loss of forests are still very high in some regions



Source: FAO, 2010. Global Forest Resources Assessment 2010

Metalink: P4.ENV.FAO.FOR.LCF.DEF, p. 347

Land degradation affects large zones and many people around the world, particularly in dryland areas. The transfer of critical production elements to other uses (e.g. dry-season grazing lands), the introduction of cash crops, and the use of water for industrial and urban purposes at the expense of rural agricultural producers sever the links in traditional dryland production chains. Left uncompensated, such changes lead to the breakdown of entire production systems.

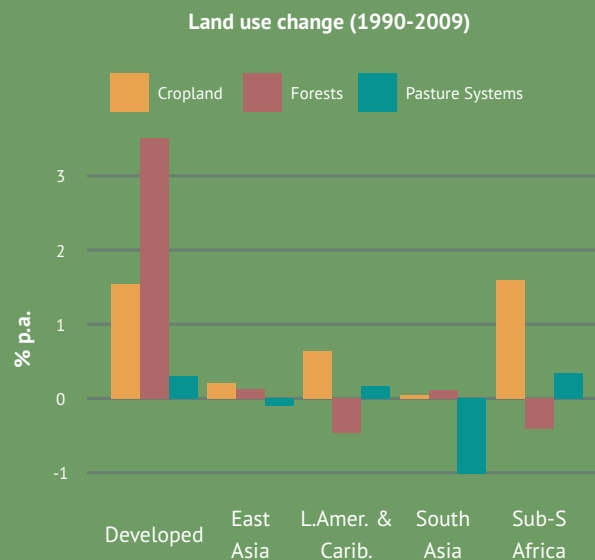
Removing the protective cover to reduce competition for water and nutrients, ploughing, heavy grazing and deforestation leave the soil highly vulnerable to wind erosion, particularly during severe droughts. Heavy grazing around water points or during long droughts prevents or delays the re-growth of vegetation or favours only invasive shrubs.

This problem is particularly acute in numerous parts of sub-Saharan Africa, where inherently low soil fertility, severe nutrient depletion and poor soil structure are prevalent. Large fertilizer applications are unaffordable and too risky in these low-potential rainfed cropping systems. However, sustainable land and water management techniques can greatly restore productivity. These techniques include soil fertility management, applying a combination of organic and inorganic nutrients, agronomic techniques (such as plant diversity, agroforestry, crop rotation) and the maintenance of protective soil cover.

### Further reading

- [FAO The State of the World's Land and Water Resources for Food and Agriculture \(SOLAW\): managing systems at risk 2011 \(www.fao.org/nr/solaw/solaw-home/en/\)](http://www.fao.org/nr/solaw/solaw-home/en/)
- [FAO State of the World's Forests 2011 \(www.fao.org/docrep/013/i2000e/i2000e00.htm\)](http://www.fao.org/docrep/013/i2000e/i2000e00.htm)
- [FAO Global Forest Resources Assessment 2010 \(www.fao.org/forestry/fra/fra2010/en/\)](http://www.fao.org/forestry/fra/fra2010/en/)
- [UN International Year of Forests 2011 \(www.fao.org/forestry/iyf2011/en/\)](http://www.fao.org/forestry/iyf2011/en/)
- [FAO Land degradation assessment \(www.fao.org/nr/land/degradation/en/\)](http://www.fao.org/nr/land/degradation/en/)
- [FAO Land Degradation Assessment in Drylands, LADA \(www.fao.org/nr/lada/\)](http://www.fao.org/nr/lada/)

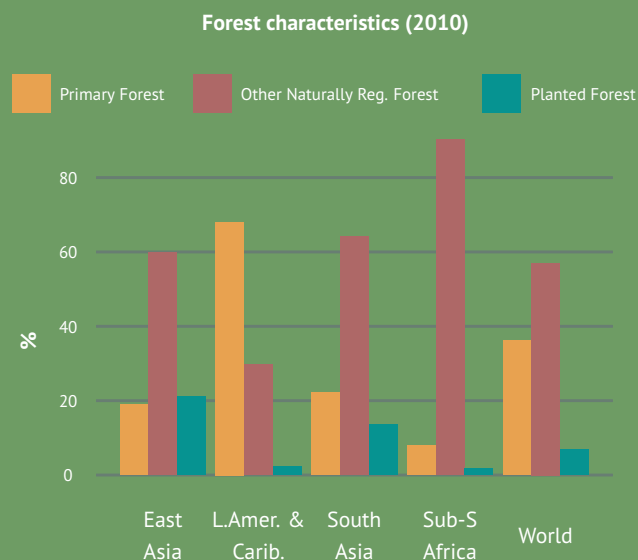
Chart 100: Cropland has expanded at the expense of forest cover



Source: FAO, Statistics Division (FAOSTAT)

Metalink: P4.ENV.FAO.ESS.LAND.CROP, p. 346

Chart 101: Primary forests now make up a small proportion of forest area

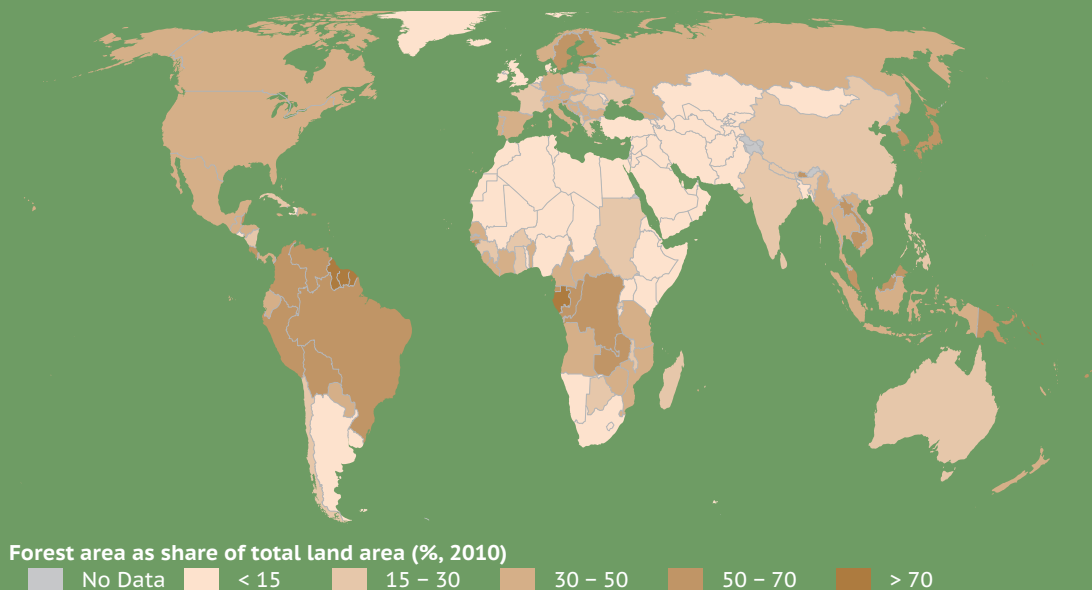


Source: FAO, 2010. Global Forest Resources Assessment 2010

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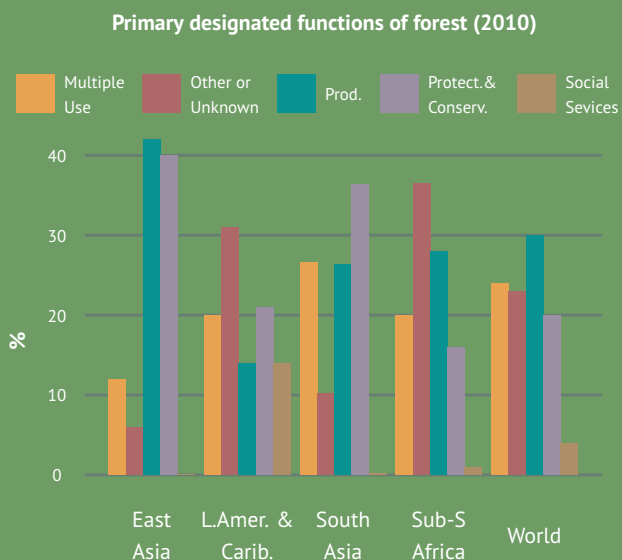
Map 56: At 4 billion hectares, the world's forests cover 31 percent of total land area



Source: FAO, 2010. Global Forest Resources Assessment 2010

Metalink: P4.ENV.FAO.FOR.LCF.FOA, p. 347

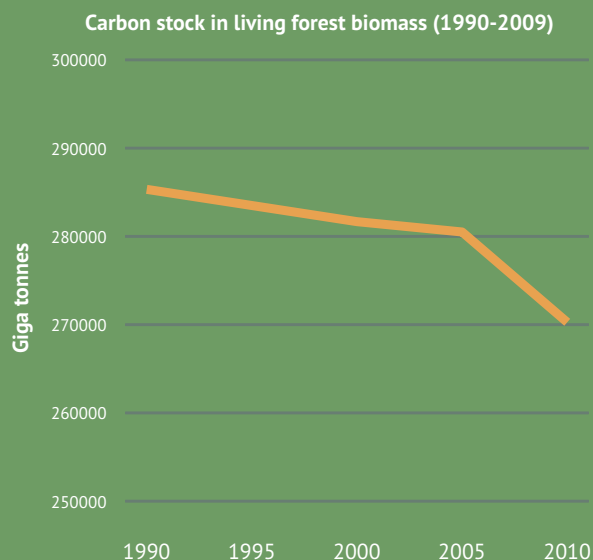
Chart 102: Other than wood production, forests perform a diverse set of functions across regions



Source: FAO, 2010. Global Forest Resources Assessment 2010

Metalink: P4.ENV.FAO.FOR.LCF.PFF, p. 347

Chart 103: 289 gigatonnes of carbon are stored in global forest biomass, but levels have fallen owing to a reduction in prime carbon-storing forests



Source: FAO, 2010. Global Forest Resources Assessment 2010

Metalink: P4.ENV.FAO.FOR.LCF.CSFO, p. 347