World agriculture: towards 2015/2030

Summary report

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, 2002

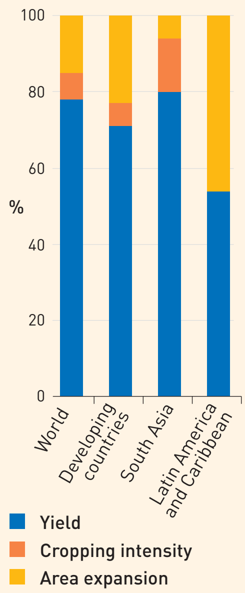
70 percent of increased production. Expansion of the area cultivated accounted for just under a quarter of production growth in these countries. However, in areas with more abundant land, area expansion was a larger contributing factor. This was especially the case in sub-Saharan Africa, where it accounted for 35 percent, and in Latin America, where the figure reached 46 percent.

The projections suggest that these broad trends for the developing countries will continue, at least until 2030: land expansion is expected to account for 20 percent of production growth, yield improvements for about 70 percent and increased cropping intensity for the remainder. In sub-Saharan Africa and Latin America, land expansion will still be important, but it is likely to be increasingly outweighed by yield increases.

The FAO study indicates that, for the world as a whole, there is enough unused productive potential, in terms of land, water and yield improvements, to meet the expected growth in effective demand. However, this is a global conclusion and there are several strong qualifications to bear in mind:

- Effective demand expresses people's purchasing power rather than the real need for food: wealthy consumers may indulge to excess, while the very poor may not be able to afford even basic foods.
- Data suggesting that food is getting cheaper may be flawed, because they do not reflect the environmental costs of expanding and intensifying agriculture; moreover, the failure to internalize resource costs may curb investment in agricultural research, holding back the potential for future growth in yields.
- Land or water scarcities and other problems will most certainly continue to arise at country and local levels, with serious consequences for poverty and food security.

Sources of growth in production, 1961 to 1999



Source: FAO data

In future, 80 percent of increased crop production in developing countries will have to come from intensification: higher yields, increased multiple cropping and shorter fallow periods.

Land resources

Is there enough potential cropland for future needs?

It is often suggested that the world may be heading towards shortages of suitable agricultural land. FAO studies suggest that this will not be the case at the global level, although in some regions and areas there are already serious shortages, and these may worsen.

Less new agricultural land will be opened up than in the past. Over the period 1961-63 to 1997-99 the expansion of arable land in developing countries totalled 172 million ha, an increase of 25 percent. In the next 30 years an increase of only 120 million ha, or 13 percent, will be required. Adding an extra 3.75 million ha

Fears of an imminent crunch between population growth and land availability are unwarranted. Most future growth in crop production will stem from improved yields. In some countries, however, land shortages may bite.

a year may seem a daunting task — but it is less than the rate of 4.8 million ha a year that was actually achieved over the period 1961-63 to 1997-99. A slowdown in expansion is expected in all regions, but this is mainly a reflection of the slower growth in demand for crops.

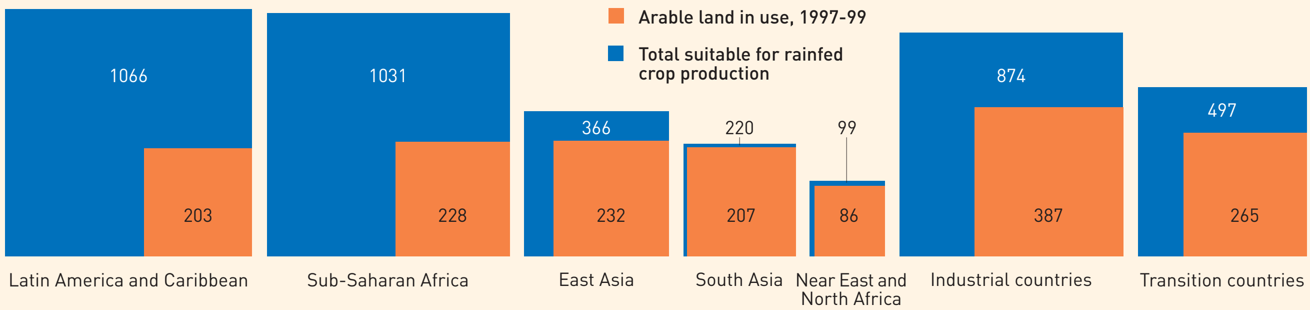
There is still potential agricultural land that is as yet unused. At present some 1.5 billion ha of land is used for arable and permanent crops, around 11 percent of the world's surface area. A new assessment by FAO and the International Institute for Applied Systems Analysis (IIASA) of soils, terrains and climates compared with the needs of and for major crops suggests that a further 2.8 billion ha are to some degree suitable for rainfed production. This is almost twice as much as is currently farmed.

Of course, much of this potential land is in practice unavailable, or locked up in other valuable uses. Some 45 percent is covered in forests, 12 percent is in protected areas and 3 percent is taken up by human settlements and infrastructure. In addition, much of the land reserve may have characteristics that make agriculture difficult, such as low soil fertility, high soil toxicity, high incidence of human and animal diseases, poor infrastructure, and hilly or otherwise difficult terrain.

The pool of unused suitable cropland is very unevenly distributed. By the end of the twentieth century, sub-Saharan Africa and Latin America were still farming only around a fifth of their potentially suitable cropland. More than half the remaining global land balance was in just seven countries in these two regions: Angola, Argentina, Bolivia, Brazil, Colombia, Democratic Republic of Congo and the Sudan. At the other extreme, in the Near East and North Africa 87 percent of suitable land was already being farmed, while in South Asia the figure was no less than 94 percent. In a few countries of the Near East and North Africa, the land balance is negative – that is, more land is being cropped than is suitable for rainfed cropping. This is possible where, for example, land that is too sloping or too dry for rainfed crops has been brought into production by terracing or irrigation.

More than 80 percent of the projected expansion in arable area is expected to take place in sub-Saharan Africa and Latin America. Although there is still surplus land in these regions, the expansion may involve cutting back on long rotation and fallow periods. If fertilizer

Cropland in use and total suitable land (million ha)



Sources: FAO data and Fischer *et al.* (2000)

use does not rise to compensate, this may result in soil mining and stagnant or declining yields.

In contrast, in South Asia and the Near East and North Africa, where almost all suitable land is already in use, there will be next to no expansion in area. By 2030 the Near East and North Africa will be using 94 percent of its suitable cropland, with a remaining surplus of only 6 million ha. In South Asia the situation will be even tighter, with 98 percent already in cultivation. In South and East Asia, more than 80 percent of the increase in production will have to come from yield increases, since only 5 or 6 percent can come from expansion of the arable area.

The projections suggest that the arable area in developing countries will increase by almost 13 percent or 120 million ha over the years from 1997-99 to 2030.

Cropping intensities will rise in all developing regions, on average from 93 percent to 99 percent. This will occur through the shortening of fallow periods and increased multiple cropping, made possible partly by growth in the irrigated area.

Is land becoming scarcer?

There is widespread concern that the world may be running out of agricultural land. The trend towards scarcity associated with population growth is aggravated by the conversion of farmland to urban uses, by land degradation and by other factors.

Certainly, much farmland is being taken over for non-agricultural uses. Assuming a requirement for housing and other infrastructure of 40 ha per 1000 people, then world population growth between 1995 and 2030 implies the need for an additional 100 million ha of such non-agricultural land. Since most urban centres are sited on fertile agricultural land in coastal plains or river valleys, when they expand they take up more of this prime land. In China alone, more than 2 million ha were taken out of agriculture in the ten years to1995.

Despite these losses, there is little evidence to suggest that global land scarcities lie ahead. Between the early 1960s and the late 1990s, world cropland grew by only 11 percent, while world population almost doubled. As a result, cropland per person fell by 40 percent, from 0.43 ha to only 0.26 ha. Yet, over this same period, nutrition levels improved considerably and the real price of food declined.

The explanation for this paradox is that productivity growth reduced the amount of land needed to produce a given amount of food by around 56 percent over this same period. This reduction, made possible by increases in yields and cropping intensities, more than matched the decline in area per person, allowing food production to increase.

Land scarcity and the problems associated with it do of course exist at country and local levels, with serious consequences for poverty and food security. In many places these are likely to worsen unless remedial action is taken.

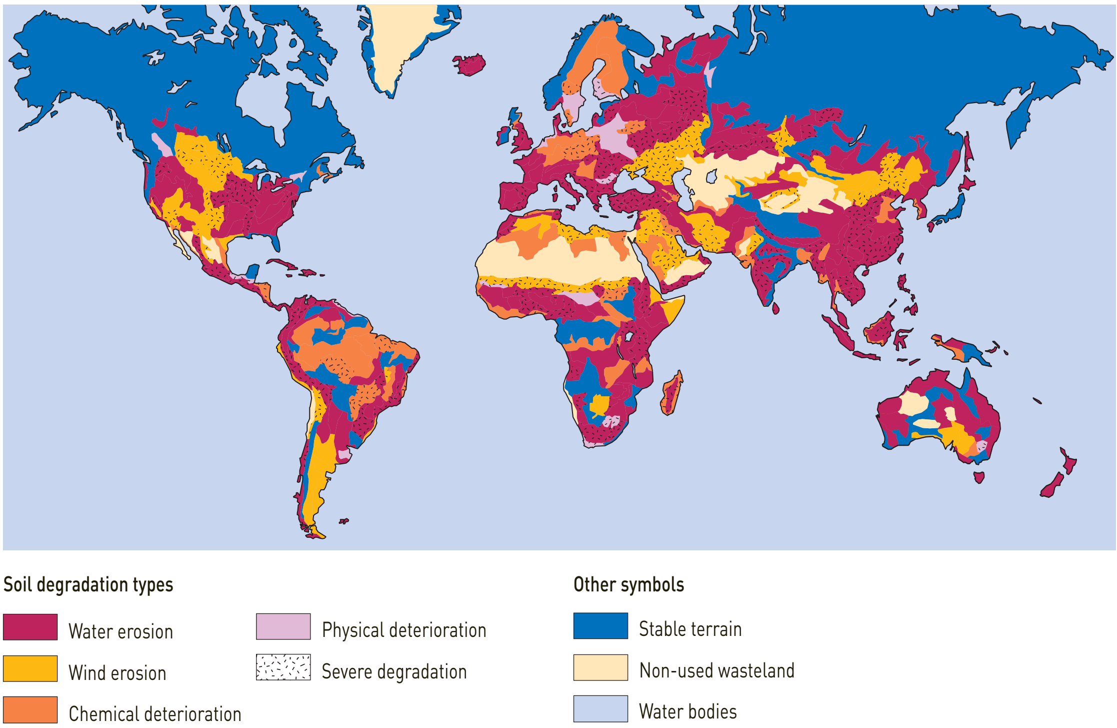
How serious is land degradation?

Land degradation is the process by which the soil's current or future capacity to produce is lowered by chemical, physical or biological changes. Some analysts claim that accelerating land degradation will offset productivity improvements, while others believe the seriousness of this problem has been greatly overstated.

The truth is that the area of degraded land is not known with much precision. Its assessment is often based on expert judgement rather than objective measurement. For India alone, estimates by different public authorities vary from 53 million ha right up to 239 million ha.

The most comprehensive survey to date, the Global Assessment of Land Degradation (GLASOD), is now over ten years old. GLASOD estimated that a total of 1964 million ha were degraded, 910 million ha to at least a moderate degree (with significantly reduced productivity) and 305 million ha strongly or extremely so (no

Human-induced soil degradation in the world



Source: Oldeman *et al.* (1991)

longer suitable for agriculture). Water erosion was the most common problem, affecting almost 1 100 million ha, followed by wind erosion, which affected almost 600 million ha.

The impact of degradation on productivity is also hard to assess. Its seriousness varies widely from site to site over even small distances, and at the same site according to local weather, vegetation and farming techniques. Degradation is a slow process that can be masked by applying additional fertilizer or by changing the crops grown. GLASOD reported in 1991 that almost all farmland in China was degraded, yet between the early 1960s and mid-1990s China tripled her rice production and increased her wheat production sevenfold. Some studies suggest annual average losses in cropland productivity may be quite small, averaging only 0.2 to 0.4 percent a year.

Degradation also has off-site costs, such as the siltation of streambeds and dams, flood damage, loss of fisheries and the eutrophication of lakes and coastal waters. These costs are often greater than on-site costs. However, the off-site effects of degradation are not all negative: losses in one place may result in gains elsewhere, as when soil eroded from uplands boosts productivity in the alluvial plains where it is deposited.

Because it is difficult to quantify, the future progress of land degradation was not taken into account in the projections made for this study. However, some projected or foreseeable trends, driven primarily by economic forces, will tend to reduce its extent and impact:

- About a third of the harvested area in developing countries in 2030 is expected to be irrigated land, which is generally flat, protected by bunds and little affected by

Principal types of land degradation

- *Sloping land* is particularly prone to water erosion, especially in wet areas where slopes exceed 10 to 30 percent and conservation measures are lacking. In Nepal, for example, some 20 to 50 tonnes of soil per ha are estimated to be eroded each year from fields in the hills and mountains, while up to 200 tonnes per ha per year may be lost in some highly degraded watersheds. Crop yields in these areas fell by 8 to 21 percent in the 25 years to 1995. Around 45 percent of the world's agricultural land has slopes of more than 8 percent, and out of this total 9 percent has very steep slopes of over 30 percent.
- *Desertification*, a term referring to land degradation in arid and semi-arid areas, received a great deal of attention during the 1970s and 1980s, when it was believed that deserts such as the Sahara were spreading irreversibly. Estimates suggested that up to 70 percent of the world's 3.6 billion ha of drylands were degraded. Since then remote sensing has established that desert margins ebb and flow with natural climate changes, while studies on the ground are showing the resilience of crop and livestock systems and the adaptiveness of farmers and herders.
- *Salinization* occurs in irrigated areas, usually when inadequate drainage causes salts to concentrate in the upper soil layers where plants root. It is a problem mainly in the arid and semi-arid zones, where 10 to 50 percent of the irrigated area may be affected. Salinization can cause yield decreases of 10 to 25 percent for many crops and may prevent cropping altogether when it is severe. It is estimated that 3 percent of the world's agricultural land is affected. In East Asia, however, the proportion is 6 percent and in South Asia 8 percent. For the arid and semi-arid tropics as a whole, 12 percent of agricultural land may be affected.
- *Nutrient mining* is also a serious problem. Farmers often use insufficient fertilizer to replace the nitrogen, phosphorus and potassium (NPK) harvested with their crops and lost through leaching, while trace elements, such as iron or boron, may also be deficient. A detailed study of Latin America and the Caribbean found nutrient depletion in all areas and for almost all crops except beans. Net NPK losses in the region in 1993-95 amounted to 54 kg per ha per year. Another study suggested net losses of 49 kg per ha per year in sub-Saharan Africa.

erosion. A quarter of the rainfed land by that time will have slopes of less than 5 degrees, also generally not prone to heavy erosion.

- The shift in livestock production to more intensive systems will take some pressure off dryland pastures. However, in the developing countries this will be partly offset by the encroachment of cropland, which will reduce the area remaining for extensive grazing.
- As people leave rural areas for urban centres, and farming for non-farming occupations, steep slopes and other marginal land will tend to be abandoned and will revert to scrub and forest. This process has already occurred rapidly in some European countries. In Italy, some 1.5 million ha were abandoned in the 1960s, 70 percent of which was sloping land. In some provinces, agricultural land decreased by 20 percent.

Other trends tending to reduce land degradation are likely, but their extent and intensity will depend heavily on the spread of improved agricultural and conservation practices, without which land degradation may worsen in many areas. The main practices and their potential impact are:

- No-till/conservation agriculture (NT/CA), which can maintain year-round soil cover and increase organic matter in soils, thereby reducing water and wind erosion.
- Increased fertilizer consumption and more efficient fertilizer use, which will reduce erosion by increasing root growth and ground cover.
- The use of irrigation, water harvesting, drought-tolerant crops and grazing-tolerant grasses, which will improve crop and vegetation cover and reduce erosion in drylands.
- The cultivation of legumes, which can add nitrogen to soils and improve their stability and texture in mixed crop-livestock farming systems.

Irrigation and water resources

A large share of the world's crops is already produced under irrigation. In 1997-99, irrigated land made up only about one-fifth of the total arable area in developing countries. However, because of higher yields and more frequent crops, it accounted for two-fifths of all crop production and close to three-fifths of cereal production.

This share is expected to increase further in the next three decades. Based on the potential for irrigation, national plans for the sector and the moisture needs of crops, the developing countries as a whole can be expected to expand their irrigated area from 202 million ha in 1997-99 to 242 million ha by 2030. This is a net projection – that is, it is based on the assumption that land lost due, for example, to salinization and water shortages will be compensated by rehabilitation or by the substitution of new areas.

> There will be no overall shortage of land or water for irrigation, but serious problems will persist in some countries and regions.

Most of this expansion will occur in land-scarce areas where irrigation is already crucial: South Asia and East Asia, for example, will add 14 million ha each. The Near East and North Africa will also see significant expansion. In land-abundant sub-Saharan Africa and Latin America, where both the need and the potential for irrigation are lower, the increase is expected to be much more modest – 2 million and 4 million ha respectively.

Although the projected expansion is ambitious, it is much less daunting than what has already been achieved. Since the early 1960s, no less than 100 million ha of new irrigated land have been created. The net increase projected for the next three decades is only 40 percent of that. The expected annual growth rate of 0.6 percent is less than a third of the rate achieved over the past 30 years.

The FAO study did not make projections for irrigation in the developed countries, which account for around a quarter of the world's irrigated area. Irrigation in this group of countries grew very rapidly in the 1970s, but by the 1990s the pace of growth had slowed to only 0.3 percent per year.

Is there enough irrigable land for future needs?

As with land in general, it has been suggested that the world may soon experience shortages of land suitable for irrigation. There is concern, too, that vast areas of presently irrigated land may be severely damaged by salinization. Once again, at global level these fears seem exaggerated, though serious problems may occur at local level.

FAO studies suggest there is still scope for expanding irrigation to meet future needs. However, irrigation potential is difficult to estimate accurately, since it depends on complex data on soils, rainfall and terrain. The figures should therefore be taken only as a rough guide. The total irrigation potential in developing countries is nevertheless estimated at some 402 million ha. Of this around half was