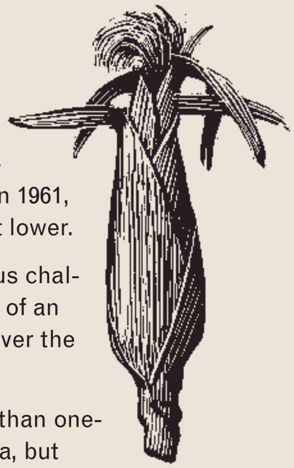
Box 2.4 Taking Stock of Agroecosystems

Highlights



- Food production has more than kept pace with global population growth. On average, food supplies are 24 percent higher per person than in 1961, and real prices are 40 percent lower.
- Agriculture faces an enormous challenge to meet the food needs of an additional 1.7 billion people over the next 20 years.
- Agroecosystems cover more than one-quarter of the global land area, but almost three-quarters of the land has poor soil fertility and about one-half has steep terrain, constraining production.
- While the global expansion of agricultural area has been modest in recent decades, intensification has been rapid, as irrigated area increased, fallow time has decreased, and the use of purchased inputs and new technologies has grown and is producing more output per hectare.
- About two-thirds of agricultural land has been degraded in the past 50 years by erosion, salinization, compaction, nutrient depletion, biological degradation, or pollution. About 40 percent of agricultural land has been strongly or very strongly degraded.

Key

Condition assesses the current output and quality of the ecosystem good or service compared with output and quality of 20–30 years ago.

	Excellent	Good	Fair	Poor	Bad	Not Assessed
Condition						

Changing Capacity assesses the underlying biological ability of the ecosystem to continue to provide the good or service.

	Increasing	Mixed	Decreasing	Unknown
Changing Capacity	↗	↑↓	↘	?

Scores are expert judgments about each ecosystem good or service over time, without regard to changes in other ecosystems. Scores estimate the predominant global condition or capacity by balancing the relative strength and reliability of the various indicators. When regional findings diverge, in the absence of global data weight is given to better-quality data, larger geographic coverage, and longer time series. Pronounced differences in global trends are scored as "mixed" if a net value cannot be determined. Serious inadequacy of current data is scored as "unknown."

Conditions and Changing Capacity

FOOD PRODUCTION

Since 1970, livestock products have tripled and crop outputs have doubled, a sign of rising incomes and living standards. Food production, which was worth US$1.3 trillion in 1997, is likely to continue to increase significantly as demand increases. Nonetheless, soil degradation is widespread and severe enough to reduce productivity on about 16 percent of agricultural land, especially cropland in Africa and Central America and pastures in Africa. Although global inputs and new technologies may offset this decline in the foreseeable future, regional differences are likely to increase.

WATER QUALITY

Production intensification has limited the capacity of agroecosystems to provide clean freshwater, often significantly. Both irrigated and rainfed agriculture can threaten downstream water quality by leaching fertilizers, pesticides, and manure into groundwater or surface water. Irrigated agriculture also risks both soil and water degradation through waterlogging and salinization, which decreases productivity. Salinization is estimated to reduce farm income worldwide by US$11 billion each year.

WATER QUANTITY

Irrigation accounts for fully 70 percent of the water withdrawn from freshwater systems for human use. Only 30–60 percent is returned for downstream use, making irrigation the largest net user of freshwater globally. Although only 17 percent of agroecosystems now depend on irrigation, that share has grown; irrigated area increased 72 percent from 1966 to 1996. Competition with other kinds of water use, especially for drinking water and industrial use, will be stiffest in developing countries, where populations and industries are growing fastest.

BIODIVERSITY

Agricultural land, which supports far less biodiversity than natural forests, has expanded primarily at the expense of forest areas. As much as 30 percent of the potential area of temperate, subtropical, and tropical forests has been lost to agriculture through conversion. Intensification also diminishes biodiversity in agricultural areas by reducing the space allotted to hedgerows, copses, or wildlife corridors and by displacing traditional varieties of seeds with modern high-yield but uniform crops. Nonetheless, certain practices, including fallow periods and shade cropping, can encourage diversity as well as productivity.

CARBON STORAGE

In agricultural areas the amount of carbon stored in soils is nearly double that stored in the crops and pastures that the soils support. Still, the share of carbon stored in agroecosystems (about 26–28 percent of all carbon stored in terrestrial systems) is about equal to the share of land devoted to agroecosystems (28 percent of all land). Agricultural emissions of both carbon dioxide and methane are increasing because of conversion to agricultural uses from forests or woody savannas, deliberate burning of crop stubble and pastures to control pests or promote fertility, and paddy rice cultivation.

Data Quality

FOOD PRODUCTION

Value, yield, input, and production data are from the Food and Agriculture Organization (FAO) national tables, 1965-97. Consistency and reliability vary across countries and years. Ecosystem analysis requires more spatially disaggregated information. Fertility constraints are spatially modeled from the soil mapping units of FAO's Soil Map of the World. Global and regional assessments of human-induced soil degradation are based primarily on expert opinion. Developing reliable, cost-effective methods for monitoring soil degradation would help to both mitigate further losses and target restoration efforts.

WATER QUALITY

There are no globally consistent indicators of water quality that relate specifically to agriculture. In agricultural watersheds, the quantity of pesticides and nutrients—nitrogen and phosphorus—are good indicators of pollution from leaching and surface runoff. In mixed-use catchments it is much more difficult to separate from other sources such as human effluents and pesticides applied in gardens and public recreation areas. Pesticide data are more expensive to monitor. Data on suspended solids from soil erosion are also scarce and difficult to interpret.

WATER QUANTITY

Irrigated area is assessed using the Kassel University global spatial data, which indicate the percentage and area of land equipped for irrigation but has some inconsistencies in scale, age, and reliability of source. Irrigation water use data are derived from country-specific tabular data sets on irrigated area, water availability and use, and water abstraction. Little crop-specific information is available on irrigated area and production. Global estimates of rainfall from the University of East Anglia are based on spatial extrapolations of monthly data from climate stations over a 30-year period. Even though the resolution of these data is coarse, it allows assessment of both spatial and temporal variability.

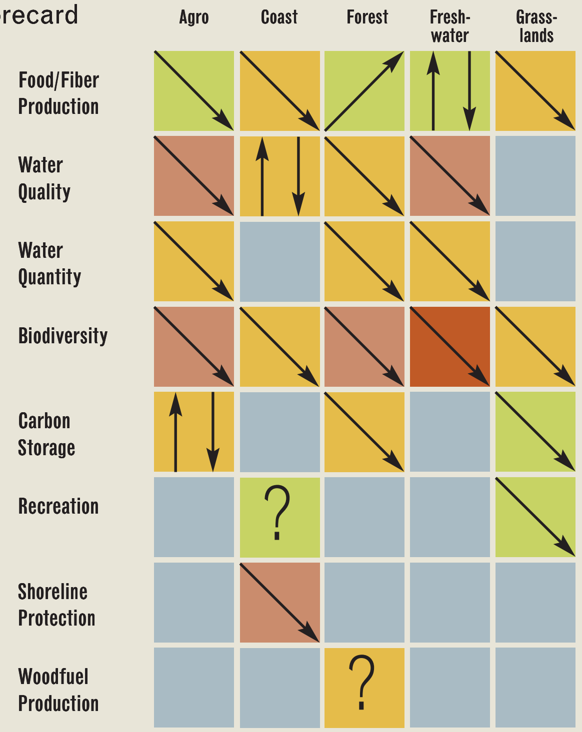
BIODIVERSITY

World Wildlife Fund for Nature (WWF) global spatial data describe potential natural habitats and ecoregions. These were developed from expert opinion and input maps of varying resolution and data, but the data do provide a general understanding of the spatial patterns of natural habitats. Genetic diversity data are compiled from major germplasm-holding institutions. Area adoption data for modern varieties of cereals are compiled from survey and agricultural census.

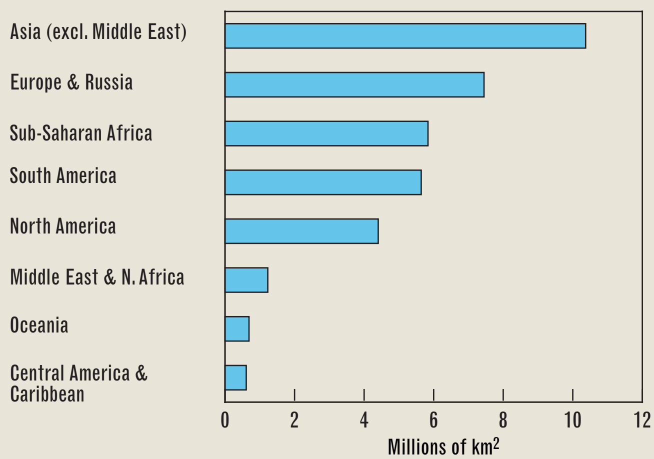
CARBON STORAGE

Storage capacity is modeled for vegetation and soils based on carbon storage capacity by land cover type at a resolution of half a degree for a single point in time. Data would be improved by better characterization of agricultural land-cover types and their vegetation content. Soil carbon data were derived for Latin America using FAO and the International Soil Reference and Information Centre's Soil and Terrain database.

Scorecard



Area of Agroecosystems



Population of Agroecosystems