

News focus

Pressure points

A major UN assessment of the world's ecosystems and the services that they provide for humans reveals that we are living well beyond our means and a rethink of the economic value of biological resources is essential. **Nigel Williams** reports.

Growing populations and expanding economic activity have strained the planet's ecosystems over the past half century and highlight the need to establish better the economic importance of ecosystems, a UN-sponsored study of the Earth's health warned this month.

The four-year, \$24 million Millennium Ecosystem Assessment — the largest ever to show how people are changing the environment — found that humans had depleted 60 per cent of the world's grasslands, forests, farmlands, rivers and lakes. Unless nations adopt more ecologically sound policies,

increased human demands for food, clean water and fuels could speed the disappearance of forests, fish and fresh water reserves and lead to more frequent disease outbreaks over the next 50 years, it said.

"In the streets of a crowded city, the aisles of a giant supermarket, or the floor of a gleaming electronics factory, the biological state of the Earth's rivers, forests, and mountains may seem a remote concern," the report highlights.

"For some time, the changes have been good to us: food output has increased," said A.H. Zakri, director of the United Nations

University Institute of Advanced Studies in Japan, and member of the study team. "The problem is these changes have been achieved at growing costs." The assessment focuses on the linkages between ecosystems and human well-being and, in particular, on 'ecosystem services'.

"There is every indication that humanity's 'footprint' on the earth is already exceeding what is sustainable," says Robert May, president of the Royal Society and one of the report's authors.

The assessment deals with the full range of ecosystems — from those relatively undisturbed, such as natural forests, to landscapes with mixed patterns of human use, to ecosystems intensively managed and modified by humans, such as agricultural land



Line out: Many ecosystems are under growing pressure from human activities. The fauna of the Galapagos Islands in the Pacific, despite having some level of protection, are not exempt. Local fishermen are keen to develop long-line fishing within the marine reserve, which could lead to the death of many animals as 'bycatch' for the target fish. Photograph of brown pelicans in the Galapagos. (Courtesy of Photolibrary.com.)

and urban areas. Ecosystem services are the benefits people obtain from ecosystems. These include provisioning services such as food, water, timber, and fibre; regulating services that affect climate, floods, disease, wastes, and water quality; cultural services that provide recreational, aesthetic, and spiritual benefits; and supporting services such as soil formation, photosynthesis, and nutrient cycling. "The human species, while buffered against environmental changes by culture and technology, is fundamentally dependent on the flow of ecosystem services." But the report stresses that its findings are not irreversible if policies change.

UN Secretary-General Kofi Annan stressed that the study "tells us how we can change course," and urged nations to consider its recommendations.

Eliminating trade barriers and subsidies, protecting forests and coastal areas, promoting "green" technologies and lowering greenhouse gas emissions thought to contribute to global warming can all help to slow environmental degradation, Zakri said.

The study was compiled by 1,360 scientists from 95 countries who studied more than 16,000 satellite photos from the US National Aeronautics and Space Administration, and analysed masses of statistics and scientific data.

The study did not aim to generate new primary knowledge, but instead sought to analyse existing data and communicate it in a useful form.

Out of 24 ecosystem services studied in the report, only nine revealed gains — mostly in increasing food production through industrial crop growth and intensive fishing and livestock production. But the scientists warn that those gains came with major drawbacks, worsening other ecosystem services like clean water, and threatening biodiversity.

The other 15 ecosystem services examined are being degraded or used unsustainably, including freshwater, capture fisheries, air and water

purification, and the regulation of regional and local climate, natural hazards and pests, the study found. The full costs of the loss and degradation of these ecosystem services are difficult to measure, but the researchers believe the available evidence demonstrates that they are substantial and growing.

A fifth of coral reefs and a third of the mangrove forests have been destroyed in recent decades, the study finds. The diversity of animal and plant species has fallen sharply, and a third of all species are at risk of extinction. "We don't, for example, even know how many species of plants and animals there are on the Earth," says May.

Disease outbreaks, floods and fires have become more frequent. Levels of carbon dioxide in the atmosphere have surged, mostly in the past four decades. "These (ecosystem) changes have resulted in a substantial and largely irreversible loss to the biological diversity of the planet," said the study's director, Walter Reid.

The study highlighted some dramatic statistics. More land was converted to cropland since 1945 than in the eighteenth and nineteenth centuries combined. Cultivated systems (areas where at least 30 per cent of the landscape is in croplands, shifting cultivation, confined livestock production or freshwater aquaculture) now covers one quarter of the Earth's terrestrial surface.

The amount of water impounded behind dams quadrupled since 1960, and three to six times as much water is held in reservoirs as in natural rivers. Water withdrawals from rivers and lakes doubled since 1960; most water use (70 per cent) is for agriculture, the report says.

Since 1960, flows of reactive (biologically available) nitrogen in terrestrial ecosystems have doubled, and flows of phosphorus have tripled. More than half of all the synthetic nitrogen fertilizer, which was first manufactured in 1913, ever used on the planet has been used since 1985.

And on one parameter the world is trying to address, the data are

clear. Since 1750, the atmospheric concentration of carbon dioxide has increased by about 32 per cent (from about 280 to 376 parts per million in 2003), primarily due to the combustion of fossil fuels and land use changes.

Approximately 60 per cent of that increase (60 parts per million) has taken place since 1959.

The assessment also highlighted the likelihood of non-linear changes in ecosystems (including accelerating, abrupt, and potentially irreversible changes) that have important consequences for human well-being. Examples of such changes include disease emergence, abrupt alterations in water quality, the creation of 'dead zones' in coastal waters, the collapse of fisheries, and shifts in regional climate.

The study, which also aims to provide information to further the UN's development goals, found that poor people, especially those in dry regions, mostly in Africa and Asia but also in parts of Mexico and northern Brazil, suffer disproportionately, largely through desertification, lack of access to clean water and increase in disease. Worldwide some 1.1 billion people still lack access to safe drinking water, with 3–4 million people dying each year from waterborne diseases, according to UN statistics.

"Sufficient information exists concerning the drivers of change in ecosystems, the consequences of changes in ecosystem services for human well-being, and the merits of various response options to enhance decision making in support of sustainable development at all scales," the study said.

The costs of strains on ecosystems are already being felt, the report says, but often by people far away from those enjoying the benefits of natural services. Shrimps on the dinner plates of Europeans may well have started life in a South Asian pond built in place of mangrove swamps — "weakening a natural barrier to the sea".

"It is time to check the accounts," the study says.