The Millennium Ecosystem Assessment
-
Findings

Marcus Lee,
MA Secretariat/UNEP-DEWA
27 October 2005

Millennium Ecosystem Assessment

Largest assessment of the health of the planet's ecosystems

Experts and Review Process

- Prepared by 1360 experts from 95 countries
- 80-person independent board of review editors
- Review comments from 850 experts and governments

Governance

- Called for by UN Secretary General in 2000
- Authorized by governments through 4 conventions
- Partnership of UN agencies, conventions, business, non-governmental organizations with a multi-stakeholder board of directors

Defining Features

Demand-driven

- Providing information requested by governments, business/industry, civil society

Assessment of current state of knowledge

- A critical evaluation of information concerning the consequences of ecosystem changes for human well-being for purposes of guiding decisions on complex public issues.

Authoritative information

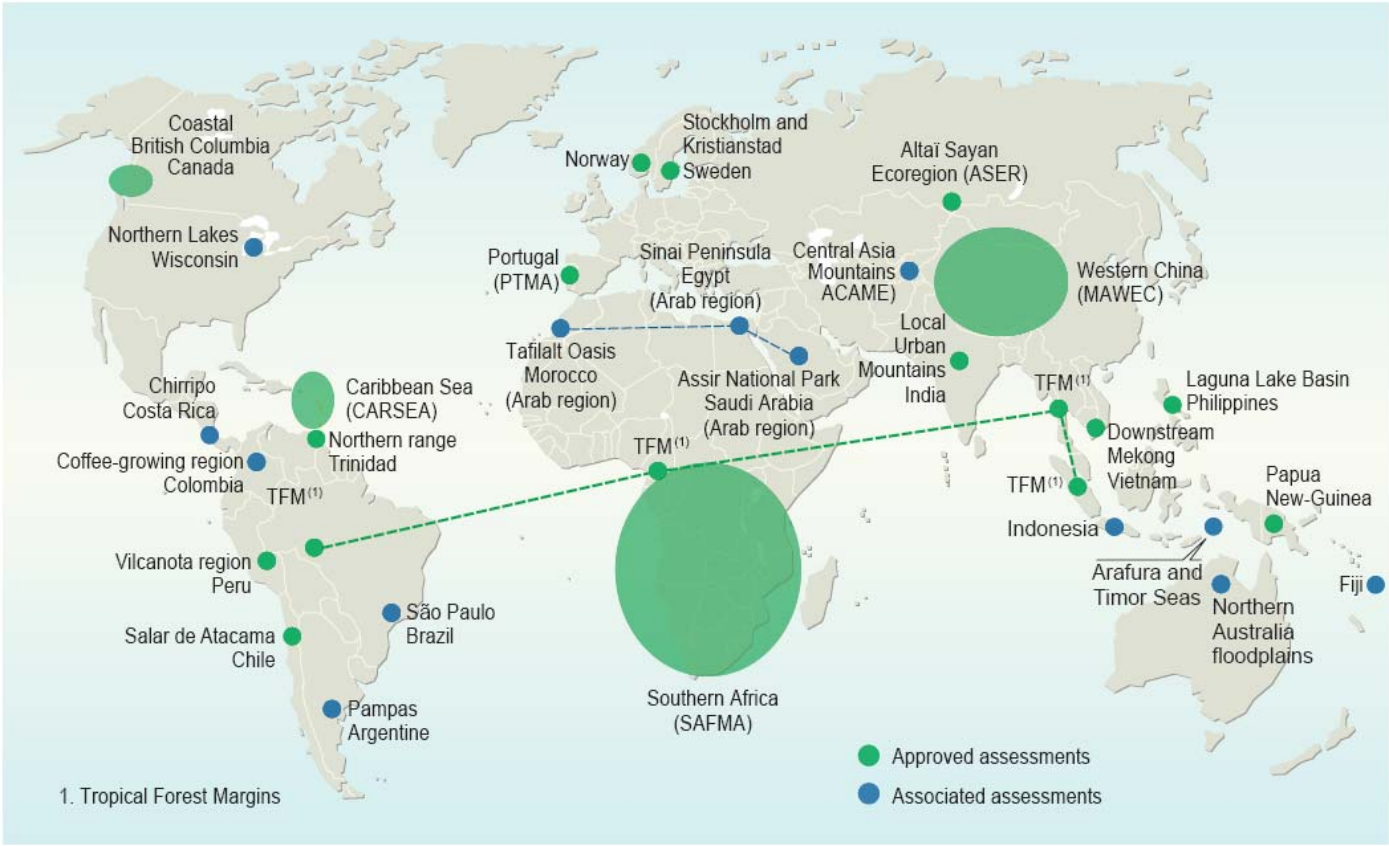
- Clarifies where there is broad consensus within the scientific community and where important controversies remain

Policy-relevant, but not policy-prescriptive

Defining Features

Multi-scale assessment

- In addition to global assessment, includes information from 33 sub-global assessments



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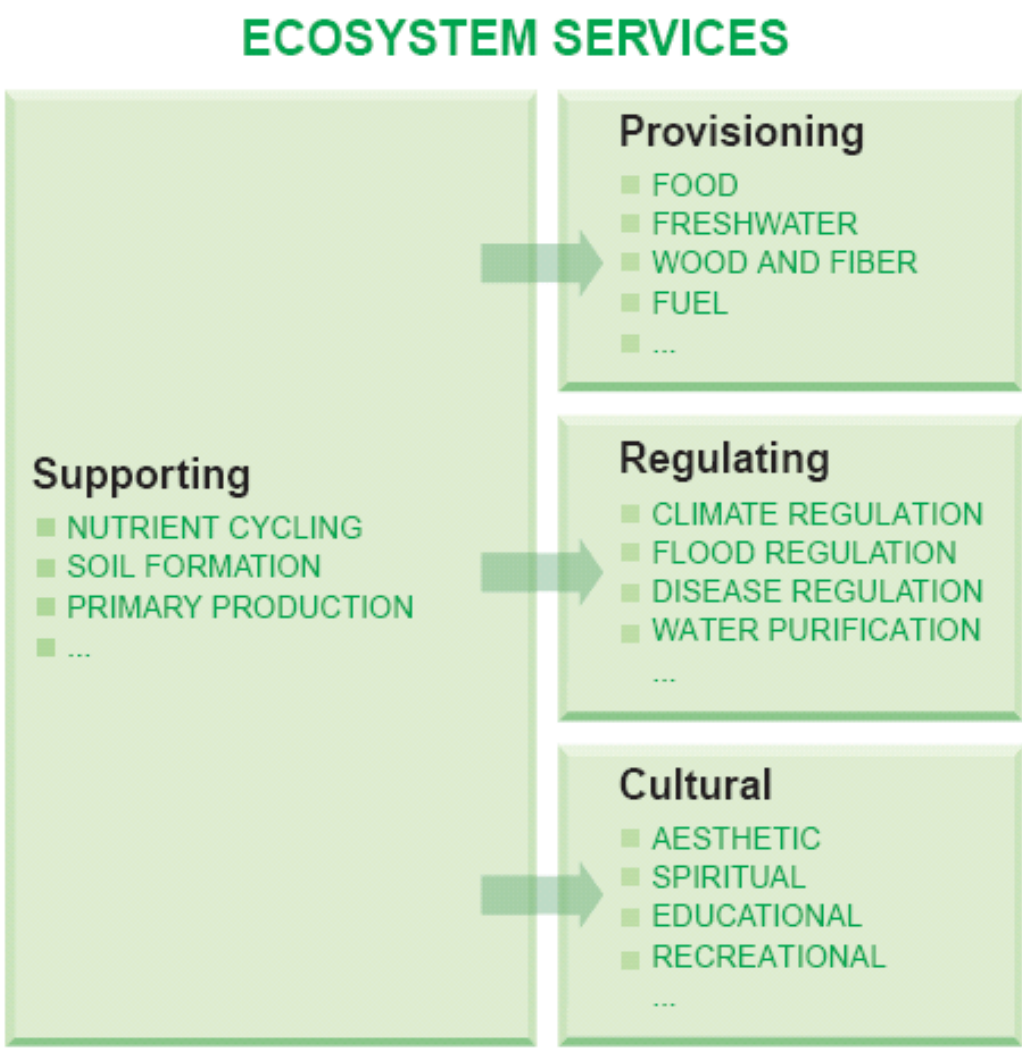
Focus: Ecosystem Services

The benefits people obtain from ecosystems



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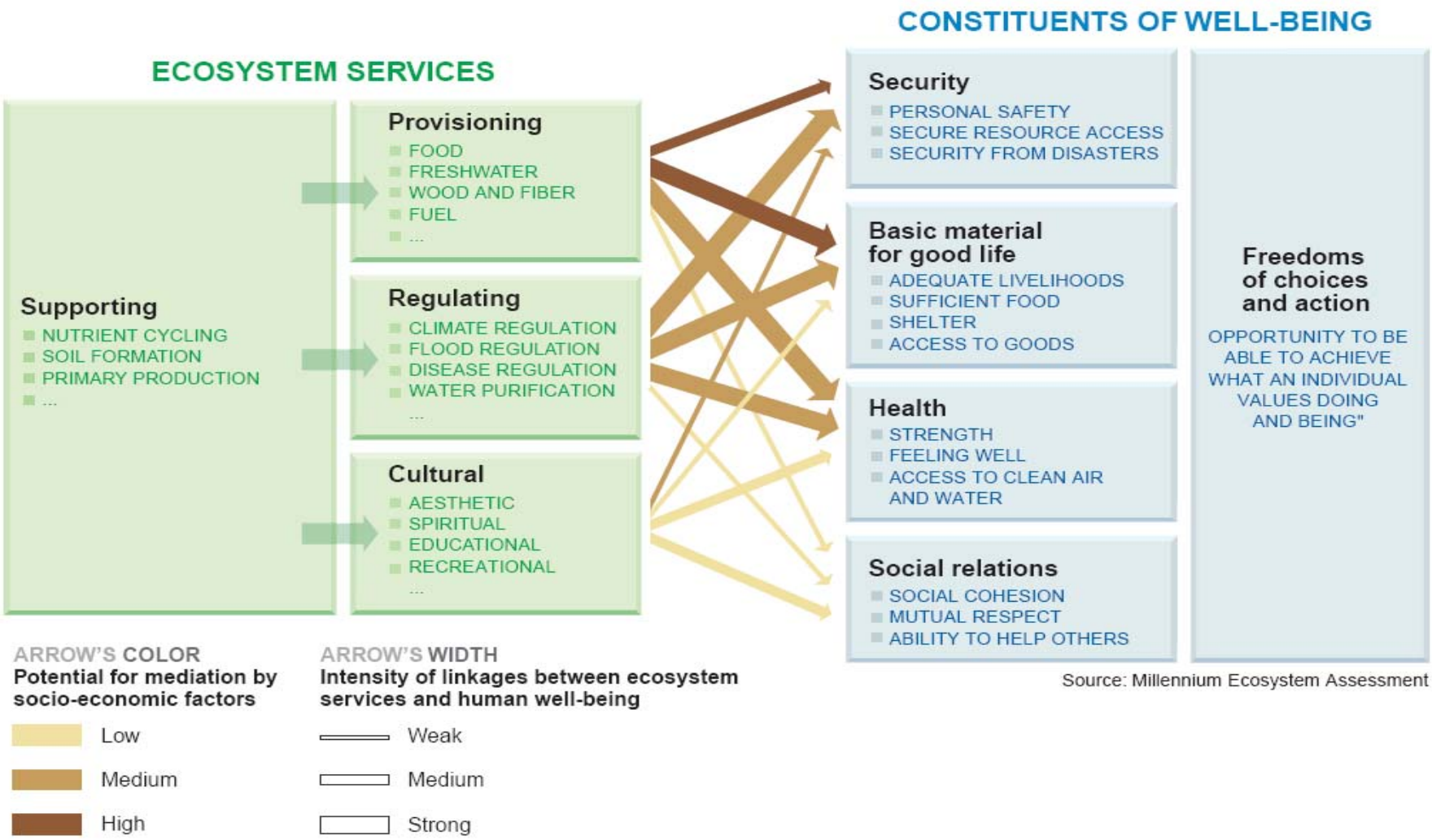
Focus: Consequences of Ecosystem Change for Human Well-being



Source: Millennium Ecosystem Assessment

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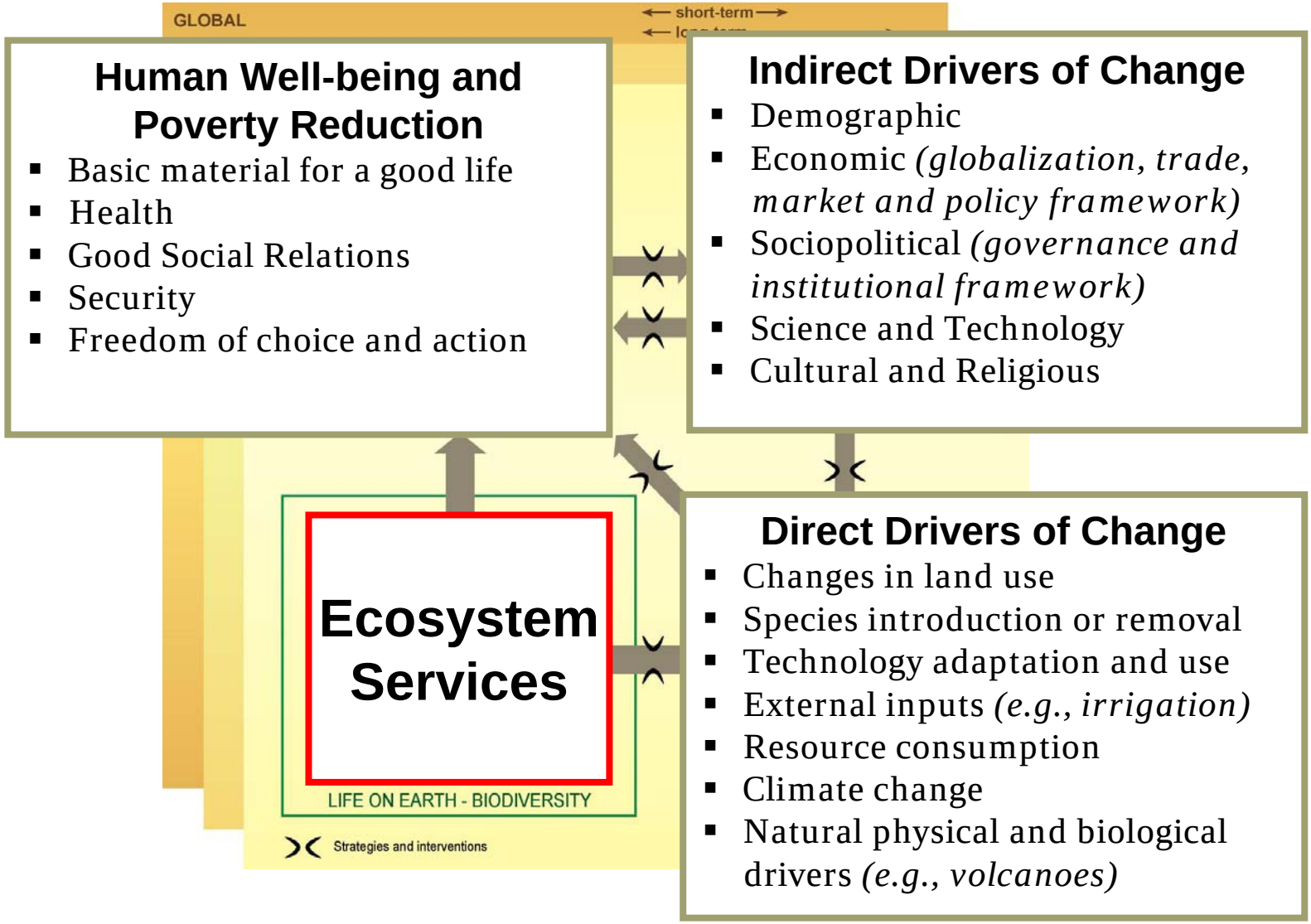
MA Framework



Four Working Groups

Condition and Trends	Scenarios	Responses
▪ What is the current condition and historical trends of ecosystems and their services? ▪ What have been the consequences of changes in ecosystems for human well-being?	▪ Given plausible changes in primary drivers, what will be the consequences for ecosystems, their services, and human well-being?	▪ What can we do to enhance well-being and conserve ecosystems?

Sub-Global	▪ All of the above, at regional, national, local scales

Technical Support Organizations

The United Nations Environment Programme coordinates the Millennium Ecosystem Assessment Secretariat, which is based at the following partner institutions:

- Food and Agricultural Organization of the United Nations, Italy
- Institute of Economic Growth, India
- International Maize and Wheat Improvement Center, Mexico (*until 2004)*
- Meridian Institute, United States
- National Institute of Public Health and the Environment, Netherlands (*until mid-2004)*
- Scientific Committee on Problems of the Environment, France
- UNEP-World Conservation Monitoring Centre, United Kingdom
- University of Pretoria, South Africa
- University of Wisconsin, United States
- World Resources Institute, United States
- WorldFish Center, Malaysia

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Financial and in-kind support

(full list available at www.MAweb.org)

Global Environment Facility
United Nations Foundation
David and Lucile Packard Foundation
World Bank
Consultative Group on International Agricultural Research
United Nations Environment Programme
Government of China
Government of Norway
Kingdom of Saudi Arabia
Swedish International Biodiversity Programme
Asia Pacific Network for Global Change Research;
Association of Caribbean States
British High Commission, Trinidad & Tobago;
Caixa Geral de Depósitos, Portugal
Canadian International Development Agency
Christensen Fund
Cropper Foundation
Environmental Management Authority of Trinidad and Tobago
Ford Foundation
Government of India
International Council for Science
International Development Research Centre
Island Resources Foundation;
Japan Ministry of Environment
Laguna Lake Development Authority
Philippine Department of Environment and Natural Resources
Rockefeller Foundation
U.N. Educational, Scientific and Cultural Organization;
UNEP Division of Early Warning and Assessment
United Kingdom Department for Environment, Food and Rural Affairs
United States National Aeronautic and Space Administration
Universidade de Coimbra, Portugal

MA Findings - Outline

1. **Ecosystem Changes in Last 50 Years**
2. **Gains and Losses from Ecosystem Change**

   Three major problems will decrease long-term benefits

   - Degradation of Ecosystem Services
   - Increased Likelihood of Nonlinear Changes
   - Exacerbation of Poverty for Some People
3. **Ecosystem Prospects for Next 50 Years**
4. **Reversing Ecosystem Degradation**

Finding #1

- Over the past 50 years, humans have changed ecosystems more rapidly and extensively than in any comparable period of time in human history
- This has resulted in a substantial and largely irreversible loss in the diversity of life on Earth

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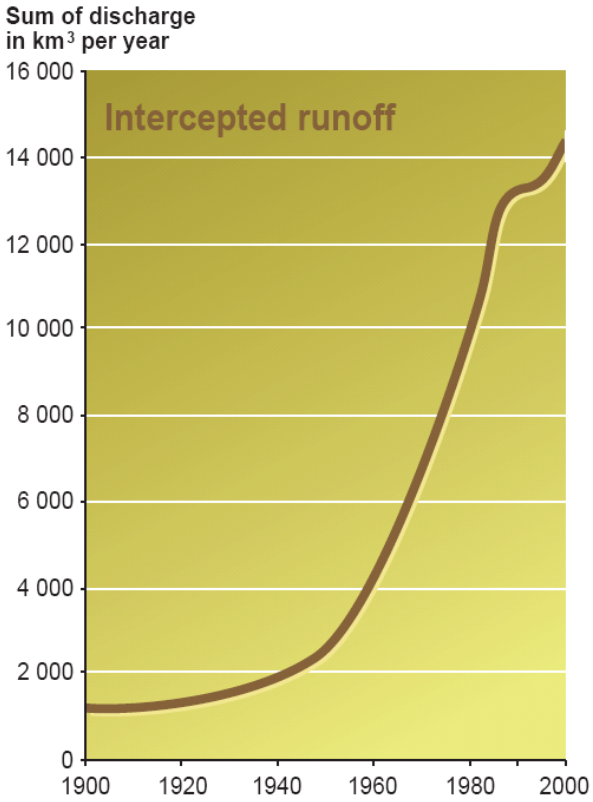
Unprecedented change: Ecosystems

- 25% of the world's coral reefs were badly degraded or destroyed in the last several decades
- 35% of mangrove area has been lost in this time
- Amount of water in reservoirs quadrupled since 1960
- Withdrawals from rivers and lakes doubled since 1960



Intercepted Continental Runoff:
3-6 times as much water in reservoirs as in natural rivers

(Data from a subset of large reservoirs totaling ~65% of the global total storage)

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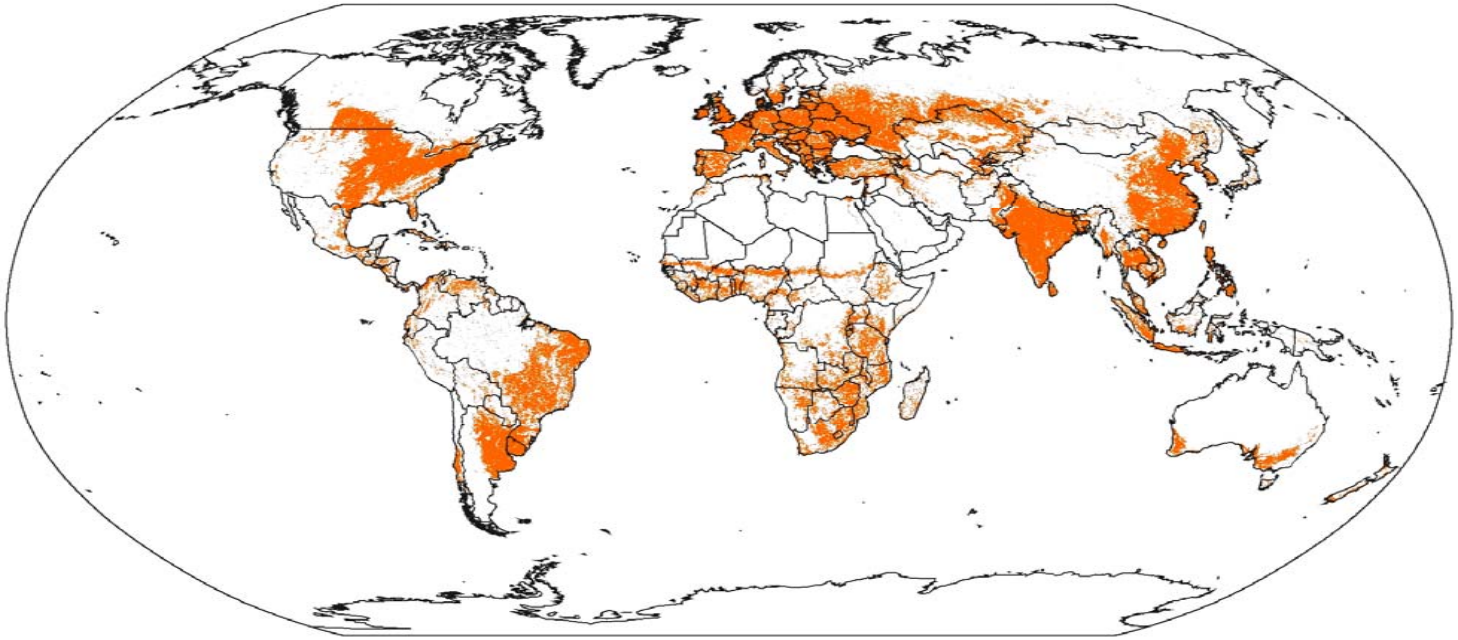
Unprecedented change in structure and function of ecosystems

More land was converted to cropland since 1945 than in the 18th and 19th centuries combined



Cultivated Systems in 2000 cover 25% of Earth's terrestrial surface

(Defined as areas where at least 30% of the landscape is in croplands, shifting cultivation, confined livestock production, or freshwater aquaculture)

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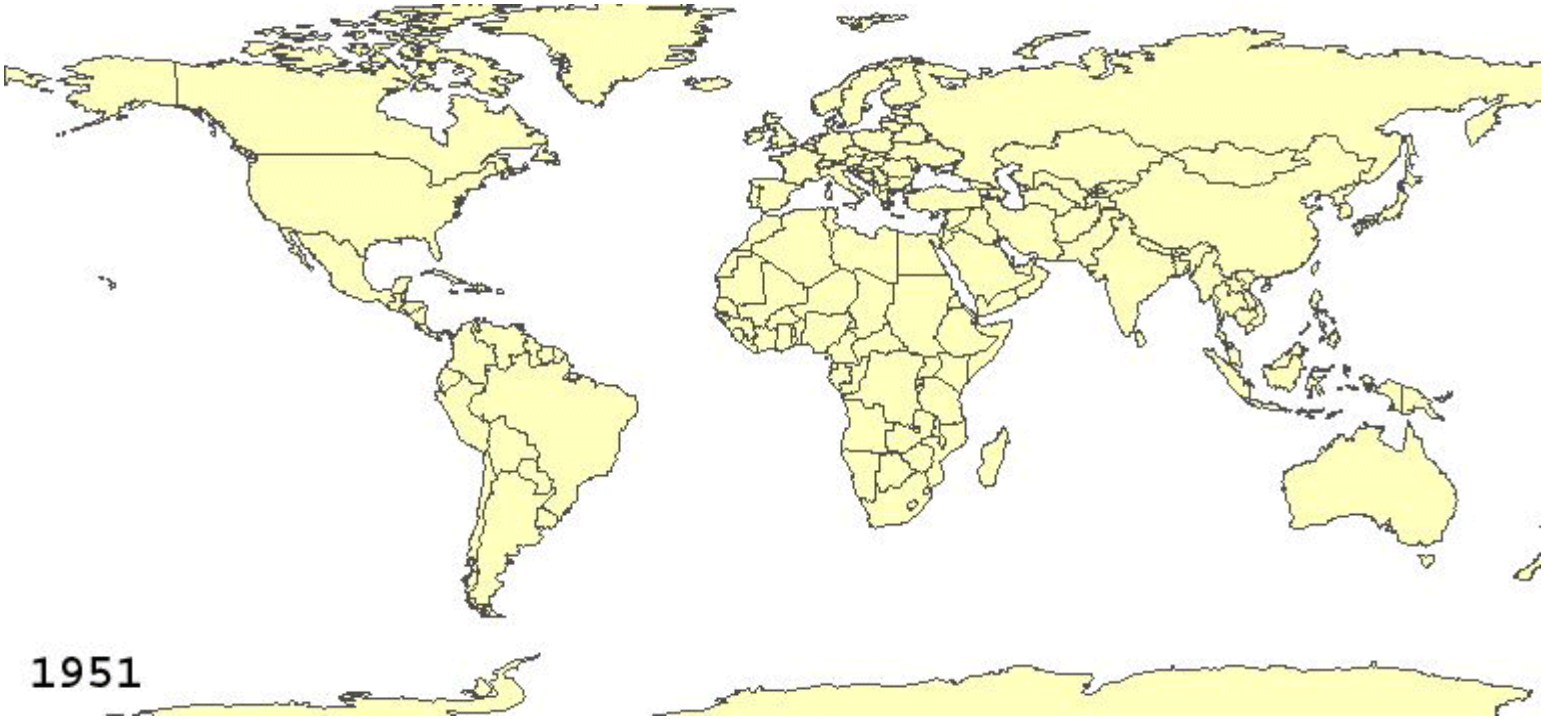
Unprecedented change: Ecosystems

Expansion of marine fisheries



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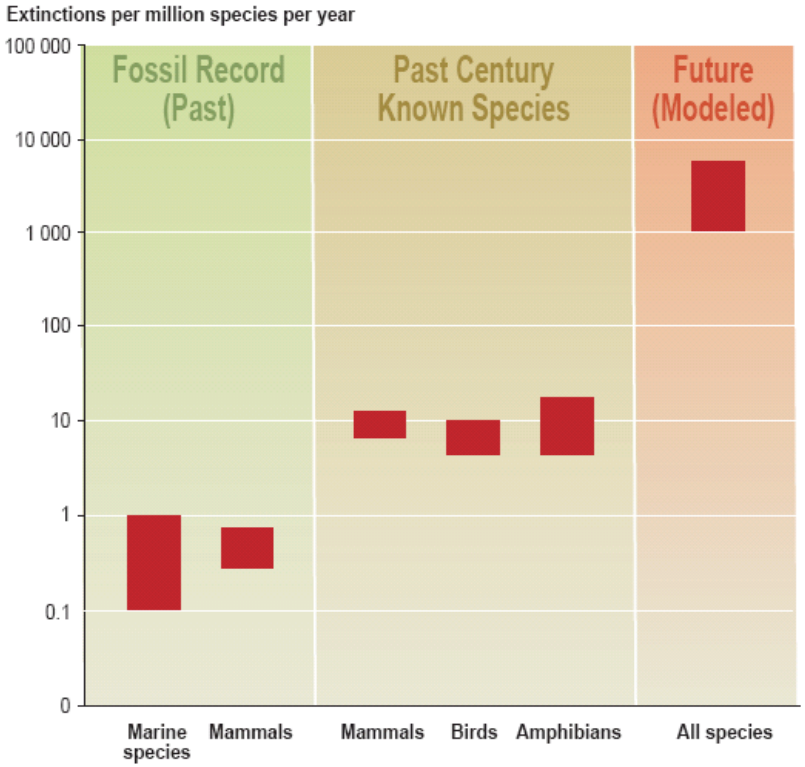
Significant and largely irreversible changes to species diversity

- Humans have increased the species extinction rate by between 50 and 1,000 times over background rates typical over the planet's history (*medium certainty)*
- 10–30% of mammal, bird, and amphibian species are currently threatened with extinction (*medium to high certainty)*



Sources: Millennium Ecosystem Assessment.

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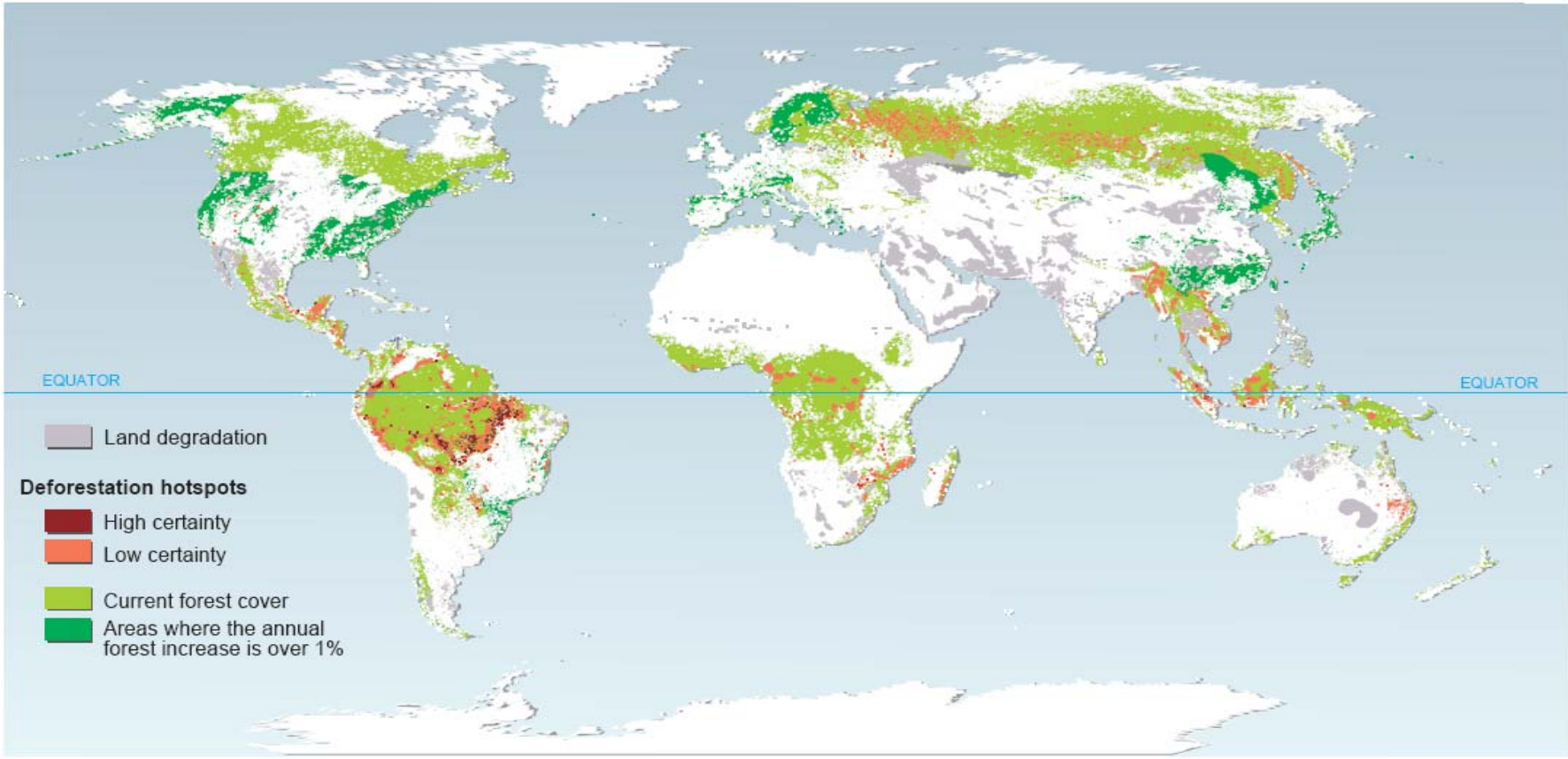
Some ecosystem recovery now underway but high rates of conversion continue

- Ecosystems in some regions are returning to conditions similar to their pre-conversion states
- Rates of ecosystem conversion remain high or are increasing for specific ecosystems and regions



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Finding #2

- The changes that have been made to ecosystems have contributed to substantial net gains in human well-being and economic development, but these gains have been achieved at growing costs
- These problems will substantially diminish the benefits that future generations obtain from ecosystems.

Changes to ecosystems have provided substantial benefits

Rapid growth in demand for ecosystem services between 1960 and 2000:

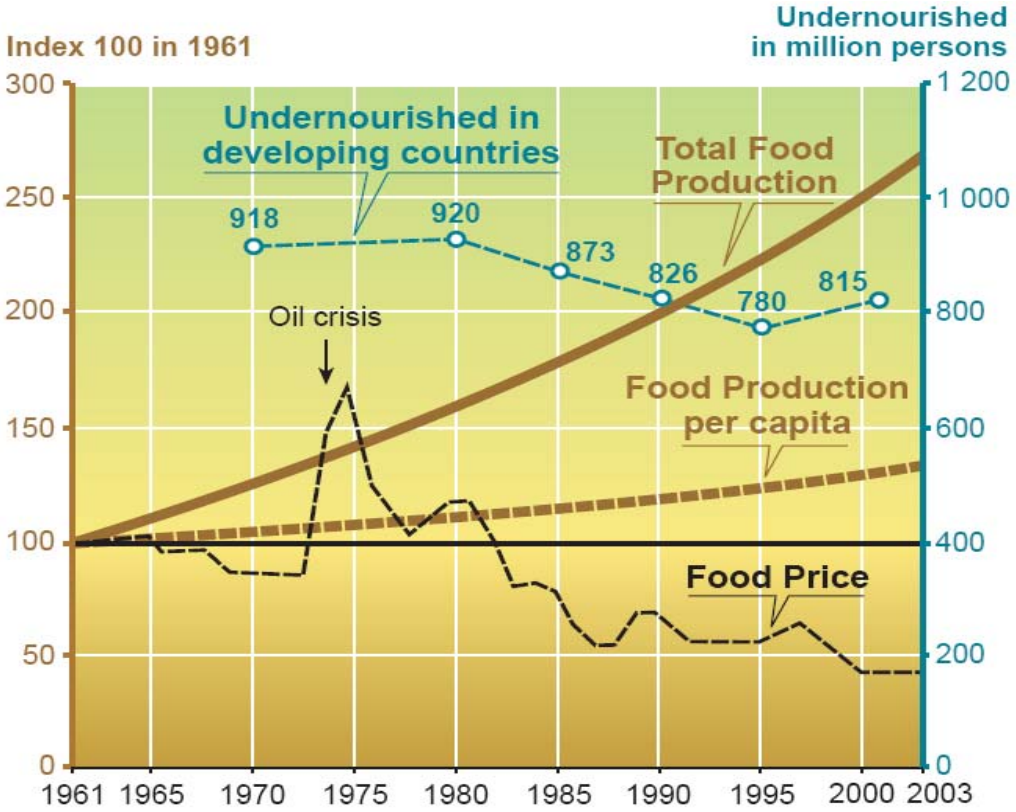
- world population doubled from 3 to 6 billion people
- global economy increased more than sixfold

To meet this demand:

- food production increased 2 ½ times
- water use doubled
- wood harvests for pulp and paper production tripled
- timber production increased by more than half
- installed hydropower capacity doubled

Changes to ecosystems have provided substantial benefits

- Food production has more than doubled since 1960
- Food production per capita has grown
- Food price has fallen



Source: FAOSTATS, SOFI.

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Degradation and unsustainable use of ecosystem services

- Approximately 60% (15 out of 24) of the ecosystem services evaluated in this assessment are being degraded or used unsustainably
- The degradation of ecosystem services often causes significant harm to human well-being and represents a loss of a natural asset or wealth of a country

Status of Provisioning Services

Service		Status
Food	**crops**	↑
	livestock	↑
	capture fisheries	↓
	aquaculture	↑
	wild foods	↓
Fiber	**timber**	+/–
	cotton, silk	+/–
	wood fuel	↓
Genetic resources		↓
Biochemicals, medicines		↓
Water	**fresh water**	↓

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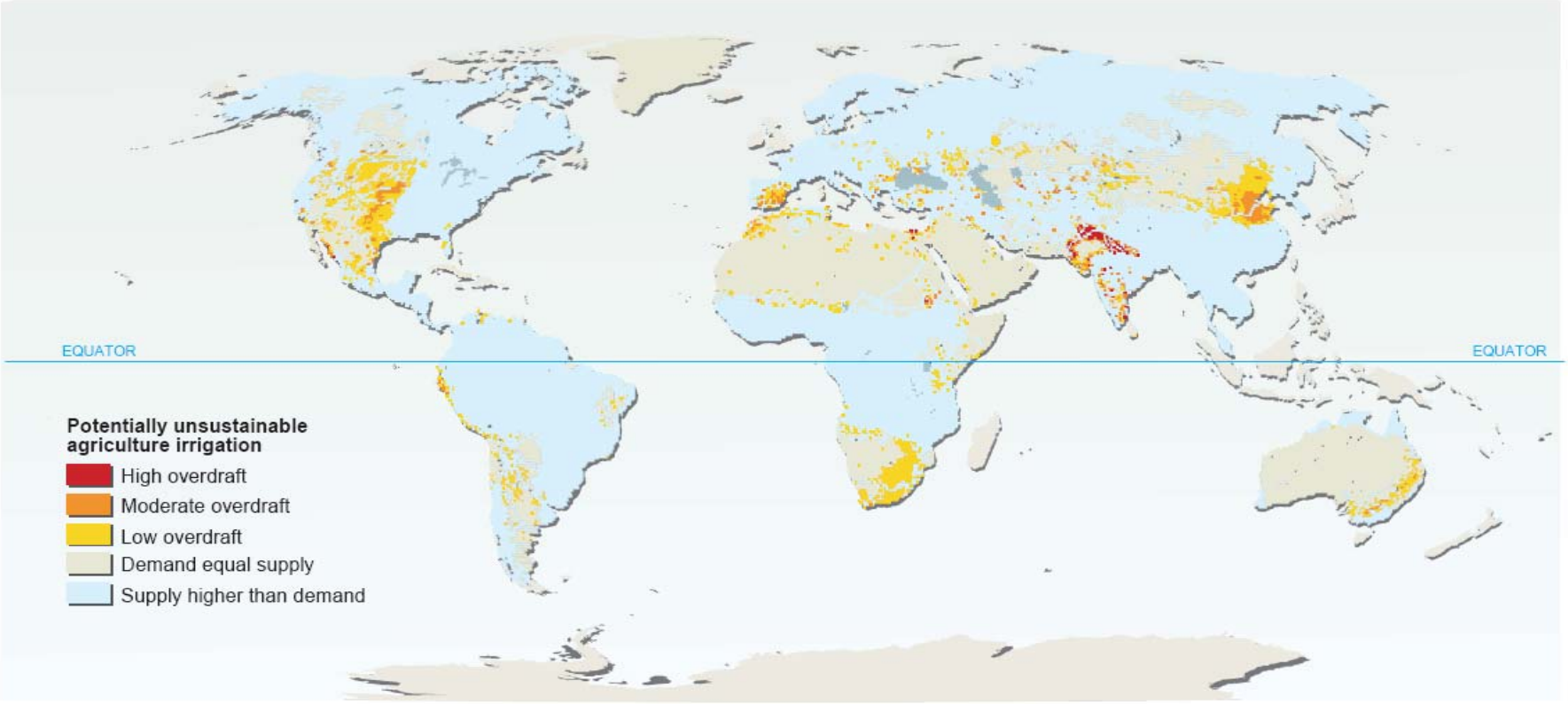
Water

- 5 to possibly 25% of global freshwater use exceeds long-term accessible supplies (*low to medium certainty)*
- 15 - 35% of irrigation withdrawals exceed supply rates and are therefore unsustainable (*low to medium certainty)*



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Status of Regulating and Cultural Services

	Status
Regulating Services	
Air quality regulation	↓
Climate regulation – global	↑
Climate regulation – regional and local	↓
Water regulation	+/–
Erosion regulation	↓
Water purification and waste treatment	↓
Disease regulation	+/–
Pest regulation	↓
Pollination	↓
Natural hazard regulation	↓
Cultural Services	
Spiritual and religious values	↓
Aesthetic values	↓
Recreation and ecotourism	+/–

Regulating Services

Air quality regulation

- Ability of the atmosphere to cleanse itself of pollutants has declined since pre-industrial times but likely not by more than 10%

Regional and local climate regulation

- Changes in land cover have affected regional and local climates both positively and negatively, but there is a preponderance of negative impacts ; for example, tropical deforestation and desertification have tended to reduce local rainfall

Water purification and waste treatment

- Globally, water quality is declining, although in most industrial countries pathogen and organic pollution of surface waters has decreased over the last 20 years
- Nitrate concentration has grown rapidly in the last 30 years

Regulating Services

Pest regulation

- In many agricultural areas, pest control provided by natural enemies has been replaced by the use of pesticides -- such pesticide use has itself degraded the capacity of agroecosystems to provide pest control

Pollination

- There is established but incomplete evidence of a global decline in the abundance of pollinators

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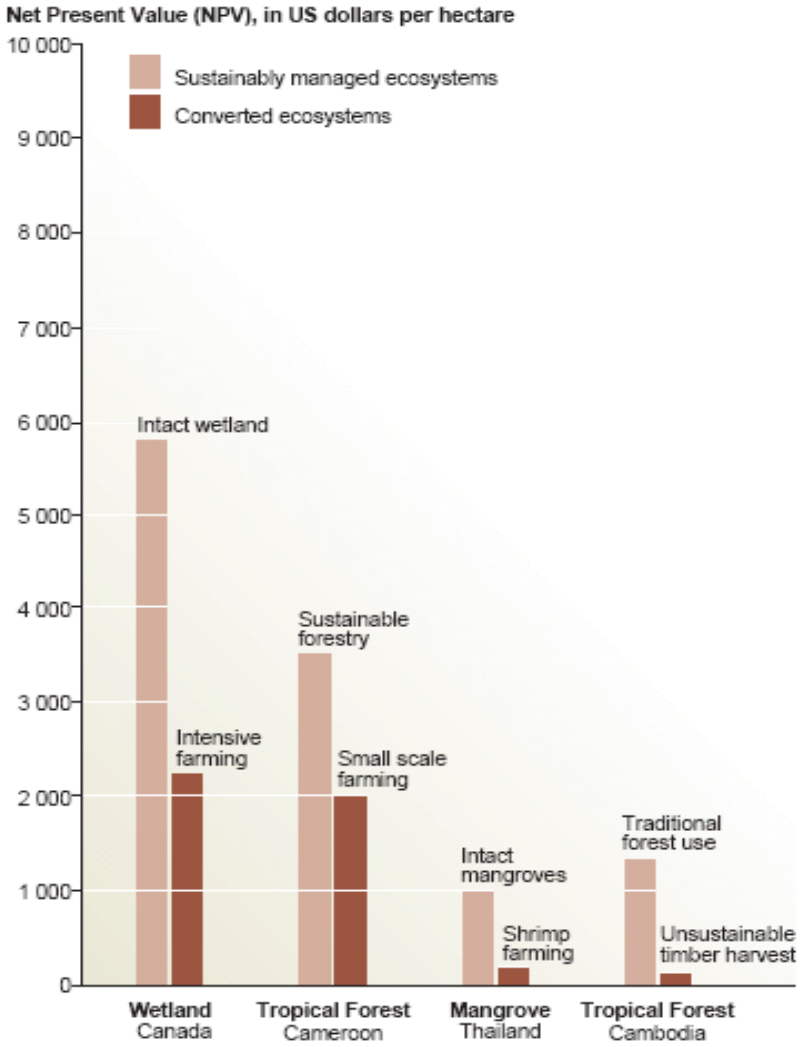
Degradation of ecosystem services often causes significant harm to human well-being

- The total economic value associated with managing ecosystems more sustainably is often higher than the value associated with conversion
- Conversion often still takes place because private economic benefits are often greater for the converted system



Sources: Millennium Ecosystem Assessment.

The degradation of ecosystem services represents loss of a capital asset

Loss of wealth due to ecosystem degradation is not reflected in economic accounts

- Ecosystem services, as well as resources such as mineral deposits, soil nutrients, and fossil fuels are capital assets
- Traditional national accounts do not include measures of resource depletion or of the degradation of these resources
- A country could cut its forests and deplete its fisheries, and this would show only as a positive gain in GDP without registering the corresponding decline in assets (wealth)
- A number of countries that appeared to have positive growth in net savings (wealth) in 2001 actually experienced a loss in wealth when degradation of natural resources were factored into the accounts

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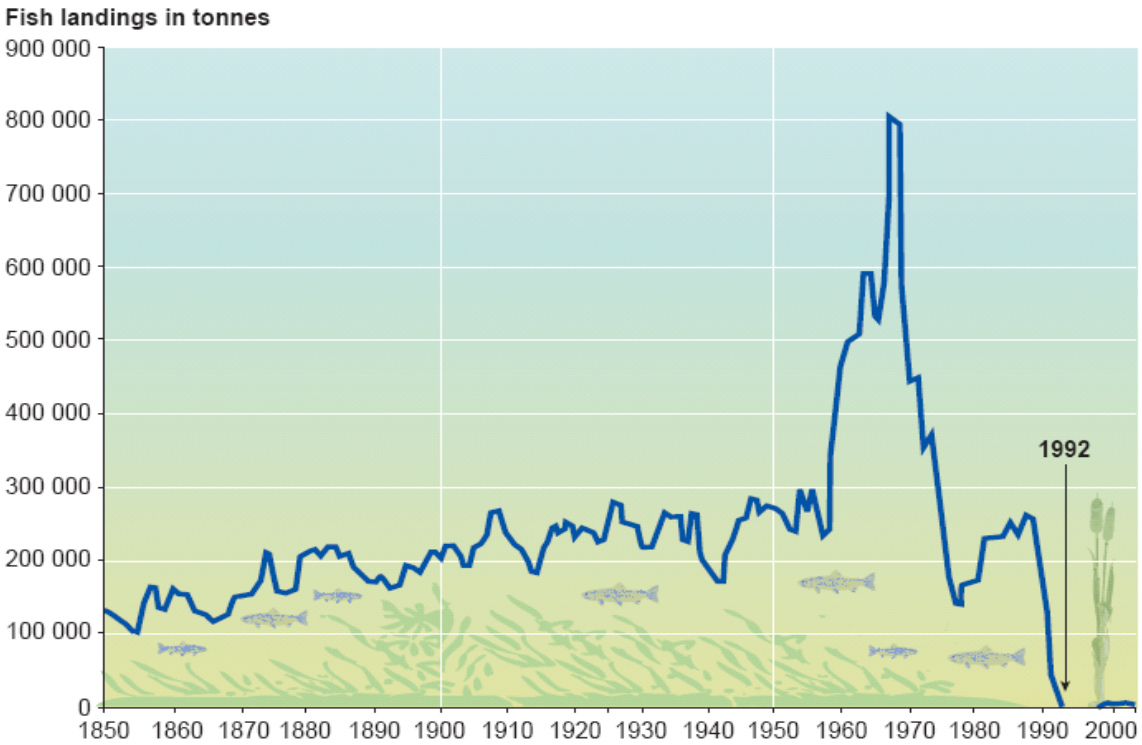
Increased likelihood of nonlinear changes

- There is *established but incomplete* evidence that changes being made in ecosystems are increasing the likelihood of nonlinear and potentially abrupt changes in ecosystems, with important consequences for human well-being

Examples of nonlinear change

Fisheries collapse

- The Atlantic cod stocks off the east coast of Newfoundland collapsed in 1992, forcing the closure of the fishery
- Depleted stocks may not recover even if harvesting is significantly reduced or eliminated entirely



Examples of nonlinear change

Eutrophication and hypoxia

- Once a threshold of nutrient loading is achieved, changes in freshwater and coastal ecosystems can be abrupt and extensive, creating harmful algal blooms (including blooms of toxic species) and sometimes leading to the formation of oxygen-depleted zones, killing all animal life

Disease emergence

- The almost instantaneous outbreak of SARS in different parts of the world is an example

Factors causing increase in likelihood of nonlinear changes

- The loss of species and genetic diversity decreases the resilience of ecosystems, which is their ability to maintain particular ecosystem services as conditions change
- Growing pressures from drivers such as overharvesting, climate change, invasive species, and nutrient loading push ecosystems toward thresholds that they might otherwise not encounter

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Level of poverty remains high and inequities are growing

Economics and Human Development

- 1.1 billion people surviving on less than $1 per day of income. 70% in rural areas where they are highly dependent on ecosystem services
- Inequality has increased over the past decade. During the 1990s, 21 countries experienced declines in their rankings in the Human Development Index

Access to Ecosystem Services

- An estimated 856 million people were undernourished in 2000–02, up 32 million from the period 1995–97
- Per capita food production has declined in sub-Saharan Africa
- Some 1.1 billion people still lack access to improved water supply, and more than 2.6 billion lack access to improved sanitation
- Water scarcity affects roughly 1–2 billion people worldwide

Ecosystem services and poverty reduction

Degradation of ecosystem services harms poor people

- Half the urban population in Africa, Asia, Latin America, and the Caribbean suffers from one or more diseases associated with inadequate water and sanitation
- The declining state of capture fisheries is reducing an inexpensive source of protein in developing countries. Per capita fish consumption in developing countries, excluding China, declined between 1985 and 1997

Ecosystem services and poverty reduction

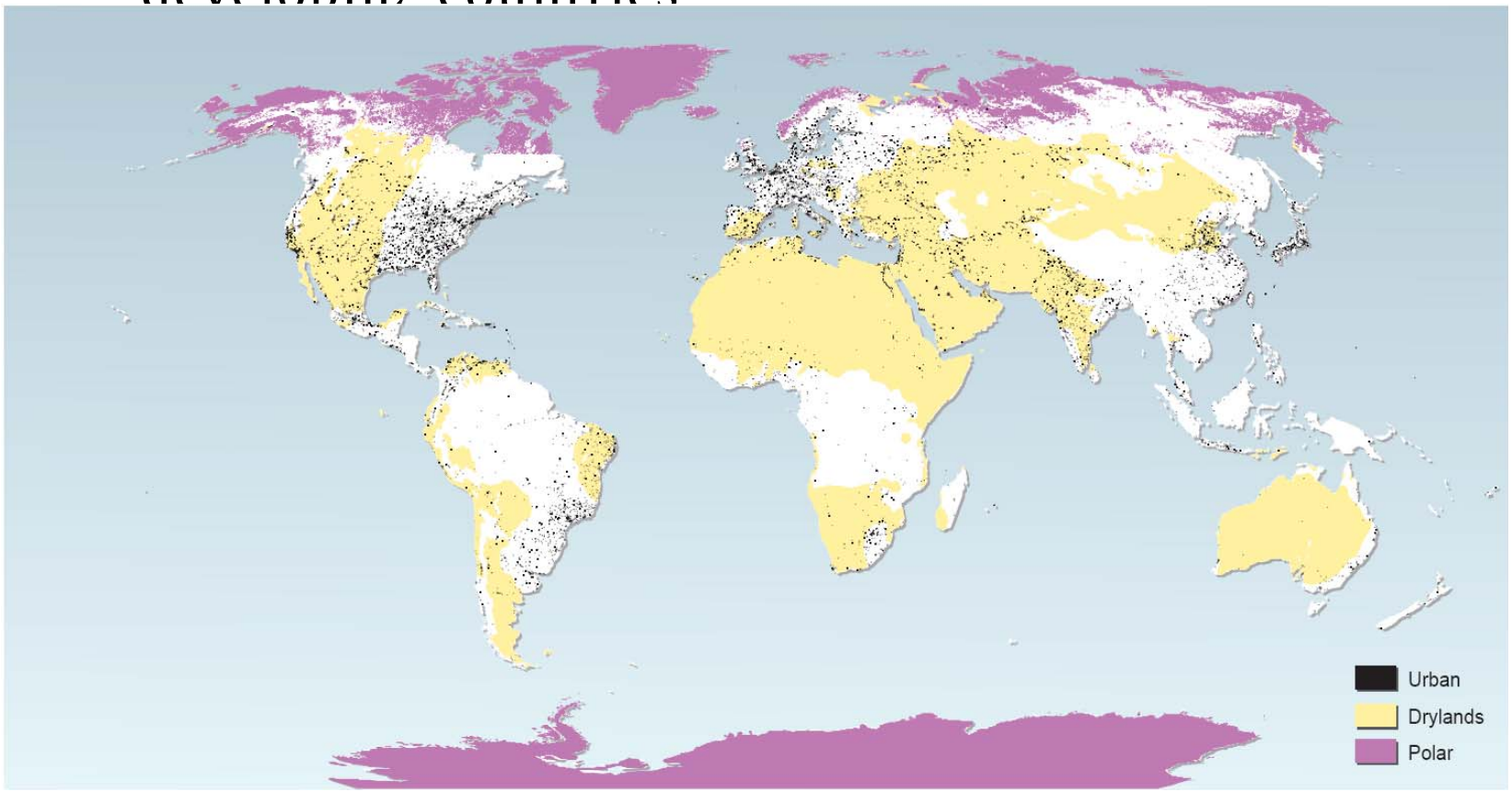
Pattern of winners and losers has not been taken into account in management decisions

- Many changes in ecosystem management have involved the privatization of what were formerly common pool resources often harming individuals who depended on those resources
- Some of the people affected by changes in ecosystem services are highly vulnerable
- Significant differences between the roles and rights of men and women in developing countries lead to increased vulnerability of women to changes in ecosystem services
- The reliance of the rural poor on ecosystem services is rarely measured and thus typically overlooked in national statistics and poverty assessments

Ecosystem services and poverty reduction

Critical concern: Dryland systems

- Cover 41% of Earth's land surface and more than 2 billion people inhabit them, 90% of whom are in developing countries



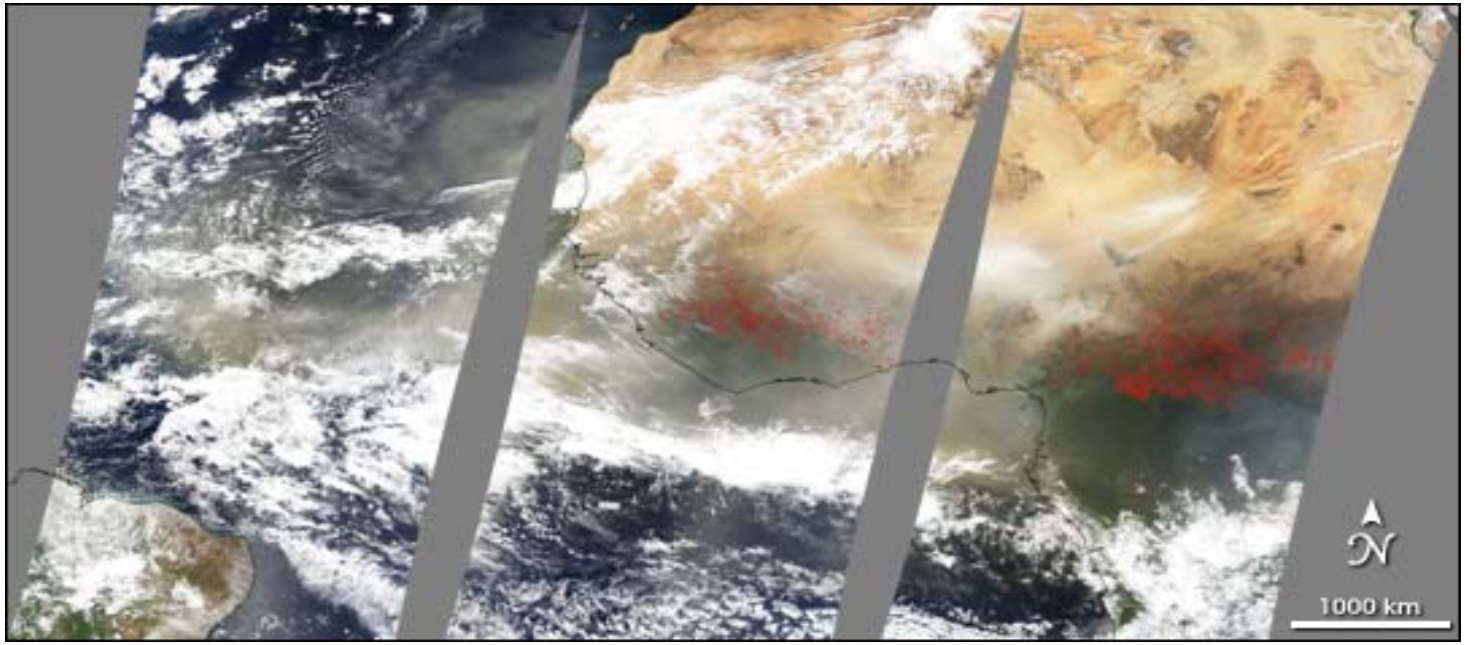
Ecosystem services and poverty reduction

Critical concern: Dryland systems

- Development prospects in dryland regions of developing countries are particularly closely linked to the condition of ecosystem services
- People living in drylands tend to have the lowest levels of human well-being, including the lowest per capita GDP and the highest infant mortality rates
- Drylands have only 8% of the world's renewable water supply
- Per capita water availability is currently only two thirds of the level required for minimum levels of human well-being
- Approximately 10–20% of the world's drylands are degraded (*medium certainty*)

Wealthy populations cannot be fully insulated from ecosystem degradation

- The physical, economic, or social impacts of ecosystem service degradation may cross boundaries
- Many sectors of industrial countries still depend directly on ecosystem services.
- Wealth cannot buffer people from changes in all ecosystem services (e.g., cultural services, air quality)



Dust Cloud Off the Northwest Coast of Africa extending to South America

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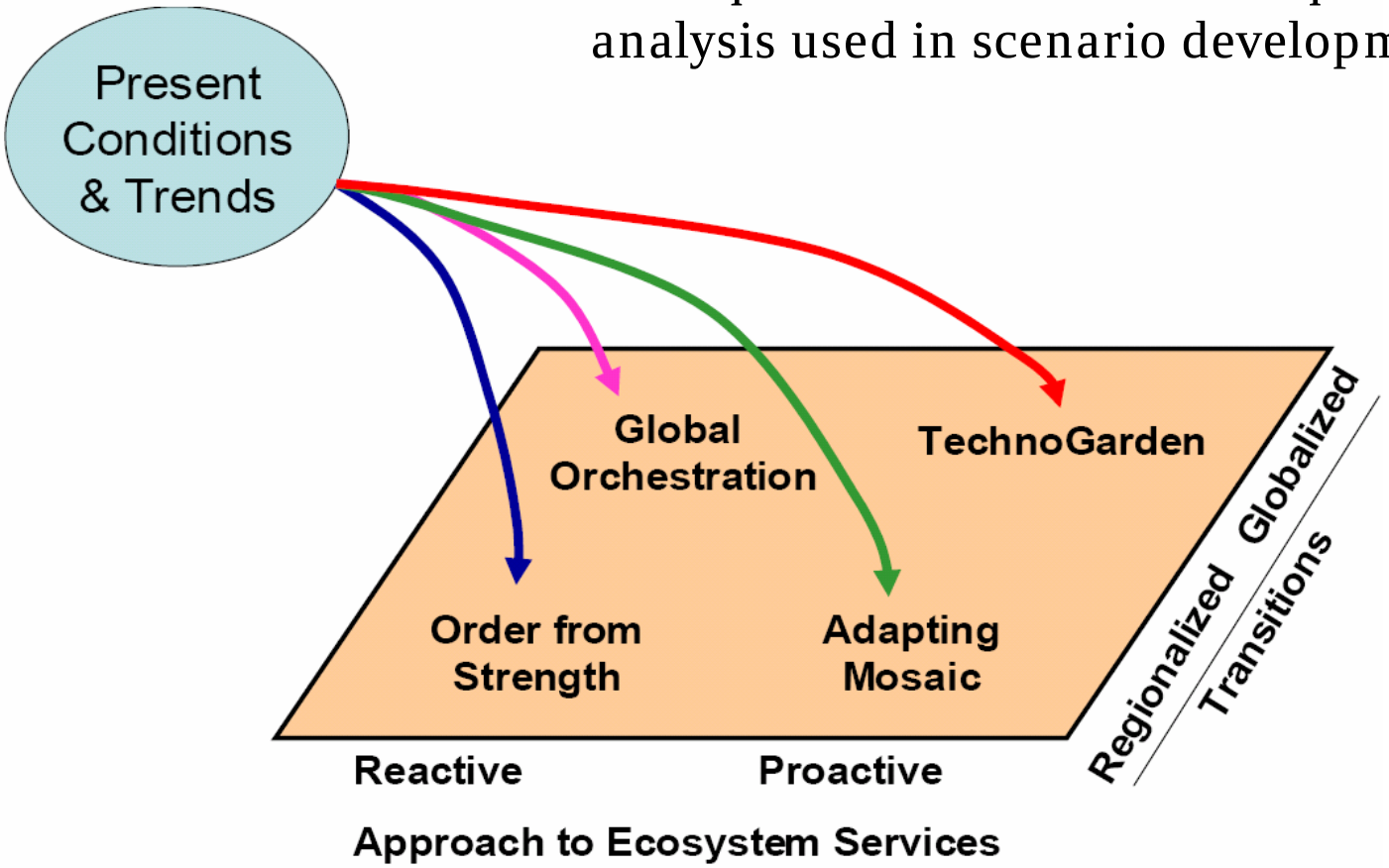
Finding #3:

- The degradation of ecosystem services could grow significantly worse during the first half of this century and is a barrier to achieving the Millennium Development Goals

MA Scenarios

- Not predictions – scenarios are plausible futures
- Both quantitative models and qualitative analysis used in scenario development



Changes in ecosystem services under MA Scenarios

- Demand for food crops is projected to grow by 70–85% by 2050, and water withdrawals by 30-85%
- Food security is not achieved by 2050, and child malnutrition would be difficult to eradicate (and is projected to increase in some regions in some MA scenarios)
- Deterioration of the services provided by freshwater resources particularly in the scenarios that are reactive to environmental problems
- Globally, the equilibrium number of plant species is projected to be reduced by roughly 10–15% as the result of habitat loss over the period of 1970 to 2050 (low certainty)

Degradation of ecosystem services is a significant barrier to achievement of MDGs

Regional concerns

- Regions facing the greatest challenges in achieving the 2015 targets coincide with regions facing the greatest problems of ecosystem degradation: sub-Saharan Africa, Central Asia, parts of South and Southeast Asia, and some regions in Latin America

Strong linkages with ecosystem condition

- Although socioeconomic factors will play a primary role in achieving many of the MDGs, targets are unlikely to be met without improvement in ecosystem management for goals such as:
  - *Poverty Reduction*
  - *Hunger*
  - *Disease*
  - *Environmental Sustainability including access to water*

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Finding #4:

- The challenge of reversing the degradation of ecosystems while meeting increasing demands for their services can be met under some scenarios involving significant policy and institutional changes, but these changes are large and not currently under way
- Many options exist to conserve or enhance specific ecosystem services in ways that reduce negative trade-offs or that provide positive synergies with other ecosystem services

Past actions and potential for substitution

Previous responses to ecosystem degradation

- Past actions have yielded significant benefits, but these improvements have generally not kept pace with growing pressures and demands.
- For example, more than 100,000 protected areas covering about 11.7% of the terrestrial surface have now been established, and these play an important role in the conservation of biodiversity and ecosystem services
- Technological advances have also helped lessen the pressure on ecosystems per unit increase in demand for ecosystem services.

Substitutes

- Substitutes can be developed for some but not all ecosystem services. The cost of substitutes is generally high, and they may also have other negative environmental consequences

Responses – Importance of Indirect Drivers

Ecosystem degradation can rarely be reversed without actions that address one or more indirect drivers of change:

- population change (including growth and migration)
- change in economic activity (including economic growth, disparities in wealth, and trade patterns)
- sociopolitical factors (including factors ranging from the presence of conflict to public participation in decision-making)
- cultural factors
- technological change

Collectively these factors influence the level of production and consumption of ecosystem services and the sustainability of the production.

Responses – Key Barriers

- Inappropriate institutional and governance arrangements, including the presence of corruption and weak systems of regulation and accountability.
- Market failures and the misalignment of economic incentives.
- Social and behavioral factors, including the lack of political and economic power of some groups that are particularly dependent on ecosystem services or harmed by their degradation.
- Underinvestment in the development and diffusion of technologies
- Insufficient knowledge (as well as the poor use of existing knowledge) concerning ecosystem services and responses that could enhance benefits from these services while conserving resources.
- Weak human and institutional capacity related to the assessment and management of ecosystem services.

MA Responses Assessment

The MA assessed 74 response options for eight ecosystem services and additional responses related to integrated ecosystem management and one driver, climate change

Summary

- Over the past 50 years, humans have changed ecosystems more rapidly and extensively than in any comparable period of time in human history.
- The changes that have been made to ecosystems have contributed to substantial net gains in human well-being and economic development, but these gains have been achieved at growing costs in the form of the degradation of many ecosystem services, increased risks of nonlinear changes, and the exacerbation of poverty for some groups of people.
- The degradation of ecosystem services could grow significantly worse during the first half of this century and is a barrier to achieving the Millennium Development Goals.
- The challenge of reversing the degradation of ecosystems while meeting increasing demands for their services can be met under some scenarios involving significant policy and institutional changes, but these changes are large and not currently under way.

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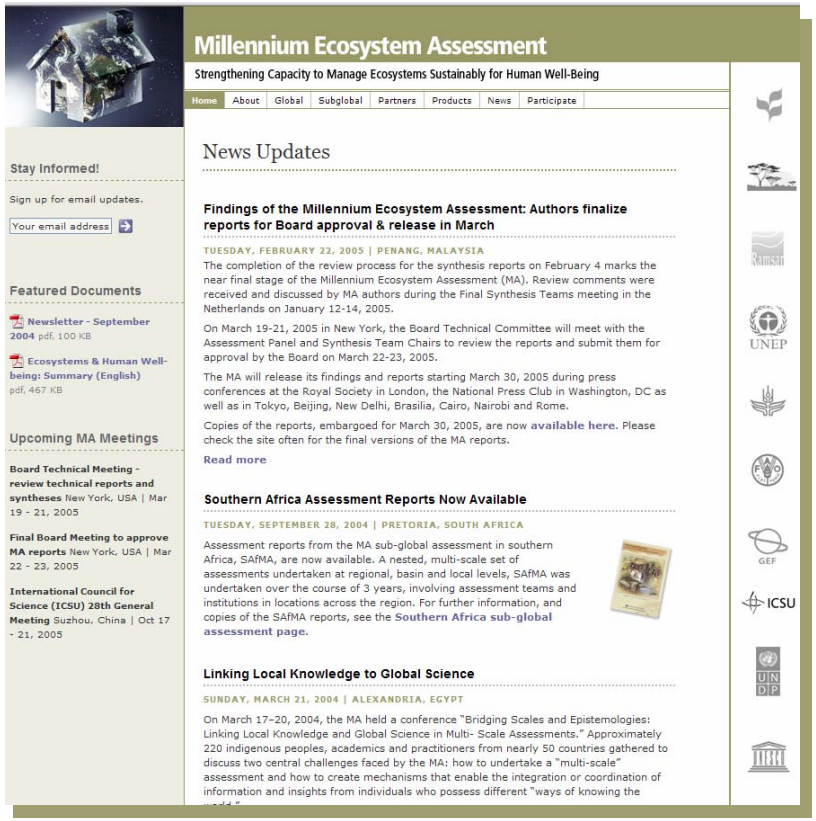
Visit the MA Website

www.MAweb.org

All MA reports available to download

Access to core data

MA 'outreach' kit

- Slides
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