Ecosystems and human well-being: findings of the Millennium Ecosystem Assessment

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Sustainable Development

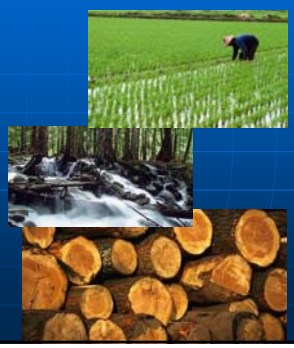
" meeting the needs of the present without compromising the ability of future generations to meet their own needs."

Our Common Future (1987)

Ecosystem Services:
The benefits people obtain from ecosystems

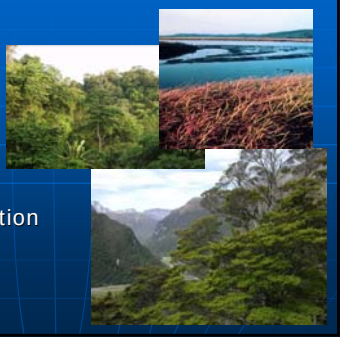
Ecosystem Services

- Provisioning Services
  - Food
  - Freshwater
  - Wood fuel
  - Timber
  - Fiber
  - Genetic Resources



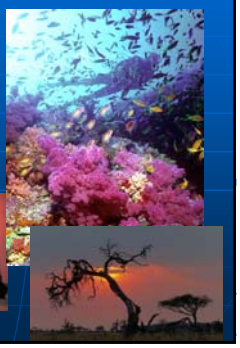
Ecosystem Services

- Provisioning Services
- Regulating Services
  - Climate Regulation
  - Flood Regulation
  - Disease Regulation
  - Water Purification



Ecosystem Services

- Provisioning Services
- Regulating Services
- Cultural Services
  - aesthetic
  - Spiritual
  - Educational
  - Recreational
  - Social Relations

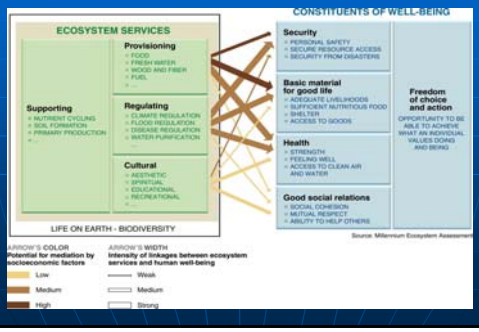


Millennium Ecosystem Assessment

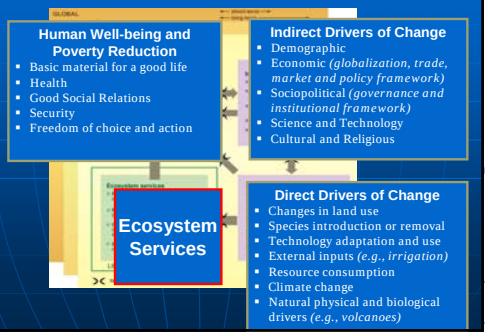
Largest assessment of the state-of-health of Earth's ecosystems

- Prepared by 1360 experts from 95 countries
- 80-person independent board of review editors
- Review comments from 850 experts and governments
- Includes information from 33 sub-global assessments

Focus: Consequences of Ecosystem Change for Human Well-being



MA Framework



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

"Fish found in Perak could be world's second smallest" – Star 15/11/06

- USM School of Biology Dr Khoo Khay Huat discovered the unidentified 10-mm new species in a peat swamp in Perak (possibly related to *Paedocypris micromegethes found in Sungai Gayuh, Sarawak and the 7.9 mm fish in Jambi)*
- ***"Tip of the iceberg" – global estimate of species ranges from 15 to 30 million species; number documented by science so far: 1.75 million species***

Unprecedented change: Ecosystems

- More land was converted to cropland in the 30 years after 1950 than in the 150 years between 1700 and 1850
- 20% of the world's coral reefs were lost and 20% degraded in the last several decades
- 35% of mangrove area has been lost in the last several decades
- Amount of water in reservoirs quadrupled since 1960
- Withdrawals from rivers and lakes doubled since 1960

Finding #2

- The changes that have been made to ecosystems have contributed to substantial net gains in human well-being and economic development
  - Since 1960, while population doubled and economic activity increased 6-fold, food production increased 2 ½ times, food price has declined, water use doubled, wood harvest for pulp tripled, hydropower doubled.
- But these gains have been achieved at growing costs that, unless addressed, will substantially diminish the benefits that future generations obtain from ecosystems

Key problem: Degradation of ecosystem services

- Approximately 60% (15 out of 24) of the ecosystem services evaluated are being degraded or used unsustainably

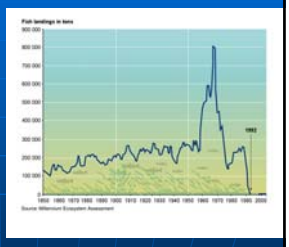
Degraded	Enhanced
Capture fisheries	Crops
Wild foods	Livestock
Wood fuel	Aquaculture
Genetic resources	Carbon sequestration (in last 50 yrs)
Biochemicals	
Fresh Water	
Air quality regulation	
Regional and local climate regulation	
Erosion regulation	
Water purification	
Pest regulation	
Pollination	
Natural Hazard regulation	
Spiritual and religious values	
Aesthetic values	

Increased likelihood of nonlinear changes

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

Examples of nonlinear change

- Fisheries collapse
- Eutrophication and hypoxia
- Disease emergence
- Species introductions and losses
- Regional climate change



THE DAILY YOMIURI

BUSINESS/BRICs

Govt admits bluefin tuna overfish

Fisheries Agency agrees to halve annual quota to 3,000 tons for 5 years

Marubeni to build Qatar power plant

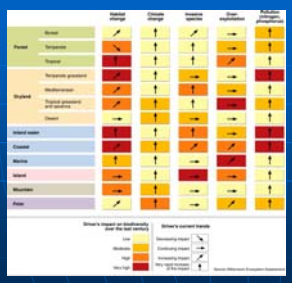
Japan tops 2004 patent application list

Bankruptcy debts low

Finding #3:

- The degradation of ecosystem services could grow significantly worse during the first half of this century

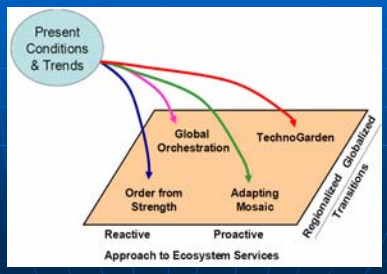
Direct drivers growing in intensity



- Most direct drivers of degradation in ecosystem services remain constant or are growing in intensity in most ecosystems

MA Scenarios

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

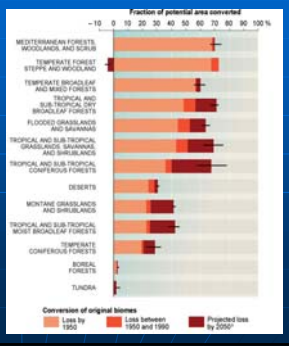


Changes in direct drivers

- Habitat transformation:
  - Further 10–20% of grassland and forestland is projected to be converted by 2050
- Overexploitation, overfishing:
  - Pressures continue to grow in all scenarios

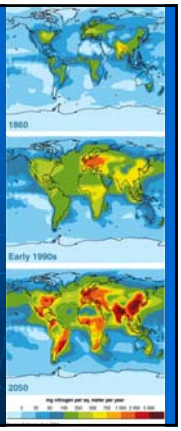
Invasive alien species:

- Spread continues to increase



Changes in direct drivers: Nutrient loading

- Humans have already doubled the flow of reactive nitrogen on the continents, and some projections suggest that this may increase by roughly a further two thirds by 2050



Estimated Total Reactive Nitrogen Deposition from the Atmosphere

Accounts for 12% of the reactive nitrogen entering ecosystems, although it is higher in some regions (e.g., 33% in the United States)

Changes in direct drivers: Climate Change

- Potential future impacts
  - By the end of the century, climate change and its impacts may be the dominant direct driver of biodiversity loss and changes in ecosystem services globally
- Net harmful impact on ecosystem services
  - The balance of scientific evidence suggests that there will be a significant net harmful impact on ecosystem services worldwide if global mean surface temperature increases more than 2° C above preindustrial levels (*medium certainty)*. This would require CO_2 stabilization at less than 450 ppm.

Finding #4:

- The challenge of reversing the degradation of ecosystems while meeting increasing demands for their services can be partially met under some scenarios that the MA considered but these involve significant changes in policies, institutions and practices, that are 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


THE TIMES

ECONOMIST'S WARNING BEATING GLOBAL WA

'If the world acts now we can both grow and be green'

Improvements in services can be achieved by 2050

- **Three of the four scenarios show that significant changes in policy can partially mitigate the negative consequences of growing pressures on ecosystems, although the changes required are large and not currently under way**

What can be done?

- Invest in ecosystems just as we invest in other aspects of the productive base of our societies like education and infrastructure.
  - The problem can't be solved so long as we treat ecosystem services as limitless.

What can be done?

- The demands and pressures being placed on ecosystems are more than they currently can withstand.
  - Reduce consumption of ecosystem services where there are already clear problems of unsustainable use, such as fisheries and water
  - Reduce harmful drivers of change, in particular climate change and excessive nutrient loading.

Examples of changes in policies and practices that yield positive outcomes

- Global Orchestration
  - Major investments in public goods (e.g., education, infrastructure) and poverty reduction
  - Trade barriers and distorting subsidies eliminated

Examples of changes in policies and practices that yield positive outcomes

- Adapting Mosaic
  - Widespread use of active adaptive management
  - Investment in education (countries spend 13% of GDP on education, compared to 3.5% today)
- TechnoGarden
  - Significant investment in development of technologies to increase efficiency of use of ecosystem services
  - Widespread use of 'payments for ecosystem services' and development of market mechanisms

Responses – Importance of Indirect

- Ecosystem degradation Drivers 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

Promising Responses

- Institutions
  - Integration of ecosystem management goals within other sectors and within broader development planning frameworks
  - Increased transparency and accountability of government and private-sector performance
- Economics
  - Elimination of subsidies that promote excessive use of ecosystem services (and, where possible, transfer these subsidies to payments for non-marketed ecosystem services)
  - Greater use of economic instruments and market-based approaches in the management of ecosystem services (where enabling conditions exist)

Promising Responses

- Technology
  - Promotion of technologies that enable increased crop yields without harmful impacts
  - Restoration of ecosystem services
  - Promotion of technologies to increase energy efficiency and reduce greenhouse gas emissions

Promising Responses

- Social and Behavioral
  - Measures to reduce aggregate consumption of unsustainably managed ecosystem services
  - Communication and education
  - Empowerment of groups dependent on ecosystem services
- Knowledge
  - Incorporation of nonmarket values of ecosystems in resource management decisions
  - Enhancement of human and institutional capacity

Ecosystem services – implications to business

- "Business cannot function if ecosystems and the services they deliver – like water, biodiversity, fiber, food, and climate – are degraded or out of balance"
- *- World Business Council on Sustainable Development*

"Increasingly for business,' green' is green." – Jeff Immelt, CEO of General Electric

Ecosystem services affect business/industry in three ways

- If current trends continue, ecosystem services that are freely available today will cease to be available or become more costly in the near future
- Loss of ecosystem services will also affect the framework conditions within which businesses operate, influencing customer preferences, stockholder expectations, regulatory regimes, and the availability of finance and insurance
- New business opportunities will emerge as demand grows for more efficient or different ways to use ecosystem services for mitigating impacts or to track or trade services

Water scarcity and business

- Water scarcity is potentially of greatest importance to business
- 5-20% of freshwater use exceeds long-term sustainable supply
- 15-20% of irrigation withdrawal is estimated to be unsustainable

Water scarcity and business

- Water scarcity will affect all businesses either directly or indirectly, just as increases in the price of petroleum affect the state of the global economy
- Governments will be called on to allocate supplies and adjudicate water rights
- Increasingly, markets and market mechanisms are being used to help achieve efficient use through prices that reflect scarcities

Business implications of ecosystem change – water scarcity

- Businesses will find themselves in competition with others – including other businesses – for water
- The cost of water may result in substantial increase in the cost of business operations
- Decisions about locating operations must address long-term water supply

Business implications of ecosystem change – water scarcity

- Increasingly, business will need to find ways of recycling supplies
- New technologies and modes of operation that reduce the consumption of water per unit of output and address water quality will be valuable
- Marketing and selling water is a new business opportunity already being pursued in some places

Climate Change

- Observed recent changes in climate, especially regional temperatures, have already significant impacts on biodiversity and ecosystems, including CHANGES in:
- - species distributions
- - population sizes
- - the timing of reproduction and migration events
- - increase in the frequency of pest and disease outbreaks
- - bleaching of coral reefs

Climate Change

Energy and Climate Change – Turning Threats to Opportunities

- Energy production and use illustrate how threats to established ways of business from ecological stress (climate change) can turn into business opportunities and competitive advantage
- Reliable and abundant forms of energy are essential for economic development and human well-being
- Throughout the 20th century and currently, energy supply has been dominated by plentiful fossil fuels (coal, petroleum, natural gas)
- Vast investment and infrastructure have grown to facilitate the production, transportation, processing, and use of these forms of energy

Energy and Climate Change – Turning Threats to Opportunities

- Despite the very important role fossil fuels have played in economic development, however, their use has taken and continues to take a toll on ecosystems and the services they provide to people
- Tolls in the form of impacts to ecosystems during extraction, spills and air pollution during transportation, and air pollution and greenhouse gas emissions during processing and use
- Climate change is directly linked to the buildup of carbon dioxide in the atmosphere from the use of fossil fuels

Energy and Climate Change – Turning Threats to Opportunities

- A critical challenge in the protection and restoration of ecosystem services is the transition to an energy future with lower carbon emissions, less air pollution, and minimal risks from the extraction and transportation of fossil fuels

Towards sustainable use of energy

- Various options already available
  - Energy efficiency improvement
  - Energy saving including demand side management, change in lifestyles etc.
    - Passive solar, greening of walls in buildings
    - Change in transportation modes etc.
  - Renewable energy
    - Biomass, biofuels
    - Solar
    - Wind
    - Tidal etc.

Education for Sustainable Development (ESD)

- **Broader concept than environmental education.**
- **Not sustainable development education, but education for sustainable development - education to enable us to better contribute to sustainable development.**

Solar power generation at buildings

Kindergarten

Solar Power 5.1kW

↓

↑ **Kindergarten**

Solar Power 3kW

Solar and Wind Power at Public Utilities

City Park

Wind Power 130 W

Solar Power 900W

↓

↑

Senior High School

Solar Power 10kW

Wind Power

130W/450W/600W

里地里山の保全・再生モデル事業イメージ

Source: Ministry of Environment, Japan

Arigato Gozaimashita