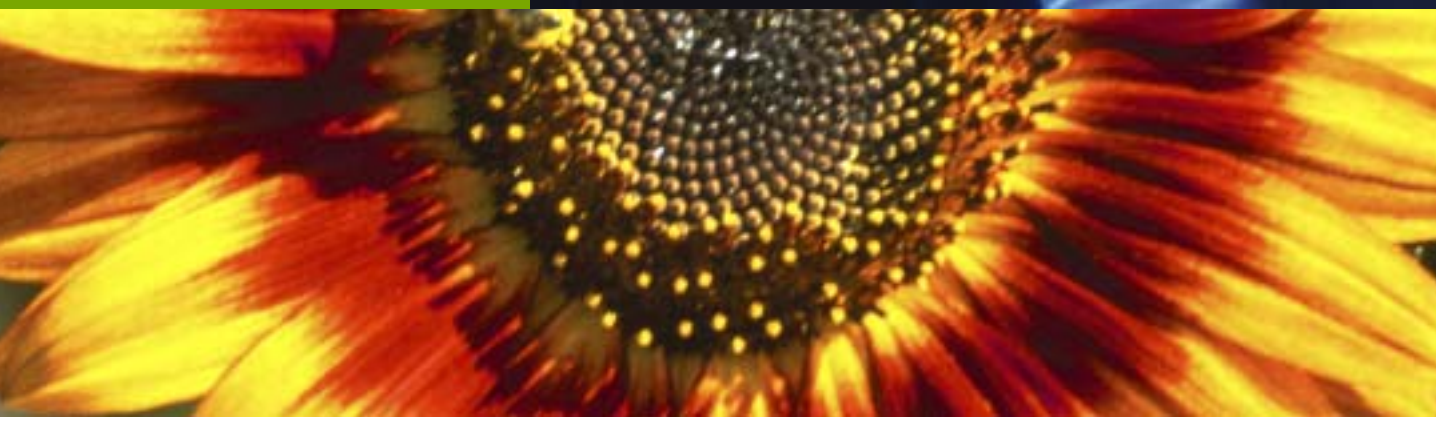
DEDICATED TO MAKING A DIFFERENCE

Business and Ecosystems



Issue Brief | Ecosystem Challenges and Business Implications

EARTHWATCH® INSTITUTE

IUCN
The World Conservation Union

World Business Council for Sustainable Development

WORLD RESOURCES INSTITUTE

The issue at a glance

Over the past 50 years human activity has altered ecosystems faster and more extensively than ever before in human history. That is the main finding of the Millennium Ecosystem Assessment[1] (MA), a four-year, international, scientific appraisal of the condition and trends in the Earth's ecosystems.

The MA classified ecosystem services, the benefits people and businesses obtain from ecosystems, into four categories:

- **Provisioning** – goods such as food, water and fiber;
- **Regulating** – biophysical processes controlling natural processes;
- **Cultural** – providing recreational, aesthetic or spiritual values;
- **Supporting** – underlying processes such as soil formation, photosynthesis and nutrient cycling.

The MA assessed 24 ecosystem services and found the majority to be degraded (see balance sheet).

The MA[2] also identified six interconnected challenges that are of particular concern for business as these further affect the integrity of ecosystems and their capacity to provide services:

- **Water scarcity**
- **Climate change**
- **Habitat change**
- **Biodiversity loss and invasive species**
- **Overexploitation of oceans**
- **Nutrient overloading.**

This Issue Brief explores the six challenges, discusses their implications for businesses and provides examples of corporate responses.

The business case

Business and ecosystem services are inextricably linked. Corporations not only affect ecosystem services but also *rely* upon them. For instance, the pharmaceutical industry benefits from nature's providing genetic resources; agribusiness depends on nature's pollination, pest control and erosion regulation services; while tourism builds on cultural services, and the insurance industry benefits from the natural hazard protections that some ecosystems provide. Because of these inter-relationships, the trends and six challenges identified by the MA pose significant risks to companies (as well as to their suppliers, customers and investors) including:

- **Operational** – increased scarcity and cost of raw materials such as freshwater, disruptions to business operations caused by natural hazards, and higher insurance costs for disasters such as flooding;
- **Regulatory** – emergence of new government policies such as taxes and moratoria on extractive activities;
- **Reputational** – damage to corporate reputation from media and non-governmental organization (NGO) campaigns, shareholder resolutions and changing customer preferences;
- **Access to capital** – restrictions as the financial community adopts more rigorous investment and lending policies.

"Business simply cannot function if ecosystems and the services they deliver – like water, biodiversity, food, fibre and climate regulation – are degraded or out of balance."

Björn Stigson,
President, WBCSD

"The awareness that your business is fundamentally dependent on the ecosystems around it for its livelihood is crucial for starting to address these issues. Without that, you are really only scratching on the surface."

Edmund Blamey,
Interface Europe

"Business cannot assume that there will be ample warning of a change in the availability of key services or that a company's past responses to changes will be successful in the future. Ecosystems often change in abrupt, unpredictable ways."

Ecosystems and Human Well-being: Opportunities and Challenges for Business and Industry, 2005

At the same time, these trends and challenges can create new business opportunities including:

- New technologies and products – that will serve as substitutes, reduce degradation, restore ecosystems or increase efficiency of ecosystem service use;
- New markets – such as water quality trading, certified sustainable products, wetland banking and threatened species banking;
- New businesses – such as ecosystem restoration and environmental asset finance or brokerage;
- New revenue streams – for assets currently unrealized, such as wetlands and forests, but for which new markets or payments for ecosystem services could emerge.

However, most companies routinely fail to recognize the link between healthy ecosystems and their business interests. Companies can pursue several steps to prepare for these risks and/or take advantage of emerging opportunities, including:

Assess impacts and dependence

- Conduct a systematic review of impacts and dependence on ecosystem services, covering direct operations and those of suppliers and customers. This may initially focus on a single business unit, facility or product line, but later could expand;
- Assess the status of relevant ecosystem services and assess key trends in order to understand their effects on a particular business;
- Consider the following: What are the conditions of the services globally and regionally? What factors are driving these trends? Who are other significant users of these services? What trade-offs among services are involved?

Explore and pursue new business opportunities

- Use the impact/dependency assessment to identify, evaluate and respond to new business opportunities;
- Take advantage of opportunities emerging in response to ecosystem changes, including new technologies, markets, businesses and revenue streams;
- Support government policies that align incentives with actions that sustain ecosystem services.

Reduce impacts and scale up solutions

- Use the assessment to develop appropriate corporate strategy, policy and operational responses guided by the hierarchy of "avoid, minimize, mitigate and offset" to reduce impacts. Set targets for improvement, and report on the results;
- Integrate assessment and review systems into existing environmental management systems;
- Build alliances with research organizations, NGOs, industry associations and governments to improve understanding of ecosystem services, scale up solutions and share assessment tools and best practices.

Balance sheet: Ecosystem services

Provisioning services		
Food	crops	↑
	livestock	↑
	capture fisheries	↓
	aquaculture	↑
	wild foods	↓
Fiber	timber	+/-
	cotton, silk	+/-
	wood fuel	↓
Genetic resources		↓
Biochemicals, medicines		↓
Water	freshwater	↓

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	+/-

↑ globally enhanced
↓ globally degraded

Source: Millennium Ecosystem Assessment. 2005.

The MA evaluated the global status of provisioning, regulating and cultural services. An upwards arrow indicates that the condition of the service globally has been enhanced and a downwards arrow that it has been degraded in the recent past.

Water scarcity[3]

"In an aggregate sense, water is a required input generating value-added in all sectors of the economy..."[4]

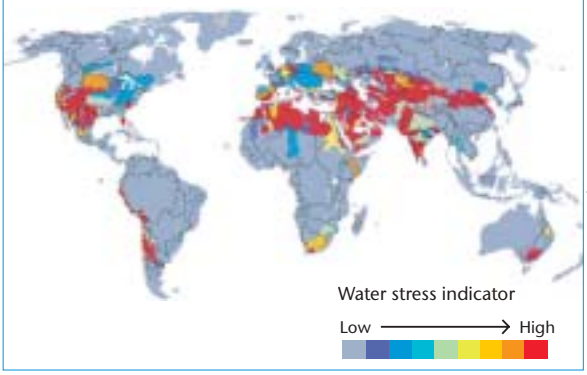
Freshwater scarcity is an accelerating condition for 1-2 billion people worldwide, affecting food production, human health and economic development. The most important sources of renewable freshwater are forest and mountain ecosystems, which provide water to two-thirds of the global population. The availability of water per person varies worldwide, but only about 15% of the world's population lives with relative water abundance.

Challenges

Worldwide, some 1.7 million people die annually as a result of inadequate water, sanitation and hygiene. Half the urban populations in Africa, Asia, Latin America and the Caribbean suffer from diseases associated with inadequate water and sanitation. Between 5% and 20% of global freshwater use exceeds long-term sustainable supply and is met by water transfer or unsustainable use of groundwater. Most water is consumed by agriculture and industry, with agriculture accounting for more than 70% of total consumption in six out of eight regions.

Freshwater quality can be reduced by wastewater from industry, storm water runoff in urban areas, overuse of fertilizer, and poor sanitation facilities in both urban and rural areas. Projections indicate that between 2000 and 2010, global water use will expand by 10%.

Environmental Water Scarcity by River Basin



Source: World Resources Institute/EarthTrends, 2005.

The water stress indicator in this map measures the proportion of water withdrawal with respect to water available for human use. In higher risk areas, the amount of water removed from the system by human activities puts the ecosystem at risk by tapping into the water needed to sustain the integrity of the ecosystem.

Water scarcity

Implications

Most corporate operations need reliable sources of water. Major business risks arising from water scarcity include:

- Higher water costs due to decreased supply or increased treatment and processing costs;
- Unpredictable water supply, which could disrupt operations, shut down plants, and challenge heavily water-dependent industries;
- Government-imposed water restrictions or rationing;
- Plant closures in areas where costs become prohibitive or operations are no longer viable;
- Risk to reputation and brand image as a result of excessive or inefficient use.

However, numerous business opportunities could emerge, including:

- Increasing access to drinking water using market mechanisms (e.g., water quality trading) or new technologies (e.g., wastewater treatment and desalination);
- Improving efficiency by streamlining processes and implementing closed-loop systems;
- Designing products and processes that are less water-dependent;
- Improving image and reputation through active involvement in water management via partnerships with government, local communities and civil society.

In August 2006, the World Business Council for Sustainable Development completed an interlinked set of *Water Scenarios to 2025*, highlighting three key challenges for business: efficiency, security and interconnectivity. These Scenarios can be used to test business strategies as well as create a framework for structured dialogue among stakeholders.[5]

"Water security for business depends on the understanding of the capacities of ecosystems, the valuation of their services, and on the water security of other stakeholders."

Jürg Gerber, Alcan

"People are starting to realize that water is not the widely available commodity they thought it was; this will, and is already, influencing customer behavior and expectations."

Noel Morrin, Skanska

Understand the value of water

Rio Tinto has developed a water diagnostic tool to help understand the cultural, social, economic and environmental risks and opportunities for water. It focuses on water supply, discharge quality, cost and community engagement. Applying the tool on 15 of their operational sites has revealed that risks are site specific and that water is a key interest for local communities.

Climate change[6]

"Observed recent changes in climate, especially warmer regional temperatures, have already had significant impacts on biodiversity and ecosystems..."[7]

Ecosystems and climate are closely interrelated; local and global climate cycles are influenced by:

- Ecosystems sequestering or emitting greenhouse gases (GHG) such as carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O);
- Changes in land cover that affect and alter water cycles and rainfall patterns over time and space;
- Higher incidence of extreme climatic events such as droughts, floods and hurricanes.

Challenges

Ecosystems influence climate, and changes in the climate can transform ecosystems. For example, changes in temperature and water availability can change survival and fecundity, and hence affect species distribution and interaction as well as the resilience of ecosystems and their ability to provide services.

The use of fossil fuels to meet the world's growing energy needs has contributed to an increase in GHG concentration in the Earth's atmosphere. There is a widespread view that this increase is leading to climate change, with adverse effects on the environment. Ecosystems and ecosystem change are also major contributors to climate change in terms of:

- CO_2 emissions from land use changes, primarily deforestation;
- CH_4 emissions from natural processes in wetlands and agriculture (ruminant animals and rice paddies);
- N_2O emissions from farm systems, primarily driven by manure and fertilizer use.

Market mechanisms, such as international trade in CO_2 emissions allowances, have been developed to help decrease GHG emissions. Targeted policies that use fiscal mechanisms to encourage emissions reductions, such as incentives for low-carbon technologies, are also likely to play an important role in efforts to stabilize emissions.

Climate change is one of the direct drivers of ecosystem change that is expected to become increasingly prominent over the next 50 years. Scientists project that climate change will affect ecosystem services, economic development and human well-being by increasing the global mean surface temperature, accelerating losses of biodiversity worldwide, changing productivity and growing zones of vegetation, causing sea level rise, and expanding the prevalence of pests and diseases such as malaria, dengue fever and cholera.

Implications

Businesses are affected by climate change, but the distribution of the impacts will vary. Those businesses that have implemented effective risk management strategies or have competitively positioned themselves will be more adaptable and could stand to benefit from climate change. Those that fail to recognize the risks and potential opportunities may suffer decreased operational efficiencies and profit margins.

Corporate responses to climate change should incorporate uncertainty regarding the nature, extent and location of change.

Business risks posed by climate change include:

- Reduced agricultural yields and insecurity of crucial raw materials, such as water, caused by higher temperatures and increasingly complex regional variation in weather patterns;
- Reduced ecosystem resilience generated by the loss of species and their stabilizing interactions;
- Decreased operational efficiencies, mounting costs, and rising insurance premiums resulting from the increased occurrence of extreme weather events, such as floods and tropical storms;
- Increased operating costs due to government-imposed restrictions on or charges for GHG emissions.

Business opportunities presented by climate change include:

- Introduction of new businesses, products or services that reduce GHG emissions;
- Reduced costs through energy efficiency improvements or switching to low-carbon fuels;
- Enhanced reputation and brand through corporate policies and proactive action to reduce GHG emissions (e.g., conducting a GHG inventory, setting reduction targets);
- Earning a place at the policy-makers' table in response to timely and effective company action.

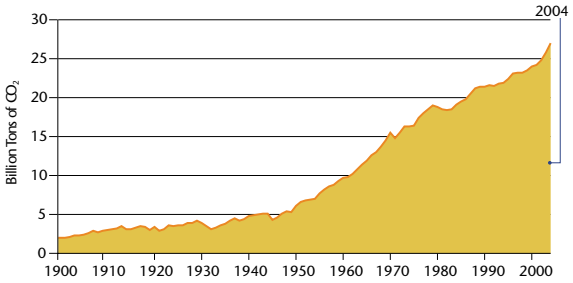
"Any change in climate is going to change agriculture significantly, as the most productive regions of today are productive because of a perfect combination of fertile soils, temperature and water availability."

Juan Gonzalez-Valero,
Syngenta International

"We must be able to demonstrate leadership on climate change and be attractive to the SRI community, which is increasing in size. If we are not proactive, it will prove challenging to maintain the leading position we have with many investors."

Priya N. Matzen,
Novo Nordisk

Global Emissions of Carbon Dioxide from Fossil Fuels, 1900-2004



Source: World Resources Institute/CAIT. 2005.

In the past 200 years, more than 2.3 trillion metric tons of CO_2 have been released into the atmosphere due to human activities. One-half of these emissions have occurred in the last 30 years.

Build scenarios to prepare for change

Skanska has begun to develop its approach to climate change by using scenario modeling. These models will be applied to new development projects to assess the potential impacts of climate change on indoor climate and help the company consider architectural designs accordingly. For example redesigning heating, ventilation and air conditioning systems can significantly lower energy demand, with annual consumption of less than 100 kW per square meter achievable in commercial offices.

Habitat change[8]

"Loss of habitat results in the immediate extirpation of local [wildlife] populations and the loss of the services that these populations provided." [9]

Changes in land use have significantly altered the capacity of ecosystems to provide services. Today, one-quarter of the Earth's land surface is covered by cultivated systems.

Habitat fragmentation is most severe in Europe and least severe in South America. Many countries in sub-Saharan Africa suffer from low soil productivity and rely on the expansion of cultivated areas to meet the demand for food.

Challenges

The economic value of converted land is often far less than that of sustainably managed natural systems that provide a greater variety and quantity of services. For example, the Brazilian Amazon, which comprises about one-third of the world's tropical forest, plays an important role in regulating the hydrological cycle underpinning the country's agriculture and hydropower. Nonetheless, between 2000 and 2005, Brazil accounted for 42% of net global forest loss, with most of this deforestation occurring in the Brazilian Amazon.

Modifying habitats changes the distribution of species. The time lag between habitat change and extinction provides opportunities to invest in habitat restoration and re-establish wildlife populations. Interventions for habitat restoration include enhancing the efficacy of resource use and management, preventing pollution, and encouraging the establishment and expansion of protected areas.

About 12% of the Earth's land area is designated as protected.

Future rates of habitat loss will depend in part on changes in human population, wealth, trade and technology. Projections for the next 50 years estimate that:

- Demand for food crops will grow by 70-85%;
- Forest cover will continue to increase in industrial countries, and commercial plantations may provide an increasing proportion of timber products;
- Some 10-20% of remaining grassland and forestland will be converted for agricultural, urban and infrastructure development purposes;
- Land conversion will mainly occur in developing countries and dryland regions;
- Land use change will continue to be a major driver of ecosystem change in terrestrial and freshwater ecosystems;
- Habitat losses will lead to global extinctions, including a 10-15% reduction in plant species.

Habitat change

Implications

Current and projected habitat loss presents significant risks and opportunities for many business sectors.

Risks to business from continued habitat loss include:

- Government restrictions on land use and conversion, and pressure for greater efficiencies on existing land in order to reduce habitat loss;
- Rising land prices and production costs stemming from competition for land;
- Tarnished reputation and image in response to corporate degradation of ecosystems and corresponding habitat loss, such as in the Brazilian Amazon;
- Government-imposed obligations to restore degraded land and habitats in response to stakeholder concerns.

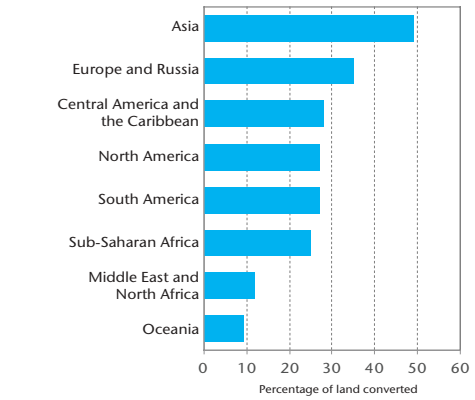
Business opportunities from more efficient use of land and habitat restoration include:

- Adoption of new technologies, design of new products and processes that improve the efficiency of land use and boost profitability;
- New businesses that restore or preserve habitats;
- Enhanced brand image and reputation through the use of certification schemes and support for habitat restoration initiatives.

"We must improve our knowledge of land and biodiversity to understand better our reliance on natural habitats. Competition for use and conservation of land are increasingly becoming issues that need corporate attention."

David Richards, Rio Tinto

Conversion of Natural Ecosystems



Source: World Resources Institute/EarthTrends 2005.

Almost 30% of Earth's terrestrial area – 2 billion hectares of forest and 1.5 billion hectares of grasslands – has been converted to urban areas or cropland.

Develop best practice guidelines through multi-stakeholder processes

Multi-stakeholder processes like the Roundtable on Sustainable Palm Oil, the Roundtable on Responsible Soy, and the Better Cotton Initiative, each established by the Worldwide Fund for Nature (WWF), are being used by an increasing number of companies and stakeholders to develop best practice guidelines around the production and extraction of ecosystem services such as commodities.

Biodiversity loss and invasive species[10]

"Humans are fundamentally, and to a significant extent irreversibly, changing the diversity of life on Earth, and most of these changes represent a loss of biodiversity."[11]

Biological diversity (biodiversity) refers to the diversity of genes, populations, species, communities and ecosystems on Earth. Estimates of total species numbers range from 5 million to over 30 million, but fewer than 2 million species have been described. Business and industry have profited from the use of microbes, plants and animals for food, fiber, construction materials, pharmaceuticals, cosmetics and other vital products for centuries.

Challenges

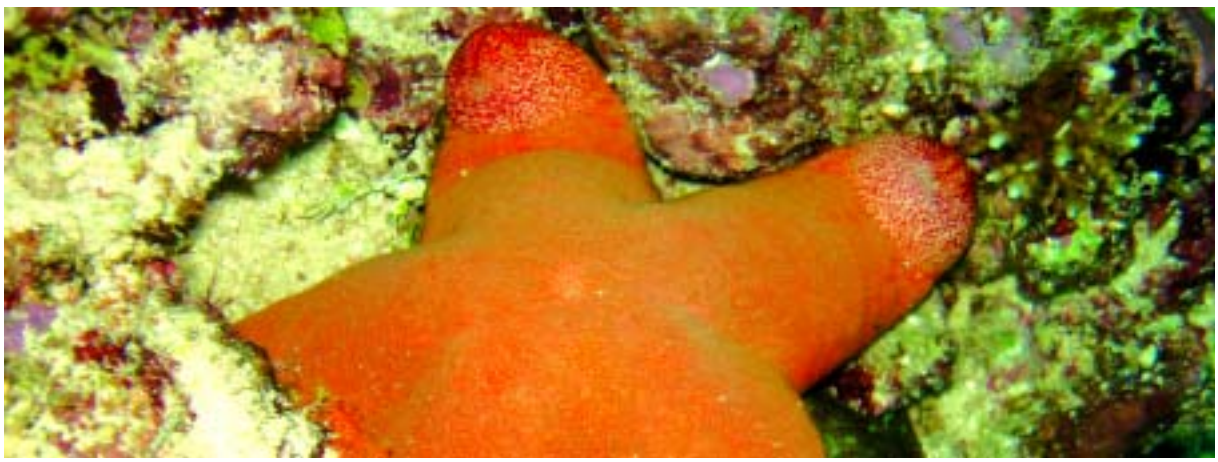
Biodiversity influences the provision of ecosystem services such as food production, pollination, seed dispersal, carbon sequestration and pest control. By degrading biodiversity, human activities are compromising opportunities for future progress and profitability in all regions of the world. Maintaining nature's diverse portfolio to draw from is a way of reducing business risk.

Over the past few hundred years, species extinction rates have increased by 1,000 times over background rates, mainly due to habitat change, non-native invasive species and overexploitation. Genetic diversity has declined globally, particularly among cultivated species. Some 10-30% of mammal, bird and amphibian species are threatened with extinction. Regions long known for their distinctive plant and animal assemblages are becoming more homogeneous due to the spread of invasive species, primarily through the expansion of international trade.

In conserving ecosystem processes, species interrelationships are as important as the total number of species. For example, loss of certain keystone species like figs and palms in tropical forests can change species distributions and ecosystem functions, thereby reducing the flow of benefits to people.

The main causes of current and future biodiversity loss are human induced and include:

- Habitat change, particularly conversion of natural systems to agriculture;
- Climate change, which may become the dominant driver in the coming decades;
- Invasive species, particularly on islands and in estuaries and freshwater ecosystems;
- Overexploitation, particularly of fish stocks;
- Nutrient overloading, especially in Europe, North America and East and South Asia.



Biodiversity loss and invasive species

Implications

Today's overuse and misuse of ecosystem services and the resulting affects on biodiversity will limit business opportunities and profits in the future. The financial benefits of ecosystem services (e.g., food and forest production, pollination for crops, wildlife for recreation, natural pest and disease control) are considerable, as are the costs of addressing problems such as invasive species. Preventive measures could make more funds available, for example for investment in and development of new technologies and markets.

Risks to business from the continued loss of biodiversity include:

- Diminishing supply and rising cost of key production inputs such as fish for the food sector; trees and associated inputs for the forest sector; water and pollinating agents for agriculture; and raw materials for biochemical industries including pharmaceuticals;
- Declining quality of natural habitat and amenities available for nature-based tourism and associated travel and hospitality sectors;
- Significant economic losses posed by the spread of invasive species;
- Growing pressure from stakeholders to prevent invasion of non-native species and to conserve endangered species and their habitat, resulting in restricted business access to critical natural resources.

At the same time, new business opportunities linked to biodiversity conservation are emerging. These include:

- Enhanced competitiveness of companies and increased consumer acceptance of products and services that are credibly associated with biodiversity conservation;
- Providing technical advice and consulting services to the wider business community on biodiversity strategy and management systems;
- Commercial supply of habitat restoration and management services, such as carbon sequestration in biomass (mainly forestry), or other forms of compensation for ecosystem damage (e.g., biodiversity offsets, habitat banking);
- Emerging markets for ecosystem services, particularly regulating and cultural services such as watershed management to deliver clean water, and private protected areas to deliver recreational value.

"As a company we are committed to the principles of the UN Convention on Biological Diversity on how to utilize genetic resources in a fair and equitable way. It is part of our value creation."

Claus Frier, Novozymes

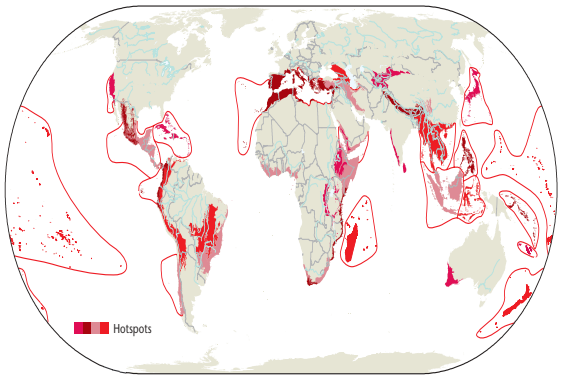
"By managing biodiversity you create opportunities for future business as well."

Steven de Bie,
Shell International

Build on scientific knowledge to improve performance

Cadbury Schweppes is engaged in an Earthwatch Institute research project in Ghana investigating the feasibility and potential of cocoa production in a biologically diverse environment. Cadbury Schweppes employees join the project as volunteer research assistants and gain a better awareness and understanding of the links between biodiversity, sustainability and the Cadbury Schweppes supply chain.

Global Biodiversity Hotspots



Source: Conservation International, 2005.

Several researchers have identified areas of exceptional concentration of endemic species (biodiversity hotspots) that are currently experiencing habitat loss.

Over-exploitation of oceans[12]

"All oceans are affected by humans to various degrees, with overfishing having the most widespread and the dominant direct impact on food provisioning services, which will affect future generations."[13]

Oceans cover more than 70% of the Earth, playing key roles in climate regulation, the freshwater cycle, food provisioning and delivering cultural services.

Coastal zones cover only 8% of the Earth, but the services they provide are responsible for approximately 43% of the estimated total value of ecosystem services. Being the most productive part of the ocean, the coastal boundary zones yield about 90% of marine fisheries. They also have high levels of pollution. Nearly 40% of the human population lives within 100 km of the coast.

Challenges

Demands on coastal zones are increasing in terms of shipping, military and security uses, recreation and fish farming. The overexploitation of oceans presents several challenges:

- Fish landings averaged 82.4 million metric tons per year during 1991-2000, with a declining trend largely attributed to over-fishing; a quarter of fish stocks are overexploited or significantly depleted;
- Fishery declines mean less cheap protein; more than a billion people rely on fish as their main or sole source of animal protein;

- Expansion of fish and shellfish farming (aquaculture) has caused loss of vegetation and biodiversity and deterioration of water quality; aquaculture of carnivorous species such as salmon and tuna consumes more fish than it produces;
- Algal blooms and dead zones (low oxygen conditions) in coastal waters are increasing in frequency and intensity, harming marine resources and human health;
- Some 35% of mangrove areas have been lost or converted over the past several decades; some 20% of coral reefs have been destroyed, with more than a further 20% being degraded;
- Invasions of non-native species are altering marine and coastal ecosystems, threatening the supply of ecosystem services.

Estimates based on current rates of diversity loss indicate that there will be no viable fish or invertebrate species available to fisheries by 2050. However, the trends in species loss are still reversible. While the demand for fish is increasing, fish farming may relieve some of the pressure on wild fisheries, but only if it reduces the pressure on wild fish stocks, and sustainable fish farming practices are adopted.

Marine tourism is growing, especially the marine wildlife tours sector, which depends on suitable local conditions, such as productive coral reefs. Future forms of ocean exploitation include fish harvesting, aquaculture, energy production, bioprospecting, seabed mining and carbon sequestration.

Over-exploitation of oceans

Implications

Changing ocean ecosystems as a result of overexploitation will affect the profitability of businesses that rely on products or services provided by the marine environment, including fishing, oil and gas extraction, and recreation.

Risks to business from continued overexploitation of oceans include:

- Depletion of fish stocks, reducing revenue and triggering new catch regulations;
- Property damage, asset losses and rising insurance rates associated with the loss of natural coastal protection;
- Decreased tourism and lower property values caused by beach erosion, coastal dead zones and coral reef degradation.

"Some businesses are already experiencing direct impacts through decreased provision of fish for food or feed, while other businesses are or may be affected by the increased frequency of outbreaks of disease or blooms of nuisance species that are symptomatic of unstable ocean systems."[14]

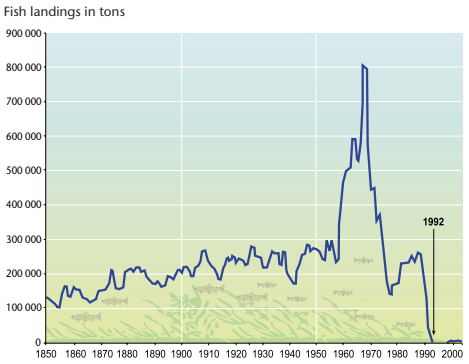
"Certification processes like MSC are vital for raising the standard among producers. It encourages participation of all stakeholders, which is essential to make it work in practice and for transparency, but it is also very time consuming."

Jan Kees Vis, Unilever

New business opportunities related to the sustainable use of marine products and services include:

- Enhanced business image and reputation through the use of eco-labels or certification programs, such as the Marine Stewardship Council (MSC);
- New products, services and markets (e.g., reef species for pharmaceuticals, mangrove restoration for flood protection, wetlands restoration for water purification);
- Investment in research & development (R&D) to overcome environmental harm from today's harvesting and cultivation practices;
- Increased market demand for low-impact fish farming, shipping and tourism.

The Cod Fishery's collapse



Source: Millennium Ecosystem Assessment. 2005.

The collapse of Canada's Newfoundland cod fishery in the 1990s forced its indefinite closure after hundreds of years of exploitation. Offshore bottom trawling, beginning in the late 1950s, increased the catch temporarily but caused declines in the ocean's underlying biomass. After more than a decade the stock has still not recovered.

Assess suppliers to reduce impact

Wal-Mart has set a goal to purchase all of its wild-caught fresh and frozen fish for the North American market from MSC-certified fisheries. In 2006, Wal-Mart gave their non-certified suppliers three to five years to develop plans and programs to become certified.

Nutrient overloading[15]

"An adequate and balanced supply of elements necessary for life, provided through the ecological processes of nutrient cycling, underpins all other ecosystem services." [16]

Nutrient cycling is essential for the supply of farmed and wild products. Main nutrients include nitrogen, phosphorus, sulfur, carbon and potassium. Human activities, particularly agriculture, have significantly changed nutrient balances and cycles:

- Over the last few decades, the flow of reactive nitrogen has doubled. Over half of the nitrogen fertilizer ever used has been applied since 1985;
- Phosphorus is accumulating in ecosystems due to the use of mined phosphorus in agriculture and industrial products;
- Sulfur emissions have been reduced in Europe and North America, but are still rising in countries like China, India and South Africa and in southern parts of South America.

Challenges

Nitrogen, phosphorous and sulfur are accumulating in many of the Earth's vital ecosystems. Nitrogen accumulation in surface and aquatic ecosystems contributes to the degradation of freshwater and coastal ecosystem services. Increases in nitrogen inputs are caused mainly by poor or absent sewage systems, insufficient wastewater treatment, and fertilizers used in food production. Erosion of soil carrying agricultural phosphorus that enters into freshwater systems contributes to eutrophication. Forest ecosystems are at high risk of acidification from sulfur emissions.

Conversely, nutrient depletion is a problem in certain regions. Harvesting without nutrient replacement in parts of Africa and Latin America has reduced soil fertility, with serious consequences for human nutrition, health and the environment. Soil nutrient depletion affects more than 85% of agricultural lands in Africa.

Land management can also play a role. Changing natural habitats into large-scale, low-diversity agricultural landscapes affects nutrient cycling and undermines the capacity of ecosystems to absorb and retain nutrients.

Nutrient overloading

Implications

Alterations in nutrient balances and recycling will affect many industries that depend directly on supporting, provisioning and cultural ecosystem services, such as the food, timber, fiber, water and tourism industries.

Business risks from nutrient overloading include:

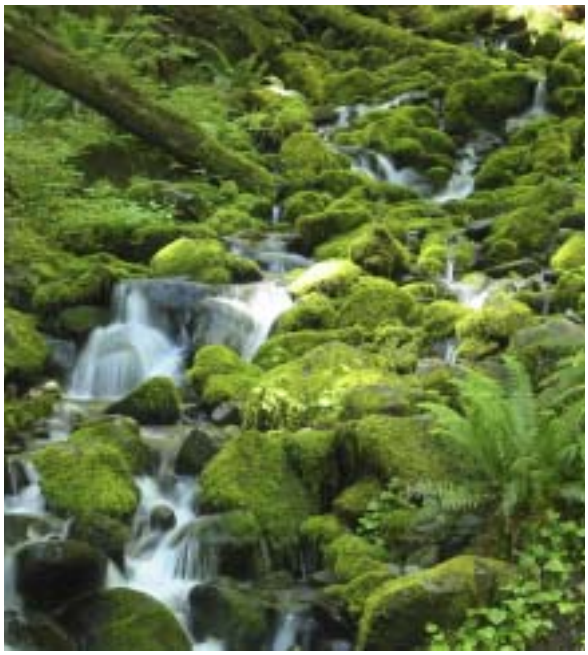
- Restrictions of use and emissions of nutrients for various industry sectors as a result of regulatory limits on nutrient emissions/releases;
- Lower profitability as a result of degraded terrestrial, coastal and freshwater ecosystems;
- Limited availability or widespread loss of raw materials as a consequence of nutrient accumulation, as in the case of acid-rain induced depletion of high-quality timber;
- Increased costs due to government-imposed obligations to pay for the restoration of degraded ecosystems.

Business opportunities to advance more efficient nutrient use include:

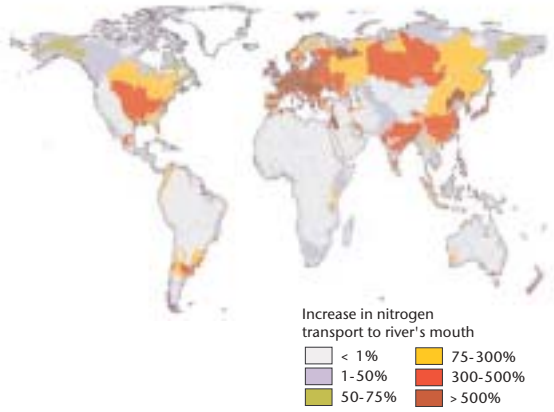
- New products and technologies that enhance soil conservation, improve nutrient use efficiency and limit leaching of nutrients to coastal and freshwater ecosystems;
- Commercial recycling of nutrients, such as sludge from wastewater treatment;
- Emerging markets for nutrient trading and associated businesses that facilitate these markets;
- Provision of technical advice and training on nutrient management to affected industries.

"We are removing nutrients from the water cycle, but we need to go further back to address especially agriculture and diffuse pollution management to ensure that excess nitrogen and phosphorus do not go into the system in the first place. We have to treat the problem ultimately."

Andy Tomczynski, Thames Water Utilities



Nitrogen Increases in Inland Waters



Source: Millennium Ecosystem Assessment. 2005.

Agriculture and industry have increased the levels of nitrogen found at the mouths of major rivers worldwide as a consequence of the exponential growth in fertilizer use, the wide-spread use of nitrogen-fixing crops and the combustion of fossil fuels.

Recycle waste to increase profits

Terra Eco Systems specializes in recycling organic waste materials to agriculture, land restoration, forestry and horticulture. Each year the company recycles more than 1.7 million metric tons of organic material including water and wastewater sludge, as well as green and kitchen waste. Through these services Terra Eco Systems provides cost-effective fertilizer solutions.

Broader perspectives

A meeting of business leaders, government officials and scientists held by Earthwatch Institute in London in September 2006 to discuss the business and ecosystems agenda produced the following observations:

- Meeting ecosystem challenges depends on scientists and business strategists with different world views developing shared perspectives and research;
- Executives may feel more comfortable responding to ecosystem challenges when other business leaders are doing the same;
- As ecosystem management becomes integral and widespread among businesses, benefits in terms of competitive environmental advantage may be reduced;
- To build a sufficient shared response to ecosystem degradation, governments worldwide must employ fiscal and regulatory mechanisms;
- Spatial information on ecosystem degradation should be widely available and accessible as a public good to help business planning and responses;
- The development of an "ecosystem marketplace" that is widely accepted and encompasses both ecosystem investments and payment for ecosystem services is crucial in adopting a response of suitable scale;
- New tools are required by businesses to manage ecosystems, recognize the true value of the services they provide, and internalize the costs of public goods and services usage in business operations.

Partnership

The collaboration between Earthwatch Institute, the World Conservation Union (IUCN), the World Business Council for Sustainable Development (WBCSD) and the World Resources Institute (WRI) aims to make the business community aware of the degradation of ecosystems and ecosystem services and promote ways that business can respond to these challenges.

The collaboration plans further publications, including one that will focus upon how new business models, markets and entrepreneurs can profit from responding to ecosystem challenges. WRI, WBCSD, Meridian Institute and several WBCSD member companies are also pilot-testing a methodology that assesses a company's impact and dependency on ecosystem services.

Notes

1. United Nations (UN). *Ecosystems & Human Well-being, Synthesis.* 2005.

2. UN. *Ecosystems & Human Well-being, Opportunities and Challenges for Business and Industry.* 2005.

3. Information extracted from: UN. *Ecosystems & Human Well-being, Current State and Trends. chapters 7 and 20. 2005; UN. Ecosystems & Human Wellbeing: Opportunities and Challenges for Business and Industry.* 2005; UN. *Ecosystems & Human Wellbeing, Synthesis.* 2005; WRI. *EarthTrends*; Earthwatch company interviews; WBCSD. *Water Facts and Trends*. 2005; OECD. *Observer.* No. 236. March 2003.

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8. Information extracted from: UN. *Ecosystems & Human Well-being, Current State and Trends.* chapters 4 and 11. 2005; UN. *Ecosystems & Human Well-being Opportunities and Challenges for Business and Industry.* 2005; UN. *Ecosystems & Human Well-being, Synthesis.* 2005; Secretariat of the Convention on Biological Diversity. *Global Biodiversity Outlook 2.* 2006; WRI, incl. Barreto, P. et al. *Human Pressure on the Brazilian Amazon Forests.* 2006; IUCN, incl. Emerton, L. et al. *Sustainable Financing of Protected Areas: A Global Review of Challenges and Options.* 2006; WRI. *EarthTrends*; Earthwatch company interviews.

9. UN. *Ecosystems & Human Well-being, Synthesis* p. 79. 2005.

10. Information extracted from: UN. *Ecosystems & Human Well-being, Current State and Trends.* Chapters 4, 10 & 11. 2005; UN. *Ecosystems & Human Well-being Opportunities and Challenges for Business and Industry.* 2005; UN. *Ecosystems & Human Well-being, Synthesis.* 2005; UN. *Ecosystems & Human Well-being, Biodiversity Synthesis.* 2005; Secretariat of the Convention on Biological Diversity. *Global Biodiversity Outlook 2.* 2006; WRI. *EarthTrends;* Earthwatch company interviews; ISIS Asset Management. *Is Biodiversity a Material Risk to Companies?* 2005; Earthwatch, IUCN & WBCSD. *Business & Biodiversity, The Handbook for Corporate Action.* 2002.

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12. Information extracted from: UN. *Ecosystems & Human Well-being, Current State and Trends.* Chapters 18 & 19. 2005; UN. *Ecosystems & Human Well-being Opportunities and Challenges for Business and Industry.* 2005; UN. *Ecosystems & Human Well-being, Synthesis.* 2005; Science. Worm et al. *Impacts of Biodiversity Loss on Ocean Ecosystem Services* November 2006: Vol. 314. no. 5800. November 2006; Wal-Mart Inc. press release. 2006 (http://www.msc.org/html/ni_239.htm); WRI. *EarthTrends*; Earthwatch company interviews.

13. UN. *Ecosystems & Human Well-being, Current State and Trends.* Chapter 18, p. 479. 2005.

14. UN. *Ecosystems & Human Well-being Opportunities and Challenges for Business and Industry,* p. 14. 2005.

15. Information extracted from: UN. E*cosystems & Human Well-being, Current State and Trends.* Chapter 12. 2005; UN. *Ecosystems & Human Well-being Opportunities and Challenges for Business and Industry.* 2005; UN. *Ecosystems & Human Well-being, Synthesis.* 2005; IFDC report, incl. Henao, J. and Baanante, C. *Agricultural Production and Soil Nutrient Mining in Africa.* 2006; WRI. *EarthTrends*; Earthwatch company interviews.

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Earthwatch Institute

Earthwatch Institute is an international environmental organization whose mission is to engage people worldwide in scientific field research and education to promote the understanding and action necessary for a sustainable environment. Since 1971 Earthwatch has been bringing together individual volunteers and scientists on field research projects as a means of providing essential funding and a dedicated labor force for international scientists. Earthwatch believe that by involving the general public in science, they gain the knowledge, skills and motivation needed to take responsibility for the environment. Earthwatch currently supports over 130 environmental research projects in 50 countries. Since 1971 the worldwide organization has recruited over 80,000 volunteers in support of 2,800 field research projects in 118 countries. These volunteers have contributed over 10 million hours to essential field work.

Earthwatch Institute (Europe)'s Corporate Environmental Responsibility Group (CERG) is a platform for enhancing good practice among the business sector. CERG members benefit from networking and shared learning with other companies committed to good environmental practice, stakeholder dialogue through report/policy feedback services and disseminating good practice through presentations at Earthwatch seminars.

www.earthwatch.org

IUCN – The World Conservation Union

Founded in 1948, The World Conservation Union brings together states, government agencies and a diverse range of non-governmental organizations in a unique world partnership: over 1000 members in all, spread across some 140 countries.

As a Union, IUCN seeks to influence, encourage and assist societies throughout the world to conserve the integrity and diversity of nature and to ensure that any use of natural resources is equitable and ecologically sustainable. A central Secretariat coordinates the IUCN Programme and serves the Union membership, representing their views on the world stage and providing them with the strategies, services, scientific knowledge and technical support they need to achieve their goals. Through its six Commissions, IUCN draws together over 10,000 expert volunteers in project teams and action groups, focusing in particular on species and biodiversity conservation and the management of habitats and natural resources. The Union has helped many countries to prepare National Conservation Strategies, and demonstrates the application of its knowledge through the field projects it supervises. Operations are increasingly decentralized and are carried forward by an expanding network of regional and country offices, located principally in developing countries.

The World Conservation Union builds on the strengths of its members, networks and partners to enhance their capacity and to support global alliances to safeguard natural resources at local, regional and global levels.

www.iucn.org

WBCSD

The World Business Council for Sustainable Development (WBCSD) brings together some 180 international companies in a shared commitment to sustainable development through economic growth, ecological balance and social progress. Our members are drawn from more than 30 countries and 20 major industrial sectors. We also benefit from a global network of 50+ national and regional business councils and partner organizations.

Our mission is to provide business leadership as a catalyst for change toward sustainable development, and to support the business license to operate, innovate and grow in a world increasingly shaped by sustainable development issues.

Our objectives include:

Business Leadership – to be a leading business advocate on sustainable development;

Policy Development – to help develop policies that create framework conditions for the business contribution to sustainable development;

The Business Case – to develop and promote the business case for sustainable development;

Best Practice – to demonstrate the business contribution to sustainable development and share best practices among members;

Global Outreach – to contribute to a sustainable future for developing nations and nations in transition.

www.wbcsd.org

World Resources Institute

The World Resources Institute (WRI) goes beyond research to create practical ways to protect the Earth and improve people's lives. Its mission is to move human society to live in ways that protect Earth's environment and its capacity to provide for the needs and aspirations of current and future generations.

For more than 20 years, WRI has demonstrated its commitment to helping find solutions to these enormous global environmental challenges. WRI's work is concentrated on making progress toward four goals:

Healthy Ecosystems – Reverse rapid degradation of ecosystems and assure their capacity to provide humans with needed goods and services.

Stable Climate – Protect the global climate system from further harm due to emissions of greenhouse gases and help humanity and the natural world adapt to unavoidable climate change.

Sustainable Enterprise – Harness markets and enterprise to expand economic opportunity and protect the environment.

Access to Environmental Information and Decisions – Guarantee public access to information and decisions regarding natural resources and the environment.

www.wri.org and www.earthtrends.wri.org

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