18/05/05, #36. 61 c
2:00 UNDP

on behalf of Mr. Walter Reid
Millenium Ecosystem Assessment

UN Indigenous Forum
May 17, 2005

Madam ~~Mr. Chairman~~ person and distinguished delegates, thank you for this opportunity to speak about the findings of the Millennium Ecosystem Assessment and the relevance of those findings and the assessment process for the UN Permanent Forum on Indigenous Issues and for efforts to achieve the Millennium Development Goals.

Five years ago, recognizing the potential threat that environmental degradation posed for people around the world, United Nations Secretary General Kofi Annan called for the first-ever international scientific assessment of the health of the world's ecosystems. The Millennium Ecosystem Assessment (which I will refer to as the "MA") was established in response to that call after governments took decisions endorsing the process through four international conventions. The assessment was carried out over the last four years, and involved nearly 2000 experts from 95 countries. The United Nations Environment Program coordinated the Secretariat.

The MA was unique in looking not just at the environment but also at the consequences of ecosystem changes for human well-being. To do this, it focused on the role of ecosystems in providing a set of ecosystem services that benefit people. These include provisioning *services* such as food, freshwater, and timber, *regulating services* such as the role of ecosystems in regulating climate and disease, *cultural services* such as aesthetic, spiritual and recreational benefits, and *supporting services* on which the other three categories depend.

While the MA was authorized through governments, it was governed by a multi-stakeholder board that included representatives of governments, UN Agencies, Business, NGOs, and Indigenous Peoples.

In addition to the global assessment of ecosystems, the MA included a set of sub-global assessments, carried out at the scale of regions, nations, river basins, and even local communities. Three of these sub-global assessments – in Peru, Costa Rica, and Papua New Guinea -- were carried out largely or entirely by indigenous peoples.

Let me briefly summarize some of the findings.

The changes that we have made to the planet over the past 50 years have been unprecedented in their pace and scale.

- More land was converted to cropland in the 30 years after 1950 for example than in the 150 years at the height of the agricultural revolution during the 1700s and 1800s.
- 20% of the world's coral reefs were lost and 20% degraded in the last several decades.
- Flows of biologically available nitrogen doubled and flows of phosphorus tripled in the last forty years. These changes to cycles of nutrients degrade water quality and lead to the creation of vast "hypoxic" areas or dead zones in coastal regions.

In the aggregate, these changes to ecosystems have provided significant benefits to people, since many of the changes were made to increase the supply of food and water needed by the growing population. But these gains have been achieved at growing costs that, unless addressed, will substantially diminish the benefits that future generations obtain from ecosystems.

There are three major costs involved:

First, of the 24 ecosystem services assessed, 15, or 60%, are being degraded. The list of degraded services includes fisheries, freshwater, water purification, flood control, air quality regulation, regional and local climate regulation, pest regulation, and loss of spiritual, religious, and aesthetic values.

Second, ecosystem degradation is resulting in an increased risk of abrupt changes that hold serious threats for people. Examples include increased risks of:

- Disease emergence
- Fisheries collapse
- Creation of hypoxic "dead zones"
- Regional climate change

Third, the degradation of these services is exacerbating poverty for some groups of people. More than 70% of the 1.1 billion poor people surviving on less than $1 per day live in rural areas, where they are directly

dependent on ecosystem services and most vulnerable to their degradation.

The MA finds that it is likely that the degradation of ecosystems and their services could grow significantly worse during the next 50 years and present a significant barrier to the achievement of the Millennium Development Goals, particularly Goal 1 which focuses on poverty and hunger. Most of the driving forces causing the degradation of ecosystems are either staying constant or growing in intensity, and two -- climate change and excessive nutrient loading -- will become major drivers of change in the next 50 years.

But the MA also concludes that the future is very much in our hands. In three of the four scenarios developed in the MA, it was found to be possible to reverse the degradation in many ecosystem services over the next 50 years. However, the changes and investments required are substantial, and not currently underway.

What should be done? First, the MA findings indicate that we need to 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 free and limitless.

Second, it is clear that the demands and pressures being placed on ecosystems are more than they currently can withstand. Action is needed to reduce consumption of ecosystem services where there are already clear problems of unsustainable use, such as fisheries and water, and to reduce harmful drivers of change, in particular climate change and excessive nutrient loading.

And third, the findings indicate that we must dramatically increase the attention and resources being given to the development needs of the poorest countries and the poorest people. The assessment documents the presence of a vicious cycle of environmental degradation contributing to poverty which in turn contributes to more environmental degradation.

Let me conclude with several observations regarding the benefits of indigenous people's involvement in the assessment and some of the lessons learned in this regard.

Environmental assessments have traditionally relied exclusively on "scientific" information, despite the fact that considerable relevant knowledge is held by non-scientists. The importance of local and traditional knowledge, in particular, was clear in the MA sub-global assessments where local community members typically hold most of the knowledge concerning changes in local ecosystems.

But the challenges to the incorporation of multiple knowledge systems in an assessment are significant and involve such issues as: how to validate information, how to prevent the misuse of information, and how to create capacity for assessments.

Recognizing these challenges the MA organized an international conference in Egypt in March 2004 involving assessment practitioners, scientists, and indigenous peoples, to discuss theory and practical experiences and to debate the strengths and weaknesses of various approaches.

Both the conclusions of that meeting and the experience of the MA indicate that while the challenges are real, the benefits of inclusion of multiple knowledge systems are significant. First, it does clearly improve the findings of the assessment. In the MA, for example, without the involvement of the local assessments and traditional knowledge the importance of cultural ecosystem services would not have been given the attention that it deserved.

Second, the indigenous assessments benefited from their involvement in the MA process in that it helped to empower or strengthen their voice in policy debates and to legitimize the knowledge that they hold.

In closing, the MA provides a powerful framework for linking environmental and development considerations. While it points to tremendous environmental challenges, it also shows that opportunities exist to reverse many of the most dangerous trends within a matter of decades.

We are also convinced that the experience of the MA will transform the nature of future environmental assessments. 'Scientific' assessments, which privilege scientific knowledge over other types of knowledge, will now give way to 'knowledge assessments' that recognize the value and legitimacy of many forms of knowledge held by different groups of people.

18/05/05 = 36, 61.

ADDENDUM TO E/C.19/2005/CRP.4
20 April 2005
Permanent Forum on Indigenous Issues
Fourth session
New York, 16-27 May 2005
Agenda item 3 of the provisional agenda
Special Theme

Millennium Ecosystem Assessment
Synthesis Report

A Report of the Millennium Ecosystem Assessment

www.MAweb.org

1. Tables and Figures

The following tables and figures complement the information provided in document E/C.19/2005/CRP.4 of 20 April 2005

Table 1. Global Status of Provisioning, Regulating, and Cultural Ecosystem Services Evaluated in This Assessment. Status indicates whether the condition of the service globally has been enhanced (if the productive capacity of the service has been increased, for example) or degraded in the recent past. Definitions of "enhanced" and "degraded" are provided in the note below. A fourth category, supporting services, is not included here as they are not used directly by people.

Service	Sub-category	Status	Notes
Provisioning Services			
Food	crops	↑	substantial production increase
	livestock	↑	substantial production increase
	capture fisheries	↓	declining production due to overharvest
	aquaculture	↑	substantial production increase
	wild foods	↓	declining production
Fiber	timber	+/–	forest loss in some regions, growth in others
	cotton, hemp, silk	+/–	declining production of some fibers, growth in others
	wood fuel	↓	declining production
Genetic resources		↓	lost through extinction and crop genetic resource loss
Biochemicals, natural medicines, pharmaceuticals		↓	lost through extinction, overharvest
Water	fresh water	↓	unsustainable use for drinking, industry, and irrigation; amount of hydro energy unchanged, but dams increase our ability to use that energy
Regulating Services			
Air quality regulation		↓	ability of atmosphere to cleanse itself has declined
Climate regulation	global	↑	net source of carbon sequestration since mid-century
	regional and local	↓	preponderance of negative impacts
Water regulation		+/–	varies depending on ecosystem change and location
Erosion regulation		↓	increased soil degradation
Water purification and waste treatment		↓	declining water quality
Disease regulation		+/–	varies depending on ecosystem change
Pest regulation		↓	natural control degraded through pesticide use
Pollination		↓[a]	apparent global decline in abundance of pollinators
Natural hazard regulation		↓	loss of natural buffers (wetlands, mangroves)
Cultural Services			
Spiritual and religious values		↓	rapid decline in sacred groves and species
Aesthetic values		↓	decline in quantity and quality of natural lands
Recreation and ecotourism		+/–	more areas accessible but many degraded

Note: For provisioning services, we define enhancement to mean increased production of the service through changes in area over which the service is provided (e.g., spread of agriculture) or increased production per unit area. We judge the production to be degraded if the current use exceeds sustainable levels. For regulating services, enhancement refers to a change in the service that leads to greater benefits

for people (e.g., the service of disease regulation could be improved by eradication of a vector known to transmit a disease to people). Degradation of regulating services means a reduction in the benefits obtained from the service, either through a change in the service (e.g., mangrove loss reducing the storm protection benefits of an ecosystem) or through human pressures on the service exceeding its limits (e.g., excessive pollution exceeding the capability of ecosystems to maintain water quality). For cultural services, degradation refers to a change in the ecosystem features that decreases the cultural (recreational, aesthetic, spiritual, etc.) benefits provided by the ecosystem.

[a] Indicates *low to medium certainty*. All other trends are *medium to high certainty*.

Figure 1. Extent of Cultivated Systems in 2000. Cultivated systems (defined by the MA to be areas in which at least 30% of the landscape comes under cultivation in any particular year) cover 24% of the terrestrial surface.

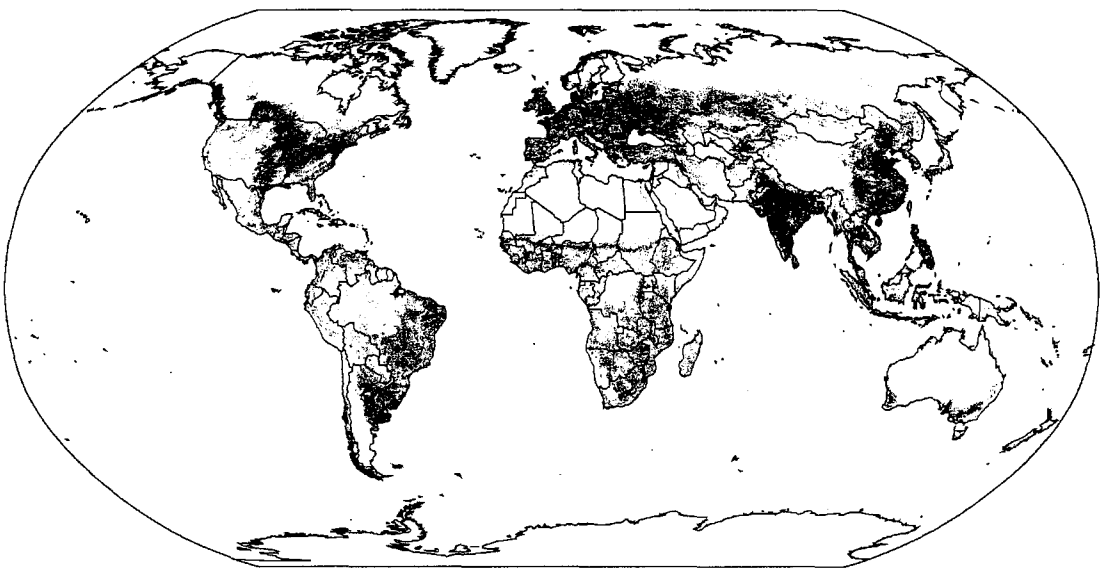


Figure 2. Locations reported by various studies as undergoing high rates of land cover change in the past few decades. (C.SDM) In the case of forest cover change, the studies refer to the period 1980-2000, and are based on national statistics, remote sensing, and to a limited degree expert opinion. In the case of land cover change resulting from degradation in drylands (desertification), the period is unspecified but inferred to be within the last half century, and the major study was entirely based on expert opinion, with associated *low certainty.*. Change in cultivated area is not shown. Note that areas showing little current change are often locations that have already undergone major historical change (see Fig 1)

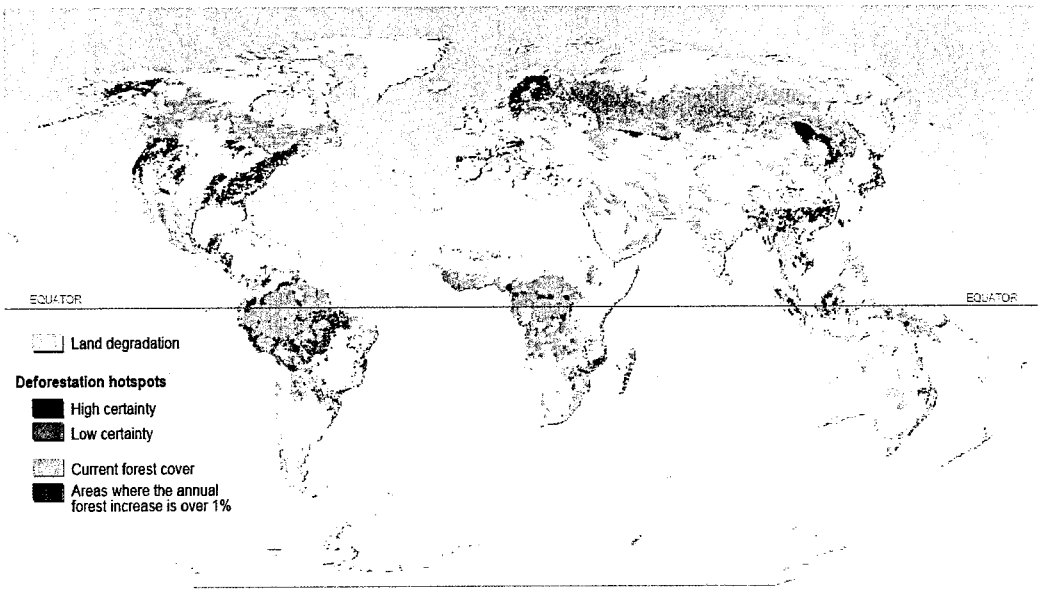
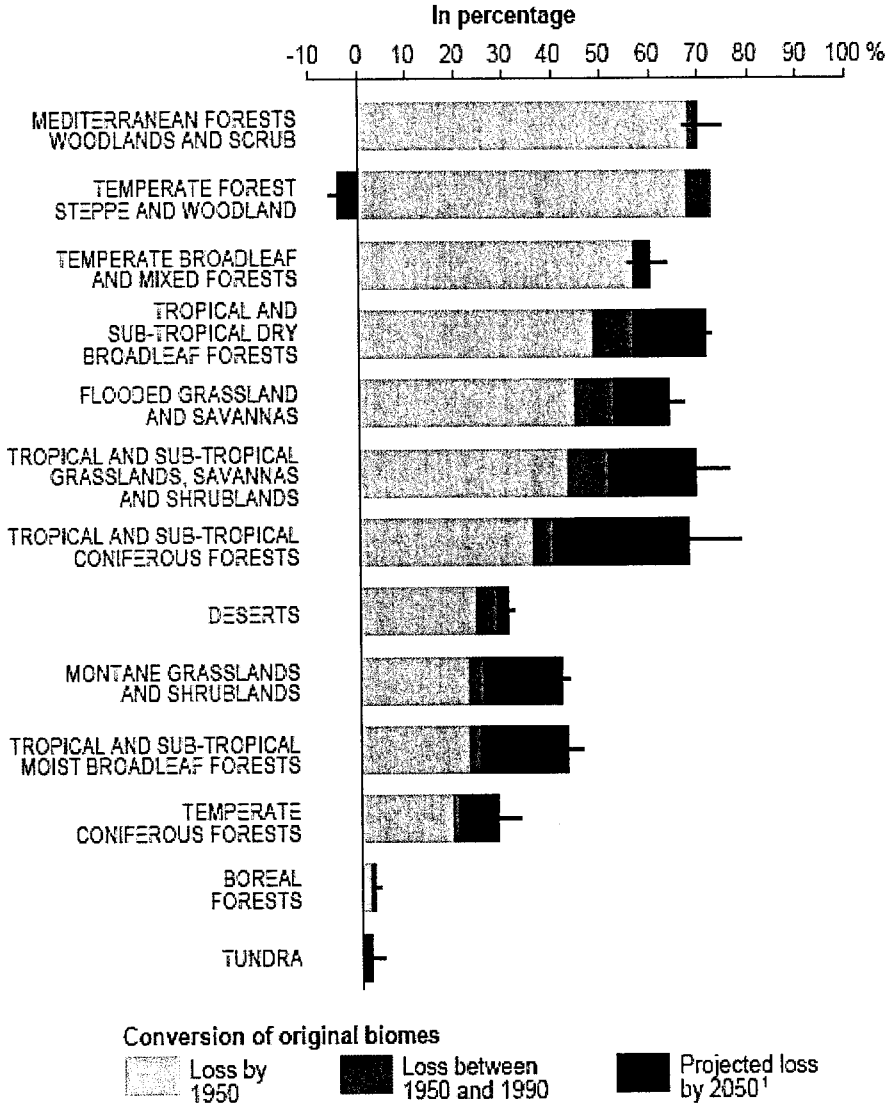


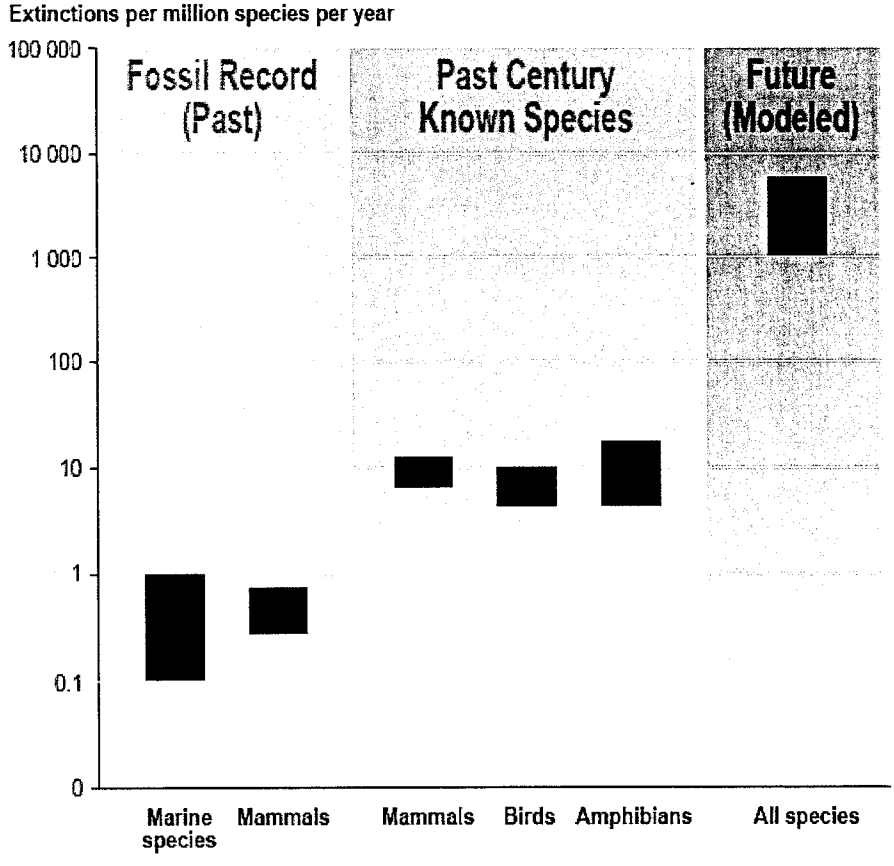
Figure 3. Conversion of Terrestrial Biomes. It is not possible to estimate accurately the extent of different biomes prior to significant human impact, but it is possible to determine the "potential" area of biomes based on soil and climatic conditions. This figure shows how much of that potential area is estimated to have been converted by 1950 (*medium certainty*), how much was converted between 1950 and 1990 (*medium certainty*), and how much would be converted under the four MA scenarios (*low certainty*) between 1990 and 2050. Mangroves are not included here because the area was too small to be accurately assessed. (Adapted from C4, S10) Most of the conversion of these biomes is to cultivated systems.



1. According to the four MA scenarios. For 2050 projections, the average value of the projections under the four scenarios is plotted and the error bars (black lines) represent the range of values from the different scenarios."

Source: Millennium Ecosystem Assessment.

Figure 4. Species Extinction Rates. (Adapted from C4 Fig 4.22) "Fossil Record" refers to average extinction rates as estimated from the fossil record. "Past Century—Known Species" refers to extinction rates calculated from known extinctions of species (lower estimate) or known extinctions plus "possibly extinct" species (upper bound). A species is considered to be "possibly extinct" if it is believed by experts to be extinct but extensive surveys have not yet been undertaken to confirm its disappearance. "Projected" extinctions are model-derived estimates using a variety of techniques, including species-area models, rates at which species are shifting to increasingly more threatened categories, extinction probabilities associated with the IUCN categories of threat, impacts of projected habitat loss on species currently threatened with habitat loss, and correlation of species loss with energy consumption. The time frame and species groups involved differ among the "projected" estimates, but in general refer to either future loss of species based on the level of threat that exists today or current and future loss of species as a result of habitat changes taking place over the period of roughly 1970 to 2050. Estimates based on the fossil record are *low certainty*; lower-bound estimates for known extinctions are *high certainty* and upper-bound estimates are *medium certainty*; lower-bound estimates for projected extinctions are *low certainty* and upper bound estimates are *speculative*. The rate of known extinctions of species in the past century is roughly 50 to 500 times greater than the extinction rate calculated from the fossil record of 0.1 to 1 extinctions per million species per year. The rate is up to 1000 times higher than the background extinction rates if possibly extinct species are included.



Sources: Millennium Ecosystem Assessment.

Figure 5. Estimated Global Marine Fish Catch, 1950–2001. (Fig C18.3) In this figure, the catch reported by governments is in some cases adjusted to correct for likely errors in data.

Figure 6. Decline in Trophic Level of Fisheries Catch Since 1950. (C18) A trophic level of an organism is its position in a food chain. Levels are numbered according to how far particular organisms are along the chain from the primary producers at level 1, to herbivores (level 2), to predators (level 3), to carnivores or top carnivores (level 4 or 5). Fish at higher trophic levels are typically of higher economic value. The decline in the trophic level harvested is largely a result of the overharvest of fish at higher trophic levels.

Figure 7. Trend in Mean Depth of Catch Since 1950. Fisheries catches increasingly originate from deep areas. (Data from C18 Fig. C18.5)

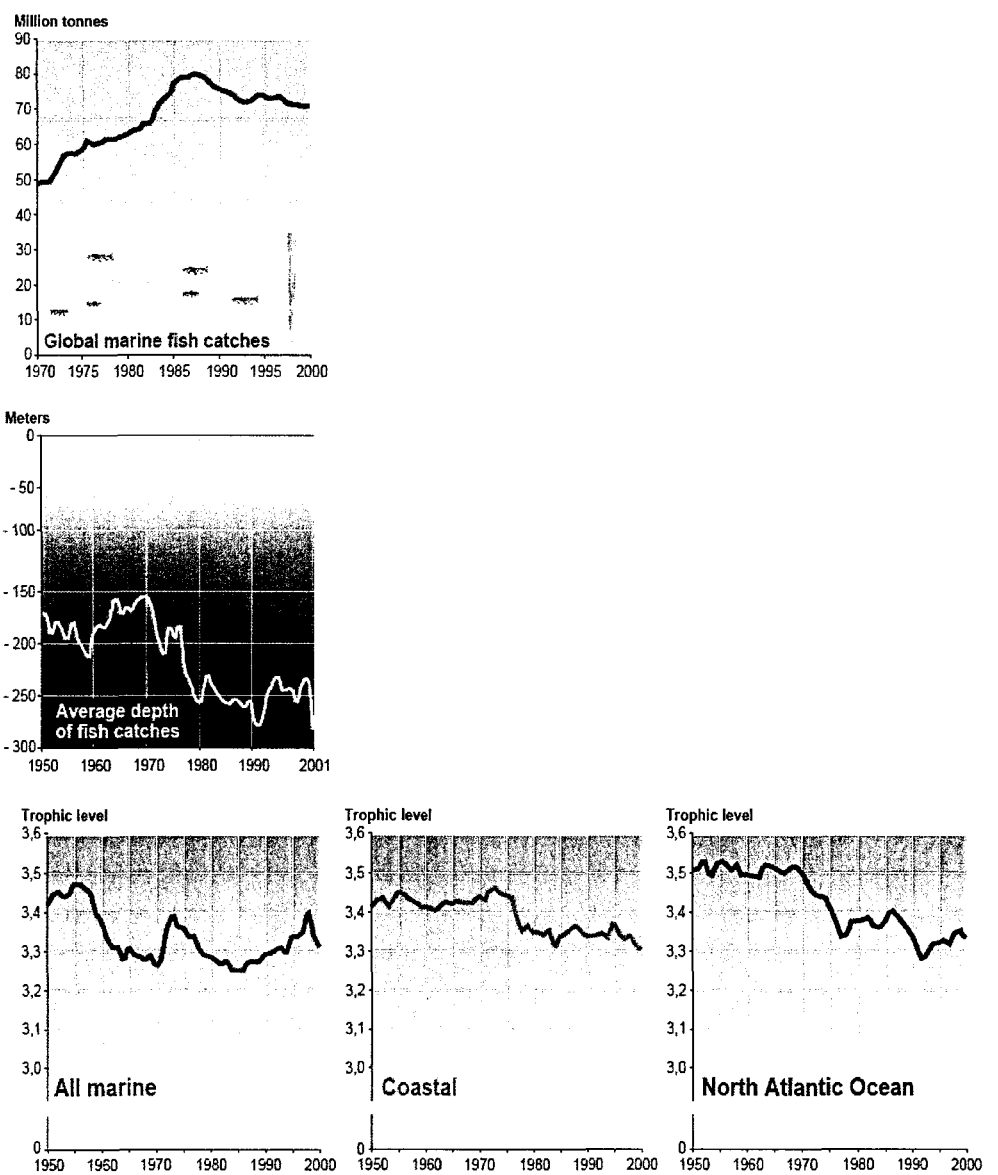


Figure 8. Annual Flow of Benefits from Forests in Selected Countries. (Adapted from C5 Box 5.1) In most countries, the marketed values of ecosystems associated with timber and fuelwood production are less than one third of the total economic value, including nonmarketed values such as carbon sequestration, watershed protection, and recreation.

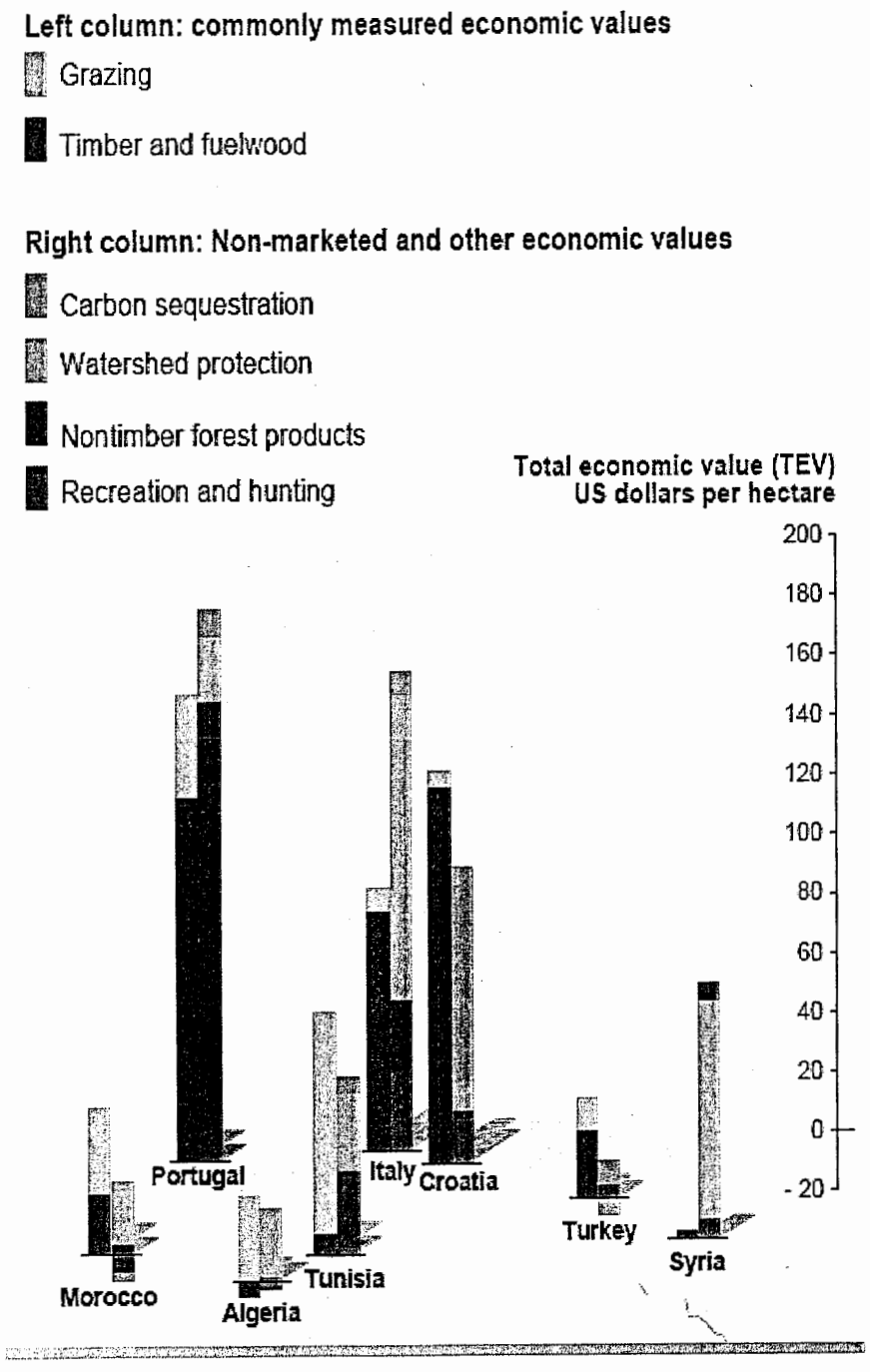
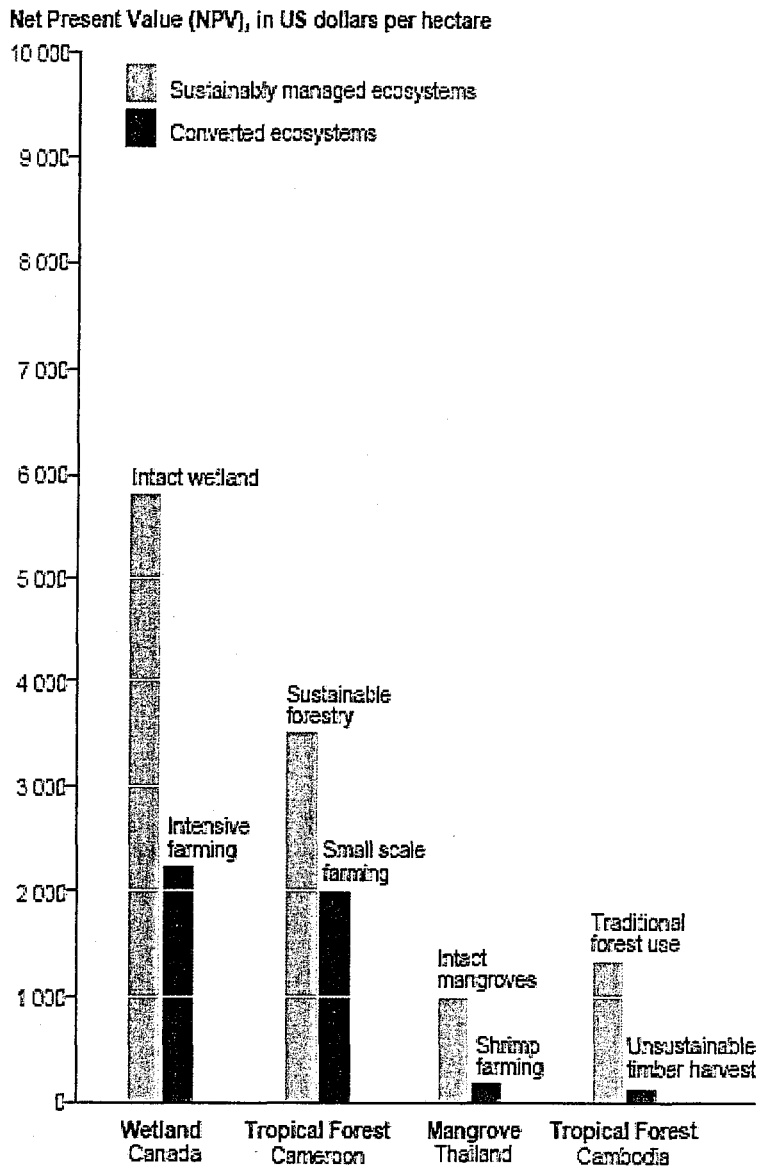


Figure 9. Economic Benefits Under Alternate Management Practices (expressed as net present value in dollars per hectare). (C5 Box 5.1) In each case, the net benefits from the more sustainably managed ecosystem are greater than those from the converted ecosystem even though the private (market) benefits would be greater from the converted ecosystem. (Where ranges of values are given in the original source, lower estimates are plotted here.)



Sources: Millennium Ecosystem Assessment.

Figure 10. Collapse of Atlantic Cod Stocks Off the East Coast of Newfoundland in 1992. (CF Box 2.4) This collapse forced the closure of the fishery after hundreds of years of exploitation. Until the late 1950s, the fishery was exploited by migratory seasonal fleets and resident inshore small-scale fishers. From the late 1950s, offshore bottom trawlers began exploiting the deeper part of the stock, leading to a large catch increase and a strong decline in the underlying biomass. Internationally agreed quotas in the early 1970s and, following the declaration by Canada of an Exclusive Fishing Zone in 1977, national quota systems ultimately failed to arrest and reverse the decline. The stock collapsed to extremely low levels in the late 1980s and early 1990s, and a moratorium on commercial fishing was declared in June 1992. A small commercial inshore fishery was reintroduced in 1998, but catch rates declined and the fishery was closed indefinitely in 2003.

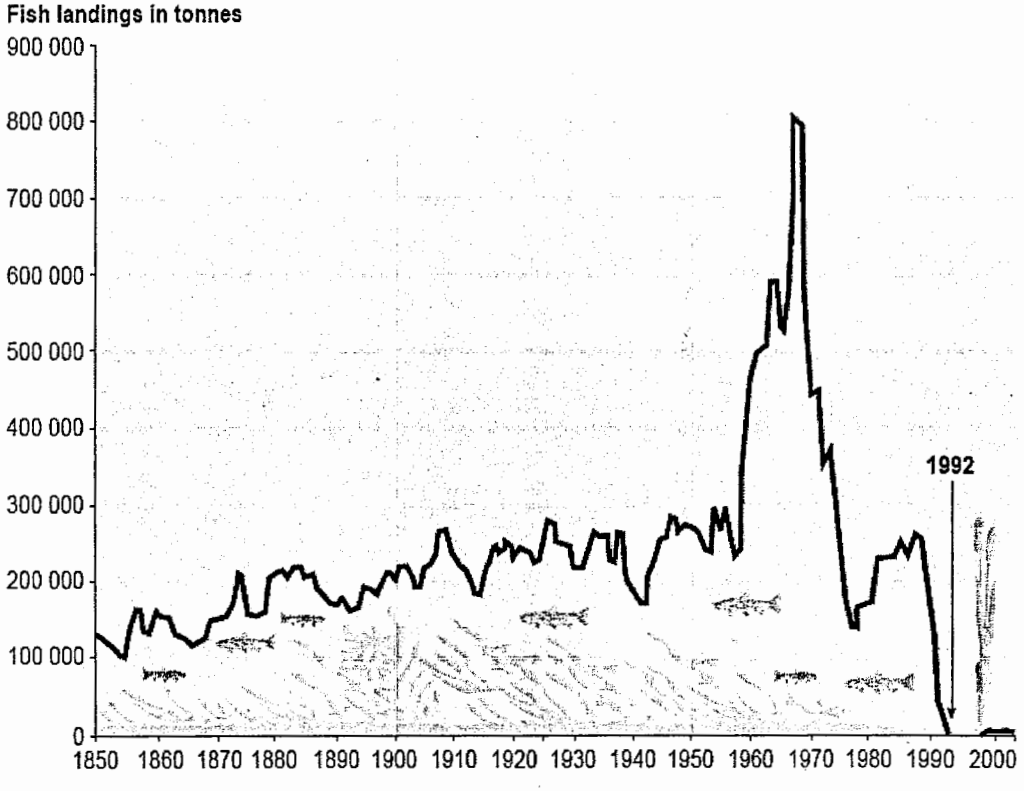
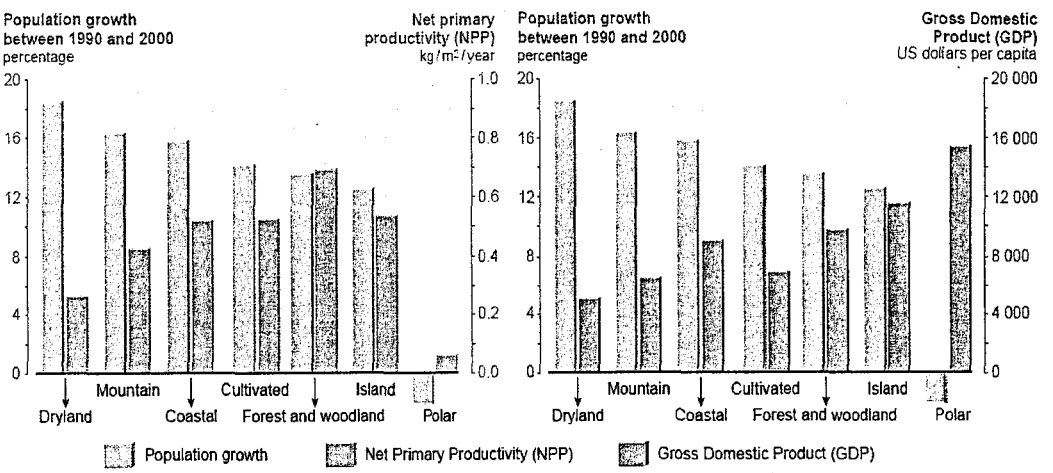
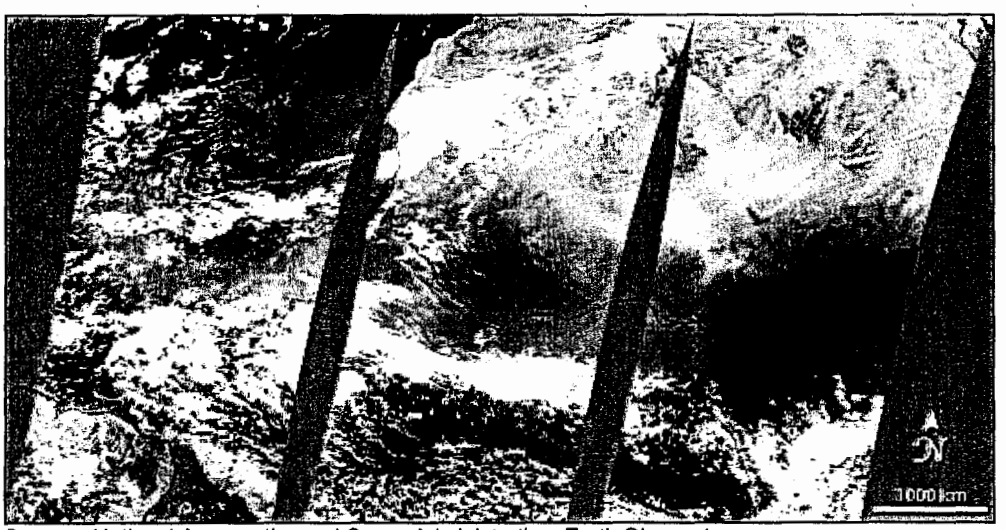


Figure 11. Human Population Growth Rates, 1990–2000, and Per Capita GDP and Biological Productivity in 2000 in MA Ecological Systems. MA systems with the lowest net primary productivity and lowest GDP tended to have the highest population growth rate between 1990 and 2000. Urban, inland water and marine systems are not included in this figure due to the somewhat arbitrary nature of determining net primary productivity of the system (urban) or population growth and GDP (freshwater and marine) for these systems.



Sources: Millenium Ecosystem Assessment; Running et al., 2004.

Figure 12. Dust Cloud Off the Northwest Coast of Africa, January 10, 2005. At the bottom left corner is northeastern South America. The dust clouds travel thousands of miles and fertilize the water off the west coast of Florida with iron. This has been linked to blooms of toxic algae in the region and respiratory problems in North America and has affected coral reefs in the Caribbean. Degradation of drylands exacerbates problems associated with dust storms. (Red dots in image are fires.)



Source: National Aeronautics and Space Administration, Earth Observatory.

Figure 13. Main Direct Drivers of Change in Biodiversity and Ecosystems. (CWG) The cell color indicates impact of each driver on biodiversity in each type of ecosystem over the past 50–100 years. High impact means that over the last century the particular driver has significantly altered biodiversity in that biome; low impact indicates that it has had little influence on biodiversity in the biome. The arrows indicate the trend in the driver. Horizontal arrows indicate a continuation of the current level of impact; diagonal and vertical arrows indicate progressively stronger increasing trends in impact. Thus, for example, if an ecosystem had experienced a very high impact of a particular driver in the past century (such as the impact of invasive species on islands), a horizontal arrow indicates that this very high impact is likely to continue. This figure is based on expert opinion consistent with and based on the analaysis of drivers of change in the various chapters of the assessment report of the MA Condition and Trends Working Group. The figure presents global impacts and trends which may be different from those in specific regions.

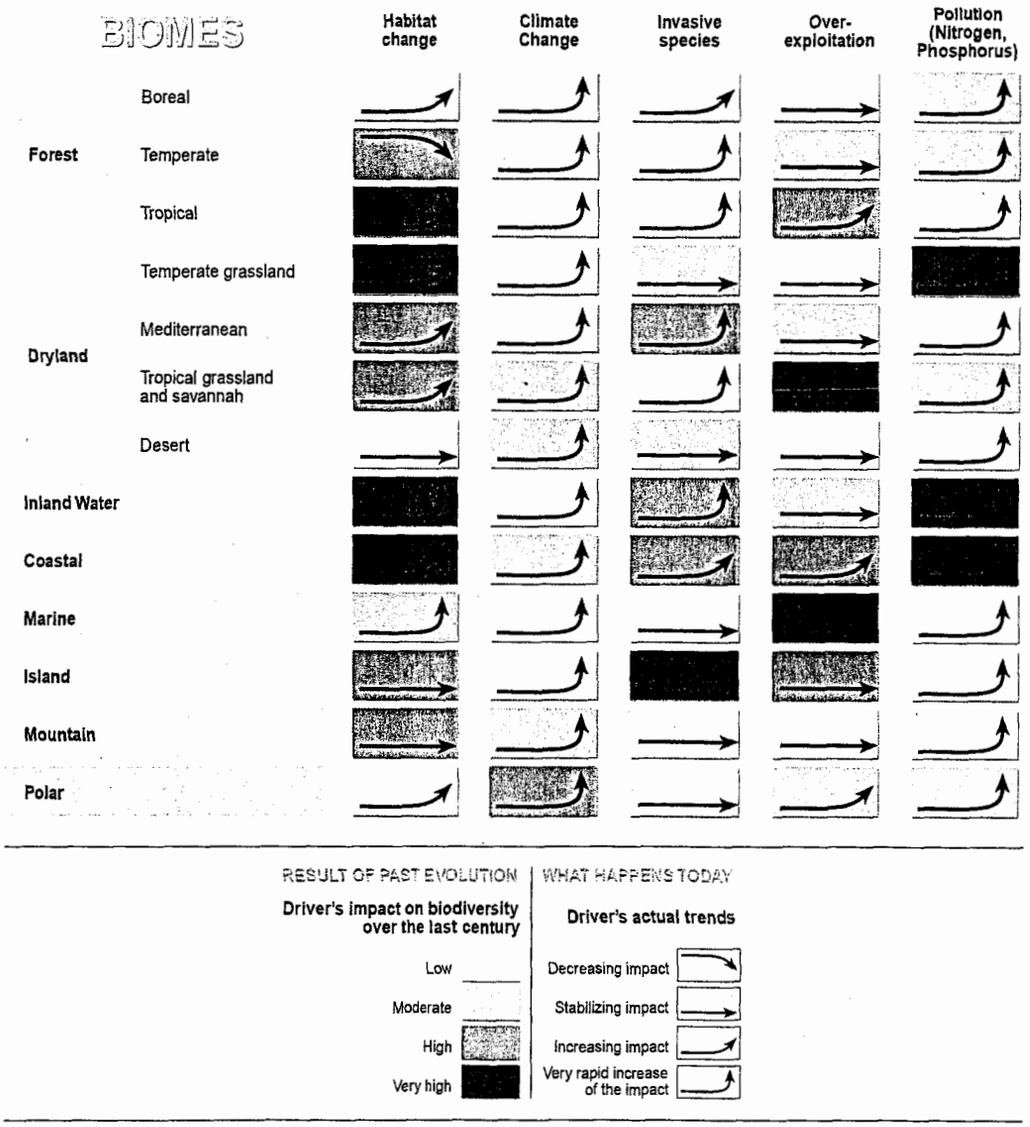


Figure 14. Global Trends in the Creation of Reactive Nitrogen on Earth by Human Activity, with Projection to 2050 (teragrams nitrogen per year). Most of the reactive nitrogen produced by humans comes from manufacturing nitrogen for synthetic fertilizer and industrial use. Reactive nitrogen is also created as a by-product of fossil fuel combustion and by some (nitrogen-fixing) crops and trees in agroecosystems. The range of the natural rate of bacterial nitrogen fixation in natural terrestrial ecosystems (excluding fixation in agroecosystems) is shown for comparison. Human activity now produces approximately as much reactive nitrogen as natural processes do on the continents (R9 Fig 9.1). (Note: the 2050 projection is included in the original study and is not based on MA Scenarios.)

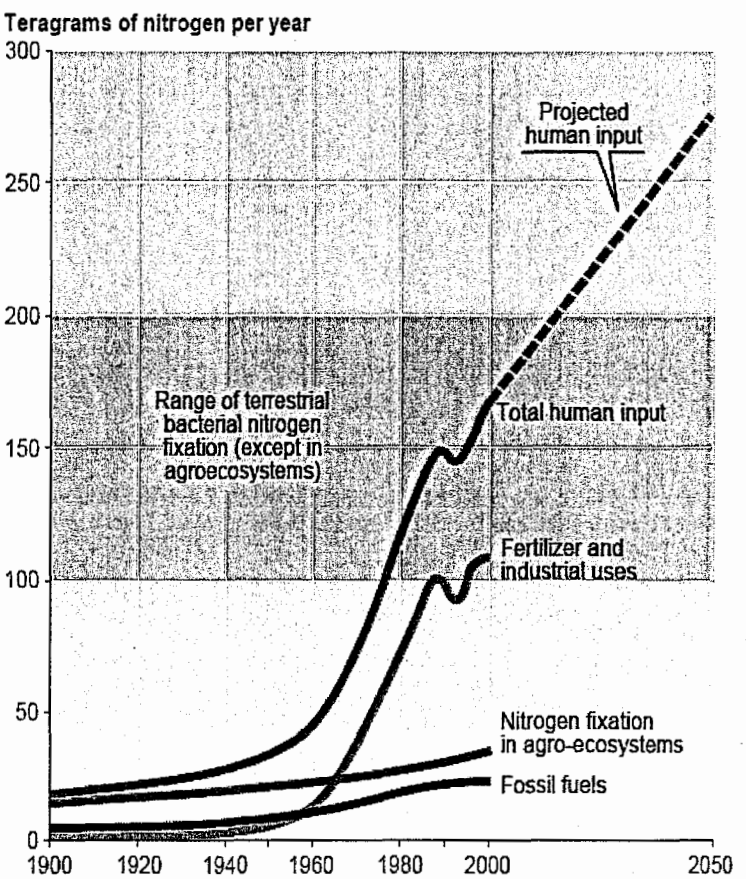
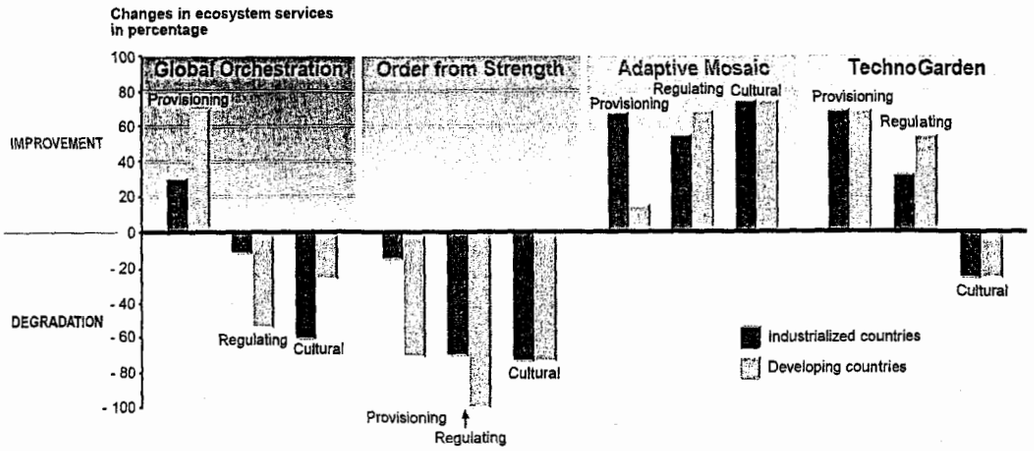


Figure 15. Number of Ecosystem Services Enhanced or Degraded by 2050 in the Four MA Scenarios (Expresed as a Percentage of the Total Number Evaluated in Each Category). Figure shows the net change in the number of ecosystem services enhanced or degraded in the MA scenarios in each category of services for industrial and developing countries expressed as a percentage of the total number of services evaluated in that category. Thus, 100% degradation means that all of the services in the category were degraded in 2050 compared to 2000, while 50% improvement could mean that five out of ten services were enhanced and the rest were unchanged or that six out of ten were enhanced and one was degrdaded. The total number of services evaluated for each category was six provisioning services, nine regulating services, and five cultural services.



2. Selected references in the Millennium Ecosystem Assessment to indigenous peoples

References are taken from the four MA reports: *Current State and Trends, Scenarios, Policy Responses and Multiscale Assessments*. Sections within each report are given in brackets.

1. Indigenous, Traditional, and Local Knowledge

Traditional knowledge (TK) broadly represents information from a variety of sources including indigenous peoples, local residents, and traditions. The term indigenous knowledge (IK) is also widely used referring to the knowledge held by ethnic minorities from the approximately 300 million indigenous people worldwide (Emery 2000). The International Council for Science defines TK as "a cumulative body of knowledge, know-how, practices and representation maintained and developed by peoples with extended histories of interaction with the natural environment. These sophisticated sets of understandings, interpretations and meanings are part and parcel of a cultural complex that encompasses language, naming and classification systems, resource use practices, ritual, spirituality and worldview" (ICSU 2002b). [Current State and Trends 2.2.5]

TK and IK are receiving increased interest as valuable sources of information (Martello 2001) about ecosystem condition, sustainable resource management (Johannes 1998; Berkes 1999; 2002), soil classification (Sandor and Furbee 1996), land use investigations (Zurayk et al. 2001), and the protection of biodiversity (Gadgil et al. 1993). Traditional ecological knowledge (TEK) is a subset of TK that deals specifically with environmental issues. [Current State and Trends 2.2.5]

Pharmaceutical companies, agribusiness, and environmental biologists have all found TEK to be a rich source of information (Cox 2000; Kimmerer 2000). TEK provides empirical insight into crop domestication, breeding, and management. It is particularly important in the field of conservation biology for developing conservation strategies appropriate to local conditions. TEK is also useful for assessing trends in ecosystem condition (Mauro and Hardinson 2000) and for restoration design (Kimmerer 2000), as it tends to have qualitative information of a single local record over a long time period. [Current State and Trends 2.2.5]

Oral histories can play an important role in the field of vulnerability assessment, as they are especially effective at gathering information on local vulnerabilities over past decades. Qualitative information derived from oral histories can be further developed as storylines for further trends and can lead into role playing simulations of new vulnerabilities or adaptations (Downing et al. 2001). [Current State and Trends 2.2.5]

However, TK has for a long time not been treated equally to knowledge derived from formal science. Although Article 27 of the Universal Declaration of Human Rights of 1948 protects Intellectual Property, the intellectual property rights of indigenous people have often been violated (Cox 2000). The Convention on Biological Diversity of 1992 for the first time established international protocols on the protection and sharing of national biological resources and specifically addressed issues of traditional knowledge. In particular, the parties to the convention agree to respect and preserve TK and to promote wide applications and equitable sharing of its benefits (Antweiler 1998; Cox 2000; Singhal 2000). [Current State and Trends 2.2.5]

The integration of TEK with formal science can provide a number of benefits, particularly in sustainable resource management (Johannes 1998; Berkes 2002). However, integrating TEK with formal science is sometimes problematic (Antweiler 1998; Fabricus et al. 2004). Johnson (1992) cites the following as reasons why integrating TEK is difficult:

- Traditional environmental knowledge is disappearing and there are few resources to document it before it is lost.

- Translating concepts and ideas from cultures based on TEK (mainly oral-based knowledge systems) into the concepts and ideas of formal science is difficult.
- Appropriate methods to document and integrate TEK are lacking, and natural scientists often criticize the lack of rigor of the traditional anthropological methods for interviewing and participant observation
- Integrating TEK and formal science is linked to political power, and TEK is often seen as subordinate.

Moreover, existing practices of TEK, such as forest management, are not necessarily sustainable (Antweiler 1998).

It has been repeatedly pointed out that if TEK is integrated it needs to be understood within its historical, socioeconomic, political, environmental, and cultural location (Berkes 2002). This implies that the ratio of local to scientific knowledge will vary depending on the case and situation (Antweiler 1998). The limitations and shortcomings of integrating TEK and formal science must be addressed, and the methods chosen to collect this knowledge should take the location-specific environments in which they operate into account (Singhal 2000). Integration can also be hindered by different representations of cross-scale interactions, nonlinear feedbacks, and uncertainty in TEK and formal science (Gunderson and Holling 2002). Due to this high degree of uncertainty, it is essential to validate and compare both formal and informal knowledge (Fabricus et al. 2004). [Current State and Trends 2.2.5]

There have been general concerns about scaling up TEK to broader spatial scales, as this traditional knowledge is seldom relevant outside the local context (Forsyth 1999: Lovell et al. 2002). Moreover, analysts warn of a downplaying of environmental problems when TEK is overemphasized. On the other hand, researchers have also warned that efforts to integrate or bridge different knowledge systems will lead inevitably to the compartmentalization and distillation of traditional knowledge into a form that is understandable and usable by scientists and resource managers alone (Nadasdy 1999). [Current State and Trends 2.2.5]

Despite these limitations, TEK—if interpreted carefully and assessed appropriately—can provide important data on ecosystem conditions and trends.

2. Equity Considerations in using indigenous intellectual property

There is potential conflict between the routine scientific documentation of traditional medicines and the protection of indigenous intellectual property. For example, knowledge on the use of over 1100 medicinal plant species known to Malaysian peoples, including the Iban, Bidayuh, Orang Ulu, Malay, Kadazan and Orang Asli, is now in the public domain so it is no longer possible to seek compensation for sharing knowledge. However, some organizations are considering whether or not indigenous knowledge in the public domain might be protected in some way, for example, through the deployment of indigenous knowledge databases or by citing local people as 'discoverers' and co-owners of patents. [Current State and Trends 10.3.3]

The CBD provides guidance on these issues. Article 8(j), for example, calls for a fair and equitable sharing of benefits with indigenous peoples when their ethnobotanical knowledge is utilised in drug research and development. Access to biological resources in some resource-rich countries is now regulated, for example, in the ASEAN countries of Malaysia, Philippines and Thailand, and in the Andean Pact countries of Bolivia, Colombia, Ecuador, Peru and Venezuela. Permit processing regulations include a formal application, contract negotiation and publication of the contract. Negotiations such as these are not easy and there has to be much good will on all sides for the views of the host countries and the research institutions and industrial organizations to be accommodated. An *ad hoc* open-ended Working Group on Access and Benefit Sharing was established by the Conference of the parties in 2004. The mandate of the Working Group is to

elaborate and negotiate an international regime on access and benefit sharing within the framework of the CBD. [Current State and Trends 10.3.3]

2.1 Evolution of the legal environment of intellectual property rights

Many significant changes in the legal and policy framework over the past decade have set the scene for better recognition of the rights of indigenous and local communities in transactions involving genetic resources and traditional knowledge. These changes include intergovernmental agreements, national measures, and codes, statements, and policies adopted by communities, researchers, and companies. Although implementation often remains a challenge, these have helped to make equitable relationships between local communities and indigenous peoples, and various outside groups more likely, and have influenced the language incorporated into national and international law and contractual agreements. A full presentation of approaches to protecting and transmitting local and indigenous knowledge can be found in *Current State and Trends,* chapter 10, section 10.4 and *Policy Responses*, chapter 14, section 14.3.2.

Over the past 20 years, indigenous peoples' organizations have issued a range of declarations and statements with clear demands in terms of bioprospecting. These demands include ownership and inalienable rights over their knowledge and resources; requirements for their prior informed consent; right of veto over research and or access to their land, knowledge, or resources; and benefit sharing. Such demands have led to calls for a moratorium on bioprospecting pending a legal framework for equitable partnerships (e.g see www.biodiv.org and http://users.ox.ac.uk/~wgtrr/decin.htm). [Current State and Trends 10.4.4]

2.2 Responses to Growing Demand for Indigenous Knowledge: Protection, Compensation, and Certification

The growing recognition of local indigenous knowledge has also led to its commercial exploitation. Market imperatives and international monetary policies have taken countries in the south to gear their economies towards export. In most cases, this has led to the exploitation of their natural resources beyond long-term sustainability. At the same time, the richness and possibilities of resources, for example medicinal herbs, and their possible economic benefits, became an important argument for the conservation of nature. The prospecting for local resources has led to exploitation of local knowledge without communities being compensated. Few mechanisms are available, to feed the benefits back to local communities that in many instances contributed to the production of the knowledge concerning certain species, or even the production of the species themselves. [Policy Responses 14.3.2]

2.2.1 "Best-Practices"

Though very important lessons can be learnt from diverse experiences in local communities, it should be noted that local and indigenous knowledge evolves in specific contexts and one need to be very careful with de-contextualizing it. This applies to several types of responses aiming at addressing issues of "knowledge systems" and environmental management. Conventional "best-practices" methods focusing on content may not be the best way to deal with local/indigenous knowledge. A content-based best practices approach is based on the assumption that it is possible to objectively validate or disqualify local knowledge. Yet, the question arises what indicators can be used to determine whether a practice is a "best practice"? Who decides what a best practice is? There are many aspects that determine whether a practice is a best practice such as economic performance, improvement of individual rights, the range of beneficiaries, and its sustainability over time. The social and economic context is important, since it defines who benefits from opportunities opened up by particular development programs and what factors constrain local participation. Basic issues such as land tenure conflicts and rights, institutional organization, farmer's and fishermen's access to basic services, and markets for their products, need to be considered. [Policy Responses 14.3.2.2]

2.2.2 Compensating for knowledge

Compensation for the use of local and indigenous knowledge by third parties is an important, yet complicated response (Moran 1999). Given the way in which such knowledge is produced, determining who owns what knowledge may not be easy. The distribution of knowledge varies according to type, use, and access to resources. Some knowledge may be shared and produced by numerous local communities (Reyes-Garcia et al. 2003). In other cases, production and diffusion of knowledge may be restricted to certain groups or individual within communities (Moran 1999). Local authority structures are important, but not the only factor, that needs to be taken into account in deciding, in close co-operation with local communities, who should be responsible for distributing benefits. As remarked above, local and indigenous knowledge may concern different domains and may be produced by different individuals or groups within communities. Though possessing certain knowledge may enhance someone's position in society, the idea that powerful people within communities are related to or responsible for local and indigenous knowledge is not necessarily correct. Thus, the popular idea that local and indigenous knowledge can be promoted by strengthening "traditional" authorities may not be valid in many cases. Such a strategy is not always "innocent", both governments and enterprises may find it easier to deal with such authorities than with whole communities (Ribot 1999). [Policy Responses 14.3.2.3]

Furthermore, the distribution of benefits is influenced by the particular articulation of relations between companies that seek local and indigenous knowledge, national legislation, and authority structures and regional government bodies (Schutz 1970, Berger and Luckman 1971, Laird 1994). [Policy Responses 14.3.2.3]

2.2.3 Responses Changing Resource Ownership and Control

Control over resources is another crucial issue that influences the distribution of benefits derived from local/indigenous knowledge. Various tenurial options exist that relate to co-management, joint ventures, and the creation of conservation and sustainable management units to assign forms of land tenure rights to communities. Factors such as historical land tenure control, complexities of local institutional arrangements, and types of resource uses, all play a role. While guaranteeing tenure rights and access to resources to particular groups, legislation may constrain the level of flexibility to allow changes in production system, adoption of new technologies, accommodation to population increases, and higher pressure over particular resources. For instance, communities that are "allowed to stay" in conservation areas are often forbidden to carry on or increase their agricultural activities (West and Brechin 1991, Stevens 1997, Agrawal and Ostrom 1996, Mcgraph et al. 1998, National Research Council 2002). [Policy Responses 14.3.2.4]

Uncertainty concerning tenureship not only poses problems for the distribution of benefits, but also for strategies that are becoming more and more common, for example reinforcing traditional leadership to conserve local and indigenous knowledge. The link that is not always made explicit is that communities do need control over natural resources, but whether this should be through traditional leadership remains to be seen and depends on the local context and history. Local government institutions that are democratically elected and have real authority over resources may be in some cases a better option. Yet, there is a tendency among many governments to shift responsibilities back and forth between "traditional" authorities and local government bodies, without giving any of them real decision-making powers. This decreases communities' control over resources, and increases central government's control, often undermining the efforts of both sides (Ribot 1999, Spierenburg 2003). Another problem concerns the control over territories that contain resources deemed of national importance such as oil and minerals. In most cases central governments refuse to devolve authority over such resources. [Policy Responses 14.3.2.4]

2.2.4 Certification Programs

Certification programs have emerged as tools to control the source and distribution of particular products and their means of extractions (Zarin et al 2004). Examples include forest products, fisheries, and agriculture. The criteria taken into account are biological and ecological

components of production areas and ecosystems, approved management plans and environmental impact assessments, compliance with national legislation, and the participants involved, among other issues. Less attention is given to the impact of particular resource extraction upon people/communities in those areas using the same resource basis. Sustainable forest certification ensures that wood products that are being sold to the consumers have gone through a checklist to guarantee that they meet the standards set by the certification process (Certified Forest Products Council, 2002). Although this is a very positive response, many communities, however, do not have access to certification programs for their products or are not aware of their existence, thus limiting their participation in a growing market. In addition, the financial costs involved in establishing a certification program reduce the chances for local communities to be able to participate independently. Capacity building at the local level to prepare, implement, and monitor certification programs could be implemented alongside the regulations requiring certification in international markets. [Policy Responses 14.3.2.5]

2.2.5 "Fair Trade"

"Fair trade" is a long-lasting movement initiated to help disadvantaged or politically-marginalized communities, aimed at paying better prices and providing better trading conditions, along with raising consumers' awareness of their potential role as buyers. Yet, from the early 1990s, fair trade began to overlap with initiatives focusing on the environmental performance of trade (Robins 1999). Among the inheritor perspectives is the so-called "Rainforest Harvest", which focuses on the conservation of tropical forests and their dwellers. Proposed in the late 1980s by Jason Clay, the "Rainforest Harvest" centered on helping indigenous and other rainforest communities. The baseline argument was that the introduction of fair and environment-friendly markets was a powerful approach to protect people's standards of living and promote their empowerment (Clay 1992). Prompted by conservationists and indigenous advocacy groups, and made possible by consumers' interest, a series of trade initiatives began to be installed. This is also combined with the concerns over environmental management by indigenous and rural communities, linking issues of social justice and recognition of the stewardship of these communities over natural resources. Though this is a very positive response, care should be taken of the issues already mentioned in relation to the benefits generated by local and indigenous knowledge. Furthermore, successful fair trade initiatives depend upon local skills concerning market negotiations as well as leveling skills vis-à-vis middlemen and retailers. Commodities such as coffee, while experiencing a growing market, have seen decreasing prices due not only to increase in production (the "Viet Nam factor"), but also as a function of the centralized control of stocks by a handful of companies. Shortening the commodity chain between producers and consumers is one of the most notable contributions to rural development that may allow communities to increase their income and to value their resources and production systems. [Policy Responses 14.3.2.6]

3. Loss of Traditional Knowledge

Losses of traditional knowledge of biological resources in recent centuries has been well documented and it is very likely that much local knowledge of medicines has been lost to humanity in general and to pharmaceutical prospecting in particular (Laird, 2002). The current situation has been reviewed by Maffi (2001) and there is a growing literature on the issue, (e.g., Mathooko (2001) and other publications from the International Society of Ethnobiology), that documents global losses in traditional knowledge of biological sources worldwide, especially as older generations are unable, for various reasons, to pass on their wisdom to the next generations. [Current State and Trends 10.5.2]

Loss of traditional knowledge systems has many direct and indirect effects on ecosystems and human welfare. The loss of traditional knowledge has a direct effect on the depletion of fauna and flora and the degradation of the habitats and ecosystems generally. For example, in the transmigration programme in Indonesia the traditional knowledge of the transmigrant is of no

value under the changed ecological situation, leading to adoption of wrong technologies ending up in land degradation (Whitten et. al. 1987). Traditional is knowledge is largely oral and there is significant loss every time an old person dies without leaving a record of what they know. Equally significant is the loss of languages, which are the vehicle by which cultures are communicated and reproduced. It is estimated that more than 5000 linguistic groups contain the (traditional) knowledge of humankind, many of which may disappear by 2020. Traditional knowledge is a key-element to sustainable development, particularly in relation to plant medicine and agriculture, which may offer solutions and cures to pandemics such as AIDS and cancer, and many other health problems that are emerging with globalisation. [Current State and Trends 17]

4. Vulnerable People

Globalization is contributing to natural hazard vulnerability as it is changing the sensitivity and coping options available (Adger and Brooks 1003, Pelling 2003). On an international scale, increasing connectedness is causing societies to become more dependent on services and infrastructure "lifelines." In such a connected world the consequences of natural disaster reach far beyond the area physically damaged. It has been estimated that the possible extent of damage caused by a extreme natural catastrophe in one of the megacities or industrial centers of the world has already attained a level that could result in the collapse of the economic system of entire countries and may even be capable of affecting the financial markets worldwide (Munich Re 2000; Munich Re 2002). Globalization has also increased the risks faced by marginalized indigenous peoples; and many of these are developmental effects that will become apparent over only the long term. Traditional coping mechanisms have come under severe pressure, and adaptation strategies, at one time effective, can no longer cope (Pelling 2003). [Current State and Trends 6.5.2]

Political and social marginalization, gendered relationships, and physiological differences are commonly identified variables influencing vulnerability, but incorporating this conceptual understanding in global mapping remains a challenge. Because many indigenous peoples are less integrated into political and social support systems and rely more directly on ecosystem services, they are likely to be more sensitive to the consequences of environmental change and have less access to support from wider social levels. [Current State and Trends 6.3.3]

The continuing over-consumption of natural resources is resulting in erosion of time-tested and value-based institutions in many societies. Among the most powerful forces that influence both local cultures and ecosystems are various government policies and expansion of national, regional and international markets that stimulate privatisation of land and aim to 'fix' populations in space, leading to loss of traditional lifestyles (eg. pastoralists and nomadic peoples). For example, central government policies in Somalia in the 1970s and 1980s sought to 'settle' semi-nomadic groups so they could be better 'controlled' and provide taxes to government. Another example is goverment policies that are driven by international market forces determining coffee prices leading to extension of coffee plantations into dried zones that are ecologically unsuitable for coffee production in the Western Ghat region in southern India, leading eventually to abandonment of the plantations and forest degradation (Ramakrishnan et. al., 2002). [Current State and Trends 17.2.1.2]

5. Linking Knowledge Systems for Everyone's Benefit

To achieve conservation and sustainable use of ecosystems, 'traditional' and 'formal' knowledge systems need to be linked. There is an emerging need and opportunity for building bridges between the 'traditional' and the 'formal' knowledge systems to improve quality of human life. The complex relationships that exist between ecological systems and cultural systems can be understood only by linking our 'formal knowledge' system, based on a hypothetical-deductive approach and inductive reasoning to understand ecosystems, with the 'traditional knowledge' system, derived through societal experiences and perceptions. Our understanding of the tangible benefits derived from traditional ecological knowledge (TEK) such as medicinal plants and local species of food is relatively well developed. However, our knowledge of the

linkages between ecological processes and social processes, and their tangible and intangible benefits (such as spiritual and religious values), and the influence on sustainable natural resource management at the landscape level needs to be strengthened. [Current State and Trends 17]

5.1 Knowledge Systems

Language, knowledge, and the environment have been intimately related throughout human history. Local and indigenous languages are the repositories of traditional knowledge about the environment and its systems, its management and conservation, which in the contemporary context needs analysis and validation (Figure 17.1). (Ramakrishnan, 2001; Ramakrishnan, et al., 2004). [Current State and Trends 17.2.1.1]

Approximately two-thirds of the world's languages are linked with forest-dwellers; indeed, almost 50% of all languages are spoken in tropical/sub-tropical moist broad-leaved forest biomes (www.terralingua.org). Further, nearly 24% of all languages are spoken in tropical and sub-tropical grassland, savannah and shrubland biomes. But just as with species, the world is now undergoing a massive extinction crisis of languages and cultures. At present, the greatest losses are occurring in high-risk situations, such as where languages are not officially recognized, populations are marginalized by rapid industrialization, globalization, depopulation, poor health, low literacy or considerable ecosystem degradation. Especially threatened are the languages of indigenous peoples who number 350 million (representing over 5000 linguistic groups in 70 countries) according to a special UNESCO meeting in New York in May 2004 (www.unesco.org/culture/indigenous). It is estimated that there are more than 5000 indigenous linguistic groups, representing over 350 million people (see section 17.2.1), which contain most of humankind's traditional knowledge. Many of these linguistic groups may disappear by 2020 (United Nations, 2004), which is an important obstacle to finding pathways for more sustainable ecosystem management (Berkes et al., 2000). It is also true that much of the traditional knowledge that existed in Europe (such as knowledge on medicinal plants) has gradually eroded due to rapid industrialization of the past century (Hughes, 1998). [Current State and Trends 17.1.3, 17.2.1.1]

There is an increasing recognition of the validity and importance of farmers' knowledge of ecosystems, species, germplasm, and soils (Brush and Stabinsky 1996). Similarly, numerous studies have demonstrated the importance of local and indigenous knowledge on aquatic systems (Dyer and McGoodwin 1994). Nevertheless, the drive for modernization and technological change is often based on the substitution of small-scale practices. Understanding of crop and forest biodiversity lies in the oral history and cultural memory of local and indigenous communities, but is frequently disregarded as backward and unneeded. The pace of technological, agricultural, and environmental change, large-scale environmental modification by infrastructure development often happens at the expense of local resources and knowledge. While this has an impact on local food security and economies, it is also relevant to (national and international) issues of conservation and economy. Priorities for economic development are often based on technological modernization (such as monoculture and industrial fishing) and frequently contradict policies to promote local and indigenous knowledge, conservation of germplasm, and local management strategies. Despite their productivity, local technologies are often perceived as extensive when compared to high-input production systems. While technological change may contribute to increased food production, one needs to be careful with substituting local technologies, knowledge, and forms of production. This does not automatically mean that one or the other is better; one should avoid extremes of either dismissing or idealizing both forms of knowledge, technology, and production systems (Netting 1993, Brondizio and Siqueira 1997, Posey 1998, Nazarea 1998, Pinedo-Vasquez et al. 2001, Zarin et al. 2004). [Policy Responses, 14.3.1]

Science tries to replace "haphazard" experimentation by controlled experiments that are context-independent and thus more widely applicable. This is one of the reasons why governments and development agencies have long favored "scientific" solutions, and where they have become interested in local knowledge, often try to de-contextualize it by compiling "best practices" that

can be disseminated to other parts of the country or even the world. Scientists who do acknowledge the existence of local knowledge generally apply scientific methods to verify and validate the knowledge to reach a wider acceptance in policy and academic communities. [Policy Responses 14.3.1]

Most farmers, indigenous or not, draw upon different sources of knowledge and integrate different technologies and techniques that best fit their interest, needs and conditions (Reij and Waters-Bayer 2001, Scoones 2001). Experimentation and diffusion of knowledge are central tenets of livelihood strategies at any level (Barlet 1982, Netting 1993). [Policy Responses 14.3.1]

5.2 Developing Responses to Decreases in Ecosystems Services and Human Well-Being in an Integrated Manner

Despite changes in perceptions of nature–human links (for example, people and parks debate), many policies and economic incentives concerning management systems and conservation strategies are still based on separating people from their environments, freezing, and stereotyping both cultures and ecosystems. Such policies have a limited success in addressing the linkages between ecosystem functioning, development, and human well-being. There is a range of possibilities of interactions between humans and nature. Responses concerning economic development and conservation strategies need to take into account the historical, political, economic and cultural contexts of these interactions. It is only too common to lay the responsibility for environmental problems and conservation either in the hands of local communities or blame the private sector, while disregarding the linkages between local, national, and international policies and economic pressures. Overcoming the idealization of cultures and the dichotomic view of local communities as either "noble" or "bad" is equally important to promote sustainable responses to ecosystem management and development. Recognizing various types of knowledge (scientific, local, indigenous), their role in conservation, production systems, and management strategies may help to avoid the extremes of either dismissing local perceptions, practices, and knowledge as "un-scientific" and harmful, or idealizing them. [Policy Responses, chapter 14]

The literature shows that conditions that favor better outcomes of environmental management tend to include: representative participation and governance, clear definition of boundaries for management, clear goals, and an adaptive strategy, flexibility to adjust to new contexts and demands, and clear rules and sanctions defined by participants. In this context, any process related to ecosystem management and economic and human development is mediated by given land tenure conditions that influence the distribution of benefits derived from local and indigenous knowledge, innovations, and practices. Co-management, joint ventures, and other forms of control of resources are nested within historical conditions of land tenure control, the nature of the resources, and institutional arrangements. Hence, these forms of management are more likely to be successful if they accommodate changes and are flexible to changes in production systems and markets. [Policy Responses, chapter 14]

Fostering the articulation of international and national conventions and regulations linking biodiversity and local and indigenous knowledge is important, taking into account that knowledge is produced in the dynamic context of inter- and intra-group interactions, power relations, and historical settings. Responses such as compensating for the utilization of local and indigenous knowledge and resources entails taking into account relations between companies, national and regional governments, and communities as well as the power dynamics of these relations. Responses such as certification programs are more likely to be effective in addressing local economies and human well-being if they take into account the impact of particular resource extraction upon people and communities using the same resource basis, but not necessarily sharing resource ownership. Certification programs are better served if accessible to communities and small producers' co-operations that often are not familiar with bureaucratic and costly procedures of certification. Responses such as "Fair Trade" tools are more effective if they promote the participation of local producers in processes of commercialization and price

negotiations, the transformation and retailing of their products. Such responses are not only important for rural development and the conservation and management of natural resources, but also for commercial enterprises retailing the local producers' products. [Policy Responses, chapter 14]

Eco-, cultural, and agro-tourism can provide important opportunities to link conservation and development. However, as the literature suggests, these forms of tourism are not necessarily the same thing as community-based tourism. Community-based tourism entails institutional capacity building in marketing and negotiation, defining access to benefits, and representative participation in decision-making processes of community members, tourism operators, and government agencies. Conflicts about resource use, development of infrastructure, the conversion of ecosystems, and dispossession of communities have negative impacts on the possibilities of eco-tourism contributing to human well-being and economic development. In cultural tourism, problems may emerge in the representation and ownership of cultural symbols, the reproduction of stereotypes, consent among and within communities, and the blurring of boundaries between the public and private. In both forms of tourism, economic incentives and credit programs to foster tourism activities and capacity building could benefit from representative participation of local communities. The risks and opportunities provided by tourism are related to the economic position of communities and relations of power. Economic deprivation can lead to over-exploitation of resources and accepting unfavorable positions in the tourism industry (low-skilled labor, sex industry, drugs). Increase in land use value for tourism real estate development purposes may lead to displacement and dispossession. This is especially a risk for communities that enjoy informal or communal land rights. [Policy Responses, chapter 14]

5.3 Issues of Particular Relevance to Indigenous Communities: Bioprospecting & Forest Management

5.3.1 Benefit Sharing and Partnerships in Ethnobotanical Bioprospecting

Historically, much corporate drug discovery has depended upon indigenous knowledge delivered to modern science through ethnobotany. For example, in Europe, aspirin was first isolated from *Filipendula ulmaria* because it had long been used in folk medicine to treat pain and fevers. Farnsworth et al. (1985) showed that at least 89 plant-derived medicines used in the developed world were originally discovered by studying indigenous medicine. Among the best known is quinine, used in South America to treat fever. It has been the single most effective cure for malaria. Quinine comes from the bark of trees of the genus *Cinchona* that grow in the Andean region. More recently the drugs vincristine and vinblastine were discovered in the rosy periwinkle (*Catharanthus roseus*) from Madagascar. When the Eli Lilly company studied this plant they found that the periwinkle had anti-cancer properties. Vincristine has given children with leukaemia a likelihood of remission, and vinblastine has cured many people with Hodgkin's disease. [Current State and Trends 10.2.3]

Benefit sharing and the creation of partnerships within the diverse bioprospecting industries can be both complex and time-consuming. Since many legal issues were largely clarified at the Convention on Biodiversity (CBD), the protection of the rights of indigenous communities and source countries has often created tensions with the investment sector concerned with altered levels of returns and profitability (Dalton, 2004). The chain of events leading to sales frequently involves multiple stages that include generating the appropriate knowledge, harvesting, processing, manufacturing and distribution. Accordingly, the economics of each stage vary greatly and assigning and protecting intellectual property is often an underlying factor. However, when agreements are reached, the types of benefits are varied and may include benefits to society such as increased food production, better health and cleaner environments; benefits to the local suppliers such as employment, training and capacity-building, and benefits to local, regional, national or international corporations in the form of profits. Most current partnerships also emphasise the benefits of biodiversity conservation. [Current State and Trends 10.3.1]

Examples of national and international agreements and partnerships on ethnobotanical bioprospecting can be found in *Current State and Trends*, chapter 10, section 10.3.2.

5.3.2 The Importance of Forests to Indigenous Peoples

In planning and managing ecosystems, a balance between the provision of cultural and amenity services needs to be found. Due to changing cultural values and perceptions, there is an increasing tendency to create landscapes with high amenity values at the expense of traditional landscapes with high cultural and spiritual values. The remaining traditional landscapes require urgent protection in order to create diversified landscape systems that contribute towards strengthening buffering mechanisms and reduce the vulnerability of ecosystems and human society to environmental change. [Current State and Trends 17]

The 60 million indigenous people who live in forest areas are especially dependent on forest resources and the health of forest ecosystems. Utilization of forest resources, on its own, can rarely lift these people out of poverty, but forest destruction may make their life harder. [Current State and Trends, chapter 21]

Forests play important cultural, spiritual and recreational roles in many societies. For many indigenous and otherwise traditional societies, forests play an important role in cultural and spiritual traditions and, in some cases, are integral to the very definition and survival of distinct cultures and peoples. Forests also continue to play an important role in providing recreation and spiritual solace in more modernized, secular societies, and forests and trees are symbolically and spiritually important in most if not all of the world's major religious traditions. [Current State and Trends, chapter 21]

From 150 to 200 million people belonging to indigenous groups in over 70 countries, mostly in tropics, depend on NWFP to sustain their way of life including their culture and religious traditions (CIDA 1998). China dominates world trade in NWFP (estimated at $11 billion in 1994), followed by India, Indonesia, Viet Nam, Malaysia, the Philippines and Thailand (Iqbal 1995). [Current State and Trends 21.5.4]

Institutional factors are also frequently important, and are closely tied to economic drivers of deforestation. These may involve formal pro-deforestation policies and subsidies (e.g. for colonization, agricultural expansion or logging) as well as "policy failures" such as corruption or forestry sector mismanagement. Property rights issues, although much discussed in the deforestation literature, were only a major indirect driver in the cases Geist and Lambin analyzed for Asia, and tended to have an ambiguous effect on forest cover: both tenurial insecurity (e.g. open access conditions, denial of indigenous land rights) and the legalization of land titles (enhanced tenurial security) were reported to influence deforestation in a similar manner. While property rights issues may not be the most dominant factors driving deforestation, it is widely recognized, however, that clear property rights are a fundamental basis for instituting sustainable forest management. [Current State and Trends 21.6.1]