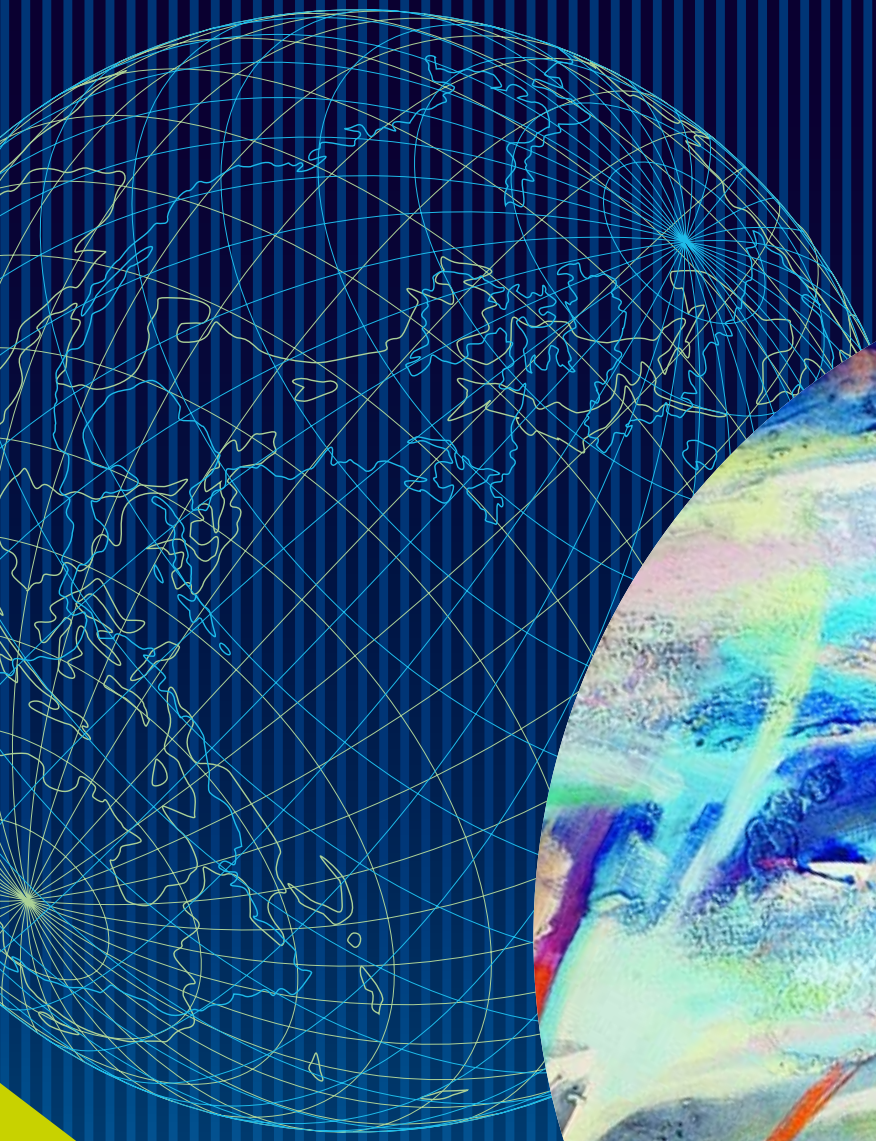
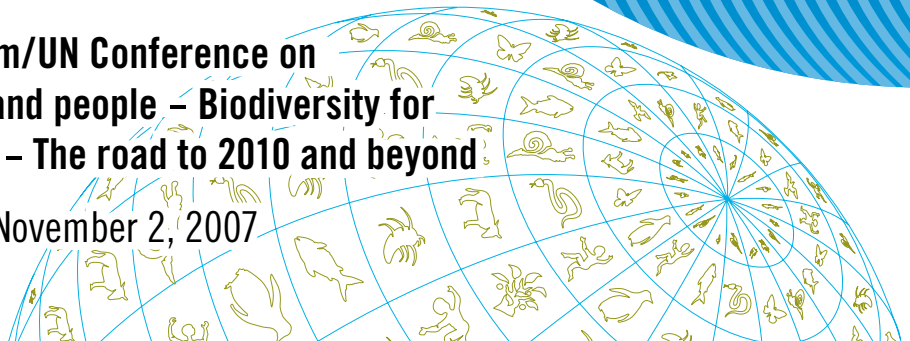


conference proceedings

The Trondheim/UN Conference on Ecosystems and people – Biodiversity for development – The road to 2010 and beyond

October 29 – November 2, 2007



TRONDHEIM CONFERENCES ON BIODIVERSITY

Proceedings of the
Norway/UN Conference on Ecosystems and People
– Biodiversity for development – The road to 2010 and beyond

Trondheim, Norway, 29 October – 2 November 2007

Edited by
Odd Terje Sandlund and Laila Saksgård

Hosted by
Norwegian Ministry of the Environment
In collaboration with

- United Nations Environment Programme (UNEP)
- Secretariat of the Convention on Biological Diversity (CBD)

- Norwegian Ministry of Foreign Affairs
- Norwegian Ministry of Agriculture and Food
- Norwegian Ministry of Fisheries and Coastal Affairs

Organized by
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In collaboration with

- Norwegian Institute for Nature Research (NINA)
- Norwegian University of Science and Technology (NTNU)

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Sør-Trøndelag County Authority

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Preface

The 2005 Millennium Ecosystem Assessment (MA) stated that biodiversity is being lost at rates unprecedented in human history. The loss of biodiversity and decline of ecosystem services constitute a major concern for human well-being, especially for the well-being of the poorest.

The eighth Conference of Parties (COP-8) to the Convention on Biological Diversity (CBD) in March 2006 in Brazil noted in its decision VIII/9 that the MA "finds that the degradation of ecosystems could significantly increase in the first half of this century, and that this is a key barrier to achieving the United Nations Millennium Development Goals (MDG), and that, at the same time, many of the actions being undertaken to promote economic development and reduce hunger and poverty could contribute to the loss of biodiversity" and emphasized "that the MDGs, the 2010 target of significantly reducing the rate of biodiversity loss, and other internationally agreed targets related to biodiversity, environmental sustainability and development need to be pursued in an integrated manner".

Progress in the implementation of the Strategic Plan and follow-up on progress towards the 2010 target and relevant MDGs will be discussed as a key strategic issue for the CBD at the ninth Conference of the Parties (COP-9) in Bonn in May 2008. COP-9 will also consider the need to review and update targets and timelines as part of the process of revising the Strategic Plan beyond 2010. Several key issues will also be discussed at the thirteenth meeting of CBD's Subsidiary body on scientific, technical and technological affairs (SBSTTA-13), which is to be held in February 2008 in Rome.

The Trondheim Conferences on Biodiversity have since 1993 provided an opportunity for policy makers, managers and scientists to get a scientific and technical update and to have an open and constructive dialogue on key issues being discussed under the CBD.

Given the background above, the title chosen for the fifth Trondheim Conference on Biodiversity was "Ecosystems and people – biodiversity for development – the road to 2010 and beyond". This was to emphasize the extra challenge of meeting the 2010-target while also meeting the development targets under the MDGs.

A total of 228 participants from 75 countries, international organisations and non-governmental organisations spent the week 29 October – 2 November 2007, at the 5th Trondheim Conference, hearing presentations of scientific studies, policy principles, and practical case studies, providing insights and inspiration for enhanced efforts in achieving the objectives under CBD.

Focus was on the critical role of biodiversity and ecosystems in providing goods and services that are necessary for human well-being and security and for economic development. We have put much emphasis on finding topics and speakers that could illustrate and highlight the role of biodiversity in poverty alleviation and in reaching the United Nations' Millennium Development Goals (MDG). We also wanted participants to be able to consider progress on the goal to achieve by 2010 "a significant reduction of the current rate of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation and to the benefit of all life on earth". Lastly, we wanted the program of the conference to provide participants with insights and inspiration for enhanced implementation of CBD's Strategic Plan.

It should be noted that this made it necessary to have a broader approach than at the previous four Trondheim Conferences, but we believe this was useful in order to give participants a broad review of key topics relevant for the chosen theme and to enable us to take a holistic approach in this regard. We also wanted participants to recognize the complexity of the issues, and how linkages need to be made, *inter alia*, to the water, social and economic agendas.

We believe the 2007 Trondheim Conference have provided illustrative examples of the linkages between biodiversity and the MDGs and also of possible trade-offs between conservation and development , and that ways and means of overcoming identified obstacles to the Strategic Plan have been introduced. The quality of Conference presentations and panel discussions were very high, and provoked lively participation from the audience.

We hope these Conference Proceedings will containing all manuscripts and abstracts submitted by speakers, provide valuable background and reference material for CBD implementation in general and for preparing SBSTTA-13 and COP-9 in particular, and would like to thank the speakers and panel discussants for sharing their knowledge with us.

Trondheim, January 2008

Finn Katerås, Conference Director

Peter Johan Schei, Conference Chair

Odd Terje Sandlund, Proceedings Editor / Programme Committee Chair

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Conclusions and recommendations from the Norway/UN Conference on Ecosystems and people – Biodiversity for development – The road to 2010 and beyond Trondheim, Norway, 29 October – 2 November 2007

All governments have agreed to achieve, by 2010, a significant reduction in the rate of biodiversity loss. In adopting this target in 2002, the Conference of the Parties to the Convention on Biological Diversity (CBD) saw it "as a contribution to poverty alleviation". The Johannesburg Plan of Action linked the target to the negotiation of an international regime to ensure the fair and equitable sharing of benefits arising from the use of genetic resources. Following the 2005 United Nations General Assembly Summit, the target was integrated into the framework for the Millennium Development Goals (MDGs), highlighting the strong interdependence between biodiversity, ecosystems and people. Indeed the Millennium Ecosystem Assessment concluded that the loss of biodiversity and decline of ecosystem services is a barrier to achieving the MDGs and that the MDGs and the 2010 Biodiversity Target need to be pursued in an integrated manner.

The fifth Trondheim Conference brought together 228 participants, comprising scientists, managers, policy advisors, and NGO and community representatives from 75 countries to explore further the relationship between biodiversity, ecosystem services and human well-being and to understand the synergies and tradeoffs inherent in various development paths. The Conference also aimed to consider how to make best use of time remaining before 2010 to move towards the Biodiversity Target, to contribute to the eradication of hunger and poverty, and to support the broader set of the MDGs, in particular, the eradication of hunger and poverty.

Human well-being and development depends on biodiversity and ecosystem services

The combination of increasing population, unsustainable levels of consumption and climate change is putting the world's ecosystems under increasing stress. We need ecosystems not only to provide increasing quantities of food and clean water, but also to act as carbon sinks and to contribute to fuel production, and also to maintain essential cultural, regulating and supporting services. But most of these essential services are under strain – 15 of the 24 ecosystem services examined by the Millennium Ecosystem Assessment are degraded. As wetlands are lost, for example, services such as flood control, water purification and fishery production are all lost. Poor people, and those marginalized from decision-making processes are usually the most vulnerable to such changes.

We need to recognize and manage trade-offs among ecosystem services for the broader benefit of society
The framework relating biodiversity and ecosystem services to human well-being, developed by the Millennium Ecosystem Assessment, is an important tool in understanding these linkages and in managing tradeoffs among ecosystem services.

Different types of trade-off can be identified:

- **Temporal Trade-offs**: "Benefits Now, Costs Later" (e.g.: Overfish now – no fish or jobs later; or build on wetlands now – suffer floods later).
- **Spatial Trade-offs**: "Benefit Here, Cost There" (e.g.: Logging here – flooding there)
- **Beneficiary Trade-offs**: "Some Win, Others Lose" (e.g.: subsidized private shrimp farmer wins – local community loses from loss of fishing and coastal protection).

These trade-offs are real, but we can move towards "winning more and losing less" by improving access to information on ecosystem services and their valuation, integrating ecosystem services into global, national and local planning ensuring equity and consistency of rules and their application, framing and using appropriate incentives and/or markets, and clarifying and strengthening rights of local people over their resources.

Strengthening rights over resources and ecosystem services is a social, economic and environmental necessity
Strengthening rights, particularly of indigenous peoples and local communities, over land, resources, ecosystem services and the benefits that arise from their management, and traditional knowledge is both a moral imperative and a social, economic and environmental necessity. Experiences from many parts of the world indicate that this is essential for effective biodiversity conservation. Completing the unfinished business of land reform, assuring customary tenure, land reform and addressing land claims is also a vital pre-requisite for the effectiveness and fairness of market-based approaches to ecosystem management. Without recognition of rights, market-based approaches are likely to reinforce existing inequities and contribute to cycles of conflict.

Enhancing resilience of socio-ecological systems is essential for adapting to global change
Adapting to climate change and other global change phenomena requires resilience of integrated socio-ecological systems (people, as societies, integrated with the natural environment). Resilience is defined as the capacity to buffer disturbances, to recover, renew and reorganize and to learn and adapt. As the UN Secretary General has observed in September 2007: "Building "resilience thinking" into policy and practice will be a major task for all of the world's citizens throughout the new century". Change is inevitable, but we need to understand ecosystem change, especially the existence of thresholds and the potential for non-linear change in order to avoid or mitigate negative impacts on human well-being.

Biodiversity plays a crucial role in providing the basis for adaptation and adaptability. Among the other key elements for resilience are: social capital and institutions, innovation and flexibility, and adaptive governance. These are consistent with the principles of the ecosystem approach adopted by the CBD. There is a need to apply these elements through a process of experimentation and learning by doing. Good governance – with equity in process and outcomes – is a key requirement at all levels – from local, through national, to global.

Ecosystem services should be integrated into decision making
The framework relating biodiversity and ecosystem services to human well being, and other tools and methodologies developed by the Millennium Ecosystem Assessment, help to put into operation the ecosystem approach that has been adopted by the CBD.

More effective use should be made of these tools and the many others already available, including impact assessments, and the tools developed under the CBD. National Biodiversity Strategies and Action Plans need to be updated and used to integrate biodiversity into sectoral and cross-sectoral planning processes.

Capacity needs to be strengthened in all countries for the integration of biodiversity and ecosystem services in planning processes, building upon the Millennium Ecosystem Assessment, thereby strengthening also science-policy linkages. Such integrated assessments undertaken at the appropriate spatial and temporal scales with the participation of decision makers and relevant stakeholders can help governance adapt to changing conditions. They would also lay the foundations and generate the information needed for a future global assessment, efficiently serving the CBD.

Economic and financial incentives should be adjusted to sustain ecosystem services
Markets fail to value critical services leading to the degradation of such services. The value of many ecosystem services', particularly regulating services, accrues to the public and is not recognized until the services are lost. As a result of this market failure, the financial and business case for maintaining ecosystem services is often missing, weak, or obscured. There is a need to promote pro-poor economic and financial incentives for sustaining ecosystem services, including, for example taxation mechanisms, elimination of perverse subsidies, payment for ecosystem service schemes and other market mechanisms. These all require strong institutions, an effective regulatory framework and the safeguarding of rights, particularly rights of indigenous and local communities. Market based approaches can complement but not replace public funding and official development assistance.

Responding to current and emerging challenges and opportunities

Challenges and opportunities arise from the contemporary global change processes and some of the policy responses being discussed to address these changes. Application of the concepts and principles outlined above can help to maximise the ecological and social benefits and to minimize the corresponding costs – to win more and lose less. A number of examples were presented at the conference addressing different agendas.

The Climate Change agenda:

Protecting nature can reduce emissions from deforestation and degradation (REDD)
Protecting forests, wetlands and other intact ecosystems can be a cost-effective way of reducing greenhouse gas emissions. But this will only be achieved effectively and efficiently if based on a clear understanding of ecosystem structure and functioning. For example: because biodiversity underpins ecosystem resilience; the permanence of carbon sinks is enhanced in some intact natural ecosystems compared to some degraded or simplified ecosystems. Moreover it is necessary to consider that the whole ecosystem, including soils (especially of peatlands) and not the wood alone acts as a sink for greenhouse gases. It is also important to distinguish between flows of greenhouse gases (annual sequestration rates) and standing stocks which can amount to several decades of annual flows.

In addition to considering sequestration of greenhouse gases, measures are needed to ensure that REDD "does no harm" to biodiversity or livelihoods. This should be a minimum requirement. Further REDD schemes should be devised to also allow for biodiversity and livelihoods incentives to be harmonised with those for carbon sinks in order to generate multiple co-benefits.

Biofuels must be developed in a socially and environmentally sustainable way
It is evident that large-scale growing of biofuels may pose significant threats to biodiversity and local livelihoods. For example, the conversion of tropical forests into monocultures of oil palm or soybean involves the loss of large amounts of biodiversity as well as greenhouse gases. Biofuel plantations may also displace local people. Tools for addressing these threats include zoning, certification, and incentives for smaller farmers and for the avoidance of large monocultures etc. Sound biodiversity-related criteria are needed to inform ongoing initiatives to develop standards. It is necessary to develop global standards on biofuels. Such standards would reduce transaction costs and avoid market distortions. Standards need to be relevant also for second generation biofuels based on cellulose from numerous sources.

Biodiversity is necessary for adaptation to climate change
Biodiversity underpins ecosystem resilience and thus adaptation to climate change. There is a need for adaptation planning to make better use of biodiversity and ecosystem management. For example:

- Genetic diversity provides both adaptation to current needs and adaptability to future ones and is essential in ensuring the resilience of agricultural systems.
- Wetlands help to buffer against floods, storms and other extreme events associated with climate change

There is also a need to do more in the CBD to actively address the role and management of biodiversity under the

impacts of climate change and activities to address those impacts.

The Food and Health agenda:

Cooperation is needed to combat malnutrition and obesity
Many countries are facing the double burden of malnutrition from micronutrient deficiency and obesity from over-consumption of energy-dense foods. Dietary diversity – underpinned by biodiversity – can contribute to overcoming these challenges. Cooperation among policy makers, researchers and the private sector in the health, agriculture and environment sectors is needed to ensure that people have access to diverse and healthy food sources.

Biodiversity sustains future food supplies
We need to maintain genetic diversity – and associated traditional knowledge -- among crops and livestock both in genebanks and farmers' fields, and in fisheries in order to provide adaptation to current conditions and adaptability to changing environments. Other components of biodiversity such as pollinators, pest control organisms and soil biota, also sustain productivity in agricultural ecosystems and fisheries. Many people, in particular poor people, are dependent on fisheries and other wild food sources for their food and nutrition. But most marine fisheries are over-exploited while freshwater fisheries are threatened by habitat change. While the application of the ecosystem approach to fisheries management is a promising approach, greater efforts are needed to reduce overfishing and to end destructive fishing practices.

Healthy ecosystems contributes to healthy people
Clean water, regulation of pests and diseases and other major determinants of human health depend on ecosystem processes. Intact wetlands, for example, can also reduce impacts of extreme events associated with climate change. Maintenance of healthy ecosystems thus contributes to human health and well-being and needs to be considered in health policy.

Biodiversity provides medicines
Biodiversity – and associated traditional knowledge – provides traditional medicine and is the basis for a substantial proportion of modern drugs. Maintaining this storehouse requires conservation and sustainable use of biodiversity and the fair and equitable sharing of the benefits derived from the use of medicine-related biodiversity.

The Fisheries and Oceans agenda:

There is an urgent need to stop overfishing and destructive fishing practices and to establish marine protected areas
The Johannesburg Plan of Action calls for the establishment of a network of marine protected areas by 2012 and the restoration of fisheries by 2015. These goals are being pursued through a number of global and regional processes and organisations. Understanding of biodiversity and its role in supporting marine ecosystems is crucial to realizing these goals efficiently. Key actions should include an end to overfishing and destructive fishing practices in areas both within and outside national jurisdiction, abolishing of perverse subsidies and the establishment of a network of marine protected areas.

The road to 2010 and beyond

We need to act with urgency to maximise progress by 2010 towards the Biodiversity Target
We have heard several examples of progress towards the 2010 target. A good example is that the rate of deforestation in the Amazon has been substantially reduced since 2002 through coordinated action across thirteen ministries of the Brazilian Government. But overall the notable lack of implementation demonstrates that governments and other actors need a greater sense of urgency to make the most of the few years left before 2010 to achieve maximum progress towards the 2010 Biodiversity Target and to lay down the pre-requisites for sustained and continued action. A lot can and should be achieved in the coming three years. Governments, civil society and the private sector all have an ethical responsibility to act. Examples of progress towards the 2010 Biodiversity Target will help inspire sustained action.

The following constitutes a 10 point action plan, as proposed at the conference by the President of CBD COP-8:

1. Completion of an international regime on access and benefit sharing;
2. Adoption of a system to protect traditional knowledge;
3. Approval of an ambitious strategy for the mobilization of financial resources for the implementation of the Convention;
4. Significant enlargement of the CBD financial mechanism in phase 5 of the Global Environment Facility;
5. Enhanced mainstreaming of biodiversity in global, regional and national public policies as well as in the private sector;
6. Consolidation of national and regional Systems of Protected Areas, with mechanisms of financial sustainability;
7. Consolidation of sustainable forest management systems in public and private forests and the opening of market access that allows value to be added to timber and non-timber forest products in the country of origin;
8. Creation of mechanisms at global and national scales that value the conservation of natural ecosystems in private and community lands, including the payment for ecosystem services and incentives for reduced deforestation;
9. Definition of global and national adaptation strategies on climate change which focus on the consolidation of ecological corridors and the protection of the variability of genetic resources;
10. Consolidation of a system of global environmental governance that articulates and optimizes the existing mechanisms and processes.

Biodiversity loss must be halted in the first half of the 21st century
The 20th century was characterized by social injustice and by the unsustainable consumption by a minority that has resulted in the Earth's sustainable carrying capacity being exceeded. Future targets established under the CBD will

have to recognize that this situation cannot continue. Biodiversity loss must be halted within the first half of the 21st century. Future targets should address the drivers of biodiversity loss, highlight the benefits to be achieved through the sustainable use of biodiversity and the fair and equitable sharing of benefits arising from the use of genetic resources. In setting targets beyond 2010 a broad cast of actors needs to be involved, including civil society, the private sector and scientific bodies, as well as governments. National targets should be developed within a global framework to allow for more concrete action. Such targets should be quantitative so that progress can be assessed and further strengthen accountability.

There is a need to strengthen the interactions between the biodiversity and climate change regimes. There is equally a great need for an enhanced integration of biodiversity into the agendas on development and global trade.

We need a stronger interface between science and policy makers that could be facilitated through a regular mechanism for scientific assessment and capacity building for policy implementation, with intergovernmental and stakeholder involvement. It is therefore important to continue the processes to develop such a mechanism. A critical point in making this information relevant to decision-makers is to frame the information in economic terms, so that trade-offs become clearer.

We need to build awareness for action through better communication

The presentations and discussions at the Fifth Trondheim Conference illustrated the relevance of biodiversity to many topical issues including climate change, food and health. Enhanced efforts are needed to frame information on biodiversity in economic terms to make trade-offs become clearer. A greater investment in communication is also needed to raise awareness of these linkages among decision makers and the general public, and to mobilize the efforts needed to achieve the 2010 Biodiversity Target.

A call for interaction to the meetings of the United Nations Framework Convention on Climate Change at Bali in December 2007

from the participants of the Norway/UN Conference on "Ecosystems and people – Biodiversity for development – The road to 2010 and beyond".
Trondheim, Norway, 29 October – 2 November, 2007

The world faces the combined challenges of combating climate change, desertification and the loss of biodiversity, while at the same time ensuring achievement of the Millennium Development Goals. Meeting these challenges will require a better and more coordinated management of ecosystems. This is necessary to maintain biodiversity and the resilience of these systems to ensure the continued provision of ecosystem services to safeguard future well-being of communities.

228 scientists, policy advisors, and NGO and community representatives from 75 countries have met at the 5th Norway/UN Conference on Biodiversity. The aim of the Conference was to explore further the relationship between biodiversity, ecosystem services and people, and the challenges of meeting the 2010 Biodiversity target. The Conference has recognised important linkages between managing biodiversity and ecosystems, and mitigating and adapting to climate change.

There are a number of opportunities for combined contribution to the objectives of the Climate Change Convention, Convention on Biological Diversity and the Millennium Development Goals. These include:

- *Adaptation to climate change*. Biodiversity supports ecosystem resilience and thus contributes to adaptation to climate change in several ways. For example:
    - Genetic diversity provides better adaptability to a changing environment
    - Agricultural biodiversity underpins food security
    - Intact ecosystems help to buffer against climate induced disasters
- *Reduction of emissions from deforestation and degradation* - and management of the natural environment to maximize the role of ecosystems as carbon sinks
- *Protecting forests, wetlands and other natural ecosystems* has been demonstrated to be a cost-effective way of reducing greenhouse gas emissions, as well as contributing to adaptation.

However, realizing these multiple benefits is not automatic. It requires that we make use of knowledge of biodiversity and ecosystem structure and functioning. We have to make sure that international instruments are mutually supportive to each other. This implies that climate change adaptation and mitigation activities, including production and use of biofuels, 'do no harm' to biodiversity or to the rights and possibilities of indigenous and local communities.

The participants conclude that the objectives of the Climate Change Convention, the Convention on Biological Diversity and the Millennium Development Goals can only be achieved if there is close cooperation among the actors within the regimes. We call for dialogue and interaction at several levels, including:

- **Interdisciplinary research and assessment**
- **Cooperation among policymakers at the international level**
- **Cooperation at the national level in implementing UNFCCC and CBD**
- **Development of new mechanisms to fully realise synergies between the two conventions**

Peter J. Schei, Conference Chairman

Opening address

Heidi Sørensen
Deputy Minister of Environment
Norway

Your Excellencies, distinguished delegates, ladies and gentlemen,

Welcome to Trondheim and to the official opening of the Fifth Trondheim Conference on Biodiversity.

Norway is honoured to organize this Conference. We have some exciting and interesting days ahead of us. But first, I would like to thank the Mayor of Trondheim, Rita Ottervik, for her very warm welcome. Her city has become a prominent centre for biodiversity knowledge and science in Norway. It's good to be here – in my home region. And I would also like to thank Mr Peter Johan Schei for chairing this conference. I think it is fair to say that you are one of the founding fathers of the Convention on Biodiversity, and "Mr Biodiversity" in Norway.

The Trondheim Conference has become an important meeting point. Here, policy makers, managers and scientists can have an open dialogue on key issues being discussed under the Convention of Biological Diversity. I very much hope that these discussions will provide a valuable contribution to the next Conference of the Parties in Bonn this spring.

This Conference is very well timed! Biodiversity is now being placed high on the international political agenda, in the context of broader development issues. The title of the conference, "Ecosystems and people - biodiversity for development - the road to 2010 and beyond", sets the tone. The dialogues you will have are vital not only for today, but also for far into the future. They are important to peoples' well-being world wide.

As an international community, we have committed ourselves to the goal of "significantly reducing the loss of biodiversity by 2010". In fact, the shared goal in Europe is to "halt the loss of biodiversity" by 2010. In addition, we have promised to make real progress to combat poverty around the world by 2015.

I would like to thank Ms Marina Silva, the Brazilian Minister of the Environment and President of COP 8, for the excellent way you organized and chaired the previous COP in Curitiba. The appeal from Curitiba led to the integration of the 2010 target as part of goal 7 of the Millennium Development Goals on ensuring environmental sustainability. Under your able leadership, and because of your personal and untiring commitment, it has been firmly stated that biodiversity conservation is everybody's business.

We need to be more mindful of the value of biodiversity, and of how biodiversity contributes to poverty reduction and to the benefit of all life on earth. There is a need for more and better linkages between principles and actions in biodiversity and development cooperation.

One example world wide is the development of ecotourism. Conservation of nature, protecting the rainforest or the establishment of new national parks attracts tourists to countries building up a sustainable society. If handled environmentally correct, ecotourism has a great potential to countries with a low income rate.

Last year I visited Madagascar, and I would like to praise their ambition to actively use ecotourism as a means to economic growth. Commitments were also made at the same time to protect biodiversity by tripling Madagascar's conservation areas.

Norway wants to play a leading role in making environmental concerns an integral part of all development cooperation. In 2006 Norway presented an "Action plan for environment in development co-operation". We realize that we must deal with environmental problems if we are to reduce poverty and solve the development problems the world is facing. What is more, we see frequent examples on how environmental cooperation contributes to peace, reconciliation, security and regional development.

Our new Minister of the Environment and International Development, Mr. Erik Solheim, will address the conference at the closing session on Friday. His nomination as Minister for both the environment and international development shows the Norwegian commitment for the topics dealt with at this conference.

Ladies and gentlemen,
There are many important issues on the agenda this week. The broad agenda reflects the enormous complexity of the Biodiversity convention and the challenges we are facing. You will later today hear more about our progress towards the 2010 target. We all know that this target is hard to reach. But I strongly believe that the efforts we are all doing in order to reach the 2010 target, will make the way forward beyond 2010 less stressful.

There is also an urge to address the linkages between climate change and biodiversity. Deforestation is causing loss of biodiversity, and is accounting for roughly 20 per cent of global emissions of greenhouse gases. It is therefore an area of common concern how to respond to the environmental threats related to deforestation in developing countries. In this respect a much closer cooperation between our two conventions should take place.

Deforestation activities may threaten the ability to reach several long term goals. Time is a critical component here! The need for an early action is urgent in order to avoid the most dramatic and irreversible consequences in relation to both the Convention on biodiversity and the Climate Change Convention. When preparing for the Bali meeting in December on climate change, Norway will carefully consider how financial means could stimulate early action to limit and reduce deforestation activities in tropical forests.

Biodiversity worldwide is disappearing faster than ever. At the first Trondheim conference on biological diversity in

1993, Ms Gro Harlem Brundtland expressed that "the library of life" is on fire. The truth is that it is still burning 14 years later and 20 years after the Brundtland report on environment and development was published. The growing demands for biological resources are mainly caused by population growth and increased consumption. But even in a sparsely populated country such as Norway, we are losing biodiversity. It is therefore essential to get a better knowledge of existing species and habitats in order to be able to protect them.

The Norwegian seas are known for its many species of fish, whale, seals and other Arctic species of marine life. To our great surprise, some mapping activities of the sea bed discovered huge areas of cold-water coral reefs never seen before in our latitudes. Due to these mapping efforts several cold-water coral reefs of considerable value for biological diversity have been identified outside the Norwegian coastline. This led us to rethink the management of our fisheries, trawling activities, and oil production plans.

Under the Convention on Biological Diversity, mainstreaming of biodiversity concerns is recognized as a key challenge. This challenge cannot be solved by the environmental sector alone – all sectors must contribute. This conference is also an example of this, as it is being organised by my Ministry in co-operation with the Ministry of Foreign Affairs, the Ministry of Food and Agriculture and the Ministry of Fisheries and Coastal Affairs.

Improved knowledge and easily accessible information on biodiversity is necessary in order to stimulate sector integration. The Millennium Ecosystem Assessment is a success. The assessment clearly shows that a scientific platform for the Convention of biodiversity in line with the Intergovernmental Panel on Climate Change is strongly needed to improve decision making on biodiversity. Likewise - we have to communicate the biodiversity agenda in a clear and understandable language. We need to bring forward the added value of biodiversity benefiting the society as a whole.

It is also a priority for Norway to reach an agreement on the third objective of the convention of biodiversity - the fair and equitable sharing of the benefits from genetic resources. The recently held negotiations in Montreal on access and benefit sharing show us that we are still far from consensus. I will therefore encourage all of us to work on obtaining constructive results at the next session in Geneva in January. We need to resolve the outstanding questions before 2010.

Ladies and gentlemen,
Nature is the basis of our existence. A natural environment with a rich biological diversity adapt easier to changes such as a warmer climate. Biodiversity is a basis for sustainable development and human well-being. Biodiversity is our life insurance.

It is my sincere wish that the fifth Trondheim Conference will live up to the expectations. I count on your dedication and commitment. I would like to wish you all a very successful and inspiring Conference.
Thank you.

Opening statement

Marina Silva
Minister of the Environment
Brazil

Ladies and gentlemen
It's an honour and a privilege for me to be here in Trondheim and participate in a conference that focuses on the importance of biodiversity in combating poverty and in achieving sustainable development.

Our responsibility, as the last CBD Conference of the Parties was chaired by us, shows us that it is necessary to have a vision of the future and keeping as our long term goals the principles and objectives of the Convention, so that our children and our grandchildren can, as ourselves, be the beneficiaries of the enormous wealth of our biological diversity.

This is what I call our ethical responsibility to the future generations. However, this vision should be based on concrete actions and on political decisions that allow us to implement, presently, the objectives, decisions and agreements to which we have committed ourselves. Otherwise, the future will only be a recollection of our – not fulfilled – good intentions.

Nothing that threatens life serves the common cause of humanity and this is a paradigm that has to generate normative and political consequences. Politically, we cannot admit a retrogression in the progress already attained. In normative terms, it is fundamental to work with the implementation of legal and political frameworks that protect the biodiversity and the legitimate aspirations for development of the poor countries, the main holders of the natural patrimony of the world.

The Conference in Curitiba, in 2006, has given us the opportunity to make some worrying and challenging reflections on the low level of implementation of the commitments of the Convention. These are commitments that involve all of us, developed countries and developing ones alike, whose implementation is based on the principle of common but differentiated responsibilities.

Now with less than three years to 2010 there is still a lot to do to achieve, even partially, the target, adopted by us in Johannesburg, of reducing significantly the current rates of loss of biodiversity. This is an effort that demands from all of us much more than what we have done so far. Therefore, I appeal to all of us to look, with a sense of urgency and relevance, to the few years left until 2010.

Ladies and gentlemen
In the context of global efforts for the implementation of the Convention, there is a theme I would like to emphasize in a particular manner, given the meaning it has to the fulfilment of its three objectives: the negotiations of an international regime on access and benefit sharing of the genetic resources and the associated traditional knowledge.

Although benefit sharing is the only objective of the Convention whose results, 13 years after it came into force, are unimpressive, it is a theme that is still treated with much precaution and resistance by a major part of the developed countries. For the developing countries, however, the negotiation of this regime constitutes a priority and deserves to be treated as relevant and urgent, at the risk that we compromise, politically, the progress expected by all of us in the implementation of the other objectives of the Convention.

The title of this Conference – "Ecosystems and People – Biodiversity for Development" – has a direct relation to the necessity of adopting an international regime of benefit sharing that results from the access to genetic resources and associated traditional knowledge. This is an essential step to be taken in order to achieve the objectives of the Convention and to contribute to the eradication of poverty and to sustainable development.

In this respect, I was worried when I received the report from the latest meeting of the Convention's Open Working Group on Access and Benefit Sharing last month. In this meeting in Montreal, it was worrying to notice the lack of political will and consensus to make progress in the elaboration of the international regime, to fulfil the decision adopted in the COP-8. In some aspects, there was a true retrogression, which will make it difficult for all of us to come to Bonn with a significant progress that allows us to adopt the regime before 2010.

I insist on this point, because the theme of benefit sharing is missing in the agenda of this Conference, whose focus is on biodiversity and people, biodiversity and the eradication of poverty. For Brazil, the fair and equitable sharing of the benefits generated by the use of genetic resources and of associated traditional knowledge is not only an inalienable right of the countries of origin of these resources, but an effective means of generating, in a sustainable manner, benefits that make possible a broader and better distribution of the wealth between rich and poor countries.

Ladies and gentlemen,
Although the adoption of an international regime on access and benefit sharing constitutes one of the major debts in the work done so far under the Convention, the second meeting of the Convention's Open-Ended Working Group on Review of Implementation last July in Paris, saw low rates of implementation in most parts of the Convention. This deficit of implementation reflects the complexity of a theme that, more and more, is associated to the development issues, in its broader concept.

These issues are not new. A debate has been evolving on how to harmonize the implementation of the multilateral environmental agreements with the global trade regime, with the attainment of the Millennium Development Goals or with the issue on food security.

A sustainable environmental logic is incompatible with an economic gear that is based on growing and choking social

inequalities. The complicity of social injustice, with the prodigal consumption of a few, has characterized the 20th century and reached its saturation limit. It is not acceptable that the poorest countries and, within their nations, their poorest communities continue to suffer the main onus of environmental degradation.

The false dichotomy between environmental conservation and the economic growth tends to thwart the true mainstreaming in building public policies, so as to overcome the historical isolation of the environmental sector from the center of planning and decision-making of the State. The mainstreaming of the environmental policy in the sectorial actions of all government agents is a difficult and long-term task, but it demands a determined and strong starting point. This is the logic we have been trying to improve since the beginning of President Lula's Government.

This strategy has been the milestone in Brazil for reducing the deforestation levels, which is no longer merely an environmental issue in Brazil and is now treated as an issue for the whole Government. In this sense, it is necessary to correct the idea given by some people, especially in the context of the discussions on efforts to mitigate climate changes, that deforestation reduction is a challenge of low cost and complexity. It is not. The reductions of the deforestation rates demand fundamental changes in the economic model of some developing countries.

Thus, more than command and control actions, we are attacking the causes of this deforestation; in particular its economic vectors and proposing alternatives of social and economic growth that embrace the concerns and necessities of all actors involved in the process. This common effort of the many governmental and non-governmental actors, besides the political complexity, imply in the investment of significant institutional and financial resources, but it has already resulted in a reduction of over 50% of the deforestation rates in the Brazilian Amazon in the last two years.

In the international arena, as well, there is no other way than that of mainstreaming. The agenda of this meeting reflects this reality, when it includes such broad themes.

Among other themes in the agenda of this conference, the biofuels issue is one of the emerging themes in the international scenario. Brazil has a lot to contribute to this discussion, since Brazil holds an important accumulated knowledge in the area of biofuels. And Brazil recognizes that, despite the opportunity that his energy alternative represents for many developing countries, this is an opportunity that only makes sense if done in a socially and environmentally sustainable way.

In the biofuels area, the Brazilian strategy is composed of several actions, emphasizing the cooperation with other developing countries. This is, by the way, a priority for Brazil. Many countries have been working intensely to strengthen initiatives of subregional, regional and bilateral nature, trying to take advantage of their experiences in the solution of common problems. However, the capacity to implement theses initiatives is naturally limited, if the developed countries do not provide a greater support.

Ladies and gentlemen,
One natural conclusion that springs from the observation of this agenda and of the participants of this Conference is that the role of implementing the commitments to biodiversity is not only the role of the governments, but also of the civil society. The main challenge of public policies consists in the planning towards the shared actions and building agreed proposals that aim to the elaboration of a vision of the future among the different actors involved for the decentralization, the social control and for the incorporation of a multidisciplinary vision. In this way, governments, at all levels, and the civil society work for the conservation and the sustainable use of biodiversity in a regime of coresponsibility.

The Conference of the Cities and Biodiversity held in Curitiba in the beginning of this year was an initiative that involved mayors of many cities in the world. The declaration adopted in that occasion affirmed the commitment of the local governments to contribute actively for the implementation of the three goals of the Convention on Biological Diversity and for the achievement of the 2010 target.

Another initiative that has counted with the support of Brazil, the United Kingdom and many other institutions aims to promote the insertion of the private sector in the biodiversity agenda. With the purpose of establishing consistent partnerships among all sectors, the partnership tries to make possible the development of market instruments and financial mechanisms in the benefit of biodiversity.

This is a fundamental step so that the enterprises can assume their share of responsibility with the environment and the society. I believe that the Summit Conference in Lisbon next month will be an additional step in the building of this partnership and contributing to a better comprehension of the competitive advantages of the conservation and sustainable use of the biodiversity. Associated to the role of the private sector in the conservation of the biodiversity, I would like to emphasize another theme that shows the clear intersection of the environmental themes with other sectors, the international trade of products based on the natural resources. In this point, there is a clear cause relation between the current patterns of international trade and the aggravation of the economic, social and environmental asymmetries between the developed world and the developing one.

One example of the unfeasibility of this model is the tariff escalation applied to imported products with more value added in the origin – this mechanism fosters the generation of jobs and income in the rich countries and condemns the poor countries to under-employment and the unsustainable exploitation of theirs biological resources.

The treatment of biodiversity as a theme of transversal nature also can be seen reflected in the agenda of and in the structure of international institutions, where the challenges include improving the coordination and cooperation among international organizations and multilateral environmental agreements.

There is a clear unbalance between the objectives praised in the agreements, which were negotiated with great ef-

forts, and the adoption of the innovative strategies of cooperation based on the confidence of the fulfillment of the commitments assumed by each part: those who detain the implementation means and those who need to have access to them.

It was with the objective of deepening the ongoing debate on the international environmental governance theme that Brazil hosted an informal dialog to discuss this theme in Rio de Janeiro last September. In the meeting in Rio, many points of consensus were identified, especially on the perception of the environment as an integral part of the development process and the need for using this perspective for the strengthening and improving of the international environmental governance.

Ladies and gentlemen,
The Millennium Ecosystems Assessment concluded that the driving factors of pressure on biodiversity will keep the same and will increase in the near future and that we will most probably not achieve the Biodiversity Global Target for 2010. Unfortunately, it is quite probable that the scientists are right, but I believe that we can achieve important results if we work in an unified and focused way to reach by 2010 a significant progress in the processes and mechanisms that will be crucial to achieve the targets agreed in the near future after 2010. Therefore, I suggest a global pact to achieve the following ten feasible and possible objectives by 2010:

- Consolidation of an international regime on access and benefit sharing;
- Adoption of a protection system for traditional knowledge;
- Approval of an ambitious strategy for mobilization of financial resources for the implementation of the CBD;
- Significant enlargement of the CBD financial mechanism in the phase 5 of the Global Environment Facility (GEF-5);
- Enlargement of the mainstreaming of biodiversity in global, regional and national public policies as well as policies in the private sector;
- Consolidation of the national and regional Systems of Protected Areas, with mechanisms of financial sustainability;
- Consolidation of sustainable forest management systems in public and private forests and with the opening of market access for timber and non-timber products with value added in the origin;
- Creation of mechanisms in a global and national scale that values the conservation of natural ecosystems in private and communitarian lands, including the payment for ecosystem services and incentives for deforestation reduction;
- Definition of a global and national adaptation strategy for climate change which focuses on the consolidation of ecological corridors and the protection of the variability of genetic resources;
- Consolidation of a system of global environmental governance that articulates and optimizes the existing mechanisms and processes.

Ladies and gentlemen,
There is no more time for rhetoric, for actions dissociated from the multilateral efforts or for us to continue the game of attributing to the neighbors the greatest responsibilities. More and more, the impacts of our lack of action can be felt upon ourselves, not any longer upon the future generations. Act now is not a matter of political will, it is a question of responsibility, of commitment, of vision, of ethics and of survival.

We need to be prepared to face this challenge, as nations, as institutions and as individuals who are aware of their role in this debate and of their commitment with the planet's population, in order to ensure the right for a better future to all of us that are here now and for all generations that will come after us.

Thank you

Opening statement

Ahmed Djoghlaf
Executive Secretary
United Nations Convention on Biological Diversity
Montreal
Canada

Ladies and Gentlemen,
Addressing the ceremony held earlier this year to mark the 20th anniversary of the Brundtland report, the Prime Minister of Norway, HEM Jens Stoltenberg stated, "The Brundtland Commission report changed everything. It opened a whole new era of thinking. It launched a movement. As leader of this commission all of Gro's remarkable skills came into play, as a consensus builder, as a visionary. At the end of the day, Gro presented a consensus document and a milestone in the history of the United Nations."

At the United Nations General Assembly, following her appointment as Special Envoy of the Secretary General on Climate Change, this visionary and consensus builder, Mrs. Gro Harlem Brundtland, stated, "It is irresponsible, reckless and deeply immoral to question the seriousness of the situation. The time for diagnosis is over and the time for action is now". She stressed the importance of 2007 as a year when the wheels have to be set in motion. The call for action to find a solution to "the tragedy of the commons", as Mrs. Brundtland called it twenty years ago in her seminal report, Our Common Future, is being heard for climate change.

Indeed several steps have been taken. Early this year and for the first time in its history, the United Nations Security Council devoted a special meeting to address the issue of climate change and security. Three special envoys of the Secretary General have been appointed. A summit of the United Nations General Assembly with the participation of 70 heads of State and Government exclusively devoted to climate change was convened last month in New York. Later this year and not far from the place where we are meeting today, the Nobel Peace Prize will be presented to Mr. Al Gore, the former Vice-President of the United State of America, and to the Intergovernmental Panel on Climate Change (IPCC). In so doing, the prestigious Norwegian Nobel Committee has recognized, for the second time in its history, the environmental dimension of the concept of peace and security.

The security implications of environmental degradation were recognized by the Committee in 2004, when it awarded the Nobel Peace Prize to an environmentalist for the first time in history, namely Professor Wangari Maathai. On that historical occasion, Mr. Ole Danbolt Mjøs, the chairman of this prestigious institution noted that, "This year, the Norwegian Nobel Committee has evidently broadened its definition of peace still further. Environmental protection has become yet another path to peace." In accepting the Nobel Peace Prize, Prof. Wangari Maathai stated that, "There can be no peace without equitable development and there can be no development without sustainable management of the environment in a democratic and peaceful space. I hope that this prize will help many people see the link between peace, development and environment." Indeed sustainable development is the new name for peace and security. Nobel Laureate Wangari Maathai has tirelessly worked to highlight the link between peace and the environment, "In a few decades, the relationship between the environment, resources and conflict may seem almost as obvious as the connection we see today between human rights, democracy and peace." It is encouraging to note that world leaders are seeing this link. Foreign Minister Frank-Walter Steinmeier of Germany stated last week, "There is a 'cold war' at North Pole that we have to prevent. Climate change is a threat to worldwide peace and security."

Just as climate change is indeed a security issue, so too, is the biodiversity crisis. Prime Minister of Norway, HEM Jens Stoltenberg, in his article for the third publication of GINCANA, stressed the connection between the two when he noted that, "Climate change and biodiversity are strongly interlinked. Climate change affects biodiversity and biodiversity can affect the world's climate, most importantly when forests are lost. Active management and preservation measures aimed at protecting biodiversity cover a wide range of measures which also have the effect of mitigating climate change." Thus both issues require our attention.

According to the Millennium Ecosystem Assessment, the pressures on the planet's natural functions, caused by human activity, have reached such a high level that the ability of ecosystems to satisfy the needs of future generations has been seriously, and perhaps irreversibly, compromised. Impacts on the natural functions of our planet have never been so destructive as in the last 50 years. During the last century, the extinction rate of species increased a thousand times. All countries are being affected. Even here in this country, a country that has demonstrated environmental leadership; the Norwegian Red List contains 3886 species, and 1988 of these are classified as threatened. The IUCN red list search listed 624 endangered species in Norway. It is examples, such as these that have led some experts to believe that we are at the eve of the sixth global mass extinction of species and may be the first generated by us – human-beings.

This unprecedented loss of biodiversity was confirmed by the Fourth Global Environment Outlook launched last week by the United Nations Environment Programme (UNEP). The authoritative assessment of the state of the environment of our planet by the world environmental authority of the United Nations system, since the launch in 1987, of the Brundland report, prepared by more than 500 experts and peer-reviewed by more than 1000 experts, reiterates that we, human beings, are witnessing and are responsible for a reduction in distribution and functioning land, freshwater and marine biodiversity more rapid than at any time in human history. This unprecedented loss of biodiversity is being compounded by climate change.

The fourth assessment report issued early this year by IPCC, demonstrates that up to 30 per cent of all known species are likely to be at increased risk of extinction before the end of this century. It is for this reason that on 22 May of this year, the International Community, thanks to the generous contribution of the Government of Norway, celebrated the International Day for Biological Diversity under the theme "Biodiversity and Climate Change". To further raise awareness of the impacts of climate change, an exhibit to mark the celebration of the International Polar year was mounted in collaboration with UNESCO. The goal was to put a human face on climate change by highlighting the negative impact of climate change on indigenous people, their biodiversity and their lifestyle.

The unprecedented loss of biodiversity is also compounded by another human cause, namely invasive alien species. A warmer world will aggravate the negative impact of alien invasive species, one of the major causes of species extinction in many ecosystems and a scourge that causes tremendous economic loss for the regions affected.

Earlier this year, while paying an official visit to New Zealand, I saw the staggering impact of alien species on the unique terrestrial and marine ecosystems of the 700 islands that make up New Zealand. Every night, possums, whose numbers are now estimated to be 70 million, eat 22,000 tonnes of vegetation. Possums infest 95 per cent of the land area of New Zealand and are causing major changes to the composition of the country's forests. They were originally introduced from Australia for their fur. However, now, they are contributing to a widespread decline and even extinction of indigenous and endemic vegetation, most of which is part of the cultural heritage of the Maori people. Such examples of biodiversity loss and the consequent degradation of cultural heritage are tragic losses that need to be mitigated and reversed.

While living in Kenya as a UNEP staff, I also witnessed the dramatic impact of alien species, this time on the unique biodiversity of Lake Victoria and on the livelihood of surrounding communities. Lake Victoria's ecological and natural resource base has been dramatically altered through water hyacinth infestations as well as the introduction of the Nile Perch. In the mid=1990s, the water hyacinth invaded more than 12,000 hectares of the lake and affected the livelihood of around 40 million people. As they did then, these infestations tend to impede electricity production, irrigation, navigation and fisheries activities. Moreover they enhance water losses through evaporation and facilitate the proliferation of diseases by slowing the flow of water. Water hyacinths are estimated to cause US$ 150 million in lost productivity and revenues in seven African countries. A South America native, the water hyacinth is now found in more than 50 countries on five continents.

It is estimated that 480,000 alien species have been introduced into the varied ecosystems of our planet. Since the 17th century, invasive alien species have contributed to nearly 40 per cent of all known animal extinctions. One study from the United States of America estimates costs of US$ 137 billion per year from an array of invasive species.

In addition to exacerbating impacts from invasive species, climate change may also result in reduced agricultural yields, due to drier conditions, particularly in warmer regions. Global warming is likely to alter the production of rice, wheat, maize, beans and potatoes, which are major crops in Africa and staples for millions of people. Moreover, approximately 35 per cent of world crops depend on pollinators such as bees. However, their populations have already decreased by 30 per cent in the last twenty years, hindering crop maturation. Climate change is likely to give a new dimension to the question of food security, an issue for which we already have troubles finding solutions. According to the Food and Agriculture Organization of the United Nations, in 2007-2008, Africa will pay 22 per cent more for its importation of cereals. The World Bank projects that the price of major cereals may raise up to 40 per cent as their stocks fall to their lowest levels. The United States Department of Agriculture recently stated that wheat stocks may reach their lowest levels in 30 years by the spring of next year. It is for these reasons that the international community will celebrate next year's International Day on Biodiversity under the theme "Biodiversity and Agriculture". The celebration of this important event will coincide for the first time with the convening of the meeting of the Conference of the Parties in Bonn.

As species are lost, so too are valuable traits such as drought and pest resistance, and high yields, among others. To mitigate this loss, Norway has taken the lead to build an International Seed Vault. This "Noah's Ark" project, which aims to safeguard crop diversity by storing about 1.5 billion seeds, and three million varieties, in an underground vault on Spitsbergen in the country's arctic Svalbard archipelago. These efforts to provide "back-up" for the world's food supply should be applauded as a major initiative at the service of humanity.

Indeed, twenty years ago, the Brundtland report provided ample evidence that poverty needed to be addressed if the environmental challenges were going to be met. Unfortunately, the impact of climate change on agriculture will aggravate poverty. In 2080, 200-600 million people are likely to join the endless list of people affected by hunger and malnutrition.

The loss of biodiversity will affect all segments of society but the poor will suffer the most. As we know, more than 1.6 billion people depends on forests and forest products for their livelihood, while more than 3 billion people depend on marine and coastal biodiversity. More than 132 million hectares of forests are lost annually and some predict that fish may disappear from the oceans by 2048. Yet, biodiversity can be a formidable tool to halt and reverse poverty.

As Mrs Gro Harlem Brundtland stated "you cannot tackle hunger, disease, and poverty unless you can also provide people with a healthy ecosystem in which their economies can grow". I am therefore extremely grateful to the Government of Germany for considering the support of a programme on biodiversity and poverty alleviation for achieving the Millennium Development Goals (MDGs) which will not be achieved without mainstreaming the three objectives of the Convention on Biological Diversity (CBD) into development plans and strategies.

The Brundtland report approaches environment and development issues as one common challenge to be solved by collective multilateral action rather than through the pursuit of national self -interest. It is for this reason that the Secretary General has responded to the call from the Parties to the Convention on Biological Diversity to integrate the 2010 biodiversity target as part of the Millennium Development Goals. Last week in New York, a Memorandum of Understanding (MoU) was signed between four United Nations Economic Commissions with a view to mainstreaming biodiversity into regional economic processes and integrating biodiversity into poverty reduction strategies. It is the first time in the history of the 500 Multilateral Environmental Agreements, that such an agreement has been signed. To facilitate this work, a senior environmental expert from the French Government has been seconded to the Secretariat for an initial period of at least two years. I am pleased to welcome Mr Eric Belvaux who has joined us this week and started his assignment here in Trondheim. I am extremely grateful to the Government of France for its support in integrating biodiversity into the development sector as a follow up of the Paris message.

Indeed this year's Trondheim Conference theme is about ecosystems and people: the interlinkages between ecosystem goods and services, on the one hand, and human well-being, development and activities, on the other hand. The Norwegian playwright Henrik Ibsen once said "A thousand words will not leave so deep an impression as one deed'. Last week, by establishing for the first time in the history of international cooperation for development a ministerial portfolio linking Environment and Development Cooperation, Norway has shown the world the way ahead in operationalizing the Brundtland approach. Let me congratulate HEM Erik Solheim for his appointment as Norwegian Minister of Environment and Development Cooperation.

Ladies and gentlemen,
The name Trondheim derives from the Old Norse Þróndheimr, meaning home of the strong and fertile ones. Trondheim's internationally renowned university and the city's many research centres ensure that it is a city of innovation and development in science, business and industry ventures. Trondheim is truly the nation's technological capital and the city of the youth. Therefore, your meeting today could not have found a better place to make its impact than here in Trondheim. Indeed, the famous poet and historian Snorre Sturlasson wrote "No King in Norway could rule in peace if he failed to have the people of Trøndelag on his side." And so we can be assured of success here this week thanks to the welcome provided by the city of Trondheim and the region of Trøndelag.

As sustainable development is now the new name of peace, let us ensure that your proceedings here, in this great city of Trondheim, will ensure the success of the ninth meeting of the Conference of the Parties to the Convention on Biological Diversity and be guided by the wisdom of Henrik Ibsen who stated, "A community is like a ship; everyone ought to be prepared to take the helm." Indeed the 190 Parties to the community of biodiversity should be prepared, in May next year in Bonn, to take the helm inspired by the Trondheim report. In doing so you will be responding to the call of Mrs. Gro Harlem Brundtland and ensuring that 2007 is remembered by generations to come as an important year when the wheels for protecting life on earth were also set in motion.

Thank you.

Communicating the Issues: Ecosystems and People – Biodiversity for Development

"Get down off our mountain tops, walk the talk, analyze the chemistry of change!"

Frits Hesselink[1]
HECT Consultancy
The Netherlands

Introduction and summary

The title of the 2007 Trondheim Conference brackets biodiversity with the words "people" and "development". This has major implications for the way we communicate. We are not focusing on the need for more scientific reports, for example, but on how to communicate with the public and policymakers as part of a global effort to reduce poverty. I am grateful to the organizers for the opportunity to share some personal reflections how strategic communication can help the conservation community succeed in halting the loss of biodiversity.

In this paper I frame my observations in terms of three key areas of action. To bring about change, we in the biodiversity community need to (1) Get down off our mountain tops, (2) Walk the talk, and (3) Analyze the 'chemistry' of change. I preface my plan with an overview of the communication challenges of the 21st century, most notably how computer technology is changing the way we communicate with our audiences. For biodiversity managers and the biodiversity community at large, the challenge is to change the way we conduct our business.

Get down off our mountain tops means for me to move from a focus on research about species and ecosystems to a focus on partnering for change with people in other sectors – in government ministries, universities and businesses. This implies a paradigm shift and a change in culture in the biodiversity community. We have to become a learning community. The community also has to set the example, 'live' the change or walk the talk, individually and as organizations. Credibility and reputation are based on what we do and how we do it, not merely by putting a new marketing spin on our messages.

Analyze the chemistry of change means for me that we have to realize that information alone does not lead to change. In the past, the biodiversity community has relied too much on legal and financial instruments. It has not paid enough attention to the question "What actually makes people or organizations change?" How do we move from one-directional communication to two- or many-directional communication? How do we 'brand' biodiversity? How do we 'frame' hot issues? How do we find motives? How do we become a learning community?

The paper draws on my practical experience as a consultant in many biodiversity conservation projects around the world; on advice, suggestions and contributions from colleagues[2]; and on information I have 'googled' from the world wide web. So instead of references to literature, you find footnotes referring to URLs.

Communication challenges in the 21st century

When we communicate about biodiversity we face many challenges. We use too much jargon, the concept is not well-understood, and our audience – already burdened by information overload – is fragmenting as new media technologies give people more options in how they obtain information. The Executive Secretary to the Convention on Biological Diversity mentioned some of these challenges earlier this year when he said that our messages may turn people off instead of inspiring them to take action:

"Traditional messages on biodiversity from governments and NGOs urging the public and other stakeholders to change their daily practices need to be reviewed. Often these messages use too much jargon, are negative, too didactic, abstract or filled with doom. Instead of turning people on, they risk switching them off. The lesson to be learned is that communication has to be strategic, positive and tailored to different circumstances and cultural situations."[3]

The European Center for Nature Conservation (ECNC) cautions that research reports are only the beginning of efforts to communicate biodiversity:

"Biodiversity is a subject that generates weighty research reports backed up by painstaking research. These reports have only a small impact on policymakers and the general

[1] Frits Hesselink is managing director of HECT Consultancy, specialized in stakeholder management, strategic communication and knowledge management (www.hect.nl). He is a former Chair of the IUCN Commission on Education and Communication (CEC) (1994-2000) and the lead author of the 2007 CBD Toolkit on Communication, Education and Public Awareness (CEPA) (http://www.cepatoolkit.org). He is also the author of the blog 'The Art of Positive Change': http://cepatoolkit.blogspot.com.

[2] The author would like to offer special thanks to IUCN CEC members and colleagues David Ainsworth, Andy Alm, Peter Bos, Gwen van Boven, Susana Calvo, Elisabeth Crudgington, Jinie Dela, Tommy Garnett, Susan Guthridge-Gould, Wendy Goldstein, Sandra Hails, Wiepke Herding, Eddy Idle, Gillian Martin-Mehers, Sylvi Ofstad, Ana Puyol, Erika Vohman and Keith Wheeler for their help in reviewing, commenting and contributing to this article.

[3] Dr. Ahmed Djoghlaf, Executive Secretary to the Convention on Biological Diversity in his foreword to the CEPA Toolkit (www.cepatoolkit.org).

public. In part, this is because of the information overload: there are so many reports, so much information, that people are no longer willing or able to absorb them all. Generally speaking, between 20 seconds and five minutes are spent on research reports on which people have sometimes worked for years. That means that research reports are not the end, but the beginning, of intensive communication activities in which the message has to be conveyed

to the target group. The target group may consist of policymakers or the general public."[4]

The Royal Society for the Protection of Birds (RSPB) finds that existing efforts to conserve biodiversity are hampered by fragmented and confused communication. The 2006 study on 'Communicating Biodiversity'[5] argues that if biodiversity were better understood, it would be better protected. It recognizes a need to brand biodiversity and build it into a known and valued concept which can compete effectively for people's attention, time and dedication. In addition to challenges specific to biodiversity issues, we must contend with challenges particular to our audience, such as their attitudes, perceptions, media habits as well as competition for their time and attention.

In my own work, I have found that for the general public in most countries[6], environment is a lesser concern than crime, education or security. Biodiversity is of even less a concern than the 'environment'. The public – especially in the OECD countries – lacks a real connection with nature. Children and young people are increasingly disconnected from the natural world. They have come to think of nature as more of an abstraction than a reality[7].

And there is increasingly more noise in the system, which makes it even harder for people to hear our biodiversity message. We are competing with so many other messages when we want attention for biodiversity. When we analyze the competition, we can develop strategies. In the near future, for example, we will see more conflicts and disasters. We can prepare to use these events as opportunities to increase people's understanding about how they relate to biodiversity and sustainable development.

Also, the battle for consumer leisure time has only intensified in the 50 years since television gained widespread popularity. Today a vast variety of entertainment and information options are available to people in their homes. Media has multiplied and fragmented. Media habits – especially among young people – are fragmenting and changing more every day. TV consumption by youth is less than that of elder generations. Instead, they are making use of recent computer-based technologies such as the DVD, MP3, Podcasting, Skype, blogging, wikis, video games, MySpace, YouTube and Facebook. More than ever before, individuals are making choices about when and how they use media. The amount of information in general pumped at people has grown tremendously over the last decade; at the same time, people are in control of which information they want to take in. It's not the way it used to be.

If the conservation community wants to succeed and halt the loss of biodiversity, it needs real and deep changes in how it communicates. The big question is: Do we continue with business as usual? Or, do we take these trends and changes in society into account when we communicate biodiversity? In the following three sections I offer suggestions about how to begin to deal in a different way with this challenge. The suggestions are framed as:

- Get down off our mountain tops
- Walk the talk
- Analyze the 'chemistry' of change.

Getting down off our mountain tops

The way we deal currently with biodiversity conservation is a system that operates on the basis of research. Scientific information is translated into a logical system of objectives, measures and actions. We work within this system, often according to funding available, with governments, the private sector and NGOs. Communication of our objectives, measures and actions often boils down to telling people what to do. For years the system has operated in this fashion. Meanwhile, negative impacts on biodiversity continue. We must question whether this logic will ever produce the desired changes. The crucial question is: what change do we want to see in the world and are we prepared to overcome the psychological barriers of being comfortable with the status-quo, and happy just complaining about the loss of biodiversity. It takes courage and personal and institutional change to get out of this comfort zone and make things really happen.

To make an impact in a fast changing world, conservation and sustainable use of biodiversity has to get down from its mountain tops. Coming down in the sense of realizing that there are different ways of seeing the world, from our different social, cultural, academic and political perspectives. Instead of talking to each other, we have to talk and engage with other sectors. Other ministries, other levels of government. The private sector. Other sciences, disciplines and trades. In short we have to get out of our own perspectives and learn how to intelligently put biodiversity on the agendas of others who view the world differently. This includes learning to identify the right times, the right places, the right language to use and stories to tell, and the right ways to engage people in meaningful dialog. We need

[4] Anneke Oosterhuis, ECNC 2006, Communicating biodiversity to policymakers and a wider audience, http://www.alternet.info/SITE/UPLOAD/DOCUMENT/Outputs/ANet_WPR2_2006_D3a_Communicating_biodiversity_to_policymakers.pdf

[5] Tim Kitchen, The Glasshouse Partnership, *Assuring Biodiversity — A brand-building approach*. Summary note of white paper commissioned by the Royal Society for the Protection of Birds (http://www.beyond-branding.com/BrandingBiodiversity.pdf)

[6] Frits Hesselink, Global Perceptions of Environment and Sustainable Development 2002-2003, IUCN 2003, http://cec.wcln.org/index.php?module=pagesetter&func=viewpub&tid=15&pid=40

[7] Richard Louv, The last child in the woods, saving children from nature-deficit disorder, http://www.thefuturesedge.com/

action strategies that build on likely scenarios for each different group we work with and hope to have join us.

This is what happens to ecologists stuck on their 'ecology mountain top': Ecologists often are totally sidelined when sanitation engineers do their work in slums for poverty alleviation programs. Ecologists carry out their research in their own 'silo'. Meanwhile, the sanitation engineers carry on with their planning. Sometimes ecologists are too late in communicating the message that the system will affect wetlands upstream or downstream. Sometimes the ecologist's language does not appeal to engineers, perhaps because it does not offer concrete solutions they immediately can apply. So the reaction of these engineers about the loss of the wetland is 'sad, but let's move on'.

More and more large, integrated environmental management programs (often managed and funded by multilateral donors) include biodiversity and nature conservation. This provides an excellent entry point provided bottom-up and interactive communication is built-in substantially and strategically from the very beginning. Governments are responsible for policy and its practical implementation. Here also much progress is still to be made. Cross-sectoral, integrated approaches are needed to deal with current demands on natural resources. The tunnel-vision that still exists in many cases is inhibiting progress at that level. Communication can play an important role towards this integration if used as a strategic management instrument instead of an end-of-pipe knowledge transfer instrument.

For organizations dedicated to conserving biodiversity (and for government ministries), getting down off our mountain tops demands a paradigm shift. The matrix illustrates this paradigm shift.

Experience from my consultancy practice

My clients work on a large logical program of objectives, measures and actions. At some point in time the scientific logic and the realities on the ground seem to clash. The results of the project are in danger. I am asked to help with this 'communication' issue. But change has its own logic. My challenge is to introduce principles of change management, marketing and communication and softly guide the biodiversity experts towards a set of final products that may work. They realize that now they will make impact. In the meantime, however, more than 80 per cent of the investment has been in research that we do not really need for the impact. This makes me wonder: Is it not time to change the logic of the biodiversity system?

What I have learned is that investments in small, concrete improvements of socio-economic conditions in communities trigger biodiversity success in the larger system.

The lessons are: Concentrate on doing one thing well. Implement easy-to-do projects that promise immediate and visible success. Action speaks louder than words. Word of mouth then creates positive change.

For example in my clients' context such small learning by doing interventions could e.g. be to introduce improved potato cultivation or local cattle breeding. To set up a partnership to collect, clean, dry and market local herbs, honey, syrup from pine branches, berries (for jam), walnuts, sweet chestnuts and hazelnuts, mushrooms etc. To market a yearly local festival of folklore, crafts and arts. Turn authentic village homes into guest houses. Stimulate solar energy. Manage municipal waste. Restore public parks. These small changes will trigger positive change for biodiversity in the larger system. Starting at the larger level almost never produces lasting results. It has to come from working on both levels. The larger system and the concrete small steps. This is difficult and time consuming and costly, but it necessary when we want real impact.

The biodiversity community getting down off its mountain tops: paradigm shift[8]

Vision	From	To
Conservation & sustainable use is	The overall goal	One of the means towards sustainable development
We cooperate	To get more power	To realize synergy
We act	To win	To share in success
Biodiversity experts should be	In control of all activities	Advisors in larger teams
Important for us is	Research logic & formalities	Impact on the ground
Knowledge is	To be translated and packaged by communication	To support transactions and communication with partners
If biodiversity is not a priority	We lose	We learn
The way we deal with risks is	We avoid risks	We take risks

[8] http://cepatoolkit.blogspot.com/2007/08/getting-out-of-our-silos.html; Originally I used the phrase 'getting out of our silos'. Silos in the sense of segregated business or organizational units that do not integrate strategies. My colleague Andy Alm reminded me I should practice what I preach and use a better metaphors, which he kindly offered and I integrated them in the text.

The new paradigm and culture shift has to be internalized in the organization: experts have to learn to tailor their knowledge generation and their messages to the language and concrete priority issues of the end users in other sectors. Knowledge generation has to support transaction and communication with other sectors instead of the other way around. Currently the paradigm still is that biodiversity experts create knowledge that has to be translated and packaged and then communicated to other sectors. Similarly we often think that a protected area is the ultimate goal and not a means towards conservation and sustainable development. And much of our actions are based on the idea of competition and trying to win from other interests

Getting down off our mountain tops means to focus on non-expert audiences and not on the converted[9]. A focus on improving social networks that foster knowledge exchange and knowledge creation. Using new tools of relationship management, e.g. the emerging online entrepreneurial social networking tools such as tagging, blogging and recommender systems. Biodiversity must be positioned and packaged as a credible solution for the priority issues of other sectors. We can, for example, present the Maya nut as a means to alleviate poverty, or the mangrove as an option to mitigate the effects of climate change. The following case study[10] about the Maya nut illustrates the new paradigm and the role of communication and learning.

Maya nut case	
Biodiversity issue	Maya nut *(Brosimum, alicastrum)* forests around the Maya Biosphere Reserve in Guatemala are threatened by increased pressure from human settlements, e.g. lack of alternative sustainable land use practices in the buffer zone of the Reserve, high dependence on fuel wood etc.
Conservation interventions before the project started	The conservation interventions were mostly stand alone legal and technical measures, focused on the bio-reserve, without taking into account sustainable buffer zone management, the needs of the local people and the positive role women can play
Results before the project started	Continued deforestation; uncontrolled wildfires; illegal logging and cattle ranching in reserve and buffer zone. Continued increase of poverty of a growing local population. Increased conflicts between resource managers and communities. Increased dependence of communities on external entities to resolve problems. Weakening of local governance.
Project interventions that triggered change	Information meetings with local women on health, food, income generation and the Maya nut. Business model to set up low costs trainings by local women to market the conservation, planting and different opportunities for sustainable use of the Maya nut in the region. Empowering local women and communities to understand and resolve their own problems using local skills, knowledge and resources. Development of autonomous community groups able to work independently of outside influence.
Supportive interventions	Free publicity and fundraising through website of the Equilibrium Fund, international awards and carbon footprint calculator. Connecting the initiative with institutions that can support other aspects of this program (business plan design, product development, marketing, fundraising etc.)
Impact	Conservation of existing Maya nut forest. Planting of 250,000 new trees. Income generation for local communities with positive impact on education and health. Creation of the largest women-owned and managed business in Guatemala. Paradigm shift from export crops to subsistence crops. Improvements in women's status as participants in conservation and economic activities in the region and in Guatemala as a whole.

[9] CEC Chair Keith Wheeler commented on this issue "in a world with 500 channels of nature edutainment and only the converted listening...how can we ever expect to break through to the masses."

[10] The case is described for the blog The Art of Positive Change (http://cepatoolkit.blogspot.com/2007/06/blog-post.html) by Erika Vohman, Executive Director of the Equilibrium Fund. For more information on the Mayanut project: http://www.theequilibriumfund.org/

I am pleased to report that the paradigm is shifting and the conservation community is already starting to get down off our mountain tops. A case in point is the World Conservation Union (IUCN). Corporate posters produced this year ask "What can an ecologist learn from an engineer?" and "What can an engineer learn from an ecologist"? They appear on the back covers of the last two issues of the IUCN magazine *World Conservation*[11]. The Secretariat of the Convention for Biological Diversity is working to realize ways that biodiversity can be of value to business and for development. A start is made to work on messages that point out that without biodiversity, you don't have the resources and ecosystem services for development.

No longer is the interaction between ecology and economy about the one winning and the other losing. It is about joint learning for sustainable development. Conservation and sustainable use are not stand-alone goals but the means to move the world towards sustainable development. It is a good start, but much more has to be done to really be '*getting down off our mountain tops'*.

Walk the talk

Change is an individual and emotional event that depends on collective actions for success. If the conservation community wants to provide leadership towards change in conservation and sustainable use of biodiversity, we have to make a special effort towards personal change that will inspire others. Our offices should be sustainable[12], the ecological footprint of our meetings minimal, and all of our activities a source of inspiration about how things can be done differently. If we want people to follow our scientific advice, we should walk the talk.

Why should others implement the changes we require of them, if we as the environmental leadership do not perform the required behavior? There is nothing more powerful than observing leaders making a sincere effort to model the actions and behavior they request from others – and nothing more disillusioning when they do not.. When employees, colleagues and other stakeholders see that the leadership is walking the talk, the message is taken much more seriously. Environmental leaders will change both on the personal and the professional level when they understand that what really matters is what they do, not what they say.

The psychology of personal and professional change works in two ways: it strengthens your own leadership abilities and it affects your audience. Your audience appreciates that you personally know what it means to make an effort to change. People trust you more as you have undergone the often painful experience of change. They like to follow a leader who has the courage to overcome obstacles.

'Walking the talk' also strengthens your leadership abilities. When you 'live' the change, it is easier to talk about it in simple terms. Your speeches will be more authentic. It enables you to listen better to those you want to change, as you can connect better with their concerns and needs. It contributes to your reputation, integrity and credibility, especially if you invite others to provide feedback where you can improve your actions and behavior.

Successful implementation of the Convention for Biological Diversity asks for this type of leadership. International environmental organizations and Ministries of Environment are looked up to for such leadership. Within these institutions are leaders who are responsible for biodiversity. There are many personal and professional changes that leaders can make in their actions and behavior[13], for example: In a country where invasive species is a priority issue, a leader might look at his or her garden at home: If it is filled with non-indigenous plants, then change it. If a major issue in the country is a bird species, what provisions for birds are made in their garden for birds? If the main issue is water, how is water managed in the garden and home? In general, leaders walk the talk when they are mindful of the ecological footprint of their own households. Of course one cannot be perfect or totally consistent, but one can make a serious effort.

Professionally, walking the talk requires that we look critically at the footprint of our institutions. How do we use water, energy and paper in our offices? How do we go about procurement, human resource management, travel and other policies? To what extent are our public meetings also a real experience of biodiversity and sustainability[14]? And, when speaking, writing or conducting meetings, to what extent are we consistently referring to our biodiversity vision and how that vision aligns with our own beliefs and values?

Analyzing the chemistry of change

Most of our communication is still based on the mistaken idea that knowledge will lead to change. Nothing is further from the truth. We have to understand that between knowledge and change a process of 'chemistry' is taking place. This process is like a 'soup of unknown ingredients', it is driven by 'winds from unfamiliar quarters' and is complex like the pattern of stars.

Instead of concentrating on acquiring more knowledge we have to start paying more attention to analyzing this chemistry. Communication, psychology and learning belong to

11 http://www.iucn.org/publications/worldconservation/docs/2007_07/00_world_conservation_2007_07.pdf

12 The Secretariat for the Convention on Biological Diversity, e.g., is doing this with its plan to green the Secretariat. The IUCN and WWF offices in Switzerland recently engaged in a week-long competition on which office would be best at reducing its CO^2 footprint. The contest showed that positive change is possible, so why not make the changes permanent?

13 http://cepatoolkit.blogspot.com/2007/08/walking-biodiversity-talk.html

14 http://cepatoolkit.blogspot.com/2007/07/conference-cup-not-bag.html

the domain of the chemistry of change. Communication in the sense How to create word of mouth, how to frame the debate, how to find the motives for change in the audience/group? Psychology here means how does our mind function? And learning in the sense of how do individuals, organizations and communities learn for change?

As a subject, biodiversity is a real challenge. Biodiversity is described by different organizations in different ways. The CBD description is technical, while other definitions are descriptive, emotive or motivational[15]. They are not easy to remember. They do not 'stick' or 'click' with the general public. For a communicator trying to 'sell' biodiversity, the concept does not seem to address any specific human needs or segmented audiences. Biodiversity does not ring a bell among the public. There is no one big story. It has no flavor. It does not resonate with emotional values.

We need analogies or metaphors that are easy to remember and illustrate the essence of biodiversity. RSPB has addressed this issue from the branding perspective. The Frameworks Institute[16] recently studied the framing of global warming[17] and touched on the same issue. But some scientific concepts DO resonate with the general public. When analyzing these concepts, we see that we must be willing to concede a little scientific and philosophical purity if we want to communicate these concepts to the public. Analogies or metaphors are very effective if they are catchy in brief exposures (a few sound bites), easy to understand and remember, and so 'contagious' that we want to think, talk and learn more about the concept[18].

We may even have to reach beyond metaphor to find parables, stories, myths, iconic creatures or characters that symbolize biodiversity, and humanity's interdependence with a diverse, interconnected web of life and natural processes. The salmon has been resurrected from native American myth as a totem creature representing biodiversity in the West of the US. It connects the mountains to the sea via the rivers it traverses, and the three-year cycles of its spawning migrations provide a compressed view of our own mortality. Many societies hold such stories.

In his book, "Last Child in the Woods: Saving our children from nature-deficit disorder", Richard Louv[19] has managed to personalize the loss of early childhood experiences in the outdoors over the past stories the older generations find familiar, resonant and treasured. The lack of such experiences for these elders' children and grandchildren is a loss that can be felt as personal pain. This pain is a motivator for change.

The task for the biodiversity community is to bring together both communication and biodiversity experts to brainstorm metaphors. This cannot be done only with biodiversity experts. I tried this once, and they came up with analogies that do not stick, such as 'the magic of life, 'the engine of nature', 'the natural health service', 'the capacity for change', 'the game of consequences', and 'the missing link in decision making'. If we can make biodiversity resonate, it is much easier to communicate.

In communicating biodiversity issues, analyzing the chemistry of change leads us to understand the importance of framing. In most countries, it seems that the conservatives in politics set the tone of debate by framing the issues as in the examples of 'free market', 'tax relief' and 'war on terror'[20]. The progressives mostly forget to reframe the issues and have a tough time attracting attention for their views. In the same way the conservation community pays little attention to framing or reframing issues: 'green coals', 'bio-fuels' and 'genetically modified' are framing the discourse. These frames make it very difficult for the conservation community to formulate their views in a way that is credible and convincing to the public.

Framing[21]

People have conceptual maps in their minds – "frames" – that help them to sort incoming information quickly and to make sense of it. The first words of a story can trigger a certain "mental model" in people's minds so that they say to themselves, "Aha, so this is about…" and stop listening to the details. This can make it difficult to change people's ideas. Research shows that 'framing' is a valuable tool for redefining an issue.

If we talk about bio-fuels our mind immediately associates bio with positive connotations such as biological and environment-friendly. We do not want to listen anymore to negative connotations. 'Agro' is associated with large-scale industrial production and intensive land use. That makes it easier to talk about related issues such as land taken away from local food production.

[15] http://www.beyond-branding.com/BrandingBiodiversity.pdf

[16] http://www.frameworksinstitute.org/strategicanalysis/perspective.shtml

[17] http://www.ucsusa.org/assets/documents/jump.jsp?origID=pdf-511

[18] The Framework Institute offers some examples of difficult scientific concepts that do resonate with the public: "The heart is a pump", "The eye is a camera", "The cell is a factory", "The kidney is a waste filter", "The brain is a computer", "Photosynthesis is like baking bread"
"Global warming is caused by a CO2 blanket".
http://www.ucsusa.org/assets/documents/jump.jsp?origID=pdf-511

[19] Richard Louv, The last child in the woods, saving children from nature-deficit disorder, http://www.thefuturesedge.com/

[20] http://www.berkeley.edu/news/media/releases/2003/10/27_lakoff_p2.shtml

[21] CEPA Toolkit, Section 1, page 27, http://www.cepatoolkit.org

The chemistry of change also is concerned with logic. Change does not occur through normal logic; it has a logic of its own. Communication research shows that the story of one person is far more compelling than an appeal for a group of people. The group's plight remains far more abstract. Logic tells us that a bigger problem should get more attention. One person suffering from a disease is certainly bad, but a thousand afflicted individuals should motivate us far more. But it doesn't work that way. The box below shows that our brains operate in an illogical and perhaps unexpected manner.

The power of 'one'

Decision Research[22] measured the contribution levels from people shown pictures of starving children. Some subjects were shown a photo of a single starving child from Mali, while others were shown a photo of eight children. The subjects shown a group of eight starving children contributed 50 per cent less money than those shown just one. Clearly, non-profit marketers need to make their marketing efforts as personal as possible. This is real "one-to-one" marketing. Our brains are wired to respond more strongly to an individual plight than the same condition afflicting a group.

The conservation community can learn a lot from the Oprah Winfrey show. All issues are personalized. Personalization works two ways: (1) Insert the name of your prospective donor, program, participant or volunteer into your e-mail, letter or broadcast; and (2) Personalize the recipients of the donations or volunteer work. When you do, your audiences will get a real sense of the difference their gift or participation makes in a fellow human's life.

Pain and fear are also important elements of the chemistry of change. Fear is an important driver in human emotions. And so is the immediate calculation by our mind whether we have any personal control over the issue. And whether the pain of change is less than the pain of not changing. Warnings about the dangers of children playing with firecrackers or riding in cars without seatbelts have an immediate, horror outcome – and safety measures are under our personal control. These messages are easier to act upon than messages about smoking, over which we have personal control but the horror scenario is long term. Likewise, they are easier to act upon than messages about biodiversity, over which we have no personal control and the horror outcomes are far away. The UK based organization Futerra has published two books with practical tips how to handle the 'chemistry of change challenges' in 'Rules of the Game'23 and 'New Rules: New Game'[24].

Change the Message to Save the Planet[25]

Dropping environmental slogans like "save the planet" and rather focus on "intelligent living" would make a big difference. People want to make things better. No one feels motivated to do something that simply makes things less bad. They need a positive vision. People want personal gain. That gain need not be financial: it could be an improvement in their health, happiness or status. People never want to live with less. But people are prepared to live differently, and they are happy to make the change if they are persuaded that this will bring other benefits.

A last, and maybe most important, element of the chemistry of change is about learning. How do individuals, organizations and communities learn for change? Learning[26] for change is a process, which takes time and investment in coaching and facilitation. To find new ways of managing learning across cultures and disciplines, and collectively creating and managing new knowledge for sustainable solutions, approaches emerge that combine change, knowledge and learning management principles. It also means that the biodiversity community itself should become much more a learning community and invest in mechanisms to share knowledge. In communication we could e.g. learn much from the Equator Initiative of UNDP[27].

That is exactly what Al Gore has done with his film 'An Inconvenient Truth'[28] and the global communication campaign around the movie. It triggered word of mouth, free publicity and, finally, even more exposure through an Oscar and a Nobel Peace Prize. From a communication perspective I would say that the following features contributed to the success of Al Gore's interventions:

- the concessions to scientific purity in the way complexity is captured
- the link with simple actions we can take in different responsibilities
- the personalized approach (one to one marketing)
- the metaphors to illustrate data and figures
- the information 'hooks' for peer exchange and learning
- the campaign with active learning events and easy access to the video
- the development of cadres of multipliers
- the use of social networking and new media.

The biodiversity community should take an example in this approach and shift from investing most of its resources in research into investing them in the learning for change processes towards sustainable development.

[22] http://www.decisionresearch.org/

[23] http://www.futerra.co.uk/downloads/RulesOfTheGame.pdf

[24] http://www.futerra.co.uk/downloads/NewRules:NewGame.pdf

[25] Gillian Martin-Mehers pointed me to an article with this title in The Guardian by George Marshall; http://www.truthout.org/issues_06/101507EC.shtml

[26] Keith A. Wheeler, Learning for Deep Change in: Journal of Education for Sustainable Development 2007 1: 45-50; http://jsd.sagepub.com/cgi/reprint/1/1/45

[27] http://www.undp.org/equatorinitiative/

[28] http://www.climatecrisis.net/

Conclusions and recommendations

We are witnessing a paradigm shift in the way the world works. The conservation community needs to embrace it. The world has become too complex, too interlinked for a simple command-and-control scheme, for one-off action-response projects. The new paradigm uses learning, it uses networks, and systems-thinking. This means moving from one-directional communication to two- or many-directional communication. This in itself is a change process for the biodiversity community. It is a matter of "getting down off our mountain tops, walking the talk and analyzing the chemistry of change". If biodiversity organizations are to change it must start at the top and be driven through against a lot of resistance. It's a challenge to those leaders.

To successfully implement the Convention on Biological Diversity and to halt the loss of biodiversity the global biodiversity community needs more than ever practical and realistic approaches. Such approaches can be characterized by:

- Leadership for change, setting the example of what it means to 'live' conservation and sustainable use of biodiversity.
- Looking for entry points for biodiversity issues in the agendas of the 'non-biodiversity community' and cooperating in transparent partnerships with respect for other interests, perspectives and methodologies.
- Recognizing that between knowledge and change is a process of 'chemistry': communication, networking, learning and the psychology of change.

To make the necessary changes towards such practical and realistic approaches, I would recommend to the leadership of the global biodiversity community:

- Get down off our mountain tops: We should invest more in knowledge about entry points for partnerships with other sectors and as a support for transactions with other sectors, instead of asking communication translating & packaging biodiversity knowledge.
- Walk the talk: We should make our biodiversity events into real 'learning experiences' and the biodiversity leadership should 'live' the change
- Analyze the chemistry of change: We should bring together the best expertise to brand biodiversity, reframe major biodiversity issues, find motives for change and the best methods of learning for change in a range of sectors and cultures and we should use the results of this analysis when we formulate objectives, measures and actions. We should not use communication stand 'alone' or 'end of pipe'.

The Role of Biodiversity In Reaching the MDGs and the Issue of Trade-offs: How to "Win More and Lose Less"[1]

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Section 1: Biodiversity Goals and the MDGs: The Stars Are Coming Into Alignment

The Millennium Development Goals are a set of goals, with specific targets and indicators, designed to address and reduce poverty in its various dimensions by the year 2015. These targets and indicators were set during the 1990s over the course of numerous international conferences and summits and were later integrated in the Millennium Declaration that was adopted by 189 nations and signed by 147 heads of state and governments during the United Nations Millennium Summit in September 2000. Five years later, in September 2005, the MDGs were reaffirmed by every country.

Box 1. The Eight Millennium Development Goals

Goal 1:	Eradicate extreme poverty and hunger
Goal 2:	Achieve universal primary education
Goal 3:	Promote gender equality and empower women
Goal 4:	Reduce child mortality
Goal 5	Improve maternal health
Goal 6:	Combat HIV/AIDS, malaria and other diseases
Goal 7:	Ensure environmental sustainability
Goal 8:	Develop a Global Partnership for Development

During this same period of time, the Convention on Biological Diversity set the 2010 Biodiversity Target, to "significantly reduce by 2010 the current rate of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation and to the benefit of all life on earth." MDG 7, ensuring environmental sustainability, makes biodiversity degradation an issue of global concern. Given that more than 1.3 billion people depend on fisheries, forests, and agriculture for their livelihoods, it only makes sense that biodiversity matters to the poor. Further to this point, healthy and diverse ecosystems are even more important to the poor.

[1] With appreciation to the Government of Norway for assistance that has made this work possible

The reliance of the rural poor on ecosystem services is typically overlooked in national statistics and poverty assessments. Research has shown that access to healthy ecosystems is a key determinant of rural income (the ability to tap natural resources, through access to land, boats, agricultural technology, or other means). For example, forest products make up 20% of household income, on average, and environmental factors are directly connected to 20% of health problems in poor countries. Environmental capital and biodiversity are critical assets for developing economies. Environmental capital makes up 26% of national wealth in non-oil exporting poor countries, making it important to realize that income growth is illusory if it is based on non-renewable 'mining' of these environmental assets.

The poorest societies are also most vulnerable to environmental degradation due to diseases, declining fisheries, and desertification. For example, half of the urban population in developing countries suffers from diseases associated with inadequate water and sanitation. The declining state of capture fisheries is leading to the reduced availability of fish, an inexpensive source of protein in developing countries. The degraded biodiversity of crop species is leading to declining food production in areas such as sub-Saharan Africa where the population continues to increase. With specific cultural roles and often limited rights, women and marginalized groups such as indigenous peoples are particularly affected by the degradation of ecosystems.

These facts directly counter the perception that sound environmental management is optional in the pursuit of economic growth by developing countries. Policies are available to secure development that maintains environmental assets while raising average incomes – and it is our obligation as policy makers to make use of them. The conservation and sustainable use of biodiversity and other ecosystem services is key to the achievement of the MDGs.

Box 2. Examples of the Contribution of Environment and Natural Resources to Economic Growth

Kenya:

- Forest products and services contribute about Kshs 7 billion annually to the economy and directly employ 50,000 and indirectly another 300,000 people.
- Over 530,000 households living within a radius of five kilometers from forests depend on them for cultivation, grazing, fishing, fuel wood, honey, herbal medicine, water and other benefits.

Rwanda:

- Soil erosion is the cause of a 30% fall in farm productivity. Conservative estimates show that the cost of soil loss alone may be up to 1.9% of GDP.
- In Rugezi wetlands degradation within the last three decades has resulted in falling water levels in Bulera and Ruhondo and led to the current energy crisis in Rwanda, threatening the economic development model based on Information Technology which requires reliable electricity.

Tanzania:

- Natural resource use provides the main source of livelihood for 76% of rural people, and fuel wood provides 95% of energy for the entire population.
- Agriculture accounts for 45% of GDP and 60% of export earnings.
- Tourism, mining and fisheries, as other key sectors of the economy, also depend on the sustainable use of natural resources. Yet all these sectors have been suffering from environmental degradation.

It makes sense then to integrate Biodiversity and MDG Frameworks. Decision VIII/9 of the 8th Conference of the Parties to the Convention on Biodiversity outlines this dynamic, noting that the Millennium Assessment finds that the degradation of ecosystems could significantly increase in the first half of this century, and that this degradation is a key barrier to achieving the MDGs. At the same time, many actions to promote economic development and reduce hunger and poverty could contribute to the loss of biodiversity.

Biodiversity exists within a social, economic and political context – we can't achieve the 2010 target outside of this context. The MDG campaign addresses sectors posing the greatest threats to biodiversity: agriculture, forests, fisheries, energy, transport and trade. The long-term success of the MDG campaign depends on sustaining biodiversity and ecosystems that provide key services to society.

The 2010 Target cannot be achieved without the engagement of a wide range of players, including the 'MDG community.' Conversely, the success of the MDG campaign depends on progress towards the 2010 Target. Fortunately, recent events have conspired to bring these two frameworks together. What we know so far is that at the national level, having national action plans, like NBSAPs, on biodiversity in isolation from other sectoral policies is not maximally effective and offers little chance achieving biodiversity targets and commitments. This is obvious because the key drivers of biodiversity loss lie in the productive sectors of agriculture, forestry, fisheries, energy, and transport. Instead, the key to meeting biodiversity targets at the national level is to integrate the targets into these other sectoral plans and national development planning frameworks. So the success of the 2010 Biodiversity Target and the MDGs depend upon each other: Development impacts biodiversity and ecosystems and, conversely, biodiversity and ecosystems sustain development.

Section 2: Countdown to 2015, how are we doing?

This summer we came to the midpoint for the MDGs – 2007 is halfway to 2015. When tracking progress towards the MDGs and looking at global and regional trends, it is important to bear in mind the difficulties in monitoring progress. First, there are over 50 indicators for the targets related to the MDGs. Secondly there is no single source of data collection. Many organizations, including OECD, the World Bank, and other institutions submit their relevant data to the UN Statistical Division and different methodologies are used for collecting data, which makes it difficult to compare. Furthermore, many of the least developed countries lack capacity to collect and analyze data. Where the data exist, they are sometimes not reliable or comparable to other data. However, there is a big push in the UN system now towards standardization of data collection methodologies and to build capacity at the country levels to address these issues. Finally, this is also a fairly new endeavor, as it was not until 2005 that the first comprehensive review was conducted.

Progress reports from the MDG Campaign:
MDG 1 and 2: On progress on income poverty, the target is to halve, between 1990 and 2015, the proportion of people whose income is less than $1 a day – this has been achieved mainly in Asia, with least progress in Sub-Saharan Africa and problems in Latin America and the Commonwealth of Independent States. The goal to achieve universal primary education, the target being that all children everywhere will be able to complete a full course of primary schooling, is in sight, but Sub-Saharan Africa is again among the regions that lag behind.

MDG 3 and 4: On achieving gender equality, the target is to eliminate gender disparity in primary and secondary education preferably by 2005 and in all levels of education no later than 2015, there has been progress made but the gap persists with respect to the ratio of girls to boys in primary and secondary education. The largest gap between the ratio of girls to boys in primary and secondary education is in Sub-Saharan Africa. Progress on reducing child mortality, the target here being to reduce by two-thirds, between 1990 and 2015, the under-five mortality rate has improved in most regions, but the target is not in sight in many of them. Again the largest gap is in Sub-Saharan Africa.

MDG 5 and 6: With respect to the goal to improve maternal health, the data related to the target of reducing the maternal mortality rate shows that it remains high in places with the highest death rates (Sub-Saharan Africa and Southern Asia). On combating HIV/AIDS, malaria and other diseases, the death rate and new infections keep rising, and the lack of progress to combat HIV/AIDS is a particular challenge.

MDG 7: The data related to this goal shows a lack of progress on most of the targets, but achieving the target access to safe water is in sight in several regions, except for Sub-Saharan Africa, Oceania and the Commonwealth of Independent States in Asia. Furthermore a report released by UNDP and UNEP at the end of last year, showed that some countries including Egypt, Peru, Vietnam and Mongolia are among a number of countries taking the lead in putting the environment at the heart of their plans to cut poverty by 2015. However, the report also showed that unless more governments take more ambitious steps to protect the natural world, overall progress of the millennium development goals will be jeopardized. Finally with respect to the goal on developing a global partnership for development, we have observed that development assistance has increased but that the specific targets are not yet met; and that the debt burden has decreased overall but remains still high for some countries.

What we cannot observe in the reported progress towards the achievement of the MDGs is the relative progress that countries have achieved. At the half-way mark for the Millennium Development Goals, we can celebrate the fact that almost all countries, including in Africa, have made some progress toward most of the MDGs. More importantly, it is in some of the poorest countries in the world such as Mozambique, Rwanda, Bangladesh and Tanzania that we have seen the most spectacular progress; these countries are now on track to achieving several Goals, proving beyond doubt that the MDGs can be achieved and exceeded by most countries. Interestingly, it is also in some of these countries where we have observed most progress on MDG 7 to ensure environmental sustainability.

Why are some countries more on track than others? When we reflect on the relative success of these countries, there is a clear pattern. In countries that have made the most progress, the political leadership has made a public commitment to achieving the MDGs. These are countries that have clearly articulated their own national agenda by tailoring the MDGs to the national, sub-national and even local contexts. They have moved beyond rhetoric to actually allocating significant resources in their budgets (both domestic and external) to the achievement of the MDGs. The leaders of these countries have made a conscious effort to make the state delivery mechanisms more sensitive to the needs of the poor by fighting corruption and increasing accountability. In these countries, the role of Northern donors has been to support the national agenda instead of the other way round. Media and civil society have also played a pivotal role in holding these Governments' feet to fire.

While celebrating these successes, there is no room for complacency. There are some Goals, particularly in the health arena, for which the majority of countries are lagging behind. Countries in severe conflict are lagging behind on most of the MDGs. Inequality is growing both within and between countries. Discrimination against women, racial and religious minorities, indigenous people and lower castes is the stubborn social basis for inequality. In order to correct the course of these countries, MDGs must be prioritized in the allocation of domestic and external resources in the budget and a greater focus must be placed on improving delivery mechanisms. Greater accountability and transparency at all levels and more citizen engagement will help improve progress as well. Also, international donors must line up behind national priorities so that resources are being allocated in ways that meet both national and international development goals.

In the midst of encouraging progress in some countries, climate change is becoming a serious threat to progress on MDGs and biodiversity. The physical impacts of global average temperature change will lower crop yields, decrease water availability; threaten cities with rising sea level, damage coral reefs, and cause species extinctions to increase. Climate change will cause extreme weather events, such as more intense storms, forest fires, droughts, floods, heat waves; and increase the risk of abrupt and major irreversible changes and large scale shifts in the climate system.'

Section 3: Trade-offs Between Biodiversity, MDGs and Climate Change: What Do We Know?

As a first step, the Millennium Ecosystem Assessment (MA) helps us understand trade-offs (cf. Table 1). Action to increase one ecosystem service often alters the capacity of ecosystems to provide others. For example, using nutrients to boost agricultural production can enhance such provisioning services as crops production while simultaneously degrading other resources such as fresh water due to resulting eutrophication. The MA has made an enormous contribution by illustrating the kinds of trade-offs that decision-makers face every day – and by giving them a conceptual framework which they can use to maximize benefits from ecosystem services for society. Also, it is key to remember that an ecosystem can provide a while range of services. For example, mangrove forests provide a number of services, such as nursery and adult fishery habitat, fuelwood and timber, carbon sequestration, sediment trapping, detoxification of water and air from pollutants, and protection of coastal areas from erosion and disaster. This last ecosystem service will become increasingly needed to assist in adaptation to climate change impacts.

Trade-offs between ecosystem services are real, but we can move towards "winning more and losing less". There are three types of trade-offs observed as impacts of investment decisions concerning ecosystem services:

1. Temporal Trade-offs: "Benefits Now, Costs Later" (winners today, losers tomorrow)
Overfish now – no fish or jobs later
Remove wetlands now – floods later
Overharvest forests now – no livelihoods later

2. Spatial Trade-offs: "Benefit Here, Cost There" (winners here, losers there)
Logging here – flooding there
Biofuels here – water degradation there
Shrimp here – no coastal protection there

3. Beneficiary Trade-offs: "Some Win, Others Lose" (I win, you lose)
Subsidized shrimp farmer wins – society loses
Subsidized corn-based ethanol biofuel farmer wins – society loses

When done badly, the trade-off can lead to 'lose-lose' outcomes. For example, deforesting natural forests on peat soils, burning the soil and then growing monoculture oil palm for 'biofuels', or corn ethanol-based biofuels which are neither good for the climate nor for biodiversity nor for human development: clearly 'lose-lose-lose.' Biofuel production also entails massive water use – the biomass required to produce biofuel evaporates between 1,000 and 4,000 liters of water for every liter of biofuel! Clearly this is a case of another kind of trade-off – one of competing agenda: greenhouse gas reduction vs. water availability.

Table 1. *The status of selected ecosystem services according to the Millennium Ecosystem Assessment.*

Ecosystem services	**Degraded ▼**	**Mixed**	**Enhanced ▲**
Provisioning	Capture fisheries	Timber	Crops
	Wild foods	Fiber	Livestock
	Wood fuel		Aquaculture
	Genetic resources		
	Biochemicals		
	Fresh water		
Regulating	Air quality regulation	Water regulation	Carbon sequestration
	Regional and local climate regulation	(e.g., flood protection)	
	Erosion regulation	Disease regulation	
	Water purification		
	Pest regulation		
	Pollination		
	Natural hazard regulation		
Cultural	Spiritual and religious values	Recreation and ecotourism	
	Aesthetic values		

If we can develop and implement a good deforestation avoidance scheme, it will be possible to have 'win-win' outcomes for biodiversity, climate change, and hopefully as well, for people. Without information for decision-makers and a proper valuation of ecosystem services for markets, without good governance and without giving rights and voice to local people, we will end up with truly sub-optimal outcomes for biodiversity and for human society.

The devastation of New Orleans, USA by Hurricane Katrina in 2005 is an example of the severe impacts 'temporal' trade-off can have – when short-term decisions lead to massive damage and costs later on. This was the result of the exposure of low-lying settlements to flooding risks which had increased with the ongoing degradation of coastal wetlands. It is essential then to avoid 'lose-lose-lose' situations and how to maximize 'win-win-win' opportunities.

Before we investigate how to achieve "win-win-win" opportunities, let me make a few general observations about trade-offs: Trade-offs are often about 'provisioning' services (i.e. food, wood, fuel) vs. 'regulating' services (i.e. water and air quality, soil, etc.). While 'provisioning' services (shrimps, biofuels, timber, etc.) can be moved from one place to another, regulating services are static. Yet, local people often have the most to lose because they can't easily move! When the shrimp or biofuels or timber leaves their environment after exhausting the local resources, regulating services are often degraded as a result. With such temporal and spatial trade-offs, in the end the local people are left behind to suffer the consequences.

As we know from the MA, the impacts of the conversion of land to large scale agriculture (increasing one 'provisioning' service, i.e. food) can lead to the degradation of other 'regulating' services such as the water quality of the downstream rivers, lakes and oceans. The well-being of fisheries becomes threatened. Soil erosion due to large-scale agriculture becomes collateral damage, with devastating consequences. In this case, the expansion of agriculture may take away the protective systems of the soil, water and land that impoverished people depend on. One major way to help ensure fairness and to help protect the environment is to empower the local people who have a vested interest in maximizing the benefits of the ecosystem services of an area. Similarly, it is important to ask who is winning in these trade-offs among groups of people? The one who builds the shrimp farm – i.e. the ones who can get the financial support from outside the community – by tapping into the market-based funds you and I contribute to through purchasing shrimp from all over the world!

Biofuels present a similar story – another 'place-based' trade-off like shrimp, where water quality suffers locally in exchange for benefiting others in distant places who receive the fuel produced. Again, giving rights and tenure to local people will improve the management of the biodiversity and other resources because they depend on 'regulating' services in a way that external beneficiaries of the shrimp and biofuels do not. Yet it is not only about 'rights and tenure,' it is also about facilitating opportunities for the voice of local people to be heard globally, so that they may speak truth to power. From our experience of working with this goal in mind as part of the Equator Initiative, such emphasis has produced extraordinary results.

Box 3. Examples of Biodiversity and Development (MDGs) Trade-offs:

- Shrimp farming vs. intact mangrove forests
- Roads vs. biodiversity (i.e. expanded markets vs. fragmented ecosystems)
- Agriculture vs. protected areas or wetlands (i.e. wetlands converted to agriculture can have huge costs in lost storm protection, flood control, nitrogen processing, etc.)
- People vs. wildlife (i.e. wild animals from protected areas near settlements)
- Water for agriculture, industry, households vs. water for aquatic ecosystems
- Fisherman vs. sustained fish stocks, i.e. "fish now, no fish tomorrow"; North Sea or Eastern Canada fishermen jobs and livelihoods in the short-term vs. their long-term livelihoods and ocean productivity into the future – a situation where temporary bans on fishing and no-take zones of Marine Protected Areas, might lead to 'winning more, losing less'.

Section 4: How de we ensure trade-offs "win more and lose less"?

- Make the economic case and improve access to information on ecosystem services
- Mainstream biodiversity into global, national and local planning
- Tap into and catalyze new environmental markets
- Strengthen rights of local people and give them voice

In summary, it is by promoting informed decision-making, value in the marketplace and fairness in society.

Making the Economic Case for Investing in Biodiversity and the Environment:

Box 4. Examples of net returns from environmental investments:

- Coral reef conservation – benefit-cost ratios of 3:1 to 5:1
- Wetland conservation – conversion of mangroves to shrimp aquaculture generally yields negative economic returns
- Water and sanitation – benefit-cost ratios from 4:1 to 14:1
- Soil and water conservation – generally pays although returns are very site-specific, with benefit-cost ratios up to 2:1
- Air pollution control – benefit-cost ratios from <1 up to 15:1

As mentioned earlier, unnecessary trade-offs between economic development and environmental sustainability objectives are often due to market failure, where the environmental costs and benefits are not internalized in the market. This exclusion of ecosystem services in turn is often due to incomplete information. Consequently, the protection of the services provided by biodiversity is

unlikely to be prioritized as long as they are perceived to be free and limitless by those using them. Effective policies will require true costs to be taken into account for economic decisions.

Recently, UNDP, UNEP, and partners met in Stockholm to plan for Millennium Ecosystem Assessment Follow-up and developed an action plan based on four key components: 1) Expanding the knowledge base to fill gaps from the first assessment and prepare for a possible second assessment. Economics of ecosystem change would be an example of issues addressed. 2) National and other Sub-Global Assessments to apply the MA framework to country and local levels, generating multi-scale information for a possible second assessment. 3) Support to implementation and the development of tools and methodologies, including capacity building, pilot studies and resource mobilization, to support the integration of ecosystem services into planning processes within countries and in the private sector. 4) Awareness raising and outreach.

B. Mainstreaming Biodiversity:

Successful biodiversity and environmental mainstreaming will result in policies identified and implemented that result in better pro-poor environmental management. Through mainstreaming biodiversity and ecosystem services, national plans, budget processes, sector strategies and local level implementation will be taken into account. Institutional processes will be established within government and stakeholder communities to ensure that parties responsible for poverty reduction and growth policies focus on environmental sustainability as well. The role of environmental agencies and CSOs being strengthened in governance processes is another key area of focus.

Mainstreaming is the integration of the contribution of the environment (including biodiversity) to poverty reduction and economic growth into national and sectoral development processes as well as building national capacity to do this. Environmental mainstreaming is a means, not an end in itself, which will result in a sustained country-led effort to 'operationalize' – from planning to implementation.

Successful environmental mainstreaming will result in the inclusion of poverty-environment linkages in national development and poverty reduction strategies. Capacity will be strengthened within finance/planning ministries as well as environmental agencies to integrate environment into budget decision-making, sector strategies and implementation programmes. As a result, poverty-environment linkages will be included in sector planning and implementation strategies. Capacity is strengthened in key sector ministries to include environmental sustainability into their strategies. Widened involvement of stakeholders will strengthen the case for the importance of environment to growth and poverty reduction. Mainstreaming will also result in improved domestic resource mobilization for poverty-environment investments, increased donor contributions to country-level environmentally sustainable investment and improved livelihoods and access to environmental and natural resources for the poor.

UNDP's Tools and Methodologies for Mainstreaming:

1) MDG Support Initiative

The overarching international agreement underpinning the MDG Support initiative is the 2005 World Summit Outcome (article 22a): *"To adopt, by 2006, and implement comprehensive national development strategies to achieve the internationally agreed development goals and objectives, including the Millennium Development Goals"*

The MDG Support Initiative is a UN initiative that assists countries in preparing rigorous national strategies that are ambitious enough to achieve the MDGs. (It asks the question: What will it take to achieve the MDGs? Rather than: How close can we get to the MDGs under the current constraints and given current available resources?) Made up of global and regional MDG Support teams, the initiative works with UN Country Teams in every region to assist governments with:

- MDG-based Needs Assessment and Planning
- Widening Policy Options and Choices
- Strengthening National Capacity to Deliver
- Responds to UN Reform process - UNDP & UNEP partnership and by working through 'One UN' pilot countries

An MDG Needs Assessment disaggregates the national socio-economic analysis by looking at the issues of who and where are the poor. In short, they are identifying the population in need. It also asks what needs to be done to meet the needs of the poor, by focusing on public investments (capital and operating costs) over the medium-term from now until 2015, and identifying the interventions required to meet the MDGs: goods, services, infrastructure, etc. In order to determine how much will it cost to implement the interventions prioritized through the MDG needs assessment, the tool allows policy makers to estimate local unit costs as a factor of population in need, determine the human resources required to meet each MDG and identify major infrastructure development needs. It also aims to support national policy dialogue and negotiations with donors and other development partners by allowing policy makers to clearly identify and assign a cost to the interventions required to meet the MDGs.

2) The UNDP-UNEP Poverty-Environment Initiative

The Poverty-Environment Initiative supports country-level efforts to mainstream poverty-environment linkages into national planning and implementation processes by providing financial and technical assistance and delivering capacity development programmes to government partners. PEI currently operates in pilot countries – in Africa (Kenya, Malawi, Mali, Mauritania, Mozambique, Rwanda, Tanzania & Uganda), Asia (Bhutan, Viet Nam) and Central America (Nicaragua) – with an intention to expand widely. PEI is implemented by working with national policy making teams to identify links between environmental sustainability & development goals and related governance/institutional factors that affect related policy and planning decisions and working with these policy makers to integrate environ-

mental sustainability into key 'entry points' to national development planning and policy. By taking a sectoral approach to planning and implementation, PEI aims to strengthen country capacity to mainstream poverty-environment.

PEI operates by creating a knowledge workspace/network and clearinghouse mechanism for participating countries, and facilitating inter-country exchanges for poverty-environment policy makers with the support of regional teams PEI teams. PEI maintains a website: www.unpei.org

The World Resources Institute (WRI) is also carrying out important work in mainstreaming ecosystem services into national and local planning processes. Their tool "Ecosystem services: a guide for policy makers" will be published this month.

3) Strategic Environmental Assessment (SEA)

SEA refers to a range of analytical and participatory approaches to integrate environmental considerations into policy, plans and programmes and evaluate the inter linkages with economic and social consideration. SEA can improve decision-making related to policies, plans and programmes, and thus improve development outcomes by supporting the integration of environment and development, providing environmental-based evidence to support informed decisions, improving the identification of new opportunities. By helping prevent costly mistakes and building public engagement in decision-making for improved governance, SEA aims to support better integrated poverty-environment policy making. SEA has been adopted by international agencies and country partners as a framework to further develop and apply common approaches for SEA.

There are twelve entry points for SEA:
Policies, plans & programme led by partner country governments:

- National Overarching Strategies, Programmes and Plans
- National Policy Reforms and Budget Support Programmes
- National Sectoral Policies, Plans and Programmes
- Infrastructure Investments Plans and Programmes
- National and Sub-National Spatial Development Plans and Programmes
- Trans-National Plans and Programmes

Policies and plans of donor agencies:
- Donors' Country Assistance Strategies and Plans
- Donor's Partnership Agreements with other Agencies
- Donors' Sector-Specific Policies
- Donor-Backed Public Private Infrastructure Support Facilities and Programmes

Other related circumstances:
- Independent Review Commissions
- Major Private Sector-Led Projects

SEA is a requirement of the Convention "Article 14 1(b): Introduce appropriate arrangements to ensure that the environmental consequences of its programmes and policies that are likely to have significant adverse impacts on biological diversity are duly taken into account" In response to this requirement, Voluntary Guidelines on Biodiversity-Inclusive Impact Assessment were produced and endorsed by the CBD COP 8 in Curitiba in March 2006. The guidelines provide guidance on whether, when, and how to consider biodiversity in project- and strategic-level environmental assessments. These suggest that CBD Parties should consider SEA as an approach for "improving integration of national biodiversity strategy and action plans and national development strategies".

4) CBD NBSAP Capacity Building Workshops

Another important program to help mainstream biodiversity is being organized by CBD throughout the world in 2008 with the purpose of catalyzing the implementation of Article 6 of CBD: "Each Contracting Party shall (…) (a) Develop national strategies, plans or programmes for the conservation and sustainable use of biological diversity or adapt for this purpose existing strategies, plans or programmes (...) (b) Integrate, as far as possible and as appropriate, the conservation and sustainable use of biological diversity into relevant sectoral or cross-sectoral plans, programmes and policies."

Workshops will provide an opportunity to share national experiences in developing, implementing and updating NBSAPs and allow policy makers to discuss best practices for effective mainstreaming into relevant sector and national plans and strategies. The workshops will also provide a venue to explore challenges to implementation and exchange solutions and approaches to overcome these. The workshops have the ultimate goal of identifying strategic priorities and next steps for action. Workshops will be held in all regions in 2008, beginning in with Asia in January 2008 and Southern / Eastern Africa in February 2008. More information can be found at www.cbd.int/nbsap/

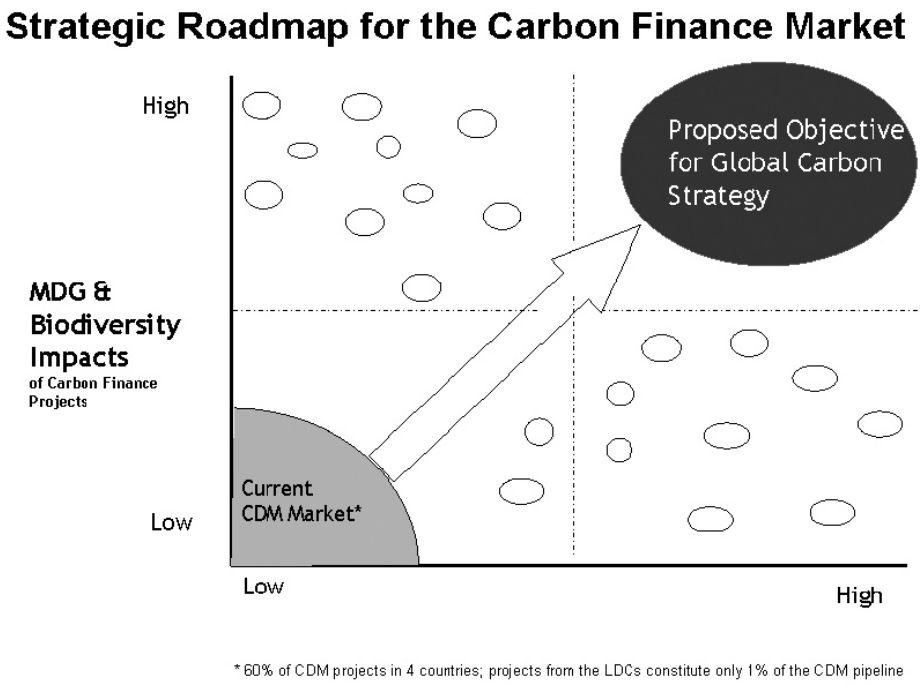
C. Environmental Markets

New and emerging environmental markets present many opportunities to 'win more and lose less' from trade-offs in the provisioning of ecosystem services. For example, UNDP launched the MDG Carbon Facility in December 2005 to expand and democratize access by developing countries to carbon finance. MDG Carbon is relevant to what we're talking about today because it is about 'winning more and losing less' by seeking out multiple benefits for climate, MDGs and biodiversity. It is designed to leverage carbon finance for the MDGs. By expanding the types of projects that receive carbon benefits, we intend to find ways to fund projects that also support biodiversity.

MDG Carbon was developed in response to the Clean Development Mechanism's failure to deliver sustainable development dividend. Sixty percent of CDM projects are located in 4 countries and projects from the Least Developed Countries (LDCs) constitute only 1% of the CDM pipeline. The CDM is sectorally imbalanced toward projects with few development and certainly few biodiversity divi-

dends like HydroFloroCarbon (HFC) & Nitrous Oxide reduction projects. As such, Carbon Finance has failed to deliver the sustainable development dividend hoped for – and certainly has not benefited biodiversity very much.

UNDP's core objectives in carbon finance are to improve access to carbon finance for a broader range of developing countries and project types through creating effective carbon markets (capacity development and one-stop shop service in carbon project development in pre-market situations); to maximize carbon development dividend through developing an MDG Carbon portfolio that strike a balance between cost-effective projects (e.g. landfill methane recovery projects) and high development impact projects (e.g. small agro-forestry projects), and; to develop capacity of program countries to combine & sequence different funding sources (EFR, ODA, GEF, CDM/JI) to channel direct investment towards climate-friendly technologies.



Currently, most CDM projects are concentrated in a very few countries (reflected on the x-axis) – and the projects selected have very few MDG or biodiversity benefits (reflected on the y-axis). Our intention is to 'grow the market' so that the types of projects that receive CDM funding benefit more countries and have more MDG and biodiversity impacts (e.g. from gas flaring or HFCs or N20 to landfill methane recovery to small agro-forestry projects).

Emerging opportunities for broader payment for ecosystem services (PES) schemes

Carbon markets are creating inroads for broader PES schemes, such as for water trading, habitat conservation and fisheries. These have even more potential than carbon finance in terms of creating win-win opportunities for furthering both biodiversity conservation and poverty reduction goals. In fact, until recently, there was no monetary value placed on ecosystem services such as recycling of nutrients, climate regulation, pollination and seed dispersal, or air and water purification … or even carbon. However, as we have talked about, there has been a growing recognition of the need to put a price tag on these services in order to slow the rate of environmental degradation and create financial incentives for sustainable development. Acknowledging that national public resources and traditional donor support would be insufficient to address climate change, the Kyoto Protocol broke new ground with the introduction of a cap-and-trade carbon market to place a value on climate stabilization services, and this created the carbon market.

A word on 'voluntary markets' which complement 'compliance markets' like the CDM: We have seen clearly over recent months and years that businesses and individuals do want to 'green' their operations and consumption – even if formal regulated 'compliance markets' may not exist yet for the impact they want to have. More biodiversity and MDG benefits are possible for projects under 'voluntary markets' because smaller scale projects which are harder to quantify and certify may be eligible. Voluntary markets have served as a source of experimentation and innovation in the carbon markets as well as the markets most likely to reach poorer and smaller communities in developing countries. This is because they lack the bureaucracy and transaction costs of regulated markets. Voluntary markets have a much higher proportion of forestry-based credits than the CDM (36% vs. 1% for CDM). Voluntary markets

provide greater opportunities for projects that contribute to sustainable development in smaller communities. They also serve as testing grounds for quantifying and monitoring and certifying of types of projects that could eventually be adopted by CDM or other formal mechanisms. Voluntary markets are growing very fast – and we in the biodiversity community should support their further growth.

Directing Benefits of Environmental Markets to Local Communities: In addition to the problem of lack of funding for those types of 'carbon sequestration' or 'carbon offset' projects that have multiple benefits for biodiversity and the MDGs, the "deal-flow" in the carbon market is currently bypassing important conservation and community based sustainable development projects in Africa, Asia and Latin America – partly because of high transaction costs. This highlights the pressing need for mechanisms to improve access to information services, build capacity, enable smaller players to enter the market, and facilitate transactions for ecosystem services for low-income and indigenous communities.

Working with Forest Trends to explore ways to address this, UNDP and other have entered into a partnership to scale-up new ecosystem markets for conservation and communities. Three interwoven Forest Trends' initiatives are aimed at enabling community stakeholders to successfully navigate PES markets (and the carbon markets in particular), as well as attract new large scale investments for conservation. These initiatives aim to track and provide accessible information on the voluntary markets, in particular, the voluntary carbon market, and to create a platform for sales with the PES Carbon Project Inventory and Offset Auction House. First, a dynamic, searchable PES Project Inventory housed on-line will provide up-to-date, accurate information on existing PES transactions and case studies, which currently are not consolidated anywhere online. Linked to this would be an online, "Ebay type" Offset Auction House, a virtual meeting place for offset transactions. Currently, suppliers seeking to sell their credits into the voluntary carbon markets have no central site where they can try to access buyers. Buyers face a range of products and there is no format to compare products. This virtual meeting place would not only bring together buyers and sellers, but also enable consumers to compare different offset projects through the use of a standardized format and a consistent means of describing offset products.

This initiative will also facilitate market entry with a project incubator, even with market knowledge and access to resources, building a PES project still requires extensive technical expertise. The third leg of this proposal is a project incubator built on the back of the Business Development Facility (BDF) experience and Katoomba Group network that would work directly with a portfolio of small and medium scale Latin American PES project developers. Without addressing these shortcomings, low-income community sellers particularly in the developing world will be unable to participate fully and equitably in PES programs, which in turn will continue to challenge the development of PES as a solution to biodiversity loss, ecosystem management and income generation for poor communities.

In the near future it is possible to imagine a transformation of the way landowners manage natural assets from managing for a single provisioning service to capturing the value of multiple services (like timber, or even carbon). The table below presents a vision of what forest revenues on a community-owned and harvested 3000 hectare forest landscape in Indonesia might look like in a decade or two based on a broader ecosystem service approach. (F. Stolle, personal communication, 2006).

Harnessing Carbon Finance for Land Restoration presents another significant opportunity with the potential for harnessing carbon finance for sustainable land management (e.g. land restoration) to deliver quadruple benefits: climate mitigation, adaptation, biodiversity and livelihoods. In order to be successful these markets must overcome the challenge of CDM rules and lack of capacity that currently provide disincentives to small land-users. To improve the climate, adaptation, biodiversity and livelihoods benefits from CDM, eligibility requirements should be expanded to include more land-use types, including a role for soil carbon storage, and limits on size of AR projects should be increased and of AR projects promoted.

Investment and capacity building should be targeted at the financial analysis of 'carbon business model' for land restoration, with ODA to provide start-up funds to defray market risks and build capacity and support the development low-cost technologies to measure soil carbon.

		Share of Revenue	
Customer	Ecosystem Service	2006	2026
Global timber market	Timber sales	💰💰💰💰💰💰💰💰💰💰	💰💰💰
Eco-tours Indonesia Ltd	Ecotourism/hunting		💰
NextPower, Indiana, US	Carbon sequestration		💰
Biodiversity Offset Exchange	Biodiversity credit		💰
Municipal Water Treatment Agency	Watershed protection		💰💰💰💰
Provincial government	Flood protection credit		💰
Local markets	Nontimber forest products		💰

Examples of land capability restoration projects that can yield these quadruple benefits include the conversion of degraded cultivated land into grassland or rangeland, the conversion of degraded croplands and pastures to forest and the conversion of degraded farmland into agro-forestry systems. However, this potential cannot be realized under current market conditions. Barriers include high up-front investment costs to bio-sequestration projects, low rates of return compared with industrial sectors and perceived risks. This is particularly challenging for smallholders. High transaction costs associated with the CDM LULUCF project cycle also present a significant barrier to participation. CDM requirements for Afforestation/ Reforestation (AR) sequestration projects need to be established including the issuance of non-permanent Certified Emissions Reduction because carbon sinks have the potential to release some or all of their carbon. Under these guidelines, AR projects are only permitted in areas without forest since December 31, 1989. Also, a 1% cap on Land Use, Land Use Change and Forestry (LULUCF) credits is permitted under CDM rules.

Our colleagues in UNDP have proposed a set of recommendations for how to remove these barriers including:

- *Market transformation through relaxation of the eligibility requirements under LULUCF CDM:* Allow the inclusion of more land-use types, ecosystems and project types into the LULUCF category; increase the size threshold of small-scale AR projects; expand the role and eligibility of soil carbon in the CDM.
- *Enhancement of the enabling environment:* Public investment in detailed financial and social analysis of the 'carbon business model' for restoration of land capability; public investment in the research and development of reliable, low-cost technologies for measuring biocarbon; improved availability of credit to cover up-front project development costs; enhanced capacities of smallholders, project proponents, government entities and other intermediaries to engage equitably in the carbon market; promotion of project bundling and aggregating institutions to allow the rural poor to take advantage of economies of scale.

The example of the conversion of degraded farmland into agro-forestry systems illustrates the role of biodiversity in Carbon Finance for Land Restoration:

- *Carbon benefit:* Globally agro-forestry systems have the potential to sequester and store 26 million tC/year by 2010 (Kauppi *et al*, 2001)
- *Livelihood benefits:* Enhance and diversify food and income streams in the form of fruit, vegetable, oil, spices, medicine, timber and craftwood etc.
- *Environmental benefits:* Restoring ecological functions and services leading to enhanced productivity of crops like maize, cassava and rice.

Further, the role of biodiversity still needs to be explored. There is a need more information about biodiversity benefits from land capability restoration projects. If activities that are good for reducing GHG, good for livelihoods, and good for biodiversity are encouraged through carbon finance, this can help developing countries see value in a post-2012 climate regime.This could greatly increase the chance of an agreement being reached among developing and industrialized countries at the Bali Climate Change meeting in December and beyond.

D. Rights and Voices of Local People:

Local communities are key to biodiversity & the MDGs. Ultimately, biodiversity conservation and the MDGs will succeed or fail at the local level. Unfortunately, local people often lack (1) clear rights to use and make decisions about the ecosystem services they depend on for their livelihoods and well-being, (2) opportunities to influence policies that impact them, and (3) means to learn from each other. There are concrete benefits to be gained from strengthening the rights of local people to use and manage ecosystem services by decentralizing decisions about ecosystem services and build capacity of local communities to manage those services, bringing local voices to the table to influence projects and policies that affect them and supporting 'bottom-up' approaches to conservation.

The Equator Initiative partnership is designed to reduce poverty through the conservation and sustainable use of biodiversity in the equatorial belt by fostering, supporting and strengthening community partnerships. The Equator Initiative partnership brings together the United Nations, civil society, business, governments and communities to help build the capacity and raise the profile of grassroots efforts to reduce poverty through the conservation and sustainable use of biodiversity. The Equator Initiative was created in response to the focus of the 2002 World Summit on Sustainable Development (WSSD) in Johannesburg on innovative partnerships and the recognition that the greatest concentrations of poverty & biodiversity are found in the Equatorial region – and that innovative 'win-win' solutions are there too. Ultimately, the Equator Initiative responds to the need to understand and recognize and learn from successful community-based action on the ground.

Through its biannual Equator Prize, the Equator Initiative honors and celebrates successful community partnerships for their outstanding efforts in poverty reduction (MDG 1) and biodiversity conservation (MDG 7). In order to be eligible for the Equator Prize, community initiatives need to be successful in diverse areas: i.e. they have to prove that they adopted a partnership approach (MDG8) by linking activities with non-governmental organizations, community-based organizations, the private sector, governments, research and/or academic institutions, and public or private foundations. To be eligible communities also need to promote social inclusion and gender equality (MDG3) through their work The winners and finalists of the Equator Prize provide proof that local communities often contribute to diverse MDGs at the same time (this holistic approach towards the MDGs may be explained by the fact that communities are frequently the first to recognize and suffer from MDG trade-offs).

The Equator Initiative experience, since 2002, has uncovered an enormous range of innovative and inspiring practices at the local level - 75 Equator Prize winners and 1000 cases of achievement in community-based biodiversity conservation and poverty reduction. Here are just two examples of the kind of solutions that communities have

found to maximize benefits to both their biodiversity and their efforts to achieve the MDGs at the local level:

Box 5. Examples from Equator Prize Finalist Experiences:

- Shidhulai Swanirvar Sangstha uses Bangladesh's extensive river network to spread environmental education. Boats have been outfitted to travel from farm to farm bringing new technologies, information, strategies, and tools. Villagers have learned and implemented ways to avoid problems such as soil erosion, ground and water contamination, over-fishing, and habitat destruction. Access to this information has resulted in higher income which has enabled residents to pay their children's education expenses, gain access to better healthcare, and improve living conditions. The Shidhulai Swanirvar Sangstha reaches an estimated 87,000 families each year.
- Burkina Faso's rural women's association, Songtaab-Yalgré, has been working to produce organic shea butter for export internationally for 12 years. The association now works with 11 villages and over 3,000 women, distributing income equally amongst members of the collective. As a result of this initiative, the income of 1140 rural women has tripled and nearly 20,000 shea nut trees are protected and managed without pesticides. The association devotes a portion of its resources to HIV/AIDS education and literacy training for women and youth. www.songtaaba.net

These community-based initiatives have resulted in impacts not only in biodiversity conservation and poverty reduction (MDG 1 &7) , but also to other MDGs such as those focusing on education and health.

One innovative tool to support communities in assessing and communicating their work to themselves and others was developed by local leaders and the international community. Innovated by GTZ, in partnership with the Equator Initiative community leaders, the MDG Poster Tool enables grassroots initiatives and communities to present their work with direct links to the MDGs. It illustrates how interventions in one field (such as biodiversity conservation) can have positive impacts towards the achievement of other MDGs. It is a free online tool that allows users to display how their work relates to the MDGs. They simply need to select a background, upload pictures and enter text that will visually tell their story. The GTZ Poster Book "Contributions by Local Communities to Attaining the Millennium Development Goals" captures the results of many community posters from throughout the world. The online MDG Poster Tool is available online at http://mdg.onlinegeneration.com/ .

The Equator Initiative is also playing a facilitation role in the development of the Community Knowledge Service, which is a good example of a local and global learning partnership. The CKS is being developed by 20+ community leaders, to support communities to share expertise and apply acquired knowledge that enhances local livelihoods while sustaining biodiversity. Program components include peer-to-peer learning exchanges and site visits, knowledge fairs and workshops, leadership development training initiatives, participatory video and radio methodologies, web-based knowledge exchange platforms and networks, local knowledge centers and written documentation of community practices. The CKS is based on the premise that local best practices may teach other communities how they can contribute to the MDGs, but they are also a way for communities to influence policy makers at the global level. In that capacity, the Equator Initiative's most recent project the Community Knowledge Service aims to develop a local and global learning partnership initiative that ensures that local best practices are identified and disseminated. In short, as a way to influence policy and to proliferate practices that result in "smart trade-offs and win-win-win solutions." The CKS is a community-driven response to the acute need for long-term investment in relationship-building and knowledge-sharing processes.

The UNDP-GEF Small Grants Programme (SGP) champions the conservation and restoration of the environment while enhancing people's well-being and livelihoods. SGP has supported 4,946 Biodiversity projects in > 80 countries with over $300 million disbursed since 1992 for community initiatives. SGP funding has resulted in a number of local successes. For example, grant support contributed to stabilizing population of last endemic parrot in Mauritius. The UNDP GEF Small Grants Programme has been a champion of the belief that to achieve environmental benefits you also need to invest in enhancing people's well-being and livelihoods. As such SGP's projects help communities balance both development and environment objectives. SGP has an ongoing portfolio of 8971 projects, of which 60 % are on biodiversity conservation. SGP has disbursed over $300 million since its inception in 1992 and was recently awarded for helping bring back the last endemic parrot in Mauritius – the Echo Parakeet. The echo parakeet has recently been upgraded from "critically endangered" to "threatened" on the IUCN red list. The initial funding for the conservation of this critically endangered bird came from the SGP in Mauritius when only 9 birds were in the wild in 1996. After the captive breeding programme developed with the funding they received, the Mauritius Wildlife Foundation has successfully released them and today there are 333 echo parakeets in the wild.

SGP intends to continue helping communities who depend on their natural resources plan for the future and balance competing interests in the midst of political, economic and environmental change. Future initiatives include:

- Clustering grants: to fund interconnected projects at the regional level to maximise synergies between community based initiatives.
- Visioning technique: Bottom-up Millennium Ecosystem Assessment type scenario building at the local level
- Conservation Measures Partnerships: developing, testing, and promoting principles and tools to credibly assess and improve the effectiveness of conservation actions.

Section 5 - The Way Forward - How and Where Can the Biodiversity Community Most Effectively Intervene?

Using the Momentum on Climate Change for Biodiversity by Finding Synergies

There is an urgent need, and many opportunities for synergies between the BD and CC communities. One of the greatest champions in the world on this matter is Dr Ahmed Djoghlaf, Executive Secretary of the Convention on Biological Diversity, who is with us today. In fact, on the occasion of World Environment Day of this year, UNDP worked closely with Dr Djoghlaf and Sebastian Winkler, head of Countdown 2015, to disseminate an important message to the G-8, and to put attention on the 2010 Biodiversity Target and the 2015 MDGs as they relate to biodiversity, climate change and development.

The message to the G8 Summit in Heiligendam, was conveyed by the German Ministry for Development Cooperation (BMZ), calling on the G8 to carry forward the conclusions of the Potsdam Environment Ministers Meeting -- recognizing that climate change exacerbates biodiversity loss and, in parallel, biodiversity loss impairs efforts to respond to climate change -- to take leadership for renewed commitments for a response to climate change and biodiversity conservation. Recommendations for action included:

- Global leadership in financing for adaptation to, and mitigation of, climate change;
- Adopting a clear mandate for a successor agreement to the Kyoto Protocol – including mechanisms such as REDD and biodiversity friendly biofuels; and, integrating biodiversity and climate change concerns into all relevant sectors of the economy and government.

These recommended actions are only becoming more urgent as the seriousness of the climate change challenge becomes clearer. I suggest that we all take them on in our efforts to ensure that we 'win more and lose less' in our environmental decision-making that concerns climate biodiversity and people.

Adaptation to Climate Change: The Most Urgent Development Challenge

The Adaptation challenge has exploded recently on the international scene. One could say that 'adaptation' has actually become synonymous with 'development' since it threatens to undo decades of development assistance if we do not take it into account. For example, food production could be reduced by climate change in Africa by up to 50% in this century.

Of course, adaptation programs may offer opportunities for 'win-win' with biodiversity and climate change, if done right. Although biodiversity is fundamental to climate regulation and must be central to adaptation and mitigation programs, the potential for conflict between the climate change and biodiversity agendas is enormous if we get it wrong. Since biodiversity underpins ecosystems which provide resilience to climate change impacts, adaptation strategies should be improved by including ecosystem resilience and genetic diversity - and biodiversity better protected by being included in adaptation strategies. Significant flow of resources towards adaptation may provide opportunity for biodiversity funding if we make the case. After all, the people most vulnerable to climate change are also most dependent on biodiversity.

Whereas our understanding of the impact of climate on biodiversity is increasing, our knowledge of the impact of biodiversity on climate is more limited. However, we do know that biodiversity underpins ecosystem functioning which are a key component of resilience (i.e. adaptation) to climate change – and genetic resources allow crops and livestock to be bred to adapt to changing conditions. We also know that biodiversity conservation contributes to the mitigation of climate change.

The adaptation agenda could be opportunity for the Biodiversity community. Enormous resources will soon be poured into adaptation programs around the world. Biodiversity and ecosystem services can and should be part of that agenda. However, the potential for conflict between the climate change and biodiversity agenda are huge if we get it wrong! Efforts to mitigate climate change can erode biodiversity if not done right: Biofuels, CDM, etc. The biodiversity community can help ensure 'win-win' outcomes from potential trade-offs by ensuring that the climate change community understands the contribution of biodiversity to climate change goals.

Reduced Emissions from Deforestation and Land Degradation (REDD): A Major Opportunity for Synergy between Biodiversity and Climate Change?

Another major opportunity for synergy in efforts to achieve widespread biodiversity conservation and mitigate climate change is to support the inclusion of a pro-poor REDD (reduced emissions from deforestation and land degradation, formerly known as 'Avoided Deforestation') approaches in a post-Kyoto climate regime. Deforestation is responsible for more than twenty percent of GHG emissions - yet avoided deforestation is not included under the current climate change regime. Forests are also home to much of the world's biodiversity and over 1 billion people living in extreme poverty depend on forests for livelihoods. Including REDD mechanisms in a post-2012 climate regime can create incentives for countries to protect and maintain their forest cover while delivering benefits to the rural poor.

Also, REDD presents an enormous opportunity to create incentives for the participation of developing countries in a new climate regime while at the same time creating new opportunities for direct resource flows from carbon markets and public finances towards the conservation of forest cover and forest biodiversity in developing countries - protecting rural poor livelihoods and contributing to the achievement of the MDGs. Valued at $10 per m ton of carbon, the prevention of further deforestation in National Parks in East-Kalimantan could generate $135 million per annum. This could provide a signigicant incentive to protect the park, considering that the total 2006 budget for National Parks in East-Kalimantan was $5 million. Another

example of the potential returns from conversion of forest cover vs. conservation of forest cover under a REDD mechanism is provided by Nicholas Stern, who estimates that $10 to $15 billion per year could reduce deforestation by half.. With a REDD mechanism in place, this price tag for significant results may not be out of reach. These examples, and many others, indicate that there may be strong financial reasons why developing countries will want to participate in REDD mechanisms.

REDD may be even more important for climate change outcomes than we had suspected in view of recent studies suggesting that the protection and restoration of forests may produce better GHG reduction results than biofuels over a wide range of conditions over the next 30 years. Similarly, Paul Crutzen's recent work points to the possibility that far more of the nitrates used as fertilizers for biomass for biofuels may be being converted to nitrous oxides than previously thought: perhaps 3% to 5% instead of the previously assumed 1% to 1.5%. Nitrous oxides are a nearly 300 times stronger GHG than CO2.

UNDP believes that REDD approaches must be pro-poor! To reach the potential 'win-win-win-win' (i.e. with benefits for CC mitigation, adaptation, biodiversity and livelihoods), local communities must also receive benefits. Clearly, for REDD to work, the benefits must reach to the local community level. Communities depend enormously on their local forests for their livelihoods and without real benefits from REDD schemes, there will be no incentive for local people to participate. Without local people, REDD will not work and the forests will not be protected. This is a serious issue of governance since local people are often overlooked when it comes time to share the benefits.

There are many other methodological and political challenges still to overcome on this issue, but we hope that an agreement will be reached at the UNFCCC COP 13 in Bali in December 2007 to move forward on REDD so that we can work together to sort out the challenges. The Poverty Environment Partnership (PEP) is preparing a concept paper and side events for the Bali UNFCCC Conference of the Parties to explore the socio-economic implications of the various REDD models that are currently being considered. We hope to make a contribution to understanding how to design a REDD mechanism that maximizes benefits to people, the climate and biodiversity.

Conclusion: A Systematic Approach to Trade-offs to 'Win More and Lose Less'

What Can the Biodiversity Community Do To 'Win More and Lose Less' with Trade-offs?

(a) Valuation and Improved Information:
We must continue to build the economic case for 'return on investments' in the environment for poverty reduction and carry out more in depth 'full cost accounting studies' (like those on mangroves and shrimp farms) for other ecosystems. We must actively support the Millennium Ecosystem Assessment Follow-up (MA II) and advocate for a special IPCC report on the interactions between climate change, biodiversity and ecosystem services and human wellbeing. For adaptation links, we must undertake research into the mechanisms of biodiversity function in ecosystem structure, in climate regulation, and in human livelihoods and on how alteration of host-pathogen and predator-prey relationships impact human health and productive sectors (e.g. agriculture, forestry and fisheries), with likely economic consequences.

(b) Mainstreaming Biodiversity
We must ensure that biodiversity goals are integrated in national development strategies through:

- NBSAP Capacity Building Workshops
- MDG Support Initiative
- Poverty-Environment Initiative (PEI)
- Strategic Environmental Assessment (SEA)
- WRI tools

…and focus closely on mainstreaming Biodiversity in climate change adaptation planning.

(c) Environmental Markets
We must explore options and mechanisms to expand carbon finance benefits to biodiversity and the MDGs (including for land restoration) and build capacity and provide start-up funds to give access to carbon finance benefits to more countries. We must learn from the carbon market experience and support establishment of markets for other ecosystem services beyond carbon such as water, biodiversity, fisheries, nitrogen, etc., including through voluntary markets. We must also advocate for national or global regulatory interventions that will create markets for payment for ecosystem services.

(d) Rights and Voices of Local People
Finally, It is imperative that we support local and global learning partnerships that identify and widely disseminate community level best practices in conservation and poverty reduction and invest in scaling up successful local 'win-win' approaches to biodiversity protection and the MDGs We must ensure efforts to mainstream biodiversity and ecosystem services into national plans and policies also focus on empowering local level rights, tenure and action We must build capacity at the local level so that communities can participate in, and benefit from, new environmental markets. We must also develop programs to help communities apply Millennium Assessment methodologies at the local level.

What do we need to know about biodiversity, and how can we find it out?

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'What gets measured gets done' is a modern-day mantra. There has been a flurry of activity trying to put measurements in place for biodiversity, but a coherent system has yet to emerge. Part of the problem is that an emphasis on near-term targets has lead to a focus on what can be quantified, given the data already at hand, rather than what is needed as part of a sensible adaptive management approach. It is necessary to be minimalist if a biodiversity observing system is to be sustainable, but at the same time the set of measurements must be sufficient; in other words, sensitive to the changes it is intended to detect, unambiguous, and providing a basis for action. It is wishful thinking that a topic as multi-faceted as biodiversity will be amenable to reduction to a single value, but it is possible to express it meaningfully in a small number of mutually-supportive indices.

Taking a needs-driven approach to a biodiversity observation system, rather than one based on what is readily available, there are three broad groups of questions that need to be answered: what biodiversity is located where; how is it affected by human activities; and what are the consequences of those impacts? These questions can be addressed by an intelligent fusion of museum collection, field observation, remotely sensed, map-based and modelled information. A blueprint is suggested for an integrated and iteratively-improving biodiversity observation system that could deliver these answers in the foreseeable future.

Introduction

It is well-established that the biological diversity of the world is disappearing at a rate far in excess of the long-term background rate of species turnover (Mace et al. 2006). The causes are several, but are all ultimately linked to the dominance of the planet by humans, especially in the past two hundred years. At the same time that many thousands of species are declining in abundance, there is an explosive emergence of other species, often with detrimental consequences.

It remains unclear just to what degree human welfare is dependent on the maintenance of high levels of biodiversity, or particular mixtures of species, either locally or globally. There are tens of thousands of particular cases where people use individual species as food, medicine or material resource. These do not, per se, constitute a human dependency on biodiversity – the overwhelming majority of these uses are substitutable, or non-essential, or based on only to a tiny fraction of the extant biodiversity. Nevertheless, there is an uneasy feeling among scientists that widespread and deep biodiversity loss cannot be a good thing: the biological redundancy and self-regulation which keeps the supply of ecosystem services dependable is gradually being eroded; resilience of ecosystems to shocks is being undermined; and potentially useful species are being irretrievably lost before their value is understood. Furthermore, ordinary people in almost all societies – from indigenous communities to modern urban dwellers – express concern for biodiversity, in their own ways, ranging from cultural and spiritual affinity with nature to the billions of dollars donated to organisations dedicated to biodiversity conservation.

The 1992 UN Convention on Biological Diversity was a result of the growing concern regarding biodiversity loss. In 2002, the parties to the Convention set a target of 'reducing the rate of biodiversity loss' by the year 2010, as goal subsequently endorsed by the World Summit on Sustainable Development and incorporated among the Millennium Development Goals. One of the problems in achieving this apparently straightforward target has been agreeing on how to measure the rate of biodiversity loss. Only about a tenth of all existing species have been scientifically described, which means that the current rate of species 'discovery' actually exceeds the documented rate of loss. A set of biodiversity status indicators is emerging (Table 1), but they are highly limited by the availability of reliable data at a global scale.

This paucity of information is despite the fact that biodiversity, in the broad sense, is one of the oldest areas of environmental observation and scientific documentation. Much of this vast store of data (an estimated 2 billion records) resides in the collections of museums and herbaria, until recently largely inaccessible from outside (and even from inside) the organisations. A concerted intergovernmental effort, called the Global Biodiversity Information Facility (GBIF) is bringing this information into electronic form and the public domain. Hundreds of millions of records have already been made available.

The volume of biodiversity data is exponentially increasing, driven by the expansion of the observation effort to all parts of the globe (including some previously unreachable, such as the depths of the oceans), and by new, data-rich technologies, such as genome analysis and remote sensing.

It is therefore surprising that we remain unable to answer some of the simplest questions, such as 'How much biodiversity is there on Earth?', and 'How much have we lost in recent times?' Part of the problem lies in the complex and multi-facetted nature of biodiversity itself, and part is in the uncoordinated way in which biodiversity data has been collected and stored in the past.

'Biodiversity' is a catch-all phrase for the variety of life on Earth. For many people, it simply means species richness, i.e. the number of different species in a defined area. In principle, this can be estimated from current and past observations, coupled with some judicious interpolation. In practice, our reliable knowledge extends only to vertebrates, and in some regions, to plants.

The species richness definition of biodiversity is inadequate to make the case for maintenance of high levels of biodiversity. The functional role of biodiversity in assuring the steady supply of the things that make human life possible and enjoyable (in other words, in underpinning the supply ecosystem services) relates only weakly and indirectly to the number of species present. It relates somewhat better to measures of diversity which include consideration of the abundance or level of activity of the various organisms, especially if we are able to cluster them into 'functional types' that perform certain valued roles (Diaz et al. 2005). The need to emphasise ecological function and the difficulty of dealing with thousands of organisms (some of which may be un-described or hard to observe) has pushed biodiversity managers and policymakers in the direction of assessing the status of ecosystems rather than individual species. Ecosystem function is also hard to observe, so we often rely on ecosystem extent and structure as proxies. In an ecosystem context, biodiversity depends as much on the diversity of interactions between organisms as it does on the diversity of organisms themselves, so notions of connectivity and spatial organisation become important. Simultaneous with this 'upward' migration of biodiversity indicators, the insight that the diversity of organisms is a reflection of the diversity of genes they contain has propelled biodiversity concepts and observations down the biological hierarchy as well, to include measurements of the level of diversity within and between populations of the same species.

It should be clear from the above that not only is the amount of biodiversity information very large, but it comes in many forms and at a range of scales. A single metric of biodiversity will not adequately capture all the complexity of the world. But it is the firm conviction of many researchers in this field that a reasonably-small set of observable biodiversity measures, intelligently combined, can go a very long way to help us monitor and manage the accelerating crisis of global and local biodiversity loss.

The purpose of this paper is to provide a high-level outline of what an integrated biodiversity observation system might look like: what its key components would be, what outputs could be expected, and who the main institutions might be in making it a reality.

Existing initiatives and actors

The phenomenon of an abundance of primary observations but a dearth of useful information (especially at policy-relevant scales) is widespread in the field of environmental data. It is partly a consequence of not paying sufficient attention in the past to the issue of information flow, but also because the very concept of global-scale information is a relatively new one, and the technology to satisfy this need is even more recent. In 2003 an intergovernmental Group on Earth Observation (GEO) was established to address the issue of environmental data sharing and gap filling, and led to a proposal for a 'Global Earth Observation System of Systems', which came into existence in 2005. The second GEO summit defined nine 'Societal Benefit Areas' (SBAs), of which biodiversity is one. Note that large elements of what the biodiversity observation community would consider to be their domain of interest and expertise are located in the ecosystem SBA, and other elements are in the agriculture SBA (e.g. fisheries and agricultural biodiversity), health SBA (emergent diseases) and water SBA (freshwater ecosystems). Fragmentation is inevitable when a highly integrated field is carved up into operational chunks, and should not be allowed to be an obstacle to progress.

There are several other international initiatives to put the biodiversity observations house in order. They are proceeding in parallel, with some loose coordination established by an overlap in membership. The Global Terrestrial Observing System (GTOS) is one of three global observing systems established in the 1990s to serve the observational needs of the Rio Treaties. The other two are the Global Ocean Observing System and the Global Climate Observing System; all three reside within the UN organisation framework. Biodiversity is one of the five areas where GTOS is mandated to work, but GTOS' strategic priorities in a highly resource-constrained situation have focussed largely on climate issues. A task team was initiated in 2006 to elaborate what a terrestrial biodiversity observation component within GTOS might entail.

Diversitas is an ICSU-affiliated research programme on biodiversity, and is one of the four 'global change' programmes making up the Earth Systems Science Partnership. It has a core project known as 'bioDiscovery', which aims to address the science gaps constraining the development of a biodiversity observation system. Its plan is close to publication, but the actual research activities have yet to begin.

An international conference on biodiversity loss was convened by the Government of France in 2005, and the outcome was a call for an 'International Mechanism of Scientific Expertise on Biodiversity' (IMoSEB). This aims to create an overarching politically-endorsed mechanism for the periodic assessment of trends in biodiversity, rather like the Intergovernmental Panel on Climate Change does for climate. The IMoSEB consultative process is still underway.

The GBIF activity has been described above. Other notable activities are the 'Barcode of Life', an intervention to massively accelerate the identification of unique species by using genetic marker technology; the Census of Marine Life, a campaign to improve the systematic knowledge of marine biodiversity; and EcoPort, a way of soliciting biodiversity information in a wiki-like fashion from a vast network of experts.

Thus it can be seen that many strands are converging on the need for a biodiversity observation system, and the mechanisms by which it might be achieved. The time has never been more propitious for the establishment of a system, but by the same measure, design mistakes made at this point could have long-term consequence.

Table 1. *The emerging set of biodiversity indicators for the CBD 2010 target. Those in normal font are approved for implementation, while the italicised indicators are regarded as promising, but in need of more testing. Note A is a list of participants in the process of elaborating this list, which is itself an indicator of the breadth and depth of the interested parties.*

Focal Area	**Indicator**
Status and trends of the components of biological diversity	• Trends in extent of selected biomes, ecosystems, and habitats • Trends in abundance and distribution of selected species • Coverage of protected areas • Change in status of threatened species • Trends in genetic diversity of domesticated animals, cultivated plants, and fish species of major socioeconomic importance
Sustainable use	• Area of forest, agricultural and aquaculture ecosystems under sustainable management • *Proportion of products derived from sustainable sources* • *Ecological footprint and related concepts*
Threats to biodiversity	• Nitrogen deposition • Trends in invasive alien species
Ecosystem integrity and ecosystem goods and services	• Marine Trophic Index • Water quality of freshwater ecosystems • *Trophic integrity of other ecosystems* • Connectivity / fragmentation of ecosystems • *Incidence of human-induced ecosystem failure* • *Health and well-being of communities who depend directly on local ecosystem goods and services* • *Biodiversity for food and medicine*
Status of traditional knowledge, innovations and Practices	• Status and trends of linguistic diversity and numbers of speakers of indigenous languages • *Other indicator of the status of indigenous and traditional knowledge*
Status of access and benefit-sharing	• *Indicator of access and benefit-sharing*
Status of resource transfers	• Official development assistance provided in support of the Convention • *Indicator of technology transfer*

Note A: The members of the 2010 Biodiversity Indicators Partnership are: BirdLife International, CasaTierra, CBD Secretariat, CGIAR, CITES Secretariat, CMS Secretariat , Conservation International, Countdown 2010, Department of National Parks, Wildlife, and Plant Conservation (Government of Thailand), Division of Environment (Government of Tanzania), European Environment Agency, FAO, GEF, GBIF, GISP, Global Footprint Network, International Council on Mining and Metals, International Nitrogen Initiative, IPGRI, IUCN Species Survival Commission , IUCN Sustainable Use Specialist Group, IUCN World Commission on Protected Areas, Ministry of Finance and Planning (Government of Grenada), Ministry of Science, Technology, and the Environment (Government of Cuba), NASA-NGO Conservation Working Group, NatureKenya, OECD, Orbis Institute, Ramsar Convention Secretariat, RSPB, Sea Around Us Project, Terralingua, The Nature Conservancy, UBC Fisheries Centre, UNDP, UNEP DGEF, UNEP-GEMS Water Programme, UNEP-WCMC, UNESCO, University of Queensland, WDPA Consortium, Wetlands International, WHO, Wildlife Conservation Society, WWF, Zoological Society of London.

An analysis of needs

In the era where observations were made directly by those who intended to use them, the issue of alignment between what was observed and how it was used did not arise. However, that is no longer the case. Observations are used by people several steps removed from the observers, and for totally unforeseen purposes. The result is a need to 'reverse engineer' the observation systems such that they satisfy the requirements of users.

The following needs analysis is based on both formal and informal sources. One formal mechanism is the ongoing process of the UN-CBD task team on indicators, which since 2005 has been working to define the indicators for the 2010 target of 'reducing the rate of loss of biodiversity'. The second is the work of the GEOSS task that is defining user needs for biodiversity information. From these sources the following salient points emerge:

- There is a broad-based and widespread need for dependable biodiversity-related data that is currently unmet. A suggested list of the main user groups and their needs is given in table 2.
- The biodiversity indicators required by the users are currently only partially defined. This is a chicken-and-egg problem: some of the potential indicators are deemed impractical because the datasets needed to populate them do not exist at the global level; but the datasets do not exist because to date nobody has articulated a sufficiently strong need for them. Some of the aspects of biodiversity are better articulated (e.g. species composition) than others (ecosystem function).
- No existing system is able to satisfy these needs to more than a small degree. Without a coordinated effort, no effective system is likely to emerge spontaneously.

Table 2 *provisional list of the main groups of biodiversity information users and their needs.*

User group	**Needs**
Global NGOs in the field of biodiversity and its conservation eg. IUCN, WWF, TNC, CI, Birdlife International	Threatened taxa and their location Protected areas and their effectiveness Ecosystem maps at moderate resolution Species richness per ecosystem type Trends in indicator species
National and local NGOs (Many, but not all, are affiliates of above)	Often issue or taxon-based: Distribution and abundance of species, Maps of key habitats and habitat changes Stocks of important resources. Threats due to water or air pollution.
International treaty bodies dealing with biodiversity UNCBD, Ramsar, CMS, CITES, and others	Trade in endangered species Migratory pathways and population trends in migratory species Extent of key habitats: notably wetlands, coral reefs, tropical forests
National and sub-national government Typically ministries of environment or similar, but also ministries dealing with forestry, fisheries, agriculture, health, water resources etc	Reporting obligations to international treaties Design and implementation of national policy Trends in crop and harvest biodiversity Outbreaks of novel pests and diseases, spread of weeds Status of key biodiversity-based natural resources (fish stocks, timber trees) Trends in nature-based economic activities, such as tourism
Conservation agencies National or sub-national biodiversity authorities tasked with conserving natural resources: National Parks, fisheries, forests, biodiversity	Geographical distribution of elements of biodiversity Trends in populations, especially of keystone species Location and trends of rare and endangered species
Land custodians: private, commercial and communal	What biodiversity should be on the land? What is the status of the biodiversity present on the land outside of my area of custodianship?
Researchers: universities, national research bodies, museums and herbaria	Precise locations and dates of confirmed species observations. Location in collections of samples. Current and past taxonomic status. Population sizes, age and sex structure.
Individuals: members of the public with and interest in biodiversity, citizen monitoring groups, amateur naturalists	Species lists for general locations. Rare sightings. Ability to report sightings and incidents. Natural history information and illustrations for species.

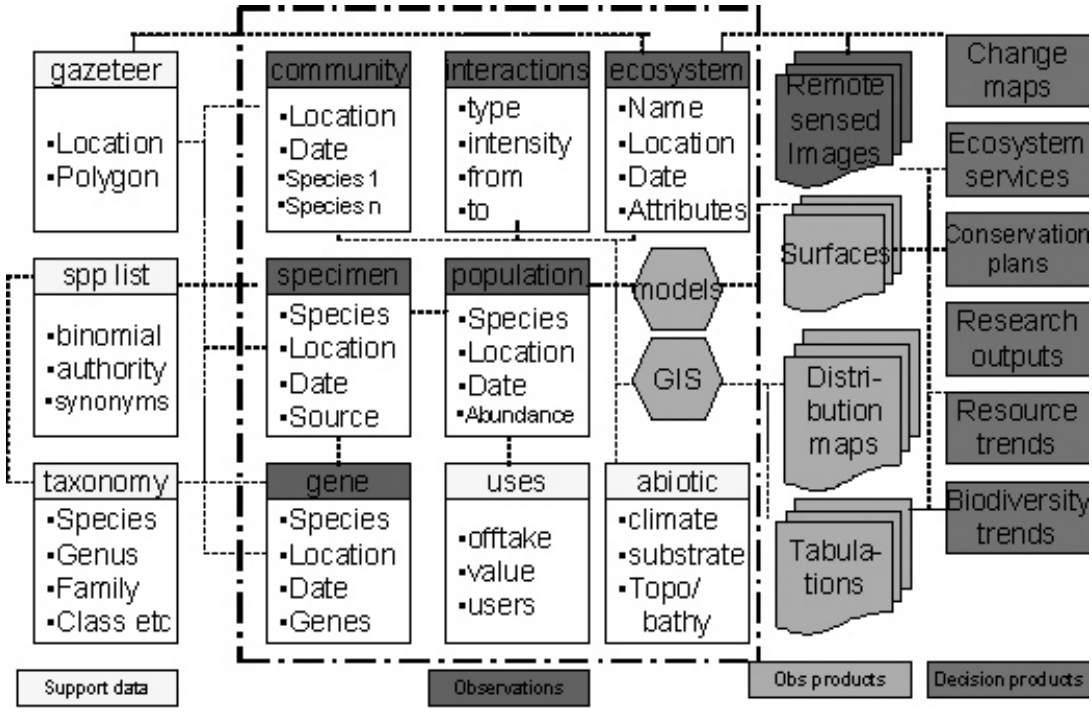

Figure 1. *The core set of data record types for a biodiversity observation system are relatively few (the area enclosed by the dotted line). This core set has a necessary supporting set, most of which already exist. From this combination, a rich set of derived datasets can be built to serve specific user needs.*

An integrated observing system for biodiversity

Standing back from the issue of what data are currently available or might easily be collected, and looking at the question of biodiversity information from a very broad societal benefit perspective, I submit that there are three groups of questions that need to be answered by such a system.

- **What is the spatial distribution of elements of biodiversity** (e.g. species, ecosystems), at a given time? This question is largely addressable by a fusion of data from historical collections, field observations (often supported by images) and map data. This fusion is assisted by the increasingly sophisticated use of niche modelling techniques and remote sensing, which help to fill in the gaps left by spatially patchy sampling.
- **How is the abundance of selected elements of biodiversity affected by human activities?** This question is addressed using a combination of *in-situ* observations and remote sensing data, the latter often working as an input to models of ecosystem processes such as net primary production, or as a way of delineating suitable habitats. A key need is to codify information about linkages between biodiversity elements, in order that cascading and indirect effects might be adequately addressed.
- **What are the consequences for human wellbeing of those changes in biodiversity?** This question is the one which we are furthest from being able to answer. It must be built on an improved knowledge of ecosystem function. It also requires that the biodiversity observation system contain information about people – where are they, and what elements of biodiversity do they use?

Although the needs for biodiversity observations are many and varied, what is striking is that at the foundation level, the number of essential types of data involved is quite small (Figure 1). This means that the complexity lies in how these fundamental types of observation are linked together to generate different perspectives for users, rather than in the primary observation itself. This is a strong argument for why an integrated, coordinated system is highly desirable (as well as being the key reason why such a system has not yet arisen).

Biodiversity observation systems and indicators to date have been largely based on the presence or absence of biodiversity elements at a location. For instance, is a species extant or extinct? What is the total number of species in an area? Does forest cover exist at a location or not? This is an inadequate basis for a really useful system, because it is insensitive to change up to the point where the biodiversity element in question finally disappears – which

is usually too late to do anything about it. A system that gives warning of progressive deterioration (degradation) and incremental improvement (restoration) will need to be 'abundance-based' rather than 'presence-based', where 'abundance' can also mean a measure of the level of performance of an ecosystem function: in other words, the notion of 'integrity' or 'health' of the biodiversity element.

This does not require that every element of biodiversity be monitored in every place at all times. Scholes & Biggs (2005) suggest that an 'activity-based' approach, analogous to the way in which greenhouse gas emissions are calculated, is sufficient. The emissions of every smokestack and square meter of the land surface are not monitored to get the global total of emissions. Instead, detailed emission information is collected for representative 'activities', such as coal-fired electrical power generation, and then this 'emission factor' is scaled up by an 'activity factor' that measures the area or intensity of the activity. In the biodiversity example, the 'impact factor' of various activities on given groups of organisms needs to be assessed in a large, but not unachievable, set of locations. The number of organisms that need to be assessed can be reduced by clustering them into 'functional groups' that can be expected to show similar response functions. In the medium term, these impact factors can be estimated by a variety of expert-judgement or ecosystem modelling approaches. A particularly promising approach is that of estimating the 'human-appropriated net primary production' (HANPP, see Haberl et al. 2004). Since the abundance of organisms must relate in some fairly direct way to the energy that is available to sustain their populations, estimating changes in HANPP should provide a proxy for abundance changes across broad function groups. HANPP can be estimated on a repeated basis using a combination of remotely-sensed data and knowledge of ecosystem use (e.g. harvest intensity).

It *is* necessary that a representative sample of populations, covering a sufficiently diverse set of species to represent important functional groups, be tracked over time. The power of this analysis is increased further if many of these observations are of known individuals, which are followed over their lifetime.

The idea of 'functional groups' comes up repeatedly as a way to reduce the clutter of biodiversity and to extrapolate across information gaps. A functional group is a set of species that react in a similar way to a specified set of drivers, and performs a defined role in an ecosystem. Generally, function types include a combination of considerations relating to the trophic position of the organism (primary producer, herbivore, predator, detritivore, etc.), body size (which influences many other factors) and potentially any other relevant ecological attributes. Obviously, functional groups can be defined with increasingly restrictive membership rules until each contains only one species (or even individuals within a species). But making them this specific does not help in simplification or extrapolation. Rather, functional typologies should be recognised to be hierarchical. Some of the most useful insights for policymakers can be gained at the upper levels of the hierarchy, which are possible to define even in our present state of ignorance.

More generally, the notion of 'function' can serve as a very useful a cross-level integrator. For example, ecosystems have in the past generally been defined either in terms of 'structure' (e.g. grassland, forest, shrubland, etc.), or in term of composition (contains the following characteristic species). The structural approach is useful, but somewhat crude – it lumps together things that don't necessarily work in the same way. On the other hand, the compositional approach very rapidly leads to a very long list of 'ecosystems', which may differ only marginally from each other in terms of how they respond to stresses or deliver ecosystem services. Defining ecosystems in terms of the proportions of various function groups of species they contain is compatible with both the 'structural' approach at high levels of aggregation, and the 'compositional' approach at disaggregated levels, but offers an intermediate (and scaleable) level of complexity between. Building a robust and universally applicable ecosystem classification based on functional group notions is an urgent challenge for a biodiversity observation system, and one that is being tackled by a GEOSS working group. Many users require information at the 'ecosystem' level, but currently there is no widely-accepted ecosystem classification system that also lends itself to detection by remote sensing and model-based extrapolation.

Might the notion of 'function' also be useful in bridging the other level-disjunction in biodiversity, that between the gene and the population? Methods of identifying the presence of particular genes are advancing rapidly, making it possible for the first time to realistically engage with this level of biodiversity. Is it possible to associate certain ecological functions with the presence of certain genes – for instance, the capacity to fix atmospheric nitrogen, or perform a particular type of photosynthesis? This could conceivably provide one logic for connecting changes in biodiversity, at whatever level, into changes in ecosystem service, and thus into changes in human wellbeing.

Building the system

An integrated biodiversity observation system could look something like the wiring diagram in figure 1. Note that most of the component parts of such as system, including the supporting variables, already exist. The GBIF has solved most of the problems associated with constructing and managing unique taxonomic identifiers, in the face of a classification system that is historically not static. The integration of collection-based information with non-collection observations (e.g. species lists for sites) is a work in progress. The issues of unique location identifiers (points, areas and volumes) are well understood, as are the range of time-identifiers (e.g. instant or period?). The recording of genetic information has developed its own data structures, as has the hierarchical mapping of land covers, and various schemes for the classification of functional types.

A crucial missing element is a way of systematically capturing the interactions between biodiversity elements (and particularly between species). This is the core of what we mean by 'biodiversity' – the richness of connections that defines the unique or replaceable role an organism plays in a system, and the degree to which changes in the abun-

dance of one biodiversity element will impact on, or be impacted by, abundance of other elements.

Interoperability (the ability of semi-independent data systems to exchange information unambiguously and efficiently) is central to all information systems that are built primarily out of pre-existing and coexisting parts. Interoperability, in turn, depends on shared standards, which must be simultaneously strong and flexible. Fortunately such standards already exist. 'Darwin Core' and 'ABCD' are already highly evolved. An XML variant called Ecological Metadata Language is under development. These interoperability standards have already established a support community, exemplified by the IUCN-associated 'Conservation Commons', and the OASIS-affiliated Biodiversity Information Standards.

Biodiversity observation systems offer a unique opportunity (and need) for widespread volunteer involvement. Many of the key aspects of biodiversity, such as organism interactions, will for the foreseeable future only be observable in situ, by knowledgeable people. Fortunately, tens of thousands of such highly motivated observers exist. Volunteer-based systems have proved very successful in observations of groups as diverse as birds, mammals, reptiles, plants and butterflies. The model of diffuse knowledge systems ('wikis') as opposed to the traditional highly-centralised knowledge systems has been enabled by the internet culture. Existing examples, such as Wikipedia, demonstrate that if properly structured, such self-organising knowledge systems are not necessarily less reliable than traditional expert-controlled systems.

The monitoring of ecosystem function and extent will rely heavily on remotely-sensed inputs, fused with models. The distinction between 'observations' and 'models' is already moot in this domain – information rich images (such as maps of forest cover, or net primary productivity) are already dependent on implicit or explicit models. Reliance on this data-model fusion requires a sufficiently diverse, comprehensive and harmonised system of in *situ* 'observatories' in order that the models be built and tested.

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Ecosystem services for rural poverty reduction (Abstract)

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The role and relevance of biodiversity in providing goods and services for human well-being cannot be ignored. Be it production landscapes or services such as watershed management, biodiversity and ecosystem services have an increasingly significant role in securing rural and urban livelihoods. This was demonstrated through recent reports such as the Millennium Ecosystem Assessment Report. The call by Ministers of Environment during the 8th Conference of Parties (COP) to the Convention on Biological Diversity (CBD) to include the 2010 target *("…to achieve by 2010 a significant reduction of the current rate of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation and to the benefit of all life on earth"*) as a target of the Millennium Development Goals (MDGs) is one of the most significant moves in the recent years to put biodiversity back onto the central platform for achieving sustainable development.

Biodiversity provides for 80 percent of medicines for the people in developing countries. In countries like Senegal wild resources and non-timber forest produce form 50 percent of income to rural households. Forests, wetlands and grasslands provide what are widely called 'ecosystem services', which are a mainstay of poor communities. These include clean water, soil fertility, pollution control and protection from floods, and regulation of disease. The impacts of floods, landslides, drought, crop failure and disease, for example, are each intensified whenever ecosystems are already degraded. It was poor communities living in such conditions who were most severely affected by loss of such opportunities as well as choices.

A major challenge currently facing the international community is finding ways to transform these precarious living conditions for the poorest of the poor. Key drivers of change related to biodiversity loss and reduced availability of ecosystem services include habitat loss, climate change, economic policies that does not take into account the full values (of the negative externalities which lead to inefficiency), disjointed focus on efficiency and equity issues and lack of choices. This presentation and a forthcoming paper (to be co-authored with Dr. Anantha Duraiappah of UNEP-DEPI) will address the role of these drivers in providing ecosystem services and the impacts of poorly understood economic and governance systems to deal with conservation action for development purposes.

How important is biodiversity in the development agenda – a view from the south (Abstract)

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Brazil´s unsustainable development has generated several environmental impacts. Despite that, the country still has one of the biggest tropical forests of the world and other very rich biomes, such as Cerrado and Mata Atlantica. Biodiversity should then be a valued asset. The current PAC program from the Brazilian government repeats the inadequate development model, with huge infra-structure and agribusiness projects putting pressure on forests and indigenous people and traditional communities. These are also the highest priority areas for biodiversity conservation.

If proper consideration is given to biodiversity in effective sustainable development initiatives, it is a major challenge to find new approaches in order to integrate social, economic and biological issues, and establish an appropriate basis for economic initiatives planning. It means to integrate those peoples' perspective in to the development agenda.

The first step should be based in Amartya Sen´s development as freedom approach in order to identify what is the development that those peoples desire. What are the basic conditions that society has to guarantee them in order to allow them to make their own choices? Community based management, which provides local groups better living conditions, promotes social inclusion and is an instrument of poverty eradication.

The infrastructure planning processes should face this in order to establish priorities. Another great opportunity to find this way is the consultation processes established by ILO 169. The right to say no to those initiatives that put into risk the traditional way of living must be ensured to these populations.

Long-term and intangible benefits of biodiversity are difficult to see and measure. Biodiversity conservation protects humanity against critical problems such as diseases, plagues, climate phenomena, genetic vulnerability of crops, and lack of water, among others. These benefits must also be considered when making choices facing development.

Dryland management for poverty alleviation in Africa

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Abstract

Drylands have always been associated with poverty and low productivity of both human and natural resources. Dryland populations in Africa are economically marginal with poorly developed or limited physical and economic infrastructure. The people are often politically marginal, being poorly represented in the governmental and other power structures and often physically at the periphery of the nation states. Although these problems have been appreciated for a long time, attempted solutions through various development interventions have had mixed results. This is due to the scant regard that is given to the so called human factor leading to a breakdown in the structures and functioning of these societies. Wherever there exists a human population, it is certain that there will also exist a complex of ethnic, biological, and social influences which must be understood and incorporated in the development plans and interventions. Development of drylands must be based on a proper and realistic appraisal of the socio-economic and ecological factors and the populations must be empowered to undertake that development themselves. That development must take into account the changed circumstances due to modernization and seek to remove drylands from their isolation and link them to high potential areas in the country and the rest of the world. While there is need to alleviate the suffering of people who derive their livelihoods from drylands in the short term, priority must be given to restoration of the structure and functioning of social and ecological systems and this will naturally result in the conservation of biodiversity and delivery of essential ecological services. A community based approach to natural resources management is proposed as a possible way forward. It originates from the disillusionment with the observed current ability of central governments to manage common property resources, assess local conditions and priorities, and design and implement a successful conservation and development program. This has created an increasing appreciation of the need to decentralize ownership of and mobilize local initiatives and energies through a more participatory and integrated mode of operation.

Introduction

Despite the global awareness and concern over the issue of poverty in the last half century, the situation of the people who live on the world's drylands has continued to deteriorate and their critical natural resources base has also undergone accelerated degradation. Poverty alleviation is

conditional to the sustainable use of the dryland resources but these resources are in themselves limited in their production potential. Their potential is limited by the low and erratic rainfall which leads to low productivity per unit area of land except where irrigation has been possible to overcome the water shortage. Low levels of output have led to the low levels of development with poorly developed or limited physical and economic infrastructure, e.g. transport and marketing systems are limited and short term expansion or contraction in production cannot be sustained. Partially because of their low productivity, the occupants of drylands are often politically marginal, being poorly represented in the governmental and other power structures, and often physically at the periphery of the nation states, a factor which can complicate the solution of the areas' problems, since their very marginality means that the process of development of the relevant nation states will not by itself take care of the problems of drylands.

I would like to suggest that not withstanding the importance of the ecological approaches of conserving the natural resources base, the solution to alleviating the poverty of dryland populations lies to a large extent in a better understanding of the structure and functioning of their societies and their perception of poverty and wealth. Development is about people and where there exists a human population there also exists a complex of ethnic, biological, and social influences whose continued neglect has led to the continued failure of poverty reduction programs especially in drylands.

The impact of modern changes and introduction of uncoordinated development programs like formal western education, introduction of western religion, infrastructure of roads, water development, new farming and ranching methods, new forms of local and national governance, health and trade policies, have all contributed to the observed lack of progress in poverty reduction and increased deterioration of the natural resources base. It is unlikely that there will be meaningful progress until the root causes of this situation are addressed. I would like to reflect here on a few of these constraints from the eyes of a non-economist and suggest possible approaches by which we could make progress.

Breakdown in social structures in drylands

The breakdown of social structure of the dryland population is perhaps the most important cause of land degradation and consequent poverty in drylands in Africa. According to the explorer Burton (1861), for example, the period beginning with the 16th century to the middle of the 19th century was for the interior of East Africa, the age of tradition. The situation of inhabitants of this region, although they lacked the luxuries of coastal dwellers, was not one necessarily to be pitied. They used iron tipped weapons to hunt with, and often iron axes, hoes, and knives to cultivate sorghum, roots crops and pulses which were the main stay of their diet. They kept goats and fowls and in those areas – more extensive than today – where the tsetse permitted, they herded cattle.

The explorer Burton (1861) comparing their condition with that of the other peasantries with whom his wide travels had made him familiar, found village life in East Africa a tolerable comfortable affair. "The Africans in this region, superior in comfort, better dressed, fed and lodged and less worked than the unhappy Ryot of British India. His condition where the slave trade is slack, may indeed be compared advantageously with that of peasantry in some of the richest European countries".

When Burton came to the country in 1856 he found it divided into a mosaic of chiefdoms, each with its chief, councilors and elders. Each had its court of slaves and he noted in particular the characteristic rituals with which the chiefs were buried. The medium of inter-tribal trade was fairly common and general over this region, for example, between the women of Masai and Chaga and Kikuyu (Christie, 1876).

But as the use of firearms became widespread and ivory became scarcer and dearer, and the threat of European competition – both economic and political became explicit – the situation changed as ivory was sought with blood. What this meant in burnt villages, destroyed crops, and slaughtered, starved and kidnapped inhabitants may be read in various travelogues of the period. For example the German traveler Herman Wissmann (1891) wrote "Where thousands of Beneki, inhabitants of the strikingly beautiful and prosperous villages, had joyfully welcomed us, where in peace and amity we had been conducted from village to village, we now found a waste, laid bare by murder and fire, the clearing in the bush on both sides of the straight tracks, which three years before had been occupied by neatly cultivated plots of the Beneki, were now overgrown with grass of man's height, while here and there a burnt pole, a broken skull and broken pottery were left as the only reminders".

A knowledge of the history of an area – human activities, habitat changes, fauna density and diversity changes is important. It is quite possible that the neglect of the history of drylands as a background to their present ecological setting, has contributed to the current situation in drylands where serious problems can be observed because the factors determining the prevailing situation are not understood.

Demographic changes and policies towards sedentarization

The political programs for drylands, of both colonial and post colonial governments, were very much directed towards one feature of pastoral systems – their mobility (Niamir-Fuller, 1999). Colonial officials brought with them a cultural bias against mobile people, who were viewed as primitive, shiftless and immoral. European ignorance of the nature of pastoral mobility resulted in it being seen as antithetical to good land husbandry because there were very few visible ties to the land. The "nomad" would destroy the land with his livestock and move onward towards "greener pastures". Mobile populations were also less easy to administer. Colonial governments often instituted measures to limit the mobility of their subjects and their subjects'

animals. In Eastern Africa, this was done through the establishment of grazing schemes, grazing blocks and group ranches as good models of proper land use and livestock management in the hope that pastoralists would be convinced about the necessity to reduce their livestock numbers, to overcome overgrazing and to reduce soil erosion to manageable levels. Once settled, a rural population would be medically treated, schooled, and taxed.

Other forms of settlements have developed from famine relief centers created to provide food for people following droughts after they have lost their livestock. Such situations are sometimes exploited to introduce unplanned settlements around Christian mission famine relief centers, non-viable irrigation schemes and fishing villages around rivers and lakes. These cultural and political biases leading to failed policies against nomadic pastoralism have in many cases been continued into today's post colonial independent Africa.

Many pastoral people still feel very insecure about their present position. As part of the reason why secure tenure of their properties continues to be denied, they see continued encroachment into their remaining territory by agricultural people and their exploitation by the sedentary middlemen. Innovative policies which recognize the complexity and linkages between pastoral people and their environment will go a long way in relieving the current situation**.** In the words of Lee Talbot (1986), while discussing the Maasai situation, "Clearly new approaches to deal with the demographic pressures at work in Maasailand must be undertaken within a system framework that comprises the ecological system of the rangelands themselves, within which nomadic pastoralism was developed, and the demographic system operating in Kenya generally and in Maasailand in particular. In short, they must recognize the intimate relationship between the demographic and the environmental factors and their effects on the capacity of these lands to support a growing and varied population". In the modern sense, the continued rural to urban migration due to lack of resources and opportunities in drylands have indeed aggravated the problem.

Introduction of modern land tenure and dryland resource management

A major source of weakness in modern dryland management interventions has been the disruption of ecological system boundaries and confining of dryland populations to non-viable territories that do not cater to their year round grazing needs and livelihoods. Pastoralism based on nomadism is a biological necessity for survival on low potential rangelands affected by uneven distribution of rainfall and frequent droughts. The establishment of state boundaries across these territories and the enforcement of regulations that limit nomadic movement disrupted the basic fabrics of these societies and their functioning.

The failure of independent African states (nations) to rationalize the boundaries established during colonial rule to "divide and rule" can be said to be the most fundamental cause of rangeland degradation in Africa. In order to create the present day nation states of Africa it was deliberate policy to establish boundaries which divided major tribes so that they would have no coherent power to challenge colonial authority. This affected rangeland people more than the other sedentary tribes since they controlled large expanses of territory across which they moved with their livestock.

In Kenya, for example, reduction in pastoral territory due to forced reduction in movement across state boundaries, reduction in territory due to annexation of land for commercial settlement, resulted in increased human and livestock population pressure leading to serious overgrazing and soil erosion on those rangelands. Attempts to define rangeland units in terms of group ranches and grazing blocks for pastoral people were largely unsuccessful because the remaining lands after annexation of drought reserves were never good enough for year round grazing. Weather fluctuations resulting in increased droughts have further compounded human suffering in these pastoral areas leading to inherent food deficits that have resulted in famine relief becoming almost a permanent feature.

Continued political instability across Africa caused in part by insecurity of land tenure seems to throw into question the viability of the modern African states as nations. It would seem prudent at this time to revisit the whole issue of land tenure and ownership as a broader issue of policy both at the national and regional level as there can be no progress in range improvements without some form of security of tenure.

Water Development

The introduction of watering sites on drylands without accompanying control and management of the livestock herds has almost inevitably led to the destruction of the surrounding grazing land as much by trampling as by sheer pressure of foraging. In many parts across the Sahel of Africa the effects of such destruction, followed by soil erosion, has been described as similar to open cast mining.

The provision of new or improved water supplies in arid rangelands is one of the most comprehensible of human urges. Hydrologists and engineers and technicians have frequently performed with great skill in such a cause. But this becomes dangerous when such work is carried out on a narrow front, without any surrounding strategic design for controlling livestock numbers or diluting human greed for exploitation. From the strictly ecological viewpoint, in many areas, it would have been far better if no water projects had been engineered at all.

Wildlife Conservation

Africa currently prides itself of having currently set aside over 10 percent of its territory in national parks or other protected areas for wildlife conservation. Most of these national parks are found on rangelands which support a broad array of migratory wildlife and pastoral livestock that have co-existed here for centuries. The introduction of national parks which are set aside specifically for wildlife conservation alone has introduced an element of instability

in these ecological systems as the practice of allocating a single purpose for land, for example in national parks, is completely foreign to the African cultures on which it was imposed. Furthermore, the process of setting aside these national parks was largely done by decree instead of a negotiated compromise, which alienated many societies that had hitherto coexisted with wildlife. Apart from taking large territories of their grazing land, wildlife conservation laws which prohibited subsistence hunting saw a large portion of the male population of these societies put in prison for what came to be called poaching. All these factors have contributed to a hardening of local attitudes towards wildlife conservation as it is currently implemented and national parks are not yet fully accepted in their new environment.

Although the independent African governments have been quick to quote lucrative tourist revenues as a justification for national parks, tourist revenues into the pockets of corrupt government officials does little to console pastoral people who see wildlife use their remaining grazing lands every day when they cannot take their livestock into national parks even during the dry season. The situation is even made worse when wildlife damages, without any compensation, their few crops which they have introduced to survive under the changed circumstances.

Wildlife conservation is still an indispensable part of the African culture and landscape. It can also contribute substantively to the ailing African economies in terms of tourist revenues. But national parks must be accepted by the local people who live in drylands where they are located by contributing to their aspirations and welfare. This means that current policies which have contributed to the present threat on the wildlife resources must be changed to take into account the needs of dryland people and the resulting conservation program must be acceptable to the local population. This must include possibilities of organized game harvesting to control wildlife populations outside protected areas and reduce human wildlife conflicts. Pastoral people continue to feel very insecure about their present position as they see wildlife conservation as part of the reason why they have been denied tenure of their land and development of their economies. This need for a more accommodating policy is more urgent today than it ever was before in the light of increased populations and accompanying poverty.

Spread of agriculture into drylands

Increasing areas of drylands in Africa are being put under snatch crops. Due to the unreliable rainfall in these areas, there is usually a tendency to occupy the higher sections on the slopes of hills, thus inviting soil erosion, and at the same time a failure of rains can mean a total loss of the crop. The general result in this form of agriculture, in the ecologically delicately balanced areas, is to convert potentially good quality grazing land (for livestock and wildlife) into areas of lowered fertility, liable to water and wind erosion.

It is understandable that increasing human population in arid and semi-arid areas, anxious to safeguard themselves against prospects of famine, and perhaps unable to obtain revenues from livestock sales due to such reasons – apart from cultural reluctance – as disease barriers or flooded stock routes, may be tempted to put in snatch crops to secure an accessible basic food supply. It is also understandable that in many countries governments encouraged snatch cropping, or even more varied and persistent cropping partly to enlist support from the local populations through a build up of production statistics, and partly through lack of any interest, training or experience in landscape ecology, leading them to believe that practices acceptable in higher potential areas could equally well be applied in marginal and arid rangelands. But in the interest of survival of the dryland populations, there must be developed techniques of land use management, and systems of socio-economic administration, calculated to reduce (and eventually eliminate) all land use malpractices.

Livestock population pressures

Regulation of livestock population pressures in order to achieve carrying capacities, which are consistent with good practice in sustainable management of drylands, has been the subject of discussion and experimentation. This involves the regulation of animal movements which is partly determined by the state of herd health, functioning of livestock markets, and cultural needs for survival, which require certain minimum herds per family of pastoral people. The inherent mistrust between the pastoral people and government has undermined the possibilities for finding amicable solution to the problem of overstocking and overgrazing the range.

Whether in respect of rinderpest or any other (endemic) livestock disease, and in terms of all modern technology and drugs, the Veterinary Service over the past decades has become ever more sophisticated and successful. But while due tribute should be paid to the professional integrity and skill of practitioners, it has to be stated that – in contexts of the environment – impact of the Veterinary Service has represented an important ingredient of an ecological disaster. Veterinary practice has succeeded in sweeping away most of an erstwhile controlling factor (i.e. endemic disease) which under natural circumstances – alongside other influences – kept stock numbers and habitat in some sort of balance. But we have not effectively introduced (a few sporadic attempts in just a few areas always failed to survive local inertia and political protestation) any accompanying controlling factor applied to the size and behavior of herds as related to the health of the ecosystem. Thus, and together with other evolving opportunities or contrivances, the Veterinary Service has kept alive an increasingly large number of cattle and other livestock, and could pride itself of such fulfillment of its brief and duty. But the overall state of our drylands has become more and more depressing in appearance, in as much as such life-preserving work has greatly contributed to the degradation in health of so many ecological systems by which future life (human as well as animal) must be and might have been sustained. Policies and technologies should be developed under which the Veterinary Service may contribute within the perspective of sustainable use,

as distinct from grave mismanagement, of dryland resources.

Prospects for sustainable dryland management and development

Science and technology

The success of any dryland development effort will depend largely on the availability of attractive interventions. This should be based on stocktaking of available technology which will need to distinguish agro-ecological variations and the associated constraints in the form of moisture stress, nutrient deficiencies, soil structure and erosion, and weed, pest and disease problems. There will be need to review the different land management systems (e.g. pastoral, agro-pastoral, agro-pastoral, settled crop production, with or without livestock), and the interrelation between different enterprises, the seasonal labor shortages, and the risk aversion strategies that characterize each system. Such stocktaking would need to assess not only the technical but also the financial and risk implications of each intervention and how it fits into the existing and traditional land management practices.

In view of the diverse nature of dryland farming, as discussed in the previous paragraph, it will nevertheless be extremely important to interact with land users on opportunities and constraints from the perspective of their present land use system rather than to prescribe particular treatments. If the people are made aware of the options to overcome constraints and exploit opportunities, they can select the treatment that best fits their situation and interests. This assumes that existing research and development experience are used to compile a “menu” of promising treatments which would form the basis for discussions with local land resource users. The compilation of a treatment menu may also help identify priority gaps in our knowledge and stimulate more interest in dryland management problems, an area of research which has so far been given little emphasis.

Community based natural resources management

Community based natural resources management holds much promise for sustainable development of drylands, especially those areas occupied by pastoral people. It originates from the disillusionment with the ability of central government to manage common property, assess local conditions and priorities, and design and implement a successful conservation and development program. This has created an increasing appreciation of the need to decentralize ownership and mobilize local initiatives and energies through a more participatory and integrated mode of operation. Such a community based integrated conservation and development strategy is being promoted in most recent efforts in relation to natural resources, but effective means of implementation is still elusive. Although the importance of popular participation is widely recognized, progress in its implementation in drylands has been very limited. The previous integrated rural development projects implemented in the early sixties had much relevance and promise, and it will be useful in future to reconsider that experience. The management of natural resources is frequently complex and calls for simultaneous action through well coordinated planning and implementation. Main elements of the strategy include the degree of integration (the responsibilities that should be entrusted to the local community), interactive planning, common property resources management, mobilization of local resources, and organization of community activities.

The village being a relatively small, homogeneous and cohesive group probably provides the best organizational basis for implementing the above tasks. The normal village nevertheless contains people with very diverse interests, resources, competence and ambitions (such as farmers and landless, herd owners and people without livestock, wealthy and destitute, educated and illiterate, politically active and indifferent, men and women), and it may be necessary to form sub-groups and to guard against dominance by any one group or person. There is a need for better understanding of how village decisions are taken, how minority views are protected, what type of planning and resource generation presently prevails or used to prevail, etc. (i.e. village dynamics).

The local community should play an active role in the planning, execution and maintenance of investments; it can manage and help protect public forests and parks; it can become a conduit in the dissemination of new technology and provision of veterinary services; and it could organize itself to take part in marketing, input distribution, savings and credit. The range of activities would depend on the analysis of local conditions and priorities.

Improved livelihood should be the objective of community based activities, and village members would need to interact with government staff in an analysis of opportunities and constraints. This may include the performance of existing land management systems, the identification of areas which are particularly vulnerable to degradation, the scope for infusion of new technology and improved management, and the need for investment. The resulting plan would reflect local agro-ecological conditions, resources and priorities.

Non-farm opportunities

In drylands a substantial part of family income is based on non-farm activities. Some of this may be comprised of remittances by family members that have left the area permanently or seasonally. But some part also has its origins in trading and crafts. The investment priorities of local communities include improvement in infrastructure (water supply and roads) and social services (education and health) which are of profound importance both for production and living conditions and which also may promote specialization, mobility, and migration. It is important to match sectoral development priorities in terms of the use of national resources with local initiatives and funds and to ensure the sustainability of whatever facilities are created. Other non-farming opportunities include participation in

wildlife management and tourism. The private and commercial sectors and public service institutions are increasingly absorbing the emerging educated people from dryland areas.

Conclusion

Despite considerable development efforts, drylands in Africa have continued to deteriorate in resource productivity and human livelihoods. This is largely due to the scant regard which has been given to the so called human factor, and ecological processes leading to the present setting. In order to make positive progress, development interventions will have to give priority to restoration of the integrity of dryland societies in both their structure and functioning. This will require a better appraisal and evaluation of the cultural, political, ecological and socio-economic factors, and balance resources against local human population needs in both the short and long term. A new paradigm for development will have to emerge which will alleviate long standing prejudices and suspicions created by the ivory trade, slave trade, colonization, and independence. People must be enabled to see for themselves the advantages to be gained by such development. This process will have to be guided by organizational structures which appropriately recognizes and merges the traditional systems and the modern forms of governance. In order to cater for the increased populations that go beyond the capacity of the natural potential of drylands, economies will have to be diversified to take into account the changed circumstances brought about by the nation state and globalization. Although we may want to regret the past, life for the people in drylands will never be quite the same again, but we must try to assist in making change less painful.

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Biodiversity, traditional medicine and health (Abstract)

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Today's globalized and fast developing world and its rapidly increasing number and volume of anthropogenic activities are putting tremendous pressure on the environment, its natural resources and ecosystem services.

An important threat to human health relates to the biodiversity loss induced by e.g. habitat change and degradation as a result of overexploitation of natural resources. Millions of people primarily in the least developed countries depend partly or fully on plant, animal or mineral based products collected from ecosystems for medicinal purposes. Thus, acknowledging that many countries in Africa, Asia and Latin America are much dependant on the use traditional medicine (TM) to help meet some of their primary health care needs, the World Health Organization (WHO) launched its first comprehensive traditional medicine strategy in 2002. The strategy is designed to assist countries to develop national policies on the evaluation and regulation of practices related to TM, or to so called complementary or alternative medicine (CAM); to create a stronger evidence base on the safety, efficacy and quality of the TM/CAM products and practices; to ensure availability and affordability of TM/CAM including essential herbal medicines; to promote therapeutically sound use of TM/CAM by providers and consumers; and to document traditional medicines and remedies.

The intimate inter-linkages between development, environmental change and human health have been the subjects of epidemiological research for decades. The burden of disease suffered by individuals and populations and its relation to biological, environmental, social and institutional health determinants are thus well described for many conditions. However, to fill the remaining knowledge gaps, the study of global and local ecosystem changes including biodiversity degradation, and their respective impacts on human health, needs a continued, determined and joint cross-disciplinary effort by researchers and subsequently by policy makers, health professionals and citizens translating new knowledge into action.

Recognizing, that with development, an increasing pressure is put on fragile ecosystems and biodiversity resulting in degradation and possibly extinction of valuable plant and animal species, the role of well tested development planning instruments such as environmental impact assessment and newer tools like biodiversity impact assessment and health impact assessment may become increasingly important as inter-sectoral action tools in safeguarding high biodiversity, traditional medicines and ultimately the health of human populations.

Biodiversity, grassroot innovations and poverty alleviation (Abstract)

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Way back in 1988-89, when Honey Bee network was just emerging, I asked a question, as to why regions of high biodiversity invariably had most poor people. The situation has not changed much in the intervening years. But then new options have emerged, new initiatives have been taken and new innovations have evolved through creation of a bridge between excellence in informal and formal science. I will like to share the experience and draw the lessons which can be replicated following the best ethical practices. But then we will have to question one basic assumption, that is, to treat the poor only as consumers or recipients of advice, aid and assistance. Instead, we should treat the economically poor as providers of rich knowledge, informal institutions and ideas for grassroots entrepreneurship.

Five key lessons that I propose to share are:

a) building a regional, national, and international registry of traditional knowledge and innovations based on biodiversity may help in reducing transaction costs of the potential entrepreneurs, investors, fellow learning communities and even traders;
b) compliance with the Prior Informed Consent of the communities to respect their knowledge rights for eventual benefit sharing, keeping in mind the share of not only individual knowledge holders, but also their communities, nature conservation, and the ones who add value and innovation augmentation fund etc., in a transparent manner;
c) pooling the best traditional practices and grassroots innovations where necessary to develop new natural products for diffusion through commercial and non commercial channels. These could be through small and medium scale enterprises, having benefit sharing contracts with small or medium scale corporations;
d) development of lateral markets instead of reliance only on verticals; so that many of the self-help or micro-finance groups move towards micro-venture finance groups, and
e) creating open source technology pool to support livelihood options of disadvantaged communities.

In order to pursue these objectives, SRISTI has organized Traditional Food Festivals, Shodh Yatras (walk through the villages every summer and winter, so far we have walked about 4,000 km in India), natural product development in the Sadbhav-SRISTI-Sanshodhan-laboratory, create demand for “richer food of poor people” in urban areas to create market and non market based models of poverty alleviation and sustainable resource use practices.

So far the globalization has meant generally squeezing of spaces for small innovators and entrepreneurs. It has been by and large a one-way street. The Honey Bee Network has been trying to reverse this process. It is trying to create a new ethics and institutional culture in which grassroots innovations developed by often uneducated or less educated or valorized people or communities, are allowed to address global as well as local demands. Already the innovative products have reached five continents. But, a great deal remains to be done. The successful entrepreneurs can mentor the start-ups whether in formal or informal sector. However, the mechanism of mentoring small, scattered and disconnected innovators without access to much education, banking or communication systems is not easy.

Distributed mentoring is a challenge that we have to meet, if Grassroots to Global (G2G) is to become an international reality. In other words, if triangle of linking innovation, investment and enterprise has to be formed across the world, then transaction costs of each actor will have to be reduced considerably using online platforms. Assume that a Norwegian entrepreneur selects an innovation from India and wants to set up an enterprise in South Africa with investment from say, the US, then a G2G model would have come about. Likewise, if entrepreneurs in developed countries can find applications for ideas of grassroots innovators in the third world, then a poverty alleviation model will emerge which would look at “poor as provider” of solutions. Diversity, development, dignity will manifest when ethics, equity, excellence, efficiency, empathy, environment and education fuse.

Local communities and biodiversity management (Abstract)

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Local communities are primary stakeholders in biodiversity issues and therefore there is an emerging need for their prime involvement in the process of planning and decision-making, implementation, management and monitoring of natural resources. In most cases, they bear the so-called "opportunity" costs of conservation due to the strong links between livelihoods of the poor and the environment. Local people are consistently being shown to have the skills, knowledge, cultures, traditions and organizational capacities that can be harnessed for successful conservation programmes; hence the recent paradigm shifts in favour of the participatory Community-based Natural Resource Management approach.

In order to maximise conservation gains based on its traditional strengths of hard science and knowledge-based conservation interventions, BirdLife International currently works with local people at Important Bird Areas as a mechanism to tap into their knowledge, skills, and grassroots support for the conservation of birds and the sustainable management of natural resources. These groups are generically known within BirdLife as Local Community Groups (LCGs) but their names and functions vary between regions: from Important Bird Areas (IBA) Caretakers in Europe to Site Support Groups (SSG) in Africa.

In the African context, an SSG is an independent and organised group of voluntary individuals that work to promote conservation and sustainable development at IBAs and other key biodiversity sites, in partnership with relevant stakeholders. These groups play a critical role in actual conservation of species, sites and habitats, education and awareness raising, biodiversity monitoring, policy and advocacy and sustainable development through initiating a wide range of nature-based sustainable income generating enterprises. They link the wider local community, the government and the site management authorities. In some cases, group influence may extend to the global level through the support of national partners and BirdLife's Global Secretariat.

Currently, in Africa, over 150 of such grassroots constituents (SSGs) have been established and are active in site based conservation and sustainable development initiatives at a suite of more than 100 IBA sites. This paper demonstrates by various case studies how the SSG approach works in various parts of Africa where BirdLife and its network are currently implementing conservation and livelihood programmes in partnership with communities. The various means by which BirdLife implements this concept are discussed including the development of appropriate guidelines to enhance the establishment, growth and sustainability of SSGs. Experiences, lessons learnt, successes, and challenges from this approach are presented. Recommendations are made for further development and expansion of the concept across Africa.

The role of biodiversity in poverty alleviation – culture, rights and biodiversity

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I would like to thank the organizers of this conference for inviting me. It is my first time in Norway. I am very glad to be here, to see the land where the Saami Indigenous Peoples live. This is a country full of history and tradition. It is a country which has made steps to archive success in implementing the Convention on Biological Diversity and by playing the role of positive model in sustainable development.

I was happy to be invited to this meeting because it looks beyond what we think is environment and what or how the different aspects of development link together, how this linkages can be discussed in a holistic way to make a difference in our ways of fighting "poverty". It is a conference that will have discussions on the critical role of biodiversity in providing services that are necessary for human well being and security for economic development. I came here also to listen carefully wanting to know what has been achieved so far as we focus on the 2010 targets of *reducing the loss of biodiversity globally*. I want to hear examples of what has been done and the outcomes at all levels. I am hoping that before I leave, my expectations will have been met.

In my presentation, I will take you right to the ground, trying to bring to your attention what is happening with our environment as Indigenous Peoples, what we should do, how the question of climate change has dominated the world agenda. Poverty has been mentioned and many examples have been sighted, to qualify the need to get worried on the loss of biodiversity globally.

I was encouraged by presentations in this meeting that gave good examples of the role played by indigenous, tribal and local communities in the conservation and protection of biodiversity, and that the traditional and indigenous knowledge they have is important and cannot just be compared with the education that we get from high learning institutions. It is important to work with and learn from these communities what they have, and share together for the success of meeting our targets. The need for involving the communities was further emphasized during the presentation of communicating the issues. The presenter informed us that without communicating issues, then we will not meet our target. Indeed Information is empowering and without information, advancement for many will remain elusive.

When we talk about poverty, what do we mean by the word poverty and who divines it? Who is poor? I ask this because for the last 20 years as far as I can remember I have heard many say "*the poor people who live with less than a dollar per day*". It is 2007 and we are still saying the same thing. Why is it not changing? Does it mean this dollar is still the same? Does it also mean that we have not been doing anything in changing the world? Are we worse off than before? I think we have to take action now or 2010 will be here tomorrow with nothing changed.

***Figure 1**. Rendille Indigenous Women from Marsabit Kenya listening carefully during training on women's rights and the environment.- Photo by IIN*

The indigenous and local communities I work for who are many nomadic pastoralists, hunter-gatherers, and other small minority groups give me the motivation to always want to hear examples of how their life's have been changed or affected by the loss of biodiversity and what it means to them. Biodiversity is everything to them, it is the food they eat, the seeds, medicinal plants and wild fruits they collect.

These communities are the same as those in many countries. The majority of them are indigenous women and children. These categories of members of the community are important. Coming from Africa I have been always encouraged by the words of one of our great leaders, the late Mwalimu Julius Nyerere, 1st President of Tanzania, who once said, "Just as women's development in Africa is dependent upon national economic development, so is national economic development dependent upon women in Africa, and cannot easily take place without them".

As a woman I will always carry these words with me and in all the work. Indeed in Africa, there is no success if women are not involved or playing a role in any given activity of development. They feed the world. Women are custodians and holders of our Cultures and Traditions knowledge. They are the ones who pass that knowledge to the next generations. When a child is born, the first words they learn are from the mother. If we have to fight poverty we should start by recognizing the role women play in feeding the world, the rights of Indigenous Peoples and local communities and their role in conservation. The Convention on Biological Diversity reaffirms the important role women play in the conservation and sustainable use of biological diversity, and the need to involve them in the process. This is my reason for giving some examples of the role of indigenous women.

This conference has come when Indigenous Peoples world wide are still celebrating the adoption by the UN General Assembly of the United Nations Declaration on the Rights of Indigenous Peoples. This is a non-binding instrument that has seen Indigenous Peoples fighting for its adoption for over 24 years. The Declaration is a further important step forward for the recognition, promotion and protection of the rights and freedoms of Indigenous Peoples, and also recognizes that respect for indigenous knowledge, cultures and traditional practices contributes to sustainable and equitable development and proper management of the environment. It further affirms that all peoples contribute to the diversity and richness of civilizations and cultures, which constitute the common heritage of humankind.

I work for nomadic pastoralist and hunter gatherers in Kenya, Uganda and Tanzania, and network closely with the rest of the communities in Africa. These groups have identified themselves as Indigenous Peoples as defined by the United Nations. Those that still live in their traditional lifestyles, close to their lands and cultures and traditions are most of the time marginalized because of their way of life. Together we have become a global family with Indigenous Peoples worldwide working for the advancement of our people. In Africa these communities are spread all over the continent, in marginalized areas. Most of the time they are victims of displacement causing them to become destitute and environmental refugees, because of both man-made problems and natural disasters.

I am standing here talking to you with pride that as we speak about biodiversity conservation, indigenous and local communities are clearly recognized and their way of life, cultures and traditions are seen as important and fully recognized by the Convention. "The convention recognizes the close and traditional dependence of many indigenous and local communities embodying traditional lifestyle on biological resources and the desirable of sharing equitable benefit sharing from the use of traditional knowledge, innovation and practices relevant to the Convention of Biological Diversity and sustainable use of its component".

My presentation will also be looking at culture, rights and biodiversity. These three aspects go together. Some people look at traditional cultures and lifestyles and the people practicing and living in them as primitive. But remember that culture, rights and biodiversity go together, if these communities know their rights to these resources then there could be a difference. The traditional knowledge of these communities is very important. Their knowledge of biodiversity and natural resource management is often systematically exploited, misappropriated and eroded. The ownership rights on indigenous medicine that are harvested from indigenous forests need to be recognized and the communities given the opportunity to be partners and participate in the access and control on the resources generated from the environment. It is however, unfortunate that this does not happen and most of Indigenous Peoples and local communities have been facing challenges in their own lands. They have lived in their lands and used traditional ways of conserving and protecting their resources. For years the hunter-gatherers have lived and protected their forest and know how to manage them even when natural disasters take place. These forest areas contain resources. Unfortunately the lands inhabited and taken care of by these communities often happen to be very rich in resources of interest to outsiders, such as gold, wildlife, etc. These resources are the cause of their problems. Sometimes in the villages they wonder whether it was a curse to have these lands, because they have been pushed out in the name of development.

Human rights are the natural fundamental rights that are necessary for basic need of life. The denial of the rights of Indigenous Peoples to physical, mental, social, emotional, and spiritual survival, affects their health and wellbeing as peoples, women, children, and communities. If we have to fight poverty and continue conserving the biodiversity in these lands, we have to take action and not just talk.

Indigenous communities across Africa are facing many challenges, yet in spite of all this, in the face of incredible adversity, an immense amount of knowledge about the environment, land, sustainability and wildlife is maintained and passed from generation to generation. Traditional art still finds a market, traditional dances and songs are still being celebrated, traditional meals are still being served on a daily basis and appreciated by Indigenous Peoples and their communities. Similar to many other indigenous cultures, Africans have managed to retain a large part of their

culture in the face of impending globalisation. However, it is and has not been an easy battle and Indigenous Peoples have to fight daily just to stay alive, to feed, cloth, shelter and to educate their children for the continuance and sustenance of their traditions and cultures.

Figure 2. *Alice Lesepen women leader standing outside a Rendille traditional house made to community museum on traditional items-* ***photo IIN***

The diminishing resources in Indigenous Peoples lands have caused many conflicts. Climatic changes that have caused frequent droughts and threatening the advancement of desertification in Africa is something to worry about. Security has become fragile and the poverty levels are going up because of rural urban migration. As people move they move with culture that gets eroded on the way. Men and young people are moving to towns and urban centers to look for opportunities leaving women, children and the old struggling on their own. Even where the agro-pastoralists and hunter-gatherers practice other modes of livelihoods like farming it is becoming difficult, because of the irregularity of the rains, which they cannot adapt to anymore because of the failure of traditional institutions at the community level. When this happens, the whole cultural structure changes. Changes in the traditional social, cultural and political institutions and practices have led to a loss of practices, culturally appropriate health, rules and codes of behaviors which have long been instrumental in ensuring gender-sensitive structures.

Land issues are a significant problem in Indigenous Peoples' territories. The protection of rights to land and natural resources is fundamental for the survival of indigenous tribal communities in Africa and such protections are provided by Article 20, 21, 22 and 24 of the African Charter. Many indigenous peoples' organizations work to address the grabbing and destruction of their lands, whether for settlement or conservation purposes. In fact, indigenous communities previously occupied 90% of the land currently designated for wildlife conservation. These communities have, for a very long time, coexisted with wildlife with minimum conflict.

The three objectives of the Biodiversity Convention; conservation, sustainable use and fair and equitable sharing of benefits from genetic resources, have been practiced at the community level. However, this has not been recognized at all. Indigenous Peoples and local communities are always generous and do share what they have. They do not understand now why someone takes their resources without sharing. We need to change our attitudes and accept their way of life and be kind enough to also give and share what we get from them. The genetic resources taken from their lands should be equally shared and that way they can play a role in making sure those resources do not disappear but continue to be conserved, as they will have already tasted the accrued benefits from the resources.

Recommendations

- It is important to fully involve indigenous and local communities in the planning and implementation of policies and other instruments in their respective countries.
- Developing an international regime of access and benefit sharing of genetic resources has to be participatory, indigenous and local communities have to be fully involved.
- There should be continued practice on sustainable agriculture, resource management practices, traditional livelihoods, especially with regard to food security.
- Knowledge held by our elders should be carefully protected and efforts to encourage them to share their knowledge with their loved ones are important in order to maintain continuity.
- A better and protected way of documenting that knowledge should be further discussed and success stories should be sought for the sake of ensuring collective intellectual property rights that exist within the community.
- Lack of awareness on Intellectual property rights and the guidelines in the Convention on Biological Diversity especially the article 8j and its related provisions has caused the disappearance of vital plants and loss of knowledge to foreigners. There is need to begin a process of capacity training on the Convention so that there can be a better understanding on the protection of our knowledge.
- Governments should look at the rights of Indigenous Peoples in a more holistic way and take action to protect these communities and not look at the demand of their rights as negative and further marginalizing them.
- Communication strategies have to be put in place in order to reach out to the communities and other key players at all levels. Development of alternative media like folk media, communication radios and other means of communications will be crucial.
- There is need to have political commitment in order to succeed in the efforts of meeting the 2010 targets.

Biodiversity, climate change and resilience

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Abstract

Biological diversity appears to enhance the resilience of desirable ecosystem states, which is required to secure the production of essential ecosystem services. The diversity of responses to environmental change among species contributing to the same ecosystem function, which I here call response diversity, is critical to resilience. Response diversity is particularly important for ecosystem renewal and reorganization following change. Here I present examples of response diversity from both terrestrial and aquatic ecosystems and across temporal and spatial scales. Response diversity provides adaptive capacity in a world of complex systems, uncertainty, and human-dominated environments. We should pay special attention to response diversity when planning ecosystem management and restoration, since it may contribute considerably to the resilience of desired ecosystem states against climate change induced disturbance, mismanagement, and degradation.

Introduction

Adapting to climate change and other global change stresses requires resilience of integrated social-ecological systems. Resilience is defined as the capacity to buffer disturbances, to recover, renew and reorganize and to learn and adapt. As the UN Secretary General has observed: "Building 'resilience thinking' into policy and practice will be a major task for all of the world's citizens throughout the new century". Change is inevitable, but we need to understand ecosystem change, especially the existence of thresholds and the potential for non-linear change (Scheffer et al. 2001, Folke et al. 2004). Biological diversity appears to play a substantial role in ecosystem resilience and in sustaining desirable ecosystem states in the face of change (Peterson et al. 1998). This role is related to the diversity of functional groups in a dynamic ecosystem undergoing change, and the species diversity within these groups (Walker 1992, 1997; Norberg et al. 2001). Luck et al. (2003) point to the importance of diversity in species and populations within functional groups in helping to maintain ecosystem services (i.e. ecological redundancy). In particular, the variability in responses of species within functional groups to environmental change is critical to ecosystem resilience, a property called 'response diversity', and defined as the diversity of responses to environmental change among species that contribute to the same ecosystem function (Elmqvist et al. 2003).

In semi-arid rangelands, resilience of production to grazing pressure is achieved by maintaining a high number of apparently less important and less common, or apparently 'redundant', species from the perspective of those who want to maximize production, each with different capacities to respond to different combinations of rainfall and grazing pressures. They replace each other over time, ensuring maintenance of rangeland function over a range of environmental conditions (Walker et al. 1999). The role of genetic and population diversity for response diversity is illustrated through sockeye salmon production in the rivers and lakes of Bristol Bay, Alaska. There are several hundred discrete spawning populations that display diverse life-history characteristics and local adaptations to the variation in spawning and rearing habitats. Geographic regions and life-history strategies that were minor producers during a certain climatic regime have been the major producers during others allowing the aggregate of the populations to sustain its productivity in fluctuating freshwater and marine environments. The response diversity of the fish stocks has been critical in sustaining their resilience to environmental change. Such management is in stark contrast to the common focus on only the most productive runs at a certain moment in time (Hilborn et al. 2003).

Biodiversity in ecosystem renewal and reorganization

Recovery after disturbance has generally been measured as return time in the disturbed site. Frequently, the sources of ecosystem recovery have often been taken for granted, and the phases of ecosystem development that prepare the system for succession and recovery largely neglected.

In coral reefs, three functional groups of herbivores play different and complementary roles in renewing and reorganizing reefs into a coral-dominated state. These keystone functional groups - grazers, scrapers and bioeroders – prepare the reef for recovery. Bioeroding fishes remove dead corals and other protrusions, exposing the hard reef matrix for new settlement of coralline algae and corals. Grazers remove seaweed, reducing coral overgrowth and shading by macro-algae. Scrapers remove algae and sediment by close cropping, facilitating settlement, growth and survival of coralline algae and corals. Without bioeroders, recovery may be inhibited by extensive stands of dead staghorn and tabular coral that can remain intact for years before collapsing and taking with them attached coral recruits. Without grazers, algae can proliferate, limiting coral settlement and survival of juvenile and adult colonies. Without scrapers, sediment-trapping algal turfs develop, smothering coral spat and delaying or preventing recovery. The extents to which reefs possess these functional groups are central to their capacity to renew and reorganize within a coral dominated state in the face of disturbance (Figure 1) (Bellwood et al. 2004).

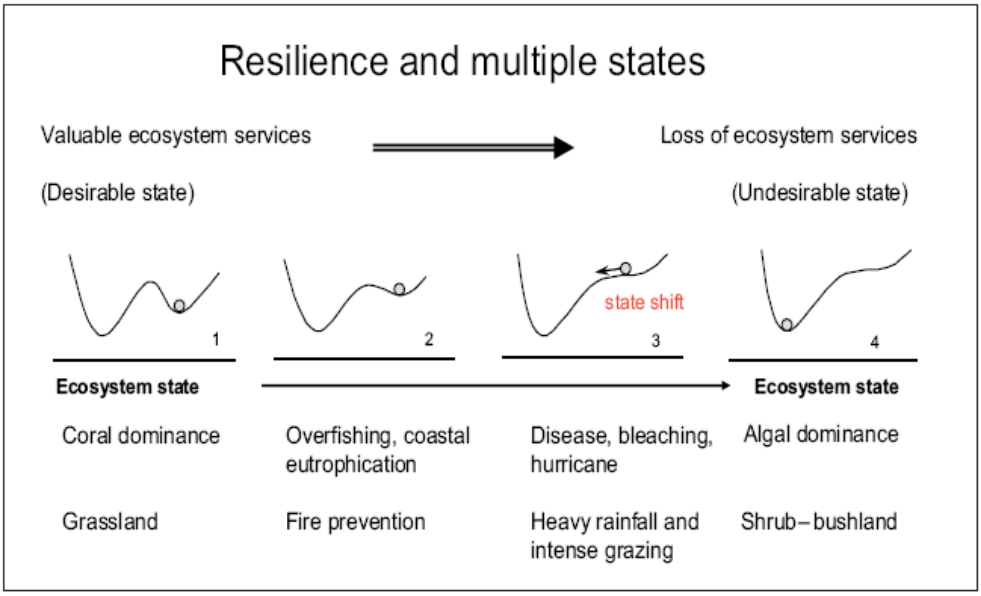

Figure 1. Shifts in coral reef and rangeland ecosystems from a more to a less desirable state as a consequence of human-induced erosion of resilience. The stability landscapes depict the basins of attraction at different conditions. If the size of the attraction basin is small, resilience is small, and even a moderate perturbation may bring the system into the alternative basin of attraction. The actual shifts in coral reefs and grasslands are caused by disturbance events, which resilient ecosystems would have absorbed through reorganization supported by response diversity (modified from Deutsch et al. 2003).

The biological sources of renewal and reorganization for ecosystem resilience consist of functional groups of biological legacies and mobile link species and their support areas in the larger landscape/seascape. For example, large trees serve as biological legacies after fire and storms in forest ecosystems (Franklin & MacMahon 2000, Elmqvist et al. 2001). Mobile link species, like resource-, genetic information- and process linkers connect habitats sometimes widely separated in space and time (Lundberg & Moberg 2003). For example, vertebrates that eat fruit, like flying foxes, play a key functional role in the regeneration of tropical forests hit by disturbance such as hurricanes and fire by bringing in seeds from surrounding ecosystems for renewal and reorganization (Cox et al. 1992, Elmqvist et al. 2001). The functional group of grazers on coral reefs connect a wide range of spatial scales from centimeters, such as amphipods and sea urchins, to 1000's of kilometres, such as green turtles. By operating at different spatial and temporal scales, competition among species within the guild of grazers is minimized and the robustness over a wider range of environmental conditions is enhanced (Peterson et al. 1998).

Sustainability is not about saving the environment for its own sake or about conserving certain species for ethical reasons. It is about sustaining the potential and capacity for prosperous social and economic development. Sustaining this capacity requires understanding, and proper management and policy of feedbacks, and interrelations between ecological systems and social and economic systems across temporal and spatial scales. Human society is part of the biosphere and ecological systems provide the basic foundation on which social and economic development depends.

Human simplification of landscapes and seascapes for production of certain target resources to be traded on markets has produced stability of resource flows in the short term, but only at the expense of reduced functional diversity and eroded resilience in terrestrial and aquatic environments worldwide (e.g. Bengtsson et al. 2002). Managers seek to command and control processes of change in simplified landscapes in an attempt to stabilize ecosystem outputs and sustain consumption patterns (Carpenter & Gunderson, 2001). Paradoxically, the mental model of optimal management of systems assumed to be stable and predictable has in many respects reduced options and compromised the capacity of life-support ecosystems to buffer change (Ludwig et al. 1993) by suppressing disturbance and by reducing the diversity of the environment (Holling & Meffe 1996). An adaptive solution with flexibility to cope with and respond to environmental uncertainty and social and economic disturbances is needed, a solution that is in stark contrast to the command-and-control philosophy that has marked the development of modern sectoral approaches to natural resource and environmental management.

We must explicitly account for the role of biodiversity in ecosystem resilience for sustained social and economic development in formulating management and policy. Managing for resilience is critical for coping with uncertainty and surprise in a biosphere shaped by human action (Folke et al. 2002). Human homogenization of landscapes and seascapes has altered disturbance regimes (Paine et al. 1998) and eliminated entire functional groups of species (Jackson et al. 2001). Ecosystems with high response diversity provide a buffer that insures the system against the failure of management actions and policies based on incomplete understanding. This allows managers to learn and actively adapt their resource management policies. In other words, response diversity increases the tolerance for management mistakes. In some systems, it may also be possible to test and analyze the degree of response diversity through non-random removal experiments, as suggested by Diaz et al. (2003).

Conclusion

In this paper I have stressed the essential link between ecosystem services, functional groups, and response diversity. I have focused on the role of response diversity in sustaining and enhancing desirable ecosystem states in the face of disturbance and human-induced environmental change, and highlighted its cross-scale nature. Bengtsson et al. (2003) suggested that in the future, dynamic refugia and reserve networks may serve a key role in management and the restoration of response diversity. Interestingly, there are several examples of local groups and societies worldwide that appear to have managed for response diversity for a long time (Berkes et al. 2002). The erosion of response diversity may increase the vulnerability of specific functional groups, or even result in the loss of entire groups. This may, in turn, lead to social and economic vulnerability, changes in nature's capacity to supply human society with essential ecosystem services, and ultimately degraded social-ecological systems.

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Climate change, land degradation and biodiversity in Africa – the challenge remains: how do we reach out to the people?

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Abstract

Throughout the past few decades environmental practitioners refined strategies to achieve improved and environmentally sustainable development. Two levels have been emphasized: (i) An enabling policy framework linked to political commitment; and (ii) Communities and empowerment of people at the local level to manage the environmental resources linked to their livelihoods. Despite widespread acceptance of these as strategic levels, progress towards improved livelihoods and achieving the Millennium Development Goals remains relatively low or, at best, the successes have been mixed. This is also the case when assessing success in conversing biodiversity, halting and reversing land degradation, and coping with anticipated climate change – as well as mitigating contributions to the phenomenon.

This paper explores some of the prevailing key challenges to addressing climate change, land degradation and biodiversity in Africa, and presents some important lessons learnt in this context from Namibia and elsewhere in Africa. A focus is on the recently prepared third National Development Plan in Namibia, which constitutes an interesting case study on how the country is dealing with mainstreaming environmental sustainability throughout its national development planning process, and with linking an enabling policy framework with local level action. The case study also indicates inherent challenges and shortcomings, primarily related to the need for commitment to long-term strategies and investments both from the national level and from the international community. Specific recommendations on how the international Multi-lateral Environmental Agreements (MEAs), for example the UN Conventions to Combat Desertification (UNCCD), on Biological Diversity (CBD) and the Framework Convention on Climate Change (UNFCCC), can provide more focused impetus for priority action in Africa. This includes that joint delivery mechanisms for the Conventions should be established at, especially, the community level, and that long-term investments should be committed to make the needed contributions to poverty alleviation and empowerment of local resource users and managers.

Climate change, land degradation, biodiversity and livelihoods in Africa – what are the linkages?

Over the past years a growing effort is made in establishing conceptual linkages between the various major environmental management issues, as laid out by the three so-called Rio Conventions (UNCCD, UNFCCC, CBD), and development. Especially in a developing country context it is imperative to make a strong case for the environmental agenda – and how it contributes to improving livelihoods and helps combating poverty. A number of formally established conceptual frameworks illustrate the importance of sustained environments and development. The Millennium Ecosystem Assessment (MA, 2005) probably establishing the currently best known and most widely cited framework linking biodiversity and human well-being, through an ecosystem services focus.

In essence it is argued that biodiversity maintains healthy ecosystems and healthy ecosystems are critical to maintaining essential ecosystem services without which life on Earth would not be possible. This could be more effective if it was down-played to an individual-level, especially in Africa, where a majority of people continues to depend directly on the natural resource base for their daily livelihoods. This includes for agriculture and food production, water availability and quality, and a variety of natural resource based livelihood support elements and incomes.

Figure 1 illustrates, as an example, how prolonged drought (climate change induced or pertaining to natural variability), through various inter-linkages, impacts on water and natural resources, e.g. degradation of rangelands through over-utilization induced by inappropriate management practices, also impacting on biodiversity and natural ecosystem resilience, and critical livelihood elements such as food availability, health and household incomes. Many other such linkages can be established.

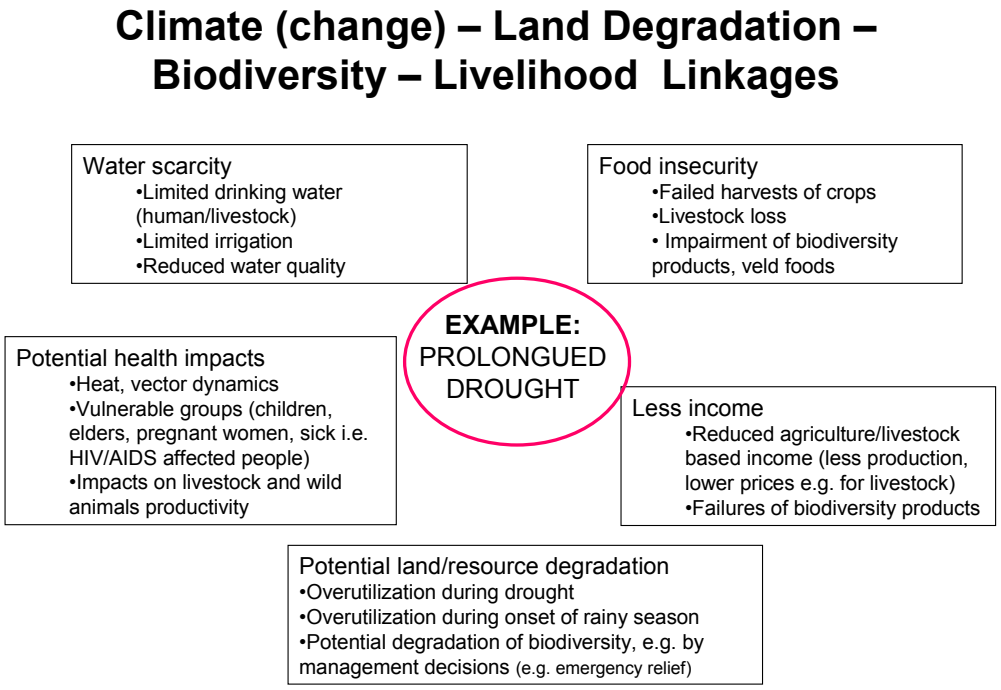

Figure 1. *Linkages between climate (change), land degradation, biodiversity and human livelihood are illustrated in context of occurrence of prolonged droughts. Drought conditions impact on water and food availability, which in turn may impair health of people and livestock. Failed harvests and poor meat prices, as well as the need for investments to cope during droughts, reduce household incomes, directly impacting on livelihoods. Poor land management practices applied may lead to land degradation, for example induced by setting disincentives for de-stocking through emergency relief fodder supply. Biodiversity can be damaged due to over-utilization and poor management practices. Adopted from Zeidler & Chunga (2007).*

What has been achieved? Africa's delivery on the MEAs

Although international environmental conventions were established prior to the UN Conference on Environment and Development (UNCED) in 1992, the so-called Rio Summit gave new impetus to placing environment and development issues onto the global agenda. A suite of Multi-lateral Environmental Agreements (MEAs) were incepted during and after the Rio Summit, amongst them the UNCCD, UNFCCC and CBD. Even the most outspoken MEA critics will have to admit that these conventions have leveraged a great deal of support and implementation both in developing countries and developed countries alike, and established an intense dialogue on related issues. The ratification of these international instruments places the responsibility on countries to establish national policy frameworks that would enable and promote sustainable environmental management, and also leverage international funding sources for country-based implementation activities.

The 2nd Global Biodiversity Outlook (GBO 2; SCBD, 2006) includes diagrams that illustrate trends of countries ratifying the CBD, clearly displaying great successes with more than 190 signatories, including in Africa, who have ratified the instrument. Similar results are discernible for the other two Rio Conventions. A great number of countries, including in Africa, have developed the key implementation instruments under the Conventions, inter alia National Action Programmes (NAP) under the UNCCD, National Biodiversity Strategies and Action Plans (NBSAP) under the CBD, and National Actions Programmes of Adaptation (NAPA) in eligible Least Developed Countries (LDCs). Reporting requirements are met at different levels and with varying success, however. Investments into strategic implementation programmes have been significant, including through bi-lateral support and through investments of the multi-lateral Global Environment Facility (GEF). Overall it can be observed that the environment has found its way onto the development agenda and that some promising results at the political level have been achieved – even if ever so mixed in their impacts.

New challenges - changes in the development cooperation

The international development framework is continuously developing and changing. For years now it is observed that the level of Official Development Assistance (ODA) is diminishing, despite the fact that through commitments such

as the MDGs opposite targets are being set. Although it may be argued that donors are getting more effective at targeting aid or are targeting to strategic levels with wider impact, a reduction in ODA available may impact delivery on development. Although conservation money may be de-linked from ODA, development investments are not, and it is important to track available investments.

The recently adopted Paris Declaration (March 2005) on international Aid Architecture has moved the modalities of aid delivery in the future. Based on the Paris Declaration recipient countries of aid have a much stronger say in how to allocate funding, and much of the aid is extended as budget support. Priorities as set out the national Poverty Reduction Strategies (PRS) will receive priority funding (Bojö & Reddy, 2002).

What do the changing aid architecture and investment frameworks mean for environmental management and conservation in developing countries? What are the implications for the existing delivery and implementation mechanism of the MEAs? It is critical to examine opportunities and challenges for the environmental agenda to ensure that it does not fall aside when setting development priorities.

Namibia: mainstreaming environment in national development planning – a case example

To keep environment on the development investment agenda, it is critical that environment – be it climate change, biodiversity, sustainable land and water management – find their way into the PRS of the countries and into the regional development frameworks. For Namibia recent studies such as those of Zeidler & Jones (2007), Jones (2001), and Krugmann (2001), include detailed analysis about how environment has been mainstreamed into the development frameworks in Namibia.

Namibia has recently engaged in the preparation of its 3rd National Development Plan (NDP), which is the localised equivalent to the PRS. The overall theme of NDP 3 is "Accelerated Economic Growth through Deepening Rural Development". The process of development planning in Namibia is outlined in Figure 2, and clearly indicates how the international frameworks link to national development planning and how bottom-up and top-down processes connect. It is critical that Namibia has chosen Environmental Sustainability as one of the Key Result Areas of NDP 3 (divided into two sub-sections: A. Optimal and sustainable utilisation of renewable and non-renewable resources, and B. Environmental sustainability), thus keeping environmental management on the top of the national development agenda. A detailed situation analysis was conducted clearly demonstrating the contributions environmental management makes to rural development. Additionally environmental sustainability was an obligatory cross-cutting issue and all other Key Result Areas (7 in total) had to demonstrate that they have sufficiently taken care of mainstreaming environmental concerns. Issues and key interventions pertaining to all Rio Conventions have found their way into the final NDP!

Namibia is only one example of an African country that has identified environmental sustainability as key to sustainable development, and interesting lessons for the successful implementation of MEAs can be learnt.

How do we reach out to the people – Community-Based Natural Resources Management (CBNRM) as a key strategy?

Keeping the environment high on the development agenda is but only one critical step in achieving better environmental management and condition, whilst alleviating poverty. The truly biggest challenge remains coining well-intended policy into on-the-ground action. It needs to be realised and recognised that reaching out to and engaging the local people in natural resource and environmental management requires continued investment and has to be the focus to effect lasting changes.

In southern Africa a diversity of approaches to CBNRM have been tested over the past decade – and some astonishing results have been achieved (Artzen et al. 2007). Mostly emanating from a wildlife perspective, the Namibian Conservancy concept, for example, has demonstrated that people and wildlife can indeed co-habit, and game populations have increased dramatically over the last decade, including in communal areas which were largely depleted of wildlife resources at the end of the apartheid era. Investments have been made into community development, mainly through systematic institution and capacity building, and through creating an enabling policy environment which allows people to benefit from natural resources through reformed tenure arrangements. Incomes derived from, e.g., wildlife based tourism, tourism joint ventures, trophy hunting and the utilization of other biodiversity-based products have become significant and run into the millions throughout the country, earning certain communities and households additional cash income. Incentives to accept wildlife as a viable land-use are generally paying off, despite drawbacks such as human-wildlife conflicts. Often the establishment of conservancies has gone hand-in-hand with improved land use and resource use planning and the establishment of formal management plans. The conservancy concept is now being broadened to focus on sustainable range and land management, and to simultaneously address other natural resources issues such as water management.

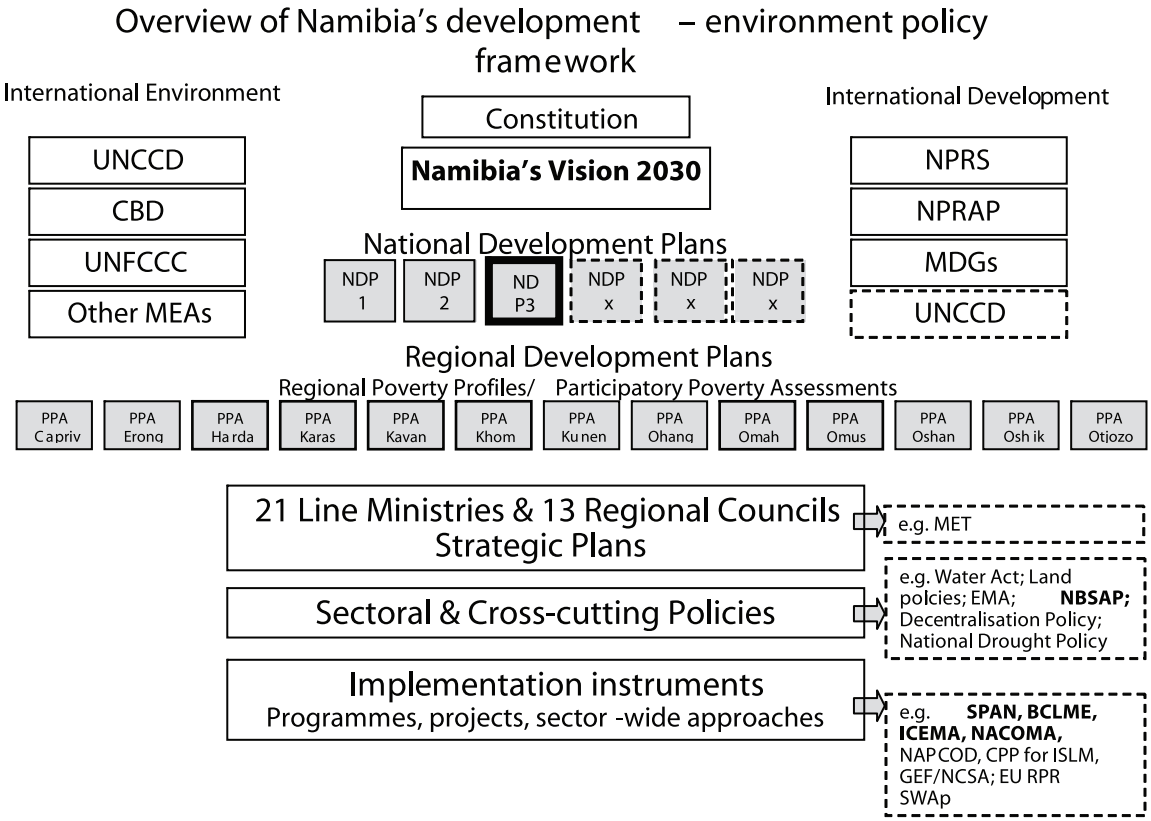

Figure 2. *Namibia's environment and development policy framework as it contributes to achieving the national Vision 2030. Bottom-up participatory inputs are solicited e.g. through Participatory Poverty Assessment, aggregated at the regional level to Regional Poverty Profiles, and should feed into Regional and National Development Planning especially through the Regional Councils. Further, Line Ministries contribute to planning and delivery through sectoral and cross-sectoral policies and implementation instruments as well as institutional Strategic Plans. This diagram was used in the Namibia mainstreaming case study (Zeidler & Jones, 2007) as a guiding tool to review the institutional and practical linkages within the environment and development framework, identifying both the domestic set-up and the international instruments which are influential. The CBD and other MEAs play a significant role in agenda setting. After Zeidler & Jones (2007).*

The investments into community development are enormous and include training in product refinement, marketing, and negotiations, amongst others. Irrespective from which angle the community-based approach stemmed, agriculture, water, wildlife – the important element is the investment into local people and management structures. Any environmental challenge, including those posed by climate change impacts, land and water management and biodiversity conservation need to be addressed by the local resource manager. It thus seems only logical to consider CBNRM as one of the key delivery mechanisms for the successful implementation of any of the MEAs on an in-country level (Roe et al. 2007; IRP 2007). Whereas there is merit in negotiating MEAs individually on the global level, the national agendas and in-country service delivery may need to be addressed through a more integrated approach, i.e. through community-level delivery through one mechanism.

What commitment is needed?

MEAs usually leave the implementation to the country level, although international guidance is prepared and international partners provide support. It needs to be examined if we can improve on national level implementation through a changed and improved international framework; such reflections could take place in the context of further analysing and capitalizing on opportunities posed through, i.a., the Paris Declaration. It is clear that the major investments made into continued global dialogues and science generation need to deliver better at the implementation level, e.g. through supporting national level research and pledging resources for systematic and long-term local level engagement.

Of course not all countries are similarly open to decentralisation and CBNRM investments. However, examples from southern Africa and elsewhere in Africa demonstrate that major commitments have been made and from a govern-

ance point of view, many Governments realise that investments into their people are key to sustainable development (Artzen et al. 2007; Roe et al. 2007; IRP 2007).

The international community can support developing countries through a dual approach of:

- Continuing support to inclusion of top environment issues into the policy frameworks and national development agendas, both in developed and developing countries alike. In how far the various MEA's should be integrated into a common environmental sustainability approach should be examined, but it seems likely that specific instruments as set out e.g. through NAP, NBSAP and NAPA are useful and should be retained, even if in an adapted form.
- Investing into CBNRM approaches, and support country governments in the difficult task to empower their people. It has to be recognised that the human and financial resources required are enormous and that long-term commitment is needed to achieve the development goal.

CBD – moving towards implementation

What does this mean for the CBD? Recognising the changing development cooperation framework and development realities in Africa, the CBD discourse needs to engage with some of the critical issues, such as:

1. **Synergies & Complementarity:** In the development-poverty alleviation-environment nexus, what are the biodiversity-related key challenges and opportunities? In how far is it possible to become more embedded in a more integrated "environmental sustainability" context? Which synergies and complementarities can be capitalised on to achieve real on the ground impacts at the local level? Often the various MEAs do not fully capitalize on such opportunities because they fear to become redundant if they show "too much synergy". There is, as indicated above, a strong notion that, at a certain aggregated level, "environment" may strategically be addressed as one, while at the level of individual MEAs, a more disaggregated approach may be needed. It is important to make strategic decisions about such targeting to actually be able and deliver the relevant key messages to policy makers outside the environment lobby.

2. **Paris Declaration:** how to make the environmental case? Where are the entry points to National poverty reduction strategies (PRSP) and National Biodiversity Strategies and Action Plans (NBSAP)? Recognising the fundamentally evolving aid architecture – how can the NBSAP be shaped to make useful contributions? Which other tools, such as mainstreaming, can be applied? Is there room for a dual approach? Are GEF-project investments sufficient to help countries achieve environmental sustainability – and poverty alleviation? The various implementation instruments, especially the NBSAP, need to be revisited and it needs to be considered if the instrument, as initially developed, is still fitting into the further evolving development context. It is critical to look beyond policy formulation and to focus on establishing mechanisms that place priority to national implementation. Global Partnerships should, in this regard, be directed to deliver and support on the country level.

3. **Joint implementation delivery mechanisms?** Is CBNRM an opportunity for a joint-delivery mechanism for the MEAs? What type of investments by donors, national Governments and Civil Society should be promoted? The various environmental issues promoted by the various MEAs do not usually exist in isolation when addressing them at the community or natural resource manager level. Thus, local level outreach and management programmes should perhaps be set up to service all MEAs, and be developed as agreed to a local level delivery mechanism. The establishment of working CBNRM initiatives requires a great deal of investments into institution building, which could be supported by all MEAs, and various thematic programme could then be established, based on the priorities of each of the communities involved. Such thematic priorities may relate to individual biodiversity concerns or integrated concerns relating to climate change adaptation, which may also address desertification priorities.

4. **CBD: to be addressed/housed by Development Ministries, not only Environment; critical part of development agenda!** CBD still has a reputation of mainly attracting environment ministries and agencies, especially in developed countries, with little connection to the development agenda. It is not the point to transform the CBD into a development instrument, however it is important to make the linkage especially in a developing country context. Some countries have been able to make the connection and are represented by delegations which include development experts as well as technical biodiversity experts.

5. **GEF & Implementing Agencies: at this stage probably the most practical mechanisms, but certain constraints; how can CBD connect better?** It is recognised that the CBD is an instrument of international law with a relatively small Secretariat. Delivery on implementation can consequently just be limited in nature. However, it is important to search for the most strategic entry points for the Convention to really make the link between global dialogue and national agenda setting and real term implementation. Although currently the GEF is a key implementation mechanism for the various MEAs, project delivery is perhaps not optimally linked, and parallel structures and authorities are being established. The fact alone that GEF Focal Points are not necessarily MEA Focal Points, and interactions may be quite limited in certain cases, is just one example of such disconnection.

6. **Target 2010: hard for developing countries to demonstrate successes; improve on Target 2020!** A specific point is made concerning the CBD-set international biodiversity conservation target for 2010 to significantly reduce biodiversity loss at that time. Although biodiversity loss is a significant issue in developed

countries, much needs to be achieved in developing country nations to ensure that the target can be met. The currently formulated indicators are difficult to demonstrate and report on by many developing countries. Even though some significant contributions towards the target have been made, it may be hard to solicit the relevant data and to bring it into the reporting format. This may be due to, e.g., lack of data, lack of competent personnel in a position to report on the indicators, lack of financial resources to hire such experts, or simply having different priorities for allocating resources. It is often criticised that process indicators do not provide us with real measures of success; however, in many developing countries process reporting could at least highlight some of the commendable efforts made towards meeting the 2010 target. It is important to find ways for countries that have made significant progress and have shown strong biodiversity commitments to be able to demonstrate their successes. A 2020 target should provide more of such opportunities.

Conclusions

Climate change, biodiversity and desertification/land degradation amongst other environmental issues remain critical to the development agenda. Over the past decade the environment and development contexts have evolved significantly, and a great deal of lessons learnt on what works or what works not so well has been generated. It is important to continue efforts to eradicate poverty, and the successful implementation of the MEAs constitutes relevant contributions. It is important that challenges and opportunities for delivery on the country level in particular are being explored and optimised.

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Biofuels – opportunities and challenges

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I will start my presentation with a brief introduction to biofuels. Next, I will contexutalise the subject – asking why a focus on biofuels is so topical today. Next, I present major problems, opportunities and challenges tied to production of biofuels. I will give examples of how challenges are approached today and, finally, point to further major challenges ahead.

Biofuels are simply fuels produced from biological material. The major biofuels in use today are:

- Bioethanol, refined from plants rich in sugar and starches, notably sugarbeet, sugarcane, corn, wheat and other grains.
- Biodiesel, based on oil extracted from plant material rich in such oils, notably, palm oil, soy beans, jatropha, rapeseed, etc. as well as animal fat.

At a testing stage are what has come to be labelled second generation biofuels, based on cellulose, with refining processes that in fact may facilitate the use of every part of a plant's biomass.

Today, biofuels are used as additives to conventional fuels in various mixtures, normally 5%, without any need for engine modification. They are also used as substitutes, where high-fraction mixtures need specific engine design, what is typically known as flexifuel engines.

Why then such a focus on biofuels? By 2005, only 1% of global transport fuels marketed was biofuels. However, recent growth rates are impressive. From 2002-2005, the world saw a tripling of consumption. The frontrunner country in use of biofuels was Brasil, basing between 20-30% of total fuel demand on bioethanol produced from sugarcane. Germany is another example of a fast-growing market. Today biodiesel cover around 6% of German demand for transport fuels, up from next to nothing in three years.

Global production is still highly concentrated to the United States and Brazil, with global shares of production amounting to 49 and 41%, respectively. The European Union is the third major producer, accounting for 4% of the global total. However, more than 70% of global biodiesel production occurs in the EU. The new growth in demand is, however, about to change this picture as many countries around the world has initiated production of biofuels.

Global demand has been highly policy-driven, prompted by new concerns for energy supply security and climate change, but also by the agricultural industry seeking new opportunities outside the food and feed markets for its products. The European Union has recently taken a lead position in biofuels policy development, setting a 10% market share target for 2010, and also the United States has formulated ambitious goals. Today, the list of countries with formulated goals for biofuels and policy programmes is long.

Current estimates of global technical and economic potentials vary a lot, between 4% and 30% share for biofuels in 2050. The high end of these estimates certainly warrant closer examination of what this could bring about in terms of challenges and opportunities.

Biofuels have been pointed to as a major solution to the climate change problem. And in fact, biofuels could be carbon neutral, in the sense that carbon released when combusted will amount to the carbon taken up from the atmosphere during photosynthesis.

However, based on life-cycle analysis of fuels, this 'truth' about the climate neutrality of biofuels has been challenged. Concerns have also been raised regarding the impacts of biomass production for biofuel on other environmental qualities, such as maintaining global biodiversity, and also regarding the impacts on broader social development issues.

At the same time, biofuels have by some been identified as a major opportunity for generating economic benefits to the world's agricultural regions and to provide new employment and industrial development.

Many current life cycle analyses point to the lower energy balances of biofuels relative to conventional fuels as a problem for their capacities to contribute to reduction of climate gas emissions. This is in particular a concern if the energy input to cultivation, harvesting, transport, and refining of biomass is based on fossil fuels.

There is, however, great variation among biofuels in terms of rates of energy output to the amount of energy required in order to produce the fuels. One reason for this is variation in acreage needed for cultivation of different types of biomass.

Energy balance variation among biofuels also reflects variation in land-use practices, notably variation in nitrogen fertilisers put into cultivation of biomass. Production of N-fertilizers is highly energy intensive and degrades into nitrous oxides when used. Nitrous oxides are a far more potent climate gas than carbon dioxide.

Studies also point to energy balance variation across areas due to variation in soil productivity and local climate. Currently, tropical plants are generally more favourable in terms of energy balances. This is due to sunlight and water conditions, as well as the fact that cultivation is to a larger extent based on labour-intensive methods in the tropics, in addition to a more restricted input of fertilisers and pesticides.

Another problem which has been identified is that biofuel biomass cultivation may replace major above- and underground carbon stores. Burning of forests release huge

amounts of climate gases, and cultivation of grass- and peatland soils releases carbon stored over long time in the plant's root systems.

Studies indicate that problems are smaller when biomass for biofuels is cultivated on degraded agricultural land and on arid lands. There may also be opportunities for actually increasing the soil's capacity to sequester carbon if the production of biomass for biofuels is based on perennial plants augmenting the root system over time.

Furthermore, studies and practices have shown that cultivation of biomass for biofuels may cause destruction of habitats and biological diversity, for example when tropical forests are cleared to provide areas for cultivation. The international community has been greatly alarmed by clearing of rainforest in Malaysia and Indonesia associated with establishment of plantations for palm oil production.

Studies have also pointed to other impacts of biofuel biomass production impacting on habitat and biodiversity, such as spreading of monocultures, overexploitation of water resources, pesticide use, and compaction and erosion of soils. In addition, some studies indicate that some plants used as biomass for biofuels may be characterised as invasive species.

Again, second-generation fuels have the potential to cause less problems, and may even provide opportunities for restoring biodiversity. Studies indicate that some native grasses may give higher yields than traditional agricultural products.

Social development issues should be added to the list of potential problems. Production of biomass for biofuels will compete for land with production of biomass for human food, animal feed and industrial fibres. Major price increases on food products linked to biofuels production have been reported, for example with the rising prices on maize for tortillas in Mexico. The agricultural population and industries in food exporting countries may gain from higher prices, whereas food import countries and poor people in cities are potential losers.

Added to this list are reports on substandard wages and poor working conditions on plantations producing biomass for biofuels, and an absence of any trickle down effect on local communities from industry development. We see an increasing concentration of lands on the hands of a few large landowners in developing countries, and takeover of land for biofuels cultivation by major international agrobusinesses, wiping out traditional ways of living and sending people into poverty.

The challenges are indeed huge, notably to develop a global regulatory system enabling people to act on opportunities while avoiding the environmental and social problems.

An initial response to the challenges is associated with the many initiatives aimed at developing standards for sustainable biofuels production and processing. Environmental NGOs, notably the WWF, has taken a series of initiatives together with industry representatives and social groups to develop standards by which producers of biofuels voluntarily agree to comply with both environmental and social principles and criteria for sustainable production. These initiatives are focused on sustainable production of palm oil, soy beans and sugar cane, and more recently also biofuels in general.

At the governmental level, EU and various EU member countries lead the way in the development of standards. The EU aims at having standards in place by early January 2008. Any biofuel marketing business in Europe will have to report on these standards. This work is based on work already carried out by individual member countries in which the draft standards developed by the UK and Dutch governments are seen as particularly interesting models.

At the global level, various UN organisations support this work with the aim to develop a truly global standard.

The EU draft is still veiled in uncertainties concerning the scope and strength of criteria. In a recent hearing on the draft, the EU Commission paid most attention to the climate and biodiversity effects.

Considering the draft standards developed in the UK and the Netherlands, they certainly include different environmental and social criteria. The two countries have cooperated closely acknowledging that the standard could not be mandatory for biofuel marketers before potential conflicts with WTO rules are removed. Hence, both systems will initially be established as mandatory reporting systems for biofuel marketers eligible for support under national schemes.

As my presentation has shown, there are still many challenges ahead to ensure that production of biofuels will be an environmental and social blessing and not a curse to the world.

- First of all, a major challenge is to transform current effort at developing standards a truly international effort, to guide biofuel marketing companies around the world.
- Standards for companies are not sufficient, however. They must be complemented by better monitoring of land use and impacts on food prices at the national and international levels
- Obviously, financial and advisory support is needed for implementation of sustainability standards in developing countries.
- Financial support is necessary for conservation of carbon stores and areas rich in biological diversity, as pledged by the Brazilian Minister for the Environment yesterday.
- There is, moreover, a need for funding of efforts to overcome barriers to the commercialisation of technologies utilising cellulose-based biomass, i.e. second generation biofuel technologies.

Transitions in Forest Tenure and Governance: Drivers, Projected Patterns and Implications for the Global Community[29]

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Abstract

Forest tenure and governance will continue to be strongly influenced by growth in the global economy, shifts in social and political systems, and rising concerns over impending ecological change. This paper briefly presents our perspectives on major drivers shaping forest tenure and governance, some projected patterns to 2020, and the implications of these transitions for forests, forest peoples, and those concerned with forest livelihoods and conservation today.

In short, we find that the cumulative effort of these social, political and market trends will be heightened threats to the rights and livelihoods of rural and forest people and increased the likelihood of conflicts. At the same time, there will be increased opportunities for improved well-being, expanded recognition of human and civil rights, and greater local voice in development. Promoting tenure and governance reforms will be of key importance, and essential to improve these outcomes. Many activities and changes will be required, including better and broader dissemination about tenure and governance reforms, information on lessons learned and technical assistance to those implementing reforms, shaping global climate regime and funding mechanisms to support local rights, and ensuring funding to finance reforms.

Introduction

Major shifts in the global economy and in social, political and ecological systems are affecting forests and forest livelihoods in such a way that future challenges in the forest sector will be quite distinct from those faced in the past. The forest sector is now much more embedded in the global economy than ever before, and in the next few decades the influences of other sectors will continue to magnify the impacts on forests, forest peoples and forest governance.

This paper briefly presents our perspectives on: (1) the major drivers shaping forest tenure and governance; (2) projected trends to 2020; and (3) the implications for those concerned with forest livelihoods and conservation.

Despite important steps toward forest conservation over the last few decades, the global forest estate is still characterized by unclear and contested property rights, disenfranchised and poor indigenous and local peoples, corruption, and boom-bust industrial models of unsustainable exploitation. Rather than a linear continuation of progress forward, global trends suggest a fundamentally altered forest sector in coming decades. This will pose dramatically different challenges to donors, governments, and activists. As globalization reaches further into remote areas, and countries complete the division and allocation of state-claimed resources, different models of forest governance will be required. Yet these changes are not necessarily imminent, and the global forest community should make best use of the period between now and 2020 to lay the institutional foundations for creating sustainable livelihoods and forests, before the more challenging decades ahead.

Global drivers shaping forest tenure and governance

Forest tenure and governance will continue to be strongly influenced by growth patterns in the global economy, shifts in social and political systems (and the differentiated responses of constituencies and governments), and rising concerns over impending ecological shifts. Here we briefly identify key emerging drivers in these areas and consider the implications for forests, forest governance and forest peoples.

Shifts in the global economy

Growth of the BRICs and relative decline of western influence

Over the next 50 years, Brazil, Russia, India and China—the BRIC economies—will become a much larger force in the world economy. As a whole, the world economy will continue to grow at record pace—global GDP is projected to increase from $55 trillion to $80 trillion by 2020—and many projections place the BRIC economies with an increasingly large share. According to the landmark 2003 analysis by Goldman Sachs, in less than 40 years the BRIC economies could be larger than the G6 (in US$ terms) and by 2025 they could account for more than half the size of the G6 economies.[30] More recent estimates show that by 2050, emerging economies will account for as much as 78% of global GDP, and the BRIC economies alone will constitute 44% of global GDP (see Figure 1, next page.)[31]

[29] This paper was first prepared upon invitation by Chatham House as a background document for the "Blue Skies" meeting on Illegal Logging and Associated Trade: Exploring Options, held at Chatham House on January 24, 2007.

[30] Goldman Sachs. 2003. Dreaming with BRICs: The Path to 2050, Global Economics Paper No. 99 (October 2003).

[31] Grant Thornton International. 2007. International Business Report: Emerging Markets. Brazil, Russia, India, China.

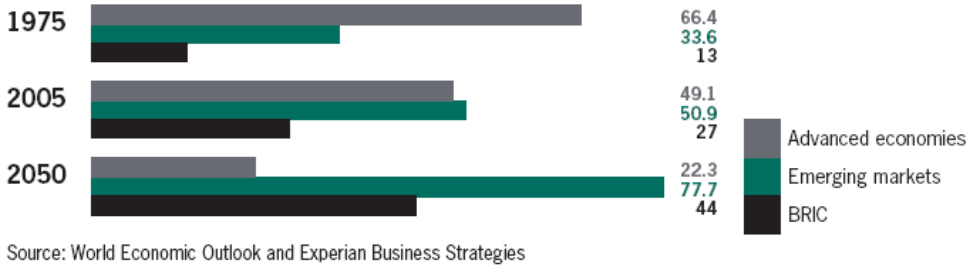

Figure 1. *Share of Global GDP, 1975, 2005, 2050. Reproduced from Grant Thornton International 2007. International Business Report: Emerging Markets. Brazil, Russia, India, China.*

These tremendous market shifts are already influencing economic and political landscapes, and the continuing trends could significantly reshape political influence and business practice. If the projections are correct, the new investors emerging from the BRICs and other middle-income countries will diminish the unilateral influence of the previously dominant Western economies, bringing new values and creating new rules of the game. Patterns of investment, standards for business practices and ethics, multilateral legal and implied commitments, social and environmental obligations, and the influence of Western lobbies—all may well undergo profound changes, with significant repercussions on markets and investment trends. As these emerging economic powers exert growing influence on the global economic and financial systems, the reverberations of their policies and actions will be felt far beyond their geographic and sectoral borders.

These shifts have two key implications relevant to forests. First, there will be many more industrial and political players, and this greater and more dispersed set of actors will make it much more difficult to identify and influence markets and business practice, particularly because in the near term this growth will occur in countries where information and transparency remain limited. Second, new economic players will bring to the table an entirely different set of cultural, social, political and operational contexts which will exert new influences on industry practices and business standards. It may be that future industry, forestry in particular, will not adopt or adhere to initiatives based on Western standards and values, including corporate social responsibility initiatives like certification and the Equator Principles. Thus these approaches used today may be less relevant and powerful tomorrow.

Growing demand from developing economies, with Asia in the driver's seat

Economic growth and wealth creation in developing economies—coupled with increased consumption and continued population growth—will have a substantial impact on demand for commodities in the coming decades, in turn increasing pressure on natural forests and landscapes. The economic and population growth in the BRICs and middle-income countries comes will lead to an increase in demand for energy, agricultural products, water, forest products, and other basic commodities for both internal consumption and the production of finished products for export.

By 2020, global demand for food is projected to double, as is demand for specific agricultural products like palm oil, implying a serious increase in competition for land and in pressure on natural forests.[32] In this same period, demand for meat is expected to increase by 50%. The increase in livestock will have disproportionate impacts on forest and agroforestry landscapes: multiplying demand for livestock feed and exacerbating land pressures, and multiplying production of methane from livestock—a greenhouse gas more potent than carbon dioxide.[33]

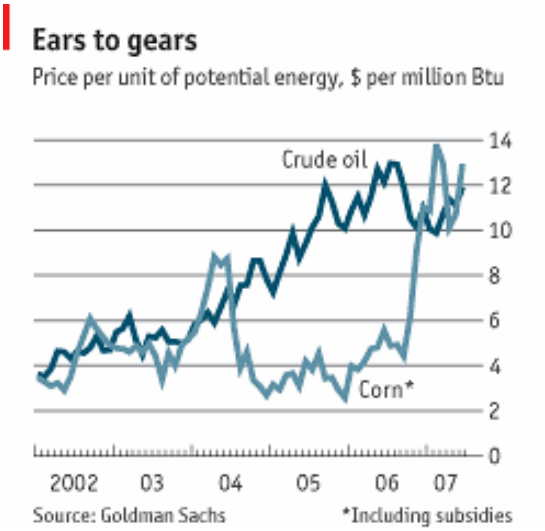

Figure 2. *Convergence of food and fuel markets. Reproduced from: The Economist. 2007. Agricultural Commodities – Biofuelled: Grain prices go the way of oil price. June 21st 2007.*

[32] IFPRI 2002. International Food Policy Research Institute: Impact Projections. 2020 Vision. Water and Food to 2025.; and FAOSTAT. Accessed December 2006.

[33] Steinfield, H., Gerber, P., Wassenaar, T., Castel, V., Rosales, M. & de Haan, C. 2006. Livestock's Long Shadow: environmental issues and options. FAO, Rome.

The growing role of Asia will be particularly important. In 2005 alone, China and India accounted for 24% of the world's consumption of palm oil.[34] Other commodities show parallel trends: since 2001, sugar prices have doubled, prices of oil, steel, and gold have tripled, and copper prices have quintupled – primarily due to growing demand from China.[35] Though this recent exponential increase in demand prices will not continue indefinitely, the general trend of strong growth in Asia will continue in the near term and will ultimately magnify the effects of economic growth of Asia on the world's rural and forested landscapes.

Similarly, while the global economy is expected to double in the next three decades, global trade is expected to triple in this same period.[36] Despite general increases in energy prices, transportation costs will remain relatively low as a result of the increasing size of ships and more efficient shipping infrastructure. This "deepening" of globalization will strengthen the effect of global prices on all basic commodities, continuing the downward pressure on local prices from more efficient producers elsewhere.

The implications of increased demand and growing trade in commodities are stark. First, the opportunity cost of forest land will rise as alternative industrial land uses become increasingly lucrative, pushing forward the frontier of forest conversion and increasing the pressures and threats to indigenous peoples and forest communities. Second, these demands will be felt despite distance and geographic location, exerting land and market pressures across the world wherever productive natural assets are located. Third, there will be greater pressures put on forest lands for exploration and extraction of energy, and growing tensions and conflict over subsoil resource rights for water and energy.

Two recent events—a cooperation pact to secure energy supplies between China and India, and the Saudi King Abdullah's visit to the two countries—show how the rising demand for natural resources by China and India will shape world economic and financial markets.[37]

Energy: Big changes, huge impacts

In terms of energy use we see two shifts that will influence forest tenure and governance in the coming decades: a massive surge in demand for energy and the rise of alternative energy sources, including biofuels.

By 2030, demand for energy is projected to increase by 50%, and demand for oil alone may increase by 40%.[38] Alternative energy sources, including biofuels, are becoming progressively more important but their relative importance remains uncertain. Despite much recent buzz, a significant switch to these fuels will be incremental, due to constraints of infrastructure and the tremendous investment required to adapt existing fuel and transport infrastructures. This is unlikely to happen on any large scale until soaring prices for traditional fuel and modes of transport provide sufficient incentive. Nonetheless, even these incremental shifts will have important influences on prices, both of the commodities that are used to produce the fuel, such as corn for ethanol, and on the land where these commodities might be grown.

Growing concerns over "energy security" will be another key dimension that affects economic and political affairs, with a likelihood of increasing conflict over energy—as we have seen in the Arabian Gulf and more recently in Eastern Europe. Speculation over both biofuels and alternative energy sources and supplies is likely to expand and distort markets for land and commodities.

Biofuels could be either a major positive or a major negative force for forest landscapes and forest owners. Biofuels made from forest products could increase the value of forested land and help promote sustainable management. On the other hand, biofuels from other plant matter such as switchgrass, grown as crops, could create yet another competing land use putting pressure on forests. Furthermore, growing demand for biofuels is already competing with food production and exacerbating food security issues, hunger, and inequities between rich and poor. For example, ethanol production in the United States—based almost entirely on grains—is growing dramatically, with plans to add 78 new plants (a 72% increase).[39] In late 2006, demand for corn-based ethanol soared, creating a rapid rise in corn prices and thus tortilla prices in Mexico and similar protests erupted in Italy in 2007 over the price of pasta—good examples of the web of linkages between biofuels and food, and the vulnerability of the poor—both the producers and consumers of food—to shifts in the energy markets. Indeed, some analysts now predict major food riots and conflict unless the food and energy markets are de-linked.[40]

Markets for food, fuel and fiber will increasingly converge…increasing pressure on forest lands and exacerbating food insecurity, inequality and conflict.

The trend is clear and the wide-ranging effects on food security are already apparent: in twelve ethanol-crazed months between 2006 and 2007 corn prices in the US increased 43%, pushing up all food and beverage prices an average of 3.6%. Beef and poultry prices were almost 5% higher, milk 3% higher, and the prices of eggs rose by more than 18%.[41] As these trends amplify and biofuels compete for land and agricultural products, markets for food, fuel and fiber will increasingly converge and compete for the same land, increasing pressure and speculation on forest lands and exacerbating food insecurity, inequality and conflict.

[34] USDA 2005. Oil; Palm - Production, Consumption, Exports, and Imports Statistics.

[35] The Economist, 2006.

[36] Global Prospects, The World Bank, 2006.

[37] World Economic Forum Annual Meeting 2006, Davos

[38] The Economist, 2006.

[39] Don Roberts, CIBC. 2007.

[40] Runge, C. & Senauer, B. 2007. How biofuels could starve the poor. Foreign Affairs.

[41] US Bureau of Labor Statistics, as cited in The Washington Post. June 2007.

Forest industry and trade: from North to South
These shifts and trends in other sectors will affect the forest sector in significant ways, yet the sector itself is not static, and industry and production patterns will also continue to define forest sector shifts. Key among these transitions are the strong growth in domestic demand for forest products in developing countries (relative to the more mature western markets), increased supply from industrial plantations, the increasing integration of small and medium producers in national and regional market chains, the growing possibility that cellulosics and other emerging technologies will expand, and the potential expansion of certification and standards, such as the European Union's Voluntary Partnership Agreements.

Implications for tenure and governance will be mixed. Growing domestic demand will provide increased market opportunity for local producers, and this will create incentives to secure and invest in natural forests. Yet the expansion of the plantation sector will continue to threaten the land rights of indigenous peoples and local communities and it will continue to put strong downward pressure on the prices of pulp and paper. In some cases, the plantation sector may provide opportunities for local producers in specific situations. As long as certification and corporate social responsibility standards remain significant and relevant, they may continue to drive a wedge between small domestically-oriented producers and the larger (currently Western) industry that can bear the additional costs.

The integration of small producers in domestic supply and marketing chains (i.e., in local versions of "Wal-Mart") is already underway in some areas of South America. This process will yield some benefits to producers, but will simultaneously make them more vulnerable to market shifts and more dependent on fewer buyers. It will reduce their market leverage.

A major question in predicting future trends in the forest industry is whether there may be a rebound in forest fibre supply, from South back to North. As the social and economic costs of establishing plantations in the South increase, Northern forests and other natural forests may become financially more attractive, potentially increasing the incentive for investments in their governance.

Shifts in social and political systems

Declining (relative) authority of central governments
Public authority is shifting both from central government to local bodies (decentralization) and from government to private and civil society (devolution). More than three fourths of developing countries are now undergoing decentralization and devolution processes.[42] This trend implies a further dispersal of authority—creating the potential for more local empowerment, but also challenging national governance and making it more difficult to develop and maintain national policy and to track and influence policy makers.

[42] Contreras-Hermosilla, A., Gregerson, H. & White, A. 2006. Forest Governance in Countries with Federal Systems of Government: Lessons for Decentralization. CIFOR and Rights and Resources Group.

At the same time, urbanization is increasing at a rapid pace. Twenty-three cities are expected to have populations of ten million or more by 2015. Nineteen of these are in developing countries.[43] The rise of these mega-cities around the world could create a return to the politics of city states, where decisions in urban areas are more influential than national governments (with relatively more equal representation) in driving markets and land use in rural areas. This even stronger imbalance in decision-making authority and power could threaten the local rights and authorities of rural and forest peoples over their own lands.

At the national level, these trends parallel a decreasing importance of international and intergovernmental arrangements in some spheres, replaced by the rising influence of civil society and informal networks across the world. Examples include the relative decline in global relevance and influence of the UN Forum on Forests, the FAO, and the World Bank. These institutions have and will maintain a high degree of relevance on some issues and in some smaller countries, but on the whole their relative influence will continue to be mediated by the influence of independent standards and monitoring systems, the increasing role of local agreements and civil society pressures, and more questioning of government legitimacy by those who feel that their rights are not being upheld.

Increased access to information, transparence and empowerment
A second major social and political driver of forest tenure and governance is the rapid expansion of telecommunications and political transparency particularly in well-populated developing countries. By the end of 2006 there were an estimated 2.4 billion mobile phone users worldwide, almost 60% in developing countries.[44] Though access to new, inexpensive and efficient communication technologies is still far from universal, expansion is rapid and the trends are clear. For example, in April 2007 the One Laptop Per Child Foundation launched sales of its low-cost laptop in developing countries, initially at $175 each with a goal of $100 a laptop. This has spurred investment in a similar low-cost laptop aimed at developing markets from Intel, and companies like Visa and many mobile networks are actively pursuing opportunities to provide services to the so-called "bottom of the pyramid" markets. Accompanying these important trends in technology is the expectation of more transparent government processes and greater access to public information. More than 70 countries have implemented some form of freedom of information legislation since 2006.[45]

These trends will eventually result in a much wider set of people with an increasing quantity of information and with access to a growing range of media. Mapping information and technology will become increasingly available and accessible, particularly with the advent of lower-cost GIS

[43] World Bank, 2001. Urbanization & Cities: Facts and Figures.

[44] Entrepreneurial Programming and Research on Mobiles, Massachusetts Institute of Technology. 2007.

[45] Privacy International. 2006. Freedom of Information around the World.

and GPS systems and web-based mapping applications. Automated translation options are becoming faster and cheaper, even as English is spreading as the lingua franca—spurred by the speed of telecommunication, the internet, and media globalization.

These shifts will imply a greater ability to hold governments accountable and to mobilize wider support, bringing empowered local community voices in direct confrontation with entrenched economic interests. In many parts of the world, indigenous and ethnic groups will be able to take advantage of this information and access to press for rights, recognition and reconciliation of historic wrongs.

Continued poverty: more pain and peril

Despite the forecasted growth of the global economy and the increased pace of urbanization, it is clear that even in 2015 widespread poverty will persist, especially in remote rural forest areas. Few analysts and policy-makers expect the world to meet the Millennium Development Goals in the timeframe originally promised.

In 1990 over 1.2 billion people, more than 28% of people in the developing world, lived in "extreme" poverty—on less than one dollar a day. Progress to alleviate poverty is slow and uneven across regions, with particular improvement spurred by economic growth in Asia, but there has been a serious lack of progress in most African countries (see Figure 3, below). In Africa, extreme poverty declined by 4.8% between 1999 and 2007, yet to reach the MDG target and halve extreme poverty by 2015, the pace of poverty reduction needs to be nearly double this rate.[46] And while there have been great gains in diminishing poverty in China and some other Asian countries, even in these countries the rural and forest areas are being left behind. The continued and growing disparity in wealth and economic growth between urban and rural areas is a global phenomenon.[47]

As long as poverty, severe inequality and continued powerlessness persist, many people will suffer, with implications for many other major trends considered here. Poverty and inequality will continue to fuel unrest, conflict, migration and urbanization in many parts of the world, in many cases intensifying threats on forest peoples and pressures on forest lands.

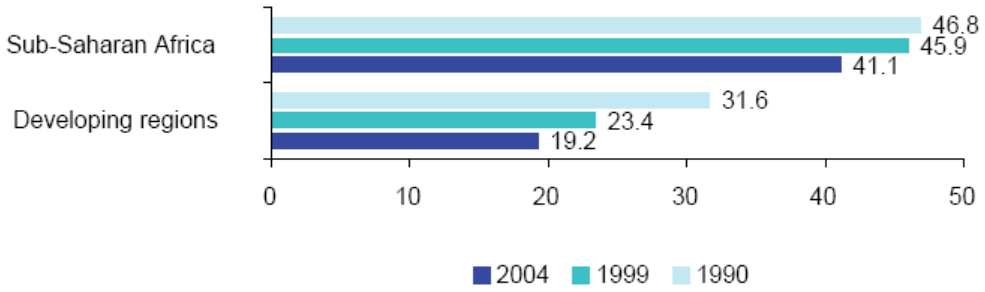

Figure 3. *Proportion of people living on less than US$1 a day in 1990, 1999 and 2004 (%). Reproduced from UN 2007. Africa and the Millennium Development Goals: 2007 Update. United Nations, New York.*

[46] United Nations. 2007. Africa and the Millennium Development Goals: 2007 Update.

[47] Ravi Kanbor William.

Continued Threat and Changing Nature of Violent Conflict

In the past twenty years, 30 countries in the tropics have experienced significant conflict between armed groups in forest areas (see Figure 4, next page.)[48] And much if not most of this conflict is strongly linked to poverty and insecurity of access to resources.

Armed conflicts in the forest are often, though not always, a product of limited or contested rights—human rights, civil rights, or tenure and property rights. Logging is often cited as a means to finance violent conflict. Further, growing population pressures on increasingly scarce natural resources exacerbate stressful local relations and political situations. Rwanda is an extreme example of the effects of heavy resource pressures from a diverse and growing population, and the absence of alternative sources of land or livelihoods.[49]

Informal alliances facilitated and sustained by better and cheaper communication will also change the nature of local conflicts. Protests that were once easily suppressed will no longer remain isolated. Connectivity will ensure that others affected by similar problems can join forces, expand the geographic scope of their campaigns, magnify the political stakes of inaction and force governments to respond. Indigenous and other disenfranchised groups will be able to use external alliances to leverage media and political attention and protect themselves from reprisals.

Despite the positive influences that new access and ease of communication will bring, combined with a lack of rights, persistent poverty and conflict, these new tools and abilities will result in parts of the world continuing to endure open conflict and relative unrest.

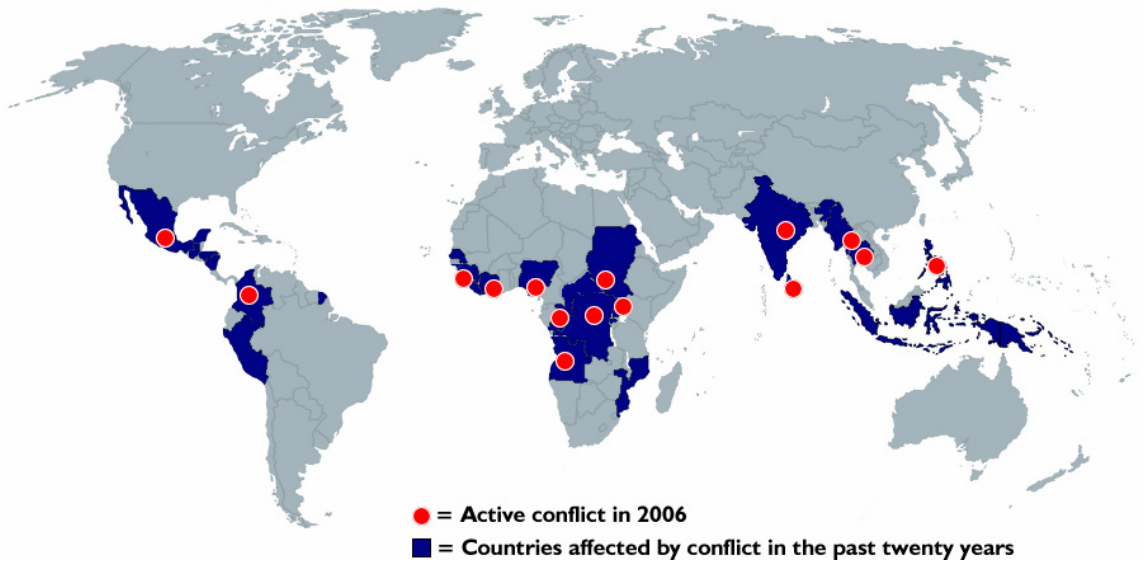

Figure 4. *Tropical Countries Affected by Conflict in the Past Twenty Years. Data from CIFOR. 2007. Fact Sheet on Forests and Conflict.*

[48] David Kaimowitz, 2003. ETFRN News.

[49] Gasana, J. 2002. Remember Rwanda? World Watch Magazine.

Increased Migration and Urbanization: New (and more) Constituencies

Though the level of rural population is expected to remain stable over the coming three decades there will be continued, and increased, urbanization – changing the nature of political and market constituencies, and thus forest governance.

In 2000, 47% of the world's population was urban, and current trends project that 60% of the world's people will live in urban areas by 2030.[50] National politics will increasingly be dominated by urban interests. By 2020 there could be 2 billion slum dwellers globally - a growing, and perhaps more demanding political force, distracting attention away from rural areas.[51] The rise of these mega-cities will alter resource consumption and political realities in many developing economies. Decision-making may begin to reflect a more pronounced urban-bias, and there may be declines in interest and incentive to invest in rural governance and economic viability. Tourism may increase as an income stream for rural peoples, as rural areas become a vacation refuge for wealthy urbanites in lesser-developed and middle income countries – a shift that is already underway in the US and other developed economies.[52]

Another important shift affecting rural governance is private financial remittances. As urbanization, inter-regional and international migration increase, remittances to rural areas are likely to become the dominant development mecha nism.

Remittances increased by $US 20 billion in 2005 alone, doubling since 2001 and reaching $US 200 billion in 2006.[53] Already, remittances are much greater than Overseas Development Agency in many countries in Latin America, further challenging the power of governments and inter-governmental agencies to steer and control development.

Shifts in ecological systems

Climate change: More heat and more uncertainty

Social and ecological systems will face serious adjustments to climate change. Forest systems in particular are integral to the climate system. Changing land use accounts for 18-20% of global greenhouse gas emissions, the overwhelming majority of which come from deforestation and changing use of forest lands (see Figure 5). As this is a significant cause climate change, reforestation and avoided deforestation must be part of the solution.

The Stern Review in particular has provided new, robust estimates for the implications and threats posed by climate change, galvanizing Western governments and encouraging the debate on climate mitigation. A new urgency to act is spreading worldwide, and in many countries the political will to act has become a reality, increasing the opportunity. However, this brings with it the risk of poorly targeted projects.

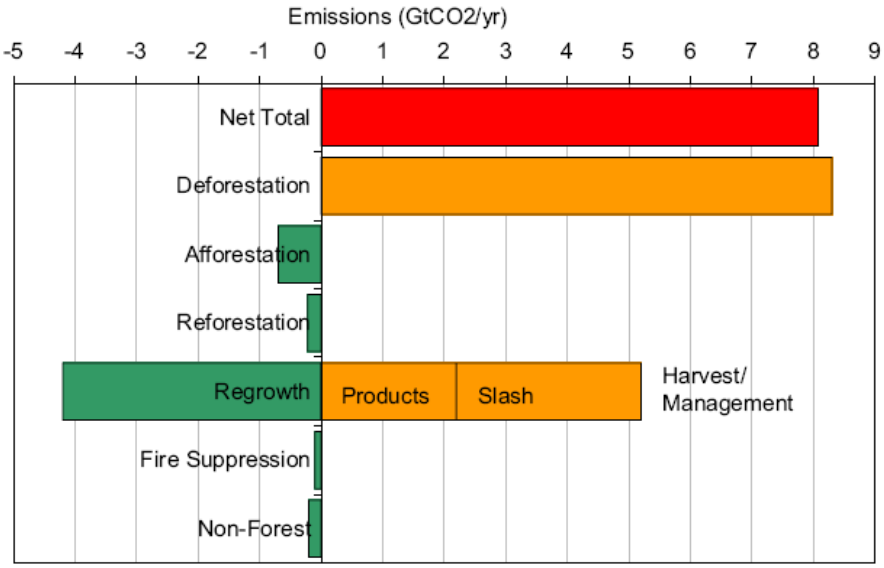

Figure 5. *Sources of emissions from global land-use change. Reproduced from: Stern 2006. The Stern Review: The Economics of Climate Change. HM Treasury, London, UK*

[50] World Bank, 2001. Urbanization & Cities: Facts and Figures.

[51] EcoAgriculture Partners, 2006. Urban Forum, June 2006.

[52] US Forest Service, 2006.

[53] World Bank, 2006.

Climate change is already having significant impacts on forests and this is now focusing the attention of governments and citizens like never before. For example, in 2005, the Amazon had an unprecedented drought. Pine beetle infestations have destroyed more than 8 million hectares of forests in British Columbia and are worsening throughout western Canada and the United States (winters are not cold enough to kill larvae), and wildland fires in the US have doubled in the past 40 years.[54]

The implications of climate change for forest tenure and governance are many and diverse. To begin, forest peoples and the poor who depend on forests and other natural resources will be among those most exposed and most vulnerable to catastrophic events, including changes in weather, rainfall, vegetation, and the distribution of wildlife populations. According to the Stern Review, average mean temperature increases of 1-2°C could cause extinctions of 15-40% of species and force millions of people into extreme poverty—with up to 220 million more people living on less than $2 per day in South Asia and sub-Saharan Africa.[55] These are the same people who have limited and insecure rights to their lands, forests and other natural assets. Climate change is likely to spur increased migration, and thus increase conflicts between local people and immigrants – in addition to making it increasingly difficult for the already established populations to adopt production systems that can reliably improve their incomes.

This growing global concern is generating a flurry of ideas and initiatives, all likely to pose varying levels of threat and opportunity for local people. There is, however, a degree of uncertainty regarding the long-term effects of these initiatives. An example is the recent proposal to "buy" portions of the Amazon, thereby "protecting" the forests from deforestation (and also from the sovereignty of local peoples and national governments.) Such ideas and initiatives will set legal and market precedents that, once established, will be difficult to change. Increased concern and fear will accelerate the number and ambition of ideas and initiatives, making the recognition and strengthening of local property and civil rights an even more important priority.

A third important implication is that concern about climate change is bringing central governments back to the table in the climate and forest debates. The concept of "avoided deforestation" is now being actively considered and governments are beginning to develop national responses – establishing new institutions and legal frameworks to manage this issue across their territories. This shift is occurring even in the US, where a national carbon regime is likely to be established within the next five years. It is highly likely that governments will respond with an aggressive global initiative in the near term, as their constituencies demand more responsible action to mitigate climate change.
A related effect will be the desire of environmental groups and governments to extend public regulatory authority across landscapes beyond protected areas - since climate change will force the movement of species and ecosystems, rendering the protected area concept of declining relevance, and at the same time increasing conflicts with local property owners, indigenous peoples and other local communities and governments resistant to additional government regulation of private land use.

The potential change and its impact are huge – as are the implications of a new global climate regime. There is tremendous scope for climate investments to be conducted in a manner that strengthens local rights and reduces rural poverty, and protects remaining natural forests and restores degraded ones, while at the same time bringing about a reduction of carbon emissions. The Stern Review concluded that "major institutional and policy challenges" would have to be overcome to realize the climate and social benefits of avoided deforestation, and it identified those challenges as including: clarifying forest-related property rights, strengthening law enforcement, and overcoming entrenched systems of vested interests.

Water: Greater demand and greater uncertainty
By 2025, two-thirds of the world - 5.5 billion people - will live in areas facing moderate to severe water stress. The World Bank estimates that India could run short of water by 2020. Annual global water withdrawal is expected to grow by 10-12% every 10 years. Demand for water will increase by 50% by 2020.[56] Implications of these developments are mixed.

Greater demand and scarcity of water may increase initiatives for financing the improved management and restoration of natural forests for conservation rewards. Then again, greater demand for and scarcity of water, exacerbated by climate change, may increase conflicts, particularly as competing demands for land use for other needs like agriculture and settlement come in direct conflict with the need for water.

Forest tenure and governance: Possible patterns by 2020

As outlined above, the demands of a rapidly expanding global economy, partially driven by the BRICs, will put tremendous pressure on land and forest resources for the production of commodities and meeting energy demand. Land and forest-based conflicts are likely to intensify, partially propelled by increased connectivity and political power of rural and forest-based social movements, facilitating the expression of long-held social grievances.

Governments' centralized control of forest and land resources will decline, leading to greater changes in forest tenurial arrangements and greater changes in regulatory regimes that govern forests and forest trade. Formal international arrangements on forests are likely to decline in importance, paving the way for a stronger role of informal arrangements of all types, locally mediated agreements, and independently set standards. At the same time, a more

[54] Canadian Forest Service, 2003. United States National Interagency Fire Center, Wildland Fires Statistics. Woods Hole Research Center, Amazon Scenarios.

[55] Stern 2006. The Stern Review: The Economics of Climate Change. HM Treasury, London, UK

[56] IFPRI 2020 Vision. Water and Food to 2025. 2002.

ambitious global carbon regime is very likely to emerge – and this regime could overwhelm and absorb relatively weak forest regimes. A few possible scenarios regarding the effect these drivers will have on forest tenure and governance are given below.

Whither forest tenure?

Forest tenure has already changed dramatically in recent years – with the amount of forest owned and officially administered by indigenous and traditional communities doubling over the last 15 years. Communities now own or administer at least 25% of developing country forests. The drivers described previously, as well as the new legislation and land reform initiatives underway across the world, suggest that this trend is likely to continue, and the percentage of community-owned forests is likely to double again by 2020. For example, taking 2006 alone, the Indian Parliament passed the "Scheduled Tribes and Other Traditional Forest Dwellers Recognition of Rights Bill," the Government of Indonesia declared that it would allocate 60% of degraded state forests to communities, and the Administrator of the Chinese State Forest Administration declared that strengthening local property rights and reforming the public forest are his first priority.

The future will bring increased political pressure on governments to recognize and devolve property rights.

These transitions are driven by three primary considerations. First, governments are increasingly aware that widespread public ownership discriminates against the rights and claims of indigenous people and local communities. Second, there is an increasing convergence of the economic and environmental agendas. Without secure rights to own and use their assets, indigenous and other local community groups lack long-term financial incentives to sustainably use their forest resources for their own development. Third, there is growing recognition that governments and public forest management agencies have often been poor stewards of public forest land, that more forest land remains in the public domain than is socially or economically reasonable, and that communities and private households often manage forests as well as or better than public authorities or large-scale industry.

The future will bring continued and increased political pressure on governments to recognize and devolve property rights. However, given past experience, most reforms are likely to be chaotic and incomplete, and unlikely to be combined in parallel with the regulatory reforms necessary for local people to actually benefit – and thus have incentives to invest. Tenure reforms are often passed in response to political pressures largely fuelled by forest communities asserting their rights, but they are seldom accompanied by rights to use these newly owned assets - initially, at least. Substantial regulatory reforms directly conflict with existing and well-entrenched industrial interests, which tend to be difficult to dislodge. Governments are often caught between two contradictory pulls and they resort to muddling along to "get it right", especially with issues as politically contentious as property rights and citizenship.

We therefore expect substantial "progress" in the recognition of local ownership and administration of forest land by 2020, and that progress on reforms in regulations controlling access and use is likely to lag. Local ownership rights are likely to continue to be de-linked from rights of benefit and use, fuelling conflict with governments and continued, unsustainable exploitation.

Whither forest governance?

Emerging patterns in governance are likely to respond to two contradictory pressures. One will reflect the new connectivity and the tighter organization of communities, decentralization processes, and related recognition of local rights and authority, which will enhance incomes of peoples hitherto untouched by global economic growth. The other pressure will come from a tremendous increase in demand for commodities and energy, combined with climate change, and changing business rules and players. These will increase pressure for forest conversion and expose smallholders to an ever more competitive and often unfair market. The implications differ at various levels of governance. Some possible scenarios include the following:

At the national level:

- **Decentralization.** Trends in decentralization of governance will continue, partially due to perceived failure of centralized systems, but also in response to demands from local governments and communities. Greater access to information and connectivity will force more accountability and transparency in government. Entrenched economic interests will blur progress, maintaining existing regulatory regimes that impede community progress.

- **Empowerment, rebellion, conflict.** Those regions lagging in the process of tenure reforms and decentralization will witness greater organized resistance from people—heightening the possibility of increased armed conflict and social tension. Tenure reforms are a priority for "post-conflict" countries like Liberia and Mozambique, and combined with civil rights can reduce or resolve social and political conflict.

- **National economic priorities.** National-level (and increasingly nationalistic) concerns and ambitions to capture commodity markets and energy supplies will put greater pressure on forest and agroforest landscapes. These "national imperatives" will collide with the aspirations of remote rural forest communities, and provide more fuel for social tensions, all of which will be even more difficult to control because of the more dispersed and more difficult to control industrial sector.

At regional levels:

The current movement towards regional trade agreements will continue, with countries making agreements with producers to address needs for commodities, improve their position in the global economy, and establish more local standards for business and social responsibility relevant to their circumstance. Civil violence from one country will threaten to spill into others and social movements will increasingly mobilize across borders.

At the international level:
Possible conflicts may emerge between population-rich and resource-rich countries. For example, growing demand for commodities and energy in China and India is propelling expansion to Latin America and Africa as markets for manufactured goods and suppliers of raw material.

Conflicts may emerge between world leaders who dominate in the current economic model, and rising economic powerhouses, particularly between China, India and Brazil and the West, as rising economic powers challenge competitiveness and dominance of the old guard.

At the level of international and intergovernmental institutions:
The Rio conventions will increasingly be shaped by human rights issues, macro-economic trends, and commodity demands and pressures.

With new economic drivers, proliferation of markets and information, and greater participation by communities and social movements, intergovernmental forums will have less and less influence in response to: (a) private capital moving faster than governments can control it, as net exporters are becoming net consumers and investors; (b) domestic markets becoming increasingly more important than international trade; (c) industrial production shifting to developing economies outside the Western sphere of influence, generating more regional agreements based on regional values; and d) declining willingness of citizens and society to accept solutions crafted, if not imposed, by global forums.

Globalization, paradoxically, has shrunk the Western sphere of influence and has fostered a decline in the value and usefulness of the existing stock of (Western-precipitated) international protocols. More regional agreements, informal consultations on common issues, and the joint pursuit of resources are becoming more common. The regional and informal arrangements will propel and shape the next generation of international architectures governing various global resources, including forests.

Forums like the UNFF are likely to survive, not because they resolve issues but because officials within governments will want some intergovernmental mechanisms to enable the exchange of information. As the influence of many international and intergovernmental institutions diminishes, global protocols, specific forums and advocates will need to become more responsive and more collaborative. Specific forums like the Committee on Forestry (COFO) and other mechanisms that allow the informal exchange of information among governments are likely to grow stronger, especially to provide better mechanisms for exchanging information and lessons learned to help governments better position their own policy and implementation arrangements. It is unlikely that world leaders will wait cannot afford to wait for international agreements to reach consensus in the face of new and intensifying challenges like civil conflict, climate change, changing pressures on resources and populations, and a rapidly changing global marketplace. Instead, actors are likely to turn to more effective mechanisms and forums that address these issues at more specific and relevant levels and timescales.

Despite these trends, it is very likely that a more robust, expansive and ambitious global climate change regime will emerge. Since such a regime is likely to channel significant funds and rigorous sanction mechanism, this regime could become the leading international instrument affecting the fate of forests and forest peoples.

Implications for advocates of forests and livelihoods

The over-arching implication of these trends is that by 2020 the forest sector could encompass two sharply contrasting models of use and development. The dominant model – largest in terms of number of hectares, forest-dependent people and production, will be the more chaotic, with loosely-defined property rights and judicial infrastructures. It is likely that this larger and chaotic model will be more driven by domestic agendas and emerging markets in developing countries, rather than international agreements or models like sustainable forest management (SFM).

The remainder of the forests and forest production will be more “modern” and “legal” – but will be largely limited to the Western world and small enclaves of industrial plantations devoted to fiber supply. Existing arrangements and approaches in the forest sector are by and large designed to advance this small controlled model, but they may be largely ineffectual in influencing the other.

However, without significant local and regional action and intervention in the climate regime, the forest sector in 2020 may appear only incrementally different from today. The more fundamental shifts will occur in the decades following, when the BRICs and today’s developing economies fully dominate global markets and intergovernmental politics (and thereby trade and governance), and when climate change and rural conflicts challenge the ability of any governance structure to effectively manage forest landscapes. These challenges put the period between now and 2020 in sharp relief – as an opportunity to make substantial headway establishing the institutional foundations that can better accommodate conflict and change and enable development, before the scale of the challenge becomes much greater.

To change this basic scenario, the development community will need to be more aware of the fundamental role of tenure and governance in fostering both conservation and pro-poor economic growth. And all will need to be much more proactive in engaging and creating investment by the development community in these arenas. The impending climate regime, and the associated convergence of the food, fuel and fiber markets may provide a window of opportunity to advance these goals.

A particular political and operational challenge will be to engage the leadership and new constituencies of national governments and mega-cities in the developing world to: (1) reject the entrenched elite interests now controlling the forest landscape and industry; and (2) make the necessary investments to establish equitable property rights and governance structures in their forested hinterlands. Some

countries will be able to successfully muster the leadership to "manage" these tensions and transitions and make these investments, but others will be less successful and succumb to the status quo. Substantial finance from the North to compensate forest owners and dwellers for the provision of global pubic goods, such as carbon sequestration, or for investment in pro-poor business models, would have dramatic impacts, if not be required, in order to shift dominant incentive structures.

Making substantial progress will require advocates for forests and livelihoods to increase their focus on the politics and markets of developing countries, and on the BRICs in particular. The development community must also become more attentive and nimble in engaging and supporting the civil society and social movements who increasingly shape the direction and effectiveness of policies. In parallel, advocates will need to become more engaged in encouraging (and assisting) governments to effectively devise and implement land and land-use reforms, as governments become open to learning about and acting on these issues.

In order to enact significant change across the world, advocates will need to work with and through informal social networks and to take advantage of new telecommunications technologies. There is a clear need to assist decision-makers, at the community, national, and international levels, helping them link to other decision-makers, distilling lessons on the nature and pacing of tenure and governance reforms, and helping them to analyze scenarios pertinent to their economic and socio-political situation. There is also a need to enable social movements and civil society actors to exchange information and lessons, so they can more constructively engage governments in a dynamic global framework.

What to do?

It would be easy to look forward and imagine a bleak future, one characterized by further forest decline, social unrest and political upheaval as the rural poor seek to redress the historic wrongs they have suffered. Throw in the impact of climate change, and the future could look even more daunting. However, it needn't be like this. We have the chance to bring about real change which will benefit both forest peoples and the environment in which they live. The window of opportunity may be relatively brief, so now is the time act.

If we are to avoid a bleak future, these are some of things we need to do:

1. There is now plenty of evidence to show that secure rights of tenure and good governance can play a key role in alleviating poverty and improving forest management. Governments should be encouraged to strengthen local ownership of land and rights of access, especially in heavily forested poor countries

2. Every effort should be made to share existing experiences about the importance of tenure and good forest governance, and share the lessons learned in countries and places which have introduced forestry reforms and experimented with decentralization and community forestry. These messages need to be disseminated as widely as possible to encourage governments to introduce the far-reaching reforms which are needed to tackle poverty and ensure sustainable land management.

3. Development agencies should be encouraged to invest in programs and activities which enable forest-dwelling communities to take control of their land. In some cases, technical assistance will be required. It is imperative that countries recovering from conflict, and those prone to conflict, are given all help they need, as the inequitable distribution of land is a major cause of conflict.

4. Every effort should be made to ensure that the new global climate change regime and other conservation-oriented funding mechanisms recognize the importance of tenure and property reforms. They must ensure that local people are properly rewarded for reducing emissions from forest degradation, and for providing environmental services such as clean water and biodiversity.

5. Civil society has a key role to play, not least in creating alliances between governments, the private sector and local communities. Development agencies and governments should invest, whenever possible in local, rather than international, NGOs.

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Measuring and monitoring the flow of forest ecosystem services

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Justification and background

It is now widely agreed that the importance of maintaining a steady flow of ecosystem services is critical for achieving sustainable development, for maintaining ecosystem integrity, and for satisfying human needs at national, regional, and global scales (MEA 2005). However, if the ecosystem services paradigm is to make effective contributions to nature conservation and human well being, more emphasis may be needed into incorporating its biophysical underpinnings and application into decision making. Although much has been reported about developing typologies, assessing tools for economic valuation, estimating the monetary value of many of these services, as well as on their current demise, such efforts will have to be escalated. Increasing our efforts at quantifying the delivery of ecosystem services as well as applying existing scientific knowledge may help in making well-informed, practical decisions, and for assessing trade offs during land planning. This is potentially critical outside protected areas where forest biodiversity loss continues unabated yet its maintenance can be important to environmental sustainability.

Overall, regulating ecosystem services (i.e., pollination, pest control, water filtration, nutrient cycling), as opposed to provisioning services (i.e. production of food, fiber, fuelwood), are more prone to decline as the former are generally unable to capture the prevailing paradigms of production, exchange and regulation and also because they are usually influenced by many externalities. Partially because of this, they are being subjected to a relatively new kind of environmental management which aims at resource conservation through contingent contracts between providers and beneficiaries of the service. In spite of progress made on designing "compensation and reward schemes" for environmental services, there is emerging consensus on the current need for, as well as the lack of, a sound characterization and knowledge-based application of the biophysical flow of ecosystem services for further guiding decision making (see i.a., Balvanera et al. 2001; Kremen 2005; Kremen & Ostfeld 2005; Carpenter et al. 2006).

This paper presents a brief discussion, based on two (regulating) ecosystem services in tropical forest landscapes, water provision and animal-mediated pollination, on the following two aspects: (i) what we know about how land use affects the flow of these two services; and (ii) what are the implications in the context of designing compensation and reward schemes (also known as payments for environmental services) from a biophysical standpoint? It is not the purpose of this document to present an exhaustive review about the biophysical flow of these two services but to highlight major scientific and practical issues and to provide some directions for future action.

It may relevant to briefly mention why compensation and reward for ecosystem services, including regulating services, are gaining prominence as a conservation tool. Among others, these include (Scherr et al. 2007):

1. An increasing demand for ecosystem services due to expanding human population growth and economic activity. For example, urbanization in many parts of the globe is creating large cities with expanding demand for natural resources and healthy ecosystem services.

2. The realization that traditional, "command and control" approaches to ecosystem conservation based on financial resources injected from the outside, specially in the developing world, may not always be sustainable over the long term. Compensation and reward schemes tend to rely less on subsidized benefits and more on services both provided and received.

3. Decentralization and devolution trends in the management of natural resources in many tropical countries are conferring a greater degree of local ownership potentially providing opportunities for designing and implementing compensation and reward schemes of local relevance.

Measuring ecosystem flows for watershed services

Today, compensation and reward schemes for watershed services in tropical regions are both numerous and vary greatly in size and scope. However there is still not a lot of hard evidence regarding their effectiveness for delivering the type of service they are supposed to. It is argued that one of the reasons is the little consideration of scientific and technical information into the design, implementation, and monitoring of these schemes partially due to the fact that they currently comprise more supply- than demand-driven approaches (Porras & Grieg-Gran 2007). That is, they may fail to truly reflect the needs from those who may be affected by the effects of unsustainable land use on downstream watershed services. Another reason for the apparent lack of attention about measuring service flows is that most compensation schemes for watershed services are for improved land practices such as organic agriculture, soil conservation, and sustainable forest management, instead for targeting the provision of the service in itself. It appears that there is little evidence available showing that schemes are delivering the benefits they are supposed to; both water provision and quality.

It could be argued that to the extent that untested assumptions or else acceptance of conventional wisdom drive the design of watershed service schemes, their long term sustainability may be questionable. As far as provision of water is concerned, the relationship between forest cover — or lack thereof — and water yield is most of the time context specific yet extrapolations abound. Or else the need for technical input is disregarded at the expense of conven-

tional wisdom (e.g. “more forests – more water”). One notable exception may relate to the presence of upstream cloud forests in the context of their role in fog and mist interception which may influence dry season flows in the adjacent lowlands. However, the links between quality of water and presence of forest cover are, for the most part, well established (for a review of the discrepancies between public perceptions and scientific evidence of forest-water relationships, see Bruijnzeel et al. 2005).

A recent study (Kosoy et al. 2007) may illustrate some of the above points. Three different schemes for compensation for watershed services across Central America were compared, highlighting the perceptions of those stakeholders involved in each (Costa Rica, Honduras, Nicaragua). Notably, most of the beneficiaries of the service perceived that “more forest invariably means more water” (although the perception of forest cover and water quality was also held). Moreover, most of those receiving the supposed benefits of the service they were paying for did not know exactly how they were initially involved in the scheme. This underscores the fact that measuring the flow of the service may not always be an issue. The study also concluded that technical input, including basic hydrological budgets as well as economic valuation of the service played a minor part of the decision making process in designing and implementing the schemes in each or the three countries.

Practical implications

Lack of baseline data is certainly not an impediment for starting up a given watershed scheme. Yet it could be argued that there is a need for measuring water flows to adjust management interventions over time in the context of land use, especially when the client has a genuine voice and/or demand when participating in a given scheme. Although estimating the basic components of the water balance is a fairly well established technique for predicting the behavior of the system, managing stakeholder expectations by being explicit about uncertainty may be important for gaining long term acceptance. Yet there is enough robust scientific data so that myths about forest-water relationships stop being perpetuated in the context of designing compensation and reward schemes for watershed services (Calder 2005). When the causal links between ecosystem processes and land use practices are well established such as the case of water quality and forest cover, schemes are more likely to work as there is less public-science divergence. Also, when properly designed, local monitoring yield locally relevant results that help local communities to understand the consequences of their own management decisions and may assist them in changing attitudes on resource use. In this context, the application of rapid appraisals of the hydrological situation and the perception of key stakeholders in the watershed are potentially useful for examining the opportunities for negotiating land use agreements that include compensation schemes (e.g., Jeanes et al. 2006).

Measuring ecosystem flows for crop production through animal pollination

Although the major caloric inputs in the human diet come from a few staple foods for which animal pollination is not relevant, animal pollination is nevertheless important to the reproduction of many crops. The majority of wild plants also benefit from animal pollination for their reproduction which in turn can also be important for providing calories and micronutrients. For many tropical crops, there is ample evidence that production is improved by animal pollination. Overall, pollinators are responsible for up to 35% of the global crop production, equivalent to about 87 crops of global importance (Klein et al. 2006).

What do we need to know about measuring the flow of pollination services in tropical forested landscapes, and why their measurement is potentially critical in the context of designing and implementing compensation and reward schemes? There is scientific evidence that for many crops, agricultural intensification or else loss of natural and semi-natural habitat which harbors insect pollinators, has a measurable effect on crop production (Kremen et al. 2007). That is, fruit or seed production can decline for some species in the context of the proportion of natural or modified forest habitat in the surrounding landscape, or else as a function of the linear distance away from these habitats. Among one of the crops where distance from forest negatively affects yield is coffee, a global commodity. For those crop species for which there is a suspected dependence for animal pollination, measuring the flow of pollination services is relatively straightforward through changes in seed or fruit set of open-pollinated flowers exposed to natural levels of pollination against “exclusion” treatments in which only self- or wind pollination can occur. If we can quantify seed or fruit set at different levels of landscape fragmentation or else at contrasting linear distances from the nearest forest, we can infer the behavior of the flow of the service and its links to land use dynamics (see an example for coffee in Priess et al. 2007).

Practical implications

There is still a lot to be learned, and there are a few issues that may be important to take into account in the context measuring the flow of pollination services and its implications to the design of forest-based compensation schemes. One is that measuring the flow of pollination services through changes in crop production will only provide a reliable estimate when the amount of fruit or seed right before harvest is measured as opposed to early fruit or seed set. In other words, if any extra benefit of pollination on crop production is measured too early, there is risk of overestimating the benefit of the flow because many fruits fail to develop fully before harvest, generating misleading conclusions when translated into potential economic benefits (Bos et al. 2007). Second, some agroecosystems may be more amenable for detecting sensitivity to pollinator declines. Essential criteria for assessing how important the flow of pollinator services may be for a given agricultural crop are degree of dependence on animal pollinators as well as inability to self pollinate and assuring that other

agricultural inputs are sufficient. In other words, crops need to be more pollinator-limited than water- or nutrient limited otherwise it would be difficult to discern the real cause. Again, extrapolations are to be avoided — local work will always be needed on measuring ecosystem flows. At least for coffee, it has been shown that the importance of forest-based insect pollination in enhancing crop production appears to vary between locations probably due to differences in soil fertility or extent of agricultural inputs traditionally used.

There are also implications for the design of forest-based compensation schemes for pollination services. Although, at least in the tropics, forest conservation solely based on the provision of pollination services to adjacent agricultural land is uncommon if existent at all, a sound quantification of the flow of pollination services in forested landscapes may help to assess habitat conservation priorities when other ecosystem services can be included. For example, to what extent are biodiversity protection, pollination services, pest control, and water quality bundled in a single location or forest fragment? (See a modeling case study in Chan et al. 2006). Measuring the flow of pollination services can in itself be useful in refining decision making for maintaining natural habitat conservation in rural landscapes that depend heavily on agricultural production (Bodin et al. 2006). Opportunities for "designing" farms for agricultural pollination services can also be explored.

Conclusions

A few general conclusions can be derived from the above discussion, that are potentially applicable to other ecosystem services. It is potentially critical to acknowledge that ecosystem flows are inherently dynamic in space and time, and that this variation may dictate adjusting management interventions as appropriate. In other words, designing and implementing a given compensation scheme needs to be treated as an ongoing experiment with associated uncertainties. In the particular case of watershed services, relying less on perceptions and untested assumptions on biophysical relationships between forest cover and delivery of the service may help to refine the design of current and future compensation schemes. Implementing cost-effective monitoring tools and approaches as an integral part of watershed schemes, particularly in local contexts, may also be potentially critical for long-term viability. Monitoring is integral to an adaptive management approach where one important objective is to keep managing the system as circumstances change.

Finally, it is not being argued here that we need to "do more research". Ecological knowledge about the flow of many ecosystem services is abundant; it is largely a matter of refining knowledge gaps in particular contexts of human alteration and habitat modification. (In the case of pollination services, see a discussion in Kremen et al. 2007). There are also well developed indicators to measure their quality and quantity. Scientific knowledge always needs refinement but more emphasis on practical applications of existing knowledge is equally necessary. Currently, most ongoing compensation and reward schemes, particularly in tropical regions are incipient and many might have been established with inadequate information on ecological flows. For their long-term sustainability as an alternative land use option and conservation strategy, a more explicit incorporation of biophysical flows and their monitoring may be needed.

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Russian forestry and the Millennium Development Goals

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The Russian Federation has by far the largest forest resource of any country in the world with 50 percent forest cover, amounting to 770 million hectares of forested area and 82 billion m3 of growing stock (Table 1).

The forest estate is comprised of the lands covered with growing forests and designated for growing new forests as well as non-stocked forest lands required for needs of forest management in compliance with identified goals. The lands of the forest estate are further classified into:

- *Forest lands* (stocked and non-stocked),
- *Non-forest lands* which are either not designated for growing forest or suitable for this purpose without special treatment (arable land, hey-making grounds, grazing lands, waters, roads, rides, bogs, sands, etc).
- *Stocked forest* land is the areas which are actually covered with forests.
- *Non-stocked forest lands* are those areas which are designated for forest growing but temporarily are not covered with forest (non-forested cutover areas, burnt areas, open lands, dead stands, etc).

An analysis of the forest account data (aggregated in Table 1) shows that the overall species composition is as follows: pine: 20%; spruce, fir: 17%; larch: 31%; siberian/korean pine: 10%; birch: 12%; aspen: 4%; and hardwoods: 6%.

Larch stands prevail in the Asian part, reaching over 40% of the total growing stock. Larch forest harvesting is difficult due to the absence of railways and automobile roads. In addition, water transportation (floating) of larch timber is technically unfeasible. Larch forest is also out of demand for domestic pulp and paper industry due to the high share of tar in the wood.

In European Russia aspen and birch in over-mature stands are dominating in the growing stock due to lack of demand for such timber from wood-processing industries.

The forest yield is low (the mean annual increment is 1.2 m3/ha) since 75% of the forests are located in the taiga and tundra zones, and over 60% grow on permafrost soils and areas with excessive humidity. Under these conditions, forest logging may cause irreversible environmental consequences (erosion, intensive swamp formation, etc.).

Low-yield forest (with growing stock below 50 m3/ha) occupy over 25% of the forest land and serve as an ecological shield in the northern European and Asian Russia which protects the southern areas of the country against cold Arctic winds.

The belt of pre-tundra and low site class taiga forest is 300-500 km wide and stretches along the entire Arctic coast from Murmansk on the frontier with Finland and Norway to Chukotka on the frontier with USA.

Table 1. *Forest Resources in the Russian Federation (as of January 1, 2003).*

	Forest Estate area, 106 ha	**Forest land, 106 ha**	**Stocked forest land, 106 ha**		**Glowing stock, 109 m3**			**Forest cover, %**	**Total growth per annum, 106 m3**
			Total	Incl. mature & overmat.	Total	Mature and overmature			
						Total	Conifers		
Russian Federation	1172	877	770	329	81.3	43.8	34.4	49.7	963
European and Ural Part	206	172	167	60	21.8	9.6	6.3	39.1	355
Including the Baltic Region	0.4	0.3	0.3	0.05	0.05	-	-	19.5	0.01
Northern Region	104.4	79.0	76.6	39.5	8.1	5.2	4.3	52.1	97.9
North-Western Region	12.1	10.3	10.0	2.8	1.7	0.7	0.3	53.1	31.0
Central	22.3	21.2	20.6	3.3	3.4	0.8	0.3	43.5	65.2
Volga-Vyatka	14.6	14.0	13.5	2.4	1.9	0.56	0.29	51.9	44.3
Central Chernozem	1.6	1.5	1.5	0.1	0.2	0.02	-	8.6	4.1
Volga	5.8	5.1	4.8	0.8	0.6	0.14	0.02	9.1	13.9
North Caucasus	4.6	3.8	3.7	1.1	0.6	0.3	0.08	10.7	9.0
Ural	41.0	36.9	35.6	10.4	5.12	2.0	1.1	44.0	92.1
Asian Part	966.0	705.5	603.0	269.0	59.5	34.2	28.0	47.4	608.0
Incl. Western Siberia	150.0	95.1	91.1	42.6	10.9	5.9	3.4	37.3	124.5
Eastern Siberia	312.3	251.5	228.9	108.9	27.8	16.3	14.3	55.5	277.2
Far East	503.7	358.9	283.0	117.4	20.9	12.1	10.3	45.9	208.5

Abundant forests with dominating mature and over-mature stands are exposed to frequent pest and fire outbreaks due to lack of roads and low population density. Over 30% of the total area of forest estate is referred to high fire classes. Aerial fire management is the only practiced fire control method for over 70% of the forest estate area due to lack of appropriate ground services. Forest fires kill about 300,000 ha of forests per year, primarily in Asian Russia. Forest pest and disease outbreaks affect over 3 million ha or 4.5 ha per 1000 ha of forest stocked land.

The Asian part of Russia accounts for 80% of the entire commercial growing stock, while this area only have 10% of the human population and about 13% of the gross national product.

Forest resource capacity is not confined to timber harvesting. Forests are an abundant source of resin products, a broad range of secondary forest resources (birch bark, willow bark to extract tannin, Christmas trees, spruce, pine and fir branches to produce carotene, etc.), and other non-timber forest products (harvested hay, grazing resources, honey from bee-keeping, tree sap, wild fruit, berries, mushrooms, nuts, medicinal plants, and technical resources).

The forests provide habitats for most valuable commercial fur animals and birds, and are used for hunting, recreation, tourism and sports.

In addition to the economic and social functions, forests constitute a vital element of the biosphere and play the most important role in climate regulation, water conservation and regulation, soil protection, and sanitation. Russian forests are a decisive factor for biodiversity conservation, regulation of the carbon cycle, and carbon storage.

Taking into account the abovementioned description of forests and their location, only 60% of growing stock is considered as an economically accessible resource for commercial use, mainly due to lack of transport roads (40% - in Asian part, 80% - in European part). This factor plays a decisive role in in the estimation of wood supply capacity. The annual allowable cut for final cutting is estimated at 550 million m3, of which conifers constitute 310 million m3. At present only 25% of the allowable cut is utilised to produce output in forest sector (Table 2). The dynamics of output over the last 20 years period is a result of drastic changes in the forest sector during the economic reforms.

As of 2005 almost 100% of the forest industries were turned into enterprises with private ownership, mainly as joint stock companies both with and without government shares. In the forest sector, the process of privatization was accompanied by a severe structural and financial crisis associated with big economic and social losses.

The crisis was caused by the following factors:

1. Grave mistakes in locating timber industries during the Soviet period when major logging and processing capacities were located in Siberia – in remote areas far from both domestic and export markets.
2. Significant decline in consumption of end-use forest products due to lack of effective demand for them among the population in view of low per capita incomes (about US $ 1200 per year in 2005).
3. Inefficient structure of wood consumption with only 15% of the total harvest processed by chemical and chemical-mechanical methods.

It may be added that the volume of wood harvesting as presented by official statistics (Table 2) reflects only final cuttings done by the private industry. In fact total volume of wood harvesting amounts to about 210 million m3. In addition to official data it includes 50 million m3 harvested by thinnings and sanitary cuttings and 25 million m3 of illegally logged wood. Under the structural crisis, the financial situation of the forest sector largely depends on the export opportunities of the forest and paper industries.

In 2006 export earnings from the forest sector reached US $ 9,5 billion, or over 60% of total revenue. The structure of exports was as follows:

- round wood – 51 million m3,
- sawn wood – 16.8 million m3,
- plywood – 1.6 million m3,
- pulp – 1.9 million tons
- paper and paper board – 2.69 million tons.

Since in the 1990s and in the beginning of the 2000s the forest sector development was not given a high priority compared to oil and gas extraction. Its share in percent of various national economic parameters amounts to:

- 2.8% of gross domestic product,
- 4.5% of export revenue,
- 3.7% of total industrial output,
- 8.3% of employment,
- 3.0% of capital industrial assets.

Table 2 *Forest Industry Outputs in the Russian Federation, 1985-2005*

Products	Units	1985	1990	1995	1998	2000	2005
Wood Harvesting	mln.m3	337.3	303.8	116.2	78.2	94.0	116.0
Industrial wood	mln.m3	237.7	221.4	82.7	58.6	73.0	95.0
Sawn wood	mln.m3	79.5	75.0	26.5	18.6	20.0	22.5
Plywood	thou.m3	1594	1597	939	1102	1484	2598
Particle board`	thou.m3	4673	5568	2206	1568	2335	4594
Fibre board	thou.m3	1450	1546	748	618	890	1325
Pilp, after crafting	thou.tons	7950	7530	4197	3210	4960	7320
Paper & paper board	thou.m3	7910	8320	4074	3595	5312	7450

The New Forest Code (2006) and a new forest policy are designated to change the current situation of ineffective utilization of forest resources. The new forest policy recognizes that the former centralized system of forest administration has failed. This system has been able to reach the proper economic, social and ecological goals in the forest sector.

The key strategic goals of the new forest policy are as follows:

- To convert the huge biological resources into economic values.
- To establish a new balance of power between the Federation, the Regions (Subject of the Federation), and private business.
- To separate forest administration and forest management.
- To establish a competitive environment in the forest sector, selling the licenses for resource use only through auctions.
- To administrate the forests on sustainable basis.

Decentralization of the forest administration and management is based on power delegation in two steps:

- First – from federal to regional authorities.
- Second – from regional authorities to private business under forest leasing agreements.

At the same time the monopoly of federal public ownership of the forest estate will be preserved mainly due to political reasons. The institutional organization of the public forest administration is at two levels: the federal level (Figure 1) and regional level (Figure 2).

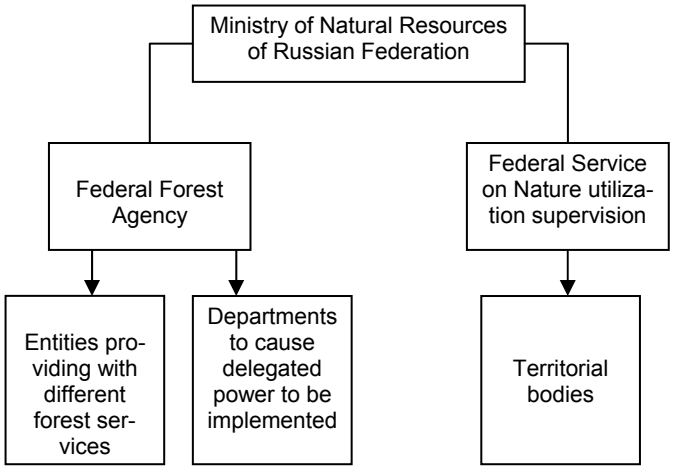

Figure 1 *The federal system of forest administration in the Russian Federation.*

The **Ministry of Natural Resources** would be responsible for

- developing national forest policy in compliance with the principles of sustainable forest management, and
- drafting and adopting regulations and guidelines for decision-making in the area of forest use, protection and renewal.

The **Federal Forest Agency** would be responsible for:

- providing the regional authorities with various services to facilitate proper decisions in the area of forest use, protection and renewal,
- ensuring that the delegated power is implemented by the regional authorities.

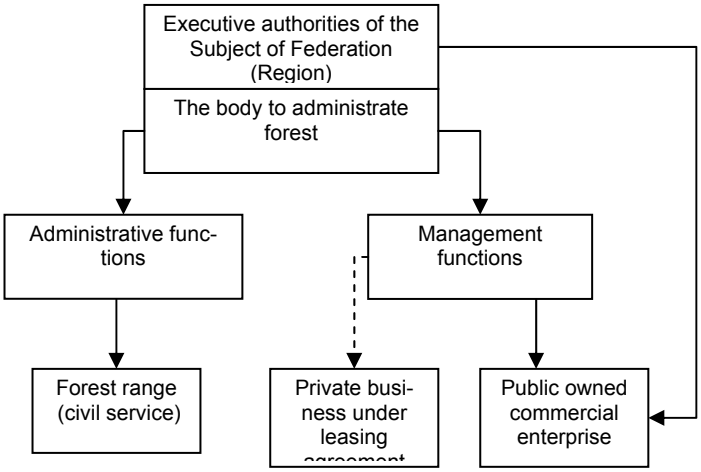

Figure 2 *The Regional system of forest administration and management in the Russian Federation.*

The **Federal Forest Agency** provides services such as:

- forest resource monitoring, forest inventory,
- pest and disease monitoring,
- seed breeding,
- forest research,
- secondary and continuous vocational forest education,
- international cooperation.

The **Federal Service on supervision of Nature Utilization** would

- effect forest law enforcement,
- ensure that the regulations and rules are implemented.

The **Regional executive authorities** would:

- draft and adopt regional forest long-term plans,
- make decisions to allocate forest estate areas for use under arrangements of tenure (leasing agreements, cutting agreements),
- be responsible for guarding the forest resources, in particular prevention of illegal cutting,
- be responsible for forest protection and renewal,
- make decisions regarding financing forestry operations.

The main mission of the **Regional forest administration** is:

- to increase resource use, develop end-products, and attract large-scale investments into forest industries,
- to improve the efficiency of ecological surveys in the forest estate and to ensure its conservation.

The New Forest Code have established the legal tools to administrate forest areas. These tools include:

1. Regional forest management plan covering 10 year periods (drafted and adopted by the regional authorities).
2. Silvicultural and environmental regulations formulating the requirements for sustainable forest management for each forest range (drafted and adopted by the regional authorities).
3. Forest harvesting plan formulating the responsibilities of forest users in accordance with leasing or cutting agreements (drafted by forest user and adopted by the regional authorities).
4. Public hearings of forest harvesting plans (carried out by the regional authorities).
5. Public forest register providing the legal basis of relations between the public authorities and private contractors.
6. Public cadastre of forest plots as a legal step to promote privatization of forest land.

In accordance with the Forest Code there are two ways to obtain rights to harvest publicly owned resources. These are the tendering procedures a) to conclude leasing agreements, and b) to conclude cutting agreements**. Leasing agreements** cover a period of between 10 and 49 years and provide the rights to harvest resources and at the same time responsibilities to manage the forest area (i.e., forest regeneration and protection, construction of roads, etc.). **Cutting agreements** provide only cutting rights for a period less than one year. The regional authorities make all decisions concerning the granting of rights for use of the forest estate on the lease basis.

Figure 3 shows the decision making process in the allocation of harvesting rights. Only a harvesting declaration sent by user to the regional authorities gives the practical access to public forest resource. This process includes some bureaucratic resolutions, which contributes to corruption and the development of a shadow economy. The financial funds related to forest use lack openness and transparency. Basic stumpage rates are established by the federal government and charged to the federal budget. Parties to a forest lease agreement do not participate in negotiations on the rates of forest payments. Forest users charge to the regional budget only the difference between auction stumpage price and basic rates established by federal authorities. This financial fund is insufficient to cover all forest management costs (reforestation, silvicultural treatments, forest protection). As a result of this financial policy, the industry is forced to carry out forest management operations on its own account.

Rigid centralization of the management of forest use payment is coupled with a lack of competition in forest markets which accounts for low public revenues from forest use as expressed in low stumpage prices (Rbl 48 or US $2 per m3 in 2006).

In order to attract investments into forest industries the Forest Code provides an opportunity to obtain harvesting rights without tendering procedures. This may occur when the forest user's investment in the development of wood harvesting and manufacturing amounts to more than US $12 million.

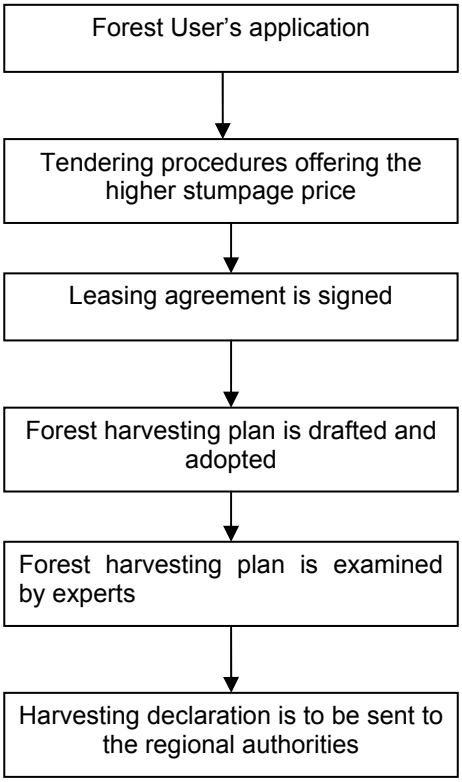

Figure 3 *Decision-making procedures to grant the rights of forest use on a lease basis*

The new financial system is based on the following principles:

- guaranteed funding for reforestation, forest growing and protection at levels sufficient to ensure continuous sustainable forest use and sustainability of the environmental functions of the forest,
- economic incentives for all parties to forest relations in order to generate increased public revenues from forest utilization to be established and implemented,
- distribution of revenues from payments for forest use among the parties to forest relations with regard to their responsibilities for the ecological state of forest land,
- exclusively competitive allocation of budget funds under close supervision of federal and regional authorities,
- transparent and open financial flows to the whole range of activities in the forest sector: from wood harvesting to end-product manufacture.

Apart from potential economic benefits, the new forest policy would substantially streamline the forest account process, forest inventory and biodiversity conservation.

Local forest governance and the role of community-based forest management

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Introduction

In recent years, issues relating to governance and environment such as biodiversity loss and climate change have taken a central stage in national and international policy debates. People involved in forest sector management have been drawn increasingly into the debates and are pressed to reconsider ways in which the forest resource is managed and governed.

This paper discusses aspects of forest sector governance, especially local forest governance. It draws on lessons learned from field implementation of community forestry and other relevant forest policies in some selected Asian countries, and the author's own personal field experiences.

In the paper following a brief overview of factors generally influencing the forest sector, it uses some key elements to examine local forest governance and ways community-based forest management or community forestry programs contribute to it. The paper also highlights some challenges and opportunities facing the future of forest sector governance.

The context

The international community has articulated new visions of the forest as reflected in the Rio Forest Principles, Agenda 21, and the outcomes of the conventions on biodiversity and climate change (WCFSD 1999). These visions have led many nations to move away from regulatory approaches focused primarily on central government management and policing of forests to more inclusive social, environmental and governance goals that accommodate multiple, and often conflicting, interests (Anderson et al. 1998).

National governments around the world have revised, or are revising, their forest policies, which in turn has resulted, or is resulting, in adjustments of the overall forest governance system. Some key areas of concern to changes in forest governance include forest laws; trade in forest products; forest tenure and ownership; international regimes related to forests' the role of national and international organizations and civil society organizations; policies and programs of decentralization; devolution; and government forest agencies.

Forest and other related laws

Forest legislation of different nations has evolved over time and will continue to do so in the future. It now includes aspects that go far beyond the growing and cutting of trees, and generally recognizes the role of forests beyond simply timber sources to include for example their role as habitats for wildlife, resources for grazing and agriculture, contributor to soil and water conservation, and more recently source of biological diversity. Some of these – wildlife, grazing, soil and water conservation and biological diversity – have become areas of law in their own rights. The role of forests as carbon sinks is less often featured but is expected to become more prominent in the future. It is, therefore, important to recognize that forest legislation has become increasingly complex as it has grown in ambition and scope, and that laws relating to other sectors increasingly impinge, directly or indirectly, on how forests are managed and used.

Trade in forest products

While there are many dimensions to trade in forest goods, the most prominent considerations in recent years concern the extent to which trade laws, domestic or international, or voluntary trade-related mechanisms (e.g. certification) can influence the sustainable management of forests and help combat illegal harvesting and processing.

International policies, laws and organizations

It is important to take into account the proliferation of various international regimes and Millennium Environmental Assessments, including for example biodiversity conservation, climate change, indigenous peoples as well as international agreements on timber trade. All these have provisions that influence the options available for sustainable forest management (Tarasofsky 1999). Equally important are the policies and programs of international development organizations, NGOs and Civil Society Organizations. Organizations such as the World Bank, the International Timber Trade Organization, the Food and Agriculture Organization, IUCN (World Conservation Union), WWF (World Wide Fund), United Nations Forum on Forests, Forest Stewardship Council, Forest Peoples Programmes, the Rainforest Alliance, the Nature Conservancy, Conservation International, etc., all of which give significant importance to the legislation on sustainable forest management and can, and have, stimulated new thinking about the role and scope of forests.

Forest tenure / ownership

One issue that lies at the crossroads of forest and other areas of legislation is forest tenure and ownership, especially the rights over forest and forest products use. While clear and secure tenure and use rights are increasingly seen as key to sustainable forest management, property rights in forests remain complex and contested. Forests may for example be owned by state or private individuals or held as common property by local communities or other groups. There may also be a discrepancy between what formal legislations prescribe and what is seen as legitimate on the ground. For example, indigenous and tribal commu-

nities around the world follow their own traditional and customary laws even where a state formally asserts its ownership. Policy makers concerned with forestland and governance issues are increasingly confronted by the demand to modify heavily state-centered forest legislation to accommodate customary tenure regimes or to enhance the rights of access, control, and management of local communities (Christy et al. 2007).

Decentralization and devolution

Trends all over the world towards decentralization and devolution have been major influence towards involving local communities' in forest management - as a part of general decentralization in government and of a parallel trend to devolve rights and responsibilities to community groups. Both decentralization and devolution (often used interchangeably) represent efforts to move forest management and decision-making closer to the forests themselves and to the people who in one way or another depend on, or interact with, them regularly (Fisher 1999; Larson 2005; Capistrano & Colfer 2005; Blaikie & Springate-Baginski 2007). The rationale is that forest management and governance is enhanced if it is informed by local problems and needs and receives the support of local officials and private citizens. Devolution of rights and responsibilities to local groups in many recent forest laws has taken different forms, ranging from quite modest protection and benefit-sharing arrangements between government and village committees to more ambitious co-management arrangements and even in some cases to turning over of the forest ownership to local/indigenous communities.

Local communities' increasing involvement in forest management

In recent decades, national and international forestry related policy and program documents have been referring more commonly to terms like community forestry, community-based forest management, co-management, joint forest management, and so on. For example, the World Bank's Forest Strategy calls for support to policy and legislative reforms needed to implement community forest management, giving emphasis to tailoring designs for local needs. In this paper, community forestry[57] or community-based forest management is used interchangeably. According to Arnold (1998), the main reason for promoting greater local involvement in forest management is seen to come from any of several directions. It may be:

- Coming from a conviction that local management leads to more effective conservation, protection, and afforestation,
- Intended to help enhance local livelihoods,
- Driven by local demands for the recognition of long-standing land claims, especially where indigenous groups are asserting historical land right claims, and
- Related to governance reforms in general, especially promotion of local democratic institutions.

Indeed, over the last three decades, increasing number of local people and rural community groups are reported to have assumed more active roles and responsibilities for forest resource management. According to a recent study (Bull & White 2002) globally some 420 million ha (11%) is now in some form of community managed or administered system. The proportion of community owned forest in developing countries is reported to be around 22% of the total forestlands and with the current trends the figure is expected to reach 45% by 2015 (Bull & White 2002).

Role of government forest agencies

As the range of issues that forestry organizations must consider has broadened so have forestry organizations been evolving. This has also been spurred by the increasing number of interest groups, or stakeholders. Civil society organizations and NGOs, business people, academics, forest dependent local communities, media groups and the general public - all are trying to push their own agenda. Non-forest institutions, especially those concerned with the environment, increasingly overlap with the forest sector. All this demands for a mechanism to ensure better coordination - on issues that overlap sectors, to promote greater public oversight and monitoring of forest decision-making, to institutionalize public participation, and to encourage greater private sector involvement.

Thus, unlike in the past – where the state forest agencies operated in relative isolation and having sole responsibility for "forestry", it is no longer possible for them to continue to operate in the same manner. Dealing with this complexity of change has tested the capacity or willingness of forest departments across the region.

The question therefore is how government forest agencies could effectively accommodate the multiple, often conflicting interests (Anderson et al. 1998) and at the same time justify access greater public resources to accommodate these. Could national environmental councils have a role in coordinating with relevant sectors / ministries? Similarly, how might the government forest agencies adjust themselves as local communities increasingly assume responsibilities for forest management in the future?

Local forest governance and role of community-based management

With the above background information, let us now look at forest governance[58] in general and local forest governance

[57] Community forestry refers to management and use of forest resources by groups of local people for commercial and non-commercial purposes, including subsistence, production of timber and non-timber forest products, protection of environment - wildlife and biodiversity, and social, cultural and religious significance.

[58] Put rather simply, governance in this paper refers to decision-makings and processes used for making and monitoring such decisions, assessing their impact, and subsequently for treating outcomes of the assessment. It considers questions such as who makes decisions and who implements them, and how? In what ways other stakeholders (not involved in decision-making and/or implementation) respond to such decisions? What mechanisms of checks and balances are there?

in particular. As the ultimate objective is to ensure both sustained and improved forest quality along with the sustained flow of forest goods and services to society, any judgment on forest governance should be based on the extent to which it contributes to these. The term 'local' is used for activities that are planned and executed at a sub-national level (e.g. including regional / provincial, district, or village/community level).

In this paper the term 'local' refers to a village/community – where the use and management of forests actually takes place. As at the regional/provincial and national levels, several internal and external forces are at work in a village setting and these influence the way forest and other resources are used and managed there. How village/community members organize themselves and respond to such internal and external forces is critical for the sustainable governance of the village forest and other natural resources. However, while community/village level governance is the focus, it also attempts to relate them to general forest governance issues and how they contribute to national level governance.

Before getting into the details of local forest governance, let us look at the general contributions of community forestry to forest conservation, rural livelihoods and building of local institutions.

Contributions to forest conservation, rural livelihoods and local institutions

Many people describe the role of community forestry in sustainable forestry, especially in developing countries (see, for example, Gilmour & Fisher 1991; Ascher 1995; Hobley 1996; Arnold 2001; Blaikie & Springate-Baginski 2007). Malla (2007) has attempted to document lessons learned from community forestry over the last three decades. Some of these are presented below.

Local communities can manage large forests, including areas of high biodiversity values

Through community forestry programs, hundreds of thousands of hectares of degraded forestlands around the world have now been regenerated with forests and trees, restoring wildlife habitat, improving watersheds and landscapes, and ensuring the flow of benefits to rural households. Community forestry may have, in places, even contributed to reverse the forest degradation trends. One recent study (Oli & Kanel 2006) records that the forest area in the hills and mountains of Nepal have increased from about 3.58 million ha to over 4.01 million ha (16.5%) between 1985 and 1996, whereas in the low land plain areas (including the inner lowland) where community forestry implementation is being resisted by major stakeholders, forest area has declined from some 2.03 million to about 1.82 million ha or 12.7% in the same period. Overall, the forest cover of the country has increased by nearly 4.0%.

Similarly, there is evidence of local communities protecting and managing large contiguous tracts of high value biodiversity conservation areas. Some one-third of the 370 million ha of community-managed forest areas is reported to be of high biodiversity value forest, and that is comparable to 470 million ha of the public (or government) managed protected areas (Molner et al. 2004).

Community forestry can help increase flow of forest products and cash income to villages

While maintaining and improving the forest condition, community forestry programs have reported increased flow of forest products to local households. In addition, local people are reported to have accrued a significant amount of cash income from their community forests, and the funds generated have been utilized for a range of village development works. For example, in Nepal, a rapid assessment of forest product utilization, income and patterns of expenditure of 1,788 forest user groups from 12 hill and lowland districts was carried out in 2002 and extrapolated to all forest user groups in the country (Kanel & Niraula, 2004). The results showed that the total annual cash income from the sale of community forest products was 747 million rupees (more than US$10 million). This amounts to almost 42% of the annual budget of the Ministry of Forest and Soil Conservation. At the present time 100 percent of this forest-derived income is going to the forest user group accounts.

This figure does not include the cash equivalent of subsistence forest products and other income generated by the user groups, which, if taken into account, was estimated to bring the total income to 1.8 billion rupees (almost US$24 million). In other words, 1053 million rupees (or US$14 million) worth of forest products flow to local community members annually

Some 36% of the income from community forest was reported to be used for village development activities, including schemes of drinking water, irrigation and electricity, for building schools and roads, and for supporting income generating activities by creating revolving funds, etc. (Kanel & Niraula 2004).

Community forestry can strengthen existing (or build new) local forest institutions and networks

In almost all places where community forestry program is advanced, the formation of local forest organizations has been critical to the program success. Often local community members themselves have formed their own organizations to manage forest and related natural resources – generally referred to as indigenous or local system management. In other cases, especially under the government community forestry program, an outside agent - NGO or government agency played a catalytic role to form the organizations, building on the existing use rights to forests. The community organizations enabled people to negotiate with government officials and provided a forum for presenting many, and often conflicting needs of the people dependent upon the forest and related natural resources.

As community forestry programs expand and local communities gain experience, it has been revealed that the forest users find it much more convenient and effective to exchange experiences and learn from each other, and even form their own associations. These associations play an important role in supporting forest users and negotiating on their behalf with government agencies and industries, to ensure their use rights to forests and other benefits are not

undermined. Example of one such federation is the federation of community forestry users of Nepal or FECOFUN. The formation of this federation in 1994 is described by Shrestha et al. (1997) and expansion of its activities over the years by Ojha et al. (2007). Today, FECOFUN is the country's largest civil society concerned for forestry and local communities, with elected members at district, regional and national levels and mobilizing one-third of the nation's 24 million people.

Community managed forests could serve as important source of investment

Overall government spending on public protected areas, especially in developing countries is reported to be very low, whereas the cost to manage existing public protected areas and/or to expand these or to create new ones is increasing. A study by Green & Paine (1997) of 123 conservation agencies in 108 developed and developing countries (comprising 28% of all public protected areas), reported an annual budget allocation of US$3.2 billion or US$893 per square kilometer overall in developed countries, compared to only US$ 10 per square kilometer for developing countries studied. Furthermore, 60% of sample parks which are in developing countries received only 10% of the total capital expenditure budgets provided to all parks (Molner et al. 2004).

Local communities have been reported as spending significant amounts of time, labor and financial resources on forest management and conservation activities, and this has been estimated to be worth between US$1.2 – 2.6 billion per year (Khare 2003). This is about the same as the annual budgetary allocation of the developing nations for their public protected areas system, and two to three times the annual allocation of all overseas development assistance for public protected areas conservation worldwide (Molner et al. 2004).

Elements of good (forest) governance

Some key elements of good forest governance include: an appropriate, enabling policy and legislation (Ascher 1995; Lynch & Talbot, 1995; Lindsay 1999; Moore 2005), transparency and disclosure, public participation, accountability, and combating illegal logging and corruption (Christy et al. 2007).

Enabling policy and legislative framework

While a national policy and legislative framework alone cannot ensure good forest governance, it can establish certain pretexts; for example, they provide scope for meaningful participation in forest decision making, increase the stake of concerned people in sustainable forest management, improve the transparency and accountability of forest institutions (Lynch & Talbot 1995); and set forth rules that are coherent, realistic and comprehensive (Christy et al. 2007).

Community forestry programs have progressed rapidly in places where community use rights to forest resources are secured through well designed and executed legal frameworks. In other words, for local communities to become actively engaged in forest management and therefore governance, a sense of ownership, or secured use rights to forests, is critical (Lynch & Talbot 1995; Ellsworth & White 2004; Moore 2005; Gilmour et al. 2005). Furthermore, the legislation, once in place, functions best when translated into simple guidelines describing how a process should be developed to assist government and NGOs staff in their work with local communities.

In countries like Nepal, the government has issued guidelines for field implementation. Such guidelines explain methods and procedures for negotiating use rights to forest and forest products, institutional arrangements for forest management; roles and responsibilities of local communities, government forest departments and other stakeholders; preparation of management plans; harvesting and sharing of forest products, sharing of benefits, and so on.

These documents are very useful and serve as a basis to discuss with the general public, especially local rural people to make them aware of their use rights to forests.

Transparency and disclosure

Transparency forms one of the most important elements of good governance. It allows concerned people to see what is happening in forest administration. The rationale is that government agencies responsible for forest administration, business companies, and other concerned individuals will be less likely to act against the prevailing rules and norms if these are open to scrutiny (Christy et al. 2007). The first step toward transparency is to make the legal rules and provisions freely available to the public. Ideally countries should publish their laws or at least forest regulations before they are made effective. The information must be in style and language suitable for the general audience.

Generally, despite the increasing demands on forest administrations around the world to be more open and transparent in their actions and decision-making, the reality is that the forest administrations, especially in the developing countries, still have far greater influence than the public over forest policy and law reforms. In terms of community forestry, national governments, with the exception of few countries – such as India, Guatemala, Mexico, Nepal, Philippines, and Tanzania - have been slow in releasing documents related to forest policy and regulations. Where community forestry program has advanced and become a part of the mainstream forestry program, national governments have made public their community forestry laws and regulations in simple and easy to understand media.

With respect to the actual management of a community forest, transparency and disclosure may be considered from the perspective of how forest user representatives (or committees) negotiate with a range of other stakeholders/interest groups within and outside the forest users group. Two such negotiations are critical: one relates to negotiation with the government forest agency and the second relates to negotiation amongst the members and various interest groups within the concerned community or forest user group.

In Nepal, for example, community members organize themselves into forest user groups. The groups or nominated representatives negotiate with the government forest

agency for use rights to the forest and responsibility and authority of forest management and control. Once the use rights for a specific forest are negotiated and roles and responsibilities determined, forest users prepare a management plan, normally with support from a forest department official. The plan, prepared in local language, specify agreed rules for forest use (i.e. when people may or may not have access to forests, which products, which seasons or months), agreed sanctions for breaching rules, monitoring mechanisms and the roles and responsibilities of general forest users, user group committees, and government forest agencies. Copies of the plan and agreements signed by representatives of forest users and the government forest agency are retained in the village.

As for the transparency and disclosure within a given community, forest user groups, with some exceptions, are reported to have adopted fairly open and transparent decision-making systems. Generally, management plans are discussed in the forest user general assembly and approved by the assembly before they are finalized and signed by the user committee chairperson and government forest representative. There are even reports of cases where forest user groups are using public hearing and public auditing activities as a part of the steps towards improving their forest governance system and making it more open and transparent (Maharjan & Shrestha 2006).

Public participation

Having in place an appropriate enabling policy and law and making the information available helps set the stage for public participation (Christy et al. 2007). As with other government agencies, there have been increasing demands on forest administrations to make major forest decisions through consultations with the public or concerned interest groups. The rationale is that whilst forest administrations may have forestry technical expertise, the public knows its own values and needs, and without public participation these needs might not be reflected or articulated properly and the response of the forest administrations might not be effective. Public participation can also foster a sense of ownership of forest policy and law; and this in turn could provide forest administration with legitimacy and to greater confidence and effectiveness in carrying out their roles and responsibilities.

Participation of local community members in forest management is central to most community forestry programs. It is fair to say that community forestry programs, at least in countries where they are advanced, have been reasonably successful in engaging local community members in the management of local forest resources. For example, in India, some 84,632 joint forest management groups managing more than 17 million ha of forests (Saigal et al. 2004) and in the Philippines 5,500 people's organizations are involved in the management of 5.97 million ha of forests (Pulhin et al. 2005). Similarly, in Nepal, since the concept of forest user groups was first introduced in 1987, there are now some 11,858 forest user groups, involving nearly one-third of the country's population (24 million) in the management of more than 850,000 ha of forests (Bhattarai 2005).

Within a given community, participation in decision-making by individuals and groups is critical to effective forest management and governance. In earlier phases of community forestry in Nepal, India and the Philippines, a few powerful male members occupied the executive committee positions and dominated committee and general assembly meetings. Women and other disadvantaged members of the community were unable to speak up and their concerns would not be part of the discussion in these meetings. While powerful local elites may still be dominant in many places, there have been attempts at finding new processes and approaches to overcome this barrier (see for example, Malla et al. 2000). Today, at least in areas where community forestry program are properly planned and implemented, the situation is different. The forest user committees and assembly meetings are now reported to be more conscious of the needs of all interest groups, especially of woman and disadvantaged members. Field reports indicate that there have been significant increases in the numbers of women and other disadvantaged members elected to the executive committees. These committees, besides having access to funds, information and other resources, play a key role in decision-making of how forest resources should be used and managed, including negotiation with government forest agencies and other stakeholders.

Accountability

Another important aspect of good governance is accountability (Larson 2005; Christy et al. 2007) in particular accountability that holds a government agency or group or person responsible for their actions. Accountability can be promoted through adopting transparency mechanisms and whilst decentralizing forest administrations maintain an oversight and standard setting role for central government (Christy et al. 2007).

While information on accountability issues is limited it would appear that community forestry has contributed to enhance accountability at all level of governance at least in areas where its implementation is properly planned and executed. At the forest user group level, the chairperson and other committee members are increasingly becoming accountable to forest users, and not just the concerned government forest agency. There are reports of instances where the forest user group chairpersons and other officials had to resign for mismanagement of group funds or similar behavior unacceptable to the forest user group members in general. In addition there have also been examples in Nepal where a number of forest user group officials, having won the confidence of local people, have been voted into political positions in village and district councils.

At the national and sub-national levels, forest user federations, such as FECOFUN and concerned NGOs and civil society organizations have started to play important role in forest decision-making processes. These now act as pressure groups on behalf of forest users. There are numerous reports from India and Nepal on community groups who, with support from civil society organizations, have organized demonstrations, pursued court cases, against government agencies, and attracted attention of media (see, for example, Shrestha & Britt 1997). Public pressures, such as these, have often forced government agencies to re-

consider their actions and to transfer or even remove concerned government officials.

Thus, community forestry has contributed to accountability through:

- Making actions of forest users committee and the forest agencies open to scrutiny. Many actors outside the executive committees and government agencies, such as the media, civil society, legislature, and the voters, can bring pressure to bear on forest executive committees and the government forest agency.
- Dispersing power among actors that have an incentive to keep an eye on one another. Giving some authority to local communities empowers them and to build capacity and skills, and raise concerns about the actions of government agencies.
- Keeping local forestry office and community members alert, making them more accountable to the people, while allowing the central/regional/district forest agency to retain oversight and perhaps standard-setting authority.

Combating illegal harvesting and corruption

Illegal forest activities and corruption in some countries have been a major challenge for concerned national governments, international community and donor agencies, civil society, local community members and the public in general. Illegality refers to those actions against the law and involves such activities as the illegal harvesting forest products, transporting, processing and trading in domestic and international markets. Corruption refers to the abuse of entrusted power for private gain, which goes beyond bribery and could take place entirely outside of government (Christy et al. 2007).

Not only do illegal forest activities and corruption undermine state authority, but they also deprive the state of revenue. In addition illegal activities often lead to biodiversity loss and negative impact on the livelihood means of forest dependent communities, and such activities increase investment risk and reduce the investor's willingness to comply with sustainable management practices. Although governments usually have a major responsibility to suppress illegal activities, lack of law enforcement, and sometimes illegal acts by state forest administrations themselves, are among the main factors of failure in forest regulation.

At the local level, in areas where local community groups have assumed responsibility for forest management and protection, the situation seems to be somewhat different. Not only has community forestry regulation secured tenure and use rights of local communities to forests but it has also helped created opportunities for them to benefit from forest management. This in turn has helped create a sense of ownership of forests amongst the local communities and thus respect for forest law. Moreover, through the use of highly participatory processes to adopt the rules and regulations for the use of community forests, the community members find it easier to enforce the law effectively. These as well as actions towards promoting transparency and accountability have all served to deter illegal actions and to make their detection easier.

Future challenges and opportunities

The positive contributions of community-based management and hence of improved local forest governance described above, although impressive, should be viewed with some caution. While the above lessons will be useful to further advance good forest governance, there remain many challenges (see, for example, Malla 2007). Some key challenges and opportunities are as follows:

Scaling up of activities for improving local forest governance

Only in a few countries, such as India, Nepal, and the Philippines has community forestry become a part of the mainstream forestry program. In other countries, advancing community-based management beyond 'pilot' project sites remains a major challenge. One reason for this is the gap between national forest policy and the lack of or nascent national regulatory framework. Many countries have progressive forest sector policies and strategies that promote community-based management, but in many cases national laws have not been reformed to implement these policies (Moore 2005). Without a supportive regulatory framework, community-based management programs can go only up to a point, but no further.

Natural forests in the majority of developing countries are set aside as protected areas (national parks, wildlife reserves, etc.) and controlled by the government forest agency. As government policies deny use rights to the protected areas, local people living in and around the resource take little interest in their management. With such an exclusive approach to protected area management, the overall goal for putting in place a good forest governance system may never be realized.

Equitable distribution of benefits

Equitable distribution of benefits to the concerned community members is critical to the effectiveness of local forest governance. Earlier, community forestry programs were introduced as a crude response to solve either restore degraded forestlands or relieve shortage of forest product supplies (fuel wood, etc.), to rural households. As community forestry programs became more sophisticated, issues relating to benefit sharing within and between the communities surfaced. In some examples whilst community forestry programs created income generation opportunities or forest product flow, the programs have not benefited the poorer local people as much as they could or should. For example, of the US$10 million cash income generated from community forests in Nepal, only 3% has been targeted to pro-poor activities (Kanel & Niraula 2004). Such inequities could seriously undermine the positive contributions to good local governance, which the community forestry program has instilled. There is therefore a need for a close attention to mitigate this issue while preserving the positive effects.

Forest product market

To date, community forestry programs and therefore local forest governance, have generally concentrated on activities relating to the restoration of degraded forestlands

and/or protecting the existing natural forests. Concerned with issues of deforestation and forest product supplies for household needs, earlier community forestry activities emphasized limited utilization of forest products – generally only for household subsistence needs. The general perception was that once a forest is open for commercial use, it will lead to overexploitation of the resource.

Meanwhile, markets for forest products (both domestic and export) have expanded in recent years, with significant increases in the number of small-scale forest-based enterprises (Molner et al. 2006). In response to the market demand, private tree growers have responded by growing more trees on their land and the state forest agency has independently been signing agreements with forest industries for harvesting wood and other raw materials (generally from outside the community forests).

These give rise to some serious equity issues. First, a rather passive, or lack of more proactive, response from the community-managed forests means that only the state and/or private tree growers (who are often large landholders) can benefit from opportunities provided by emerging markets. Second, local people - many of whom are poor, landless or small landholders and who depend on and manage community forests, cannot take advantage of the opportunity.

Community forestry policies, which emphasize the use of forest products to meet subsistence needs and discourage commercial activities, is not very attractive for the poor. They are therefore less willing to invest their human and financial resources into forest management (Malla 1993). Thus, not only does this serve as a disincentive for poor people, but it also puts a serious question mark to the overall effort towards good forest governance, especially local forest governance.

Power relations between different stakeholders

Community forestry, hence local forest governance, is fundamentally about a shift in authority and responsibility for forest management to local communities (Malla 2001). While remarkable progress has been made in enabling community groups to negotiate with government forestry agencies for forest management authority and responsibility, some new issues have arisen. For example:

Community/village level
As different interest groups operate at the local level - all having some stake in the village forest, more often than not it is the powerful male local elites that are reported to dominate the forest user committees and corner for themselves most of the community forestry benefits (Malla 2000). As villagers increase the sale of their timber and non-timber forest products, there will be increased conflict with local powerful sales agents who jealously guard their own market. In other words, a supportive policy and legislative framework is important but not a sufficient condition for effective community forestry programs (Malla 2001). Creating space for the poorer, less powerful groups, and within them space for women and other disadvantaged people, is therefore crucial for the equitable and sustainable local forest governance.

Regional/national level
Major interest groups at the regional or national level include the state (government), forest industry, tourism industry (especially eco-tourism), environmentalists and NGOs / civil society concerned for local communities' use rights to forests. Forest industry owners push for agreements that open forests and felling areas for industrial use, environmentalists press for more forests to be included under the protected area system, and those involved in promoting eco-tourism to declare forests as national parks. The group of NGOs / civil society organizations that advocate local communities' perspectives is probably the weakest of all in terms of pushing their agendas and influencing decision-making processes. A test for good forest governance is how well it accommodates such multiple interests in forests, and how it ensures that there is a provision to support the existing, or help form new, forest users alliance to lobby local communities' perspective.

Impact on forests and livelihoods of forest dependent people

The recent increased attention to bigger social and environmental issues, such as poverty and global warming has further added to challenges facing the forest sector governance. For a major, long lasting impact, community-based management and therefore local forest governance must aim to contribute to addressing these bigger goals.

Forest dependent people
Hundreds of millions of people live in and around the forests; many of them are poor and heavily depend on forests for livelihoods. The overall governance of the forest sector and local forest governance cannot be justified as long as the problems of these forest dependent people remain unaddressed. While forestry alone cannot, or may not be sufficient to, get these poor people out of the poverty trap, a more pro-poor forestry strategy may be required in such areas. Such a strategy may include allocating parts of forest lands on fixed term lease agreements and close collaboration with other relevant sectors, including humanitarian aid, health, education, finance, etc.

Environmental sustainability
Another main challenge is the extent to which the effort on local forest governance contributes to the overall goal of environmental sustainability (help minimize biodiversity loss and global warming). In general, community-based management programs have been reasonably successful in rehabilitating degraded forestlands and managing parts of the existing natural forests. Such forest areas, although substantial in size when combined, are too fragmented and scattered around the countryside to have any major impact on the overall forest sector or the land use system.

As indicated earlier, the majority of the protected areas, which mostly include natural forests, are controlled by government forest agencies and policies adopted for managing them deny use rights of local communities. Local people living in and around these protected areas show little interest in investing their time and energy to manage the protected areas. Therefore, in order for community-based management and therefore local forest governance to make a major, lasting impact on governance of the overall

forest sector and beyond, it must also consider influencing the management of protected areas.

One way to address this problem is by reconsidering the current approach to planning forest management in terms of protected and non protected areas. Concepts such as ecosystem forestry (see, for example, Sayer & Maginnis 2005) that considers landscape level planning and integrated land use system could be useful here. Community forestry and ecosystem forestry can be complementary to each other as the former focuses on forestry activities through grassroots level institutions, whereas the latter helps to scale up forestry to the landscape level and aims for improving the overall land use system.

Summary and conclusion

The perceived role of the forest in society has broadened dramatically in recent years with challenges and opportunities for ways in which the forest resources are managed and governed today and in the future. While debates at the international and national levels on forest governance are important, the key to effective forest governance is how the policies and legislations are actually applied on the ground.

It is clear that community-based management does play important role in improving the local forest governance that is transparent, participatory and accountable to people - at least in areas where it has become an integral part of forestry policy and practice, and where governments have recognized local communities' use rights to the forest, their abilities, and the value of their participation. Community forestry has thus effectively placed local communities - living in socially and geographically marginal areas - on their countries' development agendas.

In demonstrating ways to simultaneously improve the forest sector governance as a whole and address issues of poverty and the environment, community-based management represents a major contribution to our understanding of the path to sustainable development. The means by which the community based forestry programs were developed provide powerful lessons for what it takes to advance this kind of development. At the same time, these lessons reveal the challenges ahead and the difficulties inherent in efforts to the growing problems of environment degradation and social inequity.

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The impacts of market-based biodiversity conservation on Indigenous Peoples, local communities and women

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Introduction: "It's the economy, stupid"

Since the Brundtland Commission in 1987 clearly linked environment and development objectives, it has become increasingly fashionable to approach biodiversity conservation from an economic perspective. In the early nineteen nineties, it was still considered to be very forward looking if a conservation organization decided to include economists in its staff. Analyzing the impacts of economic, trade, finance and subsidy policies on biodiversity was a relatively new thing at that time. "It's the economy, stupid", was a popular slogan that was used by more progressive conservation scientists and NGOs alike. By looking at biodiversity conservation through economists' eyes, the biodiversity conservation community hoped it would gather the capacity to influence economic policies and incentive schemes and adapt them to the needs of biodiversity conservation.

Alas, we probably underestimated how influential economists could be. Instead of adapting economics to the imperative of conserving our planet's biodiversity, there has been an increasing tendency to adapt biodiversity conservation policies to mainstream economics (CENSAT, 2005). The economic rationale is very straightforward: if it is possible to give biodiversity and other environmental 'services' marketable asset prices, market forces will then lead to the conservation of biodiversity.

The now popular use of the term 'environmental services' was clearly inspired by the idea of integrating biodiversity policies into classic development policies. The authors of the UN Millennium Ecosystem Assessment popularized the term in a not very subtle attempt to integrate the findings of the assessment into the multitude of programs and policies that are being put in place to implement the UN Millennium Development Goals. It was undoubtedly felt that a utilitarian approach would be more successful in convincing development policy makers of the importance of biodiversity conservation. It should be noted, though, that many Indigenous Peoples and other social movements have expressed concern about this term as they consider it an expression of a utilitarian attitude towards biodiversity that does not take into account its intrinsic value and holistic nature (Acción Ecológica 2003, and CENSAT 2005).

The main policy mechanisms that have been classified as 'environmental services' markets until now are:

- carbon trade
- biodiversity offsets
- certification
- trade in genetic resources and related knowledge
- ecotourism and
- watershed services

This paper will mainly focus on carbon trade and biodiversity offsets. It will elaborate upon the overall dilemmas of using market-based approaches to address social challenges and the specific dilemmas caused by the three steps that have to be taken to set up a market for 'environmental services'. It will subsequently highlight a specific example that demonstrates these dilemmas - the proposal to introduce a biodiversity offset scheme through the new Paraguayan 'Payments for Environmental Services' scheme - and consider the impacts this scheme will have on Indigenous Peoples and other money-poor groups in Paraguay, such as women.

A neoliberal environmental approach: trading in rights to pollute

There are two main problems with establishing markets for 'environmental services' as part of a market-based approach to biodiversity conservation. Firstly, there are the overall problems associated with using market-based approaches to resolve public challenges. It would be naive to ignore the political dimension of this debate: the concept of carbon trading, for example, has very obvious roots in neoliberal circles in the USA (Lohmann 2006). It was Ronald Coase of the University of Chicago who started to actively promote trading in 'rights to pollute' in the 1960's. In his view, a perfect market would 'optimize' pollution, balancing its costs and benefits. This idea found fertile ground in conservative environmental circles in the US and emissions trading was included in the 1990 Clean Air Act. This development is often quoted as a major success, but if it is compared to command and control approaches to air pollution it is actually quite meager. A US trading scheme to eliminate leaded gasoline, for example, took 23 years to implement fully, while control and command measures to ban leaded gasoline had the same impact in China in 3 years and in Japan in 10 years. (Lohmann 2006)

Nevertheless, as a result of being sold as a success story, the emissions trading system soon gained popularity in US NGO and governmental circles. It was the US administration, under the leadership of then Vice President Al Gore, which introduced this concept into the negotiations for the Kyoto Protocol of the Framework Convention on Climate Change, making its inclusion a condition for the US joining the Protocol. The fact that other countries accepted this condition and were subsequently left with a Kyoto Protocol that was essentially a US construct (although not yet signed by the US) can still be seen as one of the most remarkable tales of environmental political intrigue. As Larry Lohmann says of the Kyoto Protocol: *"Its environmentalist backers....were left in the odd position of having to champion an agreement largely written by the US for US purposes based on the US experience and US economic thinking, but which no longer had US support.....a little tested idea spearheaded by a small US-elite was now per-*

ceived as a global consensus and the 'only show in town'." (Lohmann 2006)

Social-democratic governments initially expressed skepticism towards this market-based mechanism. For example, the Clean Development Mechanism that was eventually established as a carbon offset facility under the Kyoto Protocol was originally based on a Brazilian proposal for a Clean Development Fund to be financed through penalties paid by industrialized countries that had exceeded their emissions targets, and was supposed to be used to finance 'no regrets' clean energy initiatives in the South. It was essentially a compliance mechanism, but the links with compliance were ruthlessly cut by the US, in the hectic negotiations sessions that took place before the Kyoto Protocol was finally agreed.

Considering these political dimensions, it is not surprising that it is the large social movements, especially in the global south, which have been most vocal in expressing their concerns about the commercialization of life through market-based approaches to conservation.[59] Their skepticism concerning the assumption that markets can solve social or environmental challenges, such as the need to conserve biodiversity, is deeply rooted in their experience of free markets having done a very bad job in terms of solving other social challenges in developing countries. There are striking similarities, for example, between the assumptions that were made, almost ten years ago, about the benefits that the privatization of water services would bring, and the assumptions that are currently being made about the benefits biodiversity privatization will have for biodiversity conservation. (FoEI 2005) However, the lesson that has been learned in relation to water privatization – that it can have extremely negative impacts on the poor - has not yet been appreciated by the biodiversity conservation community.

Nevertheless, there does still seem to be a rapidly growing consensus in the conservation community that markets for 'environmental services' will require strong regulation to be effective and equitable. However, few seem to realize the inherent contradiction in this approach: if those regulations are so essential, perhaps it is in fact more appropriate to focus on promoting the regulations themselves, rather than market-oriented processes?

Commodifying the commons

The second major set of problems is inherent to the challenge of trying to squeeze something as holistic as global biodiversity into the structured and relatively rigid framework of the market. For anything to become marketable, a number of steps have to be undertaken:

- it needs to be commodified and transformed into a clearly defined legal object or entity that can be traded
- that object or service then needs to be privatized in terms of becoming the clear property of a specific owner who has the legal right to sell it
- there then needs to be a buyer willing to pay to become the new owner of this property

In relation to biodiversity, these three steps raise numerous moral and technical dilemmas - and it should be emphasized that these dilemmas are not just theoretical. For example, the Republic of Paraguay has just adopted a law on payments for 'environmental services'[60] and is now faced with the highly complicated question of developing an adequate regulatory system to implement the general principles of this law. As a first step, the Secretariat of the Environment in Paraguay has been charged with the quite daunting task of putting an appropriate market value on all the 'environmental services' provided by Paraguayan ecosystems.

In most existing market-based conservation approaches, the complexity of separating and commodifying the various elements of ecosystems has proven to be overwhelming. Ecosystems are complex, highly interactive systems, and most values are integral to the system itself. Yet there have been attempts to commodify and allocate separate values to genetic resources and related traditional knowledge, carbon storage capacity, watershed services and landscape values. The carbon sequestration capacity of organic material seems relatively straightforward quantity to commodify, compared with some of these other 'services', yet even so the influence of ecosystems on climate change is extremely complex: there is much more to it that simply providing a carbon sink and methodologies for calculating the carbon value of natural ecosystems are severely disputed. Some scientific studies even classify important ecosystems like boreal forests in contradictory ways: some as sources of carbon, some as carbon sinks. The fact that carbon stocks in natural ecosystems are by definition non-permanent has also undermined their price in the world market.

Other possible market values are even more difficult to commodify. It is assumed that ecotourism, for example, could be used as a mechanism to commodify landscape values. Yet ecotourism has often destroyed the very landscapes people come to visit (and most ecotour companies prefer to see as few other ecotourists as possible). Payments for watershed protection services have also been criticized as they are seldom based on a profound scientific analysis of the relationship between the ecosystem that is being protected and the watershed. There are no linear relationships between forest protection and water quantity, for example, and certainly not between tree planting and water quantity - planting species like Eucalypt can actually have a profound *negative* impact on water tables.

Furthermore, certified timber, including Forest Stewardship Council-certified timber, still includes timber derived from large-scale monoculture tree plantations, meaning that there is no positive linear relationship between certification

[59] See for example the Declaration of Puyo, by the Confederation of Ecuadorian Indigenous Peoples, May 2006, and the declaration "Chake Nuha, the trap of agrofuels and environmental services" by a large coalition of Paraguayan social movements, April 2007

[60] Ley 3.001/2006 on the Valuation and Retribution of Environmental Services

and biodiversity values either. Studies that include the entire global market value of certified timber in the overall value of 'environmental services' markets show a remarkable lack of understanding of the relationship between certification and biodiversity values. As monoculture tree plantations normally replace more biologically diverse ecosystems like natural grasslands, the biodiversity value of certified timber can be highly negative (Lang 2003). Assumptions that plantations would decrease timber exploitation from natural forests have also proven to be false until now (Lang 2003).

Business as usual

For proper valuation of ecosystem services, it would also be important to establish an appropriate baseline in order to ascertain exactly what proportion of the service delivered is the result the 'provider's' efforts. In general, establishing proper baselines and verification of the added value of the activities of providers of 'environmental services' has proven to be a tremendous challenge. This makes it hard to define what would have happened with a specific environmental value in a business-as-usual situation.

This lack of 'additionality' is actually at the heart of the criticism of most current Clean Development Mechanism projects. Both the carbon market and certification systems like the Forest Stewardship Council rely on independent consultants to verify whether a project provides additional benefits to the environment and complies with environmental standards. Unfortunately, there is an incentive for 'independent' consultancy firms to manipulate base-lines and/or be overly lenient, as many of them generate income from market-based schemes related to carbon trade and certification. There are other conflicts of interests too. Consultancy firm Det Norske Veritas, for example, was asked to verify the additionality of the World Bank Prototype Carbon Facility-financed project run by Plantar in Brazil: however, Plantar is also a regular client of this same consultancy firm (Lohmann 2006, Counsell 2002).

Another major problem is that of 'leakage', which is inherent to forest-related carbon projects and many other PES schemes. Leakage means that the environmental benefits of a project are undermined or even completely negated, because the destructive activities are simply moved to another area. Protecting a forest area from logging, for example, makes little sense for the climate and provides few environmental benefits if the logging shifts to a nearby area, or another country.

Who owns biodiversity?

A second condition for setting up an 'environmental services' market is that the service has to be handed over to an entity that can sell it. This has lead to profound equity-related questions. Who does own biodiversity? The government? The owner of the land where the biodiversity is found? The community that manages that land? The men within that community who make decisions or the women who actually manage the land in practice? Or the Indigenous community that managed the land in sustainably until Western landowners took over their land in colonial or post-colonial times?

Whether national governments, local communities, Indigenous Peoples or legal land owners own genetic resources is one of the most difficult questions arising in the Access and Benefit Sharing discussions under the UN's Convention on Biological Diversity. Very similar issues are now being raised within the UN Framework Convention on Climate Change (UNFCCC) negotiations, regarding proposals for 'Reduced Emissions from Deforestation and Degradation' (REDD). These involve compensation schemes, and again, the question is: who should that compensation be paid to? Individual land owners, local communities and Indigenous Peoples or governments? To take the logic of the market-oriented approach to its logical conclusion, the sellers and buyers should really be private, non-subsidized entities. In reality however, the supply-side of markets for 'environmental services' has been dominated by governmental and not-for profit actors who are allowed to use public funding to set up their markets. In this respect, concerns expressed by the Argentine government and others about hidden subsidies are quite legitimate.

Hidden and non-hidden subsidies

A last indispensable step in setting up a market in 'environmental services' is that a buyer needs to be found. As far as commercial buyers are concerned, this has proven to be more or less impossible without strong environmental regulation. Commercial buyers are only interested in paying for assets like genetic resources and carbon if regulations (limits on the emissions of CO_2 for example) require them to do so. Here too, the actual 'market' has been overwhelmingly dominated by public and/or philanthropic institutions that have 'bought' environmental assets for public benefit purposes. In fact, of the 264 examples of 'environmental services markets' that the International Institute for Environment and Development analyzed in 2002 (Landell 2002), hardly any could be considered to be purely commercial (the exception being a few ecotourism projects with dubious impacts on biodiversity). Most are rather conventional schemes that support community-based biodiversity conservation initiatives, which have suddenly been re-baptized as 'payments for environmental services' schemes in order to make them more acceptable given current trend towards market-based approaches to conservation.

The World Bank in particular, has championed the use of public funds to support projects which have subsequently been reclassified as 'payments for environmental services' schemes and which it can therefore showcase as examples of market-based approaches to conservation. This might look innocent, but in a polarized and highly political debate - as in the current negotiations on REDD - it is far from so, as these projects have subsequently been used as arguments in favor of commercial carbon financing for reduced deforestation projects.

Furthermore, the World Bank has a commercial interest in including reduced deforestation projects in carbon trade, as it already acts as the major public (and well-paid) carbon

finance broker in the international carbon market, through its Prototype Carbon Fund, which was set up in the early 1990's. Consequently, the Bank is expected to launch the successor to the Prototype Carbon Fund, the Forest Carbon Partnership Facility, at the 13th Conference of the Parties to the Climate Change Convention in December 2007 (ignoring the fact that governments have not yet actually made a decision about whether or not to include forests in carbon trade in the post-2012 climate change agreement).

A classical case of using PES to showcase how environmental projects might be included in carbon markets was the very generous grant the World Bank gave to the Kenyan Green Belt Movement, to enable it to market the carbon it sequestered through its tree planting projects on the international carbon market. The fact that the founder of the Green Belt Movement, Wangari Maathai, had just received a Nobel Peace Prize, and that the twelfth Conference of the Parties of the Framework Convention on Climate Change was held in her home town Nairobi, made it very attractive for the World Bank to showcase this particular project during that meeting, holding it up as an ideal example of how carbon finance could contribute to community-based projects. However, the fact that some 90% of the funding came from a World Bank grant, rather than commercial sources, was not highlighted during these events.

The myth of effective and equitable markets in 'environmental services'

Whether or not socially beneficial projects like the tree-planting activities of the Green Belt Movement would actually benefit from purely market-based approaches has proven to be a very controversial question. In most theoretical literature it is assumed that market-based conservation mechanisms could be effective and equitable but *only*:

- If all values are properly accounted for
- If returns are equitably distributed to the proper 'owners'
- If the market is properly regulated
- If those regulations are effectively enforced, and
- If there is an equal level playing field so that all biodiversity consumers and producers can participate equitably

In reality, however, it is difficult to assess whether it is ever possible to meet all these conditions or to find evidence of environmental services markets having a positive impact on poverty alleviation, since the overwhelming majority of existing payments for 'environmental services' projects are funded through public or philanthropic financing. Moreover, most existing PES schemes are accompanied by strict regulations, sometimes even prohibiting the very activity that is being paid for, and most 'success stories' are only really successful because of effective public governance, rather than their links to the market.

A famous example in this respect is the Costa Rican Payments for Environmental Services scheme, which is arguably one of the oldest PES schemes for biodiversity conservation, and perhaps the most well known. In its understandable attempts to sell this scheme on the international carbon market, the Costa Rican government tends not to mention the fact that the scheme was actually accompanied by a nation-wide deforestation ban when it was introduced. (FoEI 2005, CENSAT 2005). So while there is general consensus about the fact that the *overall* policy was successful in terms of halting deforestation in Costa Rica, it is hard to tell whether this success was due to the deforestation ban or the far more expensive PES system.

In this light, it might be interesting to compare these results with the results of the Paraguayan deforestation moratorium that was put in place in 2004, without a compensation system for the landowners. Notably, this moratorium succeeded in reducing deforestation by an estimated 86%, in a country plagued by bad governance.

Economically speaking, however, the Costa Rican PES system has been anything but a success. When Costa Rica tried to sell its subsidy scheme to compensate farmers for the 'environmental services' they provide (by not deforesting their lands) on the carbon market, they found that protecting a ton of carbon cost them around US$27, while market prices varied between US$4-16 per ton. The only reason the entire system stayed afloat was because most of the resources came from a national petrol tax, matched on a regular basis by official development aid. In itself, the system is widely supported in Costa Rica, but to call this combination of taxes and subsidies a market-based approach is rather inaccurate. Furthermore, implementing the same system in a larger country could be extremely expensive: at one REDD negotiating session, for example, Joao Capobianco, Brazilian Vice-Minister for the Environment calculated that it would cost Brazil roughly US$5 billion a year to apply the same system to the most threatened 30% of the Amazon forests (Lovera 2006).

The practical and legal dilemmas of a wild idea: PES in Paraguay

The full story of the Costa Rican PES system was obviously not taken on board when the Government of Paraguay decided to adopt a similar PES law. That it was inspired by Costa Rica is quite well-known: several joint workshops with Costa Rican advisors preceded the introduction of the law, which was chased through the Paraguayan Parliament and Senate in September 2006. When *The Law on the Valuation and Retribution of Environmental Services* was adopted, it did not include any specific regulations or financial backup. Instead, the law simply stipulates that all owners of land and its natural components that generate 'environmental services' will have a right to corresponding compensation for those services. There has been no calculation of the total budget this would require.

In fact, the most noteworthy difference between the Costa Rican and Paraguayan PES systems is that the former has a clearly defined financial back up in terms of a petrol tax, while the Paraguayan PES system is supposed to be financed mainly through biodiversity offsets. There is an undeniable offset dimension to the Costa Rican gasoline tax too, but the broad scope of environmental violations that can be offset through the Paraguayan PES law actually legitimizes environmental crimes. For example, biodiversity offsets of up to 10% of the project's budget are re-

quired whenever a major infrastructural project is expected to cause substantial environmental impacts (according to its Environmental Impact Assessment) meaning that they pay to offset these 'legitimate' impacts by paying to protect biodiversity somewhere else. The law also allows landowners who have violated the pre-2004 forest law (that stipulated that landowners should maintain at least 25% natural forest cover on their land) to simply compensate for this by buying biodiversity offset certificates. Meanwhile, those landowners who do still have more than 25% forest cover and are willing to comply with the current legally binding deforestation ban are now suddenly compensated for their obedience to the law and may receive a payment for these 'environmental services'. A relatively cheap, successful forest conservation policy has thus suddenly become a very expensive forest policy, through which every hectare saved may in fact be negatively compensated by an environmental violation elsewhere in the country.

That this system is a major step forward for large landowners is indisputable, as is the fact that the overwhelming majority of Paraguayan legislators are themselves large landowners. In fact, in December 2006 many legislators insisted that they would only support the continuation of the deforestation ban if the regulatory framework for the PES law was swiftly implemented. It is important to analyze seemingly innocent theoretical proposals like PES in the light of the impact they may have on public governance, especially in countries where corruption is a widely recognized problem, as is the case in Paraguay.

While Geographical Information Systems (GIS) have had a major positive impact on forest governance in general, as they allow for relatively easy verification of tree cover, the road between observing an environmental crime and getting the violator to pay up can be an exceptionally long and bumpy one in a country like Paraguay. Actually receiving payment for your environmental services is likely to be an even bigger challenge, especially for those thousands of small land-holders that do not have close family and friends administering the system. There are numerous cases of other public subsidies that have not reached their destination in Paraguay (and ones that have even reached totally illegitimate destinations). Any country that faces major challenges in terms of forest governance should really question whether a complicated money-channeling system like PES is appropriate in comparison to more straightforward regulations.

Biodiversity offsets for soy expansion

A major source of income for the PES system in Paraguay is expected to come from soy growers and other landholders who have conserved less than the legally required 25% of forest cover. These landholders can now compensate for their past omissions very easily by buying 'environmental services' certificates. Hence there is no requirement or responsibility to restore qualitatively and quantitatively ideal forest cover anymore. This new 'non-requirement' also matches the Roundtable for Responsible Soy's Basel criteria for 'responsible soy', which allows soy producers to convert forest, provided compensation is paid to nature conservation projects or organizations. However, the fact that one of the same large nature conservation organizations that promoted the concept of responsible soy is also playing a key role in the promotion of PES in Paraguay, including through radio commercials alerting Paraguayan landholders to the possibility of biodiversity offsets and PES, makes the entire proposal rather suspect.

To analyze the environmental impacts of biodiversity offsets fully, for a crop like soy for example, it is important to take into account all the environmental impacts of the crop itself, as well as losses incurred and impacts due to associated deforestation. Soy expansion is considered by many to be one of the most important environmental and social problems in Paraguay. The National Federation of Farmers in Paraguay, the national association of NGO networks, and many other movements and NGOs have expressed very clear opposition to soy production, including with respect to proposals to produce supposedly 'responsible soy'. Large marches and other demonstrations were also organized to oppose the 'Roundtable on Responsible Soy' when it met in Asunción in September 2006. Even President Duarte Frutos has referred to soy production as an *"egoistic and excluding development model*" (ABC Color 2006).

In Paraguay, 2.8 million hectares of soy have been planned for cultivation this year and soy planters expect to reach 4 million hectares within the next two years. No less than 35 million liters of herbicides and insecticides were utilized for soy production in 2006, resulting in numerous cases of intoxication and water contamination. The soy farms are overwhelmingly foreign-owned and provide very little employment per hectare of land. The resulting rural unemployment contributes to the expansion of the agricultural frontier and thus even more deforestation – while many small farmers and Indigenous Peoples move to the cities, some move to the agricultural frontier, burning forests to start a new farm. Cattle ranching has so far been the main direct cause of deforestation in Paraguay, but the current rapid expansion of soy on former cattle land is pushing cattle ranching into the forests

Will the poor benefit?

It has often been assumed that PES systems will benefit the poor, as many of the most precious ecosystems on the planet are inhabited by Indigenous Peoples or other money-poor local communities. Here again, the economic rationale sounds convincing, but the reality of the matter is quite different. Even in situations where there are no problems with corruption (and we should not underestimate how many countries do have such problems), the bureaucratic know-how required to sell an environmental service is a significant hurdle for people who do not possess legal skills and who might not be able to properly read and write the official language of the country. The relationship between rural poverty and education is linear and most Indigenous Peoples speak a native, non-official language, putting them at a severe disadvantage in this respect. Having a handful of representatives or community representatives with higher education and/or legal skills can definitely put Indigenous communities in a better position to negoti-

ate PES contracts, should they wish to, but it would still be naive to overlook their disadvantageous overall position.

In practice, conservation NGOs have so far tended to play the role of broker in most individual PES contracts. Their intentions may often be laudable, but it would be really dangerous to turn these private, often foreign organizations into formal tools for implementation of a national public policy as important as equitable forest conservation. Aside from simply not having the scope and capacity to help every local community and Indigenous People in the entire country in an equitable fashion, these organizations seldom have Indigenous rights and national social development as their primary mission.

On top of these practical obstacles, which will probably be overwhelming for the majority of communities, there is the often almost insurmountable legal obstacle that many of the poorest groups in society do not have formal title over their land. The gender dimension is also very important in this respect: in most families it is the men who have legal title over the land (if the family has any legal title at all).

Women constitute the overwhelming majority of the world's poor. As they dedicate a substantial amount of their labor to activities that are not financially compensated, like childcare and household activities, and as they are still discriminated against in labor markets all over the world, they tend to have much lower formal incomes than men. Consequently, they are much less likely to be in a position to be able to buy land. Levels of education and reading and writing skills are also a lot lower amongst women in most developing countries, and many cultural traditions frown on women playing a competitive role in formal market-based labor systems. Once again, these hurdles can be overcome by NGO brokers, but it is neither practical nor morally or socially appropriate to formalize the role of these private brokers in a country-wide system.

While some PES systems, including the Paraguayan one, do formally recognize Indigenous Peoples' rights to land ownership, and thus to PES compensation, one should not underestimate the gap between formally recognized territorial rights and the original land rights of most of the Native Peoples in the Americas. Indeed, there are vehement ongoing disputes all over the world regarding Indigenous Peoples' land rights, since most Indigenous Peoples have only been granted rights over a very limited amount of (economically unattractive) land, instead of over their original territories. What should definitely be taken into account in this respect is the additional negative impact PES policies have on land reform campaigns and campaigns to obtain recognition of land titles. Both Indigenous Peoples and landless rural workers' movements have expressed concern that PES systems might lead to (and indeed are already leading to) increased land pressure and a subsequent inflationary impact on land prices. This in turn might make political campaigns for Indigenous land rights and land reform a lot more complicated, as large landholders have an increased incentive to hold on to their land.

Even more serious social impacts become visible in relation to economically marginalised groups in society requiring the use of those 'environmental services'. Clearly people with less money will loose out in a system in which they suddenly have to pay for 'services' that they used to receive for free. Women and Indigenous Peoples have less money than other groups in society, and are a lot more dependent, especially in developing countries, upon free access to resources like freshwater, fuelwood, medicinal plants and bushmeat for their families' survival. The experience with water privatization shows very clearly that it is the poorest groups in society that suffer most from privatization policies, often with fatal outcomes (FoEI 2005)

Here too, the practical outcomes of PES projects have been influenced by the fact that conservation organizations and public institutions like municipalities have played a major role in financing and implementing those 'PES' projects. So far many of them do seem to have built in safeguards to avoid major negative impacts on social groups on the demand side of social services, but the logic of the market could lead to very different outcomes if they were not checked by these social safeguards. One can envisage, for example, that Indigenous Peoples in the South American Chaco who suffer from droughts triggered by Amazon deforestation might be asked to 'compensate' soy farmers who are good enough not to have burnt down the entire Amazon forest. Or women from downhill villages, who see their streams being polluted by the logging and plantation companies that devastate uphill forests, being expected to similarly 'compensate' these companies in order to obtain some unpolluted water.

San Rafael: biodiversity offsets for the expanding soy frontier

The above-mentioned impacts on Indigenous Peoples are clearly illustrated in a specific case concerning the impacts of biodiversity offsets on the Mbya Guarani communities in the San Rafael hills in the South of Paraguay. The San Rafael hills have been proposed for demarcation as a national nature reserve, a proposal that is strongly opposed by the Mbya Guaraní, who consider it to be their traditional homeland (tekoha) and fear that their territorial claims will be undermined if the area is formally declared a nature reserve. Most land in the San Rafael hills is also under private ownership as well, and the entire area is under severe pressure as the large soy monocultures that stretch out East and South of the hills are rapidly encroaching into the area. It is expected that soy producers in the area will benefit greatly from the proposal to offset the damage caused by soy expansion by buying 'environmental services' certificates from those land owners who still own a substantial amount of the forest land within the proposed reserve.

The Mbya Guarani people, in communities like Arroyo Morotí and Arroyo Claro, on the other hand, might have to pay a high price, even if it is not a financial one. First and foremost they already suffer from the continued expansion of soy monocultures. Their freshwater resources are dangerously contaminated due to runoff from the agrochemicals used on the surrounding soy plantations. The Arroyo Morotí community in particular has expressed strong concern about the declining quality of the drinking water in the brook that they depend on, which has been severely con-

taminated by the agrochemicals used by a neighboring soy farmer. Moreover, due to the increased land pressure there are regular incursions into the forest. The forest of the Arroyo Claro community, for example, was devastated by invading farmers ten years ago. After eight years spent pursuing legal remedies they were successful in having the invaders removed from their land two years ago. Sadly, they returned in September 2007 and again threaten to continue deforesting the area. As a result of these environmental problems many Mbya Guaraní have already become environmental refugees and have ended up on the streets of Asunción, the capital of Paraguay, where they live an extremely marginal life.

But the Mbya Guaraní communities may also be impacted negatively by the expansion of the private nature reserves that are supposed to compensate for the soy expansion. Some of their hunting areas have already been severely restricted, leading to overexploitation of the remaining areas and malnutrition due to lack of protein. Furthermore, their current land rights claims are being frustrated by the prospect of the private reserve owners being compensated through a PES scheme. These landowners' rights, both within and outside the designated nature reserve area, are disputed by the Mbya, who consider the entire area their 'tekoha', an area which they have always managed sustainably. The communities are angered by the fact that landowners who acquired large amounts of land under illegal or at least dubious circumstances during a dictatorship are now hoping to be able to claim compensation for the 'environmental services' provided by the forests the Mbya Guarani have conserved for centuries.

Could Mbya communities benefit from PES?

Of course, to evaluate the impacts of PES on Indigenous Peoples it is crucial to look at possible positive impacts too. From a legal point of view, communities like those of the Mbya Guarani People of San Rafael in southern Paraguay, might be able to claim PES themselves for the areas that are legally theirs. To do this, however, there are a number of obstacles that have to be overcome. First and foremost, there is the language barrier that was pointed out above. While Guaraní is formally the second official language of Paraguay, all commercial and legal transactions are documented in Spanish, a language that few Mbya Guarani speak well enough to enable them to engage in contractual negotiations and arrangements.

The overwhelming majority of these forest-dwelling people also lack the marketing skills needed to sell 'environmental services' like carbon in an increasingly convoluted market. The requirement to obtain an Environmental Impact Assessment prior to offering 'environmental services' will also inhibit the participation of poor landholders in the system, as this is a very costly process. Large tracts of land with one clearly defined individual owner will have a competitive advantage over territorial lands controlled by (not always well-defined) communities.

Selling 'environmental services' might also lead to serious governance problems as it might not always be clear whether the leader of a village has the right or the mandate to undertake such a legal transaction. In general, it should be cautioned that changing the currently predominantly non-monetary economy of communities into a monetary one will also have profound impact on many cultural and environmental values and traditions. Women are likely to suffer most, as their interests are more likely to be overlooked in commercial transactions normally closed by men. Women also have a disadvantageous position in monetary economies in general, as they spend a significant part of their time on activities like childcare and household management that are not rewarded in monetary terms. Moreover, they are generally underpaid in the formal labor market, as well as being responsible for providing clean water and other non-monetary goods for the family.

Furthermore, with respect to water, it does not matter how much money might be earned by selling 'environmental services', clean and healthy drinking water cannot be otherwise obtained: there are no formal public water services anywhere near the communities and even buying water would be impossible because the distances that would need to be traveled are too great (especially since the communities themselves do not have any form of transportation).

In summary, the Paraguayan PES law is likely to have a number of negative impacts on Indigenous Peoples and other poor sectors of society, like landless farmers:

- Paraguay has extremely inequitable land distribution and the overwhelming majority of any funds will undoubtedly go to large landholders.
- The law is likely to frustrate land reform programs and ongoing land rights claims by Indigenous Peoples as it will increase the value of unused land.
- The system will probably be subject to serious governance problems. In particular, it is likely that politically influential groups will have far better access to the funds than politically marginalized groups like Indigenous Peoples and small farmers. Bad governance and market-based conservation mechanisms are a risky combination.

Conclusions

There are some fundamental questions that tend to be overlooked when market-based conservation mechanisms are proposed. Markets cannot work without privatization. Does that mean that we need to privatize and put a price on all elements of biodiversity in order to make environmental services markets work? Is this feasible? Is it equitable? Is it ethical? And who has the right to own that biodiversity? Is biodiversity a so-called *"BioNullius",* something to be colonized, as Indian activist Vandana Shiva once questioned?

An important consideration when proposing PES schemes is that the most efficient PES schemes are not equitable: paying large destructive landholders is economically-speaking more 'efficient' than channeling funds to community-based schemes and/or paying Indigenous Peoples who were not planning to destroy their forest anyway. In fact, this equity aspect is at the heart of some very politi-

cized debates around the proposal to compensate countries for reducing deforestation as part of a future climate regime. Those countries that have already done a successful job conserving their forests risk losing out from some of these proposals, as they are obviously not able or less able to 'reduce' their deforestation rates.

In the end, a remarkable degree of the enthusiasm generated by PES seems to be based on the Costa Rican PES experience. However, its supporters often overlook the fact that the Costa Rican carbon and genetic resources 'markets' were only developed as a result of a combination of government intervention, generous Official Development Aid and other donor support. As soon as these markets were left unsupported, they proved economically unviable. Moreover, the success of the Costa Rican PES scheme might have been the result of the fact that deforestation was also illegal. An important moral and legal question in this respect is whether it is right to pay people to comply with the law of their land. This would imply that land ownership confers a right to destroy biodiversity regardless of national legislation. Do poor communities have to compensate soy farmers for not contaminating their water resources with agrochemicals? How do we avoid payments for 'environmental services' and compensation to reduce deforestation being turned into 'the Polluted Pays Principle'?

As stated above, these negative impacts *can* be avoided in strictly regulated initiatives. In fact, there seems to be a growing consensus amongst biodiversity policy makers that we do need to control market forces through strict regulation and effective enforcement. Experience so far shows that the best 'PES' schemes are actually conventional subsidy or integrated poverty and development projects. Re-baptizing them as PES was supposed to mobilize political will amongst economically powerful sectors for biodiversity conservation. But the negotiations on reducing deforestation under the Climate Change Convention demonstrate that the main interest in these schemes still comes from the conservation sector: commercial carbon traders have hardly shown any interest in the rather risky and uncertain business of forestry offsets.

In itself, reclassifying sustainable forest management subsidies as Payments for Environment Services schemes does not have to be harmful. However, there is a major risk involved if these schemes are subsequently included in multilateral and bilateral trade agreements. There has been a tendency by certain governments to not only reclassify conventional subsidy schemes and other forms of public support for biodiversity conservation as 'Markets for Environmental Services', but also to subsequently include them in bilateral and multilateral agreements on 'Trade in Environmental Services'. The assumption is that this will stimulate trade in 'environmental services' and bring social and environmental benefits. However, trade agreements are also likely to undermine or even prohibit the social safeguards needed to make 'environmental services' function, as described above. The proposed liberalization of trade in 'ecosystem services' under the World Trade Organization's General Agreement on Trade in Services (GATS) and similar clauses in bilateral and regional trade agreements imply that special safeguards for Indigenous Peoples' and/or local communities could be challenged as being 'discriminatory' by governments and/or large corporations and foreign conservation organizations (depending on the dispute settlement processes attached to the various agreements). So the use of the term 'markets in environmental services' might also have severe negative legal consequences.

The great advantage of public governance systems is that they can be shaped in a manner that directly benefits the most marginal groups in society, including women and Indigenous Peoples. Already in 1992, international public governance adopted the principle of rewarding the so-called incremental costs of providing global environmental benefits. Both the Convention on Biodiversity and the Framework Convention on Climate Change that were signed that year oblige all governments to conserve forests, and require developed countries to contribute new and additional financial resources to reward developing countries for the incremental costs of providing global environmental benefits through reducing deforestation. The Global Environment Facility was established to manage these funds. The fact that the overwhelming majority of developed countries have not complied with these legally binding agreements does not imply that they do not exist anymore.

New and additional financial resources are still required to support sustainable, democratic and well-enforced public governance of biodiversity, including through redirecting perverse incentives, banning deforestation and safeguarding Indigenous rights. As Adriana Ramos of the Instituto Socio-Ambiental in Brazil pointed out at the fifth Trondheim Conference on Biodiversity: *"The majority of areas where we stopped deforestation in Brazil are Indigenous lands".* Respecting Indigenous land rights has arguably been one of the most equitable, effective and efficient policy incentives for sustainable forest management.

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Conservation of crop biodiversity for a food secure future

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Abstract

Use of the diversity found within and among crops, and their wild relatives, underpins the continued production of food. This diversity is known as PGRFA – Plant Genetic Resources for Food and Agriculture. It is a resource as important as the air we breathe and the water we drink.

Diversity in time and space is a foundation for sustainable agriculture. It can result in high levels of production and greater environmental protection. The spatial diversity in traditional and organic agriculture reduces risks, increases stability and spreads labour demand. In modern agriculture, diversity in space is often replaced by diversity in time. A steady turnover of new varieties is required to keep pace with evolving pests and changing environmental conditions and consumer demand. Crop diversity is thus the basis of sustainability throughout the spectrum of agricultural practises. Yet this diversity is eroding, thus endangering our future food security. There is a pressing need to conserve PGRFA, both *ex situ* and in *situ*.

No country in the world is self-sufficient in PGRFA. Interdependence is everywhere. Conservation efforts thus need to be global. This has been difficult in the past, but there is reason to be optimistic about the future. An international, legally binding treaty entered into force in 2004 to help ensure the conservation of PGRFA, their sustainable use and the fair and equitable sharing of the benefits arising from their use. This agreement has created the international policy framework necessary for the establishment of the Global Crop Diversity Trust by FAO and Bioversity, the latter acting on behalf of the CGIAR.

The vision of the Trust is to create an efficient and effective global system for the conservation and use of PGRFA held in *ex situ* collections. The Trust is working to raise an endowment, the interest from which will guarantee funding of such a global system in perpetuity.

Introduction

The theme of this year's conference "Ecosystems and people - Biodiversity for development" goes right to the core and purpose of the Global Crop Diversity Trust. Crop biodiversity is arguably the subset of this planet's biodiversity that has the most direct social and economic value. It underpins food production worldwide and the continued conservation and availability of this diversity is key to ensuring a food secure future. All agricultural production systems rely on crop diversity. Subsistence-oriented production systems often display high *spatial* crop diversity. Many different species and varieties are maintained simultaneously to provide a complete diet throughout the year, and to increases stability and resilience of the agroecosystem. Modern market oriented farming systems typically rely more on diversity over *time*; a constant turnover of varieties is needed both to hedge against evolving pests and diseases that can be especially severe within monocultures, and to adapt to changes ranging from climate patterns to consumer demand. To ensure this turnover of varieties, modern agriculture is reliant on plant breeding, whether by farmers themselves or professional plant breeders. Access to crop diversity for plant breeding and research is greatly facilitated by gene banks where the diversity is conserved and made available. Crop diversity is under threat from a number of factors of which displacement of traditional cultivars in the field by modern high yielding cultivars and destruction of the habitats where the wild relatives of crops occur are probably the two most important. By collecting crop diversity and maintaining it in gene banks the continued existence of this fundamentally important resource is ensured. Or would be ensured, had it not been for a different set of threats causing crop diversity to be lost in the very gene banks which have been built to conserve it. Such threats come from many directions such as natural and man made disasters or, more commonly, from a simple lack of funds to be able to keep the diversity alive. After years of international policy controversy over the legal status of crop diversity an international Treaty is now in place. This Treaty provides the necessary framework for establishing an effective and sustainable global system for conservation and availability of crop diversity.

Crop Diversity

What is crop diversity?

Crop diversity, a subset of the total biodiversity, includes those plants that humanity relies on for food, clothes and shelter. While the number of plants used in agriculture throughout time is about 7000 out of 250 000 named plant species (FAO 1998), 'crop diversity' is a more restricted term and refers only to those plants and their wild relatives that have undergone domestication by humans. Only some 150 domesticated crops have historically entered into world commerce (Fowler & Hodgkin 2004) and only about 30 of these are commonly said to "feed the world" (95% of calorie intake). Furthermore only three, maize, wheat and rice, provide about 50 % of the energy intake of the world's human population. Looking at those figures one could be lead to think that diversity is not a concern for food production and food security. Nothing could be more wrong; it is a question of looking at the right level of biodiversity. The CBD's definition of biodiversity singles out three levels: ecosystem diversity, species diversity and genetic diversity. The term crop diversity used in this article refers specifically to genetic diversity *within* crop species. Looking at crops from a gene's-eye view, there is a myriad of varieties of crops, the number of which is a useful indicator of genetic diversity. However, taking a broader view, the genetic diversity of greatest interest to agriculture is the total ge-

netic variation found within a crop species, its intraspecific variation, and variation in closely related species that can potentially be used in plant genetic improvement. This diversity is known as Plant Genetic Resources for Food and Agriculture (PGRFA). Fowler and Hodgkin (2004) use a condensed version of the National Research Council (USA) definition of PGRFA: 'Seeds, plants and plant parts useful in crop breeding, research, or conservation for their genetic attributes'. The Convention on Biological Diversity (1992) employs a more generic definition of genetic resources: 'Genetic material of actual or potential value'. In any case *value* for human use is at the core of the concept.

Crop domestication and improvement have taken place since the beginning of the Neolithic revolution some 12 000 years ago. Early farmers selected the wild plants best adapted to their needs and environment and these evolved over time, under a combination of human and natural selection, to form a vast array of domesticated farmer varieties or landraces. Soil and climate conditions, pests and diseases pressures as well as cultural needs and aspirations were all factors that shaped the first crops. As agriculture spread and became the dominant lifestyle worldwide the crops continued to evolve and diversify in the new environments they encountered. The spread of crops around the world can be called the first globalization of agriculture. The grains first domesticated in the "fertile crescent" in the Middle East, such as wheat and barley dispersed to northern Europe, southern Asia and the African continent. The rice originally domesticated around the Yangtze river valley soon became the staple of large parts of the Asia. Sweet potato went island hopping from the coast of South America across the pacific and had reached New Zealand before the island was first visited by European seafarers. In historic time the spread of the agricultural crops accelerated and only a few years after Columbus reached the Americas potatoes was introduced into the northern European cuisine. Now, no one can imagine Italian cooking without tomatoes or chillies, originally from Central America. Likewise maize, originally domesticated in the highlands of Mexico, together with cassava, a root crop with origins in the South American tropical lowlands, are currently among the most important staples in Sub-saharan Africa.

The globalization of crops induced an enormous selection pressure to adapt to diverse conditions and to borrow an expression from evolutionary theory, the crops underwent "adaptive radiation". Rice, for example, is currently the primary food for three billion people around the world and an extreme range of varieties exist: some Himalayan varieties flourish at more than 2600 metres above sea level, while others, such as those grown in the Mekong Delta, can grow under 2 metres of water. This diversification and radiation of crops shows the interconnectedness of agriculture and food security worldwide. All countries depend, to a greater or lesser extent, on crops that were first domesticated in distant lands during the earliest days of agriculture. A survey by Palacios (1998) used the criterion "food energy supply" to determine to which degree the crops consumed in a country are indigenous or not. Unsurprisingly she found that most countries are heavily dependent on crops originating outside their national borders. For example Germany is 83% dependent, Colombia 84%, Nigeria 46 to 61% dependent, and the world average is about 70% dependency (Esquinaz-Alcazar 2005). The interdependence among countries for crop species is paralleled by interdependence with respect to PGRFA. Modern varieties are the result of decades of plant breeding efforts and most varieties, especially of major crops, have a pedigree involving dozens of crosses among landraces of widely different geographic origin.

Why we need Crop Diversity

PGRFA for food security

Genetic diversity is needed to meet challenges such as constantly evolving pests and changing climates. In order for agriculture to be able to adapt and stay productive, farmers and the breeders need to have a range of genetic resources to work with. This goes for traditional agriculture as well as modern high yielding agriculture. Traditional agricultural production systems in general are more diverse than market oriented farming systems, both in term of *intraspecific* and *interspecific* diversity. These production systems are designed for subsistence, thus a variety of crops that compliment each other nutritionally are grown. In addition the spatial diversity in these production system increases stability and resilience to abiotic and biotic stresses, and helps spread labour demand over the seasons. Hence, a diverse agricultural production system is diverse not only in nutritional output, but also makes the production system more resilient to ecological and environmental changes. The diversity of subsistence-oriented production systems is often upheld as the ideal for sustainable farming (e.g. Altieri 1995) in contrast to market oriented farming which is often portrayed as poor in diversity. Modern agriculture is indeed characterized by crop specialization and by genetic uniformity of the varieties grown. However, it is not the case that market oriented agriculture has relieved itself of the ecological and evolutionary necessity of maintaining diversity, it is just that it relies more on this diversity over time than in space. As Duvik (1984) pointed out, farmers quickly learn which cultivars are most profitable and safe and they also drop a cultivar very quickly when it gets into trouble or a better one comes along. This diversity in time through cultivar replacement is happening at a faster pace than ever before – a dimension of diversity not often anticipated outside the circles of breeding and PGRFA science. The following sections provide some examples of how diversity matters for world food security.

- **Diversity and yield**

The Green Revolution is the name used for the rapid increase in crop production that took place as a result of development and dissemination of modern high yielding varieties of staple crops in the developing world since the mid 1960's. Most notable was the development and dissemination of semi-dwarf modern varieties of wheat and rice in Latin America and Asia. While the growth in yield was enhanced by a greater use of inputs such as fertilizer, irrigation and mechanization, the genetic improvement achieved by breeding accounted for nearly 50% of the total yield increase. Evenson and Golin (2003), in a large scale

Green Revolution impact assessment study, consider so-called counterfactual scenarios, i.e. what would have happened had the Green revolution not taken place? The results are telling: equilibrium prices for all crops combined would have been from 35 to 66% higher in 2000 than they actually were. In real terms there was a 40% drop in the price of grains from 1965 to 2000 caused by the yield increase. A price drop, of course, has two sides, and whereas developing countries consumers – and especially the urban poor - in general benefited from declines in food prices, many farmers and farm workers experienced a real income loss due to higher input costs and lower market prices for their goods. The fate of this deprived group of rural poor small scale producers coupled with detrimental environmental effects such as soil erosion and chemical pollution has led to the largely negative public perception of the Green Revolution. However, the fact remains that the world's food production has more than kept pace with population growth. While the world population has doubled food output increased by 160% from 1961 to 2003 leading to an increase in food production per capita by around 25% in the same period. This increase would not have been possible without the improved seeds and input factors that characterized the green revolution. According to FAO statistics, although the number of undernourished people in the world has only declined from roughly one billion in 1960 to about 800 millions today, the world's agriculture today feeds 5.6 billions adequately compared with only two billion in 1960. Thus, the green revolution was a mixture of gigantic achievements, large shortcomings and many negative environmental consequences. I will later come back to one such negative consequence; the loss of plant genetic resources in the field.

- **Diversity against pests and diseases**

Crops, like all other species, need to adapt. The environment and other species associated with the crops, such as the plant diseases, weeds and beneficial organisms, are constantly evolving, and to stay useful and productive the crops likewise need to evolve, both by natural selection as well as by artificial selection. Since the rediscovery of Mendelian genetics early in the last century this selection process has come increasingly to rely on the science of *plant breeding*. Having access to genetic resources is essential to adapt crops to the shifting biotic and abiotic environment. A wheat variety resistant to a strain of powdery mildew lasts in average five years in Norway before its resistance breaks down. Similarly the US Department of Agriculture estimated that new varieties of many different crops also maintain resistance to biological stresses for an equal average period of five years (Smale & Rubenstein 2002). This disease and pest pressure is closely connected with the degree of uniformity in the field; the larger the areas planted with one or a few uniform varieties, the higher is the need for variety turnover. Genetic resources play a crucial role in hedging the threats.

One of the largest threats to grain production in Africa and even worldwide is the development of a new strain of the wheat disease stem rust. Caused by the fungus *Puccinia graminis,* stem rust has been a problem since the time of the Roman Empire. While in the last decades it has been largely controlled by the development of resistant varieties, recently a new and potentially devastating strain of the disease has emerged in East Africa. In August 2005 an expert panel sounded the first alarm about the new, virulent form of stem rust and pointed out that it could devastate world wheat crops. It is estimated that as much as 80 percent of all wheat varieties planted in Asia and Africa are susceptible to this new strain. The spores of wheat rust are mostly carried by wind over long distances and across continents and in January the disease had jumped the Red Sea as was detected in a field in Yemen. Plant breeders and pathologists from international and national agricultural research centres are now screening varieties for resistance. Lately, reports have appeared from CIMMYT that resistance genes to the new race have been found both in a screening of cultivars in Kenya and from a study of wild wheat in the Middle East (Olivera et al. 2007). The next step is to breed these genes into suitable cultivars that farmers will adopt.

This scenario resembles what happened in the 1970's when an outbreak of grassy stunt virus devastated the rice fields of millions of farmers in South and Southeast Asia. At that time scientists from the International Rice Research Institute (IRRI) screened more than 17,000 cultivated and wild rice samples for resistance to the disease. A wild relative of rice, *Oryza nivara*, was found to have a gene for resistance to the grassy stunt virus. This gene is now routinely incorporated in all new varieties of rice grown across more than 100000 square km of Asian rice fields.

- **Diversity and climate change**

Nicolas Stern's Climate Change report to the British government argued that the failure to react to global warming is the greatest market failure of our time. One can argue that the failure to securely conserve the PGRFA is another such major market failure. PGRFA does not trade well as a commodity. Its value is all in its use and that "latent value" is not visible before the resource has been utilized in some form of breeding program. Indeed, the first market failure is set to aggravate the other. In the face of climate change it is becoming clear that agriculture is facing a massive challenge to adapt. Climate change models tell us that what is an abnormally hot and dry year now will be considered an abnormally cold and wet year in 2100. Severe negative consequences are foreseen for the food security of the poor in many parts of the world. The Fourth Assessment Report of the IPCC on Climate Change Impacts, Adaptation and Vulnerability states that "In some countries (in Africa), yields from rain-fed agriculture could be reduced by up to 50% by 2020." The grotesque fact is that some of the poorest regions of the world will be hit hardest. E.g. Southern Africa will be extremely marginal for maize and rice will be strongly adversely affected in SE Asia. Both crops are the main staple in the respective areas. Climate change is posing a great threat to crop diversity as it will affect the distribution of crops and crop wild relatives. Studies find that landraces and wild relatives of crops stand the risk of extinction simply because their ecological niche is about to disappear so rapidly that they are unable to adapt naturally. In one study, between 24 and 31 of 51 wild groundnut species were projected to go extinct and their distribution area reduced on average by 85 to 94%, depending on the migration scenario, over the next 50 years (Jarvis et al. in

press). The paradox is that the genetic resources being lost are also the basic raw material allowing agriculture to adapt to climate change. A population of a particular wild crop relative species that is unable to cope with a change in temperature can still contain unique traits for e.g. drought tolerance that are lost if the population goes extinct. We are facing a severe risk of loosing options for the future.

The loss and conservation of Crop Diversity

The loss of crop diversity is called "genetic erosion". An irony of modern agriculture is that such loss is undermining its very basis of past and continued future success. As farmers adopt new varieties the old varieties fall out of use. If the varieties replaced are old cultivars carrying unique genes and traits their displacement might mean extinction of this diversity forever. When FAO assembled its report on the State of the World's Plant Genetic Resources for Food and Agriculture, all the regional reports, except Africa, concluded that the main cause of genetic erosion is the substitution of local varieties by modern high yielding varieties. To counter genetic erosion there is a need for conservation efforts to maintain the material that has fallen out of use as "genetic resources". There are two ways of conserving PGRFA, *in-situ* or *ex-situ*:

In-situ conservation is based on conservation in the natural habitat of the plants, in the case of wild relatives this means the natural ecosystems and in the case of domesticated material it means conservation as a part of the production system. This last conservation form is often referred to as on-farm conservation and a number of projects, mostly driven by the NGO sector exist to help enhance it. For the wild relatives of crop plants there are few but some substantial projects where conservation of PGRFA is the main objective behind establishing protected areas, some of these are funded by the Global Environment Facility, however it is widely recognized that the protection of centres of diversity for crops and their wild relatives is insufficient (WWF 2006)

Ex-situ conservation is carried out through preserving and managing genetic resources in facilities outside their natural habitat or agricultural production system. Collections of seeds or vegetative materials maintained in gene banks represent the most common form of *ex-situ* conservation. There are different types of gene banks conserving diveristy as whole plant, as seeds or as plant parts. Collections of plants, especially of vegetatively propagated species, can be grown in the field in what are known as field gene banks. Collections of seeds can be kept for long periods of time – often up to several decades – under low temperature conditions, for example in large cold rooms or even in domestic deep-freezers. Crops such as the banana, which do not produce seeds, or that are normally propagated vegetatively, can often be conserved as living plant tissues or plantlets grown in test tubes (*in vitro*). Such tissues are generally kept under conditions that minimize their growth rate. In some cases they can be maintained for very long periods at extremely low, cryogenic, temperatures in liquid nitrogen, under which conditions all growth is essentially suspended.

Nikolay Vavilov, a Russian botanist and geneticist was a pioneer in the efforts to collect and conserve Crop Diversity worldwide. Vavilov organized a series of botanicalagronomic expeditions around the world in the 1920-30's and collated what remains one of the largest collections of plant seeds in the world, situated in St. Petersburg. In the late 1940's the Food and Agriculture Organization of the UN started discussions at the international level regarding concerted efforts to conserve what they already realised was a vanishing resource. When the International Board for Plant Genetic Resources (IBPGR) first started its work to coordinate global collection and conservation efforts they planned for 50 base collections and 60 active collections where comprehensive collections of PGRFA would be made freely accessible as a global public good (Fowler and Hodgkin 2004). The situation we have today is far more complex. According to FAO there are about 1400 holders of collections of PGRFA around the world and together these maintain more than 6 million samples of which 1-2 million is estimated to be unique (FAO 1998).

Much of this material is held in substandard facilities vulnerable to both natural and human caused disasters. There are examples of gene banks that have been destroyed, and all their content with them, by wars, civil strife and typhoons. The largest threat to ex-situ collections, however, is lack of funding and inadequate management as a consequence thereof. Samples conserved *ex-situ* need to be regenerated and fresh seeds returned to the gene bank when the viability of the samples drops below a critical level. With the large number of samples held, the cost of regeneration has increased management cost of many of the world's gene banks far beyond their budgets. A study shows that the regeneration backlog has increased in 66% of the developing country gene banks between 1995 and 2000 (Imperial College, 2002). In fact today more crop genetic diversity might be under threat in gene banks than in the wild.

Another major shortcoming of the current situation is that many national gene banks function more like closed-door conservation facilities than gene banks providing germplasm to farmers, breeders and researchers. A major role of gene banks is to make the material available to breeders. Access to plant genetic resources, and the sharing of any benefits arising from their use, has been the subject of major controversies that finally, to a large extent, have now been resolved through the negotiation and establishment of important global policy instruments.

International policy framework

The issue of access to PGRFA has been on the international agenda for more than two decades. With advances in breeding and modern biotechnology, and the concomitant increase in the use of intellectual property protection, access to genetic resources became the subject of considerable controversy. As Fowler & Hodgkin (2004) put it: "The concept of these resources as the "common heritage of mankind" was undermined by the introduction and application of intellectual property rights in developed countries, followed by assertions of national sovereignty and restrictions on access to PGRFA in developing countries". To

understand this development it is useful to look at the policy framework governing access to PGRFA at the international level.

In the CBD, adopted in 1992, it was recognized that there were a number of outstanding issues relating to PGRFA that needed to be dealt with in FAO forums (CBD decision II/15). The Commission on Genetic Resources for Food and Agriculture with 164 members negotiated the International Treaty on Plant Genetic Resources for Food and Agriculture. The Treaty was adopted by the FAO conference in 2001 and entered into force 90 days after ratification by 40 states on June 2004. The reason why it was necessary to negotiate the Treaty has to do with the special nature of PGRFA:

1. The high degree of global interdependence with respect to PGRFA means that ready access is important for all countries, North and South, rich and poor.
2. It is difficult – and often impossible - to determine country of origin of PGRFA
3. The concept of national sovereignty in the CBD has been widely interpreted as requiring bilateral negotiations with respect to access and benefit sharing. Such bilateral regimes tend to be slow and expensive and can considerably hamper access to materials and hence agricultural R & D. There is a clear advantage to be had from handling access and benefit sharing of PGRFA on a multilateral basis.
4. The status of *ex-situ* collections acquired prior to the entry into force of the CBD remained unclear and needed resolution.

The main achievement of the Treaty is arguably the establishment of the Multilateral System of access and benefit sharing (MLS), set up in exercise of the contracting parties sovereign right to handle their genetic resources in any way they see fit, as recognized by the CBD. The MLS mainly includes PGRFA of crops listed in an Annex 1 to the Treaty and that is under the management of the contracting parties and in the public domain. It establishes rules regarding access and benefit sharing and these are set out in a Standard Material Transfer Agreement (SMTA) that is to govern all transfers of PGRFA between Parties to the Treaty. Material acquired under this agreement must continue to remain available to other contacting parties in the same way. If a product derived from material from the MLS is not "available without restriction to others for further research and breeding", e.g. through being protected by a patent, a mandatory payment will be made into a multilateral fund. If the product stays available without restriction to others, payment is voluntary. The funds so generated will be used to support the conservation and use of PGFRA in developing countries.

The role of the Trust

The International Treaty has a funding strategy "to enhance availability, transparency, efficiency and effectiveness of the provision of financial resources". The multilateral fund described above it part of this strategy. Another essential element of the funding strategy, as recognized by the governing body of the Treaty, is the Global Crop Diversity Trust, established in 2004 as an independent organization under international law by FAO and Bioversity, the latter acting on behalf of the CGIAR,. The Trust's overall objective, as stated in its Constitution, is "to ensure the long-term conservation and availability of plant genetic resources for food and agriculture with a view to achieving global food security and sustainable agriculture." In large part, it plans to achieve this objective by helping existing institutions safeguard distinct and valuable plant genetic resources held *ex situ*, with priority given to collections that come under the International Treaty's Multilateral System. The guiding principle is the International Treaty which requires that Parties "*cooperate to promote the development of an efficient and sustainable system of* ex situ c*onservation*". This is in line with the Global Plan of Action for the Conservation and Sustainable Use of Plant Genetic Resources for Food and Agriculture, adopted by 150 countries in 1996, which calls on countries to *"develop an efficient goal-oriented, economically efficient and sustainable system of* ex situ *conservation"* and to *"develop and strengthen cooperation among national programmes and international institutions to sustain* ex situ *collections…"*

The Trust is uniquely placed to view this work globally, rather than nationally or institutionally. It is currently supporting the development of a set of conservation strategies that will guide the allocation of resources to the most important and needy crop diversity collections. The conservation strategies aim to identify those collections that together cover the full spectrum of genetic diversity of those crops included in the multilateral system of the Treaty, and describe international collaborative strategies for their efficient and cost-effective conservation. The Trust is working to raise a $260m endowment, the interest from which will guarantee funding for an efficient global system of conservation of PGRFA in perpetuity.

Towards a global conservation system

As far back as the 1960's FAO's Panel of Experts on Plant Exploration and Introduction recommended the establishment of a global network of gene banks. However, for reasons outlined above, this never happened. With the establishment of the multilateral system for access and benefit sharing it is again possible to envision the establishment of a global system. Most people would agree that this global system must build on the *status quo* of *ex-situ* collections. The backbone of the system is already in place with the *Intrust* collections identified in Article 15 of the International Treaty and held by the International Agricultural Research Centres of the Consultative Group on International Agricultural Research (CGIAR) and other International Institutions. These are amongst the best managed collections and according to FAO they hold about 40% of the unique crop diversity stored in gene banks worldwide (FAO 1998). The CGIAR Centre collections have recently undergone a major upgrading through a project entitled "Global Public Goods", and in 2007 the Trust announced a project that aims to support the upgrading of other key collections. The goal of the project is, by 2011, to rescue 95% of the threatened diversity, held *ex-situ*, of 22 crops of importance for food security in the developing world. The main activities of the project are to:

- Regenerate threatened collections
- Safety duplicate collections
- Upgrade key gene bank facilities
- Develop global accession level information systems
- Promote greater use of genetic diversity through supporting evaluation
- Improve methods to conserve difficult crops (e.g. banana, yam, coconut)

Backup in the Arctic

The government of Norway is currently establishing the Svalbard Global Seed Vault with the aim of providing an ultimate safety backup for the international conservation system of plant genetic resources. The need for such a facility has been recognised in international forums for at least two decades and the FAO Commission on Genetic Resources has "commended the Government of Norway for this valuable contribution to the long-term conservation of the world's plant genetic resources for food and agriculture." (FAO 2007)

The Seed Vault is located on Svalbard, a remote arctic group of island on latitude 78°north and longitude 15°east, nearly a thousand kilometers north of mainland Norway. The vault is currently near its finalization and has been chiseled more than 120 meters into solid rock in a mountainside near the village of Longyearbyen. The day to day operation and management of the vault is the responsibility of the Nordic Gene Bank. The Trust considers the vault an essential component of a rational and secure global system for conserving genetic diversity and as such is committed to supporting its operational costs, and will assist developing countries with preparing, packaging and transporting their samples to the Arctic to ensure their safety.

Endnote

It is interesting to note that the efforts I have described here are generally happening within the context of the International Treaty, while at the same time they also match very well with some key undertakings being carried out within the framework of the CBD. For example, such efforts fit well with the Programme of Work on Agricultural Biodiversity, and more specifically address both the 2010 Biodiversity Target 3: to "*Promote the conservation of genetic diversity*" and the target 9 of the Global Strategy for plant conservation (COP 6) on crop diversity: **"***70 Per Cent of the Genetic Diversity of Crops and Other Major Socio-economically Valuable Plant Species Conserved, and Associated Indigenous and Local Knowledge Maintained."*

Nevertheless, despite the widely recognized fact that crop diversity is fundamental to fighting hunger and to the very future of agriculture, funding is unreliable and diversity is being lost. Today important initiatives are underway to organize a global system to safeguard these priceless resources. Some cornerstones of this system are now being established and the Trust is raising an endowment fund to place it on a firm financial foundation forever.

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Genetically modified organisms (GMOs) in food production (Abstract)

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Agriculture is a major source of income in the Southeast Asian region, with roughly 46% of its population working as farmers, farm workers / labourers, or in agriculture-related jobs. The agricultural land area of the region is at almost 113 million hectares, which is 26% of the total land area. Yet, in spite of these numbers, food production in the region still does not meet up to the requirements of its population, and hunger and food insecurity is very much evident. As advancements in agriculture are being introduced in the region, it remains to be seen whether these developments are the answer to hunger and food security. Genetic engineering (GE) and production of Genetically Modified (GM) food crops has been promoted widely with the following perceived benefits: ensure food security and saving the world from hunger; increase in yield / production and farmers' income; control of pests and diseases in crops; reduce dependence on chemical agricultural inputs; and improvement in the nutrient quality of crops.

The reality in the region, however, is that poverty and hunger is still prevalent, in spite of the developments and advances in food production. The GM crops commercialized on a large scale in a few countries in the world since 1996 have not addressed the main agricultural problems and challenges facing farmers in most countries of the world. These crops have also been released quickly and widely without an adequate evaluation and understanding of their performance, or of their impacts on health, environment and socio-economy.

There remains, however, a number of farmers and farming communities in the region that maintain planting of traditional food crops, and a growing number that are also developing and breeding their own varieties. The partners of Southeast Asia Regional Initiatives for Community Empowerment (SEARICE) in the region, specifically those in the Community Biodiversity Development and Conservation – Biodiversity Use and Conservation in Asia Programme (CBDC-BUCAP), have been working with farmers for the past 10 years in strengthening their capacities to manage local agricultural biodiversity (conservation, development and use). The CBDC-BUCAP partners in Bhutan, Lao PDR, Thailand, Philippines and Vietnam recognize the important role of agricultural biodiversity as sources of food, income, and medicine, and recognize the inherent capacities of farmers to manage these resources.

Beyond the advances in technology to increase food production, other issues and concerns should be taken in consideration. As the principles of sustainability go, all other aspects in food production should be taken holistically. Institutional reforms and policy support is as equally important, as well as the participation of those most affected in issues of food production and security.

Integrating biodiversity conservation, ecosystem function, and production in agricultural landscapes: issues, conflicts, and solutions (Abstract)

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Globally, 852 million people, mainly in developing countries, are still chronically or acutely malnourished. At the same time, we witness continuing loss of habitat and species extinctions in the wake of agricultural development and expansion. The first of eight Millennium Development Goals is “eradicate extreme hunger and poverty”, whereas goal number seven is to “ensure environmental sustainability”. These MDG’s will not be reached without securing the ability of the rural poor to feed their families and supply growing markets while also protecting the biodiversity and ecosystem services that sustain their livelihoods. Ecologists have a distinct role to play in the alleviation of global hunger, restoration of ecosystems functions and processes, and conservation of biodiversity by working in the agricultural landscape. The tradition of elucidating complex systems and relationships and working across scales and disciplines enables ecologists to guide management so as to build on synergies between rural livelihoods, environmental sustainability, and food security. In this session I will present development projects from Central America and from Africa that integrate ecological principles and biodiversity not solely from the conservation perspective, but with a strong focus on to contributions that biodiversity makes to achieve the Millennium Development Goals and poverty alleviation. In Central America payments for ecosystem services are being used to protect watersheds, mitigate climate change and increase the production capacity of pasture systems. In Africa, integrated interventions led by community members seek to reach multiple, often conflicting goals. Landscape ecology is used to understand the dynamics between land use and spring water quality, as well as to guide ecologically based interventions to improve water quality and minimize soil degradation. Lessons learned from both regions demonstrate that integration of ecology and a host of additional disciplines can be used to alleviate poverty, while maximizing conservation within the landscape.

Biodiversity, nutrition and health

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Abstract

The conventional view of agricultural biodiversity is as a source of plant and animal genetic resources that can be used to improve the agronomically valuable traits of crops and livestock. A few case studies show that agricultural biodiversity is the foundation also of dietary diversity, which in turn can be promoted to deliver better nutrition and better health. Such efforts are a vital component of the fight against hidden hunger, the lack of essential vitamins and micronutrients that currently afflicts about 2 billion people worldwide, mostly women and children. Many of these efforts focus on so-called neglected or orphan species that are locally important but hitherto ignored by research scientists. In sub-Saharan Africa, traditional leafy vegetables contain considerably more nutrients than "exotic" options such as cabbage and kale. A concerted campaign to promote traditional African leafy vegetables resulted in an increase of 1100% in sales in just two years, with impacts on the livelihoods of the women farmers who grow the vegetables and the urban families who buy them. In India, work on nutritious millets has had similar impact, while in South America Andean grains are delivering the same sorts of benefits to local farmers and markets. These pilot studies provide a basis on which other agencies could build scaled-up efforts to address hidden hunger in a sustainable and environmentally friendly manner. We also believe that attention should be paid to the nutrient values for crop varieties to provide an evidence base for further studies.

Introduction

Agricultural biodiversity has generally and historically been seen as a source of greater productivity for larger harvests through improved crops and livestock. In this context, agricultural biodiversity is a supply of genetic resources that specialist breeders use to create modern, high-yielding varieties and breeds. While agricultural biodiversity is indeed important for plant and animal breeding, it offers far more. In particular, it can deliver increased food security and improved health through better nutrition.

The world has made great strides in meeting the need for adequate protein and calories, thanks in large part to focused scientific research intended to deliver greater production. That is no small achievement. Nevertheless, and recognizing that more than 840 million people remain chronically hungry, more attention needs to be given to the hidden hunger of missing micronutrients. Deficiencies of vitamin A, iron, zinc and other essential nutrients afflict more than 2 billion people worldwide (Ramakrishnan 2002). Indeed, some estimates reckon that more than half the people of the world – three billion people, most of them women and young children – suffer some sort of micronutrient deficiency (Welch & Graham 2004). Coupled with this is the rise in poor countries of diseases more often associated with affluence, such as heart disease, type 2 diabetes, cancers and obesity (WHO 2007). In fact the double burden – of micronutrient malnutrition and diseases of affluence – is now increasingly found in single households, where children may suffer anemia or vitamin deficiency diseases at the same time as their parents are overweight and diabetic.

The reasons for the rising double burden of disease are not complex to understand (Hawkes 2006; Johns & Eyzaguirre 2006). At heart is a simplification of the diet, from one rich in traditional vegetables, pulses and cereals, to one that is much less diverse and that depends on the ready availability, especially in the ballooning cities of the developing world, of cheap refined carbohydrates and fats. People have enough – perhaps too much – energy and protein but lack other nutrients, perhaps because there has been a tendency in developing countries to avoid traditional foods and diets, which are often associated with poverty and stigmatized as backward. Ironically, wealthy people in developed countries have simultaneously discovered the benefits of “poor” diets, like that of the Mediterranean.

Benefits of dietary diversity

There is considerable evidence from developed countries that dietary diversity *per se*, rather than any specific food or active ingredient, protects against some diseases of affluence. In the United States, dietary diversity was associated with lower mortality rates from all causes in a large sample of women (Kant et al. 2000; Kant, et al. 1995). In Italy, diversity protects against stomach cancer (La Vecchia et al. 1997). Studies of Swedish women have shown the general protective effect enjoyed by women who eat a larger number of “healthy” foods (Michels & Wolk 2002) and a specific effect on colorectal cancer (Terry et al. 2001).

Evidence from developing countries is harder to find. Kenyan children who eat a more diverse diet develop more rapidly (Onyango et al. 1998). In Mali, dietary diversity is associated with greater nutritional adequacy of diet (Hatloy et al. 1998). Arimond & Ruel (2004) surveyed 11 countries to assess dietary diversity and growth in children aged between 6 months and 23 months. After controlling for confounding factors such as household wealth, breastfeeding status, rural or urban location and others, there remained an effect of dietary diversity on child growth, either as a main effect or in an interaction, in 10 of the eleven countries. As Arimond & Ruel (2004) cautiously conclude: “dietary diversity may indeed reflect diet quality”. In general it may be safe to conclude that more diverse diets are associated with lower mortality, greater longevity and better development; in other words, better health.

Pilot-scale interventions

There is also evidence that traditional crops are generally nutritionally superior to exotic "imports" grown locally. Bioversity International has been working with local partners in several parts of the world to promote a wide diversity of traditional crops, often neglected by modern science, in an integrated effort to boost the importance and value of these species. Studies on nutritious millets in India and Andean grains in Bolivia have been reported in greater detail elsewhere (Frison 2007). In East Africa the focus was on traditional leafy vegetables, for the important reason that these crops are both more nutritious than "exotic" crops such as kale and cabbage and less harmful to the environment. Amounts of some important micronutrients (such as calcium, iron, zinc and vitamins A and C) can be 100-fold higher in traditional species than in exotics. Traditional species also require lower inputs of water, fertilizer and plant-protection chemicals. More than 200 different local and traditional species are eaten in Kenya alone, but many of these have fallen out of favour with rural families, who perceive them as "backward". In the cities too, shoppers used to think of traditional leafy vegetables as backward and associated with poverty. They also were not attracted by the quality of the traditional vegetables that were available and often did not know how to prepare them.

Bioversity International worked with local partners such as the NGO Family Concern Inc. and Uchumi Supermarkets to tackle every link in the chain. Agronomists improved seed supplies and growing techniques, and breeders are busy selecting more attractive varieties. Farmers learned how to grow, prepare and pack the vegetables to the highest quality standards. Colourful leaflets told supermarket shoppers about the benefits of traditional vegetables and how to cook them. Members of Parliament and the media promoted the campaign. Results were astonishing: growth in sales of more than 1100% in just two years. In the first two years of the project the number of farmers growing traditional leafy vegetables for sale increased from 5 to 450, but although supply has increased massively, it still falls far short of demand. It is estimated that 60% of demand for traditional African leafy vegetables is still not being met (Obel-Lawson 2006).

Gaps

As mentioned above, there is some evidence that traditional crops are generally nutritionally superior to exotic "imports" grown locally. Indian millets, for example, generally have a lower glycemic index than other locally available sources of carbohydrate (Lakshmi Kumari & Sumathi 2002) and grain amaranths reduce the glycemic index of a meal of wheat flour (Chaturvedi et al. 1997). Glycemic index is, of course, only one aspect of nutritional value, although in view of the rapidly rising incidence of type 2 diabetes it ought to be an important consideration in food policy and dietary guidelines. Likewise, there are good data suggesting that local vegetables are often richer in many micronutrients than non-indigenous crops. Amaranth, for example, contains 12 times more iron and 8 times more calcium than cabbage. Beta carotene is almost 60 times more concentrated in amaranth leaves than in cabbage, but spiderplant (*Cleome gynandra*), another African leafy vegetable, is more nutritious still, with over 100 times more beta carotene than cabbage (Anon. 2006, and see references in Frison et al. 2006). Measurements of single components do not reveal the full panoply of benefits associated with local vegetables, but are an important consideration.

Data on the composition of various edible species that are outside the mainstream are lacking, but so too are data on the variability of varieties within a single species. For example, Kennedy & Burlingame (2003) show large ranges of ten times or more in the content of several important micronutrients among a selection of rice varieties. Among pumpkins, some varieties contain no carotenes, others up to 100 mg/100g (Murkovic et al. 2002). Human subjects absorbed almost three times more carotenoids from some tomato varieties than from others (Unlu et al. 2007). These kinds of studies are, however, few and far between. In most cases researchers have not compared different varieties of the same species.

The gaps in our knowledge of nutritional value can of course be filled by more, and more systematic, studies. Valuable though those will be, they do not address an even more important consideration: people do not consume foods or ingredients, they eat meals. And meals complicate the picture considerably. For example, different components of a meal may have antagonistic or synergistic effects on one another. The effect of phytic acid on bioavailability is perhaps one of the best-known examples (Cheryan 1980). Research on nutrient composition and bioavailability of meals, especially in the context of developing world eating habits, has barely begun. At Bioversity a fellowship is enabling a Ghanaian nutritionist to study the impact of different cooking methods on the availability of vitamin A precursors in bananas and plantains. This is exactly the sort of information needed to promote high-carotene bananas and plantains as a resource in the fight against vitamin A deficiency in west Africa and elsewhere.
Perhaps the biggest gap is this: Do interventions that boost dietary diversity improve child health and child mortality?

An exhaustive and recently-published study of one food – orange-fleshed sweet potatoes, rich in vitamin A precursors – suggests that interventions can boost dietary diversity (adding at least one food) and that this improves nutritional status. Low and colleagues examined the impact of promoting orange-fleshed sweet potatoes in a very poor rural area of Mozambique (Low et al. 2007). Over two years, the families in the study increased the area planted to orange-fleshed sweet potatoes 10-fold, from 33 to 359 m^2. Children in the intervention group were more likely to eat orange-fleshed sweet potatoes than those in the control group, and their eight-fold higher vitamin A intake was reflected in significantly higher serum retinol. Prevalence of vitamin A deficiency was 15% lower in the intervention families.

While there is no hard evidence yet for an ultimate impact on child health or mortality, it would be very surprising if there were not.

Bottlenecks

Perhaps the greatest obstacle to the wider use of agricultural biodiversity to deliver dietary diversity and thus tackle health, poverty and hunger arises from the separate silos in which those responsible for food policy and for agricultural development work, think and plan. Because of its long and valuable heritage of being a source of traits to improve agricultural production, the other contributions that agricultural biodiversity could make tend to be overlooked by agricultural experts. For health workers, biofortification and supplementation seem to be a higher priority, even though dietary diversity can probably deliver many of the nutritional benefits at lower cost and more sustainably, with positive impact on many other aspects of livelihoods beyond health (Johns & Eyzaguirre 2007). To some extent this is a chicken-and-egg problem: with a more solid evidence base, it will be harder for policy-makers and others to ignore the intersection of agriculture and health. On the other hand, if policy-makers paid serious attention to agricultural biodiversity for nutrition, the evidence base would accumulate quickly enough.

In this regard it is heartening to note recent optimistic developments. The Conference of the Parties to the Convention on Biological Diversity adopted a cross cutting initiative on Biodiversity for Food and Nutrition within the CBD's existing programme on agricultural biodiversity. Meetings and consultations have taken place, and the agreed programme of work on biodiversity and nutrition is moving forward under the joint management of Bioversity International, the Food and Agriculture Organisation of the United Nations and the CBD Secretariat. Concurrently, the Standing Committee on Nutrition of the United Nations system has also been looking more closely at the role of dietary diversity, with specific consultations and reports on the links among agricultural biodiversity, dietary diversity, nutrition and health, especially as they relate to the Millennium Development Goals. Most recently, Bioversity International and the West African Health Organization co-organized a Regional Policy Advocacy Workshop in Ouagadougou, Burkina Faso, which brought together agriculture and health policy-makers from the countries of the Economic Community Of West African States (ECOWAS)[61]. This is believed to be the first high-level, multinational meeting anywhere to bring these two sectors together to explore the interlocking benefits of promoting agricultural biodiversity for dietary diversity, nutrition and health. After plenary briefings from experts in the various fields, participants formed working groups to analyse collaboration between health and agriculture sectors, develop objectives for regional advocacy strategies and action plans to implement those strategies in the member states of ECOWAS.

That meeting concluded in September 2007 and it will be some time before its impact is manifest. Nevertheless, the very fact that the first formal encounter between policy makers from the agriculture and the health sectors took place in this part of Africa, which needs urgently to find workable and sustainable solutions to the problems of malnutrition and hidden hunger, can be taken as indicative of a willingness to work together to solve problems.

[61] Partnerships for Mobilizing the Diversity in Traditional Food Systems to Ensure Adequate Nutrition and Health in ECOWAS Member States, a Regional Policy Advocacy Workshop, 5-6 September 2007, Ouagadougou, Burkina Faso.

Conclusions

The conservation and use of agricultural biodiversity for the purposes of improving productivity will continue to be important, while its role in promoting environmental sustainability and livelihood improvements along many different pathways is likely to grow. Nevertheless, it is the realm of improved nutrition and health that deserves the greatest emphasis and effort towards innovation, especially for marginalized farmers in tropical areas, who have not hitherto benefited as much as they might have from agricultural research. Bioversity's localized successes have prompted a call for a new approach to satisfying hidden hunger: use agricultural biodiversity to diversify diets and thereby improve their nutritional value (Frison et al. 2006). Malnutrition and hidden hunger are among the biggest obstacles to human development today and a primary concern of the Millennium Development Goals and they require renewed focus. The Copenhagen Consensus (Lomborg 2006) examined a large set of global challenges, and concluded that tackling malnutrition is the second most important investment the world could make in development, preventing and curing HIV/AIDS being the first (to which, it should be noted, agricultural development and improved nutrition could also make a contribution [Anon 2003; Kadiyala & Gillespie 2004]). The panel responsible for ranking the global challenges to come up with the Copenhagen Consensus concluded that "the importance of alleviating malnutrition and hunger, especially among children, cannot be overestimated". Innovative approaches are desperately needed.

Much remains to be done, not only in using agricultural biodiversity to improve nutrition and thus well-being, but also in the realm of agricultural improvement and environmental protection. However, the prospects of meeting the Millennium Development Goals without making far greater, and more diverse, use of agricultural biodiversity are slim indeed.

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Wetlands for water and people: flowing together for a sustainable environment

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Introduction

This paper briefly:

1. reviews the current state and trends of the world's wetlands and water resources, drawing particularly on the findings of the Millennium Ecosystem Assessment (MA), and its synthesis report to the Ramsar Convention on Wetlands (Finlayson et al. 2005);
2. outlines the close and increasing collaboration between the Convention on Biological Diversity (CBD) and the Ramsar Convention on implementation on wetlands;
3. describes the role and work of the Ramsar Convention on water and ecosystems; and
4. identifies what is needed to move towards a more sustainable future for wetlands and water, particularly in the light of our rapidly changing climate.

What is the broad context for the problems and challenges we continue to face in striving to secure future sustainable use of wetland ecosystems (both inland and coastal) and their services to people? In the 1960s the driving force behind the establishment of the Ramsar Convention on Wetlands (amongst the earliest of the global environmental agreements, agreed in the city of Ramsar, Iran on 2 February 1971) was concern over the continuing destruction of wetlands and the impact of this destruction on populations of waterbirds.

Yet almost 35 years on, in 2005 the Millennium Ecosystem Assessment (MA) concluded that "degradation and loss of wetlands (both inland and coastal) is continuing more rapidly than for other ecosystems". It is clear that the underlying problem remains: economic development and consequent land-use change often remain higher priority than ecosystem maintenance, ignoring that these are closely interlinked and that paradoxically continuing to destroy ecosystems and their services is essentially "biting the hand that feeds us".

The implications of Millennium Ecosystem Assessment (MA) for future implemention of the Ramsar Convention on Wetlands

The work and findings of the MA, and in particular its synthesis report to the Ramsar Convention on wetlands and water (Finlayson et al. 2005) has proved to be of considerable value in helping to shape the future implementation of the Convention. In particular, the MA's Conceptual Framework for ecosystems and human well-being, with its focus on "ecosystem services" and drivers of change to them, was recognised and adopted by the Contracting Parties to the Ramsar Convention in 2005 (COP9, Kampala, Uganda) as providing a conceptual framework for the delivery of the Convention's core tenet of the conservation and wise use of wetlands, and the adoption of updated definitions of the Convention's "wise use" and "ecological character" of wetlands terms (COP9 Resolution IX.1 Annex A – now available as Ramsar Wise Use Handbook 1, 3rd edition – Ramsar Convention Secretariat 2007).

In particular, the MA Conceptual Framework provides the framework for where and when to apply the different components of the suite of wise use guidelines adopted by COPs over the years and compiled in the Convention's Wise Use Handbooks (Figure 1).

The MA confirmed that the ecosystem services provided by wetlands are extremely important and valuable to people worldwide – arguably with a total value in the regional of US$ 14 trillion annually. Amongst the many different services delivered by and through wetlands, there a major values of a range of hydrological services – notably water supply, water treatment and flood control – and there is also major value of the amenity and aesthetic services provided by wetlands (Figure 2).

Both the MA and Ramsar Convention have stressed that the global hydrological cycle is fundamental to the maintenance of the ecological character of wetlands and continued provision of their services. By their very definition, if there is no water, there will be no wetlands.

But the fundamental role of wetlands in the hydrological cycle remains much less well recognized. Wetlands signifycantly influence the functioning of the hydrological cycle, the supply of water to people, and the uses they make of it, e.g. for irrigation, energy, transport and drinking. Almost all of the world's consumption of freshwater is drawn either directly or indirectly from wetlands, so it also follows that without wetlands there will not be the water we need, in the places and quality in which we need it.

Despite, however, their increasingly recognized high economic value wetlands have long been and are still being viewed by many decision-makers are being of little value – wastelands rather than systems vital for our future – and so there is still far too little priority given to maintaining their wise use their capacity to continue to deliver their wide and valuable range of services. The 'Ramsar family' has not yet been very successful in transmitting this message at national and basin levels through engaging with the sectors with decision-making powers that drive change and loss of wetlands.

Yet there are frequently significant losses of value of ecosystem services when a naturally-functioning wetland is converted to other land-uses (see e.g. Balmford et al. 2002). Such conversions are often for a single sectoral purpose such as intensive agriculture, aquaculture or fishery and whilst there may be economic benefits to be gained by that sector, this is frequently at the expense of

those peoples and communities who have traditionally depended on the services from the wetland.

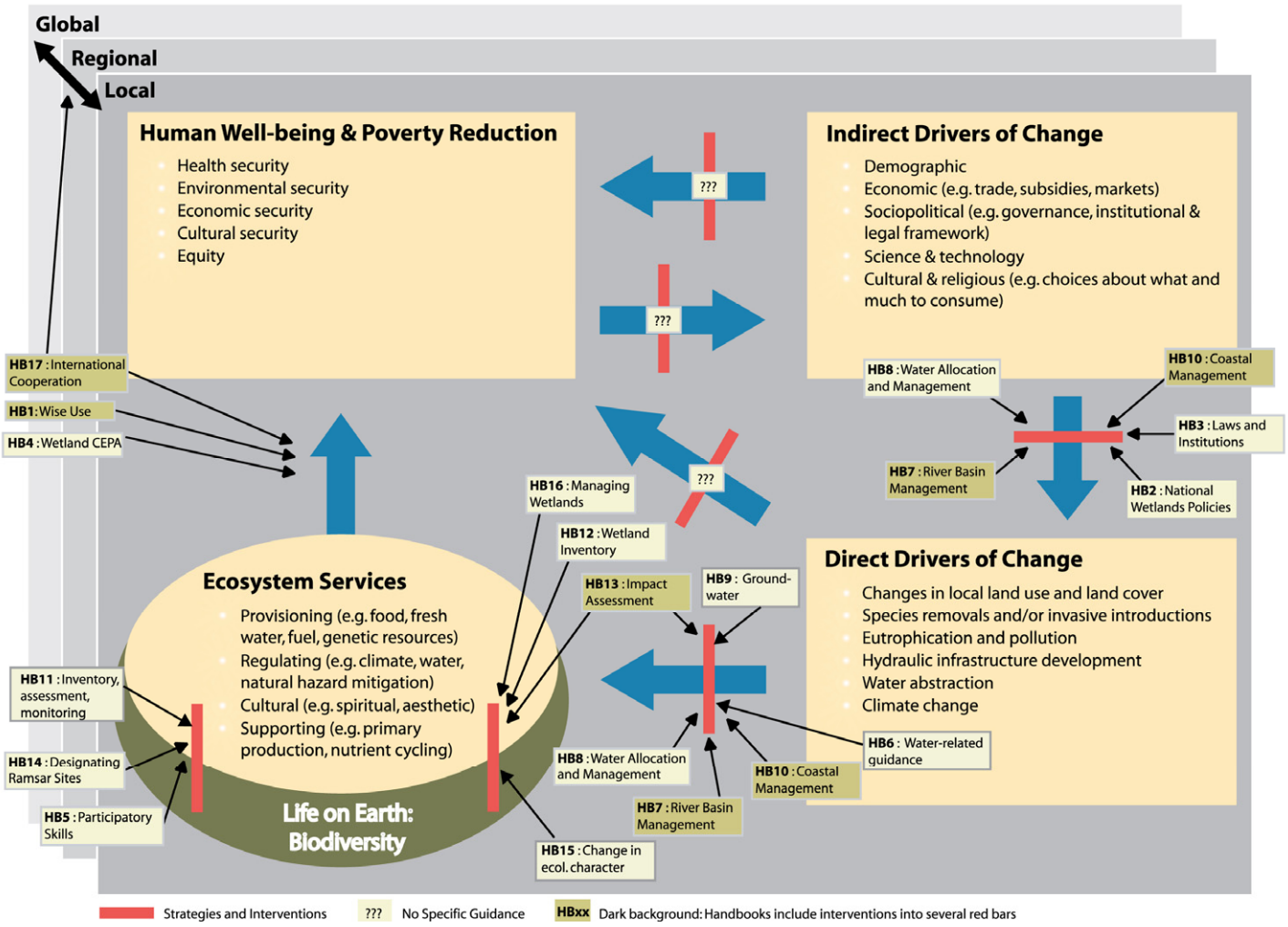

Figure 1. *A Conceptual Framework for the Wise Use of Wetlands and the maintenance of their ecological character, and the application of the guidelines in the Ramsar 'toolkit' of Wise Use Handbooks 3rd edition (2006). (From Ramsar Wise Use Handbook 1, 3rd edition 2007; adapted and updated from Finlayson, D'Cruz & Davidson 2005).*

Economic valuation of the full range of the ecosystem services provided by wetlands is, however, a developing science and there is a widely recognised need for more and better valuations of wetlands, so as to better inform decision-making on any proposals for their conversion. In recognition of this urgent need for better using and recognising wetland ecosystem value, in 2006 Ramsar and CBD jointly developed and published guidance on methods for wetland valuation (de Groot et al. 2006).

It is clear that without wetlands we lose their ecosystem services, yet with many wetland systems continuing to deteriorate this puts their services at risk. The MA reported that both inland and coastal wetlands (& their biodiversity) are being lost at a faster rate than terrestrial systems, with for example freshwater wetlands and mangroves each continuing to being destroyed at an alarming rate of 2.5% loss per year. Clearance and drainage for agriculture have been the principal causes of inland wetland loss worldwide, and expanding human use of fresh water means that less and less water is now available to maintain the ecological character of many inland water systems.

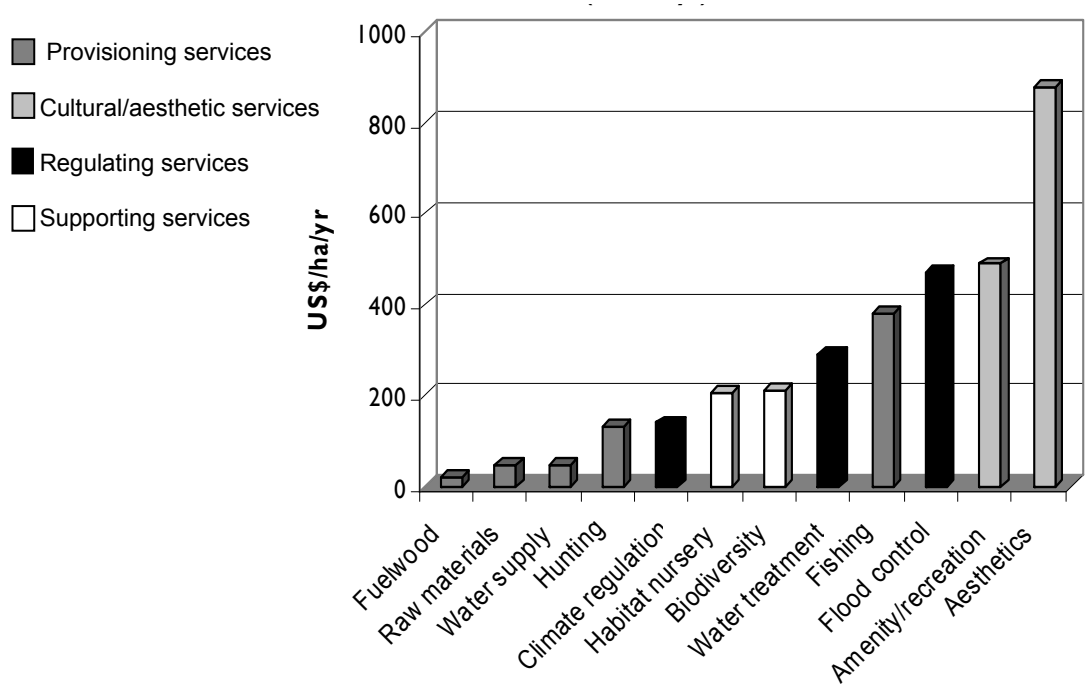

Figure 2. *Estimates of the Total Economic value (TEV) of the main ecosystem services provided by wetlands. From de Groot et al. (2006).*

In essence, the MA stressed that this situation has arisen because we have given a global focus to enhancing the "provisioning services" of ecosystems (notably agricultural production), but this has been at the expense of maintaining the many "regulating" and "supporting" services provided by ecosystems.

In seeking to deliver such provisioning services, our decision-making and implementation of management of water resources have created major problems for the maintenance of the ecosystem services from rivers and other wetlands. For example, assessment reported by the MA of 227 major river basins worldwide showed that 37% have been strongly affected by fragmentation and altered flows, a further 23% have been moderately affected, and only 40% (often those in remote and unpopulated regions of the world) remain unaffected.

Of even more concern, over 50% of the world's 500 major rivers are now heavily polluted or are drying in their lower reaches, so that the well-being of the many (and increasing) millions of people depending on these rivers has been affected, or is under increasing threat. Furthermore, 40% of the world's people now live in water-scarce river basins, and at least 20% of the world's population do not have access to safe drinking water. The ever increasing demands for upstream water for provisioning services are likely to put even more pressure in the future on the well-being of our world's increasingly urbanized and downstream population. Thus the declining ecosystem services from such wetlands threaten the well-being of individuals, local communities, entire states and the global community, and it is especially poorer people in less developed countries who are being most affected, since they are often most heavily dependent on wetlands for their livelihoods.

One particularly significant finding of the MA reported in its synthesis report to the Ramsar Convention concerns the future fate of wetland ecosystems under various sectoral and cross-sectoral scenarios for future decision-making, particularly in relation to achieving the UN's Millennium Development Goals (MDGs), shown in Figure 3. This suggests that if we continue to take a sectoral focus on for example, climate change mitigation, or one or more of the MDGs such as food security or sanitation, our stock of wetlands and their continued delivery of ecosystem services key to underpinning sustained MDG delivery will continue to deteriorate. However, shifting to a more cross-sectoral, ecosystem-based approach focussing on optimising multiple goals including the delivery of commitments to the CBD and Ramsar Conventions will lead not only to a significantly better maintenance of wetlands and their services but also will substantively contribute to achieving a number of the MDGs such as on improved water supply and sanitation and on poverty reduction. But Figure 3 also illustrates that the biggest challenge will remain meeting the increasing demands for agricultural production to meet the MDG on food security whilst not destroying the systems and services needed to support this.

The MA's clear messages on water and ecosystems has been reinforced by the recently published GEO-4 report (UNEP 2007). GEO-4 stressed that around 70% available water from rivers and other wetlands is already being taken for agricultural irrigation, but that fully meeting the Millennium Development Goal (MDG) on hunger reduction will mean doubling food production by 2050, with the implica-

tion that demand for irrigation water will further greatly increase. Yet the availability of freshwater is at the same time declining, whilst by 2025 water used predicted to rise further, by 50% in developing countries and by 18% in the developed world. So the gap between supply and demand seems to be still widening, with the still largely sectoral-based global and national governance not taking sufficient action to tackle this most fundamental of all challenges. The GEO-4 authors concluded that "The escalating burden of water demand will become intolerable in water-scarce countries".

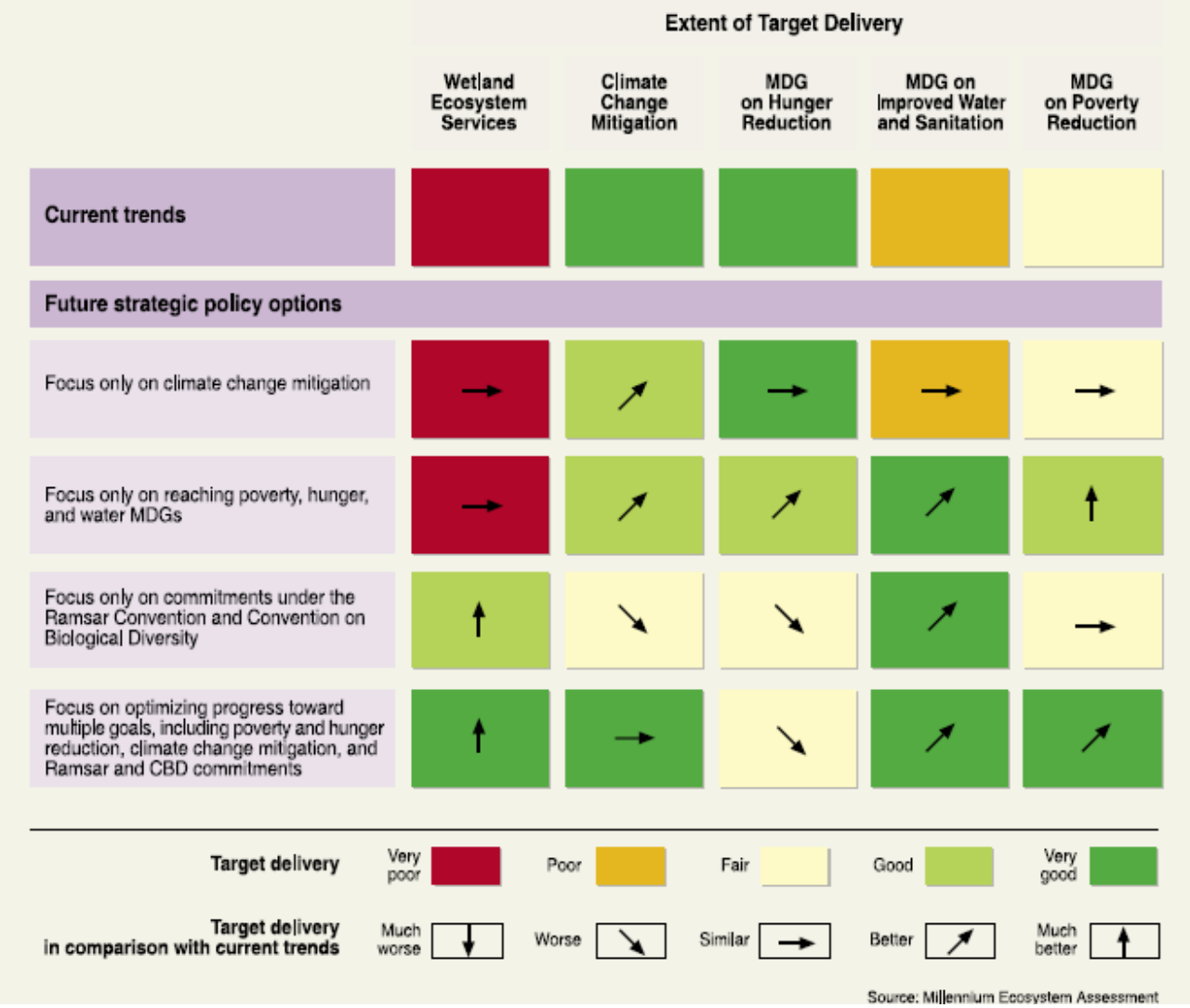

Figure 3. *Indicative trade-offs involved in approaches to achieve the Millennium Development Goals, and their implications for wetland ecosystem services. From Finlayson, D'Cruz & Davidson (2005).*

Explanatory note: The Figure shows the implications for the future delivery of wetland ecosystem services of different strategic policy options for the achievement of intergovernmental environmental commitments: carbon mitigation (Kyoto Protocol), the poverty and hunger Millennium Development Goals, and environmental conventions concerned with water and ecosystems (Ramsar and CBD). Each row provides a hypothetical case where actions are taken to achieve a particular goal (such as carbon mitigation, poverty or hunger reduction, or wetland service delivery) using strategies that maximize the short-term progress toward that goal without any consideration given to alternative goals. The colored boxes show the likely extent of achievement of the different global targets under each strategy. The arrows indicate the extent of improvement (or otherwise) of target delivery under each strategy option in comparison with current trends. Although the actual trade-offs may differ in specific locations, in general overall progress is likely to be less when the goals are addressed in isolation than when they are addressed jointly.

The role and approach of the Ramsar Convention on Wetlands – working with the CBD

How does the Ramsar Convention work to support an ecosystem-based approach to future sustainability of water and wetlands? The Convention is the oldest of the global environmental intergovernmental agreements, established in February 1971 in the city of Ramsar, I.R. Iran. The Convention addresses all types of wetlands from the mountains to the sea, covering inland wetlands such as rivers, lakes, marshes, forested wetlands and peatlands; coastal and near-shore marine systems such as estuaries, coral reefs, mangroves and shorelines to a permanaent inundation deapth of 6 metres; and human-made wetlands such as reservoirs and dams, saltpans and rice padi.

The now 157 Contracting Parties to the Convention commit to: ""the conservation and wise use of all wetlands through local, regional and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world"; and seek to achieve this through three 'pillars' of implementation:

- The "**Wise use**" of all wetlands;
- The designation and management of **Wetlands of International Importance** (Ramsar sites); and
- **International co-operation,** on shared river basins, transboundary wetlands, flyway networks for migratory waterbirds, and sharing of information and expertise etc.

Since CBD COP3, the Ramsar Convention has been recognised as the lead implementation partner for CBD on wetlands, so that implementation under the Ramsar Convention is also implementing the CBD. Although under the CBD's structure there has been a continuing focus on the work of Ramsar in relation to the CBD programme of work on the biological diversity of inland waters, this is too narrow a viewpoint, since water and wetlands provide a unifying cross-cut to all CBD's ecostysem-based programmes of work – wetlands are key components of drylands, agricultural systems, forests, mountains, coastal/ marine and islands. In addition, the global network of designated Ramsar sites (as at November 2007: 1702 wetlands covering 153 million hectares) provides a major contribution towards implementation of CBD's protected areas programme of work.

The collaboration between CBD and Ramsar is delivered through Contracting Parties at our respective Conferences of Parties (COPs) requesting specific activities and actions, and through the implementation of an agreed Joint Work Programme (JWP) between the two Conventions. We are now on the fourth of these JWPs. The 4th JWP (for the period 2007-2010) was endorsed by the Ramsar Standing Committee in February 2007 and will be considered by CBD SBSTTA13 in February 2008. In additional collaboration is progressed through the work of the inter-convention Biodiversity Liaison Group (BLG), meetings of the chairs of the scientific subsidiary bodies and through joint participation in implementation projects such as the 2010 Biodiversity Indicators Partnership (BIP GEF project), and it links with Ramsar's current work developing "ecological indicators of effectiveness of Convention implementation".

Over the years since CBD COP3, the Convention's collaboration has progressively developed and strengthened from an initial recognition of the common ground between Ramsar & the CBD; through recommending/adopting guidances prepared through one Convention for use by the other (e.g. the CBD's guidance on environmental impact assessment, adopted in Ramsar-interpreted form by Ramsar COP8); to joint development of programmes and technical guidances. Such work includes the Ramsar collaboration on the review and development of the CBD's revised inland waters programme of work, and the joint development publication of technical reports, notably on the rapid assessment of inland and marine/coastal biological diversity (2006: CBD Technical Series No. 22/Ramsar Technical Report No. 1) and on methods for the economic valuation of wetlands (2007: Ramsar Technical Report No. 3/CBD Technical Series No. 27).

Recent further developments in collaboration have included specific requests from CBD Parties for the Ramsar Convention to take the lead in developing guidance and processes, including on criteria and guidelines for designation of Ramsar sites for different components of biological diversity sensu CBD, and the development of a harmonised reporting framework between Ramsar and CBD. Progress on this work is being reported to CBD SBSTTA13 in February 2008 (see UNEP/CBD/SBSTTA/13/5).

Whilst the Ramsar-CBD collaboration approach is widely recognised as a leading model for co-operation between multilateral environmental agreements, it should be recognised that the achievements have so far been largely at the global and technical scales, and that there is an urgent need for closer national-scale implementation communication and collaboration at the national scale.

The Ramsar Convention and water management issues

Since its inception, Ramsar has recognized the "fundamental ecological functions of wetlands as regulators of water regimes" (Preamble to Convention text). The Convention is recognized as the only global environmental treaty dealing with integrated management of important water-related ecosystems and water allocation, and which provides mechanisms for applying integrated ecosystem-based approaches at all scales.

Since 1996 the Convention has taken an increasing focus on water and ecosystem issues. At Ramsar COP6 in Brisbane in1996, Ramsar Contracting Parties adopted Resolution VI.23 entitled "Ramsar and water". This:

- recognized the "important hydrological functions of wetlands, including groundwater recharge, water quality improvement and flood alleviation, and the inextricable link between water resources and wetlands";
- recognised freshwater quality and quantity as vital for maintaining coastal and marine ecosystem services – e.g. fisheries; and

- set out a range of actions to allow countries to address the looming problems of water scarcity, deteriorating water quality and related breakdown of wetland ecosystems

Since then, the Convention has progressively developed and adopted a major suite of water management-related implementation guidance for countries, including an overall framework for using the different aspects of the water-related guidance. All this guidance is provided in the 17 Ramsar Wise Use Handbooks, 3rd edition (Ramsar Convention Secretariat 2007), available on CD-ROM and from the Ramsar web-site. Water-related handbook guidance to date covers: River basin management; Water allocation and management for maintaining wetland ecosystems; Groundwater management; Agriculture, water and wetlands; Integrated Coastal Zone Management; and International cooperation (incl. for shared water resources). Importantly, the most recent river basin management guidance (adopted at COP9 in 2005) incorporates a "Critical Path" approach to water and wetland management planning and implementation.

The Convention's Scientific & Technical Review Panel (STRP) is preparing further water-related guidance for Ramsar COP10 (2008) including further elaboration and consolidation of "Critical Path" river basin management guidance, and incorporating further guidance on environmental water requirements and CEPA tools & stakeholder involvement in the process. This will be supported by river basin management case studies to be published as a Ramsar Technical Report, with further Ramsar Technical Reports due on wetlands and water quality; on environmental water requirement methodologies for estuaries, rivers, and non-riverine wetlands; and on wetlands, water and agriculture.

Securing water for maintaining of wetland ecosystem services – the challenges and opportunities

From the MA's and other findings it is clear that we know what we need to do: maintain wetland ecosystems for their key water services, and restore degraded wetlands to reinstate their key services to people. We also know a lot about how to do it: there is much and increasing understanding of environmental water requirements and restoring degraded systems, and the governments of the world have agreed and adopted a wealth of guidance, such as that in the Ramsar Wise Use Handbooks, that supports taking these responses. Yet both inland and coastal wetlands and their services continue to be degraded and lost faster than even other ecosystems. So what is still preventing our achieving better sustainability of water use and wetlands?

The challenges are many, and centre round issues of the water governance practised in many parts of the world. Water demands are still increasing rather than deceasing, with allocations still frequently being demand- rather than supply-driven. Such water allocation and wetland management decisions still tend to be made sectorally rather than cross-sectorally through fully integrated river basin management mechanisms, such that it is often the more powerful sectors or stakeholders who benefit, whilst the poorest and most at risk continue lose out, especially when water is scarce. Such a situation is hard to ally with the concurrent efforts to deliver poverty reduction strategies in the developing world. Water allocations also continue often being made in absence of knowledge of how much water is available, or how much is needed to maintain wetlands for their water, and to be more short-term reactive decisions rather than decisions based on long-term strategies.

In many basins the response to increasing demand is to allocate more water to different users, such that total allocations considerably exceed the total amount of water available in the basin, a situation in which all different water users, and the wetland ecosystems underpinning their continued access to water, are all the more vulnerable with the increasing variability and shifting distribution of water emerging as a consequence of climate change. Effective management responses for wetlands and water resources are becoming ever more urgent and more challenging with our increasingly frequent and more extreme climate events, including both intense rainfall and floods on the one hand, and prolonged drought on the other (see e.g. Oxfam 2007 for recent trends).

There are a number of currently practices water management responses to maintaining water for ecosystems which appear to be promising. These include the establishment of legislative frameworks within which allocations are required for wetlands and other ecosystems, establishing environmental water requirements (environmental flows), developing and implementing tools for payments for ecosystem services, transactional approaches to water for ecosystems, and introducing 'caps' on further water allocations in water-scarce basins.

Yet, whilst all these seem attractive in appearing better to secure water supply for wetlands, they may at best provide some degree of temporary solution rather than addressing the underlying issue of water governance. Indeed, promoting such approaches may make it even harder to achieve subsequently such shifts in governance. Even with such mechanisms in place, when it comes to the crunch of less water being available than can meet the demands of all users, water for ecosystems generally continues to be the loser even with agreed allocations when water for direct use by people is scarce. Water laws also still generally create an adversarial situation in which ecosystems must demonstrate and justify their needs against other competing needs.

Since maintaining (and restoring) wetlands is essential for securing their vital services for human well-being and poverty reduction, water resource management and spatial planning governance and practice need to be much more based on an integrated ecosystem-based approach, and to ensure that "integrated water resource/river basin management" really is delivered through integration across sectors. There is a need to achieve more high-level understanding and commitment so as to secure and implement new forms of water and land-use governance based on this paradigm. In parallel there is also a need for better encouragement and empowerment to local people and communities to value and maintain their healthy wetlands for water.

Such issues of water, wetlands and human health will be a particular focus of attention during Ramsar's 10th Conference of Contracting Parties, being hosted by the Republic of Korea from 28 October-4 November 2008, with the COP10 theme being "Healthy Wetlands, Healthy People". In support of these debates, this also the theme for World Wetlands Day 2008 (2 February), and the Ramsar Secretariat has issued a range of fact-sheets and information materials for WWD2008 on different aspects of wetlands and human health (available on: http://www.ramsar.org/wwd/8/wwd2008_index.htm). In addition a major technical report on "Wetlands and Human Health" is currently being prepared by the Ramsar STRP. This will cover the benefits of wetland ecosystem services for human health, the many health impacts of disrupted ecosystem services and degraded wetlands, global trends affecting wetlands and human health, and promising responses and interventions.

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River control and biodiversity[62] (Abstract)

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To help the preservation of biodiversity it is important to detach scholarship from a research strategy that has turned research into some sort of biodiversity-protection-politics by other means, and to reveal the ideological practice of this activity, dressed up as research. I will present some difficult trade-offs that not only countries but also the research community have to make, and by using river control as an example raise some simple but important conceptual and theoretical questions.

River ecosystems and development: River and water systems give life not only to aquatic life, but to all animals, all birds, all plants and are very important to people in terms of drinking water, irrigation water, water for hydropower, for tourism etc. This means there will always be competing interests for the various uses or ecosystem services that the river and water systems provide.[63] There is no ideal river system or river ecosystem that will serve all these means. Almost 300 major rivers in the world are transnational or trans-boundary, meaning that two or more states (and other "stakeholders") are in competition with each other for the use of waters of the river. Conflicts exist therefore not only between states and peoples but between ecosystems, physically located upstream or downstream along the watercourse. Decisions aiming at changing or protecting one ecosystem will therefore always affect the other ecosystems along the same watercourse.[64] To preserve one ecosystem upstream or downstream might therefore destroy an ecosystem elsewhere on the river.

Moreover, rivers are always in a flux, and will therefore, as a result of the workings of nature itself, change the different ecosystems it gives life to along the entire watercourse. And what is the ideal ecosystem? Example: Normally 30%

[62] Abstract based on Professor Terje Tvedt´s conference lecture

[63] See, e.g.: Coopey, R. & Tvedt, T. 2006. *A History of Water. Vol II: The political economy of water*. New York/London: I.B. Tauris.

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Elhance, A.P. 1999. *Hydropolitics in the Third World. Conflict and cooperation in international river basins,* Washington: United States Institute of Peace Press.

[64] See Tvedt, T. 2004. The River Nile in the age of the British. Political ecology and the quest for economic power, London/New York: IB Tauris. This book describes in detail the contradiction between maintaining the ecosystem in the central Southern Sudan and plans to develop the river.

of Bangladesh is under water during the flood season, some years more, some years less. Should this ecosystem be maintained or changed? All sectors of society will want services from the river ecosystems that exist and they will have different views on what they want.

River systems and management: Water control works and dams are viewed as modern temples in India, China, USA etc.[65] Most of the river ecosystems we find today are not natural, but have been changed by human interference in more or less radical ways for thousands of years. Managing or maintaining ecosystems means therefore the management and preservation of ecosystems produced by previous human actions.

This is not an argument against the need for the protection of ecosystems. On the contrary, it is an analysis that will argue that the discussions on biodiversity and its protection will benefit from liberating itself from ahistorical notions of existing ecosystems, and blindness to the fact that the very activity of protecting biodiversity one place might destroy it in other places.

[65] See, e.g.: Šiklomanov, I. A. & Rodda, J.C. 2003. *World water resources at the beginning of the twentyfirst century,* Cambridge: Cambridge University Press.

Tvedt, T. & Jakobsson, E. 2006. *A History of Water Vol I: River Biographies.* New York/London: I.B. Tauris.

Biodiversity aspects of the EU Water Framework Directive (Abstract)

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Biodiversity is a theme linking many policies relevant to catchment management. Its management poses opportunities to achieve synergies in meeting requirements of EU directives such as the Water Framework Directive, the Habitats Directive, the European Agricultural Fund for Rural Development and the EU's Biodiversity strategy.The implemetation of the Water Framework Directive (WFD) is an important driver towards biodiversity conservation in Europe. The WFD includes legal requirements for long-term sustainable water management and to reach good quality status (i.e. good ecological and chemical status) of all European waters by 2015. Good ecological status means that biological communities are close to their natural state in absence of human disturbance ('reference conditions'), and biodiversity is its key components. There is also a direct link through the requirement to protected areas under the Natura 2000 network of sites (i.e. sites designated under the Habitats Directive and Birds Directive to ensure conservation status of habitats and species of high importance. There are, however, also some potential conflicts between the requirements of these three Directives in particular regarding a potential mismatch between the WFD 'good ecological status' and the HD and BD 'favorable conservation status'.

The WFD by itself does not address all aspects of biodiversity conservation, but the ambitious environmental objectives can not be achieved without addressing key problems that go far beyond direct catchment management. There is a need for close integration of policy objectives in catchments in order to achieve a sustainable use of Europe's environment and conserve biodiversity. While urgent action to stop habitat fragmentation and destruction is needed to meet the objective of halting biodiversity loss, further development and testing of indicators of conservation success, system biodiversity and water quality is needed.

The state of the world's marine biodiversity and ecosystems

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Abstract

There is still no complete global assessment of marine biodiversity. The fourth UNEP Global Environment Outlook (GEO4), the most recent assessment of the world's marine ecosystems, provides an overview with limited optimism for the future of marine ecosystems and biodiversity under current policies. Fisheries continue to decline, coastal ecosystems continue to degrade and marine biodiversity, key to maintaining healthy and resilient ecosystems is still under considerable threat now and in the face of climate change. Humans continue to migrate to the coast, and thus adding pressure, especially in developing countries to contribute to development. However, there is still time to reverse many of the trends in marine ecosystems. The recent GEO4 report also included looking at the future of ecosystems under four different policy experiments, and for the first time, the potential impacts of these experiments on marine systems. This paper describes the current state of marine ecosystems and in particular marine biodiversity, and examines the potential impact of future policies.

Introduction

Our understanding and knowledge of marine biodiversity compared to terrestrial biodiversity is much lower. Indeed, a global assessment of marine diversity is still far from completed. However, programs such as the Encyclopedia of Life, Catalog of Life, World Registry of Marine Species, Census of Marine Life (COML) and SeaLifeBase are quickly closing this gap. The COML in collaboration with OBIS has added 10 million records to the list of marine species and expanded our knowledge of many deep-water ecosystems (Census of Marine Life 2007). SeaLifeBase and FishBase are providing an information system for describing the life history of many marine organisms and other important information for management, with 30,000 fish and non-fish species with key biological information and most are those important to human development (Palomares 2007). While these and other initiatives contribute to a better understanding of what we might lose, they provide limited information on where and how much might be lost, and especially how this will affect human development. However, for commercially important species, more is known relative to other marine species and systems, especially for fisheries systems, and is in part a reflection of our desire to better understand those things we can easily place an economic value on such as coral reef ecosystems which are highly valued for their fisheries and tourism. There is also considerable scope for the world's marine biodiversity, if it is adequately protected to contribute to further human development through the expansion of sustainable aquaculture and bio-prospecting.

The main threats to marine ecosystems including marine biodiversity, such as overfishing and land-based pollution have been articulated in past assessment such as the Millennium Ecosystem Assessment (Pauly et al. 2005) and still remain. More recently, new threats have emerged, in particular invasive species and climate change and with it ocean acidification. When one or more of these threats are present in an area, changes in biodiversity are more pervasive than when there is a single threat (Sala & Knowlton 2006).

In assessing the state of the world's biological diversity genetic diversity, species diversity, and ecosystem diversity need to be included, and ideally a set of agreed indicators should be used. A recent initiative by UNEP and the GEF is bringing together a suite of biodiversity indicators, for a more comprehensive and consistent monitoring and assessment of global biodiversity, with a view to measuring progress towards the CBD's target to reduce the rate of biodiversity loss by 2010 including marine diversity (Table 1). But until then, any description of the condition of marine diversity will be opportunistic and often regionally specific.

Table 1. *Draft indicators for the 2010 Biodiversity Targets for the marine sector.*

Indicator	Status	Data Sources
Genetic		
Genetic diversity of domesticated aquatic species	Developed	FAO FishStat and FishBase
Species		
Threatened species	Developed	IUCN Red List
Invasive species	Developing	Invasive Species Network
Ecosystem		
Marine protected areas	Well established	MPA-Global/WDPA
Fish stock status	Well established	FAO FishStat
Marine Trophic Index	Well established	FAO FishStat & FishBase

Genetic Diversity

The state of genetic diversity for wild capture fisheries and aquaculture are still poorly described with genetic information often incomplete, inconsistently reported, and difficult to access and use (Pauly et al. 2005; Pullin 2007). The threats to fish genetic resources are also overfishing, habitat degradation, land-based pollution and climate change (Grant 2007) and are not just in shallow coastal areas but also in deep seas (Smith 2007). Many of these threats also apply to other marine organisms including marine mammals and seabirds (Figure 1).

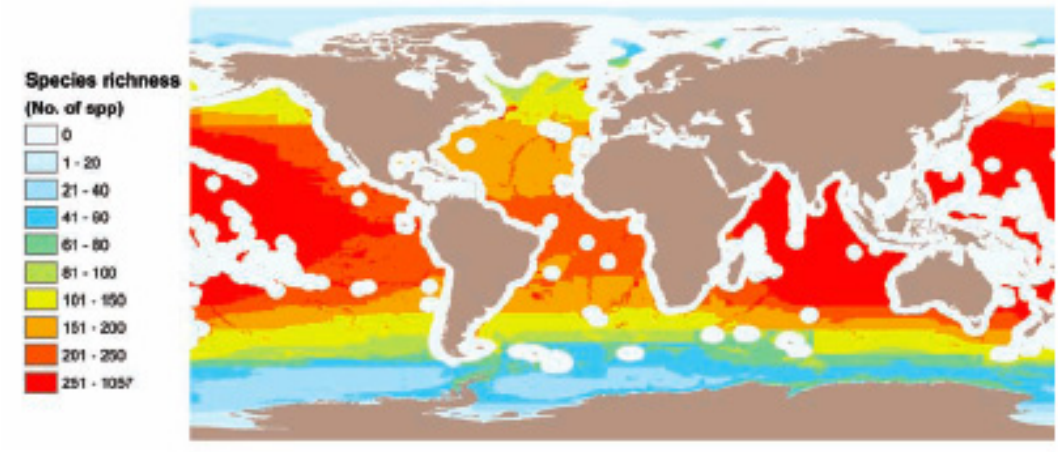

Figure 1. *Marine fish and higher vertebrate species richness in the high seas. The observed patterns largely reproduce the assumptions on latitudinal and longitudinal gradients for fish species, except in the Atlantic, where the lower background richness allows for the effects of seamounts to be visible (Cheung et al. 2005).*

In deep-sea ecosystems, fishing is the major cause of biodiversity loss for fish, invertebrates and other benthic organisms (Mossop 2007). Many deep-sea species are long-lived and late in maturing sexually, making them more vulnerable to extinction than continental shelf counterparts. Although there is also high endemism associated with fish and invertebrates on seamounts, many of the target species of fish are widely distributed (Smith 2007). However, many targeted species are caught using trawl gear, which also takes other non-target species such as sharks, which are often endemic to the area and increases the risk of local extinctions. However, overfishing of the target species such as Patagonian toothfish (*Dissostichus eleginoides*) and Orange roughy (*Hoplostethus atlanticus*) throughout the Southern Ocean does risk species extinction. Recent research also indicates that some population differences occur in Patagonian toothfish (Shaw et al. 2004). However, for most deepwater fishes, little is known about their genetic diversity including spatial differences (Smith 2007).

Extinction (ecological or commercial) of genetically unique subpopulations of fish is one of the main risks to genetic diversity despite the fact that marine fish represent large and widely distributed populations, breeding populations may be much smaller (Commission on Genetic Resources for Food and Agriculture 2007). Stocking of coastal areas with hatchery reared species is not necessarily the best solution since introducing different genetic strains can lead to reduced fitness of wild populations (Grant 2007).

Diadromous fish, such as salmon, are at greater risk of extinction, and in some cases considered locally extinct. However, such extinctions are not restricted to fish. The recent assessment of the genetic diversity and differentiation of the two remaining Mediterranean monk seal populations suggests that the threat of extinction has increased. For both populations, extensive inbreeding may be inevitable due to the small population sizes and reduced genetic diversity (Pastor et al. 2007).

The Biodiversity 2010 indicators include genetic diversity, and for marine systems the only indicator is the trends in domesticated aquatic species. In part this reflects the difficulties in studying genetic changes in wild species at large regional scales. Domestication of fisheries lags behind what has been achieved in terrestrial systems. There are approximately 500 species of fish, many of them currently freshwater, that are cultured but little is known on the number of farmed fish breeds. The current number of farmed marine fish species is much less (~ 60 based on FAO reported production in 2005 (FAO 2007)), but the potential for increasing the number of fish species is high. Whereas there are 80 species of livestock with over 6,000 different recognized breeds used in food production systems (Pullin 2007).

The lack of consistent and comprehensive reporting on the development of breeds continues to constrain our understanding of domestication of farmed species. Long-term protection of aquatic genetic biodiversity is a major factor

for sustainable aquaculture. However, global consensus on how to conserve in situ the diversity of wild relatives of the major aquatic farmed species is still lacking (Commission on Genetic Resources for Food and Agriculture 2007).

A loss of genetic diversity among aquatic organisms has consequences for human development especially for food security. Less biodiversity will limit our ability to domesticate marine species and meet the increasing demands for animal protein, and it will limit our ability to adapt to climate change and other disturbances as seen in the past (Sala & Knowlton 2006). The growth of aquaculture is a combination of increased production and an increase in the diversity of species farmed. As this industry expands, new species and lines will be needed for development and to allow the industry to produce seafood cost effectively and efficiently, especially in developing countries. Despite the issues associated with understanding genetic diversity of marine species, progress is being made on characterizing aquatic genetic resources for fisheries and aquaculture as well as conserving it (Commission on Genetic Resources for Food and Agriculture 2007).

Species Diversity

The state of species diversity continues to slowly decline at the global scale, but at regional scales ecosystems are rapidly losing populations, species or entire functional groups (Worm et al. 2006) with more marine species listed as threatened, extirpated or extinct as a consequence of human development. Lowered biomass and fragmentation of habitats are major factors leading to extinctions, especially for large, long-lived, late maturing species such as tunas and toothfish (Sala & Knowlton 2006). A recent report on marine biodiversity notes that more than 130 marine species are reported as extinct, many of them listed since the 1990s (Dulvy et al. 2003). However, there is concern that this may be an overestimation (Monte-Luna et al. 2007). There have been initiatives to recover many fish stocks with mixed results. In Canada, the recovery of cod has been slow at best (Shelton 2007) while in the Northeast Atlantic recovery is more optimistic with the recent, but extremely cautious ICES report (Scharff & Pastoors 2007).

There are two indicators proposed for the Biodiversity 2010 initiatives: rate of change for threatened species and invasive species. The IUCN Red List provides an up to date assessment of threatened marine species which number 1530 out of the more than 41,000 species on the List. In 2007 nearly 240 marine species were added to the Red List or reassessed, of those added to the list 71% are in jeopardy and 31 species risk extinction (Figure 2). Until recently many species were seabirds (Figure 3).

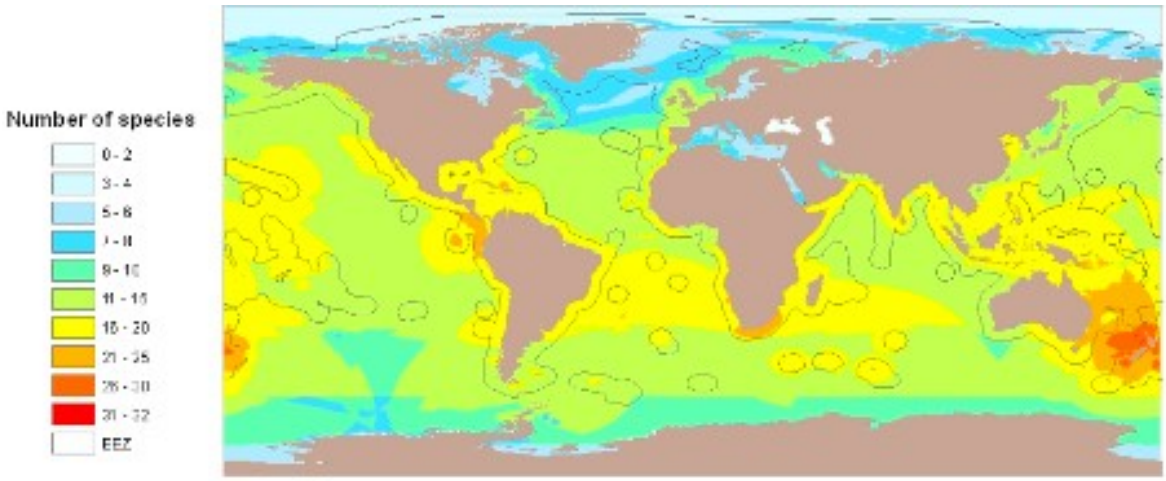

Figure 2. *Distribution of threatened marine non-fish vertebrates that are listed as vulnerable, endangered or critically endangered on the IUCN Red List ((Cheung et al. 2005) based on Baillie et al. (2004) using associated species-specific distributions (N=103)). The threatened birds largely dominate the observed pattern with 81 species listed versus 16 for marine mammals and reptiles (6).*

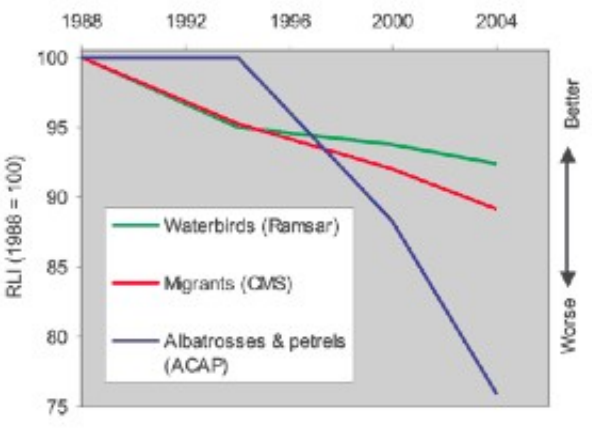

Figure 3. *Trend in seabird (albatrosses and petrels) abundance (Birdlife International 2006).*

Corals were added to the List for the first time with 2 species from the Galapagos listed as critically endangered and a third as vulnerable; 74 species of algae and seaweed with 10 of them critically endangered were also added; the Banggai cardinal fish was added and listed as endangered and the Spingy Angelsharks and Smoothback Angelsharks were downlisted from Endangered to Critically Endangered (IUCN, 2007).

The Living Planet Index illustrates the trend in plant and animal abundance since 1970 and currently includes 274 representative marine species (World Wildlife Fund (WWF), 2006). The latest assessment noted an average 27% decline in the index, and that in all four ocean basins the LPI declined (Figure 4)

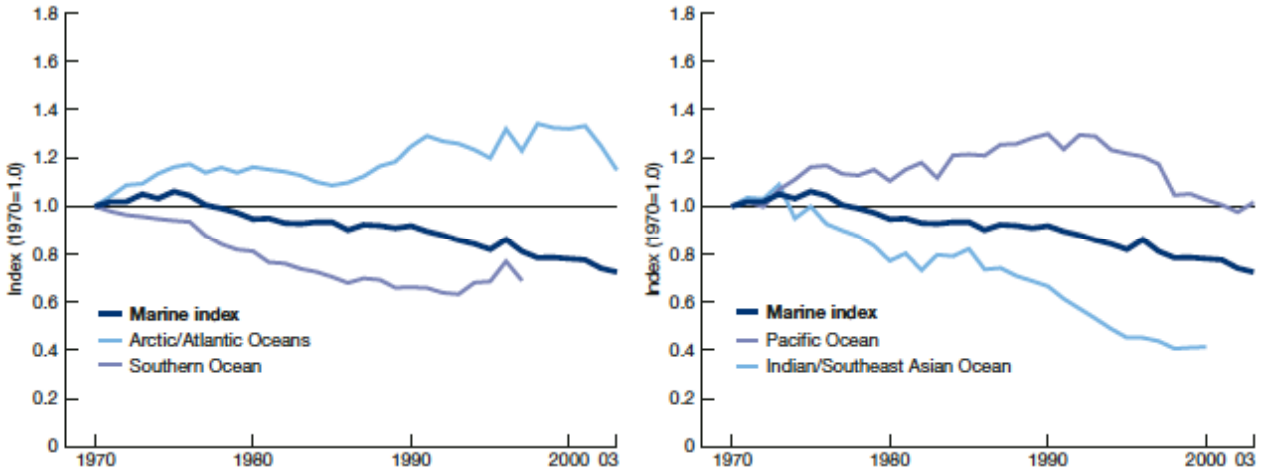

Figure 4. *The Living Planet Index globally and by ocean basin (from World Wildlife Fund (WWF), 2006).*

Although invasive species have not accounted for the extinction of the 21 species listed on IUCN's Red List, in 2004 87 of the 737 marine species listed were affected directly by invasive species (Gurevitch and Padilla, 2004). Studies of introducing non-native species (including invasive species) have shown that native populations are affected. Recent coastal studies have found that invasives are reducing the number of predatory species and secondary consumers while invasions are greatly increasing the number of lower trophic feeders and producers (Byrnes et al., 2007).

Escaped salmon from aquaculture facilities in North Atlantic rivers and coastal areas make up 20 to 40% of the salmon; in some Norwegian rivers this figure is over 80% (Ferguson et al., 2006). At first glance the substitution of farmed for wild salmon appears to be a good outcome. While there have been only a few direct studies of the interactions of native stocks of North Atlantic salmon and farmed (Gross, 1998), these more recent studies suggest, however, that farming will not benefit wild capture fisheries. Notably, the genetic effect of mixing farmed and wild salmon is lower fitness (reduced recruitment) in individual populations, which threatens the long-term survival of the stocks (Ferguson et al., 2006). Simulations of 20 % escaped salmon intruding into wild populations over 10 salmon generations suggest that profound changes to the viability of wild populations are possible (Hindar et al., 2006).

Marine Ecosystems

Fisheries continue to be the main impact on marine ecosystems in general. Close inshore systems affected by other anthropogenic effects are also evident especially around urban areas or highly developed river basins where there is either significant nutrient loading or conversion of coastal habitats with a corresponding loss of ecosystem services. This is best exemplified in the East China Sea (Figure 5) where fertilizer applications in the catchments have increased as much as 250% in Anhui and Jiangsu provinces (UNEP-GIWA, 2006) and harmful algal blooms are impacting fisheries directly as well as causing significant economic losses (Tang et al., 2006).

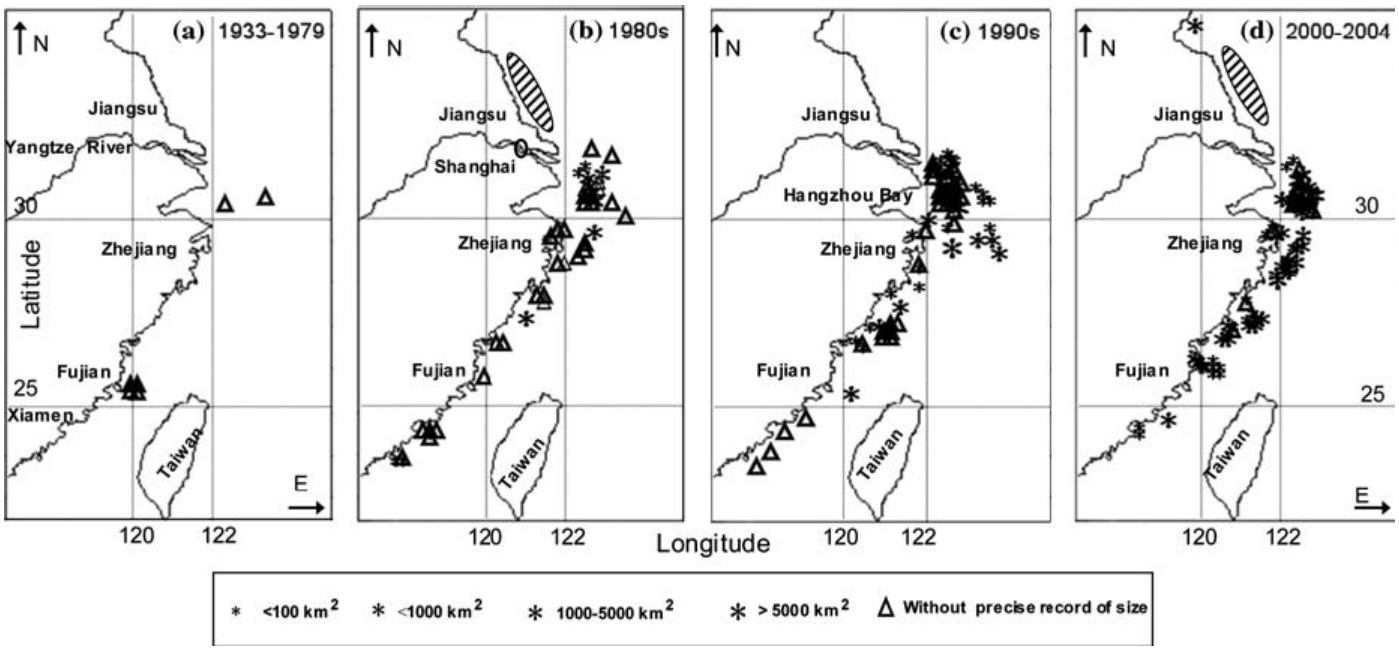

Figure 5. *Sites of HAB events in periods from 1933 to 2004. Each star represents one HAB case, and the size of the star corresponds to the size of HAB area. Each triangle depicts a HAB event without precise record of size. (Source Tang et al., 2006).*

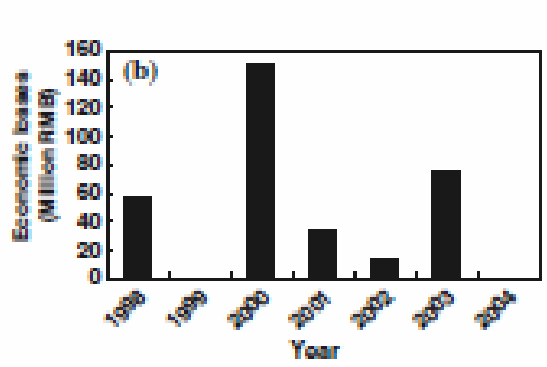

Figure 6. *East China Sea HAB Annual economic losses caused by HABs from 1998 to 2004 (Tang et al., 2006).*

The 2010 Biodiversity Indicators Program has identified 3 indicators: marine protected areas (MPAs), fish stock trends and the marine trophic index (MTI) for assessing ecosystem biodiversity (Table 1). MPAs are one of the most widely promoted tools for managing marine biodiversity and for setting management targets such as the CBD's target of 10% of a country's marine waters (Figure 7).

Recent developments to improve the quality of the data through MPA-Global make this a cost-effective indicator to track progress in meeting these targets and contribute to assessing levels of protection for marine biodiversity. However, progress towards the various targets has been slow to date with developed countries further advanced in meeting these targets compared to many developing countries (Figure 8).

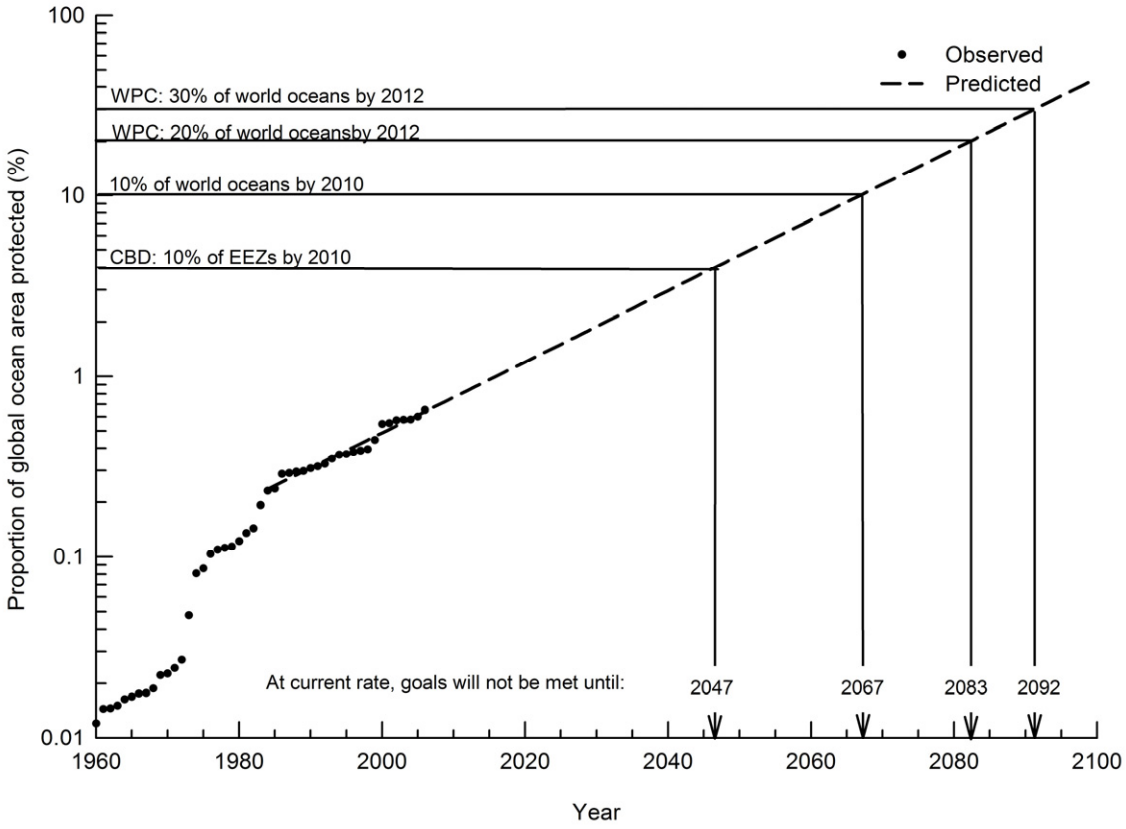

Figure 7. *Growth in cumulative global marine area protected for: total (solid circles), logged total (open circles) and no-take (squares) area (Wood et al., in press).*

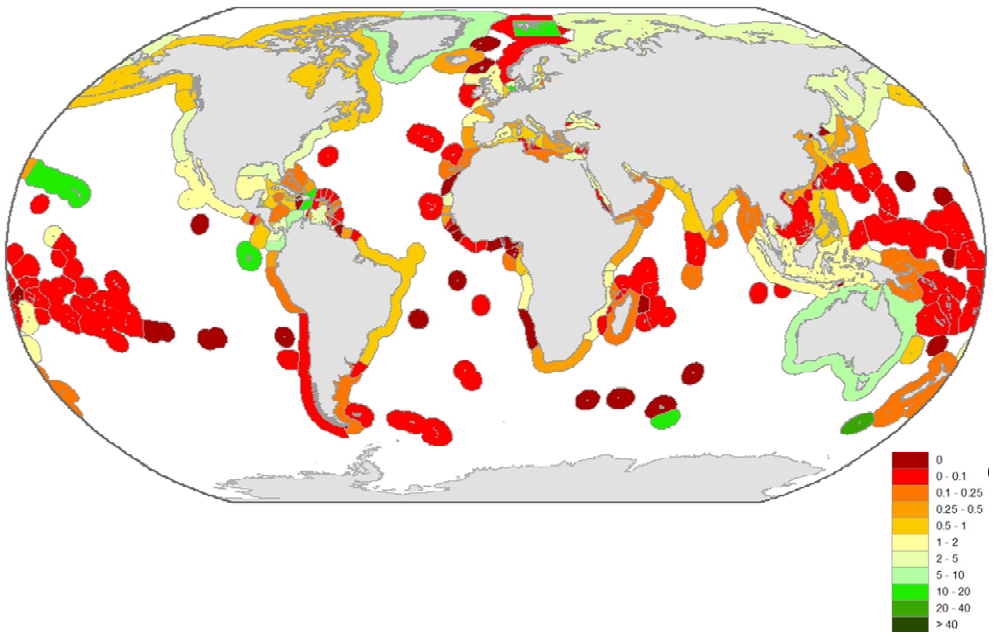

Figure 8. *Fraction of Exclusive Economic Zones of maritime countries and territories that is protected (Wood et al., in press).*

The number of commercially important fish stocks that are over exploited and crashed continues to increase although some fish stocks are recovering. However, on balance there is still a net loss of fish stocks (Figure 9)

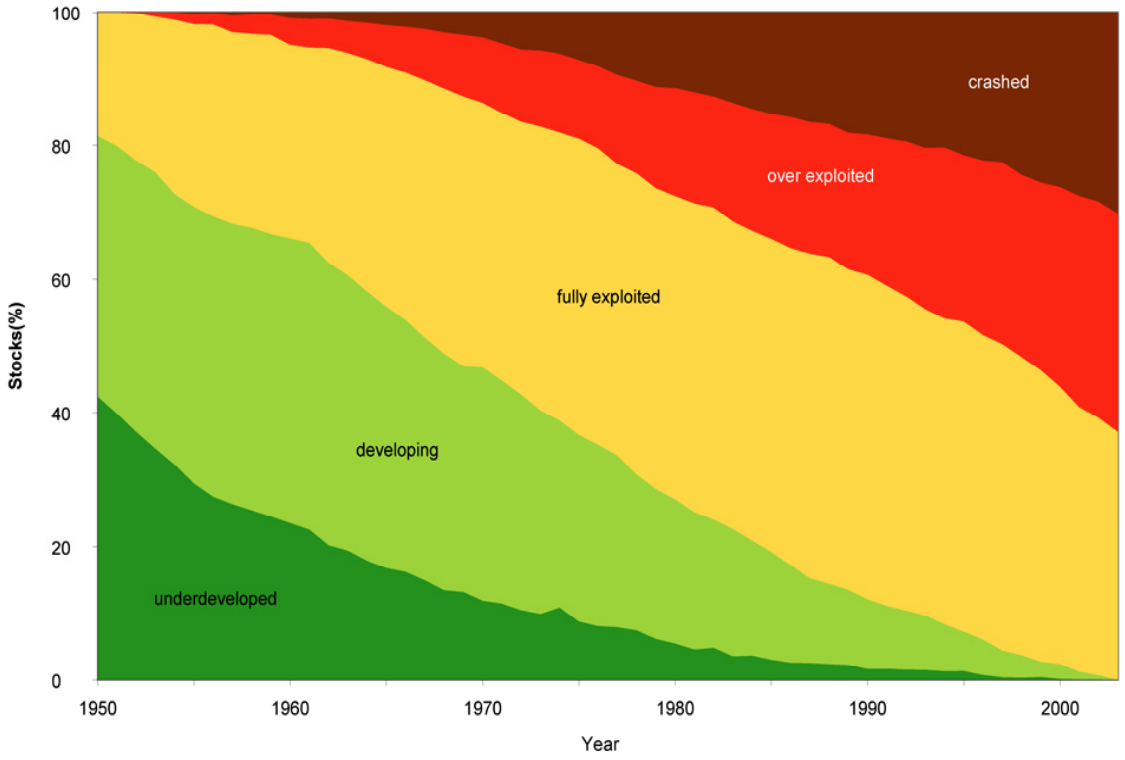

Figure 9. *Percentage of stocks under-developed, developing, fully exploited, over-exploited and crashed (Sea Around Us Project, 2007).*

The decline of fish stocks when combined with invasives can amplify the impacts of overfishing as seen in the Gulf of Main where overfishing of predators such as cod resulted in native herbivorous populations (primarily sea urchins) to increase with a corresponding decrease in kelp cover. The decline was further exacerbated by two invasive species at lower trophic levels that filled in the canopy gaps making it difficult for kelp to recruit and caused major changes in the structure of communities including the recruitment of native (Levin et al., 2002).

Declining stocks have resulted in fleets fishing further offshore and deeper, and the marine trophic index (MTI) falling. The general trend towards fishing lower down the food chain continues in many marine areas (Figure 10a). However, in other areas such as Alaska, effective fisheries management has seen the MTI increase (Figure 10b) Larger predatory fish continue to be overfished especially species such as the Atlantic bluefin tuna, which is at a high risk stock collapse in the East Atlantic and Mediterranean with current fishing mortality, which is 3 times the level for maximum sustainable yield (MSY) (International Convention on the Conservation of Atlantic Tuna (ICCAT), 2007).

a

b

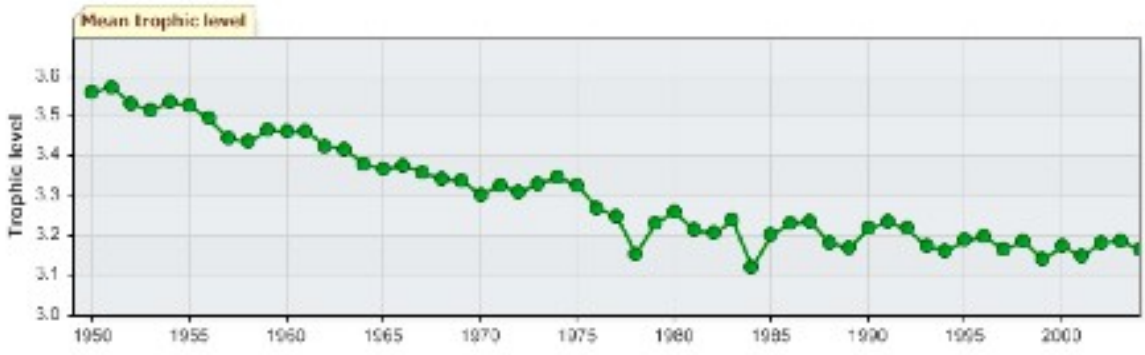

Figure 10. *Change in MTI from 150 to 2000 in a) the Caribbean Sea and b) the Gulf of Alaska (Sea Around Us Project, 2007).*

Future of Marine Ecosystems and Biodiversity

Clearly the future of marine ecosystems, their structure, function and in particular biodiversity will be impacted by climate change including ocean acidification (Pauly et al., 2005, Orr et al., 2005). However, the greatest impact will be in the policies taken in the future to address economic development including fisheries and aquaculture. In many temperate areas we are already seeing the impact of rising sea temperatures with the poleward migration of warm water species (Sala and Knowlton, 2006). But also warmer waters could also facilitate establishment of unwanted invasive species (Harley et al., 2006). Considerable uncertainty surround ocean acidification and current thinking suggests that acidification will severely impact calcifying organisms especially shelled pteropods found primarily in polar and subpolar waters; some plankton and corals (tropical and coldwater) will also be affected (Orr et al., 2005).

The development of a global model of the world's oceans (ECOcean) allows us to explore different policy options. The four Global Environment Outlook (GEO4) scenarios (UNEP, 2007) were studied using ECOcean and suggest that more fish could be taken from some of the world's ocean (Figure 11a) but biodiversity would be severely compromised (Figure 11b). While our results are in contrast to the recent estimates of fisheries collapses by 2047, it should be noted that their estimates were based on no change to how the fisheries were managed and only considered higher trophic level species (Worm et al., 2006).

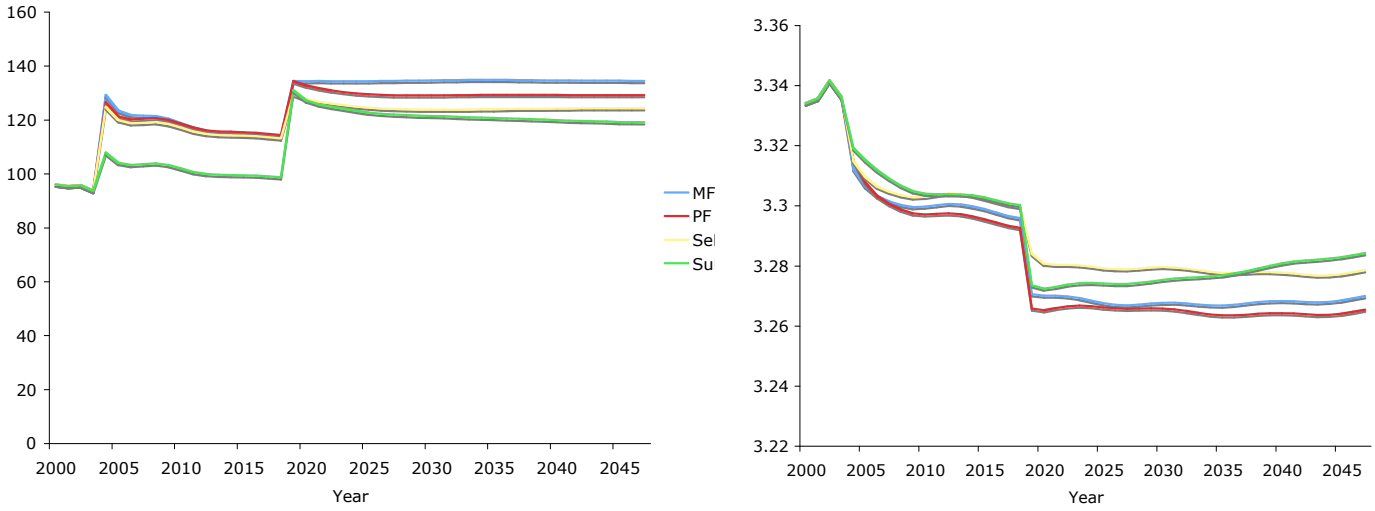

Figure 11. *Trends in marine fish landings and associated changes in the marine trophic index (MTI) under the four GEO4 scenarios (UNEP, 2007).*

There is no doubt that marine ecosystems and the biodiversity that supports them continue to be threatened, and future challenges such as increasing demands for seafood, bio-prospecting, climate change and ocean acidification only increase the threat levels. However, there is still time to reverse many of the trends in overexploitation and to minimize the impacts of others such as climate change, but this is only possible with changes in policy by government to include ecosystem based management, as well as industry implementing best management practices.

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Conservation and utilization of biodiversity in seamounts[66]

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Introduction

Seamounts are underwater pinnacles of volcanic origin. They are considered as oasis of life in the surrounding deep-ocean due to a set of coupling physical and biological factors that enrich the environment. Due to the increased productivity observed around seamounts they have become a target of fisheries interests, which has lead to conservation concerns.

In this paper we a summary of the general aspects of the geology, physics and distribution of seamounts around the world, with a view to focus on evaluating the main biotic and ecological characteristics of seamounts.

Seamounts are generally rich in benthic biodiversity, when compared with the neighbouring abyssal plains. Many of them are dominated by long lived and precious cold water corals and sponges. They do attract important deep-sea fish aggregations, and are also attractive for visitors from the epipelagic layer of the ocean, e.g. seaturtles, seabirds, sharks, tuna and cetaceans. Fisheries exploitation, the main anthropogenic threat to seamounts, has increased during the last two decades of the 20th century, with severe effects on target species, by-catch species, as well as benthic diversity, thus affecting whole habitats and ecosystems.

For this reason seamounts, and a set of associated species (e.g. orange roughy, *Hoplostethus atlanticus*), and communities or habitats (e.g. cold water coral reefs and gardens), are being includes as priority species by several international treaties, conventions and policy driven directives.

What are seamounts?

Seamounts are undersea mountains (usually of volcanic origin) rising from the seafloor and peaking below sea level (Wessel 2007). Spreading of the sea floor away from these hotspots via plate tectonic movements means that seamounts are often arranged in long chains and clusters or along the ocean ridges. These are the most extensive volcanic systems of the planet with their 60,000 km. A seamount tall enough to break the sea surface is called an oceanic island, e.g., the islands of Hawaii, the Azores and Bermuda, which were all underwater seamounts at some point in the past.

After their formation seamounts begin a process of erosion. Those that form along the spreading ridges become progressively older the further they are removed from the active centre. They are the dominant vertical and topographic features of a sea, which is otherwise largely dominated by abyssal sedimentary plains. Also, in contrast to the plains, seamounts are composed by hard-rock substrata. Both these characteristics are driving factors of the biodiversity and habitat complexity of seamounts.

Seamounts are present in various categories according to their height in relation to the sea bottom or their depth in relation to the surface of the ocean. Those that emerge from the water are islands. Geologists classify different categories according to their elevation from the bottom of the sea and their form. Underwater mountains rising more than 1000 m from the sea floor are called 'seamounts', those between 500-1000 m are 'knolls', and those less than 500 m are 'hills'. We consider here a wider definition in accordance with Pitcher et al. (2007).

How many seamounts are in the world?

Though most people may not be aware of it, seamounts are a fairly common underwater structure in the oceans (Kitchingman et al. 2007). Estimates vary greatly (Figure 1), but studies suggest that there may be between 1900 and 130,000 large seamounts, taller than 1000 m, in the Pacific Ocean, between 1000 and 2800 in the Atlantic Ocean, and between 500 and 900 large seamounts in the Indian Ocean.

The exact number of seamounts is still unknown. It may seem an exaggeration to say that we know more about the topography of the moon than about of the topography of our blue waters, but it is a fact. Pitcher et al. (2007) show a remarkable picture of an US nuclear submarine which while navigating in the Pacific ocean, south of Guam, collided with a seamount at a velocity of 35 knots. This event occurred in 2005! The seamount was subsequently "baptised" with the name of the submersible.

According to the best knowledge, there are around 15,000 clearly identified seamounts in the world's oceans and seas, but with a potential number of up 100,000 seamounts higher than 1,000 metres. Around 50% of the seamounts are in the high seas.

The number of effectively studied seamounts is a drop of water in this context: only around 300 seamounts have been the target of some geo-ecological studies. But many more have been subject to other human interventions, like fisheries.

[66] This paper, an outcome of a presentation at the 5th Trondheim Conference on Biodiversity, is based on the book by TJ Pitcher, T Morato, PJB Hart, MR Clark, N Haggan & R Serrão Santos (Eds). *Seamounts: Ecology, Fisheries and Conservation*. Blackwell Publishing 2007 - ISBN: 978-1-4051-3343-2.

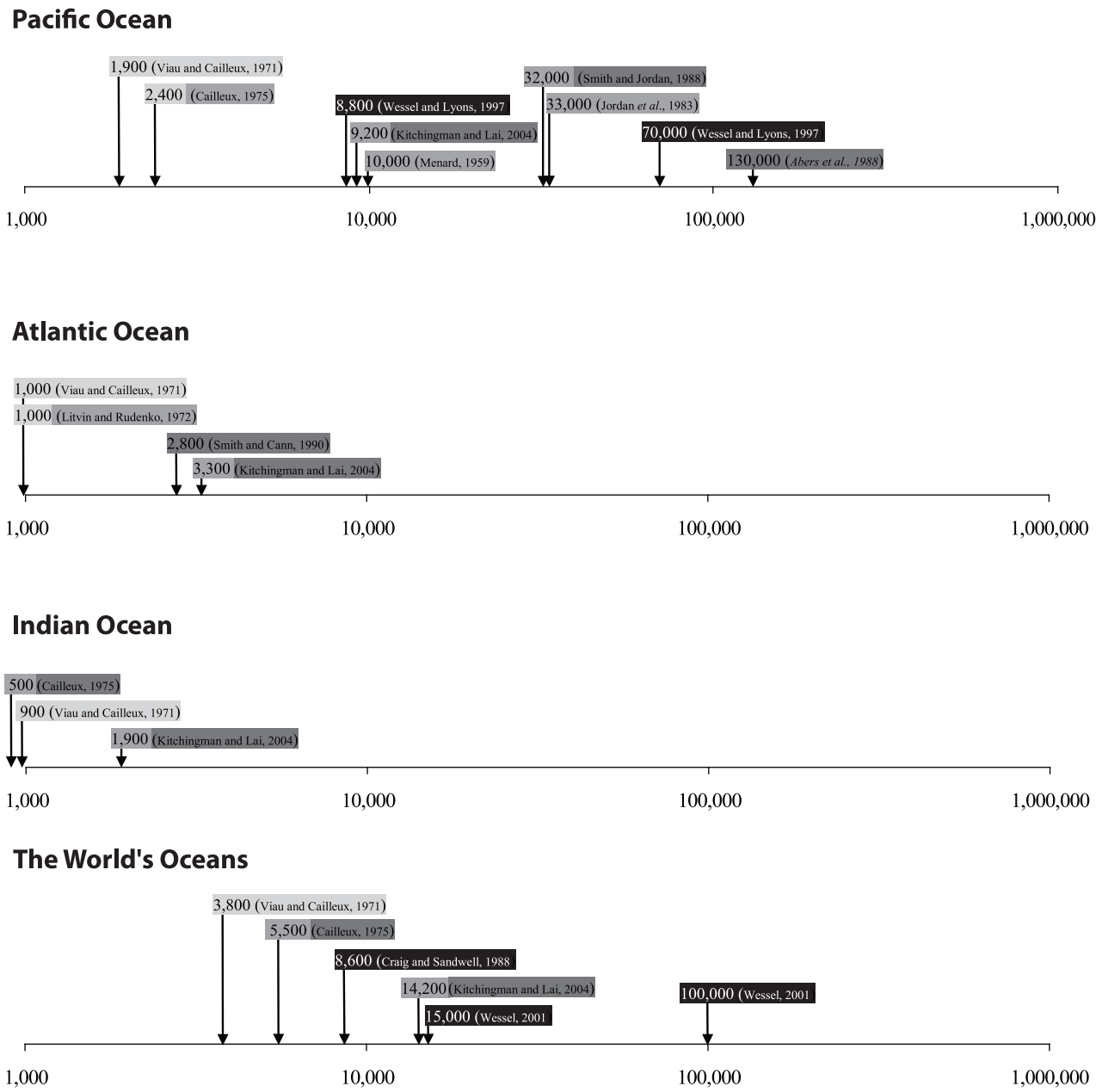

Figure 1. *Number of large seamounts (> 1000 m height) estimated by various authors and methods, where a) is for the Pacific Ocean, b) for the Atlantic Ocean, c) for the Indian Ocean, and d) for world's oceans. Adapted from Kitchingman et al. (2007).*

Why are seamounts of great interest?

There are two main factors to be taken in consideration.
The first is the geological nature of the seamounts. As said above they are generally formed by hard rocks that provide suitable substrata for the colonisation and growth of a diverse fauna, in which are included ruggedness and other complex patterns absent from the surrounding flat abyssal plains.

The second factor concerns the position of seamounts in the water column. Due to their vertical topography, seamounts induce changes in the circulation of water masses (White et al. 2007). They tend to enhance water currents and can have their own localized tides, eddies and upwellings where cold deepwater ascends from the deep along the steep sides of the seamount (White et al. 2007). These patterns may enhance primary production over and around seamounts due either to uplifting of isotherms into the euphotic zone and introducing nutrients into nutrient–poor surface water, or to stabilization of the water column above

the seamount, maintaining phytoplankton cells in a suitable light regime, promoting the growth of diatoms, and increasing growth rates and primary production (Genin & Dower 2007). For example, Mouriño et al. (2001) showed that local increase in chlorophyll *a*, enhanced carbon incorporation rates, and changes in phytoplankton species composition, were associated with a seamount.

Operating in conjunction, or separately, these two factors contribute to an increased food supply, and thus an enriched marine life, around the seamounts.

What lives on and around seamounts?

Benthos

Seamounts are said to be hotspots of marine life in the relatively empty open ocean. On the seamount floor there are often rich communities dominated by suspension feeders, e.g., gorgonians and other corals (Samadi et al. 2007; Rogers et al. 2007), that may be particularly susceptible and sensitive to disturbance by trawling (Clark and Koslow 2007). Enhanced currents and steep slopes expose the volcanic rocks and favour the growth of suspension feeders in these benthic seamount communities (Rogers et al. 2007), in contrast to the deposit feeders typical of most deep-sea benthos. Many of them form colonies or even reefs, as it are the case of *Lophelia*. These provide extra complexity and structure to the geo-morphological assets of the seamounts.

The abundance and biomass of benthic organisms on some seamounts was, however, observed to be very low when compared to other hard bottom habitats at similar depths. Though the diversity and exceptionally localized distribution of species living in these communities are acknowledged, their biology and life history remain poorly studied, except for some indications that some of these species may be extremely long-lived, e.g., up to maximum ages of over 100 years.

Fish

Numerous studies have described the species richness and diversity of fish fauna on seamounts. Wilson & Kaufman (1987) reviewed seamount biota worldwide and reported about 450 fish species collected from more than 60 seamounts. Rogers (1994) provided a list of 77 commercial species fished on seamounts. In later years, more detailed studies of certain seamounts and seamount chains provide more comprehensive species lists, especially based on in exploratory fishing during the last two decades. Based on the best available information, a total of 798 species of marine fishes were classified as “seamount fishes” (Morato et al. 2006a).

The number of known seamount fishes represents about 2.8% of the total number of known fish species. These species represent 165 families (32% of the 515 known families of fishes). Although the number of known seamount fish species is comparatively small, they represent a third of the fish families, about half of the orders of fish, and many unique adaptations. They consequently represent a relatively large and unique portion of fish biodiversity (Morato & Clark 2007). Currently recognized seamount fishes are associated with different habitats. Forty-three species are pelagic, 94 are reef-associated, 118 demersal, 68 benthopelagic, 223 bathypelagic, and 252 bathybenthic. A large portion of the seamount fish community is composed by deep-sea fishes, but many shallow water species are also known to occur on these structures. Only six seamount fishes are included in the 2000 IUCN Red List: *Sebastes paucipinis* is listed as ‘critically endangered’, *Sphoeroides pachygaster* and *Hexanchus griseus* are listed as ‘vulnerable’, and *Squalus acanthias*, *Dalatias licha* and *Prionace glauca* are listed as 'lower risk, near threatened'. Many seamount fishes have not been evaluated so far.

Figure 2. *Artistic view of alfonsinos at a seamount by Les Gallagher – FishPics/ ImagDOP.*

There is a group of fish species, however, living on (or visiting) seamounts that have raised much attention because of their high abundance and good flesh quality. They include orange roughy, pelagic armorhead (*Pseudopentaceros richardsoni*) and alfonsinos (*Beryx splendens* and *B. decadactylus*). These fish aggregate on top and around seamounts and have been subjected to intense exploitation since the late 1970s. The discovery of these commercially important aggregations of deepwater fish species on seamount structures have changed the idea that significant commercial fisheries would never develop in the deep sea due to scarcity at those depths and poor palatability of the flesh of the relevant fish species. Some of the most well known representatives of 'seamount-aggregating fishes' include the deep-water fishes: orange roughy, alfosinos, Patagonian toothfish (*Dissostichus eleginoides*), oreos, pelagic armourhead, several species of rockfishes (*Sebastes* spp.) and probably roundnose grenadier (*Coryphaenoides rupestris*) (Morato & Clark 2007). These species are the main target of the large-scale fisheries that occurs on top and around seamounts.

Morato et al. (2006a) found that 'seamount fishes', particularly 'seamount-aggregating' fishes, have higher intrinsic vulnerability than other groups of fishes. Biological characteristics leading to greater vulnerability include a longer lifespan, later sexual maturation, slower growth and lower natural mortality. Their research supports the notion that seamount fishes, especially those that aggregate on seamounts, are highly vulnerable to exploitation and that fishing on seamounts may not be sustainable at current levels and with current methods. A number of seamount populations have already been depleted. More will be depleted and some will go extinct if fishing on seamounts continues at current or even more moderate levels.

Visitors

It has been hypothesised that there are higher abundances of some "visiting" animals, such as tuna and billfishes (Holland & Grubbs 2007), sharks (Litvinov 2007), marine mammals (Kaschner 2007), sea-turtles (Santos et al. 2007) and even seabirds (Thompson et al. 2007), over seamounts. Sharks appear to be attracted to seamounts as demonstrated by Klimley et al. (1988), who showed that hammerhead sharks remained grouped at a seamount in the Gulf of California (Mexico) during the day and moved separately into the surrounding pelagic environment at night. Hazin et al. (1998) showed that catches of grey sharks were significantly higher around seamounts, mainly those with summits of about 300m and low-sloping depth profiles. The reasons for these aggregations are not clear, but Hazin et al. (1998) assumed that seamounts were used by some sharks as feeding stations.

It is known by fishermen and researchers that large biomasses of tuna are sometimes concentrated on seamounts. Several thousand tons of tuna may yearly be taken on some remote seamounts, while other seamounts closer to land are apparently always poor in tuna, even when they are located in regular fishing areas (Fonteneau 1991). Swordfish and other billfishes appear also to be attracted to complex high-relief bottom structures. For example, swordfish that moved away from the Charleston Bump were frequently found associated with seamounts, submarine canyons, and with thermal fronts of the northern wall of the Gulf Stream (Sedberry & Loefer 2001).

Although several works have correlated the occurrence of marine mammals with complex and steep topographies, the literature addressing their association with seamounts is scarce. Reeves & Mitchell (1993) noticed that when in pelagic areas Baird's beaked whales (*Berardius bairdii*) are observed close to submarine escarpments and seamounts. Seabird density and biomass has been reported to be higher around seamounts when compared to adjacent areas (Haney et al. 1995). Haney et al. (1995) showed that seabird biomass was eight times higher within a 30-km radius centred on a seamount summit. The authors attributed this seabird aggregation observed at the seamount to be related to an increase of food availability

In a recent study Morato et al. (in press) showed that some marine predators (skipjack and bigeye tuna, common dolphin and Cory's shearwater) were significantly more abundant in the vicinity of some shallow-water seamount summits. They suggested that seamounts may act as feeding stations for some of these visitors. Not all seamounts, however, seem to be equally important for these associations. Only seamounts shallower than 400 m depth showed significant aggregation effects. These seamounts may be considered hotspots of marine life and a special effort should be made in order to ensure a sustainable management of these habitats.

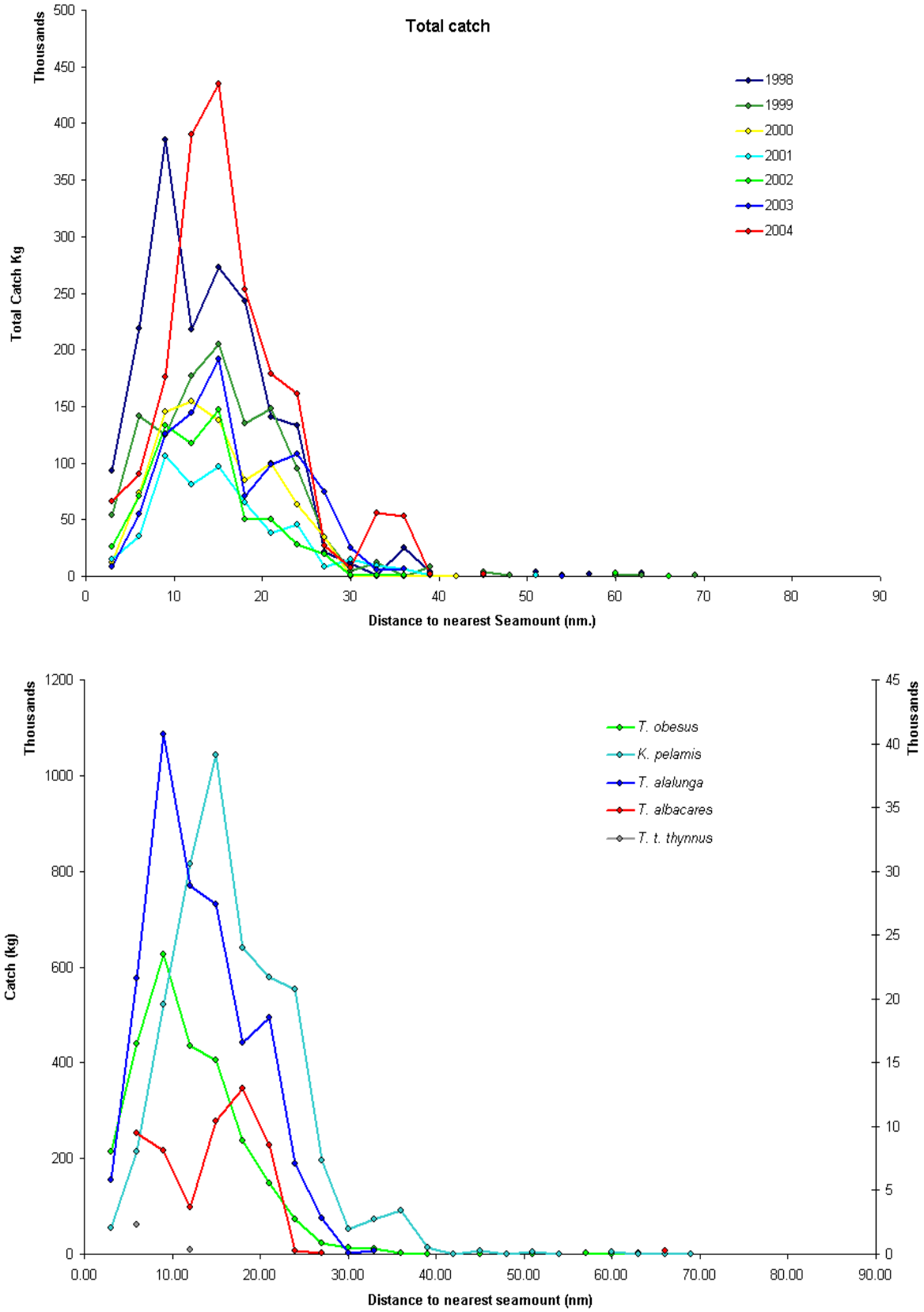

Figure 3. *Frequency distribution of the distances to seamount summit of the dataset of tuna fishing events (adapted from Morato et al. in press).*

Exploitation of seamounts: the human factor

Deep-sea fisheries are the actual main human threat to seamounts and other deep-sea ecosystems. Global landings of biotic resources shifted to deepwater species in the last 50 years (Morato et al. 2006b). A great part of the biomass extract from the deep ocean is made up of fish. Deep-sea fish are known to be of high intrinsic vulnerability (Morato et al. 2006a) due to a set of life history characteristics. It is a general understanding that deep-sea trawling and the fishing by entangled nets are comparable to mining fish, and that fish stocks are becoming commercially extinct. Sustainability is only possible with traditional fisheries.

There is a need of further comparison of population dynamics of fish stocks explored under traditional fishing methods (e.g. hook and line and bottom long line with small fishing boats up to 30 metres), and the stocks of the same and/or equivalent species fished by industrial methods including bottom trawls and automated long lining.

Industrial deep-sea fisheries are seen as unsustainable (Glover & Smith 2003). In addition to the direct effect on target and non-target species, deep-sea trawls cause extensive damage to benthic habitats (Gianni 2004).

There is a growing evidence of extensive collateral damages by fishing trawls of benthic habitats, like cold coral reefs, sponge aggregations, etc. (Roberts 2002, Hall-Spencer et al. 2002). Deep-sea corals and deep-sea sponges are long lived colonial reef building organisms, and recovery from damage may take thousands of years if they recover at all. Resilience may not be possible in highly structured deep-sea ecosystems based on reef building long lived species, at least not in the terms we are used to in shallow habitats.

Towards the conservation of seamounts habitats and biodiversity

The oceans are addressed by a set of global laws (e.g. UNCLOS) and international conventions and agreements (e.g. OSPARCOM, NEAFC, FAO code for responsible fisheries, etc.), as well as authority bodies (e.g. International Seabed Authority). However, high seas and offshore conservation fall outside existing legislation and future actions need new legal instruments (Young 2003, Gjerde 2006). Due to the fact that negative impacts on high seas habitats are fast growing, NGOs have recently established a new consortium, the Deep Sea Conservation Coalition, with a view to prpose to the UN a moratorium to stop high seas bottom trawl fishing. This action is justified because the global legal instruments are not available for management of the high seas.

Several international conventions, committees, councils and directives (e.g. OSPAR, ICES, IUCN, etc.) have defined a set of deep-sea habitats and species in need of urgent action: e.g. seamounts, cold water coral reefs, sponge aggregations, mid-ocean ridges with hydrothermal vents, etc. There is a growing interest in the establishment of marine protected areas (MPAs). As far as well managed MPAs are established for protection of priority habitats, studies on the benefits from MPAs should be initiated.

We may quote from Santos et al. (in preparation): “Growing awareness of the value of and threats to seamounts has resulted in calls for the protection and management of seamount habitats and their associated biodiversity (e.g. Gjerde & Breide 2003; Probert et al. 2007; Santos et al. 1995). They have become priority habitats under the OSPAR convention (OSPAR Commission 2004). Seamount conservation has been discussed at the United Nations General Assembly and its advisory body, the United Nations Informal Consultative Process on Oceans and Law of the Sea (UNICPOLOS). This led to the adoption in 2006 of UN General Assembly resolution A.61/L.38, which calls upon the competent fisheries management organizations to adopt and implement measures by 31 December, 2008, to, i.a., identify and close to bottom fishing activities all known and suspected vulnerable ecosystems, including seamounts, hydrothermal vents and cold water corals, until conservation and management measures have been established to prevent significant adverse impacts. This is a major break-through for a precautionary approach to management in areas beyond national jurisdiction.

The Convention on Biological Diversity has designated seamount and cold water coral conservation as priorities; seamounts are one of the habitat types which will form part of the network of marine protected areas (MPAs) being promoted by the OSPAR Convention; and these features (under the habitat category "reef") are also likely to form part of the Natura 2000 network of protected areas which is being established by Member States of the European Commission.

The next step is to develop proposals for specific MPAs and to present them to the relevant authorities with associated management plans that set out what needs to be achieved and how this might be done.”

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Deep sea genetic resources: What is their potential?[67]

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Abstract

The marine environment is reach of life and resources, including deep sea genetic resources. These resources have already proven to be of great potential and also actual value for developing applications of interest to health and industry. The body of scientific knowledge associated with these resources is sizeable already, despite the fact that the ecosystems to which they belong were officially discovered for the first time only in 1977. The relationship between actors interested in these resources, whether for 'pure' or 'directed' research purposes is unclear, which may have implications for their conservation and sustainable and equitable use. The policy community has shown a growing interest in these resources, and whether or not they are likely to be regulated is still being debated. As these resources not only pose important scientific and policy challenges but also seem to offer a great potential for meeting several of the Millennium Development Goals, it is important that policy debates and decisions on these resources continue to be informed by relevant scientific knowledge, and that these debates take place in the context of the ecosystem approach.

[67] This paper relies heavily on: Vierros, M., Hamon, G., Leary, D., Arico, S. and Monagle, C. 2007. An Update on Marine Genetic Resources: Scientific Research, Commercial Uses and a Database on Marine Bioprospecting (report presented at the United Nations Informal Consultative Process on Oceans and the Law of the Sea, Eight Meeting, United Nations, New York, 25-29 June 2007). United Nations University Institute of Advanced Studies, Yokohama and United Nations Educational, Scientific and Cultural Organization, Paris: 71 pp. (available at http://www.ias.unu.edu/resource_centre/Marine%20Genetic%20Resources%20UNU-IAS%20Report.pdf). The authors of this publication are hereby acknowledged for their contribution to this paper. I would like to also thank Charlotte Salpin, with whom I co-authored the 2005 report on Bioprospecting of Genetic Resources in the Deep Seabed: Scientific, Technical and Legal Aspects. United Nations University Institute for Advanced Studies, Yokohama: 72 pp. (available at http://www.ias.unu.edu/binaries2/DeepSeabed.pdf), which was also used for preparing this paper.

The genetic resources of the deep sea

Deep sea genetic resources are marine animals and microorganisms, and parts thereof, containing functional units of heredity that are of actual or potential value.[68]

The main oceanic realms comprehend the 'human edges' (the near shore zone, the coastal zone and the margin zone) and the central waters. In the margin zone, deeper than the light zone, and in the deep part of the central waters, in conjunction with the deep sea, the slope systems, ocean trenches and the ocean systems characterized by active past or current geological processes (namely, the mid-ocean ridges and seamounts) host a variety of genetic, species and ecosystem diversity that was basically unknown until the mid 1970s and, therefore, omitted from international debate and decisions on oceans and the law of the sea.

The biodiversity that is typical of these areas include, *inter alia*, hydrothermal vents, cold seeps and seamount communities. These deep sea ecosystems are difficult to reach, due to their remoteness, and require scientific knowledge and technology which only a handful of countries possess, including the USA, UK, Germany, Japan, Russia and China. Other countries are making human and financial investments in this direction, but deep sea research generally remains a prerogative of 'a lucky few'.

The Census of Marine Life (CoML) – probably, the most ambitious on-going international scientific programme addressing deep sea biodiversity, estimates the number of unknown species to approximately fifty percent of the species to be found in each sample; this consideration applies to the largest nine animal phyla that can be found in the deep sea realms.[69]

Virtually all deep sea ecosystems host species and communities that host genetic information actually or potentially useful from the standpoint of how they are defined by the Convention on Biological Diversity (see above), including from a commercial standpoint.

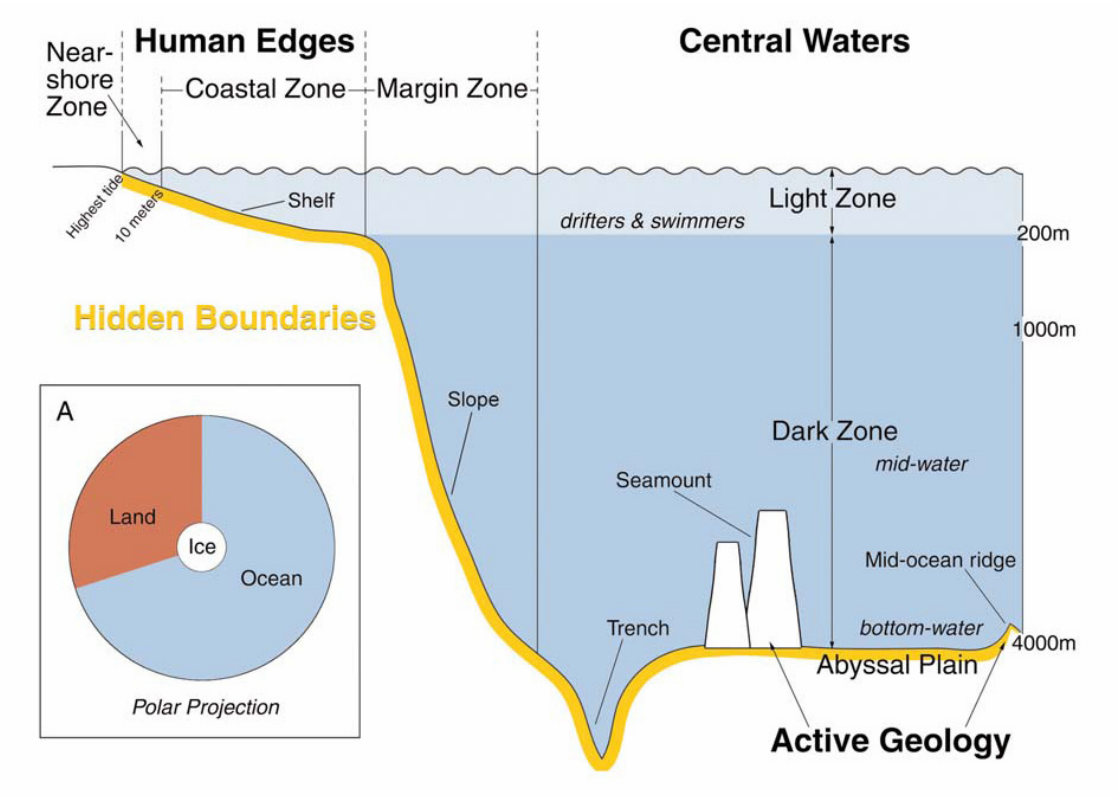


Figure 1. *The main ocean realms (adapted from, and courtesy of, the Census of Marine Life.*[1]

[68] Convention on Biological Diversity, Text and Annexes 1992. United Nations Environment Programme, Nairobi.

[69] CoML outlook, available on www.coml.org.

Marine scientific research in the deep sea and its applications

Theoretically, marine scientific research in general can be distinguished between, on the one hand, 'pure' marine scientific research, such as research reported in the scientific literature[70]; such 'pure' marine scientific research is designed and conducted in the context of large global or regional research endeavors, such as the above-mentioned CoML programme and the European Union-funded Hotspot Ecosystem Research on the Margins of European Seas (HERMES) programme, with scientific institutions such as Ifremer (France) and JAMSTEC (Japan) having developed highly-specialized skills in terms of both knowledge and equipment to carry out deep sea research; and, on the other hand, 'directed' marine scientific research, which typically leads to the filing of patents and the development of applications (products) for clinical trial and, ultimately, the market.

In practice, discriminating between these two types of research is difficult, if not impossible, as there is a flow of communication between knowledge acquired in the context of research programmes and that needed for filing patents and for developing related products.

With regard to patents based on deep sea genetic resources, hundreds of them can be found in the public domain.[71]

Examples of patents include:

- Food utilizing lactic acid bacterium derived from deep sea water (JP)
  IPC: A23C9/123; C12N1/20; A23C9/12 (+3)
- New cosmetic compositions with anti-oxidant properties comprising antiradical agents, useful for skin protection and with anti-ageing effects (FR)
  EC: A61K8/67L; A61K8/99; (+2); IPC: A61K8/67; A61K8/99; A61Q17/00 (+7)
- Method for producing wine (JP)
  IPC: C12G1/00; C12G1/00; (IPC1-7): C12G1/00
- Process for preparing seafood-tasted protein gel from transglutaminase (CN)
  IPC: A23K1/10; A23K1/10; (IPC1-7): A23K1/10
- Preparation and application of properly-cooled proteinase with special flavor (CN)
  IPC: A23L3/3571; C12N1/20; C12N9/52 (+6)
- Hydrocarbon emulsifying and solubilizing agent (JP)
  IPC: B01F17/00; C12N1/20; C12P1/04 (+7)
- Deep sea microbiological sampling and culturing apparatus and method (US)
  EC: G01N1/12; IPC: G01N1/12; G01N1/12; (IPC1-7): G01N1/12
- Submarine volcano hot liquid sampler (CN)
  IPC: G01N1/02; G01N1/10; G01N1/02 (+3)

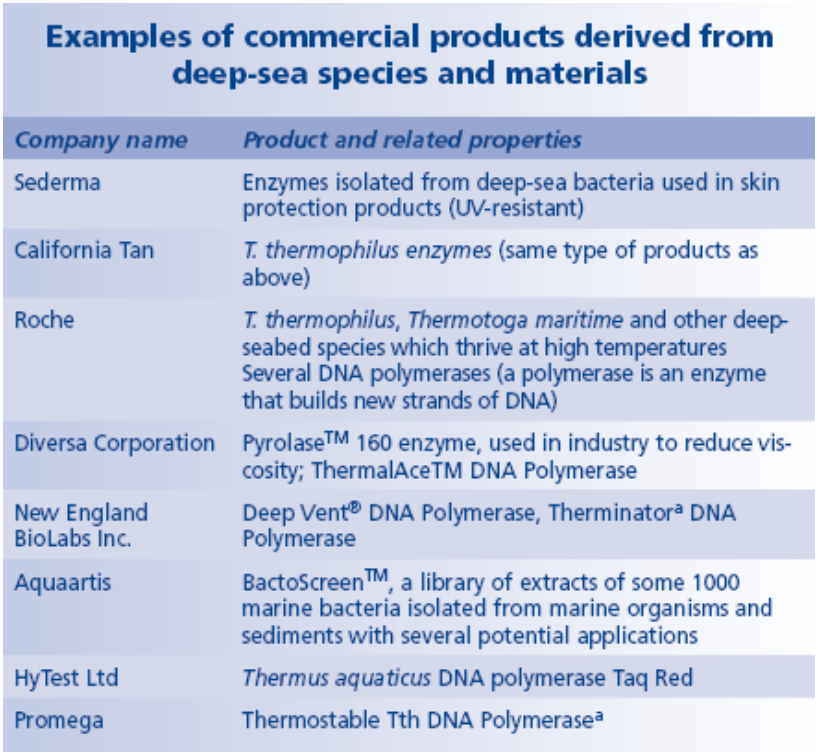
Fields of application of these discoveries include:

- Secondary metabolites for health applications (pharmaceuticals e.g. anti-tumor, anti-inflammatory and antibiotic compounds)
- Genes encoding proteins (e.g. enzymes) and metabolic pathways of biochemical reactions – *note their 'extreme' nature* – for industrial applications (e.g. production of biochemicals such as vitamins, aminoacids, etc., high-energy products such as methane, alcohol, etc. and for enhancing the effectiveness of industrial processes such as production of paper from pulp) and biomedical applications (e.g. surgery ones)
- Environmental monitoring and bioremediation

Products based on deep sea genetic resources can be found on the market, as illustrated in the table below.

[70] More than 400 scientific articles directly or indirectly relevant to deep sea genetic resources can be found in the public domain (personal communication of the author).

[71] See http://ep.espacenet.com/.



Examples of commercial products derived from deep-sea species and materials

Company name	*Product and related properties*
Sederma	Enzymes isolated from deep-sea bacteria used in skin protection products (UV-resistant)
California Tan	*T. thermophilus enzymes* (same type of products as above)
Roche	*T. thermophilus, Thermotoga maritime* and other deep-seabed species which thrive at high temperatures Several DNA polymerases (a polymerase is an enzyme that builds new strands of DNA)
Diversa Corporation	Pyrolase™ 160 enzyme, used in industry to reduce viscosity; ThermalAceTM DNA Polymerase
New England BioLabs Inc.	Deep Vent® DNA Polymerase, Therminator[a] DNA Polymerase
Aquaartis	BactoScreen™, a library of extracts of some 1000 marine bacteria isolated from marine organisms and sediments with several potential applications
HyTest Ltd	*Thermus aquaticus* DNA polymerase Taq Red
Promega	Thermostable Tth DNA Polymerase[a]

Figure 2. *From: Arico, S. 2006. The last frontier. A World of Science. 4 (2): 19-23.*

The value of deep sea genetic resources

Valuation of marine genetic resources in general (i.e. considering all marine genetic resources, including from non-deep sea realms) in the context of the world biotech-based industry market is illustrated by the examples reported in the table below.

Industry	Total estimated value of world market	Selected product annual sales value
Pharmaceutical industry	$643 billion in 2006	• $50m and $100m for herpes remedy from sea sponge (2005) • $1 billion cancer fighting agents from marine sources (2005) • $23 million for AIDS drug Retrovir (2005) • $237 million for herpes treatment Zovirax (2006) • Hemoglobin found in the blood of tubeworms colonies around hydrothermal vents
Enzyme market	- Minimum of $50 billion a year for enzymes - 1 billion per year for the DNA extraction market	*Estimated $150 million per year for Valley Ultra Thin (from deep sea hydrothermal vent source)*
Cosmetics industry	- Total $231 billion in 2005 - $38.3 billion globally in 2005 for skin care products	*Venuceane™ (a skin protection product from extremophile bacteria from the Gulf of California) developed by Crodo Oleochemicals group (global sales for Crodo Oleochemicals group in 2001 = $514 million)*

.[72] Valuation of marine genetic resources in the context of the world biotech-based industry marke

[72] From: Vierros, M., Hamon, G., Leary, D., Arico, S. and Monagle, C. 2007. An Update on Marine Genetic Resources: Scientific Research, Commercial Uses and a Database on Marine Bioprospecting (report presented at the United Nations Informal Consultative Process on Oceans and the Law of the Sea, Eight Meeting, United Nations, New York, 25-29 June 2007). United Nations University Institute of Advanced Studies, Yokohama and United Nations Educational, Scientific and Cultural Organization, Paris: 71 pp. (available at http://www.ias.unu.edu/resource_centre/Marine%20Genetic%20Resources%20UNU-IAS%20Report.pdf).

Non-economic values of deep seabed genetic resources include recent claims by indigenous and local peoples. The main use of the ocean space by indigenous and local peoples in areas beyond national jurisdiction remains navigation; however, this particular use is to be looked at as part of broader cultural systems that do not separate in a clear-cut way or at all the ocean from its constituents (coastal versus marine, pelagic versus benthic, areas within national jurisdiction vs. areas beyond national jurisdiction, etc.).

Building the knowledge basis on deep sea genetic resources for informed policy decisions

While policy reports on the issue were practically absent from international debates and negotiations on marine biodiversity, including that to be found in areas beyond national jurisdiction, the last few years have seen a host of high-quality informative reports and other resources on the subject that have been made available to the policy community.

These include a series of reports by the United Nations University Institute of Advanced Studies (UNU-IAS) and the United Nations Educational, Scientific and Cultural Organization (UNESCO), a database also developed by UNU-IAS and reports by other intergovernmental organizations, namely the United Nations Environment Programme.[73]

For the purpose of meaningful discussions on the policy aspects of access to, and conservation and sustainable and equitable use of deep sea genetic resources, the following considerations may be worth of note:

- Scientific research related to deep sea genetic resources, whether purely academic or commercially-oriented, is restricted to those very few who own the necessary technological capacity and the financial resources to access these remote areas
- Bioprospecting for deep sea genetic resources is taking place and related commercial applications are being marketed
- Partnerships between public and private research organizations are common, if not the norm, which makes it difficult to discriminate between pure and directed marine scientific research
- Information on the specific terms of such partnerships is lacking
- Information on the origin of the samples for developing practical applications of deep sea genetic resources in the context of the current patent classification system, which does not allow easy identification of patents based on the use of deep sea genetic resources, is not disclosed
- An access and benefit-sharing regime for deep sea genetic resources is lacking
- Uncertainty over access to marine biota can act as a deterrent to investment in research, thereby hampering the potential benefits of deep sea genetic resources to society as a whole. Marine research and bioprospecting undertakings are most effective when supported by clear and practical rules
- At a time when oceans are increasingly impacted as a result of human activities and fisheries depleted, bioprospecting of deep sea genetic resources may represent a sign of a shift in the economic use of the oceans

A number of policy-making processes have dealt and will continue dealing with deep sea genetic resources; these include: the Conference of the Parties (COP) and the Subsidiary Body on Scientific, Technical and Technological Advice to the CBD (COP 2, 1995; SBSTTA 2, 1996; COP 5, 2000; SBSTTA 8, 2003; COP 7, 2004; COP 8, 2006), the United Nations General Assembly (UNGA) (2005, 2006 and 2007), the United Nations Ad Hoc Open-ended Informal Working Group to study issues relating to the conservation and sustainable use of marine biological diversity beyond areas of national jurisdiction (2006, and its second meeting, foreseen to take place in April 2008), the United Nations Informal Consultative Process on Oceans and the Law of the Sea (UNICPOLOS) (2007). Other policy fora are likely to become interested and involved in issues related to deep sea genetic resources, including the World Trade Organization, the World Intellectual Property Organization and may be also other entities such as the Convention on International Trade in Endangered Species of Wild fauna and Flora (CITES).

Future policy challenges related to deep sea genetic resources include:

- The regime of the 'Area'/common heritage of humankind versus the regime of living resources in the High Seas under UNCLOS
- The lack of an international definition of bioprospecting and of 'marine scientific research' under the United Nations Convention on Oceans and the Law of the Sea (UNCLOS) (MSR)
- Possible conflicts between the provisions of the way in which UNCLOS addresses treatment of research results from MSR and those of intellectual property rights instruments
- The legitimacy of asserting intellectual property rights over resources deemed of public interest, and what constitutes a patentable invention with regard to genetic resources
- The principle for, and modalities of, sharing of ensuing benefits, including through technology transfer, capacity building, information sharing and disclosure requirements within patent applications

[73] In addition to the report under 1 above, see also Johnston, S. and Lohan, 2005. The International Regime for Bioprospecting: Existing Policies and Emerging Issues for Antarctica. United Nations University Institute for Advanced Studies, Yokohama: 31 pp. Also, please monitor www.ias.unu.edu for a bioprospecting database being currently developed, which will be online shortly and www.unesco.org/mab for the report of the UNESCO-IOC-IUCN-Australia-Canada-Mexico-The J.M. Kaplan Fund Expert Workshop on Biogeographic Criteria for the Classification of Open and Deep Ocean Areas (Mexico City, January 2007).

A further challenge, at the interface of policy with science, is that to keep the scientific community heavily engaged in debates over deep sea genetic resources, after the promising interest in has expressed in recent years.[74]

Deep sea genetic resources in the broader context: towards implementing the ecosystem approach in open and deep sea environments and the contribution of deep sea genetic resources to meeting the Millennium development Goals

Marine scientific research and bioprospecting are part of a large set of endeavors carried out in the open and deep sea environments, which includes shipping, tourism, capture fisheries, oil and gas extraction, mining, deep sea cable and pipeline industry, disposal of nuclear waste and other substances, military uses and uses by indigenous and local peoples.[75]

Indeed, deep sea genetic resources represent an important not only governance but also a development challenge. Pending resolution of problems related to access to information related to these resources and finalization of negotiations being pursued in the context of the CBD on an appropriate regime on access and benefits-sharing, these resources offer a great potential to attaining several of the Millennium Development Goals (MDGs), with particular reference to MDGs 4 and 6 (reduce child mortality and combat HIV/AIDS, malaria and other diseases, respectively, because of their health applications), MDG 7 (ensure environmental sustainability, if such resources are to be conserved and used sustainably); moreover, future discoveries based on deep sea genetic resources could lead to commercial applications which, in the context of an equitable ABS framework, could contribute to MDG one (eradicate extreme poverty and hunger).

In this regard, there is a need to transform the challenges described in this article into opportunities, namely through the development of strategic 'Type II' partnerships; this also would contribute to the realization of the MDGs, in particular, MDG 8 (develop a global partnership for development). Multistakeholder dialogue and synergies related to deep sea genetic resources will, however, need to continue being dealt with in the framework of the ecosystem approach.

[74] See, for example, Sheridan, C. 2005. It Came from Beneath the Sea. Nature Biotechnology 23: 1199-1201 and Ruth, l. 2006. Gambling in the Deep Sea. EMBO Reports 7 (1): 17-21.

[75] Vierros, M., Douvere, F. and Arico, S. 2006. Implementing the ecosystem approach in open ocean and deep sea environments: An analysis of stakeholders, their interests and existing approaches. United Nations University Institute for Advanced Studies, Yokohama: 39 pp. See also Ehler, C. and Fanny, D. 2007. Visions for a Sea Change. Report of the First International Workshop on Marine Spatial Planning. Intergovernmental Oceanographic Commission and Man and the Biosphere Programme. IOC Manual and Guides, 46: ICAM Dossier, 3. UNESCO, Paris: 84 pp.

An ecosystem approach to management of aquatic resource: integrating fisheries, aquaculture and biodiversity conservation.

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Abstract

The Food and Agriculture Organization of the United Nations (FAO) reported that the number of depleted and overexploited stocks has increased from about 10% in the 1970's to about 25% today and predicted that there is not much scope for significant increases from marine fisheries. At the same time, aquaculture has become the fastest growing food production sector. Aquaculture's contribution to world fish production has grown from 3.9% in the 1970s to 35% in 2005 and accounts for nearly half of all seafood consumed by humans. Both sectors have been accused of harming biodiversity. Responsible management of capture fisheries and aquaculture requires that natural biodiversity be conserved. Toward that end, FAO produced the Code of Conduct for Responsible Fisheries in 1995. The Code Recognizes that fishing and farming systems interact with each other, with the environment and with human communities. Therefore an ecosystem approach to fisheries and aquaculture will be necessary to ensure responsible use of aquatic resources.

The principles that characterize an ecosystem approach are grouped into three main frameworks, the normative framework consisting of agreed high level conceptual objectives; the operational framework, relating to the resources, institutions and processes mobilized for achieving the objectives and the cognitive framework, relating to the acquisition of information, analysis and translation into usable knowledge.

Introduction

The world's aquatic habitats provide a wealth of living aquatic resources for human kind. In 2002 FAO Members reported that 974 taxa of fin-fish, 143 taxa of crustacean, 114 taxa of mollusks, 26 taxa of plants and 73 taxa of miscellaneous animals such as sea urchins, sea cucumbers, and marine mammals were taken from the world's capture fisheries (Figure 1).

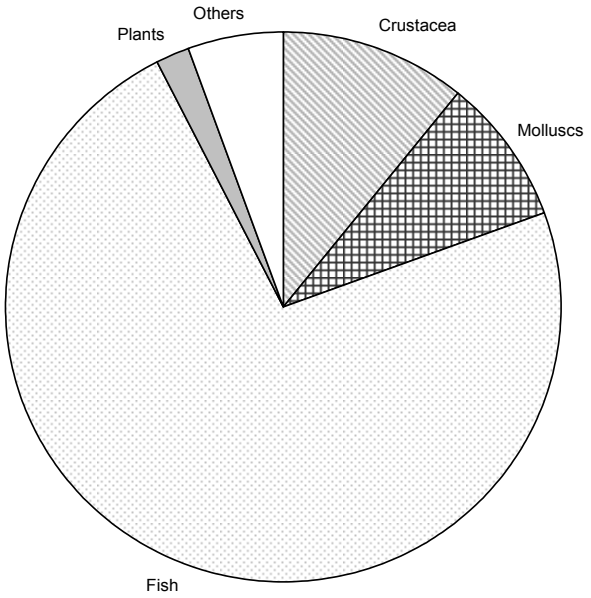

Figure 1. *Taxa reported taken from the world's capture fisheries in 2003.*

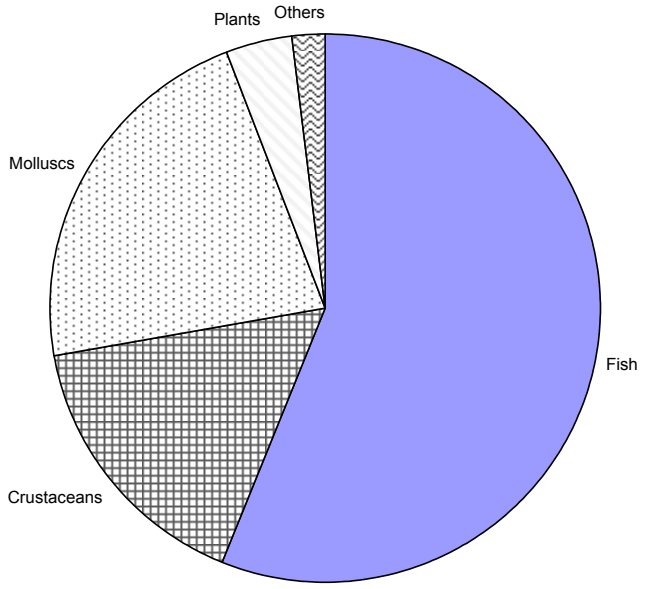

Figure 2. *Composition of the reported aquaculture production in 2002.*

Although over 1000 taxa are represented in this data set, about 10 species make up about 1/3 of total production. Overall production from the world's capture fishery increased up to the late 1980's and has now reached what most fishery scientists think is a plateau, i.e. not much more production can be expected. Aquaculture has become the world's fastest growing food production sector and currently accounts for almost half of all fish products consumed by humans (FAO 2007a). In 2002 FAO Members reported that 153 species of fish, 60 species of mollusks, 44 species of crustaceans, 11 species of plants and several other miscellaneous taxa such as echinoderms, frogs, and crocodiles, were farmed in various parts of the world (Figure 2). Contrary to the leveling in production from capture fisheries, aquaculture is expanding rapidly, especially in the developing world, and many governments have increased aquaculture development as development goals.

However, in some areas these activities have been criticized as being unsustainable and have been implicated in causing negative impacts on aquatic ecosystems and biodiversity.

An ecosystem approach was motivated by the increasing societal awareness of the negative impacts of fisheries and by the recognition that conventional fisheries management practices have lead to unsustainable use of fishery resources and aquatic ecosystems. While building on single-stock management, the ecosystem approach recognizes the limitations of conventional fisheries management practices. These include failure to consider ecosystem effects of fishing, poor and top-down decision-making processes, short-term political or financial gain often being prioritized as compared to long-term conservation goals, weak enforcement (at national and regional levels) and the often free and open nature of fisheries. In response to these concerns, and following-up from the Reykjavik Declaration on Responsible Fisheries in the Marine Ecosystem (Reykjavik, 2001), FAO is promoting an ecosystem approach to fisheries (EAF). EAF is particularly suited to deal with the biodiversity issues affecting fisheries. It is defined as an extension of conventional fisheries management that "strives to balance diverse societal objectives, by taking account of the knowledge and uncertainties about biotic, abiotic and human components of ecosystems and their interactions and applying an integrated approach to fisheries within ecologically meaningful boundaries". Its objective is to "plan, develop and manage fisheries in a manner that addresses the multiplicity of societal needs and desires, without jeopardizing the options for future generations to benefit from the full range of goods and services provided by the ecosystem". (FAO, 2003).

The ecosystem approach has been extended to aquaculture where it is a strategy for the integration of the activity within the wider ecosystem such that it promotes sustainable development, equity, and resilience of interlinked social-ecological systems (FAO 2007a). An ecosystem approach takes account of a range of stakeholders, spheres of influences and other interlinked processes. In the case of aquaculture, applying an ecosystem-based approach must involve physical, ecological, social and economic systems, in the planning for community development, also taking into account stakeholders in the wider social, economic and environmental contexts of aquaculture. This is essentially applying the ecosystem based management as proposed by CBD (UNEP/CBD/COP/5/23/ decision V/6, 103-106) to aquaculture and also following Code of Conduct for Responsible Fisheries (CCRF) indications.

Principles for an Ecosystem Approach to fisheries and aquaculture

The overarching goal of the ecosystem approach is improving human well-being and equity; the objective is the sustainable use of aquatic resources for efficient and effective delivery of food and services.

The principles that characterize an ecosystem approach can be grouped according to three main frameworks, the normative, the operational and the cognitive. The normative framework consists of agreed high level conceptual objectives; the operational framework relates to the resources, institutions and processes mobilized for achieving the high level objectives; and the cognitive framework relates to the acquisition of information, analysis and its translation into usable knowledge. The principles comprising these frameworks are elaborated below.

The Normative Framework

Incorporate elements that promote and maintain ecosystem integrity, i.e. maintain ecosystem services, and protect habitats and non-target species
Successful application requires the precondition that this principle is incorporated in relevant policy documents, which, in turn, will promote operationalization through fisheries management. Key fisheries management concerns consistent with this principle include sustainable use of target species taking into account their role within the ecosystem as a whole (e.g. considering trophic and habitat interactions), the effects of fishing on non-target and vulnerable species (including seabirds and turtles); impacts on habitat, effects on biodiversity and on ecosystem structure and functioning.

'Ecosystem well-being' is a key principle that relates to the impacts of fisheries on ecosystem structure and functioning. Through selectively removing large individuals and species, the size, trophic structure and species composition of marine ecosystems tend to change towards less diverse and complex systems (Pauly et al., 1998). Another aspect is related to exploiting target species at levels that are not sustainable at the ecosystem level, i.e. without considering the role that the target species may have both as prey or predator of other species. Modeling tools can be used to help understand how target species function within ecosystems (Plagányi, 2007 and FAO, in press). Despite progress made in this field, a high level of uncertainty is usually associated with modeling often because of poor data quality and poor understanding of the system. While modeling can help gaining insight on ecosystem structure and functioning, present knowledge cannot provide decision-makers with firm answers; adopting this principle implies relying on precautionary (risk adverse) decisions.

Also important is the impact of fishing on non-target species, particularly for those that are most vulnerable such as sea turtles, sea birds and sharks. International Plans of Action (IPOAs) have been developed for Sea Birds (FAO 1999), and for sharks (FAO 2000?). Incidental mortality of sea turtles in fishing operations has also generated major international concern; guidelines have been developed to reduce the negative impacts of fisheries (FAO, 2005a; FAO in press). Experimental work has shown that incidental catch and mortality of sea turtles can be drastically reduced through appropriate gear modifications and fishing practices.

The impacts of fishing on marine habitats, such as the impact of bottom trawling on the seabed, are also becoming a major fisheries management concern. The use of mobile gears dragging the bottom, such as dredges and trawls, leads to a direct and durable impact on the fishing grounds, modifying the structure of the substrate, the habitat and the benthic populations. These impacts are particularly evident in the case of hard bottoms populated by epibenthic organisms, while they seem more difficult to document for soft bottoms (Loekkeborg, 2005). In response to these concerns a complete international ban of bottom trawling is being suggested as a "grand solution" to the problems associated with this practice. However, under an ecosystem approach the aim of fisheries management is to optimize ecosystem use in terms of protecting ecosystems while contributing to human well-being. It will therefore be necessary, based on improved scientific information, to establish spatial management regimes that match different recovery properties with appropriate trawling intensity, including total closure of highly sensitive areas such as those with large erect sessile fauna like corals, sponges and other such structures

A number of international instruments of relevance to fisheries refer to marine protected areas (MPAs) as essential tools to conserve marine resources and manage fisheries. MPA's have been strongly advocated by environmental groups and agencies as a key fishery management instrument and, too often, as the overriding solution to overfishing. While an extensive scientific literature exists to document the ecological benefits of MPAs, research is only now reaching the point where some MPAs could be recommended in an ecosystem approach to fisheries (FAO 2007a). A key problem has been that the distinction between MPA's for conservation and as a fishery management strategy has not been made, i.e. the objectives of the MPA's have not been accurately defined. MPAs and reserves in relation to fisheries are becoming better understood, with a number of successful cases and failures from which lessons can be drawn. Judiciously and specifically designed for fisheries and integrated with conventional management measures to reduce fishing capacity, limit harvest, establish fishing rights, improve selectivity, etc., MPAs can be useful for fisheries to protect species from extinction, critical habitat, and critical stages; to act as a buffer; to improve knowledge on ecosystem functioning; and to improve livelihoods through better yields and tourism.

A key issue in an EA is to define or estimate the resilience capacity or the limits to the acceptable environmental change. In the case of biodiversity, local declines may be acceptable at the farm level (eg. below fish cages) as long as such losses can be compensated and restored, at least at the water body scale, in order to preserve ecosystem function and services. In aquaculture after a cage farm operation is halted it is expected that the relevant biodiver-

sity recovers if there is enough nearby biodiversity to provide relevant colonization and restoration.

Integrated aquaculture and more specifically multi-trophic aquaculture (IMTA) has been proposed as an effective way to diminish aquaculture impacts on biodiversity and ecosystem services. Integrated farming has been practiced in Asia since the beginning of aquaculture, due to their ancient concept of treating effluents and residues from farming practices as resources rather than as pollutants. However in the western world where aquaculture is much more recent there is no tradition of using effluents as useful inputs and it is much more difficult to apply the idea of integrated aquaculture.

Ensure equity, both intra- and inter-generational

The concept of equity implies both the intra-generational equity, i.e. fair distribution of rights of various sections of society at present and intergenerational equity, and thus the need to make sure that future generations will be able to draw the same benefits from aquatic ecosystems as we do. It is essential that policies at the national and international levels are tuned to create an enabling environment consistent with these high level goals. This may result, for example, in having to revise fisheries policy documents and relative legislation to make them consistent with this principle. However, future generations will also benefit from increased capital generated today and either used to improve living conditions or passed on to descendants of today's fishers and farmers.

The Operational Framework

The operational framework relates to the resources, institutions and processes mobilized for achieving the high goal objectives. EA principles related to this include the following.

Address the interaction of different sectors

There are numerous users of marine and coastal environments; often these uses are in conflict that must be rationally addressed. Article 9.1.3 of the CCRF provides for the sharing of natural resources among aquaculture and other sectors: "States should produce and regularly update aquaculture development strategies and plans, as required, to ensure that aquaculture development is ecologically sustainable and to allow the rational use of resources shared by aquaculture and other activities."

Conservation groups and other non-extractive users of aquatic resources have often opposed development, whether it is for fishing, fish farming or other activities. A positive way to address different priorities has been employed by a diverse group of users, FAO, Network of Aquaculture Centers in Asia and the Pacific, UNEP, World Band, and WWF that created a Consortium on Shrimp Farming and the Environment. This multi-sectoral group established international principles for sustainable shrimp farming (FAO 2006). The WWF has also established a "Dialogue" series on aquaculture to address important issues of use and conservation (http://www.worldwildlife.org/cci/progress.cfm). Similarly the Ramsar Convention on Wetlands, usually perceived as a conservation convention, has acknowledged the value of cross-sectoral approaches and the specific value of fishing and fish farming in wetlands. In 2007 world wetland day focused on Ramsar wetlands and fisheries, thus recognizing that a strategy to promote conservation of wetlands is to demonstrate the usefulness of those wetlands to a variety of users (Ramsar 2007).

Conflicts have arisen between fishing and fish farming because of the perception that fish farms adversely impact capture fisheries. Potential impacts include: spread of disease from farmed to wild fish; adverse impacts from escaped farmed fish on wild stocks through competition, predation and genetic contamination of wild stocks; pollution from fish farms; land conversion from fishing areas to farming areas, e.g. mangroves to shrimp ponds and ox-bow lakes to fish enclosures in Bangladesh resulting in reduced access to traditional fishing areas; and market competition. Some farmed commodities are cheaper and more readily available reduce economic incentives to fish.

In many areas the capture fisheries sector are aligning themselves with the conservation sectors as stewards of wild populations of fish. Indeed fishery management is a form of in situ conservation as called for by the Convention on Biological Diversity. This alliance will promote more responsible capture fishing. The aquaculture industry should likewise strive to form alliances and some have been established as described in the shrimp consortium above.

Alliances between fishers and fish farmers could benefit both sectors through joint promotion of the health benefits of fish. Culture-based fisheries done responsibly could support viable capture fisheries. Capture fisheries provide the raw ingredients for fish oil and fish meal that are used in agriculture and aquaculture feeds.

Inter-sectoral institutions are not yet well developed, though their establishment is implied in the Code for the furtherance of responsibility in aquaculture. Therefore, development of inter-sectoral institutions, to work for harmony among aquaculture, conservation and other sectors, should be pursued.

Another means to address the interaction of competing sectors is the zonation of land and water environments into those areas suitable for development and those for conservation where development would be restricted. This is already being done to some extent by the use of MPA's (above) and closed fishing seasons/areas. Countries in West Africa wish to develop aquaculture and use genetically improved species and other advanced technologies. In recognition of the value of wild fish populations they have called for the mapping and establishment of conservation areas in the Volta Basin and in return they should be allowed to develop aquaculture outside these conservation areas (CIFA 2007).

Two areas of specific ineraction between fisheries and aquaculture, culture-based fisheries (CBF), i.e. stocking, and capture-based culture (CBC), i.e. harvesting of young fish from nature for grow-out in aquaculture, require explicit treatment of how the practice of each sector impacts the other. Stocking to support CBF is a controversial manage-

ment strategy However by integrating the practice into a overall fishery management programme that defines where such practices should be allowed, that protects wild stocks and developing fisheries, sets reference points and establishes monitoring and enforcement programmes, increased production can be achieved from CBF and CBC (Bartley and Bell 2007).

The FAO Sub-Committee on Aquaculture requested that FAO address the environmental costs of aquaculture in comparison with other land-based food production sectors (Bartley et al. in press). Although determining environmental costs are complicated and a subject for more in-depth study (see section 3), such comparisons allow decision-makers to determine best uses of land and water and help consumers make informed decisions on the food they eat.

For inland areas, the integration of rice and fish farming has helped minimize conflicts between agriculture and aquaculture sectors as well as reducing amounts of pesticides through integrated pest management, documenting traditional cultural practices, providing justification for improved water-management, and increasing nutritional food security in rural areas (Halwart and Bartley 2005).

Explore novel means of promoting responsible fisheries and aquaculture, including use of incentives
Prescriptive fishery management and legislation have often not been effective and new approaches are needed. Stakeholders must see the benefits of using the EA so that they choose to farm and fish responsibly. One such strategy is the use of eco-labels and certification programmes in order to gain market share for products produced responsibly. The Marine Stewardship Council provides one certification system that involves retailers, governments, NGOs, conservationists, the fishing industry and other groups to certify fisheries that meet specified standards. Over twenty fisheries have been certified and another 18 are awaiting certification (MSC 2007). Guidelines on certification of marine fishery products have been accepted by FAO and fish products from inland fisheries; guidelines for aquaculture are being developed (FAO 2005). A novel approach in inland fishery certification recognizes that culture-based fisheries contribute significantly to production and could also be eligible for eco-certification if the culture-based fishery was managed to protect the environment, to protect wild aquatic resources, and to allow fair and equitable access to the fishery (FAO 2006).

Acknowledge that information will never be complete, but that the best scientific information and a precautionary approach should be followed
The precautionary approach recognizes the uncertainty inherent complex systems. It implies that where there are threats of serious irreversible damage, lack of full scientific knowledge shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation. This should result in conservative management action until more is known about ecosystem structure and functioning.

FAO (FAO 1996) described the following elements of a precautionary approach to capture fisheries and species introductions:

- Reference points should be established to help determine desirable situations or undesirable impacts, e.g. target and limit reference points;
- Pre-agreed actions or contingency plans should be implemented in a timely manner when limit reference points are reached or when adverse impacts are observed;
- Priority should be given to maintaining the productive capacity of the resource where there is uncertainty as to the impacts of development;
- The impacts of development should be reversible within 2 – 3 decades;
- The burden of proof should be placed according to the above requirements and te standard of proof should be commensurate with risks and benefits.

Although the above were developed for capture fisheries they can also be applied to aquaculture (Bartley 1999).

All development will have impacts
In 1996 there were over 830 million people were hungry and food insecure, about 80% women and children; the World Food Summit pledged to reduce this number in half by 2015. In 2001–03, FAO estimated there were still 854 million undernourished people worldwide. In spite of advances in some countries, virtually no progress has been made at the global level. Something more needs to be done. Food production has outpaced human population growth over the last few decades, but people are still hungry.

Recognize that human's with their economic necessities and values are an integral part of the ecosystem;
Fisheries management has shifted from an emphasis on resource management to including resources users. Fishing includes both subsistence and commercial scale enterprises. At the subsistence level, capture fisheries in many areas provide a safety net to be used when other food production or supplies fail. Development is not emphasizing subsistence aquaculture because of the difficulties of poor fish farmers maintaining ponds and quality fish. Therefore, except in emergencies or in specialized areas, fishing and fish farming are done for commercial purposes, either traded for money or bartered for other goods. Thus farmers and fishers must produce a marketable product.

The use of alien species has often been in response to trying to increase profit from fisheries or from aquaculture. Chile made a decision to introduce salmon farming in a region where few other options for development existed; now the salmon farming industry in Chile is the world's number one producer of farmed salmonids and employs around 50 000 people.

In response to disease problems with the local marine shrimp, Penaeus monodon, China, Thailand and other Asian countries introduced the white-leg shrimp, P. vannemei. Production is increasing and more alien shrimp are now farmed in China than their local species.

The EA recognizes the rights of countries to make these introductions, but would also require that the other elements of the EA be followed, e.g. maintain ecosystem functions and protect native biodiversity.

Ensure the use of the proper scales to address the issues

In the case of aquaculture, iy is particularly important to define the boundaries of the ecosystem in order to address main issues. The single farm scale is easy to picture; this is the relevant and meaningful extent of the farm which could be few meters beyond the physical boundary of the farming structures (in many cases it could be a backyard pond).

While in some cases it may be difficult to identify the relevant water body to which aquaculture, together with other activities, will have an impact, in most cases we are talking about watersheds. This includes land and inland water bodies as well as circumscribed coastal areas in the context of the integrated ecosystem. This is or should be an integrated land-water resource management level (ILWRM) and it is clear that this should be a final aim/goal for policy-making. The watershed is very important for example as a provided of remediation/recovery of biodiversity to the farm scale or for clusters of farms. This scale becomes more difficult to apply (but not impossible) when we are talking about complex coastal areas, fjords or large estuaries. In some cases these may be within a single country or cross national boundaries e.g. lower Mekong Basin. National or International policy and other issues would often mostly relate to the ILWRM level aquaculture system/s under consideration. Another scale may be useful and needed; and that is the aquaculture zone or aquaculture region.

The use of fish products in aquaculture, is related to the interaction of aquaculture and fishing and agriculture, but it is also related to the issue of scale. Aquaculture has traditionally utilized products from fisheries, namely, fish meal, oil and also trash fish converting these in high value products. Almost 50% of all aquaculture production is now firmly dependent on commercial feed. Presently it is calculated that aquaculture is using about 50% of total fish meal production and about 80% of fish oil with the predicted use of fish oil for aquaculture estimated to rise to 85% of the total available by 2010.

This dependency on fish meal and fish oil could pose a threat on the pelagic systems supporting fish meal production as it could have an impact on the food base for marine mammals and sea birds Therefore if aquaculture continue its dependency on these fish-based products it could increase its impact on biodiversity. During the past decade efforts were made to reduce fish meal use and find a replacement with vegetable proteins such as corn gluten, soybean etc. The fishmeal content of salmon has declined from 60% to less than 35%. On the other hand thinking that conversion to vegetable protein is the right "more sustainable" way to go can be somewhat misleading. Vegetable proteins containing important amounts of anti-nutritional factors, phytates etc. which can be difficult to degrade in the water specially in marine ecosystems, therefore environmental impacts could be greater at this end. However more comparative research is needed to understand the impacts of changing diets.

Engage all relevant stakeholders and allow local societies to choose the level of acceptable impacts

With humans as integral components of ecosystems, the EA seeks to empower local communities, resource users and resource managers. Co-management regimes and community management of shared resources are means to facilitate this empowerment. The idea of territorial user rights in some South Pacific marine fisheries and beach management units in Lake Victoria and other African water bodies is to establish formal structures for governance and decision making in regards to fishery resources. These administrative structures can also promote habitat protection, provide information on human nutrition and health issues, e.g. HIVAIDS, teach business management and foster good fishing practices.

Most recent international instruments require that stakeholders be more closely associated to the management process, data collection, knowledge building , decision making and implementation. Although there are steps in this direction, there a need to create appropriate mechanisms for this to happen, how to improve the consultation process and communication.

The Cognitive Framework

The cognitive framework relates to the acquisition of information, analysis and its translation into usable knowledge.

Improve the information on aquatic ecosystems, including aquaculture systems, and disseminate it widely

The complexity of an EA requires accurate information from a variety of sources and a means to present this array of information in a useful format. Scientists, the general public and policy makers will all require information presented in specific ways in order for it to be used effectively. Disseminators of information need to understand the users' needs will be different and therefore the information must be packaged accordingly.

The official FAO database (www.fao.org/fi/website/FIRetrieveAction.do?dom=topic&fid=16003), to which Member countries contribute, include relevant information on production (catch and farm production), aquaculture value, trade quantities and values, and food balance sheets, all of which will be relevant to an EA. Relational databases such as FishBase (www.fishbase.org) provide another means of integrating different sources of information for a more in-depth analysis.

The FAO Database on Introductions of Aquatic Species (DIAS) (Bartley 2006) contains information on the international transfer of aquatic species, who was responsible, why the introduction was made, and the socio-economic and ecological impact of the introduction. Analysis of the records in DIAS indicated that there have been far more beneficial socio-economic impacts from the use of alien species in fisheries and aquaculture than there have been adverse ecological impacts.

Data from a variety of sources listed above, plus data on water resources (Jenness et al. 2007 ; CAWMA 2007) can be incorporated into a geographic information system (GIS) to facilitate dissemination and comprehension. Zoning of farming or conservation areas, mapping the extent of watersheds, plotting the transfer and flow of nutrients, fish, fish larvae or other materials can be an effective means to demonstrate impacts and help make policy based on an EA.

New methodologies and approaches are being used to help assess ecosystem impacts. These include energy analysis, ecological footprint; human appropriation of net primary productivity and life cycle analysis (Bartley et al. in press). These methods each have strengths and weaknesses that must be borne in mind when presenting information. For example the ecological footprint reduces complex environmental characters into a single measure of the amount of space required for a given activity, e.g. fish farming; it treats all environments the same with regard for resource rich or endangered environments. Life cycle analysis monitors a series of data categories that contribute to the overall impact of an activity and as such allows fine tuning of impact assessment and mitigation depending on the sensitivity or values of a given area. Refinement of these methods is identified as an area of future work (see below).

Unfortunately, much of the information needed to assess ecosystem level impacts is lacking. A major conclusion of the EU funded Genimpact Study to assess the risks of farmed European species impacting native populations was that there was insufficient information on the genetic resources of European species to assess the risk accurately (Svasand et al. 2007). Life cycle analysis and information on the value of biodiversity and ecosystem services is also lacking (Bartley et al. in press).

Future areas of work:

The EA is an information and stakeholder intensive approach. Its successful application requires improved collection of basic information on biological and physical resources; their value to the humans that use and enjoy them and how complex systems change as a result of human and non-human impacts. There is a need therefore to increase the understanding on ecosystem structure and functioning, particularly as regards inter-species interactions. Key information gaps also exist on how to value ecosystem services and biological diversity and then how to account for that value in management and development.

Because uncertainty exists and change is inevitable, there is a need to develop adaptive management systems that involve all stakeholders. Related to this is the need to develop methods and guidelines to identify these stakeholders and engage them in participatory decision-making and communication. There is a strong need for research and improvement on modeling and predictive tools for environmental capacity in the case of aquaculture. Such models should be feeding adaptive management programs in conjunction with the farmers.

At the more technical level, research is needed to develop fishing gears and practices to minimize environmental impacts of fishing. In aquaculture improved feed formulation to reduce waste and improved containment facilities to reduce chance of fish escaping is needed.

Concluding Section

To deal with these issues, and based on the principles contained in the Code of Conduct for Responsible Fisheries, guidelines have been developed to facilitate implementation of the ecosystem approach to fisheries (FAO, 2003). In addition to presenting the key principles associated with the ecosystem approach, the guidelines describe a practical and systematic way of how key EA issues can be identified and prioritized for a given fishery, and fisheries management plans developed and implemented to achieve desired objectives. This is done using a hierarchical-tree approach, including three main categories of issues: those related to the ecosystem well-being, to social and economic aspects of the fishery and to governances.

Establishing well-functioning governance systems is another main concern under an ecosystem approach, both given past fisheries management failures, but also given the greater challenges posed by the EA paradigm. Although more important in fisheries, good governance is also important in aquaculture (SOFIA 2007). There are a few key elements that are considered fundamental for successful implementation of EA. These include establishing participatory management systems, as compared to traditional top-down control mechanisms and using incentives as compared to being prescriptive. It is therefore essential that stakeholder participation is envisaged at any level of the fisheries management process and decision-making. Selection of legitimate stakeholders and clear rules as regards participatory decision-making need to be further developed. Implementing the above elements is the key to responsible fishing and fish farming that improves the human condition and protects natural resources.

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Management of coastal resources: their role in supporting and protecting livelihoods

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Introduction

This paper focuses on the importance of marine living resources in supporting and protecting local livelihoods in developing countries. It also presents a large-scale WWF (World Wide Fund for Nature) approach to the management of globally significant marine biodiversity through local initiatives. Finally, it presents some experiences from the field using the case of a WWF project in Bazaruto Archipelago National Park in Mozambique.

Biodiversity and developing countries

Many of the globally most biodiversity rich areas and ecosystems are found in developing countries. In these areas poor local communities depend on the natural resources for their livelihoods and development opportunities.

WWF has developed a science-based Top 200 list of the most biodiversity rich ecosystems or ecoregions in the world. Figure 1 shows WWF's 200 prioritized ecoregions for biological diversity. The majority of these areas and ecosystems are found in developing countries. This illustrates the overlap in areas where poor people depend on the natural resources for their livelihoods and areas with globally significant biodiversity values. Conservation and sustainable management of natural resources and biodiversity with and for local communities equals development opportunities.

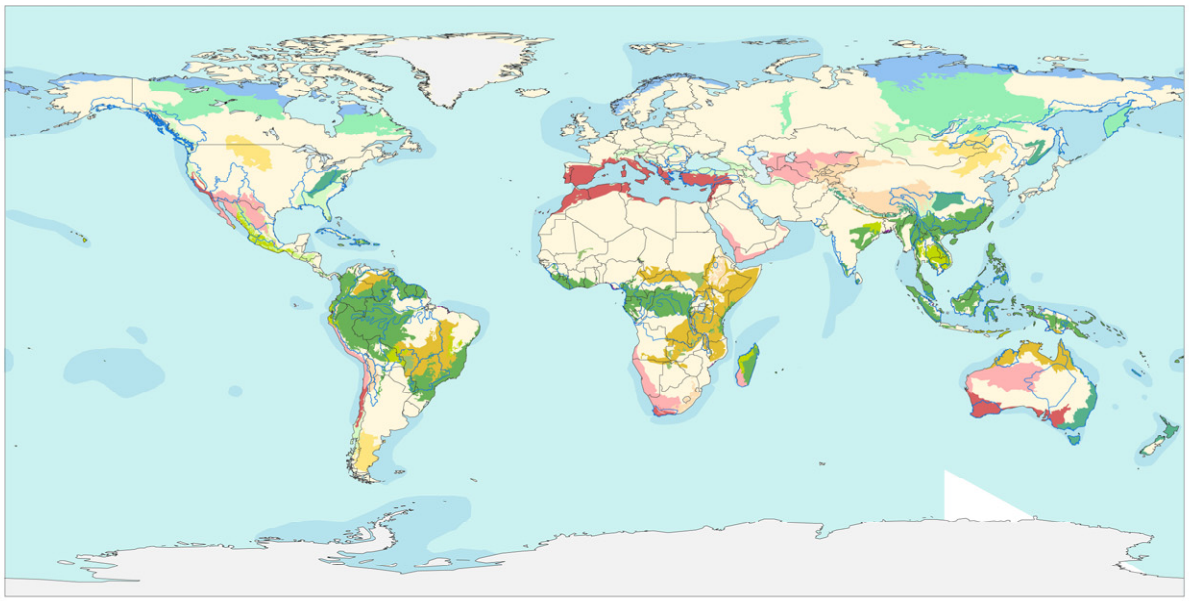

Figure 1. *WWF's 200 prioritized "ecoregions" for biological diversity. For more information on the Global 200 visit the WWF website:* www.panda.org.

The Eastern African Marine Ecoregion

The Ecoregion approach supports conservation of biological diversity and ecological processes at broader scales and the links between different species habitats within the bigger picture of national development.

The Eastern African Marine Ecoregion is an area stretching from southern Somalia, through Kenya, Tanzania and Mozambique, to the Natal shores of South Africa. This coastal marine area of more than 480,000 km^2 is referred to as an 'ecoregion' because of the way the marine and coastal habitats are linked, both physically and ecologically.

The Eastern African Marine Ecoregion contains globally important marine and coastal habitats, has high species diversity and high level of endemism, including important habitats for migratory sea birds.

The main habitats present in the ecoregion are mangrove forests, seagrass beds, coral reefs and open waters, home to over 11,000 species of plants and animals. These habitats form a mosaic along the coast, supporting rich and complex populations of marine species that rely on this diversity for their productivity.

Coastal resources and local livelihoods

The 4,600km coastline of the Eastern African Marine Ecoregion is host to an ever-growing population of 22 million, most of whom depend on the coastal seas for their sustenance, business and leisure. This comprise between 9 and 38% of the population of the countries along the coast, for whom fishing is the main commercial and subsistence activity. Foreign businesses (e.g. hotel operators) are also important especially for creating job opportunities. All depend on the coastal environment for their livelihoods. In Tanzania, for example, the estimated average consumption of seafood per person (9.4 kg/year) is greater than the combined consumption of meat and poultry.

In the last fifty years, human activities in the coastal zone have begun to alter and destroy this biodiversity, essential to the inhabitants on these shores. Though many pristine areas remain, the rate of human impact is expected to increase.

Figure 2. *The Eastern African Marine Ecoregion, stretching from southern Somalia, through Kenya, Tanzania and Mozambique, to the Natal shores of South Africa. For more information on the East African Marine Ecoregion visit the WWF website: www.panda.org.*

The four most important reasons for maintaining marine biodiversity

1) A diverse and healthy marine ecoregion is more productive and therefore provides more fish, mangrove wood, etc. for the users. Each species has a specialised way of using different resources and adapting to changes (e.g. in water salinity or temperature), thus by having more species the productivity of the habitats and ecosystem is maximised.
2) A diverse and healthy marine ecoregion, through having more species, is also more stable. This helps protect against environmental changes (e.g. sea level rise, flooding, hurricane and cyclone damage) and improves recovery.
3) A diverse and healthy marine ecoregion allows species that depend on different habitats at certain stages of their life cycle (e.g. larval period, growth period, reproduction and nesting) to continue to exist. Keeping only one habitat may not be sufficient to retain all species, but keeping all habitats in a healthy condition again maximises productivity.
4) The quality of life for coastal people, and visitors, relies in part on the marine biodiversity for aesthetic reasons.

Biodiversity conservation in the Eastern African Marine Ecoregion

To establish priorities for biodiversity conservation in the Eastern African Marine Ecoregion, WWF and partners facilitated a series of meetings, culminating in Mombasa in April 2001, to: (a) collect and analyse baseline data on the biological, socio-economic, policy, legal and institutional characteristics of the ecoregion; (b) build on approaches consistent with national priorities, and; (c) identify key sites of biodiversity that should be prioritised for their conservation value. Participants at these meetings included natural and social scientists, as well as other interested parties from all the countries in the ecoregion, except Somalia.

A common vision statement describing the Eastern African Marine Ecoregion 50 years into the future was developed: "*A healthy marine and coastal environment that provides sustainable benefits for present and future generations of both local and international communities, who also understand and actively care for its biodiversity and ecological integrity.*"

All participants contributed information and expertise to help map priority areas for species and community groups. The criteria used to select these sites included their contribution to global or ecoregion biodiversity and to national economies. A total of 21 sites within the ecoregion were identified, with eight considered to be of global importance. Bazaruto Archipelago National Park in Mozambique is one of these eight areas with marine biodiversity of global importance.

The Bazaruto Archipelago National Park, Mozambique

The Bazaruto Archipelago National Park (BANP) is one of only two marine parks within Mozambique. Covering an area of 1,430 km^2 the Archipelago supports a high diversity of marine and terrestrial ecosystems and species. The BANP provides protection to the largest and only remaining viable population of dugongs in the Western Indian Ocean; five species of sea turtles; coral reefs; whales, dolphins and other marine animals, over 1,500 species of tropical fish, and several endemic terrestrial gastropods and lizards. It is also an important bird migration area.

The Archipelago also supports a resident population of about 3,500 people living in seven communities. Most families are extremely poor and are strongly dependent on the use of natural resources for their livelihoods. Small-scale fishing and harvesting of other marine resources are the primary activities and main source of income for over 70% of households.

The Archipelago is a popular tourism destination. Several hotels within the Park contribute substantially to the local economy and livelihoods of local residents, and are important stakeholders within the BANP. Tourism provides employment opportunities and a portion of tourist taxes are shared with local communities.

WWF has provided support to the Park Administration since 1989. Norad and WWF-Norway has funded a community component, the Bazaruto Natural Resource Management Project, since 2003. The community project is implemented by the WWF Mozambique Coordination Office, the WWF Southern Africa Regional Programme Office and the local NGO Forum Natureza em Perigo, in partnership with the Bazaruto National Park Administration (BNAP).

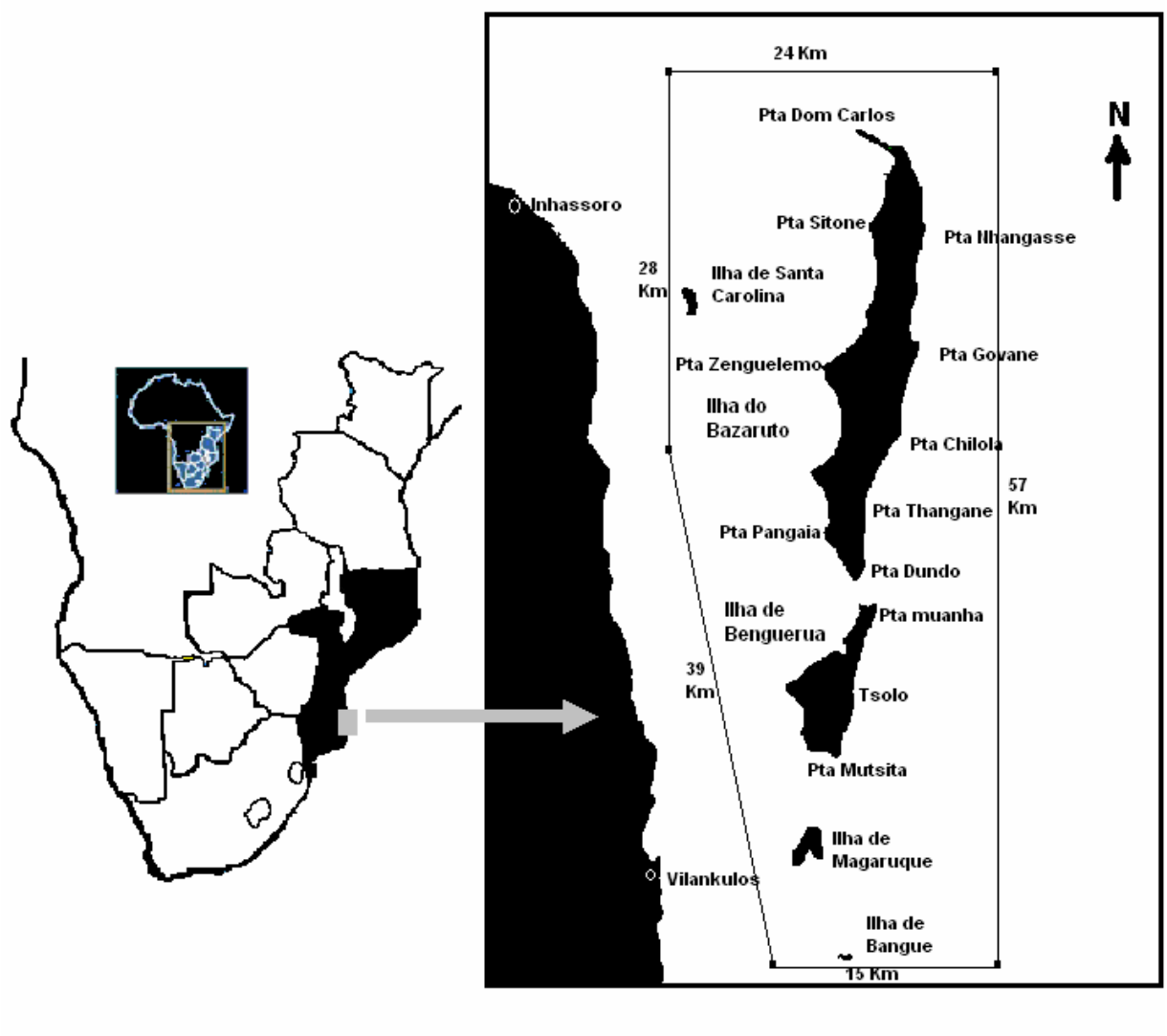

Figure 3. *Map of the Bazaruto Archipelago National Park, Mozambique.*

Project goal and purpose

The goal of the Bazaruto Marine Natural Resource Management Project is that "*Local communities benefit from and contribute to the conservation of coastal and marine biodiversity in the Bazaruto Archipelago National Park, Mozambique*".

The project purpose is that "*Community-based organisations are actively participating in the protection, management and sustainable use of the Bazaruto Archipelago National Park and its natural resources, together with the management authority and private sector partners*".

Threats to biodiversity and natural resources in Bazaruto Archipelago National Park

The main threat to the biodiversity values and marine species of special conservation interest in the Park is the over-harvesting of living marine and coastal resources, both by local artisan fishing and illegal international fishing vessels (trawlers and long liners, mainly from Asia). The population of endangered dugong is small and possibly decreasing, primarily as a result of high mortality in gill nets set for sharks. The combined effects of slash and burn agriculture, wild fires, over-harvesting of mangrove-trees, and over-grazing by small livestock threaten terrestrial biodiversity. This is further acerbated by population growth.

In addition to unsustainable resource use of natural resources, potentially unsustainable tourism development is

another key threat to the resource base of the Park. Compliance with the government's management plan for the Park is key in this respect. The management plan is currently being revised and must deliver a suitable mechanism to control future developments, such that these are limited to the capacity of the system to support such activities on a sustainable basis.

Finally, off-shore oil and gas exploration initiatives in areas bordering the National Park may pose a threat to biodiversity values and ecosystems.

Challenges in the field

The main challenges in the field focus on issues that are often general to this type of project initiatives.

1. Establishment and functioning of community based associations: Building upon traditional structures and simultaneously ensuring representative involvement; developing and making operational systems for fair and transparent distribution and use of revenues.

2. Capacity building at the local level: Ensuring proper participatory decision-making in natural resource management; dealing with constraints such as low education and literacy levels of island inhabitants.

3. Limited capacity for Park management: Limited funding for the administration and management of the Park; limited resources for the implementation of the management plan; lack of coastal patrol to control international illegal fishing; lack of clarity regarding status and rights of residents within the Park.

4. Strong private sector with large-scale investment: Controlling potentially unsustainable tourism development; collaborating on community initiatives when goals differ; arguing the case for objective versus subjective interests and short-term profits against long-term benefits.

5. Development of alternative livelihoods: Highly demanding in terms of time and human resources; need for basic education and training; need for specific activities for women; the dilemma of potentially changing traditional ways of life.

Lessons learned

Similarly, the lessons learned focus on issues that are often general to this type of project initiatives.

1. The participatory approach to natural resource management necessitates long-term investments as working with people and community structures takes time. To achieve sustainable results in the field project interventions will often need a time-frame of 10 years or more.

2. Capacity building locally will often need to start from scratch: there are no quick fixes.

3. Forming parallel structures must be avoided. Establishment of community associations should build on traditional structures and existing institutions and organisations. This necessitates site specific implementation strategies: there is no one size fits all.

4. For the ecosystem approach principle of devolving management to the lowest level to work, local rights to resources need to be properly formalised and secured.

5. Conservation efforts need to generate sufficient incentives in terms of income or other benefits to obtain the necessary support from local communities. Without combating poverty and providing alternative income-generating activities, little can be achieved towards long-term conservation.

6. The linkage between environment and poverty alleviation is highly recognised at the rhetorical level. In reality however, stakeholders at all levels (local, national, regional and international) still need to realise the importance of biodiversity. Conservation and sustainable use of natural resources are still often regarded as a luxury; something to address after other development goals have been reached.

Strengthening the scientific basis for the CBD – improving the interface between science and policy (Abstract)

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The Convention on Biological Diversity (CBD) contains a number of provisions for scientific and technical cooperation which has evolved into its current scientific basis. Credible and legitimate international assessments have proven effective in bridging science and policy, and calls have been made for a biodiversity equivalent to the Intergovernmental Panel on Climate Change. Such an equivalent is but one of the options considered under the international consultation on an International Mechanism of Scientific Expertise on Biodiversity (IMoSEB).

The recently completed GEO-4 and the ongoing International Assessment of Agricultural Science and Technology (IAASTD) have both become intergovernmental without creating new intergovernmental bodies. The Millennium Ecosystem Assessment (2005) increased its relevance through sub-global assessment. Such features can be sustained through capacity building in developing countries for collection, assessment and exchange of environmental data and information. National capacities can be coupled with research and global observing capacities through networks to strengthen the very foundation for international assessment processes.

Indicators such as the 2010 biodiversity indicators can be used more effectively to structure and strengthen the evidence base of the next generations of international assessments. The next generation of assessments will also require increased attention to medium term environmental projections, valuation of ecosystem services, and assessment of impacts of environmental change on human vulnerability and well-being. Assessment of effectiveness of policies and identification of best practices will also need more attention.

The CBD may benefit from the fact that environmental challenges are interlinked across thematic, institutional and geographic boundaries; - a feature which can be used to design complementary assessment programmes. The ongoing assessment of assessments of the Regular Process for the Global Reporting and Assessment of the State of the Marine Environment initiated by the UN General Assembly is expected to provide useful insights on how to turn a proliferated and patchy assessment landscape into a coherent scientific base for decision-making.

The role of developing countries in global biodiversity governance (Abstract)

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Global Environmental Governance (GEG) is the sum of organizations, policy instruments, financing mechanisms, rules, procedures and norms that regulate the processes of global environmental protection. Since environmental issues entered the international agenda in early 1970s, global environmental politics and policies have been developing rapidly. The environmental governance system we have today reflects both the successes and failures of this development. There is a high awareness of environmental threats and numerous efforts have emerged to address them globally. At the same time—and partly because of the rather spectacular growth in awareness and initiatives—the GEG system has outgrown its original design and intent. The system's high maintenance needs, its internal redundancies, and its inherent inefficiencies have combined to have the perverse effect of distracting from the most important GEG goal of all—improved environmental performance. All of these challenges are particularly evident in the area of biodiversity. Is our current system of biodiversity governance up to the task of addressing global biodiversity challenges? Or, are the deficiencies in governance regimes dragging the implementation down? What might be ways in which we could improve global environmental governance, in particular in the area of biodiversity?

These are some of the questions that we will address as we seek to identify a number of practical steps that can foster a more efficient and effective biodiversity governance, making better use of the resources available and designed in a way that will be more helpful to the implementation of international agreements for developing as well as developed countries. In identifying recommendations, we will consciously seek ideas that might lead us to: (a) a balance between short-term incremental improvements and deeper-rooted longer-term institutional change; (b) improved implementation of existing environmental instruments and improved effectiveness of existing institutions, including better coordination between them; (c) better incorporation of non-state actors; (d) meaningful mainstreaming of the environmental and sustainable agenda into other policy streams; and (e) greater prominence and confidence in global environmental institutions and initiatives at the level of the international leaders and public opinion.

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Business and ecosystems – the role of private business in ecosystem management

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Part 1: Ecosystem challenges and business implications

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 (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 MA2 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 nongovernmental organization (NGO) campaigns, shareholder resolutions and changing customer preferences;
- Access to capital – restrictions as the financial community adopts more rigorous investment and lending policies.

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.

> *"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

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.

Part 2: Markets for ecosystem services – new challenges and opportunities for business and the environment

Introduction

This briefing paper outlines the potential for mobilizing business and markets to conserve nature. It argues that market mechanisms can be a powerful complement to existing strategies for conserving ecosystems, if used in the right way.

The paper is intended for both the business and conservation communities, in an effort to establish a shared vision of market-based approaches to nature conservation. It builds on current scientific research underlining the economic value of ecosystems, as well as recent inter-governmental decisions to enlist the private sector in conservation efforts.

The Millennium Ecosystem Assessment (MA) assessed the global status and trends of 24 critical ecosystem services, including "provisioning" services, such as the supply of freshwater, biomass fuel, food and fibers, as well as "cultural", "regulating" and "supporting" services that underpin human wellbeing. The MA concludes that some two-thirds of the world's ecosystem services are degraded or being used unsustainably, while also noting that demand for ecosystem services is rising, fuelled by population growth and economic development.

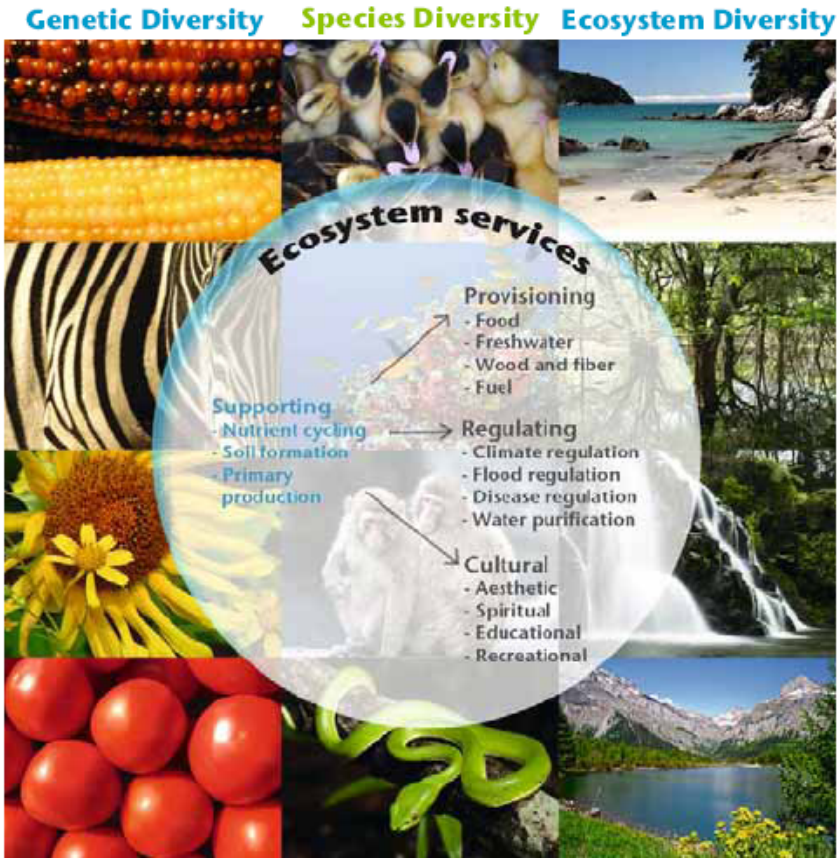
The natural wealth of biological diversity ("biodiversity") includes the myriad species, complex ecosystems and constantly evolving genetic structure of living resources. Conserving biodiversity is central to sustaining ecosystems and the services they provide (Figure 1).

A growing body of research documents how biodiversity increases productivity in different sectors, enhances people's enjoyment of nature, reduces ecological and associated health risks, and improves resilience in the face of shocks.4 At a fundamental level, all economies and businesses depend directly or indirectly on the conservation of biodiversity and the sustainable supply of ecosystem services.

Biodiversity loss and ecosystem degradation thus have profound effects on people all over the world. The decline in provisioning services such as freshwater and fiber directly affects the livelihoods of communities that rely on natural resources for subsistence and cash income, while the loss of or changes in the quality or timing of regulating services, such as natural flood defenses and pest control, can leave millions of people at increased risk of disaster.

Ecosystem degradation affects businesses that rely on natural resources for raw materials, waste assimilation or indirect support for production processes. Loss of ecosystem services can also undermine a healthy workforce. Consumers ultimately shoulder the burden in the form of higher costs of goods and services, higher insurance premiums, or higher taxes to cope with natural disasters.

Conserving ecosystems and sustaining the services they provide is a pre-requisite for prosperity. Environmentalists have long argued this. Business, governments and society at large are catching up. All stakeholders have a role in efforts to sustain ecosystem services. The conservation community has knowledge of ecosystems and methods of effective management. Business can bring capital, research and technology, sophisticated production and distribution capacities. Government can define standards and develop enabling policies. The general public needs to support the process as a whole.



"The degradation of ecosystems and the services they provide … destroys business value and limits future growth opportunities."

World Business Council for Sustainable Development, 2005

Figure 1. *The diversity of life (biodiversity) underpins the supply of all ecosystem services.*

Towards markets for ecosystem services

Conventional approaches to ecosystem management have sought to protect natural resources by regulating business practices and taxing profits (or soliciting charitable contributions) to finance public conservation programs. Such policies are an essential part of the conservation "tool box". They can stimulate business action to protect the environment and raise significant financial resources for conservation. Nevertheless, such efforts are essentially a "rear-guard" action, based on the idea of defending nature against the onslaught of growing economic pressure.

Another option is available. We can create and expand markets for a range of ecosystem services, in the same way that markets now exist at a global level for carbon, and in some countries for sulfur dioxide (SO2), nitrogen oxides (NOx) or water quality. The idea is to make the sustainable management of ecosystems and the enhancement or delivery of ecosystem services a profitable enterprise, just like any other business venture.

The potential of market-based environmental stewardship is not in doubt; the real challenge is to demonstrate to policy-makers, business leaders and the general public that a range of ecosystem services can be managed effectively, efficiently and equitably using market-based mechanisms.

It is not easy to predict how much additional investment can be mobilized or which ecosystems or businesses will benefit most from market-based approaches to conservation. Who could have foreseen the explosive growth in demand for organic foods in some countries over the past 10 years? Who would have thought that European forests would come to dominate the supply of certified timber? What is clear, in both cases, is that large changes in corporate and consumer behavior were achieved with modest investments by those leading the campaign.

A key question is how to identify the most cost-effective market-based mechanisms, in terms of environmental outcomes and financial leverage. Experience to date suggests that rapid innovation can be achieved through voluntary, sector-wide initiatives, such as certifi cation standards or voluntary offset schemes, but that widespread and sustained change in environmental performance often requires institutional and/or regulatory reforms, underpinned by the force of law.

Partnerships among governments, conservation groups and businesses can stimulate new ways of delivering ecosystem services through the market. Increased effort is needed to identify investment opportunities that deliver the most valuable ecosystem services, to develop cost-effective ecosystem management systems for big and small businesses (e.g., standards, guidelines and metrics), and to design efficient and equitable market-based environmental policy and incentives. Robust monitoring and enforcement mechanisms are needed to ensure the credi-

bility of markets for ecosystem services, and the organizations that implement them. Complementary efforts by governments and other stakeholders to conserve those ecosystems and services that are currently not marketable, but which have important option values for the future, are likewise essential, in order to secure and sustain the support of civil society for market-based conservation.

Whatever the future holds for market-based management of ecosystems, governments and NGOs will continue to play an important role. Markets cannot succeed without effective environmental regulations and equitable governance at local, national and international levels. Patience, vigilance and a good measure of flexibility will be needed by all stakeholders to ensure that market-based approaches live up to their promise.

Getting started

There is increasing awareness of the importance of ecosystems and their services for sustaining life on earth. This is accompanied by a growing sense of urgency about the need to halt the ongoing loss and degradation of ecosystems. A range of multi-stakeholder initiatives involving governments, civil society organizations and the corporate sector have consistently emphasized this point, notably the Millennium Ecosystem Assessment (MA). The challenge today is to identify the practical steps that can be taken to conserve ecosystems and the role of business in such efforts.

Several business organizations and networks have produced guidelines and seek to share good practice relating to ecosystem management. These include the International Council on Mining and Minerals (ICMM) and the International Petroleum Industry Environment Conservation Association (IPIECA). A related initiative is the Business and Biodiversity Offsets Program (BBOP), which brings together business and conservation organizations to explore how to compensate for biodiversity loss. Another example is the Ecosystem Services Review (ESR) tool, developed by the WBCSD in collaboration with the World Resources Institute (WRI) and the Meridian Institute. Designed to help businesses understand their ecosystem impacts, dependence and assets, this tool is currently being tested by WBCSD member companies Akzo Nobel, BC Hydro, Dupont, Rio Tinto, Mondi and Syngenta. The ESR tool is based on and consistent with the MA, which outlines practical ways that businesses can understand the linkages between their activities and ecosystems, how to mitigate adverse effects, and how to take advantage of positive linkages.

Understand ecosystems and their services

The first step for many businesses is to reflect on the many products and services that ecosystems supply. While some products are well-known, e.g., freshwater, food, wood, some ecosystem services are less obvious but no less important, e.g., climate regulation, protection from soil erosion, pollination.

Assess dependence and impacts

Based on this reflection, businesses can begin to assess the ecosystem products and services on which they rely, either directly as raw materials or indirectly via support to production processes, as well as which ecosystems provide these benefits, where they are located and their current status. This assessment may be applied to the entire business supply chain. Individual companies need to be aware of the ecosystem goods and services on which their suppliers, partners and customers rely, and whether their own operations have an impact on ecosystem services upon which other people depend. Such a review can start small and focus on a single product line or business unit and subsequently be scaled up.

Reduce impact and scale up solutions

The next step is to develop strategies, policies and operational approaches for ecosystem management, guided by the hierarchy of “avoid, minimize, mitigate and offset” impacts. This should include setting targets for improved performance and reporting results to shareholders and other stakeholders. Finally, businesses should build alliances with scientific and research organizations, NGOs, industry associations and governments with a view to improving understanding of ecosystem services, scaling up solutions to ecosystem challenges and sharing their tools and experience.

Explore and pursue new business opportunities

Based on the process of ecosystem assessment and response outlined above, businesses will be better able to gauge what new opportunities might exist and to capitalize on them. Such opportunities may include developing new products, services and technological solutions, establishing new markets and new businesses, or taking advantage of previously unexploited cost reductions and revenue streams. Finally, businesses should lend support to government initiatives that strengthen incentives for more sustainable management of ecosystems.

Five steps to becoming a good trader of ecosystems services

1. Know that you are selling ecosystem services at full cost;
2. Know that you are buying ecosystems services at full cost;
3. Ensure clear ownership of the ecosystems services that are to be traded;
4. Ensure clear and transparent accountability of the ecological value accruing to the owner as a result of the sale;
5. Create competition among buyers and sellers.

About WBCSD

The World Business Council for Sustainable Development (WBCSD) brings together some 200 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 about 60 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.

About the World Conservation Union (IUCN)

Founded in 1948, The World Conservation Union brings together States, government agencies and a diverse range of nongovernmental 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.

Weblinks

Ecosystem Challenges and Business Implications (November 2006)
http://www.wbcsd.org/DocRoot/Yfe91Zpuv9xjK8PThQmF/Business%20and%20Ecosystems_211106_final.pdf
Markets for Ecosystem Services – New Challenges and Opportunities for Business and the Environment (September 2007)
http://www.wbcsd.org/DocRoot/Qx4WB0UOE0IZ4HgOTtrh/market4ecosystem-services.pdf

Annex 1

Conference Programme

Session 1: Opening Session
Conference Chair: **Peter J. Schei**

Session 2: Setting the Stage
Session Chair: **Peter J. Schei**

- Communicating the issues ... **Frits Hesselink**
- The state of our ecosystems – a presentation of the Millennium Ecosystem Assessment – seen from the sub-global assessments ... **Doris Capistrano**

Session 3: Looking towards 2010 and beyond
Session Chair: **Jon Hutton**

- Preparing a global study on the economic significance of biodiversity ... **Mark Schauer**
- The Role of Biodiversity in Reaching the MDGs and the Issue of Trade-offs: How to "Win More and Lose Less" ... **Charles McNeill**
- Progress on achieving “a significant reduction of the current rate of biodiversity loss“ ... **Neville Ash**
- Quantifying trade-offs related to biological diversity ... **Robert (Bob) Scholes**

Session 4: Biodiversity and poverty: obstacles and opportunities
Session chair: Charles McNeill

- Ecosystem services for rural poverty reduction ... **Balakrishna Pisupati**
- How important is biodiversity in the development agenda – a view from the north ... **Maria Berlekom**
- How important is biodiversity in the development agenda – a view from the south ... **Adriana Ramos**
- Dryland management for poverty alleviation ... **Walter J. Lusigi**
- Biodiversity, traditional medicine and health ... **Peter Furu**
- Biodiversity, grassroot innovations and poverty alleviation ... **Anil K Gupta**

Session 5: Local governance in biodiversity management
Session Chair: **Maria Berlekom**

- Policies to support local management ... **James Murombedzi**
- Local communities and biodiversity management ... **Hazell Shokellu Thompson**
- Culture, rights and biodiversity ... **Lucy Mulenkei**

Session 6: Climate change, energy and biodiversity
Session Chair: **Reidar Andersen**

- Climate change, biodiversity and resilience of socioecological systems ... **Thomas Elmqvist**
- Climate change, land degradation and biodiversity in Africa: the challenge remains: how do we reach out? ... **Juliane Zeidler**
- Biofuels – opportunities and challenges ... **Per Ove Eikeland**

Session 7: Forest resources and biodiversity
Session Chair: **James Griffiths**

- Forest and good governance ... **Andy White**
- Measuring and monitoring the flow of forest ecosystem services ... **Manuel Guariguata**
- Russian forestry and the Millennium Development Goals ... **Anatoly Petrov**
- Local forest governance and the role of community-based forest management ... **Yam Malla**
- Market-based biodiversity conservation and the rights of indigenous peoples, local communities and women ... **Simone Lovera**

Session 8. Biodiversity and food production
Session Chair: **Bente Herstad**

- Agro-biodiversity and Food security ... **Angeline Munzara-Chawira**
- Conserving crop biodiversity for a food secure future ... **Ola Westengen**
- Potential Impacts of Genetically Modified Organisms in Food Production and Agricultural Biodiversity ... **Corazon de Jesus**
- Integrating Biodiversity Conservation and Ecosystem Function in Agricultural Landscapes ... **Fabrice DeClerck**
- Biodiversity, nutrition and health ... **Emile Frison**

Session 9 – PANEL DEBATE: Food production, food security and biodiversity
Session Chair: **Ruth Haug**

Session 10: Wetlands and freshwater resources
Session chair: **Gabriele Obermayr**

- Wetlands for water and people ..... **Nick Davidson**
- River control and biodiversity ..... **Terje Tvedt**
- Biodiversity aspects of the EU water framework directive ..... **Wouter van de Bund**

Session 11: Marine resources and biodiversity
Session chair: **Isabel Sousa Pinto**

- The state of the world's marine biodiversity and ecosystems ..... **Jackie Alder**
- Large Marine Ecosystems (LME), resource management and biodiversity conservation ..... **Kenneth Sherman**
- Conservation and utilization of biodiversity on seamounts ..... **Ricardo Serrão Santos**
- Genetic resources of the deep sea: what is the potential? ..... **Salvatore Arico**
- An Ecosystem approach to management of aquatic resources: integrating fisheries, aquaculture and biodiversity ..... **Devin Bartley**
- Management of coastal resources: their role in supporting and protecting livelihoods ..... **Anne Martinussen**

Session 12 – panel debate: How do we secure marine biodiversity beyond national jurisdiction?
Session chair: **Peter Bridgewater**

Session 13: Global governance and biodiversity
Session chair: **Maria Mbengashe**

- Strengthening the scientific basis for the CBD - improving the interface between science and policy ..... **Ivar Baste**
- The role of private business in ecosystem management ..... **James Griffiths**
- The role of developing countries in global biodiversity governance ..... **Adil Najam**

Session 14 - Panel debate: The road to 2010 and beyond
Session chair: **Jeffrey McNeely**

Session 15: Closing session
Session chair: **Peter J. Schei**

- Presentation of Chairman's report with conclusions and recommendations ..... P**eter J. Schei**
- Closing address by the 2007 chairmen of CBD's Subsidiary body on scientific, technological and technical advice (SBSTTA) **Christian Prip, Denmark and Asghar Mohammadi Fazel, Iran**
- Closing address ..... **Erik Solheim**

Annex 2

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The Trondheim Conferences on Biodiversity have since 1993 provided an opportunity for policy makers, managers and scientists to have an open and constructive dialogue on key issues being discussed under the Convention on Biological Diversity (CBD).

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The conference is hosted by the Norwegian Ministry of the Environment, in collaboration with the United Nations Environment Programme (UNEP) and the Convention on Biological Diversity Secretariat and with the Ministry of Food and Agriculture, the Ministry of Coastal Affairs and Fisheries and the Ministry of Foreign Affairs.

The conference is organised by the Directorate for nature management, which is the executive and advisory agency on biodiversity issues under the Ministry of the Environment, in collaboration with the Norwegian Institute for Nature Research and the Norwegian University of Science and Technology. These institutions are all based in Trondheim, which is a stronghold on biodiversity research and management in Norway.

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