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Item 10 of the provisional agenda*

BIODIVERSITY MAINSTREAMING: DRAFT SYNTHESIS REPORT OF THE THIRD SCIENCE FOR BIODIVERSITY FORUM

Note by the Executive Secretary

INTRODUCTION

1. The Executive Secretary is circulating herewith, for the information of participants in the thirteenth meeting of the Conference of the Parties, the draft synthesis report of the Third Science for Biodiversity Forum, held from 1 to 2 December 2016 at the Cancun International Convention Centre in Cancun, Mexico.

2. The Science for Biodiversity Forum was co-organized by the National Commission for Knowledge and Use of Biodiversity of Mexico (CONABIO), the International Union of Biological Sciences (IUBS), the Inter-American Institute for Global Change Research (IAI), the Gesellschaft für Internationale Zusammenarbeit (GIZ), Future Earth in collaboration with the Secretariat of the Convention on Biological Diversity (CBD) and other partners.

3. The document is being circulated in the form and language in which it was submitted to the Secretariat.

* UNEP/CBD/COP/13/1/

Biodiversity Mainstreaming: Draft Synthesis Report of the 3rd Science for Biodiversity forum. Cancun, 1-2 December, 2016

Executive Summary

Science is the basis of most of the decisions to be adopted by this Meeting. Scientists are committed to working in close partnership with decision-makers and other stakeholders to support mainstreaming efforts and ensure the sustainable use of biodiversity, community development and societal well-being. Development has stimulated increasing efficiency and growth in each of the sectors of society. Yet, insufficient attention has focused on how to sustain the critical components and processes of nature and society that underlie human well-being and economic activities. Safeguarding biodiversity is essential to improve our ability to adapt to abrupt changes such as extreme climate events or sudden financial market crashes and to transform the deep roots of unsustainable practices and inequity.

Mainstreaming biodiversity means integrating actions related to conservation and sustainable use of biodiversity within strategies, plans and policies relating to all sectors.

Forum participants highlighted four main areas of contribution from science to strengthen mainstreaming. Each of these areas need further research and will benefit from close collaboration with decision-makers and civil society:

a. Assessing and monitoring the ways in which biodiversity changes affect different constituents of human well-being in the short- and long-term, e.g., capabilities, food security, etc.
b. Recognizing the interactions (synergies and trade-offs) among the diversity of values of biodiversity held by individuals and society;
c. Ensuring policy coherence within and across production sectors towards the conservation and sustainable use of biodiversity (e.g. using planning at the landscape scale, creative appropriate incentives);
d. Creating partnerships between different stakeholders and scientists to co-generate relevant information and knowledge that can foster transformative change.

Understanding and monitoring the ways in which biodiversity changes affect different constituents of human well-being in the short- and long-term: Biodiversity regulates the functions of the ecosystem that support life on Earth. It regulates the services that sustain fisheries, agriculture, forestry, tourism, as well as other associated societal sectors (e.g., health and education). Biodiversity as a public good serves to meet our demand for services. It is also part of our cultural identity ("we are all born locally"), including through maintaining key social norms that foster collective action and pro-social relationships. Although science has already produced important insights in this regard, additional work is needed to better understand how biodiversity contributes

to sustaining the flows of goods and services across production sectors required to sustain and enhance human well-being at different spatial scales, under different management conditions and social-ecological contexts.

Recognizing the interactions (synergies and trade-offs) among the diversity of values of biodiversity held by individuals and society: Adequate biodiversity mainstreaming is possible only if multiple dimensions of its value are considered. Focusing on one type of value across sectors in not sufficient; valuation of biodiversity has to integrate multiple values (economic, ecological, social, cultural, etc.) in order to consider all stakeholders. Deepening methodological concepts on the analysis of values and knowledge systems can help to identify winners and losers and generate strategies for conflict mediation and socially just decision-making across scales.

Ensuring policy coherence within and across production sectors towards the conservation and sustainable use of biodiversity (e.g. using planning at the landscape scale, creative appropriate incentives): Biodiversity management is directed by regulatory frameworks (e.g. tenure rights, development priorities, institutional settings), financial incentives (e.g. taxes, subsidies), and other regionally specific socio-economic structures. Integrated models and scenarios as well as qualitative projections can produce narratives revealing possible synergies and necessary trade-offs. Science needs to provide new knowledge to understand how power relations among stakeholders within and across production sectors preclude effective and equitable mainstreaming of biodiversity.

Research on environmental policy integration can illustrate how these central strategic processes can not only produce isolated ecological targets, but identify ways of applying mechanisms within other sectors to both fit into existing institutional structures and capacities, and generate ownership in sectors to engage in conserving biodiversity.

Integrating biodiversity conservation into sectoral processes requires practical, cost-efficient, and context-specific monitoring strategies that can be operated within existing actor structures and capacities. New participatory formats, such as citizen observation systems offer possibilities for adaptive learning and knowledge co-production.

Creating partnerships between different stakeholders and scientists to co-generate relevant information and knowledge that can foster transformative change: Accessible channels and processes are needed to facilitate co-generation of knowledge by scientists, decision-makers and stakeholders at multiple scales, to support effective mainstreaming processes in the long term. This could include participation of scientists in decision support networks, the creation of lasting cooperative relationships, and tools such as the CBD's Bio-Bridge Initiative for facilitating technical and scientific cooperation, among others.

Introduction

The purpose of this information document is to present the scope and the results of the CBD Science Forum on Mainstreaming Biodiversity. The document is divided into two sections, presenting (1) the state of the art on mainstreaming biodiversity and related topics to be addressed during the forum, and (2) a roadmap to mainstreaming biodiversity – integrating science and decision-makers and science, economic sectors and conservation practitioners.

In order to move forward on "mainstreaming biodiversity" at different scales, a common understanding of the concept is necessary, as well as an appreciation for the work that has already been done on this topic; on one hand, policy-makers and civil society have been implementing this challenging integrative approach (in a world organized by sectors), and on the other hand the natural and social scientific communities have been developing research that contributes in several ways to the further development of mainstreaming. Section 1 provides a review of different approaches that have been taken to mainstream biodiversity, including examples of successful mainstreaming initiatives (see Figure 1). Section 2 is a work in progress, as we expect that the draft framework that is presented here will shift based on discussions and priorities that emerged from the Forum itself. The collaboration of scientists, policy-makers and civil society will be key to developing the outlined roadmap that can be implemented effectively through several types of mainstreaming initiatives and policies. The draft framework, along with a set of guiding questions, was used during the forum to maintain a focus for discussions on the development of a final roadmap that will be highly useful for policy makers, managers, and scientists.

The Science Forum was designed to align with specific parts of the provisional agenda of the 13th meeting of the Conference of the Parties of the Convention on Biological Diversity. Item 10 on the agenda addresses mainstreaming biodiversity in sectors such as agriculture, forestry, fisheries and aquaculture and tourism, among others. Item 19 in turn, calls on the scientific community to contribute ways and means for improving and attaining biodiversity mainstreaming. Several recommendations have been put forward on the topic of biodiversity mainstreaming for consideration by the COP, calling for special attention to sustainable use within sectors, a higher level of coordination among sectors, business engagement, subnational and local governments and genders. The Science Forum will provide the opportunity for a more concrete engagement with the scientific community on biodiversity mainstreaming through the development of a roadmap that will be informed by science and knowledge of policy contexts.

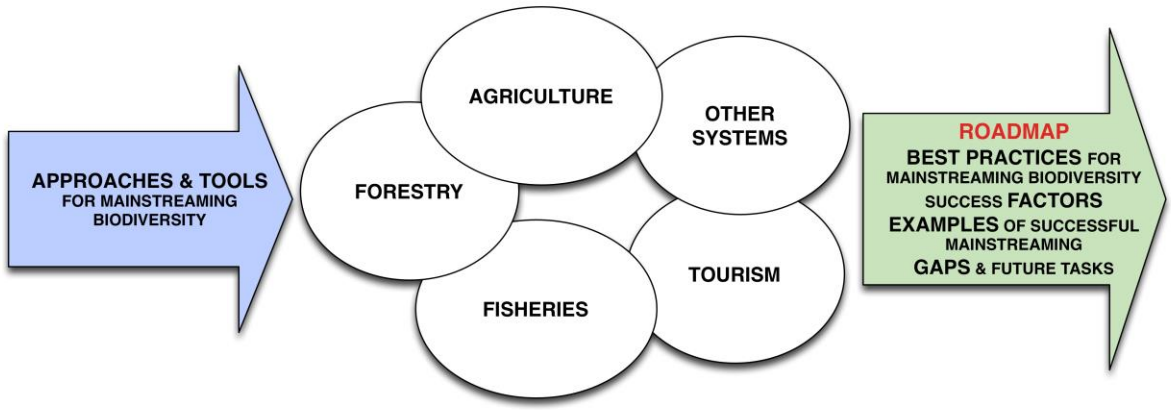

FIGURE 1. From science perspective, several approaches and tools have been created for implementing mainstreaming biodiversity. They can be applied into sectors such as agriculture, forestry, fisheries, tourism and others. They were reviewed during the forum, and best practices, success factors, as well as gaps in knowledge and some future tasks identified.

1. THE CBD APPROACH TO BIODIVERSITY MAINSTREAMING

Despite the manifold efforts triggered by the CBD and implemented by its member states in the past twenty years, biodiversity is still declining all across the globe, and there is no indication that biodiversity loss is abating, and the message that by losing biodiversity we are losing our life support system has not been understood.

Many of the world's ecosystems have been transformed into other land uses or are severely degraded, causing decline in biodiversity (Millennium Ecosystem Assessment, 2005). Already, 50% of Earth's wetlands, 40% of forests and 35% of mangroves have either been lost or irreversibly degraded (Markandya, 2015). Moreover, a study examining the trends of abundance of 14,152 monitored populations of 3,706 vertebrate species (mammals, birds, fishes, amphibians, reptiles) from around the world documented a 58% overall decline in vertebrate population abundance between 1970 and 2010. This represents a 2% annual decline in vertebrate abundance, with no signs that this rate is decreasing (Living Planet I-WWF 2016). Efforts to protect and conserve nature and its biodiversity so far have managed only to slow down environmental degradation. Nowadays, terrestrial biodiversity is projected to decrease by another 10% by 2050 (Markandya, 2015).

One of the main causes of biodiversity loss is an increase in human production, consumption and technology, coupled with a growing population. Proximate drivers of biodiversity loss are land use change and overexploitation, followed by pollution, invasive organisms, and climatic change. Most critical still, is the interaction among these drivers. These drivers, together with a bundle of different political, economic and market conditions have caused a rapid acceleration of unsustainable exploitation of natural ecosystems for food, timber, textiles, water and fuels, among others. Problems of unsustainable resource use (pollution or degradation) are often associated with governance problems at different levels, including institutional, legal, political, economic and social conditions. Typical aspects of governance problems include political governance deficits, lack of land rights, lack of institutional capacity or local empowerment, and inadequate support to withstand market failures.

Traditional approaches to biodiversity conservation, focussed on the expansion and creation of Protected Areas (PAs) as a means of protecting nature, have not proven to be effective due to negative effects from activities surrounding the areas and a lack of enforcement of conservation laws within the PAs (e.g. Pfeifer et al., 2012). Biodiversity is primarily regarded as an environmental issue, and its importance and contribution to different sectors of human production (e.g. mining, agriculture, fisheries, tourism) are not yet fully understood and accepted (Huntley and Redford, 2014).

The importance of biodiversity and ecosystem services is generally neglected when development decisions are taken, since their values that are unaccounted for in some appraisal and decision-making processes are mostly invisible and intangible. Thus, in the last two decades, studies began to clarify and measure this contribution in key economic sectors based on natural resource extraction, production, and management. Here are some examples:

Agriculture: About three-quarters of all flowering plants rely on birds, bees and other pollinators to help them reproduce. Bee pollination is thought to be responsible for about US$15 billion annually in

crop value in the United States (Sumner and Boriss, 2006)[1]. On a global scale, many fruits, vegetables and stimulant crops (e.g. tobacco, coffee, and tea) are largely or totally dependent on insects for pollination. The total economic value of pollination worldwide was estimated to be Euro 153 billion, representing 9.4% of the value of world agricultural production used for human food (Gallai et al, 2009[2]; Lautenbach et al 2012)[3]

Fisheries: In parts of Indonesia, the traditional use of mangrove products has been valued at over US $ 3,000/ha/year, contributing up to a half of the income of the poorest households (Ruitenbeek, 1992)[4]. On the Baluchistan coast of Pakistan, mangroves directly contribute around US $ 1,300/ha/year to in-shore fisheries, and are responsible for providing the nursery and breeding habitat upon which up to half of off-shore commercial fish stocks depend (Baig and Iftikhar, 2007)[5].

Forestry: Accounts for more than 10 % of GDP in many of the world´s poorest countries. In all developing countries taken together, the forestry sector provides formal employment for 10 million people and informal employment for another 30 to 50 million people (Dubois, 2002)[6]. In Cameroon, the Central African Republic and Liberia, forest products make up from just under 30% to more than 40% of national exports (OECD, 2008)[7]. In the Seychelles, forest-based ecosystem services contribute up to a quarter of all employment opportunities, one third of the government revenues and two thirds of foreign exchange earnings (Emerton, 1997)[8]. A recent study has reported the net economic cost of deforestation in Panama between 1992 and 2012: 3,700 US$ million. This is due to the loss of valuable ecosystem services such as provision of non-timber forest products (NTFP), pharmaceuticals and fuelwood, the benefits of soil protection, water regulation, pollination, carbon storage and recreation (ecotourism). Regulating services (water and soil regulation services, and carbon storage) are the most economically valuable. Of particular importance is that forests store carbon (Midler et al., 2013)[9].

Tourism: A large part of tourism activities depend on healthy ecosystems and high representation of native biodiversity. Worldwide, approximately 1 out of 11 jobs are related to the tourism sector, which is seven times more than the automotive industry. Moreover, the total contribution of Travel and Tourism to World GDP in 2015 was US$ 7,170.3 billion – 9.8% of GDP (WTTC, 2016)[10]. All over the world nature tourism is increasing. A large number of tourists visit national parks for recreation, wildlife watching and landscape appreciation. The value of tourism and recreational activities has been estimated for numerous places: e.g. for Montenegro's Protected Areas it was estimated at just

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[1] Source: Sumner and Boriss (2006). Bee-conomics and the Leap in Pollination Fees.

[2] Source: Gallai N, Salles JM, Settele J, Vaissiere BE. Economic valuation of the vulnerability of world agriculture confronted with pollinator decline. Ecol Econ 2009; 68:810–21. http://linkinghub.elsevier.com/retrieve/pii/S0921800908002942

[3] , updated including a spatial explicit map of pollination services in Lautenbach S, Seppelt R, Liebscher J, Dormann CF. Spatial and Temporal Trends of Global Pollination Benefit. PLoS One 2012; 7:e35954. http://www.scopus.com/inward/record.url?eid=2-s2.0-84860354863&partnerID=MN8TOARS
Now also picked up in Summary for Policy Makers in IPBES Pollination Assessment

[4] Source: Ruitenbeek (1992). Mangrove Management: An Economic Analysis of Management Options with a Focus on Bintuni Bay, Irian Jaya.

[5] Source: Baig and Iftikhar (2007). Are the mangroves for the Future? Empirical Evidence of the value of Miani Hor Mangrove Ecosystem as the basis for investments.

[6] Source: Dubois (2002). Forest-based Poverty Reduction: A Brief Review of Facts, Figures, Challenges and Possible Ways Forward.

[7] OECD (2008). Natural Resources and Pro-Poor Growth: The Economics and Politics.

[8] Emerton (1997). Seychelles Biodiversity: Economic Assessment.

[9] Midler, E., Pascual, U., Simonit, S. (2014). Forest ecosystems in national economies and contribution of REDD+ in a green economy transformation: the case of Panama. (Ecosistemas forestales en las economías nacionales y la contribución de REDD+ en la transformación hacia una economía verde: el caso de Panamá) UNEP. (link)

[10] World Travel & Tourism Council (2016). Travel and Tourism: Economic Impact 2016 World.

under €68 million in 2010 (2.2% of GDP). At the same time, PAs in that country were also providing a range of other services, raising their total value to €172 million (UNDP &and GEF, 2011). In many places, tourism represents most of the income of the local population. In Namibia, the tourism related economic activities amount to 15% of the country's GDP. Similar numbers in Tanzania (14%), Botswana (8,5%), South Africa (9,4%), Kenya (10,4%)[11].

Biodiversity is often the reason for tourism and can turn into a threat to natural beauty and integrity; for example in the unique oasis of Cuatro Cienegas Basin (CCB), in Coahuila Mexico, nature was threatened by destructive tourism activities. In a joint effort between scientists, communicators and the tourism industry, the uniqueness of the oasis was presented and less destructive touristic uses introduced and fostered leading to higher appreciation for the site and more protection at the same time. By mainstreaming science to action, biodiversity was conserved.

Infrastructure: In Mongolia, it has been found that every US$ invested in upper catchment ecosystem conservation generates at least US$ 15 a year in water benefits for downstream Ulaanbaatar (Emerton et al, 2009)[12]. In Portland, Oregon, Portland Maine and Seattle Washington it hast been found that every US$ invested in watershed protection can save anywhere from US$ 7.500 to nearly US$ 200 in costs for new water treatment and filtration facilities (Reid, 2001)[13]. In Central Kampala, more than a million urban dwellers rely on the Nakivubo swamp for wastewater retention and purification. These ecosystem services have been calculated to be worth several thousand US$/ha/yr. Nakivubo fills a critical gap between the level of basic sanitation and clean water services that a poor urban population requires for an adequate standard of living, and the level of services that the government is currently able to provide through existing infrastructure (Emerton, 1999)[14].

To influence, reverse or change the causes and drivers that are (directly or indirectly) harming biodiversity, and to integrate biodiversity protection into different systems, the CBD makes use of an approach that is now known as "biodiversity mainstreaming", as stated in Article 6(b) of the Convention[15] (Handbook of the Convention on Biological Diversity, CBD, 2003). The biodiversity mainstreaming approach has two main objectives:

1. To reduce poverty and nurture sustainable development without harming biodiversity
2. To use the potential of biodiversity in different economic sectors to supplement and support existing conservation efforts.

Following the adoption of a new Strategic Plan for Biodiversity 2011 – 2020 at the COP 10 in Nagoya, Japan, the CBD urged its member countries to revise and update their respective National Biodiversity Strategies and Action Plans (NBSAPs) to include biodiversity mainstreaming in all development sectors (Decision X/2). The new strategic plan contains a shared vision of twenty targets that became known as the Aichi Biodiversity Targets. Aichi Targets 2, 3, and 17 are of particular importance as far as biodiversity mainstreaming is concerned:

[11] https://www.wttc.org/-/media/files/reports/economic%20impact%20research/countries%202015/tanzania2015.pdf

[12] Emerton et al. (2009) The Economic Value of the Upper Tuul Ecosystem.

[13] Reid (2001) Capturing the value of ecosystem services to proptect biodiversity.

[14] Emerton et al. (1999). The Economic Value of Nakivubo Urban Wetland, Uganda.

[15] CBDS (2003) Handbook of the Convention on Biological Diversity

Aichi Target 2

By 2020, at the latest, biodiversity values have been integrated into national and local development and poverty reduction strategies and planning processes and are being incorporated into national accounting, as appropriate, and reporting systems.

By 2020, at the latest, incentives including subsidies, harmful to biodiversity are eliminated, phased out or reformed in order to minimise or avoid negative impacts, and positive incentives for the conservation and sustainable use of biodiversity are developed and applied, consistent and in harmony with the Convention and other relevant international obligations, taking into account national socio-economic conditions.

Aichi Target 17

By 2015, each party has developed, adopted as a policy instrument, and has commenced implementing an effective, participatory and updated national biodiversity strategy and action plan.

In addition, Aichi Target 11 stresses the importance of equity. Understanding and addressing social equity issues in biodiversity conservation policies is thus also a priority. It has been argued that considering equity is important in PA management as otherwise this could threaten conservation goals (Zafra- Calvo, Pascual et al. Submitted; Oldekop et al. 2015, Klein et al. 2015) and raise costs (Barnes et al. 2015).

Especially the first objective of the biodiversity mainstreaming approach, to reduce poverty and promote sustainable development, reveals the close link between this approach and the goals of the 2030 Agenda for Sustainable Development. Many of the Sustainable Development Goals are directly (SDGs 14 and 15) or indirectly (e.g. SDGs 1, 2, 5, 6, 8, 12, and 13) related to biodiversity, which is why the biodiversity mainstreaming approach shall be a useful tool to achieve the goals of the 2030 Agenda for Sustainable Development.

2. DIFFERENT TOOLS AND APPROACHES TO SUPPORT BIODIVERSITY MAINSTREAMING

In order to successfully implement the biodiversity mainstreaming approach and integrate it into policy and planning sectors, the GEF supported a total of 327 biodiversity mainstreaming projects with a financial commitment of US$ 1.6 billion and US$ 5.2 billion in co-financing between 2004 and 2014 (Huntley and Redford, 2014). Biodiversity mainstreaming needs to become a flexible concept with general principles and guidelines for its integration and adaptation into existing development models, policies and programs and measures and plans of different sectors. In practice it implies trade-offs between desired conservation outputs and desired social outcomes. It requires a change within particular groups of stakeholders and institutions, using appropriate entry points (IIED and UNEP-WCMC, 2014 [16]), identifying common issues and fostering the active and effective participation of all relevant actors across society (GEF, UNEP and CBD, 2007). But it also needs a strong support from the academia, in particular from ecology and environmental related sciences that generate the needed data as well as multidisciplinary teams to conduct research and document on the many dimensions of mainstreaming, as the sustainable development agenda that comprises economic, social, environmental and institutional dimensions. The biodiversity mainstreaming approach makes

[16] IIED and UNEP-WCMC (2014). Biodiversity and Development Mainstreaming: A State of Knowledge Review – Discussion Paper. http://pubs.iied.org/pdfs/G03673.pdf

use of many different tools and approaches. Below is an overview of several of these tools, based on the categorization in IIED and UNEP-WCMC (2014) and GEF, UNEP and CBD (2007).

2.1 Approaches and Initiatives Supporting Biodiversity Mainstreaming

The **ecosystem approach (EA)** was first developed by the CBD, as an option for implementing mainstreaming, is a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way; meaning that the planning, governance and coordination among sectors was crucial to implement actions favouring biodiversity at the ecosystem level.

The **Ecosystem Services (ES) approach** was officially endorsed by the CBD during COP 5 in 2000 in Nairobi, Kenya. It differs from the EA which is an approach to action, whereas the ES is an approach to understanding the services and benefits provided to humans by nature. Based on the Millennium Assessment's ecosystem services framework, the ES approach for biodiversity mainstreaming is designed to help decision-makers understand how their decisions depend on and impact biodiversity, and to identify areas and measures through which biodiversity and human well-being can both be improved[17]. Central to the approach is an analysis of the risks and opportunities as well as scenario planning to explore possible outcomes in the future based on decisions taken today. The ES approach also provides guidance on designing and implementing policies to sustain those ecosystem services that underpin social and economic development and promote a healthy state of biodiversity. It is particularly helpful to showcase the inter-relatedness of biodiversity, ecosystem services and human well-being.

In a similar vein, **Environmental Impact Assessments (EIA) and Strategic Environmental Assessments (SEA)** which make use of the ES approach can be powerful tools to support mainstreaming efforts if they are included in development planning. Both SEA and EIA explore the possible consequences of intended policies, plans and programmes before they are implemented, with the goal of accounting for all impacts on society, economics and environment. The difference is that SEA is used at a policy, planning and programming level, whereas an EIA is more traditionally used for civil society and industrial projects. In many countries, laws have been put in place that require conducting an EIA or SEA prior to new development decisions.

Many other initiatives that directly or indirectly support biodiversity mainstreaming have been put into place in recent years. **The Economics of Ecosystems and Biodiversity**, the **TEEB** initiative, is particularly helpful for biodiversity mainstreaming as it makes use of different economic valuation tools to highlight the value of biodiversity and nature. The goal of TEEB is to provide a bridge between the multi-disciplinary science of biodiversity and the arena of national and international policy, as well as local government and business practices[18]. Through its various activities and case studies, TEEB attempts to fully reflect the value of biodiversity and ecosystem services in public and private decision-making. Based on their findings, TEEB recommends strategies and measures with the aim of promoting a sustainable use of biodiversity and natural resources. A list of pilot country studies can be found on the TEEB website[19].

The **Natural Capital** concept is very similar to the TEEB initiative in so far as it extends the notion of economic capital to include goods and services provided by nature. In July 2016, the Natural Capital

[17] CBD (2011). Secretariat of the Convention on Biological Diversity. NBSAP training modules 2.1 – Module 3.

[18] TEEB (2010). The Economics of Ecosystems and Biodiversity: Mainstreaming the Economics of Nature: A synthesis of the approach, conclusions and recommendations of TEEB

[19] http://www.teebweb.org/areas-of-work/teeb-country-studies/

Coalition released a Natural Capital Protocol[20] which provides a standardized framework for organizations to identify, measure and value their direct and indirect impacts and dependencies on biodiversity and nature.

The **planetary boundaries** framework is another example and is based on a concept of safe-operating spaces for humanity for sustainable development. Out of nine planetary life support systems (e.g. climate change, ocean acidification, freshwater use, among others), only three boundaries are judged to have been crossed – the loss of biodiversity being one of the three. Based on these findings, some countries have already taken action to reduce the loss of species and to better integrate biodiversity into development plans. For example, China is now investing US$ 100 billion in eco-compensation, which includes innovative policies and finance mechanisms that reward effective conservation and restoration practices (Daily, 2010). Nevertheless, whether these efforts are helping biodiversity remains to be seen (Hua et al, 2016)[21].

An interesting, but still theoretical discussion focuses on the competing approaches of **sustainability and resilience**, both of which will be necessary for socio-ecological systems to undergo changes (whether they were social, political or environmentally driven) and still aim to the SDG. In practice, both approaches are to be implemented by policy-makers and civil society, causing sometimes confusion; some guidance and clarity on the complementarity of these approaches are needed.

2.2 Guidelines, Codes of Conduct, Standards and Certification Schemes

Guidelines are an important tool for biodiversity mainstreaming. IIED and UNEP-WCMC have developed a rapid diagnostic tool[22] intended to identify the necessary steps to create effective national biodiversity strategies that influence development decisions and improve outcomes for biodiversity and poverty reduction. **The rapid diagnostic tool** was designed to help policy-makers and other relevant stakeholders to better understand the importance of biodiversity and to identify the challenges that need to be overcome in order to promote a more effective integration of the biodiversity mainstreaming approach. The toolkit applies a stepwise approach that allows countries to keep track of their current progress and to build a roadmap for further steps that need to be taken. The rationale of the rapid diagnostic tool is as follows (IIED and UNEP-WCMC; 2012):

1. **Vision**. What is the ultimate vision of a country for biodiversity mainstreaming? Are there certain goals that ought to be met or milestones to be achieved? Which sectors are particularly interesting and what would a desirable outcome be?
2. **Institutions**. What is the political and institutional context for biodiversity mainstreaming in the country? Are key institutional structures already in place? What is the frame of the environmental, political and socio-economic systems in the country? What relevant plans, strategies, measures or decisions related to biodiversity mainstreaming already exist, and what commitments have been made?
3. **Knowledge**. What is the current state of knowledge on the interactions between biodiversity and poverty in the country? Where are knowledge gaps? Are the interactions between and dependencies of local communities and biodiversity well known? What is the state of protected area management?

[20] http://naturalcapitalcoalition.org/protocol/

[21] Hua, F., X. Wang, X. Zheng, B. Fisher, L. Wang, J. Zhu, Y. Tang, W. Y. Douglas, and D. S. Wilcove. 2016. Opportunities for biodiversity gains under the world/'s largest reforestation programme. Nature communications 7.

[22] IIED and UNEP-WCMC, 2012. http://pubs.iied.org/pdfs/G03694.pdf

4. **Initiatives**. What attempts have been made to integrate biodiversity conservation and poverty alleviation in the country? Which activities have been carried out on a government, community, civil society, media, business or development assistance level?
5. **Mainstreaming Progress**. How successful have these attempts been in the country? What has been learned from them and what impact have they had (both positive and negative)? Has there been progress in terms of pre-defined milestones or targets?
6. **Constraints**. What constraints and challenges still exist that limit the effectiveness of successful biodiversity integration? What are the motivations behind decisions that harm biodiversity?
7. **Opportunities**. Which opportunities (used or unused) exist to mainstream biodiversity in the country. Who are stakeholders that can spearhead the approach? Can a business-case be made for biodiversity mainstreaming?
8. **Stakeholders**. What is the role of society in protecting, managing and using biodiversity in a sustainable manner? What governance models exist at community level that may facilitate the adoption of biodiversity mainstreaming? What are their characteristics?

Following these steps will provide a much better overview of the different institutions, governance issues and economic implications of biodiversity mainstreaming and poverty alleviation, and this in turn will enable decision-makers to design more effective strategies for promoting biodiversity mainstreaming. The tool can thus be used to understand what progress has been made so far, what the institutional structures related to biodiversity conservation are, and which areas are most suitable for change and improvement.

In a similar vein, the African Leadership Group on biodiversity management, a group of four African countries (Botswana, Namibia, Seychelles and Uganda), is working on redefining the NBSAPs existing guidelines for biodiversity mainstreaming[23]. The guidebook contains 10 basic steps for successful biodiversity mainstreaming:

1. **Problem assessment by stakeholders**. Identification of the current state of mainstreaming efforts in the country as well as defining the specific biodiversity-development problems that need to be addressed.
2. **Identify elements of biodiversity to be mainstreamed**. Identification of important species, habitats, ecosystems, ecosystem services or genetic diversity that are under threat and ought to be included in development plans and measures.
3. **Important sectors and development goals for biodiversity mainstreaming**. Identification of particular production sectors (e.g. agriculture, fisheries) or development goals (e.g. climate change adaptation) for which biodiversity plays an integral role.
4. **Identify desired biodiversity and development outcomes**. Identification of specific envisioned improvements in both biodiversity and development, validated with community recognition.
5. **Shape a communication strategy**. Identification of behavioural attitudes and value constructs that need to be changed or replicated, and which strategies can be used to achieve this change?
6. **Identify and engage stakeholders who might support or undermine progress**. Identification of relevant stakeholders and classification of stakeholders based on their support or hindrance, and their influence on the issue.

[23] IIED and UNEP-WCMC, 2013. http://pubs.iied.org/pdfs/14625IIED.pdf

7. **Identify enabling factors for mainstreaming**. Identification of entry points that can be used to promote the biodiversity mainstreaming approach.
8. **Develop approaches and mechanisms to promote biodiversity and development outcomes**. Identification of various approaches that can support biodiversity mainstreaming (e.g. business case or strategic environmental assessments).
9. **Develop a business case to convince hesitant stakeholders.** Identification of direct benefits arising from biodiversity for relevant stakeholders.
10. **Develop a monitoring and evaluation (M&E) system for biodiversity mainstreaming.** A well-designed M&E system needs to be developed to monitor and evaluate the impact of implemented strategies.

Various other guidelines, such as the CBD Sustainable Tourism Guidelines[24] or the WTO Global Code of Ethics for Tourism[25] exist, but their rationale is similar to the examples given above.

Similar to guidelines are so-called **Codes of Conduct**, which establish a standard of behaviour in relation to biodiversity. Code of conduct refers to a set of rules that take into account social norms and responsibilities in order to guide the decisions of individuals and organizations in a way that optimizes welfare and respects the rights of all parties involved (International Federation of Accountants, 2007). Codes of Conduct can be more general, or sector-specific. A sector-specific example would be the FAO (Food and Agriculture Organization of the United Nations) Code of Conduct for Responsible Fisheries[26]. In this document, several biodiversity-related issues are discussed, such as excess fishing capacities, conservation of habitats, the need to manage biological and genetic characteristics of stock and coastal zone management. The guide advocates a precautionary principle and sets out principles and international standards of behaviour for responsible practices for effective conservation, management and development of living aquatic resources (FAO, 1995).

Certification schemes are similar to codes of conduct, but explicitly require an adherence to a set of criteria (CBD, 2011). If these criteria are met, the acting organization or institutions is qualified to use the logo or name of the certification scheme. This in turn allows consumers to easily identify products that uphold a certain biodiversity criterion and can shift consumer behaviour on a more sustainable path. There are also verification programs that are different from certification.

Standards are policies that attempt to regulate, and to some extent control, the impact of humans on the environment. They are an established norm or requirement in regard to managing a system, and they often specify a desired state or forbid an alteration of an area exceeding a determined limit (CBD, 2011[27]). An example of a standard in biodiversity is the Climate, Community and Biodiversity Standard (CCBS) developed by the Climate, Community and Biodiversity Alliance (CCBA) in 2005 (CCBA, 2012). The standard consists of a variety of criteria, of which four relate directly to biodiversity. The criteria to be met are to create net positive impacts on biodiversity, to reduce negative biodiversity impacts offsite, to monitor impacts on biodiversity and to conserve biodiversity in key areas (CCBA, 2012). Generally, adhering to standards is rewarded by, e.g., receiving a premium for a product or assuring access to stable niche markets.

2.3 Strategic and Legal Instruments

[24] https://www.cbd.int/doc/programmes/tourism/tourism-manual-en.pdf

[25] http://cf.cdn.unwto.org/sites/all/files/docpdf/gcetbrochureglobalcodeen.pdf

[26] http://www.fao.org/docrep/005/v9878e/v9878e00.htm

[27] CBD (2011). Secretariat of the Convention on Biological Diversity. NBSAP training modules 2.1 – Module 3.

One of the primary instruments for mainstreaming biodiversity is the use of **sectoral strategies, action plans and programmes**. Of particular importance hereby are the National Biodiversity Strategies and Action Plans (NBSAPs). As such, the mainstreaming biodiversity approach became a major cornerstone of the new Strategic Plan for Biodiversity 2011 – 2020 and looks to integrate biodiversity protection measures into cross-sectoral plans such as development plans or poverty reduction strategies, and into sector-specific plans such as agricultural practices or fishing standards (IIED and UNEP-WCMC, 2012). Therefore, the approach also promotes a shift in responsibility, whereby biodiversity conservation is no longer the sole responsibility of the ministry of environment, but rather that it is now a shared and common responsibility. It is hoped that this will increase the financial, human and technical capacity to implement the objectives of the CBD (GEF, UNEP and CBD, 2007 [28]), and is the reason why the upcoming COP 13 in Mexico is largely devoted to this topic. Based on the new Strategic Plan for Biodiversity 2011 – 2020 of the CBD, countries are now required to prepare national measures that ensure the mainstreaming of biodiversity into development plans, poverty strategies or similar planning activities. The mandate thereby is to incorporate biodiversity mainstreaming into all sectors that can have an impact (whether positive or negative) on biodiversity. Aside from NBSAPs however, other national strategies exist in which biodiversity mainstreaming can play a part. Specific sectors, for example, generally have their own action plans, such as National Forestry Action Plans or National Tourism Plans. Biodiversity mainstreaming can and should be included in these plans whenever they are updated, to achieve a high level of synthesis.

Biodiversity can also be integrated into a country's legal framework to support biodiversity mainstreaming (CBD, 2011). **Specific laws** can be designed for specific sectors or for specific activities to help manage biodiversity. The careful design of new laws or modification of existing laws is thereby of crucial importance. Existing governance mechanisms and cultural customs need to be carefully considered to guarantee an effective implementation. Moreover, new biodiversity laws should be designed in a complementary manner to other environmental laws and regulations. As an example, a law on hunting was instated in Lebanon in 2004, specifically designed to make hunting activities more sustainable (CBD, 2011). The law established hunting seasons and protected certain species as well as established a breeding centre for selected species.

Spatial planning is important for biodiversity mainstreaming as it determines where economic activities and infrastructure developments are implemented. By integrating biodiversity components into spatial planning, the potential for harmful projects to be implemented is drastically reduced. An example would be the Western Cape Land Use Planning Act (2014) in South Africa, whereby important areas of high biodiversity need to be identified and a plan made to conserve these areas[29].

2.4 Economic Tools

Economic tools, if well designed and implemented, constitute a great asset to biodiversity mainstreaming efforts. Important drivers of biodiversity loss are mostly economic. People use natural resources to cover their needs, expand production and develop new technologies. An important part of people behaviour is driven by incentives coming from the social, political and economic context. Therefore, economic tools can be helpful by internalizing social and environmental costs that come from nature degradation into different measures and policies, as well as promoting activities through different incentives that favour the sustainable use of biodiversity. Examples of such tools are listed below and are adapted from CBD, 2011:

- **Economic Valuation**

[28] GEF, UNEP and CBD, 2007. Mainstreaming Biodiversity into Sectoral and Cross-Sectoral Strategies, Plans and Programmes

[29] http://cer.org.za/wp-content/uploads/2013/10/provincial-gazette-for-western-cape-7250-of-07-april-2014_20140407-WCP-07250.pdf

A wide range of economic valuation methods has been developed, allowing estimation of the monetary value of biodiversity and ecosystem services. Economic valuation is a popular tool particularly in many policy circles, as it allows weighing different options and scenario in economic terms (Pascual et al., 2010)[30]. Which economic valuation methods should be applied is heavily dependent on the particular context and which biodiversity values are thought to be most important. Different methods can also often be combined to assess different values. However, conducting a complete and exact calculation of the value of biodiversity and nature is challenging, as many of the benefits of biodiversity are hidden and difficult to quantify (Wegner and Pascual, 2011)[31]. For these reasons, other tools, such as multi-criteria analysis, can be used to assess social and cultural values of biodiversity. Economic valuation helps to highlight the benefits of biodiversity conservation, to better understand the economic implications related to a loss of biodiversity and to compare different policy options.

- **Implementing positive incentives for biodiversity**

Creating incentives for preserving biodiversity is a useful tool to support and encourage biodiversity mainstreaming. Different types of incentives exist however. Direct approaches involve making payments (monetary or non-monetary) to relevant stakeholders to achieve biodiversity-friendly outcomes or reduce harmful activities. Payment for ecosystem services is a prominent example in this category. Indirect approaches are designed to support those measures that indirectly contribute to a sustainable use of biodiversity. Sustainable eco-tourism or community-based natural resource management would be examples. Incentives can be applied in a flexible manner and can easily be tailored to suit specific local conditions.

- **Phasing out or removal of harmful incentives**

Often, activities harmful to biodiversity are a by-product of policies and programmes that were designed to achieve a completely different outcome. An example here would be consumer subsidies for products for which the use of natural resources has been under-priced. Weak enforcement mechanisms for environmental laws and regulations can also act as a negative incentive. Such negative incentives, often designed to increase production, are an important reason for loss of biodiversity. Removing these incentives independently or holistically through fiscal reform can heavily improve the state of biodiversity, especially when coupled with the setting of positive incentives.

- **Taxes, User fees and other disincentives**

These measures underpin the "polluter-pays" principle meaning that those actors or institutions that cause harmful actions have to pay an amount that is judged to be equivalent to the value of biodiversity that is lost. This approach can motivate polluters to take preventive measures or to remedy damages. It further ensures that those that perform harmful activities pay for the damages, rather than society as a whole.

2.5 Tools for understanding mainstreaming

The engagement and contribution of the scientific community in this topic is crucial. Understanding the limits to the outputs for human benefits (the ecosystem services), given by ecosystem functioning, understanding how biodiversity works and the limits for production,

[30] Pascual, U., Muradian, R., Brander, L., Gómez-Baggethun, E., Martín-López, M, Verman, M., Armsworth, P., Christie, M., Cornelissen, H., Eppink, F., Farley, J., Loomis, J., Pearson, L., Perrings, C., Polasky, S. (2010). The economics of valuing ecosystem services and biodiversity. In Kumar, P (ed): The Economics of Ecosystems and Biodiversity Ecological and Economic Foundations. Chapter 5, pp. 183-256. Earthscan.

[31] Wegner, G., Pascual, U. (2011). Cost-benefit analysis in the context of ecosystem services for human well-being: A multidisciplinary critique. Global Environmental Change 21(2):492-504

provides the framework for sustainable uses and trade-offs for development. From the social sciences point of view, for instance the understanding of how to measure behavioural changes, or perception of benefits, may lead to better-informed decisions and actions regarding development that take biodiversity into account.

Indicators can play a very important role in biodiversity mainstreaming as they produce a measurable and understandable appreciation of the interactions between humans and biodiversity (CBD, 2011). They can be used to simultaneously raise awareness among the public and key stakeholders, can motivate action and can monitor the progress of on-going efforts. Ecosystem services indicators are often used in this context, as they relate to both biodiversity and to production output in terms of benefits for humans. Examples would be the amount of wood harvested in a forest from sustainable practices, the amount of crop produced through the use of sustainable agricultural practices, the diversity and abundance of species, the number of tourists per year in an area, or the amount of water extracted over a period of time. In forestry the international REDD+ mechanism uses the total country land area as the unit for monitoring of deforestation and forest degradation. This reduces monitoring errors due to "leakage", referring to changes outside the accounting system that result from activities that cause changes within the boundary of the accounting system.

Data and information. Another realm of contributions from science deal with data and information pertaining to biodiversity, from identity to functions, species occurrence and abundance, land cover (change) indicators, limits, productivity, among many others, are necessary for designing well informed policies and management, as for constructing modeling and scenarios, and indicators. These inputs should be relevant in this case where we will have several discussions on these topics, more related to ecology research and not only to social sciences. A good starting point may be the Global Biodiversity Information Facility (www.gbif.org) providing steadily increasing data on species diversity, however monitoring and Environmental Impact Assessment data are currently not systematically collected but should be available as very valuable resource for science based recommendations. To facilitate modelling of scenarios already available remote sensing and (micro-)climate information should be available to the scientific community in a pre-processed, ecologically relevant form. All these data types are already generated but a platform integrating this information is lacking.

Monitoring. To ensure meeting of mainstreaming, conservation and sustainable use goals and management objectives, several tools at diverse scales have been developed; they are meant to measure the evolution of the impacts on biodiversity of policy-measures.

Establishment of multi-dimension indicators, databases and information products may be identified in order to cover monitoring and evaluation (M&E) needs, applicable to several contexts. Monitoring of mainstreaming initiatives with such complexity may be beyond governmental capacities, especially in developing countries where most biodiversity mainstreaming are in place. Involvement of society in participatory M&E is paramount through institutional mechanisms, established operative frameworks and incentives for the public and beneficiaries.

The system of wildlife management units in Mexico (SUMA by its Spanish acronym) illustrate how a participatory approach for monitoring works, involving the direct beneficiaries of policies

in monitoring and reporting activities, and generating uniform information that goes, from local level, to administrators and federal agencies, to national level. Information of individual projects, beneficiaries, land cover and vegetation condition, wildlife uses and legal markets, among other data is feeding a national database administrated by the Ministry of natural resources (Ortega-Argueta et al. 2016).[32]

3. BIODIVERSITY MAINSTREAMING IN DEVELOPMENT SECTORS

Biodiversity underpins economies, particularly those economies that largely depend on natural resources, such as fisheries, agriculture, forestry and tourism. Habitats and individual key species support the functional structure of ecosystems, and so enable the provision of ecosystem services. It is thus essential to mainstream biodiversity in these sectors, which -on one side- are highly dependent on ecosystem services and, at the same time, are the ones with higher impacts on them, acting as important drivers of biodiversity loss. Moreover, all of these economically important sectors are at the forefront of political attention, planning strategies and processes that provide important entry points for biodiversity mainstreaming (CBD, 2011).

Biodiversity mainstreaming into production sectors has also been a strategic priority for the GEF and its implementing agencies to secure national and global environmental benefits (Castro, 2004). Hence, the GEF has created regional strategies for biodiversity mainstreaming (e.g. GEF Strategic Programme for West-Africa (SPWA), which aims to up-scale biodiversity conservation initiatives and mainstream biodiversity into production landscapes and sectors).

The CBD has also developed a series of Good Practice Guides for integrating biodiversity and poverty reduction strategies into a number of development sectors (CBD et al., 2009a and 2009b; CBD 2010a and 2010b; Bridgewater et al., 2012). Within these guides, a number of case studies and other useful information are discussed with the goal to provide guidance on how to make specific sectors (e.g. forestry) more biodiversity-friendly and improve the social benefits. More specifically, these guides address the linkages between development sectors, biodiversity and human development / poverty reduction (CBD et al., 2009a). The guides target decision-makers, development practitioners and government officials in related sectors and attempt to provide an overview of available tools and approaches to use resources more sustainably, while at the same time maximizing social benefits.

Private companies are becoming increasingly aware of an impending material risk due to a lack of attention to biodiversity issues. As a result of this, different tools and frameworks to help mainstream biodiversity into their operations and develop best practices have been developed. Examples would be the ***Business and Biodiversity Handbook for Corporate Action*** (Earthwatch Institute, IUCN and World Business Council for Sustainable Development, 2002), the ***Biodiversity Benchmark*** (Foxall, Grigg and Ten Kate, 2005), the ***Framework for Corporate Action on Biodiversity and Ecosystem Services*** (UN Global Compact and IUCN, 2012), and the ***Private Sector Uptake of Ecosystem Services Concepts and Frameworks*** (BSR, 2013).

In the following, an overview of the links between biodiversity and development sectors can be found, based on the description in IIED and UNEP-WCMC (2013)[33].

[32] Ortega-Argueta et al. (2016) A framework and indicators for evaluating policies for conservation and development: the case of wildlife management units in Mexico. Environmental Science & Policy 63: 91-100.

[33] IIED and UNEP-WCMC (2014). Biodiversity and Development Mainstreaming: A State of Knowledge Review – Discussion Paper. http://pubs.iied.org/pdfs/G03673.pdf

3.1 Biodiversity Mainstreaming into Agriculture

According to the ILO (2011) agriculture employs over one third of the world's available work force, and in many countries is the sole or primary source of livelihood. At the same time, land conversion to agricultural use is a major contributor to biodiversity loss[34], [35]. It is therefore not surprising that agriculture has become an important target sector for biodiversity mainstreaming and is considered one of the major threats to nature conservation in terrestrial ecosystems (Global Biodiversity Outlook 4, CBD, 2014). The use of pesticides and chemicals is heavily subsidized in many developing and developed countries and creates large negative impacts on the environment and biodiversity. It is hoped that a successful integration of the value of biodiversity into budget and planning strategies can reduce these negative incentives; thus these subsidies need to be revised in accordance to the respective Aichi target. And, besides the monetary value it needs to be communicated, that biodiversity has in fact invaluable positive consequences such as bio-control, pollination, soil fertility, to name just a few.

The challenge remains regarding how to increase yields (for food or other products) without compromising ecosystem services or converting more natural ecosystems into agricultural lands. Additionally, the capacity for adaptation and the capacity for change within the agricultural sector should be improved. Long-term biodiversity conservation requires the integration of sustainable agriculture and a network of protected (or natural) areas within broader production landscapes[36]. This objective can be achieved only if both farmers and decision-makers are well aware of the importance of biodiversity for the sector, and for the maintenance /provision of ecosystem services across the landscape – recognising and understanding the implications that biodiversity loss has for agriculture, and only if the relevant institutions are in place to promote the necessary changes.

In 1998, a study by the World Bank addressed a number of questions referring how agriculture affects biodiversity; how sustainable use of biodiversity enhances agricultural development, and how policies and programs can be adjusted to reduce biodiversity loss.[37] Specific recommendations were provided, such as (i) creation or protection of wildlife corridors between regions of remaining natural habitat, (ii) the restriction of the type of land use in areas adjacent to important remaining habitat for species, and (iii) the restoration of vegetation by replanting native flora.

In the years since 1998, a number of different approaches to consider biodiversity in the agricultural sector have been developed, advocating decreased use of chemical fertilizers and pesticides to reduce negative impacts on groundwater, soil, habitat and wildlife. Other approaches seek to conserve genetic diversity of crop species, using participatory approaches to reduce unsustainable farming practices in local communities. Special programmes have also been developed in some countries to support small family farms, organic farming and sustainable production. As an example, the Proambiente programme in Brazil awards farmers that make use of environmentally friendly practices with up to one-third of the minimum wage in compensation (OECD, 2013). Conservation agriculture, no-till agriculture, and climate-smart agriculture are all growing in popularity and geographic extent. These are all forms of "ecological intensification".

[34] Newbold, T., Hudson, L. N., Hill, S. L. L., Contu, S., Lysenko, I., Senior, R. A., … Purvis, A. (2015). Global effects of land use on local terrestrial biodiversity. Nature, 520(7545), 45–50. JOUR. Retrieved from http://dx.doi.org/10.1038/nature14324

[35] Gerstner, K., Dormann, C. F., Stein, A., Manceur, A. M., & Seppelt, R. (2014). Effects of land use on plant diversity - A global meta-analysis. Journal of Applied Ecology, 51(6), 1690–1700. https://doi.org/10.1111/1365-2664.12329

[36] OECD (2015). Conservation and sustainable use of biodiversity. In OECD Environmental Performance Reviews: Brazil 2015, OECD Publishing, Paris. http://dx.doi.org/10.1787/9789264240094-11-en

[37] Pagiola et al. (1998). Mainstreaming biodiversity in agricultural development – toward good practice

In agricultural ecosystems, the biodiversity of crops, livestock and aquatic organisms, make up the web of biodiversity that underpins the livelihood strategies of smallholder and family farmers and the sustainability of their production systems. There is now a growing consensus that many modern agricultural practices are unsustainable, causing environmental damage and a loss of the ecosystem function that underlies agricultural production (MEA 2005, cite). Intensive commodity monocultures and have increased crop and livestock yields to address global food demand but with destructive environmental and human health consequences (Cite). This concern has led to a renewed interest in agricultural practices that take greater account of biological processes and use the biological diversity in agricultural ecosystems to maintain or improve ecosystem services and agricultural productivity (FAO 2012). Assessments of crop, livestock, and aquatic diversity over the last decade have shown that a considerable amount of biodiversity in the form of traditional crop, livestock and aquatic diversity continues to be maintained in the production systems of small-scale farmers (Citation). Local, national and international programs are mainstreaming the use of this biodiversity in agriculture to,

(1) improve agricultural production in low input systems because of their value as locally adapted materials that require less chemical and water inputs,
(2) provide resilience, adaptability, and evolutionary potential under changing temperatures and rainfall conditions;
(3) meet the growing consumer demand for and for more natural food–based production systems;
(4) address the concerns and interests of the farmers and communities themselves who wish to retain control over their production systems.

In the Sustainable Development program of the Food and Agricultural Sector in Costa Rica (2003-2010), financed by the Inter-American Development Bank, the Government recognized environmental benefits from the local projects through a subsidy of 20-30% of the investments[38]. Another example is the Meso-American Agro-Environmental Programme, which uses sustainable land management strategies that provide goods and ecosystem services that help to reduce rural poverty. The program coincides with national priorities of the countries and contributes with knowledge based experiences within the agricultural sector[39].

The microbial health of the soil is of paramount importance in agriculture, since soil microbiome are the responsible of nutrients cycling needed for the fertility of soils. Hence the lack of understanding of basic science by agronomists and agriculture policy makers can be bridged by passing the information directly to the stakeholders. The results should be healthier soils, and more sustainable practices. As an example, the study of the soil biodiversity and the influence of agrochemicals and agricultural practices in desert soils from Cuatro Cienegas Basin in Mexico[40] (Hernandez-Becerra et al., 2016) was explained to the local community. This moved the local high-school students to learn molecular and microbial techniques to monitor such biodiversity and implement biodiversity friendly agricultural practices in the local schools showing the local producers that increasing soil biodiversity and reducing water use to a minimum, better crops could be obtained.

Globally, the demand for organic products has also been rising in recent years, as consumers have become more aware of the implications that unsustainable agricultural production has on both the environment and human well-being in the long term. This increased awareness and willingness to

[38] www.iadb.org

[39] Norheim, T, Ramos, J.L., Elizondo, D. & Baez, L. 2012. Final Evaluation of the Mesoamerican Agro-environmental Programme (MAP I) and Assessment of Proposal for MAP II. Royal Norwegian Society for Development & CABAL SA. 65 pp.

[40] Hernández-Becerra N., Y. Tapia-Torres, O.Beltrán, J. Blaz-Sánchez, V. Souza, F. Garcia-Oliva. 2016. Agricultural land-use change in a Mexican oligotrophic desert depletes ecosystem stability. PeerJ DOI 10.7717/peerj.2365

purchase environmentally friendly products at a higher price is an incentive to further develop this sector and to include biodiversity mainstreaming.

Another good practice example of biodiversity mainstreaming in agriculture can be found in East Africa. There, FAO developed an approach for mainstreaming ecosystem services and biodiversity into agricultural production and management with the goal of minimizing the use of agrochemicals (FAO, 2016). The approach details the advantages of avoiding agrochemicals in agricultural management. By phasing out these chemicals, benefits in pest and disease control, weed management, soil fertility, water conservation and pollination are expected. The approach further explains available policy measures in East Africa for mainstreaming ES and biodiversity.

Different agri-environmental schemes in European agroecosystem have been found to benefit functionally important insect diversity. The implementation of species-rich flower strips enhanced local bee abundance and richness, including Red-listed species in four European countries (Scheper et al. 2015). In Germany an increase in organic cropping from 5% to 20% in the surrounding landscape enhanced bee species richness in fallow strips by 50% and bumble bee density by 150% (Holzschuh et al. 2008). In South Korean agroecosystems five broad natural enemy taxa were positively affected by a complex landscape configuration and crop damage decreased with landscape diversity and in organically managed crop systems, resulting in higher average yields in organic compared to conventional fields. (Martin et al. 2016).

3.2 Biodiversity Mainstreaming into Forestry

Forest ecosystems are an integral part of human life. They provide food, raw materials, shelter, oxygen and recreation, and harbour approximately two thirds of all terrestrial animal and plant species on Earth (CBD et al., 2009a). In many countries, forest ecosystems constitute an important part of the national economy as they are the source of many commercially-traded products such as timber, plant medicines and clothing. As biodiversity is declining, the provision of these services is becoming increasingly threatened. Many important functions in forests that rely on a health diversity of flora and fauna are inhibited, as key species are lost. As such, there have been various efforts of considering and integrating biodiversity in the forestry sector. The challenge remains in the sustainability of economic revenues from forestry activities – after logging, forests are converted into agriculture (opportunity costs).

Some of the most common approaches include: (i) the maintenance of areas of high biodiversity within forest plantations and concessions, (ii) the promotion of community-based sustainable forest management, (iii) improved management of timber plantations and concessions through the cooperation with the private sector, (iv) reduction of illegal logging activities, (v) improved management of non-timber forest products, (vi) establishing concessions for sustainable forest management, and (vii) developing certification schemes. Though, these approaches are actually mutually supportive, as certification schemes are to promote sustainable management and biodiversity conservation.

Many different guidelines on sustainable timber production or conservation of biological diversity within the forestry sector already exist (ITTO, 1993), and the Forest Stewardship Council requires the identification of High Conservation Values forest areas and the adoption of a precautionary principle in the management of these areas (IIED and UNEP-WCMC, 2014). Logged forest restoration efforts have also been a primary means of reducing a loss of species diversity and are thus of great importance to the biodiversity mainstreaming approach[41] .

Due to the critical role that the private sector plays in forest management, many conservation efforts have focused on highlighting the importance or value of biodiversity to reduce ecosystem

[41] Harrison, R. D., and T. Swinfield. 2015. Restoration of logged humid tropical forests: An experimental programme at Harapan Rainforest, Indonesia. Tropical Conservation Science 8:4-16. Budiharta, S., E. Meijaard, P. D. Erskine, C. Rondinini, M. Pacifici, and K. A. Wilson. 2014. Restoring degraded tropical forests for carbon and biodiversity. Environmental Research Letters 9:114020.

degradation through the internalization of such value in a cost-benefits analysis. Efforts have been made to improve the management of wildlife in forest areas. Additionally, as a majority of Earth's forests are managed by local communities, participatory approaches have been used to address biodiversity issues arising from unsustainable use of forest resources. Low-impact logging is an area which has been investigated by forest ecologists and which has been shown to be effective in maintaining biodiversity. But there has been little adoption by industry.

An important step to consider in integrating biodiversity into the forestry sector has been the non-legally binding but authoritative statement of principles for a global consensus on the management, conservation and sustainable development of all types of forest of the United Nations Conference on Environment and Development in 1992. Also referred to as the "Forest Principles", this statement introduced a set of 15 principles designed to support the concept of sustainable forest management.

Good examples of biodiversity mainstreaming efforts in the forestry sector can be found in the CBD good practices guide (CBD et al., 2009a). One example of these is the rubber agroforestry sector in Sumatra (Joshi, 2009): Currently, there are approximately 3.5 million hectares of rubber in Indonesia that also act as corridors between national parks and PAs. But these systems are now being destroyed by an intensification of agriculture and other land uses. The World Agroforestry Centre (ICRAF) and local NGOs have thus implemented a conservation project for traditional rubber forests based on reward mechanisms. Agreements were made in Sumatra to preserve 2,000 ha of jungle and to provide support in the form of micro-hydro power generators, local tree nurseries and the creation of model villages. Working together with the communities in Sumatra to preserve the traditional rubber plants has been an important step[42].

The indigenous community of Ixtlán, Oaxaca, Mexico, has developed a sustainable forest management program in which long and narrow strips of forest surrounded by native forest are harvested in a 25-yr cycle. Surrounding forests spill out seeds and propagules that easily invade the cleared strips, which are managed (thinning, selection of vigorous trees) and rapidly undergo regeneration. In the scheme, the forested area (uncut and at several stages of regeneration) is greater than the cleared one. The community processes the harvested timber, and they also run a furniture factory. Economic gains derived from furniture selling are substantial and are re-invested in forest management and community development (infrastructure, schools, roads, etc.). The program includes a 36% of the total forest area set aside for biodiversity conservation and for an ecotourism business.

Another positive example of sustainable management of natural forests is Rainforest Alliance's regional program in Latin America "Forestry conservation through certification, marketing and strengthening of small and medium forestry enterprises" (Norheim 2013)[43], which recently was highlighted as one of the most successful programs financed by the Inter-American Development Bank.

3.3 Biodiversity Mainstreaming into Fisheries

[42] Ayat, A., and H. L. Tata. 2016. Diversity Of Birds Across Land Use And Habitat Gradients In Forests, Rubber Agroforests And Rubber Plantations Of North Sumatra. Indonesian Journal of Forestry Research 2:103-120.
Warren-Thomas, E., P. M. Dolman, and D. P. Edwards. 2015. Increasing demand for natural rubber necessitates a robust sustainability initiative to mitigate impacts on tropical biodiversity. Conservation Letters 8:230-241.
Karanth, K. K., V. Sankararaman, S. Dalvi, A. Srivathsa, R. Parameshwaran, S. Sharma, P. Robbins, and A. Chhatre. 2016. Producing Diversity: Agroforests Sustain Avian Richness and Abundance in India's Western Ghats. Frontiers in Ecology and Evolution 4:111.

[43] Norheim, T. 2013. Mid-Term Technical Evaluation of the Project for forestry conservation through certification, marketing and strengthening of small and medium forestry enterprises (IDB-MIF RG-M1123). Rainforest Alliance (in Spanish). 68 pp.

Fisheries support the livelihoods of many millions of people in coastal and riverine regions throughout the world, and in many cases, fishing is one of the most important economic sectors, as well as an important source of protein for 17% of the world population[44]. Economic development of aquaculture through unsustainable fishing practices, further accelerated by a growing population, however, is a severe threat to aquatic ecosystems and many species of fish, and is thus endangering the livelihood of some of the world's poorest. A loss of species diversity in aquatic ecosystems can result in the crossing of a tipping point and can lead to an irreversible degradation of an ecosystem. As a fact, fishery resources are declining, e.g. harvest rated cannot me increase as it could in previous times --which is also true for agriculture products[45].

Much as in the agriculture and forestry sector, efforts to integrate biodiversity in the fisheries sector are focussed on more sustainable fishing practices, better management of fisheries and the inclusion of community-based fishing activities into large scale sectoral plans and strategies. The FAO has been on the forefront as far as integrating biodiversity into fisheries is concerned, and developed a Code of Conduct for responsible fisheries in 1995 that highlights the importance of the ecosystem services approach in the management of fisheries[46].

Other efforts include certification schemes to showcase the value of nature and to promote eco-friendly fishing activities. The creation of Marine Protected Areas (MPAs) and no-take zones prohibiting the extraction of fish stock are also efforts to mainstream biodiversity. Collaboration between conservationists and private industry has also been applied to help develop strategies that support livelihoods and protect marine biodiversity. Fish catch quotas restricting the amount of fish that can be caught are also popular measures, but have done little to reduce biodiversity loss.

Overexploitation and government subsidies designed to support unsustainable fishing practices are causing a steady decline in many important fish stocks and in marine biodiversity overall. Policies aimed at expanding fishing activities often cause negative impacts on marine habitat and species. Another potentially harmful activity is the cultivation of alien fish species that can often cause a significant change in the functional structure of specific ocean and freshwater ecosystems.

Biodiversity mainstreaming, if integrated successfully into plans and strategies for the fisheries sector, can be of great importance to reversing main causes of ecosystem degradation and biodiversity loss in marine and freshwater environments. Effective management plans for endangered fish species and the extension of MPAs can both help to alleviate some of the stress that marine biodiversity is currently experiencing. The implementation of better monitoring systems for important marine and freshwater habitats and MPAs can also help to reduce negative impacts from illegal or unsustainable fishing activities.

An example of biodiversity mainstreaming in fisheries is the FAO/GEF project on "Mainstreaming Biodiversity Conservation and Sustainable Use into Inland Fisheries Practices in Freshwater Ecosystems of High Conservation Value" in Indonesia (FAO, 2014). The project aims at strengthening the management framework for sustainable use of inland aquatic biodiversity to increase the protection of high conservation value freshwater ecosystems, and at increasing the provision of

[44] FAO2014: The State of World Fisheries and Aquaculture, 243pp, http://www.fao.org/3/a-i3720e.pdf

[45] Seppelt R, Manceur AM, Liu J, Fenichel EP, Klotz S. Synchronized peak-rate years of global resources use. Ecol Soc [Internet] 2014; 19:art 50. Available from: http://www.ecologyandsociety.org/vol19/iss4/art50/

[46] Code of Conduct for Responsible Fisheries, Food and Agriculture Organization of the United Nations, 1995. https://www.google.de/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwi5nYLgs6XPAhWGaRQKHS_zCoIQFggcMAA&url=http%3A%2F%2Fwww.fao.org%2F3%2Fa-v9878e.pdf&usg=AFQjCNHsHGRrUYfdH4voHQsZVbzMtR7ukA&sig2=CxMdJoHF95Lz16_FHyZxbw&cad=rja

ecosystem services and to enhance food security for local people dependent on inland fisheries for their livelihoods (FAO, 2014).

3.4 Biodiversity Mainstreaming into Tourism

Tourism has become an important economic sector for many developing countries and in many cases is heavily subsidized and nurtured by local and national governments. In an increasingly connected world in which tourists are becoming increasingly aware of the nature and culture of foreign countries, the number of tourists has steadily risen. Often, however, biodiversity and ecosystems are placed under additional stress due to large numbers of visiting tourists that are unaware of their footprint in the ecosystem, this leading inevitably to harmful activities and pollution, degrading ecosystems and reducing the habitats of species. Commercial tourism development, together with the intensification of food production and contamination, have also caused habitat fragmentation and a decline in biodiversity. Cancun is actually a reminder of the footprint of this activity by international hotel developers on the local biodiversity, as well as in the cultural diversity of the local communities.

The tourism sector has focussed on emphasizing biodiversity conservation in selected sites and promoting sustainable tourism activities, also known as eco-tourism. Eco-tourism is gaining popularity as our society becomes increasingly aware of the need for nature protection. At the same time though, eco-tourism needs to be carefully integrated into tourism planning, and development strategies. It is here that biodiversity mainstreaming can be of great importance. Framing the concept of biodiversity in terms of economic implications is crucial for the tourist sector, thus allowing decision-makers to devise strategies for protecting habitats and reducing biodiversity loss. Favorable tax structures and other legal benefits are also helpful to further increase eco-tourism activities. Success in this sector can, in turn, can help finance activities ensuring that adverse impacts from tourism are reduced as much as possible.

One popular way to mainstream biodiversity into the tourism sector is by making a business case for sustainable tourism and promoting sustainable practices among local businesses. Succeeding in making large-scale tourist organizations understand the importance of biodiversity can secure financial investment and develop human resources for sustainable tourism. At the same time, promoting sustainable tourism certification schemes can help improve awareness and build a network of supporters. Working together with local communities and building capacities is another important tool for mainstreaming biodiversity into the tourism sector. Expanding the scope of sustainable tourist activities and environmentally friendly tourist infrastructures can also be helpful.

Another means of protecting biodiversity from negative impacts of tourism is to promote less-known regions, reducing the impact of tourists in traditionally popular areas. Improved management in PAs and better monitoring systems can also help to reduce negative impacts from an overload of tourists, including littering and pollution. A modernization of the tourist sector to increase water use and energy efficiency can also help to make a difference. And in some cases, ecotourists are involved in collecting data for conservation or restoration projects (Earthwatch is one example).

A UNEP, UNDP, GEF & BPSP report (2001) provides guidelines for best practices for integrating biodiversity into the tourism sector. The report names a number of steps that should be conducted in order to better safeguard biodiversity while developing tourism. The guidelines were designed to strengthen the coordination of tourism and biodiversity conservation, to create dynamic and practical inter-sectoral mechanisms for coordination, and to foster the participation of biodiversity conservation planners in meetings dealing with the tourism sector.

3.5 Biodiversity Mainstreaming in Other Sectors and Cross-Sectoral Efforts

Biodiversity mainstreaming efforts should ideally be applied in all sectors of human development to reverse the underlying causes of biodiversity loss and ecosystem degradation (i.e. mining, infrastructure, urbanization, manufacturing, education, information technology, mass media, transport, energy and others). Biodiversity offsets can be an important tool for mitigating biodiversity loss due to development projects. Over 45 compensatory mitigation projects are in place worldwide, with another 27 programs in development. Although these project offer great potential to mitigate biodiversity loss, their implementation poses a number of conceptual and methodological barriers (Fizimosis et al 2014)[47]. Long-term protected of offset areas must be ensured, and data on the spatial distribution of key species must be robust and sufficiently complete to ensure no net loss of species. Moreover, effective biodiversity offsetting may require very high offset ratios, and habitat restoration or translocation of populations cannot be certain to protect species at risk from development projects (Curran et al. 2014)[48].
While a majority of the biodiversity mainstreaming efforts have focused on sectoral efforts, it is perhaps even more important to coordinate efforts that impact more than one sector, as different development sectors are often intertwined with one another. For instance, the tourism and fisheries sectors, as well as the tourism and forestry sectors, are heavily connected to each other, and thus collaborative activities can be taken to achieve a positive effect for biodiversity.

Biodiversity mainstreaming aims to be implemented into national and sub-national strategies and development plans. These strategies and plans commonly have a cross-sectoral component, and it is here that biodiversity mainstreaming is especially important. It is for this reason that the new CBD strategic plan for biodiversity 2011 – 2020 explicitly calls for biodiversity mainstreaming to be included into national policies, plans and strategies. The role of biodiversity in contributing to poverty alleviation is well-recognized, as many of the poor directly or indirectly depend on biodiversity for their livelihoods. However, better management and sustainable use of biodiversity can also significantly contribute to the national GDP. An example of such an effort can be found in Namibia, where community-based natural resources management (CBNRM) is a major component of the country's rural development strategy (Jones, 2012). The project was initiated in 1996 following the country's independence from South Africa, and has since generated over 700 employment opportunities in hunting and tourism, while communicating the importance of a sustainable approach to biodiversity to local communities. The integration of biodiversity in spatial planning has also been used as an effective tool for mainstreaming at a sub-national level.

The project "mainstreaming coastal and marine biodiversity conservation into production sectors" – in Sindhudurg Coast of Maharatscha, India is another good example of a cross-sectoral biodiversity mainstreaming approach. The Sindhudurg coastal area is a major fish landing zone as well as a rapidly emerging tourist destination (UNDP, 2016)[49]. As such, the primary causes of ecosystem degradation are unsustainable fishing activities, an expansion of tourism, and pollution from fishing vessels or other maritime activities. This project is funded by the GEF and supported by UNDP, in partnership with the Ministry of Environment, Forest and Climate Change and the Government of Maharatscha. The project aims to address the aforementioned issues by creating partnerships and alliances with different sectors, with the goal to mainstream biodiversity conservation into the Sindhudurg's production sectors. Apart from this, the project is also designed to raise awareness

[47] Fitzsimons, J., M. Heiner, B. McKenney, K. Sochi, and J. Kiesecker. 2014. Development by design in Western Australia: Overcoming offset obstacles. Land 3:167-187.

[48] Curran, M., S. Hellweg, and J. Beck. 2014. Is there any empirical support for biodiversity offset policy? Ecological Applications 24:617-632.

[49] http://www.in.undp.org/content/india/en/home/operations/projects/environment_and_energy/mainstreaming-coastal-and-marine-biodiversity-into-production-se.html

among the local population concerning pollution and fishing activities. To date, the project contributed to a mangrove and coastal and marine biodiversity foundation, prepared a fisheries plan that includes biodiversity, rehabilitated large areas of degraded mangroves, and contributed to the rehabilitation of degraded coral sites, among other accomplishments. In the coming years, the project aims to improve planning and management in the coastal zone, minimize the impacts of tourism, strengthen the capacities of conservation and provide sustainable livelihood strategies for local communities through diversified income options (UNDP, 2016).

Ultimately, biodiversity mainstreaming into cross-sectoral efforts supports its national relevance and helps build support structures that improve the state of biodiversity mainstreaming in individual sectors. By making use of the aforementioned tools, instruments and approaches, it is hoped that biodiversity mainstreaming will play an important part in new and re-examined sectoral and cross-sectoral development plans.

Table 1. Upstream and downstream outcomes of biodiversity mainstreaming. IEED & UNEP-WCMC 2012

UPSTREAM	Governance outcomes	e.g. improved consideration of stakeholder's and right-holders' concerns (particularly those who are directly dependent on biodiversity)
	Policy and political outcomes	e.g. High-level sector, fiscal, development and social policies, constitutions and statements of national vision, include biodiversity considerations, and vice versa
	Plan outcomes	e.g. Inclusion of biodiversity-poverty linkages in development and poverty reduction strategies and in biodiversity strategies
	Budget and accounting outcomes	e.g. evidence of public-private sector resource mobilisation, inclusion of development-biodiversity linkages in national public and sector budgets; inclusion of ecosystem services in national accounting systems
	Institutional and capacity outcomes	e.g. strengthened capacity within biodiversity-related institutions to understand development and economic processes and interact in a constructive manner; valuation of the economic importance of biodiversity and ecosystem services in the economic outcomes undertaken and utilised in decision-making
	Investment and economic outcomes	e.g. improved domestic resource mobilization for poverty-biodiversity investments or recognition of potential trade-offs in sector investments such as mining
	Behavioural outcomes	e.g. key patterns and processes of production, consumption and waste treatment in sectors and localities are informed by biodiversity and poverty considerations
	Pro-poor biodiversity management outcomes	e.g. pro-poor management of ecosystem services, such as medicinal, cosmetic or edible plants; healthcare, wild foods, soil fertility; traditional breeds and crop varieties; water purification; cultural or religious benefits from biodiversity realised
DOWNSTREAM	Ultimate (biodiversity and developmental) impacts of these outcomes	e.g. improved productivity and sustainability of use of biodiversity assets on which the poor depend; protection and management of targeted species populations

Mainstreaming biodiversity and climate change

Ongoing global climate change is causing a pervasive redistribution of biodiversity in both terrestrial and marine biomes, through climate-driven changes in species distributions, or "range shifts." Distribution shifts tend to follow shifting climate zones, with a net movement poleward and upslope on the land, and poleward and into deeper water in the seas. Because species range shifts are idiosyncratic, novel biological communities are already being formed and key species interactions transformed, driving changes in ecosystem function and in some cases even feedbacks on climate itself.

Climate-driven redistribution of biodiversity directly affects human health and welfare through shifts in the distribution of disease vectors, game, timber, and fish stocks, agricultural production and crop

suitability, and traditional livelihoods and cultural practices. Mitigation and adaptation strategies must take these effects of biodiversity redistribution into account by identifying and acting on opportunities to minimize harm and capitalize on opportunities for benefits, through responsive and flexible governance systems. Protected area networks must aim to leave or create continuous corridors along climatic gradients as "escape routes" for the conservation of range-shifting wild species. Because national boundaries mean nothing to range-shifting species, international planning and cooperation are essential to coping with the climate-driven redistribution of biodiversity.

Climatic modelling suggests that farmers will need to adapt their crops, breeds, and agronomic and husbandry practices to cope with increasing temperatures (both higher daytime maxima and nighttime minima); changes in the timing, amount, and distribution of rainfall and soil moisture; and increases in the frequency and intensity of stochastic events (Jarvis et al. 2016). Crop, livestock, and fish diversity at the gene, species, and agro-ecosystem levels increases adaptability and resilience to the changing climate (Platform for Agrobiodiversity Research, 2011). Promoting agrobiodiversity therefore remains crucial for local adaptation and resilience of agro-ecosystems (Ortiz 2011; Hodgkin and Bordoni 2012). Farmers globally have extensive awareness of climate change and its impacts on their agricultural systems. The most common observations by farmers are warmer temperatures on average (especially hotter nights) and more irregular and sparse rainfall, which studies so far have found correlate very well with regional meteorological data (Gbetibouo 2009). Mijatovic´ and colleagues (2012) reviewed 172 case studies describing the use of agricultural biodiversity and associated traditional knowledge in strengthening resilience to climate change related stresses. Their synthesis shows that local communities themselves have voiced the need to ensure climate change resilience in their agro-ecosystems.

Mainstreaming climate change requires action in three related areas: reduce human impact on ecological systems (ES), for which a number of actions can be taken in the context of the CBD. Also, the impacts of adaptation and mitigation actions on biodiversity need to be taken into account in the context of the UNFCCC and related bodies. The role of ecosystems in adaptation and mitigation is considered a joint task of CBD and UNFCCC.

Biodiversity Mainstreaming and human health

Biodiversity underpins ecosystem services that are essential to human health and well-being. Services provided by ecosystems include food which underpins nutrition and food security, clean air and both the quantity and quality of fresh water, medicines, spiritual and cultural values, climate regulation, pest and disease regulation, and disaster risk reduction, including as these contribute to local livelihoods, health and economic development. Protecting biodiversity and natural landscapes can benefit human health by protecting the sources of existing and future medicinal resources.

4 A road map for technical and scientific contribution to mainstreaming biodiversity

In the following section we present the main elements to be used to develop a road map for the technical and scientific contributions from science to policy for well-being.

Mainstreaming biodiversity

Implies looking at the interactions between socio-economic and ecological systems- as these are complex interactions, a holistic approach is needed.

- There is a good amount of scientific evidence and research to make the case for biodiversity mainstreaming but the challenge seems to be conveying that information in the right format to the general public and, especially, to decision makers – there is a need to simplify the message as science is not being sufficiently used.

- Creating more incentives, and understanding to make people aware of the benefits of conserving biodiversity is key

- Education through science (and engaging the youth) is a key element of the mainstreaming approach

- Science cannot be detached from the political realities that surround decision-making processes

- "silo" science (not interlinked or inter-disciplinary) does not contribute to bring together people around the conservation and mainstreaming biodiversity approach.

Resilience and sustainability: economic, ecological and social aspects

Resilience has recently been defined as the capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation. (IPCC 5th report, 2015).

Yet, resilience is not a static concept. The resilience of social-ecological systems requires the capacity for transformative pathways, and therefore should be seen also from a transformative and adaptation perspective, not only regarding climate change, but all changes.

There is also a need to look at resilience from a long term ecological perspective and to note that while the extinction of species is a key concern, science and policy should be putting additional emphasis on looking at the dynamics of populations as these are the key for supporting ecological functions of ecosystems. For example, the effect of a decrease of megafauna population in Africa (e.g., elephants, etc.) and how this is having an impact on people given that the rodent population is increasing, which in turn is a vector for parasites that impact on the health of local human populations.

Another key perspective, is the need for good quality valuation of, for instance, marine ecosystem services in relation to fisheries, so as to understand use trends and decision-making processes.

Finally, there is also a need to understand how social power relations play out across scales: from households where gendered power relations affect biodiversity use, power relations within academic institutions which incentivize different ways of doing science that challenges options for fostering transdisciplinary research, to economic sectors where inequity is the norm and negatively affects effective biodiversity conservation investments.

Integrating approaches across the landscape

Land cover change and agrobiodiversity

The conversion of natural habitats and the increasingly intensive management of agricultural habitats are major reasons for biodiversity decline. Future integrative concepts for agroecosystem management need to (i) protect remaining natural and semi-natural habitats, (ii) add new perennial habitat elements and enhance crop diversity at a landscape scale to ensure pollination and pest control services, (iii) and improve local habitat structures by more diverse crop varieties, intercropping, more complex crop rotations, extensive soil management, and organic management. Thereby biodiversity in agroecosystems will be increased, negative environmental impacts of food production will be reduced, and an important step to sustainable agroecosystems with closed nutrient cycles and intact ecosystem functions will be made.

Forest restoration, conservation and sustainable use

Many approaches can be used to mainstream biodiversity in forestry. Sustainable forest management is only one of these. Restoration/natural regeneration on former agricultural land and plantations are also important. Multiple approaches are needed to scale up the role of forestry in mainstreaming biodiversity.

Forest management	Forest restoration/regeneration	Plantations
Reduced-impact logging/Sustainable forest management	Ecosystem restoration following logging	Diverse, native species plantations (silviculture)
Pyrodiversity (landscape fire management)	Ecosystem restoration following clearance/agricultural use	Agroforestry and Silvopastoral systems (combine agriculture with tree planting)
	Landscape restoration	Intensive monoculture forests (if land sparing favors conservation)
Maintains existing forest cover and forest habitat; critical for conservation of forest-specialists	Restores, enhances, and expands forest cover and forest habitat; may conserve forest species	Removes pressure from existing forests and provides forest products and livelihoods

We know a great deal about the ecological benefits of sustainable forest management.
The big challenge is adoption by governments and industry and finding the right incentives to increase the benefits for local people who are important stakeholders. Alternative land uses (conversion of forests to agriculture) are now more economically favorable to them.

Recognizing the conservation value and biodiversity being conserved in sustainably or unsustainably managed logged forests is essential to keeping this forest standing and to restore lost properties or maintain their economic and ecological importance.

The challenge is the low rate of adoption of SFM worldwide, especially in tropics.

- Using certification as a proxy for SFM, a minimum of 10.3 percent of all forest globally is under management.
- SFM is far less established in the tropics than in the temperate zone; only 1.9 percent of the total forest estate in developing countries.

main problem is that the demand for certified timber and ecosystem services has been too small to provoke a major shift in forest management practices, especially in the tropics.
Sustainability labels, such as that from the Forest Stewardship Council, increase the market value of timber, resulting in a 27–56% price premium for high quality hardwoods destined for export and a 2–30% price premium for lower quality timbers

SFM has yet to demonstrate that it is financially competitive as a land use compared with cash-crop plantations

Other reasons for poor adoption of SFM practices:

- Corruption can be a major hindrance to SFM because it hampers the enforcement of forest-related laws
- Timber alone is rarely sufficient to make SFM competitive with other land uses. In tropics, density of marketable species is often low and profits are reduced with selective logging.

"Perhaps the greatest obstacle to integrating production forests into effective conservation strategies has been the common perception that they are no longer important environmentally. This is an enormous misperception... Retaining logged tropical forests must be seen as one of the most pressing priorities for the future."

The biggest threat against biodiversity on forested lands is deforestation. The **main challenges** for **"**sustainable rainforest management**"** have shown not to be ecological issues but the framework conditions for the forestry sector:

- Lack of clear rights for land and forest tenure
- Direct and indirect incentives to other land uses compared with forestry
- Bureaucratic rules and regulations for forestry compared e.g. with agriculture, making it difficult to manage the forest legally (incentives for corruption)
- The lack of opportunities for long-term financing for forestry
- The quality and volume of public and private extension services for forestry as compared with agricultural extension services
- Public fiscal and trade policies that affect the private sector.

Indigenous peoples have a more holistic relationship with the forest, and often they protect the forest better than in national parks. But indigenous communities don't *necessarily* mean forest protection, because it is a question of population density, infrastructure and their vulnerable to many threats. The international community should take a more proactive role, supporting indigenous groups and local communities for both wood- and non-wood forest products. Many environmental organizations are afraid of supporting the cutting of trees, but the result might be conversion to other land use.

The opportunities for tropical forestry development are:

- Faster growing trees than in temperate regions.
- Markets for current and new non-wood forest products and raw materials
- Certification to assure or maintain access to niche markets and improved prices
- Value chain development combined with support to community enterprises
- Public-Private Partnerships, and
- Combined income from the same forest area

To conserve the rainforest, the sum of economic benefits and environmental services from the forest should be higher that conversion to other land use, even in a short-term perspective. It is a need for coherent national forest policy developed in collaboration with private sector and civil society, and enough resources to implement it and inputs from the scientific community.

Sustainable use and mainstreaming biodiversity in fisheries

Mainstreaming biodiversity in **fisheries sector** Contributions to the Road Map

- Make **better use of technology** for surveillance of illegal fishing, assessing biodiversity, sharing data
- Need of **collective action** for data collection and data sharing, as well as for fisheries management (including cross-sectors management approaches)
- **Balance** the needs for **conservation** and **livelihoods**
- Inform consumers/**advertise** about sustainable fisheries products

- Eliminate **pervasive subsides**
- **Close** all high sea fisheries

Mainstreaming biodiversity in the tourism sector

Mainstreaming biodiversity in **tourism sector** Contributions to the Road Map

- Communicate scientific findings more effectively to decision-makers at all levels (**Marketing Biodiversity**!)
- Assess pros & cons of governance & market instruments and strategies
- Award initiatives that integrate BD conservation and development
- Funding Knowledge Mobilization, Capacity building and Innovation
- Engage in policy-making; collaborate with resource users and entrepreneurs in designing, implementing and monitoring tourism plans

While global warming needs an international energy policy, the conservation of biodiversity through sustainable tourism needs to have local roots. Massive hotel chains can care less of their footprint in the local economy since very little of the capital stays on site. Meanwhile local hotels and locally focus tourism needs relay on the maintenance of their income in a longer term. These local stakeholders need to have the proper information of the value of their natural assets in order to properly take care of its conservation. Hence sustainable tourism needs scientist to engage locally, educate and participate in the local re-valorization of their biodiversity.

Mainstreaming biodiversity into climate change:

There is growing recognition in the field of climate policy that ecosystem services can make a strong contribution to climate change mitigation and adaptation, and many countries have included ecosystem-based approaches in their strategies to address climate change. However, national-level strategies for climate change mitigation and adaptation (e.g. REDD+ strategies and National Adaptation Plans), and strategies to conserve and sustainably manage biodiversity (e.g. National Biodiversity Strategies and Action Plans) are not always coordinated and aligned. Better coordination of these strategies with each other, and with further strategies that relate to ecosystem management (e.g. strategies to address land degradation or disaster risk reduction), can enable more efficient implementation of environmental policies, and make it easier to mainstream environmental policy goals such as biodiversity conservation into other sectors.

- **Successful mainstreaming:** In forestry: REDD+ where biodiversity values are regarded as a co-benefit to carbon storage.
- There are also several successful examples of **ecosystem based adaptation (EBA)** experiences. But they need to be applied at the right scale, with the involvement of key local actors.

- **Mainstreaming opportunities:** number of international environmental treaties request parties national level plans (NAPA, NBSAP, NDCs,…) if they are coordinated and reference each other, biodiversity can be streamlined in e.g. CC action, include CC thinking/ knowledge into NPSAPs/ PA management plans.

- **Main challenges:** It is known that climate change will add pressure onto biodiversity. Nevertheless, protected areas were and still are set up without climate change in mind. Range shifts of species due to CC are often not anticipated. Also increasing pressure on PA due to production areas moving uphill, e.g. in coffee. Pressure on PA increases.

- **Research gaps and agenda ahead:**
- change in species ranges and ecosystems due to climate change: some is well researched and modelled others isn't.
- Economic, social and ecological combined impacts of EBA and challenges need to be studied in order to recommend when is better to use this approach, and at which scale will it be more appropriate
- Economic, social and ecological combined impacts climate change on biodiversity and fisheries, agriculture, forestry, tourism, health and different scenarios and models need to be produced at different scales need to be produced.

- **Pushing forward the mainstreaming agenda:** science already has generated a lot of knowledge for integrated planning that can be used to integrate biodiversity into climate change action
- science can contribute to tools/ metrics/ indicators which can be consistently brought together at the national level to measure the contribution of biodiversity to societies/ wellbeing.
- Bringing models to decision-makers' attention, and use the same consistent models across policy sectors and for policy formulation.

Mainstreaming health and biodiversity

While biodiversity loss and disease emergence share many of the same drivers (e.g. land use change, habitat destruction, invasive species, etc.), for the most part, the biodiversity conservation and public health sectors have worked independently to achieve their goals and objectives, often reducing effectiveness and policy coherence. It is increasingly recognized that addressing the complex challenges of socio-ecological systems in associated scientific and policy-making arenas aiming to tackle the pervasive tripartite challenges associated with biodiversity loss, ill, health and development require the adoption of integrative, multi-disciplinary frameworks, such as One Health, which aim to bring together wildlife, ecosystem and human health.

- There is strong support that shows that risk of disease emergence is higher in high biodiversity regions that are under land use change pressure.

- there is also evidence that suggests that greater mammalian host biodiversity increases the pathogen pool from which novel pathogens may emerge into humans IF humans increase their contact with wildlife. For example, through increasing anthropic activities in high risk areas.

- Disease risk is a context and scale dependent process. Depends of the type of human activities ((e.g., hunters), cultural background and socio-economic activities. It also varies over time and space.

- This represents one example of how we can target the shared 'drivers' of disease emergence and biodiversity loss to develop synergies in understanding and conservation and health action.

Developing and adapting tools across scales for biodiversity mainstreaming

Valuation of biodiversity and ecosystem services

Research has evidence that biodiversity mainstreaming in different sectors is only possible if we integrate the different dimensions of values people have, and which includes economic, ecological, cultural, social, heath-related, inter-generational, etc. Mainstreaming one type of value across sectors is important but CLEARLY NOT sufficient; and the word "value" is not always used in the same way.

- Examples of cases in which information on different dimensions of value should be included:
- Environmental and social impact assessment schemes
- Product life cycle studies
- Tools: IPBES already produced a guide on the rationale to integrate these different values, proposing a simple protocol to do so.
- To support decision makers and practitioners to integrate the different values in all sectors, participants of the Science Forum identified the following research gaps
    - understand trade-offs (and potential conflicts) between the different *dimensions of value*, and provide a conceptual framework to address them.
    - understand trade-offs and conflicts between *different scales* for the different dimensions of value.
    - Mainstreaming values require the analysis of *inequity in power relations* from different knowledge systems, scientific disciplines and decision making approaches, and on the distribution of benefits and burdens from such decisions.

Monitoring biodiversity

Strategies for the sustainable use and conservation of biodiversity request regular observations for trends in changes. And, although there is no monitoring yet for mainstreaming biodiversity, here are some recommendations.

Sound, cross referenced, calibrated and properly validated techniques for the development of long term series of biodiversity monitoring that can function at different spatial and temporal scales, are fundamental for mainstreaming biodiversity. These techniques ranging from field data collection to remote sensing observations at different temporal and spatial scales require also advanced calibration and validation techniques. Payment for these approaches will require inter-agency collaboration with potential donors such as the World Bank and the Inter-American Development Bank as key regional players (for the Americas).

Key points to evaluate are:

- Integration of cross network techniques require key integration of biophysical variables such as Leaf Area Index, surface temperature, photosynthetic active radiation, etc. The integration will require coordinate via the Committee on Earth Observation (CEOS).
- Observations from leaf level to ecosystem level using different ground base and remote sensing techniques require advances analytics in order to ensure cross linkages with other disciplines.

Biodiversity monitoring, in order to be successful, will require a paradigm shift, moving from "it happened" to "it is happening" this can only be achieved if the scientific and decision-making community understand that current monitoring techniques are becoming obsolete. But, at the same time, new participatory formats, such as citizen observation systems offer possibilities for adaptive learning and knowledge co-production.

- A gap is perceived between the large amount of data being collected by the scientific community and the kind of data that policymakers want for decision-making, with the result that scientific monitoring data often does not feed into policymaking.

- Policymakers and the scientific community should work together to close this gap and communicate what kinds of data can be collected and what would be useful for policymaking.

- Good examples come from recent efforts by governments to work with the Biodiversity Indicators Partnership to coordinate diverse indicators systems to make them useful for policymaking, and recent developments within the Bio-Bridge Initiative. Related to this point, politicians should courageously avoid the stigma of perceived failure, and should encourage reporting of unsuccessful experiments and failures, as these often provide the most valuable lessons.

- In particular, more monitoring supported and carried out at the national level is needed. National governments should work with the scientific community to develop methods that are effective and cost-effective, and should commit to supporting them in the long term, as monitoring is only effective if it is carried out long-term.

- If done well, the costs of monitoring are easily offset by the mutual benefits for both the scientific community and policymakers. Good examples include the efforts presented by CONABIO on mapping the nation's (Mexico's) biodiversity, an unfortunately-unusual case of robust support for monitoring at the national government level.

- As an adjunct to effective monitoring, governments should consider early warning systems and establishing thresholds, so that the data provided by monitoring can actually lead to action by telling governments when deliberate action has become necessary. It is better to set "best guess" thresholds that can be refined with enhanced knowledge over time than to monitor without guidance on when to intervene or act.

- Monitoring biodiversity itself is important, but monitoring efforts should also include economic, socio-economic and other factors in order to answer more of the "w" questions, i.e. not only what and how many species there are and changes, but also the why and how of these changes. For this purpose it is important to engage all interested actors including local communities and sectors.

Modelling & scenarios

- Examples of modeling and scenarios building include: Integrating species distribution modelling in spatial planning for species conservation at the municipal level; insights from global land use modeling that can help with upscaling/generalizing findings from local and regional case studies to inform policy making at larger spatial scales; climate change models as a tool in policy development at the global level and participatory scenario development as a tool in spatial planning at the level of local communities; scenario development in the Andes, in the Great Lakes region of East Africa and in the Mekong river catchment facilitated by UNEP-WCMC; development of the Amazon Forest Code has helped reduce deforestation rates; using models of insect population dynamics in court cases that led to reduced pesticide application.

- Models are a tool to organize and store knowledge, and a way of thinking about a topic in a structured manner. With this broad definition of the term model, any systematic discussion of biodiversity issues becomes a modelling exercise, and models automatically become the core component of any mainstreaming activity.

- The same holds true for scenario development and scenario-based analysis. Caveats: see potential difficulties that can arise from different definitions of the terms under mainstreaming challenges.

- *Challenges:* there are numerous different types of models and scenarios, making communication about them challenging. At the outset is has to be made clear to all involved what type(s) of model(s) and/or scenario(s) the discussion is about. Even the distinction between the terms scenario and model is not straightforward.

- *Models* can range from conceptual models that can be depicted graphically and understood intuitively (e.g. boxes and arrows as in the IPBES conceptual framework) to more or less complex mathematical or numerical models which require training in mathematical methods and knowledge of the syntax of programming languages to fully understand their output.

- The term *scenario* can be used to refer to verbal descriptions of system behaviour (usually complex socio-ecological systems in the context of discussions about climate change or biodiversity issues), but it can also refer to modelling exercises using particular input values (assumptions) and producing output pertaining to these different assumptions.

- Contrasting reactions by different actors to models / modelling output: I don't believe it because all models are wrong, I don't trust it because I don't understand what the model does etc. versus I don't believe it unless there is a formal (mathematical, numerical etc.) model to support your statement.

- Communicating the opportunities and the limitations involved in any given modeling/scenario exercise, in particular highlighting the uncertainties of results is often difficult.

- Clarifying that the behaviour of complex systems with feedback mechanisms that work at different spatial and temporal scales is inherently unpredictable, but that scenario and modeling exercises trying to capture the essence of such systems can nevertheless raise the likelihood that policy or management decisions will be better than without such exercises is important, but difficult to achieve.

- Difficulties in defining what success of mainstreaming the application of models and scenarios actually means. Measuring success depends on the purpose and the methodology of the individual modeling/scenario exercise and requires suitable criteria and indicators.

- Validating models that address long time scales and large areas is inherently difficult -> gathering data that could be used for validation takes at least as long as the forecasting horizon, i.e. often years, decades or even centuries; experiments at large scales are not feasible. Testing the counterfactual (what would have happened if the model/scenario would not have been developed and used) is usually not feasible.

- *Research gaps and the agenda ahead:* Lack of knowledge about the way in which application of models and scenarios affects decision-making and how these responses feedback to e.g.

biodiversity and ecosystem services. Continue and coordinate better the various inter- and transdisciplinary research initiatives already underway.

- To push forward the mainstreaming agenda, there is a need to promote the use of modeling and scenario-building techniques in transdisciplinary research projects; create fora for sharing experiences with applying models and scenarios in decision-making contexts; develop repositories of information and data, ensure that data curation is done effectively and accessibility of data is maintained to facilitate meta-analytical approaches in the future which can help to quantify mainstreaming effect, and promote that as many people as possible get involved in global processes such as the IPBES, where new scenarios are already being prepared and where a lot of outreach / mainstreaming / capacity-building & capacity-sharing is foreseen.

Access and benefit sharing (ABS), the Nagoya Protocol and mainstreaming

- The third objective of the Convention is the fair and equitable sharing of benefits arising from the utilization of genetic resources, and the Nagoya Protocol has recently come into force to facilitate this.
- A key point is that this is a circular process – without access there can be no benefits developed, thus none shared and the benefits anticipated to the conservation and sustainable use of biodiversity will not be delivered.
- Particularly in the area of non-commercial research into biodiversity the potential for effective delivery of non-monetary benefits is very great. These include capacity building, provision of information, and development of partnerships between providers and users.
- In order to deliver these effectively and manage compliance, many consortia of research organisations are developing and implementing codes of conduct and best practices, thus meeting the requirements of Article 20 of the Protocol and, more importantly, becoming more effective in their management of ABS and sharing benefits.
- The potential of using global pipelines of information, such as the Global Biodiversity Information Facility, Catalogue of Life, BOLD and many others, is considerable, allowing countries to access in a usable form the information they need to manage their biodiversity according to national policies.
- Voluntary measures such as codes of conduct, best practices, guidelines and standards do not replace provider country ABS requirements, but can complement them and support compliance.
- Providers and users can work together to develop practical, sector-appropriate model contractual clauses that serve to facilitate research and benefit-sharing.
- Voluntary measures and model clauses help by raising users' awareness of ABS obligations and building capacity for development of balanced, transparent, collaborative relationships between users and providers, resulting in more effective benefit-sharing.
- A range of practical codes, best practices and agreement-building tools have been developed for ex situ collections and non-commercial research users.

Integrating approaches for mainstreaming biodiversity

- What can be learn from existing experiences of trying to implement the Ecosystem Approach (EA), which was endorsed as the primary framework for action by the CBD over 15 years ago, is that it really combines many of the recommendations about how we should manage our ecosystems for the benefit of nature and society.

- Many of the principles echo ideas about how to manage for the resilience of socio-ecological systems, whilst frameworks for understanding ecosystems, can provide and helpfully inform those seeking to implement the EA.

- It should be a key approach allowing us to mainstream biodiversity; however, little is known about its implementation.

- Studies in the UK have found that many had made good progress, however, none achieved all their goals. Two key issues underlie many *challenges*. Firstly, previous ways of conserving natural systems have often been technocratic and focused on single issues or species: this creates a legacy of ways of working, thinking and organising that do not always suit new and more holistic and participatory approaches. Secondly, new initiatives to improve environmental management often focus on creating or adjusting new projects, i.e. on the site of existing protected areas - however, if we are really to achieve the systemic change need to mainstream biodiversity, multi-level institutional changes are needed.

- It will be useful to introduce (a) the idea of *'sticking points'* and (b) the 12 Malawi principles, to help different groups to reflect on their experiences and plan future actions for different timescales and sectors. The idea of sticking points seems intuitive and a good way to stimulate debate about challenges, whilst the 12 principles should be discussed and used to support the planning, appraisal and self-evaluation.

- Failure to implement a principle is not a problem; however failure to discuss and document it is a problem.

- Future sharing of examples and experiences would help to support further learning and give new impetus to tackling these difficult issues: therefore, to aid with this, it would be useful to resurrect the Ecosystem Approach newsletter and reinvigorate the source book.

- To complement this, more social science contributions can help to understand these processes, and to interpret relevant academic concepts to other academic disciplines as well as policy and practice groups.

Mainstreaming multiple knowledge systems for biodiversity conservation

- In the sense whereby the term **conservation** is understood as a positive endeavor that includes preservation, sustainable use, restoration and enrichment of the environment (World Conservation Strategy, IUCN, 1980) there are successful cases such as the free exchanges of seeds and genetic material, in many countries in the world, and is nowadays still a common practice, or, traditional agricultural systems (i.e., knowledge, practices, institutions and conserved territories and areas) including *millpa*, *chakra* and other ecosystems that integrate a variety of species and cultivars, as well as seasonally-organized general assemblies and other ways of deciding collectively to begin cultivation and irrigation cycles, start harvesting times, start migration, etc., which remain fully alive today and conserve culture, nature and agro-biodiversity.
- Key factors for success, existing and always needed are: Community integrity, strength and organization; appropriate governance at various level (diversity, quality and vitality); security of collective and individual land tenure; maintenance of and respect to traditional knowledge (including via systematization and documentation for the next generations); respect to traditional institutions and elders, and, leadership at all levels.

- Scaling-up processes will need: Self-empowering of indigenous peoples and local communities (including via indigenous organization, strengthening of leadership and facilitation of community-to-community exchanges and learning); enhanced social awareness and respect of traditional values and ways of life (including via improved education and policy and legislation); spaces and facilitation to set up appropriate negotiation processes in land use planning with legitimate community representation.

- Traditional, indigenous and local knowledge, constructed in different ways from scientific knowledge has to be integrated into mainstreaming. Knowledge sharing from elders to young, re-valorization of traditional knowledge, re-valorization and promotion of relevant practices, recognition and awareness by society about the contribution of indigenous knowledge and conservation of biodiversity because of local practices, values and cosmologies that build upon an understanding of the connections among all life forms, need to be encouraged and promoted.

- Main challenges are for knowledge integration are: Poor acknowledgement of empirical (local) data; limited leadership of indigenous communities towards action to defend their local interest and bio-cultural heritage; limited understanding of what "mainstreaming" actually means; limited public awareness of the commerce sector and consumers of the products of indigenous peoples and local communities; government subsidies that threaten local diversity and do not acknowledge the value of seeds and technologies of local agro-biodiversity; marketing practices and penetration strategies of businesses that impose seeds, food and eating habits destructive for agro-biodiversity (such as landraces) and food sovereignty, and, poor representation of indigenous peoples in international policy development arenas.
- Main research gaps in this area are: train and provide extension workers with material that takes into consideration local (indigenous) knowledge and its values and large contributions to conservation; increase intercultural education programmes and policies; be more open to alternative knowledge and practices to govern and manage nature and biodiversity (eliminate academic arrogance); be more ethically conscious and respectful in dealing with traditional knowledge and institutions, and , acknowledge traditional knowledge in meetings such CBD COPs.

- To push the mainstreaming agenda, it will be needed: to promote ethical framework in research; include a real representation indigenous peoples in relevant meetings; document and demonstrate the importance of the indigenous knowledge; improve governance policies for indigenous people; promote policies that value local knowledge; support indigenous marketing opportunities and community empowerment; avoid imposing foreign values and lifestyles upon the indigenous peoples involved in the research.

- Some actions to which engage are: Improving education policies and involve indigenous peoples in drafting curricula; prepare better support material about indigenous knowledge for extension workers; support forest governance and management by indigenous peoples; promote values and awareness about the importance of indigenous knowledge, practices, institutions and conserved territories and areas; share successful experiences to invite replication; always link research to action, and build indigenous capacities and representativeness.

Technical and scientific cooperation

There exist many solutions to biodiversity conservation and management challenges, but decision-makers and managers often do not have access to these solutions.

Expertise on a diversity of biodiversity issues is now held in almost every country and region, both within developed and developing countries.

Successful implementation of biodiversity mainstreaming approaches need to be identified and shared with other countries and institutions in order to scale up solutions that are effective.

The Bio-Bridge Initiative (BBI) was developed to serve as the overarching programme focused on catalyzing and facilitating technical and scientific cooperation (TSC) and technology transfer under the CBD and its protocols. TSC, in that context, is defined as a process whereby two or more countries pursue their individual or collective biodiversity-related goals through cooperative exchanges of knowledge, skills, data, resources and technologies.

Many countries and institutions are already engaged in TSC, and there is a willingness on the part of scientists, academic institutions and other institutions with specific expertise to share technical and scientific knowledge and expertise more broadly, through channels such as BBI.

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