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Regional Research in Support of the Second Phase of the High-Level Panel on Global Assessment of Resources for Implementing the Strategic Plan for Biodiversity 2011-2020

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Biological Diversity

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REGIONAL RESEARCH IN SUPPORT OF THE SECOND PHASE OF THE HIGH-LEVEL PANEL ON GLOBAL ASSESSMENT OF RESOURCES FOR IMPLEMENTING THE STRATEGIC PLAN FOR BIODIVERSITY 2011–2020

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For further information, contact:
Secretariat of the Convention on Biological Diversity
413 Rue St. Jacques, Suite 800,
Montréal, Quebec, Canada H2Y 1N9
Tel: +1 (514) 288 2220
Fax: +1 (514) 288 6588
E-mail: secretariat@cbd.int
Website: www.cbd.int

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INTRODUCTION

This document is a compilation of the reports of six regional reviews undertaken in support of the second phase of the High-level Panel on the Global Assessment of Resources for Implementing the Strategic Plan for Biodiversity 2011-2020.

Owing to restrictions on the length of documents for printing, all case studies and a number of larger tables and figures have been placed into the appendices.

Objectives and approach of the high-level panel

In paragraph 24 of decisions XI/4, the Conference of Parties welcomed the findings of the first phase of the High-level Panel on the Global Assessment of Resources for Implementing the Strategic Plan for Biodiversity 2011-2020, and invited the High-level Panel, in collaboration with other relevant initiatives that could provide a more bottom-up approach, to continue its work with a broadened composition and to report back on the results of its work to the twelfth meeting of the Conference of Parties.

The figures provided were a first assessment of the total resources required to deliver the Targets, including the current levels of resources allocated to the relevant activities. It was estimated that one-off investments account for between 60% and 70% of the overall global resource needs for delivering the Targets over the 2013 to 2020 period. Through simple addition of the resource requirements identified for each Target, the costs for implementing the twenty Aichi Biodiversity Targets were estimated at between US$150 billion and US$440 billion per year. However, it was expected that these resource requirements neither should nor could be met by biodiversity finance alone, and there is potential for considerable synergies among the Targets, so that coordinated action could substantially reduce the total estimate.

By considering the range of the costs of implementing the activities needed to achieve the targets, and identifying the opportunities to most cost effectively secure such benefits through actions both within and outside the biodiversity sector, the research built on the initial work of the High-level Panel. In response to the following questions, the benefits of meeting the Aichi Biodiversity Targets were assessed by examining both the positive impacts on biodiversity directly and the wider benefits to society that result from the investments and policy developments required:

- Benefits
- Investment needs
- Resource requirements
- Policy alignment and development
- Cost effectiveness
- Benefits and costs

The aims of the second phase of the High-level Panel were to:

1. Develop an assessment of the benefits of meeting the Aichi Biodiversity Targets, examining both direct biodiversity benefits and wider benefits to society that result from the investments and policy developments required.

2. Assess the range of the costs of implementing the activities needed to achieve the targets, taking into account the further work proposed in the High-Level Panel report to COP-11.

3. Identify opportunities to secure the benefits most cost effectively through actions in both the biodiversity sector and across economies as a whole that can mobilize / make better use of resources, to deliver greatest progress towards meeting the Aichi Targets.

The second phase involved a more bottom up analysis of the benefits and costs of meeting the Targets, based on a review of regional evidence covering each of the following regions: Africa, Asia, Europe, North America, Australasia and the Pacific, and Latin America and the Caribbean. The regional research was carried out between October 2013 and January 2014. This document contains the final reports of those regional assessments.

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The High-level Panel provided strategic leadership and guidance to the research and identifying the priorities within it; working to draw key messages, conclusions and recommendations from the research; and oversaw the delivery of a draft report for WGRI-5 consideration and feedback, and a final report for COP-12.

Supported by the CBD Secretariat, the High-level Panel engaged with other relevant institutions and initiatives to secure the cooperation and provision of evidence for analysis, and to raise awareness of the study and its findings. This included within the CBD on the development of the fourth edition of the Global Biodiversity Outlook (GBO4) and regional workshops on resource mobilization. Within the UN system, the High-level Panel contributed information, and was represented where possible, within the Post-2015 UN Development Agenda and Sustainable Development Goals (SDGs) processes, in particular at the Eighth Open Working Group meeting on the SDGs and the Intergovernmental Committee of Experts on Sustainable Development Financing. The High-level Panel worked closely with the UNDP-administered Biodiversity Finance Initiative (BIOFIN) and the World Bank-led "Wealth Accounting and the Valuation of Ecosystem Services" (WAVES).

Key questions

The **key questions** addressed by the regional studies are:

- What will be the benefits of delivering the Aichi Targets?
- What investments need to be made to deliver the Aichi Targets and to secure these benefits?
- What evidence is there of resource needs at the project and country level?
- How do the identified investment needs and the benefits they will achieve align with other policy agendas, such as the Post-2015 UN Development Agenda and the Sustainable Development Goals?
- How can the Aichi Targets be delivered at least cost, taking account of the synergies between the targets and the investments required, the sequencing of actions and the synergies with other policy agendas?
- What does the evidence as identified above tell us about the balance between the benefits and costs of meeting the Targets?

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1. AFRICA

Jane Turpie, Anchor Environmental Consultants

1.1 EXECUTIVE SUMMARY

The Aichi Biodiversity Targets for the 2011-2020 period form part of a revised and updated Strategic Plan for Biodiversity, that was adopted at the tenth meeting of the Conference of the Parties to the Convention on Biological Diversity (CBD COP 10). This study, based on available evidence, provides a rapid assessment of the benefits of meeting the Aichi Targets in Africa, the types of actions required, their costs, and ways in which to secure the benefits in the most cost effective way possible. The key findings are summarised in point form:

Benefits of delivering the Aichi Targets

- The primary goal of the Aichi Targets is to reduce the loss of valuable biodiversity and ecosystem services. Africa is a key area for action, as it contains a large share of the world's biodiversity but this biodiversity is disappearing at a rapid rate.
- Africa's populations are largely rural and predominantly poor, and depend heavily on provisioning services of ecosystems (e.g. forest, fish and wildlife resources) for their livelihoods. Evidence suggests that harvested natural resources typically provide more than a quarter of rural household incomes.
- Genetic resources are important for sustaining and developing agricultural activities, including aquaculture and horticulture, as well as for pharmaceuticals.
- Ecosystems provide a number of regulating services such as hydrological services, agricultural support services (pollination, control of pests), human health services (control of pathogens), climate regulation (including carbon sequestration), sediment retention, and the provision of critical areas for biodiversity (refugia, nursery areas). Estimates of values exist for most of these, but are mostly fairly preliminary, limited in geographical area and lacking in biophysical evidence.
- There are very few estimates of the cultural value of ecosystems, even though tourism is considered to be an important growth area in Africa. Nature-based tourism contributes a high portion of national income in countries such as Seychelles and Botswana where investment has focused on this sector. Degradation of ecosystems can incur significant costs for society. Examples that have been valued include outbreaks of livestock pests (blackfly) as a result of river degradation, and the loss of water and other ecosystem values as a result of invasive alien plants in the fynbos biome. Unsustainable natural resource use in Malawi costs the equivalent of 5.3% of GDP each year.
- In Africa, the biggest proximate causes of biodiversity loss are (1) the burgeoning pressures of a huge rural subsistence populations on land and resources, most of which are subject to open access, (2) the increasing and poorly managed commercial exploitation of timber and fish resources (3) the loss of land to mineral and oil exploitation and for production of palm oil and biofuels, (4) urban demands fuelling deforestation for timber, charcoal and firewood by the informal sector; (5) illegal international trade in biodiversity and biodiversity products; (6) invasive alien species (7) hydrological alteration due to water demands, (8) water pollution, (9) relatively low levels of understanding and appreciating the value of biodiversity and (10) poor governance including inadequate implementation of existing policies and legislation pertaining to biodiversity conservation and use. These problems will be further exacerbated by climate change.
- Meeting the Aichi Targets is expected to increase resilience to future pressures and improve the distribution of benefits from biodiversity.

- Meeting the Aichi Targets will also unlock new opportunities for development, for example through better production systems and expansion of tourism. This will support development agendas.

Types of investments and priorities for action

- The required actions for the 20 targets can be summarised into those that guide and prepare for the core actions (research, planning and increasing awareness & capacity), and those pertaining to the actual changes that need to be brought about (direct conservation action, correcting incentives and improving technology).
- Estimating and communicating the value of biodiversity and implications of current trajectories to policy and decisions makers is a critical action required in Africa, in order to strengthen the political will to meet the Aichi Targets.
- As long as other strategies continue to falter, the conservation of terrestrial and marine areas in protected area systems needs to remain a core, low risk strategy for conservation, that is relatively easy to finance, for example through tourism investment.
- Along with this, substantially higher-risk investments will need to be made into promoting conservation in buffer and corridor areas. Integrated conservation and development projects (ICDPs) as a means of engendering co-operation with protected areas have mixed success.
- Restoration is often difficult and prohibitively costly, but can be worthwhile under certain circumstances, such as when the carbon or water gains generate financial returns. In particular, investments in the control of invasive alien species have been shown to have clear pay-offs, and the greater the initial investment, the better the rewards over the long term.
- While numerous facilities exist for ex-situ conservation, these are not as effective as they should be: many facilities need to be upgraded, capacity building is required, and operations need to be more co-ordinated nationally, regionally and internationally.
- Property rights, land tenure and governance issues are central to many threats to biodiversity across Africa and need to be resolved in order to develop incentives for sustainable resource use and land management. Community-based management programmes (e.g. CBNRM, CFM, LMMEs) have sound conservation and development objectives but are often fraught with problems and require ongoing support.
- Where land and resource use is practiced on a commercial scale, investment in integrated planning will be key, as well as implementation of standards and certification systems, fiscal incentive measures and strong regulation of practices. Where it is practiced on a small-scale, and property rights are secure, interventions should focus on measures to increase productivity and incomes ('land sparing'), as well as incentives such as charges and payment systems.
- Interventions to reduce the demand for overutilised resources (e.g. charcoal) and endangered species (e.g. bushmeat species, rhinoceros etc) are a very high priority, and need to be carried out on a large scale, and in the appropriate geographic locations (including urban areas and internationally).
- Performance bond and offset systems need to be established for commercial and industrial activities that encroach on habitats and threaten water quality in order to ensure no net loss.
- There is an urgent need to invest in wastewater treatment systems, but localized problems of extreme pollution caused by commercial and informal mining would be extremely costly to address and would be more likely to be driven by human health concerns. Measures to reduce pollution outputs are required on a large scale.
- The knowledge and capacity to achieve the required actions are badly lacking. Significant investments will need to be made in research and in generating the capacity required to meet and maintain the Aichi Targets.

- Traditional knowledge is being lost as traditional cultures become eroded by increasing foreign cultural contact. It is thus urgent to document traditional knowledge about the characteristics, properties and behaviour of species, as well as to understand cultural practices that influence the success of policy measures.
- Africa has relied heavily on grants to address its biodiversity issues up to now, and while it should continue to capitalise on global willingness to pay for biodiversity, opportunities to develop sustainable financing mechanisms and to stimulate private sector investment in the restoration and management of ecosystems should also be seen as a priority.
- Given the lack of political will for addressing conservation, which is reflected in poor policy, legislation and enforcement in many countries, and the wide-scale problems of governance and corruption, overcoming Africa's threats to biodiversity will be an extremely challenging exercise. In general, priority investments should be those that have a broadscale impact on biodiversity and attitudes, that deliver visible benefits and that secure highly vulnerable biodiversity.
- Parallel development actions such as education will ultimately be the most important investment in Africa's biodiversity.

Resource requirements

- Estimates of spending requirements are order-of-magnitude estimates at this stage as not enough evidence could be gathered in the time available to produced detailed costings that take geographical variation into account.
- Research and development expenditure could be in the order of $17.5 million. Investments in awareness and capacity probably need to be in the order of $7-8 million per country, and about $5-10 million needs to be spent on integrated land and resource use planning per country.
- Direct protection measures such as expanding protected area systems and restoring important natural habitats may require billions of dollars at the continental scale.
- Costs of achieving sustainable land and resource use are extremely variable, ranging up to $2,000 per ha.
- A recent estimate is available of actual spending on conservation by country which suggests that at least US$480 million is currently being spent in Africa as a whole. This is probably a fraction of the investment required.
- All African countries are spending considerably less than 1% of their GDP on direct conservation activities, and the majority spend less than 0.1%. Spending is by far the highest in South Africa, but South Africa's spending represents among the lowest investments relative to GDP. The top six spenders are countries that have a high level of benefit from nature-based tourism.
- More research is required to establish what countries are spending on all the actions that contribute towards meeting the Aichi Targets.

Alignment with other policy and development agendas

- There are strong synergies between biodiversity and global development agendas.
- There is a significant overlap between the Aichi Targets (especially targets 4, 6 and 7) and the Millennium Development Goal (MDG7) to ensure environmental sustainability.
- In addition, the Aichi Targets as a whole will make important contributions to Millennium Development Goals 1 and 6, though gains in natural capital and the flow of ecosystem services that impact on human health and livelihoods, as well as supporting economic development.
- The above synergies are not fully appreciated and the Aichi Targets (particularly target 1) will guard against development agendas focusing on economic output as a means of reducing poverty without considering the role of biodiversity.

- In turn, the pre- and post-2015 development goals will facilitate meeting the Aichi Targets and will be critical to maintaining the achievements in the longer term.
- There are also very strong synergies between the Aichi Targets and the UN conventions on addressing climate change and combating desertification, since both of these require addressing and reversing ecosystem degradation.

Achieving cost-effective delivery of the Aichi Targets

- There is a high level of synergy between the different Aichi Targets. This means that the costs of delivering all the Aichi Targets will be considerably less than the sum of the costs of delivering each in isolation.
- There is evidence that some actions will be more cost-effective than others, both at the broad level (e.g. strict protection versus incentive measures), and at the detailed level (e.g. radio broadcasts versus print media).
- Activities with the highest returns to cost are likely to be raising awareness of biodiversity values and tradeoffs, removal of harmful subsidies, strengthening protected area systems, and sustainable agriculture.
- Cost effectiveness of different actions will vary depending on geographical context and is likely to be lower in poverty-stricken, populous areas.
- Spending time on research will inform strategy and thereby increase cost-effectiveness of the next steps, but there are also trade-offs between the knowledge gained and the costs of delaying actions. Incentive measures should not be delayed where they can be adapted following further research. Protection measures should not be delayed by exhaustive planning.
- Sequencing of actions will be important in for achieving individual targets, but sequencing of addressing the Targets will not be critical in determining overall cost effectiveness, because benefits may be outweighed by the costs of delay.
- Improved governance and a better institutional and policy framework will be very important in achieving the delivery of the Aichi Targets in Africa in a cost effective manner

Overall costs and benefits

- There is little evidence as to the relative scale of the benefits and costs of investments required to meet the Targets for different initiatives, or at different geographical scales.
- The best evidence comes from the literature on restoration, in which costs of clearing invasive alien species or replanting vegetation is compared with the delivery of hydrological and carbon sequestration services.
- The net benefits of implementing sustainable use practices and expanding terrestrial and marine protected areas are generally reported to be positive.
- Because many benefits cannot really be measured in monetary terms, such as awareness of the value of biodiversity, cost-effectiveness analysis is going to be more relevant than cost-benefit analysis in many cases.

1.2 INTRODUCTION

In order to achieve the Aichi Targets, significant financial investment will be required from all sectors, including government, industry and civil society. In 2010, studies were conducted to produce estimates of the levels of investment required for each of the targets at a global level. The results of these studies were reported by the Phase 1 High-Level Panel on Global Assessment of Resources for Implementing the Strategic Plan for Biodiversity 2011-2020 to COP-11. However these investments have not been considered at all scales for all targets, and the return derived from meeting the targets also requires further investigation. A Phase 2 High-Level Panel was constituted in 2013, with a mandate to assess the benefits of meeting the Aichi Biodiversity Targets, and recommend financial resources needed to achieve the targets. The work considers the range of the costs of implementing the activities needed to achieve the targets, and identifies the opportunities to most cost effectively secure such benefits through actions both within and outside the biodiversity sector.

The work of Phase 2 builds on the earlier work assessing these targets individually at a global scale, and will help the High-Level Panel to:

- Develop an assessment of the benefits of meeting the Aichi Targets, examining both direct biodiversity benefits and wider benefits to society that result from the investments and policy developments required.
- Assess the range of the costs of implementing the activities needed to achieve the targets, taking into account the further work proposed in the High-Level Panel report to COP-11.
- Identify opportunities to secure the benefits most cost effectively through actions in both the biodiversity sector and across economies as a whole that can mobilize / make better use of resources, to deliver greatest progress towards meeting the Aichi Targets.

While the previous research outlined overall programmes of investment designed to meet each of the Aichi Targets globally, this research provides examples of requirements identified in different countries and initiatives that can be compared with the needs proposed in the previous global assessment. The HLP's first report found that it was difficult to quantify current allocations of resources for the delivery of the Aichi Targets or to compare them with the estimated resource requirements. This study examines evidence of allocations compared to needs within different countries to help address this question. The HLP is expected to ensure the alignment of its work with the Post-2015 UN Development Agenda and the Sustainable Development Goals. The extent that meeting the Aichi Targets contributes to these agendas also has implications for net resource requirements and funding strategies, in that synergies between the Aichi Targets and development objectives will reduce the extra resources required to deliver them, whereas managing potential conflicts between biodiversity and development goals could make the Aichi Targets more difficult and costly to deliver. The first phase report presented separate cost estimates for different Target clusters, and assumed that these actions would proceed simultaneously. However, it also noted that: (i) synergies and overlaps between Targets and with wider policy agendas mean that a more integrated approach to delivery could reduce overall resource needs, and that (ii) the sequence in which investments are made will affect the overall cost, particularly if there is an initial focus on the Targets that deliver the right enabling conditions for subsequent action. It is also likely that some investments will deliver greater biodiversity gain than others relative to the costs incurred. This study thus investigates what strategies should be put in place in order to deliver the targets at least cost.

1.3 METHODOLOGY

The study was undertaken as a desk-based analysis, using available data collected from a variety of sources, including academic papers, government studies, NBSAPs, country submissions to CBD on resource requirements, regional studies (e.g. EU, ADB), TEEB country studies, international organisations (e.g. OECD, UNEP, UNDP, World Bank), international programmes (e.g. GEF), multi-country assessments (e.g. BIOFIN, WAVES, Natural Capital Project), global assessments (e.g. GBO-4), NGO assessments, international databases (e.g. EVRI), and unpublished data and reports as might be obtained through consultation with organisations and individuals identified in the course of the study. The above sources were used to compile and summarise the evidence required for the research questions, but no attempt was made to aggregate or standardise the evidence.

Actions required to meet all 20 Aichi Targets were considered, but recognising that their relative importance and priority will differ between geographic areas, which will affect the strength of evidence as well as the strategies that need to be employed in meeting them. In gathering evidence, the focus was on the various actions/investments that would be required to meet the Aichi Targets, whether or not they were specifically intended to meet the targets. Any types of actions/investments for which evidence could not be found was noted as a gap.

Information was collected from different sources for a variety of countries, regions and initiatives at different geographical scales as far as possible in order to address the research questions. As well as an overall review, the chapters include case studies relating to particular countries, initiatives, locations or themes.

Costs and benefits are presented in qualitative and quantitative or semi-quantitative terms as far as data allow. Emphasis is on drawing different insights at different geographical levels, examining linkages between targets and addressing gaps and issues raised in the first report, rather than the quantification and aggregation of resource needs at a global level. Nevertheless, some comparison is made between the findings of this research and the previous assessments where possible. The sources and methods of the evidence is included and emphasis is also placed on providing critical review of the robustness of the evidence provided.

Limitations

A key challenge was that research and reports were biased toward countries with more developed infrastructure, and so many countries without reports or case studies are under-represented, potentially skewing costs towards countries with monitoring/assessment capacity. Also, very little information is available on the costs of investments made, or on their effectiveness.

1.4 BENEFITS OF DELIVERING THE AICHI TARGETS

Africa's Biodiversity and its Value

Africa has a particularly large biodiversity endowment, with one sixth of the world's endemic plant species, nearly a quarter of the world's mammal species and more than a fifth of the world's bird species. It has the highest number of freshwater fish species in the world. Its 40,000 km of coastline is rich in marine biodiversity (UNEP 2006), and its islands hold extraordinary biodiversity wealth. Africa's biodiversity is not uniformly distributed, but is concentrated in key centres of diversity that cover only 1% of the Sub-Saharan land surface (UNEP 2006). These include 8 of the world's 34 biodiversity hotspots. Certain countries, such as Democratic Republic of Congo, Madagascar and South Africa are considered "megadiverse" countries which rate among the top 17 in the world, are much higher in biodiversity than others (Lee *et al.* 2012).

Natural systems and biodiversity provide numerous benefits to society. They support local livelihoods, often providing fall-back options for stricken families that have little access to government welfare, provide inputs into economic production, save on engineering expenses such as coastal and flood protection measures, and underpin major revenue generating activities such as tourism. At the same time they provide many intangible values to society, which manifest in the form of scientific knowledge, cultural and spiritual value. As such, biodiversity makes a major contribution to societal wellbeing, both in Africa and globally. The provisioning, regulating and cultural services provided by African ecosystems are briefly outlined below.

Provisioning services

Many natural resources are harvested on a commercial scale, contributing to economic outputs and foreign income. These include timber, fish, game, medicines and indigenous resources such as flowers from the fynbos vegetation of South Africa. These values are generally recorded in the national accounts. However, in addition to these, a great deal of resources are obtained from ecosystems that are not accounted for in national statistics and do not enter into decision making processes. It is these values, in particular, that need to be communicated.

Most African economies rely heavily on agriculture. In Sub-Saharan Africa, the agriculture sector accounted for 12.7% of GDP in 2009, and employed more than 60% of the labour force. Globally, agriculture's share in GDP is only 3.2%. Although the proportional output of agriculture has been declining as a result of increased outputs in the mining and services sectors, 60% of Africa's population remains largely rural. This proportion is highest in eastern Africa (76.4%), followed by central Africa (65.9%), western Africa (55.1%), northern Africa (48.8%) and southern Africa (41.3)[1].

While farming usually forms the core activity, these rural livelihoods are often highly dependent on access to a range of natural resources as a means of spreading risk and meeting household needs for food, shelter and cash income. Since many poor and vulnerable households are in remote areas and lack access to services and government welfare, indigenous natural resources can provide a critical welfare function. Not all of these benefits are recorded in the national accounts, however. Much of the use of land and natural resources is of a subsistence nature, or forms part of the informal economy, which in Africa is between 25 and 50% of GDP. For example, in Mtanza-Msona Village in **Tanzania**, more than a third of households live below the poverty line, and the surrounding wetlands and woodland resources are critical to their well-being, supplying fuel, raw materials, wild foods, and providing opportunities for generating cash income. These harvested resources are worth some $107 per capita per year, or 37% of income (Kasthala *et al.* 2008). Similarly, in the **Democratic Republic of the Congo** (DRC), wild foods account for about a third of household production and generating twice as much cash income as crop sales (de Merode *et al.* 2003). In rural areas of Oyo state in **Nigeria**, one study has showed that indigenous fruits and vegetables contribute at least 25% to household income (Oladele 2011). In **Cameroon**, the **Central African Republic,** the **Republic of the Congo** and the **Democratic Republic of the Congo**, edible insects—especially caterpillars—are a main source of protein for communities living around forests. Their trade also provides income for rural people, especially women (Vantomme *et al.* 2004). The miombo woodlands of southern and eastern Africa provide fuelwood and other resources for approximately 100 million people (Boucher *et al.* 2011). In South Africa, it is has been shown that the annual value of wild edible herbs consumed in one area was $167 per household, and exceeded the opportunity cost of farm labour (Dovie *et al.* 2007).

About 10 million people are employed in the fisheries sector in Africa (World Bank 2009). These include major freshwater fisheries in the lakes and floodplain areas as well as those in coastal areas. For example, in **Madagascar**, many of the country's coastal areas are very poor and rely on fisheries for food security. Officially, the fisheries sector contributed US$146 million in 2011, or nearly 2% of GDP, but this is based on a gross underestimate of the full effort and catches. The current policy and legislative framework is incoherent and incomplete and is not based on a clear understanding of the true value of the country's resources. There would be significant benefits from improving the management and sustainability of Madagascar's fisheries, for which properly accounting for the value of the resource will be essential (Le Manach *et al.* 2013).

Agricultural activities, including aquaculture and horticulture, are also reliant on natural stocks for their continued output. Genetic resources provide the basis for the development of improved varieties and enhanced production. Genetic diversity allows farming systems to adapt to ever-changing conditions and to overcome the constraints caused by pests, diseases and abiotic stresses (Smith 2012). Indigenous species and breeds may be less productive but often fulfil a wider range of functions and are

1 http://www.geohive.com/earth/pop_urban.aspx

easier to manage, but this is sometimes overlooked by policy makers (Lemma 2012). For example, the Borana cattle in southern **Ethiopia** and northern **Kenya** are particularly suitable for the harsh environment in the lowlands and are part of the cultural identity of the area, but genetic erosion of this breed has become a significant problem requiring conservation action (Zander and Drucker 2008).

Regulating services

Ecosystems provide a number of services (sometimes termed 'regulating services') that either form inputs into economic production processes elsewhere or that save on expenditure. These include hydrological services (regulation of water flows, flood attenuation), agricultural support services (pollination, control of pests), human health services (control of pathogens), climate regulation (including carbon sequestration), sediment retention, water quality improvement and the provision of critical areas for biodiversity (refugia, nursery areas). These values are seldom quantified and are generally missing from national accounts.

For example, it was found that the **Nakivubu urban wetland** in **Uganda** provides up to US$1.3 million in water treatment and purification benefits annually to 100,000 local residents and nearby Kampala (Emerton *et al.* 1999).

The **montane forests of Kenya** produce significant benefits, but these have been unrecognised in the past. Deforestation of these areas amounted to about 50,000ha over the period 2000-2010, bringing economic benefits of approximately KSh1,362 million per year. However, by 2010, the cumulative negative effect of deforestation on the economy through reduction in regulating services was an estimated KSh3,652 million/yr, more than 2.8 times the cash revenue of deforestation. The reduction in dry-season river flows reduced agricultural output by KSh2,626 million in 2010, and lowered hydropower generation by KSh12 million (before including multiplier effects on the rest of the economy). The increased siltation and nutrients running off the degraded land reduced inland fish catches by KSh86 million and increased the cost of water treatment for potable use by KSh192 million. Incidence of malaria as a result of deforestation was estimated to have cost KSh395 million by 2010. The aboveground carbon storage value forgone through deforestation was estimated at KSh341 million in 2010 (UNEP 2012a). Taking into account interdependencies between sectors, the decrease of regulating services due to deforestation caused a total impact of KSh5.8 billion in 2010, which is 4.2 times higher than the actual cash revenue of KSh1.3 billion (UNEP 2012b; Crafford *et al.* 2012).

Cultural services

Ecosystems also provide **cultural services**, which are based on their various attributes including diversity, rarity and beauty. Cultural services include tourism value as well as many less tangible values that nevertheless contribute to human wellbeing.

Tourism is one of the most rapidly-growing sectors in Africa, and accounts for about 5.8% of employment in sub-Saharan Africa (WTTC 2012). Much of this tourism is nature-based, and some is species based. The Okavango Delta, virtually unknown in the 1970s, now contributes 2% to Botswana's economy. In the **Seychelles**, marine biodiversity is the main draw for a tourism industry that is now the mainstay of the economy and accounts for a third of all government revenues (Emerton 1997). Species-based tourism is of particularly high value, examples being gorilla and shark tourism. In **South Africa**, birding tourism in is estimated to be worth $79-152 million per year and is regarded as an area for investment (even though it has among the *lowest* levels of bird diversity in Africa; Turpie *et al.* 2010). Much of the tourism potential of Africa's biodiversity remains untapped. Ecotourism is thus an important development opportunity that would be threatened by biodiversity loss.

Estimates of total economic value

A number of valuation studies have been carried out in Africa, though very few of these have been undertaken on a broad geographic scale, and many are fairly preliminary estimates that are lacking in biophysical evidence. Nevertheless they serve to provide some evidence of the value of ecosystems. A few studies have taken place at a national scale, while other focus on ecosystems, particularly forests and wetlands.

In **South Africa**, a very preliminary study was undertaken to estimate and map ecosystem services at a national scale (Turpie *et al.* 2008). This study suggested that that the value of biodiversity was in the order of 7% of GDP, but admitted to some aspects that were undervalued. In a more detailed study, the value of rivers, wetlands and estuaries of the three basins in the north-east of the country were estimated and mapped based on biophysical and social data collection and modelling, and were found to be worth a total of $286 million per annum (Turpie *et al.* 2010). Provision of water for domestic use accounted for 43% of this value, and other provisioning services for another 20%. Regulating services made up 1% of the value ($4.25 million), and cultural services accounted for 3.5% ($98.9 million). Spatial variation in the value was mapped in detail, to facilitate water resource planning in the area.

Forests provide direct use values in the form of timber, fuelwood, charcoal and other non-timber forest products such as grazing, wild foods and medicines. They provide indirect values in the form of regulating services such as hydrological services, pest control, pollination and refugia, as well as carbon sequestration and storage. They are also an integral part of the nature-based tourism experience. Several studies have attempted to estimate the total economic value of forests in Africa:

- In **Tunisia**, the Total Economic Value (TEV) of forests was estimated to be US$142 million or US$120/ha (Daly-Hassen 2013). This TEV represents 0.3% of GDP, and 20 times the value of net benefits generated by forest products sold by the state. Forage production made up 55% of the value, followed by protection against soil erosion (21%). Local populations are the main forest beneficiaries, capturing 61% of total benefits, mainly through livestock grazing. Tunisian society captures 22% of TEV, in the form of soil and water conservation. The international community receives 12% of the TEV through carbon sequestration and biodiversity conservation. Finally, the state of Tunisia benefits from 5% of the forest benefits through sales of forest products, such as cork and wood (Daly-Hassen 2013).
- In **Kenya** a study of three of the Mau forest blocks (146,400 ha) estimated their total economic value to be US$238 million per annum ($1626.80/ha), of which direct use values accounted for 12.4% (Kipkoech *et al.* 2011).

Wetlands provide a wide range of ecosystem services including water quality amelioration, flood control, fisheries, tourism and coastal protection. Estimates of the economic value of wetlands across Africa reveal considerable benefits from a range of different systems:

- The Hadejia-Nguru wetlands, a floodplain in northeast **Nigeria** provides US$11 million in agricultural activities, $3.5 million in fishing and $1.6 million in fuel wood, annually (Barbier *et al.* 1997).
- The Okavango Delta in **Botswana** generates an estimated US$111.5 million in tourism revenues, $1.8 million in income to households from agriculture and natural resources, $1.6 million in groundwater recharge, P86 million in Carbon sequestration, $7.7 million in refuge value, $0.22 million for water purification and $1.8 million in scientific and educational value. Overall, it contributes 2.1% to the country's GNP, including direct and indirect impacts (Turpie *et al.* 2006).
- The **Zambezi Basin** wetlands provide over US$70 million in livestock grazing, almost US$80 million in fish production, and US$50 million in flood plain agriculture (Braat *et al.* 2008).
- The capacity of natural wetlands in the Western Cape, **South Africa** to remove excess nutrients was estimated to be worth US$1,913 per ha per year (Turpie 2010).
- As study of the mangrove forests of Gazi Bay, **Kenya**, estimated a total economic value of US1,092 per ha per year. Of this, direct use values accounted for 20%, indirect use values 25% and existence value for 55% of the total (Hoberg 2011).

Apart from forests, freshwater wetlands and estuaries, total economic valuation studies of other habitats such as coral reefs and arid ecosystems that are based on empirical data are rare.

Insights gained after degradation

In some cases, it is only when ecosystems become degraded that the value of maintaining them is recognised. For example, in South Africa it is estimated that invasive alien species in mountain catchment areas and riparian zones have resulted in the loss of 695 million m^3 in water yields, or 4.1% of the registered total water use, and that if not controlled, this could increase to 16.1% (Cullis *et al.* 2007). Another example is the impact of neglecting to provide for flow requirements in river systems in South Africa on pest populations affecting livestock production.

Threats to Biodiversity

The reliance and pressures on Africa's natural systems are immense. Africa has the world's fastest growing population, with an average annual rate of increase of 2.53 % (Lee *et al.* 2012). Highest growth rates are experienced in West and Central Africa. Population growth is an important driver of biodiversity loss. If development does not keep pace, then bigger populations mean more land under agricultural production, and increased demand for resources such as water, fuel, timber, bushmeat and fisheries. Rapid urbanisation in Africa helps to alleviate some of these pressures, but increases the demand for resources such as charcoal and water.

The proximate threats to ecosystems and biodiversity are the same as the world over. **Habitat loss and degradation** are the most important in Africa, driven by growing populations, poor land use planning and management, and increasingly from international investments in commercial food and energy crops (Cordeiro 2007). Agriculture and harvesting result in deforestation rates averaging 0.49% per annum, and are highest in west and eastern Africa (1.12 % and 1.01 % respectively; UNEP 2012). Agriculture and timber plantations also threaten grasslands in eastern and southern Africa. Even habitats that have already been transformed are experiencing further soil degradation. Wetlands are drained for agriculture and urban development. Coastal ecosystems are threatened by development, land conversion, water abstraction and pollution, particularly in west and southern Africa (Bryant *et al.* 1995; UNEP 2006, Lee *et al.* 2012). Coral reefs are being damaged by bad fishing practices, siltation, pollution and tourism. **Hydrological alteration** for power generation and water abstraction threatens river and wetland systems throughout much of Africa, with impacts extending to coral reefs and offshore fisheries. **Overexploitation** by both commercial and subsistence users threatens a wide range of species and ecosystems, such that many stocks have declined to critical levels (Heck *et al.* 2007). Much exploitation is illegal, and often fuelled by international trade. Of current concern is the upsurge in demand for rhino, elephant and lion products as well as the on-going trade in many endangered primates. **Invasive alien species** are a ubiquitous problem, of particular concern in freshwater systems and on small islands, but also in some terrestrial systems, where they can have significant impacts on the supply of water, grazing and other resources, as well as on fire regimes. **Pollution** is an increasing threat to Africa's inland and coastal aquatic systems, with important ramifications for human health as well as biodiversity (Gachanja *et al.* 2010). Much of this is as a result of agriculture and underinvestment in wastewater treatment. In addition to all of the above, **climate change** poses a significant threat to biodiversity, both directly through changing the conditions for survival, and indirectly through increasing poverty and reliance on natural resources.

As it stands now, some 1,023 invertebrate, 357 amphibian, 377 fish, 729 mammal and 706 bird species are listed as threatened in Sub-Saharan Africa (IUCN 2011), which gives an indication of the state of natural systems in general. The outlook remains bleak. In last the few decades, Africa's development has not kept pace with the rest of the world, with the result that there has been an on-going decline in the level of development, and an increasing demand for land and natural resources. Dependence on the export of natural resources has also been a problem for development, particularly since prices fell during the global recession. It is argued that foreign interests in natural resources have buoyed these economies to the extent that they have failed to invest enough in human capital and technological advancement (Habiyaremye & Soete 2010).

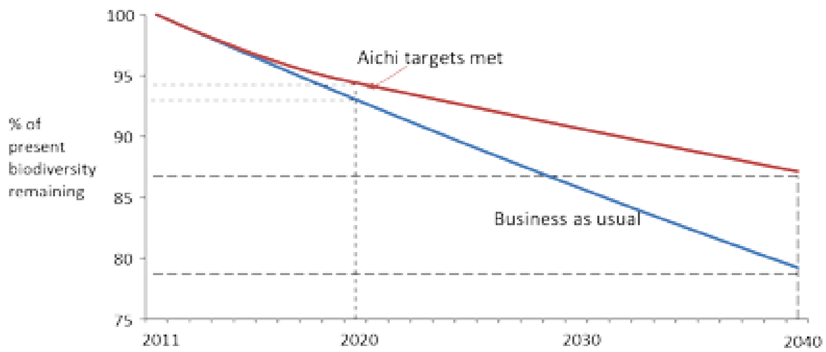

Figure 1. Hypothetical illustration of potential impact of meeting the Aichi Targets on biodiversity, compared with the business as usual scenario

The Potential Benefits of Meeting the Aichi Targets

If the Aichi Targets are met, then it can be broadly assumed that policy makers, decision makers and the public will understand the value of biodiversity, and take it into account in making plans and decisions about the allocation of land and use of resources, as well as production methods. Both producers and consumers will respond to changed incentives brought about by the implementation of better policies and strategies. All of this will result in a much reduced rate of loss of biodiversity and the ecosystem services that it supplies. As a result, ecosystems and societies will be likely to have greater resilience to future pressures, including climate change. Meeting the Aichi Targets and achieving the sustainable use and conservation of biodiversity will therefore be essential for sustainable development. Note that the benefits of achieving the targets cannot sensibly be broken down by target, since the targets act synergistically to achieve an overall set of goals. However, some reference to different targets is included below.

The primary benefits of conservation and sustainable use are expected to be a slow-down in the rate of loss of biodiversity and the loss of the values that it generates. However, the benefit of meeting the Aichi Targets is not only the avoided loss of the biodiversity values described above, but also includes achieving increased resilience to climate change, improved distribution of biodiversity benefits, improved sustainability and productivity of natural resource-based production systems and new opportunities for business. These are explored briefly in the following sections.

Avoided loss of biodiversity value

Many of the targets will directly or indirectly lead to a reduction in the rate of biodiversity loss. Those that have a particular focus on reducing biodiversity loss include targets for **ecosystem/habitat and species protection (targets 5, 19, 11, 12, 14 and 15),** the **control of alien invasive species (target 9)** and other **restoration measures (target 14)**. Although our knowledge is patchy, studies on the value of ecosystem services give an indication of the values at stake. Understanding the actual benefits of meeting the Aichi Targets requires an understanding of the likely rates of loss without intervention, which is considerably more difficult to assess.

Even if one optimistically assumes that the rate of biodiversity loss would remain relatively steady in a business-as-usual scenario, it is clear that halving the rate of biodiversity loss would have significant implications for future generations. There is no single measure for biodiversity, but the loss of forested areas is something that is easily measured and can be used as an illustration. If the rate of loss could be halved by 2020, then, if one assumes that the current rate of loss of 0.8% per annum described for its tropical forests can be applied to biodiversity generally, then we would see some 1.4% of our currently remaining biodiversity saved by the end of the Aichi implementation period. However, if that reduced rate could be sustained into the future, then by 2040 this would represent a saving of nearly 8% what currently remains of our biodiversity and its value.

Many valuation studies are conducted for the purpose of demonstrating the potential costs of degradation and/or inaction, or the benefits of conservation measures. For example, in **Kenya**, Kipkoech *et al.* (2011) showed that converting forest into other land uses in the Mau Forest area would lead to a net economic loss to the economy. Many studies in **South Africa** and elsewhere have demonstrated that investment in the control of alien invasive species would have a positive economic outcome. This includes removal of alien trees that reduce water supply (Marais and Wannenburgh 2008), Turpie *et al.* 2008), removal of invasive alien plants that reduce grazing capacity, and the removal of water weeds that impede fishing activities. Restoration projects can also yield significant benefits. In the Drakensberg mountains, South Africa, restoration of grassland ecosystems and their burning regimes has been estimated to yield $340 million worth of additional water, cost savings of $2 million from sediment control and carbon sequestration values of $3 million) (Aronson & Blignaut 2011)

Resilience to future pressures and climate change

In addition, it is increasingly being recognised that natural capital could play an important role in protecting society from the impacts of climate change. Where climate change may involve engineering and other adaptive responses, these are likely to be less necessary in areas where natural capital is more intact. The potential future benefits provided by 'ecological infrastructure' include the coastal protection and flood mitigation functions provided by mangroves and wetlands, for example. Furthermore, biodiversity may provide some degree of insurance in the form of fall-back options to help mitigate the impacts of climate change, such as fisheries that can be utilised as a source of food or income when crops fail.

Improved distribution of biodiversity benefits

The Aichi Targets also seek to ensure that the **distribution of the benefits** gained from biodiversity are more equitably distributed. Specifically this includes ensuring that the **Nagoya protocol is implemented (Target 16)** and ensuring benefits from **traditional knowledge systems (Target 18).** In southern Africa alone, the informal trade in medicinal plants is worth an estimated $35 million, and a further $280 million is generated though re-sale of plant materials by secondary users. Traditional knowledge thus presents a very real opportunity for communities to generate income (Daya and Vink 2006).

Improved and sustainable agricultural outputs

Several targets will help to improve the **sustainability of land- and natural-resource based production systems (particularly targets 6 and 7)**. This includes the harvesting of natural resources (e.g. fisheries, forestry), grazing and culture systems (agriculture, aquaculture, silviculture). In the former cases, improved management can lead to improve resource rents, and in the latter cases the improvement of culture methods may also lead to increases in production and revenues (Harding *et al.* 2012). Improved management is also likely to lead to more resilient production systems (Soto 2009).

For example, in **Malawi** it has been estimated that unsustainable natural resource use costs the equivalent of 5.3% of GDP each year (Yaron *et al.* 2011). This means that Malawi could gain US$191 million if resources were used sustainably. The largest costs result from the impact of soil degradation on agricultural productivity, the loss of fuel as a result of deforestation around urban centres, unsustainable fishing and reduced economic activity caused by indoor air pollution (Yaron *et al.* 2011).

New opportunities for 'biodiversity business'

Several of the actions required to meet the Aichi Targets will create new opportunities. For example, agricultural intensification and technological development is likely to improve incomes, establishing protected areas will create new opportunities for tourism-related business and employment, and some activities such as control of invasive alien species and restoration may be labour intensive. Some of the best examples in this regard are provided by South Africa's "Working for…" programmes (e.g. Working for Wetlands, Working on Fire, Working for Water). These are long-standing environmental restoration programmes which have specifically sought to provide opportunities for the unemployed and have created jobs for 486,000 people since 1995 (Turpie *et al.* 2008, SANBI 2012).

Furthermore, there are at least eight biodiversity offset programs in development in Africa – in Uganda, Madagascar, Namibia, and South Africa, and countries such as Madagascar, Ghana, Guinea, Mozambique, Egypt, and Uganda are creating new regulations that consider economic instruments like biodiversity offsets. These developments will create new business opportunities (White 2011).

1.5 INVESTMENT NEEDS

Identifying and Grouping Actions Required to Meet the Targets

The actions required for meeting the different Aichi Targets were described in the first round assessment for the HLP. Based on these reports, but with some further interpretation, a list of the actions required for each target is provided in Appendix 1. Many of these are common to more than one target. The main actions required to meet all the targets are summarised in Table 1.

It should be noted that while actions listed deal with all the proximate threats to biodiversity, the underlying causes of problematic human behaviour will also need to be addressed if they are ultimately to succeed. Actions such as the development of human capital through education, formulating international agreements to address shared problems and illegal trade, and addressing conflict and economic instability are of paramount importance to the successful outcomes of meeting the Aichi Targets, but are not discussed further here as they are addressed by other initiatives and are presumed to be outside of the CBD investment portfolio.

These can be summarised into about half a dozen broad categories of actions (Table 1). The way in which the groups of actions relate to each other is shown in Figure 2. The first three groups of actions are to guide and carry out planning and decision making and prepare for action, while the last three pertain to the actual changes that need to be brought about in order to achieve the ultimate goals of the CBD. These broad categories are fairly distinct in terms of the types of activities they involve, and their costs.

Many of the biodiversity problems to be solved, such as reducing the impacts of agriculture, require all six categories of actions. This means that there are also many overlaps in the requirements of the different targets. Some of these can be lumped, such as making policy makers aware of a whole range of interlinked issues, rather than just focused awareness campaigns. Others will need to be separate, focused actions.

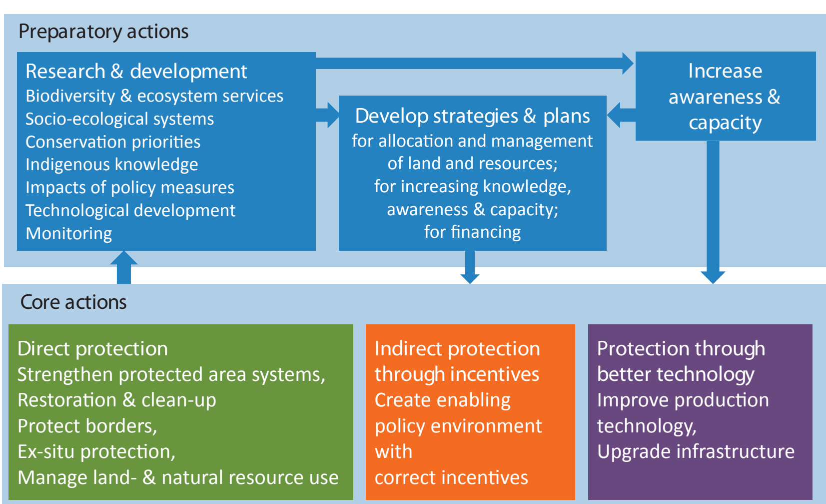

Figure 2. Broad categories of actions required to meet the Aichi Targets and how they relate to one another.

Source: Author's interpretation

It is particularly important to note that all of the core actions need to be addressed together in integrated local level planning, catchment scale planning, in coastal zone management, and in marine ecosystem management. For example, marine ecosystem management involves protected areas, control of IAS, control of marine pollution, ensuring sustainable harvesting of stocks and promoting sustainable aquaculture. The same issues are addressed in coastal systems and in terrestrial areas (ideally river basins), usually by adapting similar principles. This is gradually becoming the case as the value of integrated management systems is becoming more accepted by policy makers, but is by no means the norm at this stage. Integrating the actions in national development planning will ultimately lead to greater cost efficiency.

Because of the high degree of overlap between actions required for different targets, a target-based assessment would be repetitive and would easily lead to overestimates of the actions required and their costs. Rather than assess the actions required on a target-by-target basis, the actions required are discussed within logical groupings.

Research and Development

The first group of activities, relating to knowledge and capacity, is common to nearly all the targets. This includes the important first steps of putting values to biodiversity, introducing them into national accounting systems, and monitoring these over time. It also includes all the research that is required to inform strategies for dealing with biodiversity loss, in order to inform planning and management.

In Africa, research efforts are hampered by a dearth of good universities and lack of government funding. There is heavy reliance on involvement of the international scientific community. Research has probably also tended to be focussed in the more developed of the African nations, and in the biodiversity-rich island states. All African countries are in need of comprehensive national assessments of ecosystem services and of the dynamics of land use and socio-ecological systems. While research and understanding of many important issues are lacking in Africa as a whole, this should not stand in the way of or be used as an excuse to delay action, especially where international experience can be used as a guide. Rather, research should be an on-going activity that can be used to modify actions as better understanding comes to light.

Monitoring, which is fundamental to many types of research, is particularly neglected in many parts of Africa. For example, hydrological gauging stations for measuring stream flows and which were set up during the early part of last century in many countries, have fallen into disrepair, hampering catchment and water resource planning efforts and even the understanding of impacts of land use on water flows. While monitoring of certain resources such as timber are generally carried out in most countries along with other national primary sector activities, monitoring of small scale activities such as inland fisheries tends to be very poor and records are often not computerised or completely missing. Monitoring also includes the formal inclusion of biodiversity values into national accounts.

The most important research and monitoring actions required to support the delivery of the Aichi Targets are discussed further below.

National assessments and accounting of biodiversity values

Understanding the value of biodiversity or natural systems is a necessary (though not sufficient) condition to bring about sustainable development. While the valuation of biodiversity remains somewhat controversial, as it is a difficult and potentially misleading exercise, it is imperative that society understands the trade-offs involved in planning and decision making in order to make choices that maximise the wellbeing of society. Rather than just put a number to biodiversity, it is best to demonstrate how changes in biodiversity change the supply and value of ecosystem services (Department of Environmental Affairs 2012), and how this links to economic outputs and societal wellbeing.

The inclusion of these values in the System of National Accounts (SNA) is also essential in order for the implications to be communicated at the highest level. Without this, the role of depletion and degradation of natural resources and the natural environment in contributing to GDP is ignored, giving rise to complacency (Hamilton 2013). This is of particular concern in developing countries, where natural resources and the natural environment constitute 21%-35% of total wealth (Hamilton 2013). The WAVES programme has set the process of natural resource accounting in Africa, and has garnered government support.

Comprehensive valuation studies require a large amount of information. This includes ecological data, often requiring time series or cross sectional data on ecological variables such as vegetation cover, soil transport and river flows, ecological studies on the behaviour of organisms such as pollinators, to understand the capacity of ecosystems to supply services, as well as studies to shed light on the demand for these services. The latter includes a range of studies from spatial data on populations and infrastructure, to studies of behaviour and questionnaire surveys. In general it is the ecological data that is most difficult to acquire, but all data collection and modelling can be an expensive exercise. Some off-the-shelf models are available in various stages of development to help with the rapid assessment of ecosystem values. In time, these will reduce the costs of such assessments, but they do require costly experts and training.

Research and monitoring

Meeting the Aichi Targets will require better understanding on biodiversity, ecosystems, alien invasive species, resources, indigenous knowledge, socio-ecological systems, the drivers of degradation and the impacts of policy measures, through research and monitoring. Many developing countries lack environmental data and information, or the information that is available may be unreliable (Sanford and Vijge 2008).

Biodiversity inventories and ecological research will be able to feed into and update valuation studies, better understand invasive alien species and assess the stock dynamics of utilized species (e.g. fisheries). In addition, there is a need for an improved evidence base for defining biodiversity metrics specifically in the context of agriculture (Moran *et al.* 2012). These studies will also help determine priorities and focus conservation and restoration efforts and are essential to the implementation of certain conservation measures such as REDD+ projects.

While the importance of understanding socio-ecological systems and indigenous knowledge is recognized, much research on these areas is needed to better understand pressures and inform conservation strategy. Furthermore, it is important to understand the inter-sectoral trade-offs in the use of natural systems and the implications for distribution of benefits is important to inform policy and decision making. Socio-economic research of this nature receives very little funding at present. Basic socio-economic statistics are, however, collected regularly in most African countries. There is a need for multidisciplinary research to meet the Aichi Targets.

Indigenous knowledge is being lost as traditional cultures become eroded by increasing foreign cultural contact (Enwelu *et al.* 2012, Decher 1997). While traditional management systems have often become outdated and inadequate under modern circumstances, there is still an opportunity to document traditional knowledge about the characteristics, properties and behaviour of species to inform the development of better management systems. For instance, an estimated 80% of the African population uses traditional medicine for their health needs, including those who also visit modern health facilities, and numerous countries are now integrating traditional medicine into their official healthcare programmes (CBD 2007a). Traditional knowledge is also valuable to modern industry and agriculture, in that many widely-used products, such as plant-based medicines, health products and cosmetics, are have been identified through traditional knowledge (Sharma *et al.* 2012c). Understanding traditional beliefs and cultures can also contribute to the success of protected areas (Sharma *et al.* 2012c).

Technological development

Research is needed for the development of more efficient and cleaner production technologies that are appropriate to local situations. This includes the development of technology for treating waste water and ballast water, as well as for more resource-efficient farming and aquaculture methods and processing. Research and development should also focus on appropriate technologies that take local realities into account.

Biodiversity product development

Research is also required for the development of products that encourage the conservation of indigenous species and ecosystems. This includes the creation of marketable goods and services from forest conservation, SFM, forest restoration and the avoidance of habitat loss (African Development Fund 2013), as well as improved use of genetic resources (selective breeding and potential genetics and GM) to improve resource use efficiency, a component of sustainable intensification.

Increasing Awareness and Capacity

Education and awareness raising

Biodiversity values are still very poorly understood in many African countries. For example, a study of four municipalities in South Africa showed that people's understanding of the term "biodiversity" is very limited. The concept of "sustainability" is much better understood, but only marginally connected to nature. Thus biodiversity and the natural environment are generally not perceived as components of sustainable development, and preservation of nature is regarded as fundamentally in opposition to socio-economic development (Wilhelm-Rechmann and Cowling 2011). Broad public awareness and education campaigns are needed at all levels in Africa, from communities and school children to national decision- and policy-makers and donor organisations (Solh *et al.* 2003).

The low level of awareness of importance of biodiversity at all levels in Africa, and the prevailing belief that biodiversity conservation and human development are conflicting goals, means that there is little public pressure, and little political will to invest in conservation. Awareness-raising is therefore a very important investment, and **education of decision-makers** on the importance of biodiversity and sustainable use of natural resources is the highest priority. An understanding and appreciation of the value of biodiversity and demonstrating that investment in conservation measures can bring socio-economic development will be essential before these values will be integrated into policies and strategies. To this end, investing in ecosystem services valuation and natural capital accounting will be a very important step.

In addition, the success of conservation efforts and measures to achieve sustainable production and consumption generally, will depend to a large degree on **public awareness** and understanding of biodiversity. Raising public awareness involves the development of national communication strategies, undertaking awareness raising activities and using media (print, audio, visual, and electronic) engagement and promotions of biodiversity conservation and benefits, etc. In particular, public awareness needs to be targeted towards raising demand for Responsible Investment.

Inclusion of biodiversity in **school curricula** from pre-school through to tertiary education levels should be part of a long-term strategy to increase awareness. This requires both inputs into teaching materials as well as direct exposure to biodiversity, for example in the form of visits to environmental education centres. The great majority of schools in Africa seldom go on any outings for lack of funding. Investments in education would thus require the building of environmental education centres, transportation to them and the provision of staff to carry out education programmes at the centre.

Capacity building

Many of the activities to be undertaken for the Aichi Targets will require capacity building. This applies particularly to increasing and improving conventional conservation measures such as protected areas, restoration, control of IAS, etc., as well as to agricultural activities (see also extension). For example, Hardcastle and Baird (2008) noted that the technical capability for measuring and monitoring forests generally has been severely eroded in many countries.

There is also lack of capacity within government regarding the mainstreaming of biodiversity into planning and decision-making (Swiderska 2002). Lack of capacity is a very big issue in Africa, where illiteracy rates are high and where standards of education are often very poor. Significant investments will need to be made in generating the capacity required to meet and maintain the Aichi Targets.

Workshops and affordable training programmes, targeted improving capacity among government officials, would be required for several activities, including:

- Biodiversity monitoring and ecological survey methods
- Social and valuation survey methods
- Natural resource inventorying and accounting
- Integrated river basin management
- Integrated coastal zone management
- Sustainable development
- Protected area management and enforcement (terrestrial and marine)
- Ecosystem management (wetlands, forests, IAS, fires, etc.)
- Ecosystem-based approaches to development planning and implementation, land-use, etc.
- Sustainable agricultural, aquaculture and forestry practices

Extension services

Since many of the actions will require changes to agriculture, aquaculture and silvicuture systems, it will be essential to provide support in the form of extension officers, who themselves will need to be capacitated in terms of rationale and strategies, best management practices and in meeting the standards for certification.

Developing Plans and Strategies

Plans for sustainable production and consumption

Fuelled by consumer demand, firms have an immense impact on the state of the world's biodiversity and ecosystems. Thus influencing the behaviour of both consumers and firms could make a substantial difference in reducing their negative impacts and contributing to the restoration and conservation of natural systems. Increasing attention is being paid to how new developments, even clean energy developments, should be induced to take responsibility for their impacts on biodiversity though means such as performance bonds, banking and offset systems. Producer and consumer choices can also be swayed by information and financial incentives, including the removal of harmful subsidies. Note that the Aichi Targets only focus on the development of plans, rather than their implementation, which will require further investment.

Integrate biodiversity into development planning

Integrated land and resource planning is fundamental to achieving efficiency and other goals. Part of the reason for the lack of mainstreaming of biodiversity in planning generally has been the lack of understanding of the value of ecosystems, how they contribute to development objectives, and the full trade-offs involved in following alternative development paths. Once trade-offs are better understood so better decisions can be made in the allocation of resources and prioritisation of conservation efforts. Moving towards the mainstreaming of biodiversity in development plans will require more multidisciplinary approaches to planning, involving a large number of actors and institutions, which will in turn require more capacity and resources (Rayment 2012).

Although integrated planning and management frameworks already exist (such as 'integrated land use planning', 'integrated water resource management' and 'integrated coastal zone management'), in reality most planning is still very strongly sectoral and seldom takes the role and values of ecosystems and biodiversity into account. Mainstreaming of biodiversity into planning will force consideration of the relationships between sectors and will go a long way towards shifting mindsets. This is also essential in order for policy makers to see the value of eliminating harmful incentives and putting plans in place for sustainable production and consumption. This needs to be done both openly as well as overtly.

Furthermore, water, land use, coastal and marine planning need to be understood to be intricately linked. Land use planning affects water resources and *vice versa*, and both land and water resources planning affects coastal and marine processes. **Integrated River Basin Management** (IRBM) takes a more ecological approach to land use and water resource planning by using ecological (watershed) rather than administrative boundaries. Recognizing the important linkages, in some countries, the concept of **Integrated Coastal Zone Management** (ICZM) has been extended to **Coastal Area and River Basin Management** (ICARM) (UNCHS 1996, UNEP-MAP-PAP 1999).

While the need for integrated planning is recognised, it has not yet been widely implemented. For example, in Namibia, the Ministry of Lands and Resettlement (MLR) has the mandate to manage all land resources through Integrated Land Use Planning. In South Africa, it is now obligatory for all municipalities to develop **Integrated Development Plans** which include spatial planning, as well as for coastal municipalities to prepare **Integrated Coastal Zone Management Plans**. However, there is little capacity for integrating biodiversity in local level planning. In order to achieve this, the conservation sector will need to establish trustful, long-term relationships with local government, rather than relying on simple provision of information and brief training events (Roux *et al.* 2006). It has also been noted that attempts to mainstream biodiversity in land-use planning decision-making will be considerably improved if the maps would include ecosystem services and refer to a nontechnical term that highlights the aspect of "service provision" from nature to people (Wilhelm-Rechmann and Cowling 2011).

Progress has probably been greatest in the area of water resources planning, because of water scarcity and the need to plan across internationally-shared river basins. There have been several international initiatives for water resource planning in shared basins, such as the Nile, Orange, Limpopo, Zambezi, Ruvuma, Pangani and Okavango Basins. However, few of these have given more than a minor consideration to biodiversity. The need to set aside water to maintain aquatic ecosystems and support rural populations that depend on instream flows is increasingly on the agenda and has been recognised in water policy and law in some countries, such as South Africa and Tanzania. However, environmental flows still tend to be viewed as a requirement to meet the criterion of sustainability and allocated at minimum levels. The consideration of biodiversity and ecosystem services in the analysis of trade-offs in water allocation decisions is a relatively new development in Africa (and globally), which has been tested in the Pangani and Okavango Basins, as well as in South Africa. Because of the links to land use, coastal and marine processes, integrated water resources planning is an important first step towards mainstreaming biodiversity in development planning generally.

On reserve, off-reserve, *ex situ* conservation, restoration actions and border protection remain the core of conservation strategy, but actions in Africa to date fall well short of the targets necessary to make them effective. Management and enforcement have also been integral to natural resources, protected areas and buffer zones, but systems need to be improved and expanded to include more provision for integrated catchment and coastal management. Better protection at borders is required for prevention of alien introductions and trade in endangered species.

Strengthen protected area systems (expansion and management)

Protected areas are the main strategy for biodiversity conservation in Africa. In addition to the protection of vulnerable species and areas, they secure the supply of a number of ecosystem services such as flow regulation and flood amelioration, nursery areas for fisheries, carbon sequestration and coastal protection, as well as opportunities for research, recreation and tourism. In particular, there is a large body of evidence to support the role of marine protected areas (MPAs) in the recovery of depleted stocks and contribution to fisheries (e.g. Kamukuru *et al.* 2004, McClanahan *et al.* 2007). Nevertheless, this does come at the cost of access to natural resources, which can lead to the requirement for additional investments to gain the cooperation of communities whose access to those resources has been curtailed.

Aichi Target 11 includes specific targets for the coverage of terrestrial and marine protected areas. In addition, it requires an improvement in the management effectiveness of these areas. Thus investment in protected area systems will depend on the degree to which existing PA systems fall short of area targets as well as the level of management effectiveness.

The latter is strongly influenced by the geographic and socio-economic context of the protected areas. In addition to formally designated, state-owned protected areas the protected area system also includes private reserves and indigenous and community conserved areas (ICCAs), but these are taken to be outside of the spatial targets and overlap strongly with developing mechanisms and incentives for biodiversity-friendly activities outside of the formal protected area system. Nevertheless, these activities can be targeted in areas around protected areas in order to strengthen their effectiveness.

Investments required to strengthen protected area systems include:

- Acquisition of land and marine areas to meet spatial targets for protected area systems (by outright purchase, easements or contractual arrangements);
- Measures to improve management and enforcement (increases in staff numbers, capacity, equipment, monitoring systems, etc.);
- Measures (e.g. ICDPs, co-management) to improve co-operation of communities around parks; and
- Measures to improve connectivity through conservation outside formal protected areas (community-based management).

Development of surrounding communities (ICDPs)

Whereas parks are for the national or international benefit, the communities living around them often bear the costs of conservation. Several studies have documented clear costs to communities in terms of livelihood options lost, expulsion from traditional fishing or hunting grounds and living spaces, and violation of human/community rights. For example, research conducted on five MPAs in **South Africa** indicated that traditional, small-scale fishing communities living in, or adjacent to, MPAs are bearing the costs of marine conservation with few benefits accruing to them (Sunde & Isaacs 2008). This greatly reduces the chances of local communities co-operating with protected area managers. Many parks agencies and donors therefore make considerable investments in the communities around parks, such as sharing of revenues, access to resources, infrastructure development, service provision, and training in tourism and alternative livelihoods in order to compensate costs and reduce pressures on resources in parks. However, this has been with mixed results, and success depends heavily on strong institutions.

Investment in ecotourism is seen as an important opportunity not only for financing protected areas but also for developing alternative livelihoods for communities that bear the costs of parks. However, whether these benefits actually achieve this and reduce pressure on parks is quite case-specific. For example:

- In **Egypt**, community-based eco-tourism development appears to have been successful in the case of the St. Katherine Protectorate, a traditional Bedouin area. This has included a craft programme in order to diversify income and maintain cultural diversity. Local communities have come to realise the value of the protected area as a drawcard for visitors, and are now interested in maintaining and protecting the area, even reporting violations and using peer pressure to discourage damaging activities (CBD 2011);
- On Wasini Island off the coast of **Kenya**, nature-based tourism has led to an increase in income and living standards. However, it has made other traditional livelihoods nearly redundant and has resulted in local population growth above the national average, mainly through immigration of workers from nearby coastal areas, and has thus failed to reduce the pressure on resources (Job & Pesler 2013).

Much of the expansion of protected areas will occur in places already occupied by people. Realising the benefits of tourism is seen as one way of offsetting the expected costs (Job & Pesler 2013). For this strategy to be effective, local participants involved in tourism businesses need appropriate knowledge, skill training and assistance in reaching fair institutional arrangements (Job & Pesler 2013). The risk of this strategy is that tourism can be significantly impacted by external crises, and it is therefore important to avoid a total dependence on nature-based tourism, by maintaining a subsistence economy for times of crisis.

Ecotourism is more likely to achieve conservation benefits if: (a) it only requires modest changes in land or resource use, (b) it can leverage more protection (e.g. the government of Mozambique is establishing large conservation areas as a key element of tourism development), and (c) if the benefits are sufficiently high to out-compete basic livelihoods that may not be biodiversity-friendly (Kiss 2004) In practice, ecotourism has often failed to deliver the expected benefits to indigenous communities due to a number of factors, including lack of human, financial and social capital within local communities, lack of mechanisms for the fair distribution of benefits, and land insecurity (Coria and Calfucura 2012). Revenues have to be very large and accessible to provide the economic incentive to preserve natural habitats (Coria and Calfucura 2012). In reality, most of the revenue often flows to external stakeholders, such as tour operators (Lapeyre 2010), or is subject to elite capture. Unfortunately, alternative income-generating activities often don't live up to expectations (Rosendo *et al.* 2011). This has been reported for efforts aimed at marine protection as well.

Community-based management

Community-based management is another option for achieving some level of biodiversity conservation outside of strict protected areas, thus avoiding the high costs of protection, while at the same time creating development opportunities. There has already been a substantial amount of investment in these kinds of initiatives throughout Africa, in the form of community-based natural resource management (CBNRM), sustainable forest management (SFM), and locally managed marine areas (LMMAs) and so forth. Community-managed areas can theoretically provide a range of benefits including biodiversity conservation, improved harvests, improved local governance, community organisation, resilience and adaptation, health, integrated resource management, cultural survival, improved social and human capital, and security of tenure for local traditional resources (Harding *et al.* 2012). However, the success of these ventures is highly variable, and dependent on the characteristics of the community (see Ostrom 2007) as well as the environmental and socio-economic context. These options are discussed under the section on sustainable use of resources.

Restoration

Restoration (or rehabilitation) efforts include the clean-up of pollution, removal of IAS, and the recovery of habitats and endangered species populations. Restoration efforts sometimes involve several or all of these actions. In South Africa, removal of alien species is the main element of restoration of many terrestrial and riparian habitats. In most cases, the degradation has come about because of differences in who bears the costs and benefits, and restoration costs are often prohibitive to private or communal land owners. Private and public benefits need to be weighed up against one another in determining who ultimately pays for rehabilitation and restoration actions.

Control of invasive alien species

The control of invasive alien species involves mechanical removal, biological control, chemical treatment, habitat management and construction of barriers (Turpie *et al.* 2011, based on Gherardi & Angiolini 2004). In some cases, mitigation measures and/or adaptation can be more sensible (McNeely 2001). For priority species, control or eradication is desirable, as opposed to mitigation or containment (Turpie *et al.* 2012).

Restoration of degraded habitats

Habitat restoration may be desirable in order to restore productivity, the supply of ecosystem services, or as a means to conserve endangered species. Examples include the restoration of rangelands that have been overgrazed, the restoration of forests that have been overharvested or converted to agricultural land, and the restoration of mangrove forests that have been lost as a result of overharvesting or changes in hydrological regimes, the restoration of estuarine systems affected by water diversion, and the restoration of wetlands that have been drained and converted to agricultural land. The costs of restoration depend on habitat type and the degree of degradation.

Endangered species reintroduction, recovery and management actions

Reintroduction and recovery programmes are a last resort necessary for species that have declined to dangerously low levels either locally or for the species as a whole. There are several such programmes already operational in Africa. Many projects exist for a range of mammals, reptiles, amphibians, birds and plants. Many of these are linked to zoos, including local zoos such as the Johannesburg Zoo in South Africa. Most of these programmes are initiated and run by international organisations that partner with local institutions. For example:

- In **Tunisia, Chad, Senegal** and **Morocco**, NGOs (C2S2 and the Sahara Conservation Fund) are working to reintroduce the scimitar-horned oryx, which was exterminated from the wild in the early 1990s, as well as addax and addra gazelle, of which only a few hundred individuals remain (www.saharaconservation.org).
- In **Niger**, another Sahara Conservation Fund (SCF) project is working on reintroducing the North African ostrich, which is critically endangered may soon become extinct like the Arabian ostrich. The SCF launched an international fundraising appeal and involves partnering with a wildlife organization (CERNK) that will manage the breeding programme, with the aim of releasing ostriches into existing protected areas (www.saharaconservation.org).
- In the **Republic of Congo** and **Gabon**, the Aspinall Foundation works with local partners and national governments to stop the decline of the critically endangered western lowland gorilla, whose numbers have declined by 60% over the past 20-25 years. The "*Projet Protection des Gorilles*" (PPG), which also involves conservation and anti-poaching activities, has released 51 confiscated wild-born orphans and captive-bred individuals into the Batéké Plateau region which was first large wilderness area to see the extinction of gorillas in these countries (www.aspinallfoundation.org).

Reintroduction programmes are particularly important for small island states where extinction rates are particularly high due to introduction of alien species such as rats and cats. The case of the Aldabra white-throated rail, which was reintroduced to Picard island and has now reached its predicted carrying capacity (Šúr *et al.* 2013), suggests that these programmes can be highly successful when the original problem is removed.

Fire management

Certain ecosystems become more vulnerable to fires following human disturbance such as harvesting or infestation by invasive alien species. The change in fire frequency can have detrimental impacts on biodiversity, even in fire-dependent ecosystems. In these cases, interventions are required to reduce the risk of fire, and may include cutting fire breaks or convincing landowners and local communities to change their agricultural practices. Community based fire management in Caprivi, Namibia, yielded impressive livelihood and livestock gains within a few years, making it an attractive and viable option for communities (Hardcastle and Hagelberg 2012).

Ex-situ conservation

Ex situ protection of endangered species in botanical and zoological gardens, arboretums, gene banks and pollen banks is considered to play an important role in biodiversity conservation. There are at least 54 zoological gardens in Africa, of which 13 are in South Africa; Nigeria and Madagascar each have six, and Algeria, DRC and Egypt each have three. There are also a number of sanctuaries, such as the Chimpanzee sanctuary at Ol Pejeta, Nanyuki, Kenya, the Chipangali orphanage, Bulawayo, Zimbabwe, and Enkosini Eco Experience, Namibia.

There are about 89 botanical gardens in Africa. Of these, some 61 are in the Western Central and eastern African countries, with 20 in Nigeria, nine in Kenya, five in Ghana, five in Senegal, and four in Cameroon. In Nigeria, there is no central co-ordination of the botanical gardens (Borokini 2013). Most African countries have seed and field gene banks (FAO 2010). These tend to focus on agrobiodiversity, but some countries such as South Africa also include a significant effort on storage of biological diversity generally. Many countries report problems in using their facilities, however, due to problems such as lack of funds, equipment, staff and unreliability of electricity supply. For example, Guinea lost its entire ex situ collection as a result of failure in the electricity supply (FAO 2010). Only Benin, Cameroon, the Congo, Ghana, Kenya, Mali, Nigeria and Uganda have in vitro storage facilities.

Thus, while numerous facilities exist for *ex situ* conservation throughout Africa, these are not as effective as they should be: many facilities need to be upgraded, capacity building is required, and operations need to be more co-ordinated nationally, regionally and internationally.

Border protection

Border protection measures are required both for the prevention of introductions of potentially invasive alien species, as well as to prevent illegal trade in endangered species. Border protection involves not only the checking of freight by trained staff, but also the implementation of ballast water treatment measures. Several countries have now also developed 'rapid response' measures for situations where prevention measures are not sufficient and the invasive species is only identified once introduced or established (McEnnulty *et al.* 2001, NISC 2003, NEANS 2006, Locke & Hanson 2009, Turpie *et al.* 2012).

Sustainable use of land and resources

Achieving the sustainable use of land and natural resources[2] fulfils multiple objectives, one of which is reducing impacts on biodiversity. It is generally assumed that, under the right institutional settings, more productive production systems would reduce the growth in demand for virgin land (or coastal areas) as well as the demand for harvested natural resources. This, together with less damaging methods (less habitat damage, lower pollution outputs, less water wastage, less soil erosion, fewer genetic escapees etc.), will amount to more sustainable practices.

Achieving sustainable use of land and resources will require a revision of policy, legislation and institutions (or property rights) in order to change incentives and drive positive behaviour. These measures include:

- Allocation of clear property rights over land and resources;
- Removal of subsidies that encourage activities that cause environmental harm;
- Use of financial incentive measures (taxes or charges and subsidies or payments) to influence choices;
- Introduction of methods and technologies that improve productivity ("land sparing") and reduce harm;
- Setting standards for regulation and establishing certification systems to encourage achievement of higher standards;
- Performance bonds and offsets to ensure no net loss

Note however, that the actual choice of instruments and their combination is context specific and crucial to their successful outcome. For example, introducing methods to increase production in a situation without clear property rights would exacerbate rather than decrease the problem of biodiversity loss. Similarly the balance of measures to deal with industrial/commercial scale production on private land or concessions would be different from that used to deal with small scale production on communal land areas. The measures are described using examples, but it is not possible to describe the measures required for each subsector in detail. The detailed design of the policy measures to be implemented will be an important part of strategic planning.

Furthermore, while conservation efforts might be successful locally as a result of these measures, if the overall demand for resources such as fish or charcoal remains high, then the pressure will simply be displaced to areas where management is more lax (termed 'leakage' in policy impact studies). Thus, the above actions need to be complemented by interventions to address demand.

Land and resource-based activities (agriculture, aquaculture, silviculture, and the harvesting of

2 Although the Aichi Targets highlight fisheries and forestry, sustainable harvesting pertains to all renewable natural resources, including wildlife and water.

fisheries[3], forest and wildlife resources) are all practiced on both a commercial/industrial scale as well as on a small scale. Thus while they may provide important economic outputs, they also provide small-scale livelihoods for the majority of Africa's population and a fall-back option for people who have been marginalised and lack other options (e.g. Sandker *et al.* 2012). Allocation and management of these resources is thus a complex issue.

Allocation of property rights

Lack of well-defined property rights (e.g. forestry, fisheries, pollution, grazing, water, wildlife, intellectual) is argued to be one of the most important drivers of overexploitation, land degradation and biodiversity loss. Property rights systems in Africa have undergone major changes through and following the colonial period, and 7 to be a problem in the face of increasing populations and a large proportion of Africa's poor living in communal land areas where traditional systems of management have been weakened. Much effort is expended on rectifying this problem, through **community-based management programmes, the allocation of rights to resources such as fish, water, wildlife and grazing, and in the allocation of rights to pollute**.

It is widely asserted that devolving property rights to local communities can bring financial returns, social justice and environmental sustainability. These efforts often require substantial changes in policy and legislation, applied with extreme caution, given the high degree of sensitivity of these measures to their socio-economic and environmental context. This requires donors and investors to form innovative partnerships with local rights holders, with the donors bearing some of the set up costs. Numerous initiatives have been undertaken throughout Africa to address this issue in rangelands and wildlife areas, e.g. community-based natural resource management (CBNRM), in forests, e.g. sustainable forest management (SFM), and in coastal areas, e.g. locally managed marine areas (LMMAs).

These initiatives involve strengthening institutions and capacity for ecosystem and resource management. For example, evidence is growing that community-based management can have a major impact on the livelihoods of the poor, on the character of forest governance and on citizenship more generally (Brown *et al.* 2002). Implementation can be challenging, however, as there can be major disjunctures between the resident geographical community and those who claim ownership of the forest in question, which sometimes include urban elites of local origin. As a result, setting up community-based management projects can be an involved and costly process. Successful community-based management is highly dependent on a range of socio-economic contextual conditions, and p to now, there has been mixed success.

Reducing overexploitation in small-scale inshore fisheries will involve allocation of property rights such as fishing rights and/or territorial use rights in fisheries (TURFs) to eliminate open access problems, coupled with regulation and enforcement. The establishment of **locally managed marine areas** (LMMAs) is potentially an effective way of dealing with the problems of inshore fisheries.

In addition, property rights also pertain to **intellectual property**. Thus addressing property rights includes implementation of the Nagoya Protocol. This protocol sets out clear provisions on access to traditional knowledge associated with genetic resources, strengthening the ability of indigenous and local communities to benefit from the use of their knowledge, innovations and practices (Sharma *et al.* 2012). This encourages the advancement of research on genetic resources which could lead to new discoveries for the benefit of all, and creates incentives to conserve and sustainably use genetic resources (Sharma *et al.* 2012). Initiatives are required that make forest conservation more attractive to communities, such as beekeeping, butterfly rearing, tourism, or through systems of "payments for ecosystem services" (including REDD). This would strengthen CFM or co-management arrangements.

Removal of harmful subsidies

Subsidies are often put in place in order to address employment and food security issues, and are common in the agricultural sector. For example,

3 In this report, fisheries are taken to include a wide range of aquatic resources including plants and invertebrates.

in **Botswana**, agricultural input subsidies increase the exploitation of natural resources and sometimes lead to unsustainable use of natural resources. For instance, the loan schemes supporting purchase of livestock for keeping in communal lands that are already overgrazed around settlements tend to exacerbate the problems of overgrazing and diminish the productive potential of those rangelands. Following lack of grazing and desertification, the poor might tend to adopt desperate means of survival and begin to overharvest fuel wood and other veld products to sell as a means to earn an income, with a negative impact on biodiversity (Yaron *et al.* 2012).

Subsidies that encourage activities that cause environmental harm need to be adjusted or removed. This is often difficult politically, as those subsidies have typically been put in place to increase production and food security, protect producers and encourage employment, and the beneficiaries of subsidies sometimes have a strong political voice. In **Malawi**, the Ministry of Agriculture and Food Security spends 85% of their budget, which amounts to about 10% of the national budget, on the Farm Input Subsidy Programme. This programme subsidizes improved inputs like hybrid (maize) seeds and fertilizers. The scale of the subsidy is reportedly hindering investment in other areas and there are also concerns over the impacts of the subsided fertilisers on local ecosystems. As yet there are no plans to tackle the issue of subsidy reform (UNDP-UNEP 2013).

The process of removal of subsidies will sometimes involve extensive negotiation, public and international pressure. While this may involve a costly process, their elimination will free up budgetary resources that can potentially be used for beneficial activities. Economic analysis is needed to demonstrate these potential benefits.

Introduction of financial incentives/measures

Many of the Aichi Targets will require the use of incentive measures to bring about positive behaviour. These include taxes, charges and deposit-refund systems to increase the costs of damaging activities, subsidies, payments or even buyouts to reduce harmful activities and encourage conservation activities. Subsidies and payments require funds and are popular, but go against the polluter-pays principle and are not always effective. This includes "payments for ecosystem services". Taxes and charges are effective, but politically unpopular. Nevertheless they can be shown to be pro-poor. Buyouts are potentially effective, but costly.

Of the measures listed above, buyouts have not yet been attempted in Africa, and their effectiveness is not proven. For some types of fisheries, removal of some effort may not result in a proportional reduction in catches as it may allow other actors to increase their catches to an extent. Buyouts are likely to be required when capital investment in fisheries is high, making exit difficult. The initial cost is high, but would lead to savings in management costs in the long run. The costs of would vary depending on the types of fisheries, and might also include retraining costs (Harding *et al.* 2012).

Improved organisation and marketing

Sustainable agriculture will require better governance and organization of production. According to (Hardcastle and Hagelberg 2012), access and benefit sharing arrangements will be expensive to secure and need to be linked with wider work on governance. Success with equitable revenue-capturing schemes would greatly strengthen enhanced governance, by for example raising community willingness to act against illegal activities (Hardcastle and Hagelberg 2012). Production can also be improved through access to reliable markets. Lack of access to markets is a key constraint facing rural smallholders in Sub-Saharan Africa (Lewis *et al.* 2011*a*).

- In **Burkina Faso, t**he producers of shea products formed a union (the NUNUNA Federation) and introduced informal measures to protect and conserve 3,345 hectares of shea-tree areas. Investments in technological improvements (shea butter processing factory) and certifications (Fair Trade) have helped the 4,000 members achieve a 95 per cent increase in income, while the position and workload of shea nut collectors has also improved. In addition, the NGO TreeAid has led to ongoing discussions with government over how to establish more secure commercial rights and so create a stronger incentive to enrich or restore forest areas with desirable trees like shea (MacQueen 2013).

- **In Zambia**, the Community Markets for Conservation (COMACO) model was developed in the Luangwa Valley, to promote and maintain sustainable agricultural and natural resource management practices among the communities surrounding national parks. The least food-secure households are identified and trained in sustainable agricultural practices that minimize threats to natural resources while meeting household needs. In addition, people responsible for severe natural resource depletion are identified and trained to generate alternative income. The project also provides extension support and transport of produce to a trading centre and ultimately to high-value markets. The project has brought about productivity levels that give COMACO access to stable, high-value markets and progress toward economic self-sufficiency and has also resulted in the stabilization of previously declining wildlife populations. In 6 years, the 60 extension staff have trained more than 40,000 farmers, 19,000 of whom are registered as having completed training and being compliant with Conservation Farming (CF) practices.

Improved methods and technologies

There is some debate about 'land sharing' systems, such as agroforestry, versus 'land sparing' systems, which involves sensitive intensification. Under the right conditions, agroforestry systems tend to be high in species richness and more similar to neighbouring forest reserves, and can thus play an important role in biodiversity conservation in human-dominated landscapes. Tscharntke *et al.* (2011) claim that although traditionally land sharing has been considered more biodiversity-friendly, land sparing is better as there is no loss of biological control, and it compliments small farm holdings more than land sharing does. Land sparing is considered to be a more promising strategy for minimizing negative impacts of food production, at both current and anticipated future levels of production (Phalan *et al.* 2011).

Improving methods and technologies in **agriculture** includes the introduction of better seed varieties, encouraging reduced tillage, reducing reliance on external inputs, introducing more efficient cropping methods (e.g. polyculture), effective livestock management and efficient irrigation. For example:

- In **Ethiopia**, the seed industry is monopolised by state-run supplier focusing mainly on selling improved and hybrid varieties, and there is also no supply of local varieties (which also hampers the progress of achieving Target 13). Farmers therefore meet their needs through informal exchange systems (Atilaw and Korbu 2011, Fukuda 2011), as occurs in many parts of Africa (Kuyek 2002), but only to a limited degree because of the belief that everyone has the same crops and varieties. A community seed bank project has been successful at integrating the traditional styles of obtaining seed through exchange, but providing a greater choice of sources of seed, contributing to the management of agro-biodiversity, seed security and improved welfare for the farmers, and also ensuring in-situ conservation of genetic diversity (Atilaw and Korbu 2011, Fukuda 2011). This provides an example of a cost-effective intervention through supporting decentralised projects in order to circumvent central government inefficiency.
- In **Namibia**, the UNDP-GEF Conservation Tillage Project (CONTILL) advocates conservation tillage as a method for achieving resilience to climate change. The project encourages farmers to produce and apply compost-based fertilizer, to practice minimal soil disturbance using ripping and furrowing, to create in-field water harvesting, and to apply crop rotations, which enable farmers to secure their own food supply and to market surpluses. The project aims to reduce the negative effects of floods, drought and irregular rainfall patterns, rising temperatures, and soil degradation, and has already resulted in an increase in agricultural yields of up to 500% (UNDP 2011).

Improving the sustainability of **aquaculture** systems involves better site selection, management, culturing different species together (integrated multi-trophic agriculture – IMTA), and the use of enclosed, and especially re-circulating, systems to avoid contamination of surrounding areas. IMTAs are cost-effective, generating revenues from the lower trophic level species that are farmed together with the main cultured species. Closed containment is only viable for high value species. These systems require further research and technological development to become more effective and affordable, as well as government incentives and regulation to help their implementation (Harding *et al.* 2012).

In plantation **forestry**, investments in new and more efficient technologies have been lagging behind, providing opportunities for major gains through technology transfer (Hardcastle and Hagelberg 2012). Among small-scale growers, impacts of plantation forestry can also be achieved by promoting indigenous species as an alternative to exotic species. For example:

- In **Uganda** farmers deliberately plant trees for wood and other uses. However, these planted trees are mainly exotic species, because farmers do not have access to diversity, quality and quantity of indigenous species. Investment in promoting commercial seed networks and better quality seed practices using indigenous species would have benefits for people through reduced erosion and continued supply of forest products, and at the same time reduce landscape fragmentation and increase habitat for other species (Boffa *et al.* 2005).
- In **Zambia**, indigenous fruit trees play an important role in household livelihoods, and domesticating some of these species may be a good avenue for development (Kalaba *et al.* 2009).

Improved processing could be a way of reducing pressure on tropical forests by decreasing the number of trees felled to yield a similar volume of products (Hardcastle and Hagelberg 2012).

Even if new methods are shown to be more productive, investments by poor farmers may be expected to be slow (Mortimore 2005). Better conditions for private investment, such as local financial infrastructure and tenure security, would facilitate entry to niche markets and increase the profitability of sustainable forest management in general (Reichhuber and Requate 2012*a*).

Standards and regulation

Standards and regulations need to be addressed in many land- and natural resource based production systems. Most commercial production takes place on private land or concessions which provides the opportunity for improved management and regulation regarding methods and inputs. A priority in this regard is regulating timber harvesting methods and regulating the construction of forestry roads to minimise collateral damage through increased access to non-timber forest resources.

Certification

Certification systems are introduced at some cost to producers and consumers, but through increasing consumer awareness and access to markets, these measures can also provide an advantage to producers.

Investing in organic production and marketing may represent a cost-effective investment in livelihood improvement through access to lucrative organic markets. Many African production systems would be relatively easy to convert to recognised organic systems, and there is provision for a shorter conversion period for land that has a history of minimal agrochemical use (Thamaga-Chitja & Hendriks 2008). However, indigenous systems have been eroded with the advent of the Green Revolution (Juma 2007), and capacity-building would be critical for success. Government intervention, such as subsidized organic certification and facilitation of group certification among smallholder farmers would be vital to promote local organic production (Thamaga-Chitja & Hendriks 2008).

Opportunities for certification are also increasing with the growing demand for legally and sustainably sourced timber and fish. Forest certification has traditionally been applied to large-scale commercial ventures, but is also being applied in community-managed lands. For example, The Mpingo Conservation Project in Tanzania obtained the first FSC certificate for community-managed natural forest in Africa. The certification raised revenues by US$1,800 for the two communities involved, half of which was used to pay forest patrols and management activities (creating jobs and boosting the local economy) and the other half to build new houses

(Oldfield 2012). It is anticipated that FSC certification will enable communities to earn more than $19 per log compared to $0.08 they received before the start of the Project (Oldfield 2012). Communities with more than 7,000 hectares of forest are expected to earn more than US$100,000 per year from this scheme (Ball, 2010).

Certification can be strengthened by public procurement policies and voluntary partnership agreements. Public expenditure constitutes a strong market force which can bring about sustainable production. Such practices are now the norm in many northern countries, such as requiring SFM (Hardcastle & Hagelberg 2012), but have not been introduced in most African countries. Voluntary partnership agreements (VPAs) serve to broaden the number of countries within which for concern for legality is an important consideration. For example, this could apply to timber exporting countries meeting certain requirements in order to facilitate their access to markets. This does not necessarily eliminate unsustainable practices within producer countries but it does exclude it from international trade (Hardcastle & Hagelberg 2012).

It is important that investors require specific beneficial practices. For example, payment of a planting grant can be on condition that a certain proportion of the area is left untouched. For example:

- In **Uganda**, the Sawlog Promotion Grant Scheme supports plantation development only on degraded land, maintains standards through training and linking grant payments to achievement of defined standards confirmed by field inspection (Hardcastle & Hagelberg 2012)
- In **Ethiopia, f**ield research conducted in the coffee forest areas showed that forest coffee certification activities do not adequately promote conservation of the coffee forest ecosystem and its biodiversity. This is mainly because certification standards are designed to target agricultural coffee production systems and not biodiversity. In fact, the higher prices paid to producers for certified coffee provides an incentive for farmers to clear the forest areas more (Stellmacher *et al.* 2010).

Managing demand for resources

In order to prevent 'leakages', or diverting resource use to other areas, interventions to achieve sustainable use need to include measures to reduce demand for those resources whose production or harvest is difficult to control on a wide scale. The most important examples are charcoal and fish. Reducing the demand for charcoal will entail introduction of alternative technologies, particularly in urban centres. Reducing the demand for certain fish involves consumer awareness campaigns.

Provision for implementing performance bond and offset systems

Many damaging activities such as infrastructure development and mining carry major environmental costs. Current requirements for mitigation and rehabilitation, as provided for under EIA regulations, are often weak and ineffective, especially where developers withdraw and declare bankruptcy at the end of a project. Performance bonds and offset systems ensure that residual damages are either rectified or offset by conservation actions elsewhere. However, in order for these systems to work effectively and not be misused, very strong policy, legislation and sets of procedures need to be in place. These measures also apply to the protection of important flora, such as on private lands in the fynbos areas of South Africa.

Address pollution problems

The most important pollution-related threats to biodiversity in Africa are in freshwater and marine systems. Marine pollution problems include plastic pollution of sea and coastal areas, as well as oil pollution events. The pollution of freshwater systems poses a major threat not only to biodiversity, but to human health and production systems:

- Agricultural runoff results in the eutrophication of freshwater systems, in turn leading to clogging of water bodies and toxic algal blooms in dams that are used for domestic water supply;
- Mining activities are the cause of the most severe pollution in freshwater systems, particularly as a result of the abandonment of mines and informal mining activities that use toxic chemicals.

- In many areas, including South Africa, wastewater treatment infrastructure is out dated or has not been adequately maintained, resulting in badly polluted river systems.

Measures to reduce pollution outputs and the risks of oil spills are required on a large scale. These include:

- Upgrading and repair of wastewater treatment systems
- Stemming acid mine drainage and damaging commercial and informal mining activities
- Convincing governments to ban the sale of plastic carrier bags and restrict packaging

In addition, **certification** can be applied to discourage pollution in coastal areas. For example, in South Africa the uptake of the Blue Flag certification system for beaches has influenced public management to provide better controls over water pollution, and also to improve water quality monitoring and safety on beaches (Spenceley 2010).

Develop sustainable financing strategies

Devise sustainable financing mechanisms for protected area systems

Developing countries harbour most of the world's biodiversity, and its protection generates benefits at a global scale, including genetic resources and carbon sequestration. However, protected areas are far more costly for developing than for developed countries, often exceeding 1% of GDP. These costs can be offset to a degree through grant finance, but annual Global Environment Facility finance and co-finance averages only 8% of the opportunity costs faced by low-income countries, which is justifiable on the basis that the role of the GEF is only to finance global environmental public goods, not the local benefits that countries derive from their conservation efforts (Hamilton 2013).

UNDP has provided an excellent evaluation framework to assist countries in the development of sustainable financing strategies for parks. Such strategies include revising park pricing strategies, enabling voluntary payments and donation, and setting up endowment funds. While it is not particularly expensive to set such systems in place (apart from the endowment itself, which creates the incentive for a swift response), some further investment is required to ensure its success.

Payments for ecosystem services

Outside of protected areas, financing mechanisms to fund conservation efforts include setting up systems of payments for ecosystem services (PES). PES projects aim to pay landowners to take the necessary actions to ensure the delivery of ecosystem services. Usually this involves the reduction of damaging agricultural or deforestation activities. The most common applications are for water and carbon storage or sequestration. The latter include REDD projects (reduced emissions from deforestation and degradation). Africa has lagged behind the rest of the world in the implementation of these projects. A large number of projects have been initiated, but few have reached the operational stage. So far the REDD projects, which were initiated later, and which rely on international buyers, have fared better than the PES projects focused on hydrological services, in which the potential buyers are local.

Facilitate private sector investment in restoring and maintaining ecosystems

Three are opportunities for private sector investment in the restoration or maintenance of ecosystems in order to secure the supply ecosystem services. Such investments could include funding sustainable use initiatives, ecosystem restoration/rehabilitation and improved ecosystem protection and management. While some commercial opportunities may exist, such as provision of water for breweries or bottling companies, it is likely that the bulk of such investment would be either in order to manage risks, in the case of the insurance industry, or in order to stimulate business through meeting the criteria for rating and accreditation systems, or simply through the marketing benefits of Corporate Social Responsibility investment. These types of investment are slowly gaining ground in Africa. Incentives for all these types of investments already exist to some extent. For example, in South Africa, the South African Breweries Limited (SAB) has formed a strategic alliance with Deutsche Gesellschaft für Internationale

Zusammenarbeit (GIZ), and WWF-SA to assess and reduce water risk in watersheds, and insurance companies such as Santam are starting to invest in ecosystem restoration in areas that are prone to natural disaster. However, most companies who are engaging in RI are focused on humanitarian goals. More advantage needs to be taken of the opportunity provided by investment in ecosystems, and this will require demonstrating the social benefits of doing so. The barriers need to be identified and the opportunities unlocked. Structures need to be put in place to develop and facilitate investment in bankable projects.

1.6 RESOURCE REQUIREMENTS

Costs of the actions required

Research and development

National assessments and accounting of biodiversity value

Preparing baseline valuation studies can be done at various levels to suit the needs of decision makers, but detailed planning generally requires fairly comprehensive assessments. The WAVES programme (s) has allocated an average of **$1.5 million** per country in order to develop natural resource accounts (Rayment 2012). This includes some capacity building.

Research and monitoring

A comprehensive desk-based **biodiversity inventory** could cost in the order of US$250,000 per country (African Development Fund 2013). Some countries, such as South Africa already have very comprehensive, spatial assessments of their biodiversity and its conservation status. However, in most African countries, there is a need for primary data collection on ecosystems and biodiversity. Thus the financial resources required are likely to be more substantial, in the order of US$1 million per country.

Research and monitoring of ecological and socio-economic systems is hard to cost, since the returns to improved knowledge do not tend to decline. The African Development Fund (2013) estimated that baseline and ongoing monitoring of forested areas alone would require $1.5 million per country with annual costs of US$400,000 per country for collecting, verifying and reporting on the additional indicators. In South Africa, the government spent US$12.5 million on biodiversity-related research during 2012-13 (National Research Foundation annual report), and $1.5 million on biodiversity monitoring by a dedicated government institution (SAEON). In total African countries should be investing in at least $15 million per year in research relevant to the Aichi Targets. Research funding needs for **technological and product development** are probably considerably larger.

Raising awareness and capacity

Awareness raising efforts do not require very big investments compared with many of the other actions required, but investment in doing them well is crucial to the effectiveness of what follows. They do, however, rely on investments in knowledge and research, which needs a considerably larger investment.

Baseline surveys help to focus awareness raising efforts. Based on assumption that national survey would need to be based on sample size of 1,000 people, Conway (2012) suggested that such surveys could cost between US$50,000 and $100,000 depending on how difficult it is to reach the public. A study commissioned recently in South Africa is within this range. Following this, the development and execution of national communication and awareness strategies and campaigns could be expected to be in the region of $1-2 million per year (see Table 2). Improving awareness among decision makes will require the employment of one or two policy advisors to national government, which could cost in the order of $100,000 per country per year. In addition, policy advice can also be generated by consultancies and academic institutions, such as those affiliated with the EfD that have specific budgets aimed

Table 1. Costs of school education programmes

Country	Project	Annual Cost (US$)
Nigeria	Family Life and HIV education	560,000
Kenya	World starts with me (sexuality)	360,000
South Africa	Midlands Meander Education Project – aim to integrate environmental education into school curriculum through educator support and co-teaching	5,000 for one school (112 children and 6 teachers)

(Source: 1, 3)

at the dissemination of policy advice. This suggests that additional allowance of at least $100,000 per country per year for other inputs to policy makers should be made, which includes production of policy briefs, workshops and events.

Thus in all, investments in awareness and capacity are likely to be in the order of $7-8 million per country.

Developing plans and strategies

All of the actions need to be addressed together in integrated local level planning, catchment scale planning, in coastal zone management, and large marine ecosystem management. In this regard, care must be taken not to overestimate the costs of meeting the targets through double-counting, for example, if one were to include the costs of Integrated River Basin Management as well as the costs of implementing soil conservation measures in agriculture.

Developing plans for sustainable production and consumption is complex and requires time by governmental and/or a multidisciplinary team of consultants. Such planning could amount to something in the order of **$500,000 per country**. If this were done thoroughly for a few countries, other countries would be able to take these plans and adjust them to their own situations.

Integrated coastal management plans costs in the order of **$100,000 per 100 km** coastal area. There are economies of scale in some of the work, but it generally involves interaction at the local government (municipal) level. Given that Africa's coastline is 26,000 km, the total investment would need to be in the order of $26 million.

Integrated river basin management is often multinational and can be extremely costly. For example,

- In **Angola, Namibia and Botswana**, the Okavango Improved River Basin Management Project (IRBM), funded by USAID, cost US$5-6 million over 4 years (2004-2008; Tortell & Ayibotele (2006).
- In **South Africa**, integration of ecosystem considerations into water resource planning added about $150 – 300,000 to the process of water resource planning in the Berg River catchment. This process included consideration of environmental requirements in the design of the dam, the capital costs of which are discussed in a later section.
- In **Tanzania**, the Pangani River Basin Management Project (2002 to 2010) cost US$ 4.78 million (Cross and Förster 2011). Of this about US$200,000 was spent on quantifying changes in ecosystem services and the overall social and environmental tradeoffs (source: Author)

Given the fact that each country will have to plan for multiple river basins as well as coastal and ocean areas, a rough estimate of the total cost of implementing and/or upgrading planning processes would be **$5-10 million per country**. These processes yield immense amounts of information, and are a very high priority.

Direct protection

Strengthen protected area systems

Establishing a new protected area may require the purchase of land at full market value, or it may simply require a change in land use on government, private or community-owned land (Ervin and Gidda 2012). As one increases the total area under protection, so the opportunity costs of protection increase, and hence also the acquisition costs. The

Table 2. Costs of establishing MPAs in Africa

		Total cost (US$)	Cost/km^2
Narou Heuleuk (4 MPAs), Senegal	102km^2	18,090,000	177,353
Seychelles MPA	182km^2	1,890,000	10,385
Mnazi Bay, Tanzania	250km^2	3,176,550	12,706
Quirimbas MPA in Mozambique	1,522km^2	7,107,750	4,670

Source: (Gabrié *et al*. 2010)

costs of creating new protected areas are therefore highly variable and site specific. The most challenging areas for consolidating and expanding protection are likely to be where land pressure is high and demand for land is the primary driver of habitat loss (Hardcastle and Hagelberg 2012).

Globally, **acquisition** costs for terrestrial protected areas range from $460 to $10,189 per hectare and management costs range from $4.68 to $76 per hectare (Talberth and Gray 2012). In Ethiopia, (Reichhuber and Requate 2012*b*) estimated the acquisition and management costs of protecting a forest area US$79/ha US$3/ha respectively. The establishment cost of 76,000 km^2 of protected areas in the Niger Delta – Congo Basin Forest Region (Nigeria, Cameroon, Equatorial Guinea, Gabon, Central African Republic, Congo and the Democratic Republic of Congo) has been estimated to be in the order of $1 billion over ten years ($132 per ha).

Balmford *et al.* (2004) demonstrated that the size of the individual MPAs is the key determinant of cost. A more recent study shows that the costs of establishing vary with both size and the duration (in years) of the establishment phase (McCrea-Strub *et al.* 2011). The costs in are somewhat higher than those estimated in (Ervin and Gidda 2012).

Current expenditure on **management of protected areas** in lower-income countries reportedly only covers 31% of requirements (McCarthy *et al.* 2012). Based on a study of management effectiveness of nearly 7,000 protected areas worldwide, Leverington *et al.* (2010) found that management of 13% of protected areas was clearly inadequate, 27% had basic management with major deficiencies, 35% had basic management, and 25% had sound management in place (Ervin and Gidda 2012). Nevertheless, many countries in West and Central Africa were found to have reached the 60% target, possibly as a result of strong efforts of IUCN in that region through the PAPACO project (Coad *et al.* 2013).

Based on reserve sizes and economic indicators, Moore *et al.* (2004) estimated that US$630 million per year would be required to effectively manage reserve networks covering 10% of each of Africa's 118 ecoregions. Costs are likely to be correlated with levels of endemism and threat and that focussing exclusively on cheap areas is unlikely to achieve conservation goals. In the case of MPAs, management costs are inversely related to the distance to inhabited land (Balmford *et al.* 2004). Based on the model developed by Balmford *et al.* (2003), reported financial needs of terrestrial protected area systems in developing countries, and data on protected size, annual GDP per km^2, human development index and purchasing power parity, Bruner *et al.* estimated that annual management costs of existing protected areas in developing countries are in the order of $208/km^2 (Ervin & Gidda 2012).

The cost of **effective management** is a difficult to estimate, because protected area management can include tourism- and education-related activities as well as ecosystem management and enforcement. Hardcastle & Hagelberg (2012) considered law enforcement to be a crucial activity, and estimated that about **US$3 million** was required per country per year for law enforcement just for the management of forests. Butchart *et al.* (2012) estimate that median annual costs of *effectively* managing protected important bird areas in low income countries would be around **$272/km^2**. Ervin & Gidda (2012) estimate an average cost of **$119/km^2** to

Table 3. Estimated costs per square kilometer for establishing new MPAs

MPA size (km^2)	Cost of establishment/km^2 (US$)
5	21,110
50	6,990
500	2,315
5,000	766
50,000	254
500,000	84

(Ervin and Gidda 2012)

Table 4. Estimated costs of effectively managing new MPAs

MPA size (km^2)	Cost of establishment/km^2 (US$)
5	47,623
50	7,723
500	1,253
5,000	203
50,000	33
500,000	5

(McCrae-Strub *et al*. (2011)

improve management effectiveness for both terrestrial and mari ne protected areas, ranging from \$50/km^2 to \$250/km^2. Estimated costs of effectively managing MPAs are given in Table 6.

Restoration

Restoration of degraded habitats, including the clearing of alien invasive species and reintroduction of populations, is considered to be one of the most expensive forms of direct conservation action. Nevertheless, restoration yields obvious benefits and numerous examples of projects exist throughout the continent.

In the case of alien plant invasions, clearing costs for different genera across a range of densities vary significantly. The costs of restoration will also vary widely according to habitat as well as the level and degradation, and thus the extent of the restoration work. These costs are likely to be disproportionately high on islands, where they are often an integral part of species recovery programmes. At present, approximately US\$60 million is spent annually on the control of IAS in Africa (UNEP 2006). The required expenditure is in the order of \$2.74 billion (Turpie *et al.* 2012), not including control of agricultural pests and pathogens. A much more detailed assessment would be needed to estimate the funds required for other restoration and reintroduction programmes.

Border protection

The required expenditure on border protection measures is likely to be related to the numbers of points of entry, and the volumes or values of freight or the numbers of passengers passing though these points (Turpie *et al.* 2012). The above estimate of costs to control IAS include border protection costs. Additional systems would need to be put in place to extend this to trade in endangered species.

Sustainable land and resource use

Measures to achieve sustainable land and resource use usually involve a suite of actions that are carried out together. These vary depending on the type of production system and its socio-economic context, as well as the degree to which intervention is required. Examples of the costs of projects are as follows:

- The **East Africa** Cross Borders Biodiversity Project (CBBP) was a full-size GEF/ UNDP project that was operational between 1998 and 2003. Its objective was "to reduce the rate of loss of forest and wetland biodiversity in specific cross-border sites of national and global significance in East Africa". The idea was to promote and achieve sustainable use of biodiversity, and to bring demands on natural resources into balance with the sustainable supply at key forest and wetland sites. In order to achieve this, the project attempted to establish an enabling environment (policy, legislation, awareness) that allowed sectoral and development agencies as well as local communities, providing support at four levels – regional, national, district and community – and ensuring strong linkages between these levels. Site-based conservation interventions took place at four paired cross-border sites which were important from a biodiversity conservation perspective. The development of an enabling environment with supports the sustainable use of biodiversity was considered to be achieved at the most successful site, while bringing resource demands in line with supply was partially achieved at the same site. The GEF funding for the project amounted to US$12.9 million with additional co-financing of US$5.5 million. Source: Conservation Development Centre (2007).

- **In Ethiopia**, some US$538,900 was spent on a suite of actions including formation of small group trade associations, business and financial capacity for production, and certification systems, all in order to increase markets for medicinal plant-based products through expansion of value chains and national and international markets[4]
- **In Zambia**, the Community Markets for Conservation (COMACO) project involved considerable investment, including construction of a trading facility, building of local depots, etc, amounting to some US$740,000 (Lewis *et al.* 2011*b*), but was not yet financially self-sustaining in 2010.
- The costs of LMMAs reportedly range from $42 to $2,000 per km^2 of managed fishing ground (Harding *et al.* 2012).
- Moye & Carr-Dirick (2002) reported that some $30 million in donor funding had been spent on sustainable management of central African forests over a ten-year period. They also recorded $5 million in funding for Institutional Strengthening and Policy Development at the sub-regional level and $10 million at the national level (but only for a few countries). In addition, $6 million per year had been committed to Community-based Natural Resources Management.
- In Tanzania, the Ministry of Natural Resources and Tourism (MNRT) and the UNDP, through the UN-REDD National Programme, recently investigated the costs of REDD projects. Four kinds of costs were distinguished: opportunity costs, implementation costs, transaction costs and institutional costs. Results showed that all cost elements have wide variations depending on the location of a project, the surrounding land-uses and the general economic conditions. Project-specific opportunity costs range from US$-7.8 to 28.8 per tonne of CO2. Combined implementation, transaction and institutional costs range from US$3.9 to 8.9 per ha and per year with up to 95% of this being implementation costs (Merger *et al.* 2012).

Making these revisions is a major process involving stakeholder consultation, and can be especially lengthy and complex when it involves the definition or reallocation of property rights. In South Africa, revision of fishing rights alone has been a process without a quick fix. Initial allocations failed, and a longer process that involves checks and balances along the way has been far more successful. However, in Namibia, the revision of property rights conditions for incentivising stewardship of wildlife was a relatively straightforward process that yielded a high level of success. Realistically, the amount to invest in these enabling actions might be in the order of $4 million per year.

Sustainable financing strategies

Based on GEF funding proposals, Ervin & Gidda (2012) estimated that the costs of improving sustainable finance for protected areas globally ranges from **$1.19 million to $60.45 million** (average of $13.33 million) per country.

Current spending on conservation

A recent estimate is available of actual spending on conservation by country (Table 7) which suggests that at least US$480 million is currently being spent in Africa. The study suggests that all African countries are spending considerably less than 1% of their GDP on conservation, and the majority spend less than 0.1%.

Spending is by far the highest in South Africa, but South Africa's spending represents among the lowest investments relative to GDP. It is interesting to note that the top six spenders are countries that have a high level of benefit from nature-based tourism.

4 Ethiopia: Capacity Building for Access and Benefit Sharing and Sustainable use of Medicinal Plants. GEF Grant Funding Report.

The expenditure was defined as "country-level conservation funding flows from multiple sources including government, donors, trust funds, and self-funding via user payments", but the nature of the expenditure was not described and is assumed to be fairly narrow, involving direct biodiversity protection measures such as protected areas and restoration. Further research should investigate the total expenditure on all the types of actions required to meet the Aichi Targets in order to better estimate the financing gaps.

Funding gaps

It was not possible to find enough evidence to make a reliable estimate of the funding required to meet the Aichi Targets, let alone the funding gap taking existing expenditure into account. This is even difficult at a regional level. For example, Moye & Carr-Dirick (2002) could not find accurate statistics on the level of government spending for protected areas management in the Central African forests sub-region (Cameroon, Central African Republic, Chad, Equatorial Guinea, Gabon and the Republic of Congo; 137). However, a couple of examples illustrate that the funding gap is likely to be very large. In South Africa, where biodiversity conservation probably receives more attention than most other African countries, the annual management expenditure of protected areas in the Cape Floristic Region (CFR) was found to be only 48% of what was considered adequate for effective management, and needed to be increased from \$6.7 million to \$13 million per annum (Frazee *et al.* 2003). In addition, South Africa has a major problem caused by acid mine drainage from mines that are abandoned after they become unviable. The cost of cleaning up the water pollution was estimated to be \$3 billion, but in the 2013 national budget, only \$15 million was allocated to this.

1.7 POLICY ALIGNMENT AND DEVELOPMENT

Synergies with other development agendas

The period for meeting the Aichi Targets straddles that for the Millennium Development Goals, and the Post-2015 Development Agenda, which will build on these. The global development agenda is currently driven by the Millennium Development Goals that were adopted in 2000 and set for the period 2000-2015.

The UN member states are now looking towards setting the post-2015 development agenda. This process was initiated at the UN Conference on Sustainable Development in Rio in 2012 (Rio+20 summit), where it was agreed to develop global sustainable development goals to be integrated into the post-2015 development agenda. Initial ideas were put forward in a document called "The future we want". The specific goals will be developed by Open Working Groups during 2013-14. The themes of these discussions are: addressing inequalities, conflict, violence and disaster, education, energy, environmental sustainability, governance, growth and employment, health, hunger, food security and nutrition, population dynamics and water. The goals are likely to address sustainable agriculture, land degradation, water, energy, sustainable consumption and production, and oceans, forests and biodiversity.

While the post-2014 development agenda has not yet been articulated in detail, the development agenda for Africa will no doubt continue to be focussed on economic growth and poverty reduction (MDG1), and there will continue to be global pressure on African states to address education (MDG2), gender (MDG3), health (MDG 4, 5 and 6), and environmental (MDG7) issues.

There are important synergies between the Aichi Targets and the current MDG goals (Table 8). In particular, the Aichi Targets will make important contributions to Goal 7, and indirectly to Goal 1 and Goal 6.

Some examples of how actions to meet Aichi Targets will address development goals are as follows:

- Expanding subsistence agriculture and need for fuel are driving deforestation and forest degradation in Africa. There are opportunities to invest in both agroforestry projects and forest restoration, both of which will benefit biodiversity both through expansion of habitat and reduction of pressure on remaining natural habitat. There are opportunities for local livelihood benefits both through carbon credit sales as well as shifts to sustainable forest management after restoration to ensure continued supply of forest products.

- Labour-intensive environmental restoration programmes not only restore the flow of ecosystem services to society but also provide signficant opportunities to address unemployment. In South Africa, the government-funded Working for Water (WfW) programme clears mountain catchments and riparian zones of invasive alien plants to restore natural fire regimes, the productive potential of land, biodiversity, and hydrological functioning. The programme was established in 1995 as a poverty-relief initiative which aimed to provide employment and training opportunities for the unemployed. Because of this focus, it has received far more government support that it would have if developed as an environmental initiative. The WfW programme has an annual budget of more than half of the countries conservation agencies and has created thousands of jobs. Its success has spawned the development of several other initiatives, including Working for Wetlands, Working on Fire and CoastCare (Turpie *et al.* 2008).
- Achieving the Aichi Targets will also address the intra-and inter- generational distribution of benefits derived from biodiversity. The benefits are highly skewed at this point, with resources being rapidly depleted by this generation, with elite-capture of the benefits in many cases.

At the same time the development goals will facilitate the Aichi Targets. In Africa, much of the pressure on biodiversity is by the rural poor, and reduction in poverty will help to address this. Achieving universal primary education will not help to achieve the Aichi Targets, but will be critical in maintaining and improving upon the achievements made, as well as being the key tool towards the ability of future generations to adapt to change.

Synergies with other conventions and plans

There have been a number of conventions that have been signed by African governments, dating back to the 1900 London Convention for the Protection of Wild Animals, Birds and Fish in Africa 1900. The African Convention on the Conservation of Nature and Natural Resources (Algiers Convention) was adopted in 1968, with the aim of ensuring the conservation, use and development of resources in accordance with scientific principals and with due regard to the best interests of people. Similar principles were embodied in Agenda 21, adopted at the UN Conference on Environment and Development in 1992. Implementation of the Algiers Convention was limited by lack of financial resources. The convention was revised and agreed at the 9th session of AMCEN[5] in 2002. In addition, the Nairobi Convention and Abidjan Convention make provision for protection of the marine and coastal environments in East and West Africa, respectively.

Environment has been identified as one of the core priority initiatives of the New Partnership for Africa's Development (NEPAD), the planning and coordinating agency of the African Union, which was established to address the development challenges facing the African continent. NEPAD's Action Plan includes improving environmental conditions in Africa in order to contribute to the achievement of economic growth and poverty eradication. It will also build Africa's capacity to implement regional and international environmental agreements and to effectively address African environmental challenges. Nepad's action plan for the first decade of the century included programmes on (1) combating land degradation, drought and desertification, (2) conserving Africa's wetlands, (3) prevention, control and management of invasive alien species, (4) conservation and sustainable use of marine, coastal and freshwater resources,(5) combating climate change and (6) transboundary conservation and management of natural resources.

5 The African Ministerial Conference on the Environment (AMCEN) is a permanent forum where African ministers of the environment discuss mainly matters of relevance to the environment of the continent.

Subregional and regional bodies, such as the African Union, the Southern African Development Community (SADC), the Economic Commission of West African States (ECOWAS), the East African Community, the Economic Commission for Africa (ECA), the Economic Community of Central African States (ECCAS) and the Intergovernmental Authority on Development (IGAD) have environmental programmes or considerations in their development agendas. For example, SADC has protocols on wildlife conservation (1999), shared watercourses (2000), fisheries (2001), Forestry (2002), and, with the help of IUCN, has recently developed a Regional Biodiversity Strategy and Action Plan. In addition, international River Basin Organisations also encourage cooperative actions within and among African states.

Most African countries have also ratified a number of international agreements, including the Basel Convention (on hazardous wastes), the Stockholm Convention (on persistent organic pollutants), the Rotterdam Convention (on chemicals and pesticides), the Ramsar convention, CITES, the Convention on the Conservation of Migratory Species of Wild Animals, the World Heritage Convention, the United Nations Convention to Combat Desertification, the Convention on Biological Diversity and the UN Framework Convention on Climate Change (UNFCCC).

The Aichi Targets overlap entirely with many of the objectives of all of the above conventions and agreements, many of which were signed well before the Aichi Targets were adopted. For example, developing plans to achieve sustainable production and consumption (Target 4) will be aligned with the goals of the UNFCCC, and reducing the loss of natural habitats (Target 5), achieving sustainable agriculture and forestry (Target 6), and restoring degraded systems (Target 14) will be aligned with some of the goals of the UNFCCC as well as the goals of the UNCCD. Many of the other targets also contribute to the goals of these conventions either directly or indirectly. Actions relevant to the Aichi Targets have also been incorporated into several of the more recently developed plans. Thus most countries should already have started implementing actions that would help to achieve these targets. A more thorough analysis of existing NBSAPs with regard to their ability to meet the Aichi Targets is needed.

Potential trade-offs

The above synergies suggest that there are opportunities for investment that lead to co-benefits. For example, investment in improved agricultural practices will provide opportunities to improve food security, as well as improving the supply of clean water to people living downstream. However, the synergies between the Aichi Targets and the development agenda are far from adequately appreciated in Africa. National development agendas are strongly focused on economic growth and the Aichi Targets may be perceived to be in conflict with this, especially where its actions require reductions in outputs of certain sectors. Areas of potential conflict include the various areas of development such as mining and energy, transport and communications. In this regard, Aichi Target 1 will be critical in leveraging government investment in natural capital in order to achieve development goals.

1.8 COST-EFFECTIVENESS

Synergies that will increase cost-effectiveness

There is considerably synergy between the actions required for meeting the different targets, mainly because of the common goal of biodiversity conservation. This means that the costs of delivering all the Aichi Targets will be considerably less than the sum of the costs of delivering each in isolation. Some of these synergies are as follows:

- **Target 1** (awareness of biodiversity value) is fundamental to its integration into development planning (**Target 2**). It is also an important strategy to achieving many of the other targets which require public and government support in order to achieve.

- **Target 2** (integration of biodiversity into planning), in turn links to many of the other Aichi Targets by helping to establish a favourable policy and institutional environment for the delivery of the targets.

- **Target 3** (elimination of harmful incentives) will play an important role in the delivery of many targets, most notably Target 4 (sustainable production & consumption), and the Targets related to reducing direct pressures on land and resources (Targets 6 to 10).

- **Target 4** (plans for sustainable production and consumption) also plays an important role in the success of Targets 5 – 10 over the longer term.

- **Target 5** (halve rate of habitat loss) will contribute to Target 8 (reducing pollution), for example through adopting green infrastructure over conventional grey solutions, as well as to Target 14 (restoring and safeguarding ecosystems).

- **Target 6** (harvest sustainably) contributes to achievement of Target 5 (halving habitat loss), Target 10 (sensitive habitats) and Target 11 (Marine Protected Areas). There are also synergies between different elements of this target.

- **Target 7** (Sustainable agri/aqua/silviculture) will contribute to Target 5 (halving habitat loss), Target 8 (reducing pollution) and Target 13 (minimizing genetic erosion), and may benefit from Targets 5, 11 and 14 though the ecosystem services provided by natural to agricultural systems. It will also help to achieve Target 6 (sustainable harvesting) by reducing the demand for wild foods and raw materials[6].

- **Target 8 (**reducing pollution) contributes to meeting Target 10 (coral reefs and sensitive ecosystems), Target 11 (conservation of terrestrial and marine systems), Target 12 (prevent extinction of threatened species) and Target 14 (restoring and safeguarding ecosystems). It also directly addresses one of the MDG goals, "halving the proportion of the population without sustainable access to safe drinking water and basic sanitation".

- **Target 9** (reduce alien invasives) contributes to meeting Target 5 (habitat loss), is particularly important for Target 12 (prevent extinction of threatened species), and is one of the main actions required for Target 14 (ecosystem restoration). It may also be important for Target 10 (coral reefs and sensitive ecosystems).

- **Target 10** (reduce threats to coral reefs and sensitive ecosystems) is dependent on several other targets, such as Target 6 (sustainable fisheries management), Target 8 (reducing pollution), and Target 11 (Marine Protected Areas), and will contribute to Target 14 insofar as people rely on the ecosystem services provided by coral reefs.

- **Target 11** (conservation of terrestrial and marine areas) is one of the actions required for Target 5 (halving rate of habitat loss), Target 6 (sustainable harvesting), Target 10 (protection of coral reefs), Target 12 (protection of threatened species), Target 14 (restoring and safeguarding ecosystems), Target 15 (ecosystem resilience). It also has the potential to contribute to Target 18 (participation and respect of indigenous and local communities) and Target 20 (sustainable finance).

- Actions required for **Target 15** (enhancing ecosystem resilience) overlap with those of many of the preceding targets, particularly Target 5, 6, 7, 8, 9, 10, and 11.

- **Targets 17 to 20** (implementing NBSAPs, using traditional knowledge, improving overall knowledge & technology, mobilising financial resources) have the potential to contribute to all the preceding targets.

Relative cost-effectiveness of different investments

Different types of investments are likely to have different levels of return in terms of contribution to the Targets relative to cost. A list of the main types of investments needed for the Aichi Targets and their expected levels of benefits relative to costs is given in Table 9 based on a combination of evidence and

6 Note that harvesting of indigenous forests is taken to be part of Target 6, and only plantation forestry is included in this interpretation of Target 7.

rationale. Of these, the communication of the value of achieving the targets is tantamount to successfully motivating the necessary investments in many of the others such that they are addressed in a way that takes biodiversity impacts into account, and not just development impacts, as drives many of these initiatives at the moment. Other actions that are likely to have very high returns are the removal of harmful subsidies, such as those supporting the extractive industries, including mining as well as fishing and forestry, and those affecting the demand for water and energy. Changes in these activities will have enormous ramifications.

The returns to activities that improve knowledge and awareness are expected to be high, provided that these activities are well designed and focused on how to gain benefits rather than moral suasion. There is also evidence many rural programmes aimed at achieving conservation and development objectives require ongoing extension and support services in order to succeed.

In general, the cost effectiveness of improving protected area systems is expected to be higher than the cost effectiveness of restoration. Similarly, actions to prevent pollution are expected to be more cost effective than attempts at cleaning up. In general, it is logical that prevention is better than cure. An exception to this may be dealing with alien invasive species: many studies have shown that their removal is well worthwhile in terrestrial and freshwater habitats, and that swift action also pays off.

Cost effectiveness of different actions will vary depending on their geographical context. For example, measures to reduce pressures through more sustainable practices are likely to be less cost-effective than strengthening protected area systems in areas of high population density and poverty (where damaging behaviour is a survival issue) or where the rewards from damaging behaviour are very high (e.g. high value species). For example, restrictions on fishing gear are largely ignored in coastal fishing areas of Tanzania, in spite of considerable management effort (Albers and Robinson 2012).

To a large extent, cost effectiveness of particular actions is also determined by how they are carried out. For example, a study on an awareness raising campaign in Kenya on the use of indigenous vegetables demonstrated that family and social networks are stronger forms of communication than mass media in influencing attitudes and behaviour change. While mass media may be successful in increasing awareness, it is less effective in changing behaviour than interpersonal communication. Broadcast media channels were slightly more effective than print media. Lessons learnt included that the message source must be credible and of high quality, should be consistent and have repeated exposure, and that informal sources of communication are important in complementing mass media. The study also concluded that campaigns should run nationally over long periods, and that characteristics of different segments of the audience should be understood for appropriate behaviour change interventions to be made (Obel-Lawson 2006).

This also applies to many of the incentive measures used to achieve sustainable land and resource use. For example, strategies such as PES have become very popular because of a few successful examples, but fail under many circumstances. If these strategies are to be used they need to be very carefully targeted to areas where all the ecological and socio-economic conditions are suitable. It should also be noted that PES goes against the polluter pays principle and potentially encourages illegal activities for resource users to claim payments (Pirard *et al.* 2010).

Cost effectiveness of actions can also be increased through combined strategies, taking advantage of the synergies mentioned above. For example, Wilson *et al.* (2007) developed a framework that combines geographic priorities with the allocation of funds among alternate conservation actions that address specific threats. This framework offers an improvement over approaches that only focus on land purchase or species richness and do not account for threats. Their study showed that it was possible to protect many more plant and vertebrate species by investing in a sequence of conservation actions targeted towards specific threats, such as invasive species control, land acquisition, and off-reserve management, than by relying solely on acquiring land for protected areas.

Investment in preparatory actions

Investment of time in preparatory actions can be important. Spending time on research will inform strategy and thereby increase cost-effectiveness of the next steps, but there are also trade-offs between the knowledge gained and the costs of delaying actions, and these trade-offs can be reduced if adaptive management is possible. The example of plastic bag legislation in southern Africa provides a good illustration. The policy would have been better implemented with more research, but could just as easily be adjusted to correct the problem, for example by following examples from other countries (e.g. Monaco) where plastic bag purchases are not even possible and people have changed their behaviour accordingly. Protection measures should not be delayed by research. Investment in investigation will pay off for the actions whose outcomes are uncertain or variable (such as implementing incentive measures).

In other cases, there is less opportunity for adaptive management, such as the gazetting of new protected areas. The planning of these areas needs to be done carefully in order to meet targets and maximise their success, and will involve time consuming stakeholder processes. Nevertheless, the expansion of protected area systems is urgent given pressures on land and marine systems, and planning efforts should not delay implementation longer than necessary. This means that waiting for a high level of consensus might be unproductive.

Sequencing of actions

Sequencing of actions will be important for achieving individual targets, but sequencing of addressing the Targets themselves will not be critical in determining overall cost effectiveness, because benefits may be outweighed by the costs of delay. There is enough information to begin work on all of the targets, and there will still be enough opportunity in most cases to capitalise on the synergies with other targets during the process of implementation.

Role of governance in achieving cost-effective delivery

Improved governance and a better institutional and policy framework will be very important in achieving the delivery of the Aichi Targets in Africa in a cost effective manner. Currently there are major inefficiencies associated with weak policies, governance and institutions. Even where policies are good, they are often ineffective as a result of weak or ineffective law enforcement. This stems from a major lack of capacity, and from widespread corruption. Systems to improve accountability will be important in ensuring that funds are well invested. This might be encouraged by socially responsible investment practices on the part of international investors.

1.9 BENEFITS AND COSTS

Protected areas

In **Madagascar**, deforestation in mountain areas is thought to be the reason for losses in production in downstream areas due to siltation, of between $40 (Maroantsetra region) and $80 (Alaotra region) per hectare. Based on management costs and estimated revenues that could be derived from farming and fuel wood and plant harvesting, the opportunity costs of the protected areas was estimated to amount to $1.8 per hectare, but would be expected to escalate. The benefits of protection were estimated to amount to an annual $10 per hectare. Protection of the area was estimated to have a highly attractive economic rate of return of 54% (Carret and Loyer 2003).

Restoration

Cost-benefit analysis is likely to favour projects where they offset the need for the implementation of significant engineering options in order to continue the supply of certain services upon which local communities are heavily reliant. For example, Van Wilgen *et al.* (1996) assessed the costs and benefits of removing alien trees from fynbos mountain catchments in the Western Cape of **South Africa**, which supply about two-thirds of the Western Cape's water requirements. Fynbos is particularly well-adapted to the dry Mediterranean climate of the Cape, where the plants' low biomass ensures conservative water use. This services has been described as playing a crucial role in the region's economy and contributed a gross domestic product of US$ 15.3 billion in 1992 (Bridgeman *et al.* 1992, cited in van Wilgen *et al.* 1995). However, fynbos is particularly susceptible to invasion from alien trees and shrubs, which have the potential to dramatically increase biomass and reduce run-off in catchments, significantly impacting water supplies within the catchments. Projected increases in alien invasives in the upper catchments of the Cape had the potential to result in the loss of more than 30% of the water supply to the City of Cape Town. Whilst the clearing of alien invasives and management of upper catchments would by no means be a cheap operation, the alternatives to optimally managed catchments would be far from attractive, and would include the implementation of sewage effluent exchange and desalinization plants. Van Wilgen *et al.* (1996) found that these alternatives would deliver water at a cost between 1.8 and 6.7 times more than optimal catchment management.

Marais and Wannenburgh (2008) carried out a more recent assessment of the benefits of river restoration through alien clearing. They calculated the water benefits associated with clearing based on the assumption that the increased yield per condensed hectare cleared was 2,250 m^3/ha/annum along perennial rivers, and 750 m^3/ha/annum for non-perennial rivers, multiplied by the local water tariff. They estimated yield would increase by some 34.4 million m^3/year, equivalent to about 42% of the yield of the new Berg River Scheme (81 million m^3/year) in the Western Cape, which was developed at a cost of around R1.6 billion. Marais and Wannenburgh (2008) concluded that the investment in clearing species known for excessive water use from riparian areas at a cost of R116 million would be a good investment.

Sustainable resource use

In **Madagascar**, a state/fishing industry partnership was set up to overcome over-fishing problems in the shrimp fishery, following widespread concerns about the state of the fishery. A new set of long-term, tradable licences was established in 2000. The shrimping industry has benefited, and there are signs that sound sustainable management regimes are in place. An approximate evaluation of the scheme suggests a very acceptable benefit-cost ratio of 1.5 (Rojat *et al.* 2004).

In **Mozambique**, as in most other African countries, renewable natural resources make a significant contribution to peoples' livelihoods and the economy, but this is not all captured in official statistics. Estimates suggest that their contribution is in the order of 47-50% of GDP. As a rapidly developing country, Mozambique's natural systems have suffered from soil loss, deforestation, water pollution and the overexploitation of natural resources. These losses, as well as the inefficient use of resources, material and energy, have been estimated to cost the equivalent of 17% of GDP annually. Excluding inefficiencies, environmental degradation costs Mozambican economy between 6 and 11% of GDP (Bandeira *et al.* 2012). This includes agricultural soil degradation worth some US$108 million. Based on the estimated costs of required investments in environmental protection, the overall benefit/cost ratio of preventing these losses was estimated to be 1.8. The analysis indicated that investments to reduce soil degradation, deforestation and to enhance coastal protection would bring the highest returns of all the actions considered. Investments in improved access to clean water and reduction of water pollution, air pollution and waste management also had positive benefit-cost ratios (Bandeira *et al.* 2012).


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2. ASIA

Luke Brander, Florian Eppink, Madhu Verma, Thang Dang, Bee Hong Yeo, Dhaval Negandhi

2.1 EXECUTIVE SUMMARY

- There is a substantial quantity of evidence on the benefits of conservation and sustainable use of biodiversity in Asia. This evidence largely pre-dates the Aichi Targets and does not relate directly to the achievement of the Targets or to any other specific policy agenda. This evidence is predominantly for South-Eastern, Eastern and Southern Asia. There is relatively little evidence for Western and Central Asia. Much of the evidence on the benefits of the sustainable use of biodiversity is for ecosystem specific local or sub-national studies, which limits the possibility of providing a coherent overview of the range of benefits across the region and across the Targets.

- Generally the benefits of biodiversity conservation are shown to be substantial and higher than the costs of conservation in most cases. Cases that find negative net benefits for conservation are due to either low local demand or extremely high opportunity costs of conservation.

- A common finding from cost-benefit analyses of conservation in Asia is that net benefits are often locally negative (i.e. local resource users lose out, particularly in the short term) but nationally or globally positive (i.e. beneficiaries that use natural resources indirectly gain from conservation). This has important implications for the funding and design of policies to provide incentives to local resource users.

- There is relatively little quantitative evidence on the investment needs, resource requirements and cost-effectiveness of options to meet the Aichi Targets. Similarly the evidence base for policy alignment is small. Most available assessments remain qualitative and do not provide a basis for estimating quantitative and robust answers to these questions.

- It is generally recognised that countries in Asia need to invest in stronger enforcement and institutional frameworks as a basis for implementing environmental management. The number of Government personnel assigned to environmental protection needs to be increased and capacities improved through training. Generally there is also a need for stronger political will for environmental conservation and enhanced public awareness of the benefits the environment provides.

- For most Asian countries (with the possible exception of those in Eastern Asia), there is likely to be a substantial gap between available and required resources for achieving the Aichi Targets. This has not been quantified at national levels but there are case study examples of large funding gaps.

- There is some evidence that investments in conservation and sustainable use of biodiversity may yield increasing returns to scale. For example, the unit area costs of marine protected areas (MPA) are found to decline substantially with the size of the MPA. If this observation holds for other types of conservation investment, it may be the case that scaling up efforts to meet the Targets can be achieved at lower unit costs than is otherwise implied by the cost data from relatively small-scale individual case studies.

2.2 INTRODUCTION

This report provides an overview of the research methods used, sources of evidence, coverage and gaps, and a selection of high quality case study evidence for the Asia region. The report provides a detailed overview of all the evidence collected and uses this as a basis to answer each research question defined in the terms of reference.

Asia comprises 50 countries.[7] The continent is extremely diverse in terms of biodiversity, socio-economics, and underlying pressures and causes of biodiversity loss. For the purposes of managing the collection and screening of evidence, the continent is divided into five sub-regions following those of the UN Statistics Division. These sub-regions and constituent countries are:

- Central Asia: Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan
- Eastern Asia: China, China – Hong Kong Special Administrative Region, China – Macao Special Administrative Region, Democratic People's Republic of Korea, Japan, Mongolia, Republic of Korea
- Southern Asia: Afghanistan, Bangladesh, Bhutan, India, Iran (Islamic Republic of), Maldives, Nepal, Pakistan, Sri Lanka
- South-Eastern Asia: Brunei Darussalam, Cambodia, Indonesia, Lao People's Democratic Republic, Malaysia, Myanmar, Philippines, Singapore, Thailand, Timor-Leste, Viet Nam
- Western Asia: Armenia, Azerbaijan, Bahrain, Cyprus, Georgia, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, State of Palestine, Syrian Arab Republic, Turkey, United Arab Emirates, Yemen

2.3 METHODOLOGY

Research methods and sources of evidence consulted

The collection of evidence has been pursued through four channels: an open call for evidence, personal contact with regional experts by email, attendance of regional conferences, and searching online databases and other sites.

An open call for evidence has been circulated through regional and professional networks to request information relevant to the research questions. The response rate to the call has not been high but it has yielded some useful responses and evidence.

Individual experts in the region (mainly personal contacts) have been contacted by email to request information directly and to further distribute the call for evidence.

A number of regional meetings have been attended by members of the research team in September and October 2013, which provided an opportunity to collect or request information from other participants. The meetings include the 4th ASEAN Heritage Parks conference organised by the ASEAN Centre for Biodiversity, Tagaytay City, Philippines; Workshop on Valuing and Accounting for the Environment in the Asia Region, organised by SANDEE, UNEP and ESCAP, Bangkok, Thailand; Fifth Session of the Governing Body of the International Treaty on Plant Genetic Resources for Food and Agriculture, Muscat, Oman; Workshop on Sustainable Water Use in Tourism, organized by the Oman Water Society, Nizwa, Oman, supported by the UN Economic and Social Commission for Western Asia.

Extensive searches have been conducted of online databases of academic papers, research reports and other websites to identify and collect relevant evidence. Databases accessed include those of the Environmental Valuation Reference Inventory, Environmental Economics Programme for South

7 Following the geographical groupings of the UN Statistics Division http://unstats.un.org/unsd/methods/m49/m49regin.htm

East Asia, and the ASEAN TEEB study. The website of the Convention on Biological Diversity was accessed to obtain National Biodiversity Strategy and Action Plans.

For the purposes of managing and collating the collected evidence an Excel database has been developed in which to record summary information on each study/report/initiative. The database contains separate worksheets for references, summary of evidence, and sources of information. The main summary worksheet contain fields for information on: location; scale of study/assessment; Aichi Target(s) addressed; research question(s) addressed (benefits, investment needs, resource requirements, policy alignment, cost-effectiveness, benefits and costs); method(s) used; robustness; total or additional assessment (whether the assessment measures total benefits and/or costs of conservation or the additional benefits and/or costs of a specific additional conservation effort). This database is used to enable an initial organisation of information and screening before developing more detailed analysis. This screening is necessary given the very large quantity of available evidence.

Overview of availability and robustness of evidence, methodological issues, evidence gaps, variations in extent and quality of evidence between questions

The database of collected evidence consists of 392 existing published papers and reports related to biodiversity conservation strategy. Specifically, the sources of information include:

- Academic papers in published journals
- National biodiversity strategy and action plans
- Studies from international research organizations or programs such as EEPSEA (Economy and Environment Program for the Southeast Asia), CBD (Convention on Biological Diversity), The Economics of Ecosystems and Biodiversity (TEEB) country studies, etc.
- Assessments of the biodiversity conservation strategies by NGOs,
- Country submissions to CBD on resource requirements
- Unpublished data and assessments by a range of the above stakeholders and initiatives

The database is organised using the five Asian sub-regions described above. The current collection of evidence consists of:

- 4 for Central Asia
- 63 for Eastern Asia
- 74 for Southern Asia
- 200 for South-Eastern Asia
- 41 for Western Asia

It is evident that the sub-regions Asia are not equally represented. An effort was made to collect evidence from all sub-regions in order to provide a balanced overview of evidence for very diverse countries and sub-regions. The distribution of screened evidence reflects, to a large extent, the disparity in available information on the sustainable use and conservation of biodiversity across the sub-regions. A substantial number of studies were found for South-Eastern Asia; similar numbers of studies for Southern, Eastern Asia and West Asia; but relatively little information is available for Central Asia. In selecting case studies to highlight in subsequent sections of this report, we have attempted to present evidence from all sub-regions. The principal selection criteria, however, is that a case study contributes pertinent evidence to the research question addressed in each section.

In terms of the distribution of studies by country, we found the highest number of studies for China (44), followed by the Philippines, Indonesia, Vietnam and Malaysia.

In terms of the scale of assessment of the collected evidence, the database records four categories of scale: local, sub-national, national to supra-national. The current collection of evidence consists mainly of local and national scale assessments, with 45% and 34% respectively. There is also a reasonably high proportion of sub-national studies (18%). The scale of assessment of the available evidence has implications for the scale at which conclusions can be drawn regarding the research questions. It is challenging to draw general region or even sub-region level conclusions based primarily on local, subnational and national level evidence.

Regarding publication dates, Figure 1 represents the number of studies published in each year. The available evidence spans 27 years, from 1986 to 2013. Most of the collected studies were published in the last 10 years, with particular high numbers of studies published in 2009 and 2010 (prior to CBD COP 10).

Figure 2 presents the number of collected studies that address each Strategic Goal. We find a reasonable quantity of evidence addressing each Strategic Goal but with significantly more for Strategic Goal D ("enhance the benefits to all from biodiversity and ecosystem services"). This reflects the very high number of studies that we reviewed that address Aichi Target 14 ("by 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable). The numbers of studies that address each Aichi Target are presented in Figure 3. There are a large number of studies that examine the benefits of ecosystem services. The numbers of studies that address each Research Question are presented in Figure 4. The majority of the studies that we collected and reviewed address the question of benefits from biodiversity and ecosystem conservation, albeit few that specifically assess the benefits of achieving the Aichi Target per se (see section 2.4). We find a reasonable number of studies that deal in some way with questions on investment needs, resource requirements, policy alignment and development, and comparison of cost and benefits. As discussed in sections 2.5-2.7, the level of detail in this evidence is mixed and limited to qualitative assessment in many cases. There is relatively little available evidence on the cost-effectiveness of biodiversity conservation (see section 2.8). Note that an individual study may address multiple Strategic Goals, Aichi Targets and Research Questions.

2.4 BENEFITS OF DELIVERING THE AICHI TARGETS

What will be the economic benefits of delivering the Aichi Targets?

We did not find any studies that specifically estimate the economic benefits of achieving the Aichi Targets. Moreover the reviewed National Reports or NBSAPs generally report the economic benefits qualitatively. Nevertheless, there are a substantial number of studies that quantitatively estimate the economic benefits of biodiversity, conservation and related ecosystem services.

Many of the reviewed studies that quantify the benefits of biodiversity conservation have applied stated preference valuation methods to assess values of natural resources in terms of public willingness to pay for conservation (e.g. Schechter *et al.* 1998; Sattout *et al.* 2007; Becker *et al.* 2010; Subade, 2007; Thuy, 2007; Chen and Jim, 2010; Hammit *et al.* 2001).[8] Many do so in the context of tourism (Sayan *et al.* 2011; Seenprachawong, 2003) or agriculture (Zekri *et al.* 2011; Poudel and Johnsen 2009). These studies measure direct use values of species or ecosystems.

The reduction of rates of habitat loss (Target 5) and expansion of protected areas (Target 11) can be expected to ensure to the provision of multiple ecosystem services (contributing to Target 14). The case study based on Ryu and Lee (2013) illustrates the potentially high economic value of a range of ecosystem services supported by the preservation of greenbelt land surrounding Seoul metropolitan area.

There is relatively little evidence on the relevance of non-use values for biodiversity conservation. Sattout *et al.* (2007) suggest that non-use values are an important component of the total economic value people place on natural resources over and above the value of direct uses. Similarly, Seenprachawong (2003) finds evidence of substantial non-use values for the conservation of coral reefs in Thailand. In this study non-use values are estimated to be of

8 See TEEB (2010), Chapter 5 "The economics of valuing ecosystem services and biodiversity" for a discussion of methods used for estimating monetary values for ecosystem services.

a similar magnitude as direct recreational uses. Although there is relatively little information on non-use values for biodiversity in Asia, the limited available evidence suggests that this is an important benefit of conservation.

The results of biodiversity valuation studies are rarely placed in an economic context outside of estimating a 'conservation value'. Exceptions to this observation include Zekri *et al.* (2011) who assess the potential to raise farming incomes by capturing tourism value, and Becker *et al.* (2010; presented in section 2.8).

Section 2.3 showed that there is generally an evidence gap for Central and West Asia. Scientific studies in particular are few but the ones identified for this report are mostly of good quality. Croitoru (2007) assesses various use and non-use forest values for Mediterranean countries, from northern Africa to France, including several Middle Eastern countries. She finds that the total per hectare value of northern countries (123 US dollars per hectare in 2007 dollars; 170 Euros) is much higher than eastern countries (35 US dollars per hectare; 48 Euros). Overgrazing in the Middle East has greatly contributed to this difference in value. This highlights the general finding that the quality of ecosystems or the extent of their degradation has a substantial bearing on the economic value of these resources.

A common finding is that the benefits of biodiversity conservation have an important distributional dimension. It is often found to be the case that poorer communities are the most highly dependent on biodiversity and ecosystem services and that these can comprise a large proportion of total household income. Losses of biodiversity and related ecosystem services (or equivalent gains resulting from achievement of the Aichi Targets) can therefore have disproportionately large consequences on the welfare of highly dependent communities. To fully assess the human welfare implications of gains or losses in biodiversity, it is therefore necessary to measure both absolute changes and their distribution across different communities. A large number of studies have estimated that economic benefits associated with direct dependency of people on natural ecosystems for their subsistence. For example, collection of non-wood forest produce (NWFP) is an important activity for forest dependent communities in many Asian countries. In Southern Asia, the economic benefits of NWFP are estimated to range from US$ 1,000 to more than US$ 6,000 per hectare per year. In the context of forest dependent communities, these benefits generally constitute 50-80% of average annual household income and are thus very significant. Ecosystems such as wetlands and coral reefs also provide important provisioning services. There are a substantial number of estimates of the economic value of these services for Southeast Asian countries but relatively few for other sub-regions. To some extent this may reflect the relative importance of such services to people in Southeast Asia.

Some evidence exists on the value of biodiversity and ecosystem services for Southern Asia. For example, coral reefs in Sri Lanka were economically valued at US$ 0.14 to 7.5 million per km^2 over a 20-year period. Wetlands in Sri Lanka and Iran have been economically valued in the range of US$ 1,000 to 2,500 per hectare per year for their use and non-use values. Attention has also been given to mangrove ecosystems – especially in Bangladesh, Pakistan and India, which are fundamental to livelihoods of people – and are economically valued in the range of US$ 1,000 to 1,500 per hectare per year. As in the case of NWFPs, economic benefits from mangroves often constitute a large proportion of average annual household income for dependent communities.

In many Asian countries, a majority of the population depends on crop production, livestock rearing and fisheries for their livelihood. The natural capital associated with each of these livelihood options has large economic benefits and significantly influences the incomes generated from such livelihoods. For example, all countries have rich crop genetic diversity, which has an insurance value for vulnerable populations.

What evidence is there of the nature, scale and value of these benefits, at national and international levels?

The available evidence on the benefits of biodiversity conservation is generally for specific local or sub-regional ecosystems. The scale of assessment is largely at local or sub-national scales and few robust national or regional assessments have been made. Consequently, the estimates derived vary greatly depending on the type of ecosystem, ecological conditions, topography, and livelihood alternatives and other characteristics of the beneficiary populations. National and regional scale assessments tend to be extrapolations from local scale information and do not necessarily account for differences in characteristics between the source ecosystem(s) and those of the national stock of ecosystems to which information is extrapolated. The reviewed National Reports or NBSAPs generally do not report any quantification of economic benefits, which may reflect the caveats involved in up-scaling many of the economic value benefits estimated at local or regional level. Some National Reports or NBSAPs report figures for the total market value (of the remaining stock) of a plant or animal species. The reliability of such estimates cannot be easily assessed and the sources are often unclear, e.g. other government documents that are not easily accessible.

The evidence base on the value of biodiversity conservation is therefore broad in terms of a large number of extant local case studies but does not provide a basis to straightforwardly draw conclusions on the magnitude of benefits for the region as a whole. Recognising this limitation on drawing general conclusions on the absolute and relative benefits associated with the different Aichi Targets for the region as a whole, we attempt to identify specific results from the available evidence that have general implications.

The evidence base provides few opportunities for up-scaling benefits from natural resource conservation beyond the original scale of assessment. National Reports do, however, identify several regional concerns, such as deforestation, status of endemic (agro)biodiversity, uncontrolled urban and infrastructural development, pollution and overexploitation of (water) resources. Problems that follow from these pressures include habitat (including wetland and coastal) loss, desertification, soil erosion and salinization. Given the fundamental nature of these environmental problems it is reasonable to assume that delivering the pertinent Targets will bring large environmental and economic benefits.

South-Eastern Asia in particular there are a large number of studies on the benefits of biodiversity conservation measures that assess the economic value of ecosystem services, biodiversity conservation and sustainable use. A review of this literature is available in the ASEAN TEEB scoping study (Brander and Eppink, 2012) and a database of valuation studies for South-Eastern Asia is available at http://lukebrander.com/.

2.5 INVESTMENT NEEDS

What types of investments and activities are needed to deliver the Aichi Targets and to secure these benefits?

National Reports and NBSAPs report mostly qualitative investments and activities needed to deliver the Aichi Targets. Several investment foci and activities can be inferred from challenges to effective environmental policy that are frequently reported in National Reports and NBSAPs. Without suggesting this summary list is exhaustive and in no particular order, these challenges are: lack of public awareness, lack of political will or capacity to enforce existing laws (from lack of staff and staff training as well as physical capital, e.g. vehicles), and an absence of adequate scientific knowledge and research skills.

Where would these investments be best directed or focused?

Section 2.4 suggested deforestation, status of endemic (agro)biodiversity, uncontrolled urban and infrastructural development, pollution, and overexploitation of (water) resources as major regional concerns. It would appear that these areas should be prioritized for investment.

While not all National Reports and NBSAPs of Asian countries specifically list activities where the investment will be best focused, the review suggests that the priorities of the region include developing baselines for biodiversity in many regions (including species information, status and distribution range), sustainable collection of NWFPs, preservation of crop genetic diversity, wetland conservation, species conservation, reducing fragmentation, developing community-based natural management regimes, building human and technical capacity for biodiversity conservation, integration in public policy, coastal zone management, sustainable rangeland management, soil and watershed conservation, sustainable tourism, sustainable fisheries management, and biodiversity monitoring. These activities have also been identified in the National Capacity Needs Self Assessments for different countries.

In the absence of hard evidence for prioritizing investment activities from this long list, it may be recommended to start with investments that are fundamental to the sustainable use of biodiversity. Such investments include establishing biodiversity monitoring centres (that can establish a baseline for biodiversity, monitor trends and raise awareness) and providing physical capital needed to enforce environmental laws (e.g., boats and off-road vehicles). Although these examples are for built capital, others require investments in soft power: high-level political support for policies that improve the sustainability of biodiversity use can make it (culturally or politically) easier for implementing agencies to protect biodiversity and ecosystems.

Since countries vary significantly in terms of their economic development, biodiversity status & trends, and institutional structures, the most urgent needs differ from country to country within each region. As regards to the regional priorities in South Asia, developing baselines for biodiversity, preservation of crop genetic diversity, and developing community-based natural resource management regimes may be regarded as the most pressing needs based on National Reports and NBSAPs. It should however be noted that these urgent needs may not apply strictly to each country and hence needs further assessment at the country level.

Which Targets will these investments help to meet, and what are the synergies and overlaps between Targets?

Given the nature of the inferred investment and activity needs it is likely that the potential for synergies between Targets exists. Increasing public awareness (Target 1), the political will and practical capability to uphold environmental legislation (Target 4) and the science base (Target 19), in general, may be assumed to benefit species and ecosystems (Targets 5, 8, 12 and 14).

In the arid countries better agricultural technologies (Target 7) and treating waste water (Target 8) will play a big role in increasing the conservation of water resources. Achieving these Targets would reduce the pressure on freshwater aquifers and inland water bodies (Target 11), and that may benefit wetland ecosystems and species (Targets 14 and 12). For instance, constructing an artificial wetland to dispose of so-called 'produced water' from oilfields has many other environmental benefits.

In countries for forest resources, sustainable forest management (Target 7) will contribute to stopping forest loss (Target 5) and help conserve the genetic diversity of wild crop species (Target 13). This will further contribute to habitat and species conservation (Targets 11 and 12) and larger, more mature forests will capture carbon (Target 15).

It is unlikely that species conservation will generate significant synergies with other Targets without additional policies. It may have tourism benefits that could be used to improve local incomes (Target 2).

While little hard evidence exists to answer this question for Asia, the activities proposed by various national programmes do point out synergies between them. For example, for many countries with forest resources, strengthening the already existing community-based management regimes to safeguard essential ecosystem services at the local level (Target 14) is likely to contribute to sustainable production and consumption (Target 4), sustainable agriculture, forestry and aquaculture (Target 7), develop fair practices for fair and equitable sharing of benefits (Target 16) and preservation of traditional knowledge (Target 18). Similarly generating a baseline status of biodiversity and monitoring its development is likely to contribute to awareness of values of biodiversity (Target 1), reducing rates of habitat loss (Target 5), control alien invasive species (Target 9), identification and conservation of Protected Areas (Target 11), halting extinctions of species (Target 12), implementing NBSAPs (Target 17) and sharing of knowledge and science base (Target 19). However, it is necessary to recognise that these synergies will need to be promoted by appropriate policies that discourage practices harmful to conservation of biodiversity and incentivise those involved in conservation.

What types of on-going annual expenditures will be required?

Referring back to earlier in this section, on-going programmes should include public awareness programmes, increased staff numbers to maintain nature reserves and enforce legislation, as well as stronger focus on research, notably monitoring of biodiversity trends.

Based on this review, the on-going programmes proposed or implemented in Asia include public awareness programmes, building human, technical, and financial capacity to develop biodiversity baselines and monitoring, identification and management of protected areas, harmonizing and enforcing existing legislations, sustainable livelihood programmes (including agriculture, livestock rearing, fisheries, tourism and NWFP collection), management of wetlands, maintenance of gene-banks, development and maintenance of biodiversity information systems, among others.

As stated earlier in this section, the absence of hard evidence for this research question suggests to prioritize actions that address underlying or fundamental causes of biodiversity loss. This is comparable to treating the cause rather than the symptoms of a medical issue. Such fundamental actions could improve public awareness (leading to, for instance, reduced national water footprints), raise people up from poverty (so fewer costs would be incurred stopping illegal logging and hunting) and increasing political will (improving available funding and reducing opportunities for unsustainable development).

How do the types of investments and ongoing expenditures identified compare to those identified in the first phase of the HLP research?

Key Message 1 from the first phase of the HLP research is that "*Implementation and delivery of the Targets requires an appropriate and coherent political and institutional framework and strong political will, particularly at the national and regional level*". Such a framework and/or the political will are currently lacking in many West, Central and Southeast Asian countries. With regard to South Asia, a coherent political and institutional framework and strong political will can be regarded to be in a nascent stage but the trend seems to be promising. In most Eastern Asian countries, such frameworks are already in place.

Key Message 2, "*Investment in natural capital will deliver significant co-benefits for sustainable development*" greatly applies to Southern and Southeast Asia and there is increasing evidence available to support it. Owing to low income status of many countries in these sub-regions, biodiversity conservation programmes have inherently included co-benefits such as poverty alleviation, empowerment of vulnerable sections of society and others to garner society's support. There is not enough evidence to conclude that this Key Message applies to West Asia. It may well apply, because in some countries communities may benefit from improving the national natural capital. Other, wealthier countries may be confronted instead with nation-wide and potentially catastrophic breakdowns in ecosystem service delivery if they do not reduce their environmental footprint.

Key Message 3 states that "*Existing evidence suggests that benefits are likely to significantly outweigh costs*". There is evidence that supports this message for Asia (see section 2.9).

Regarding Key Message 4, "*There are clear differences in the relative scale of investment required to deliver the various Targets.* (…)", although indirect evidence exists, our review does not provide clear evidence of the distinction in relative scales of investment required to deliver Targets in Asia.

Key Message 5, "*Many factors affect the magnitude of the estimates of the investments needed* (…)" also applies to Asia. The countries of this region are very different economically and face very different environmental problems. Important differences extend to social, political, ecological and climatic conditions.

Key Message 6, "*There are many inter-linkages and co-dependencies to consider both between the Targets themselves, and between the Targets and other national policy goals*", applies to Asia, although the evidence is not available to make these inter-linkages explicit. The evidence of inter-linkages between targets themselves and with other policy agendas exists implicitly, little explicit analysis is available.

Key Message 7 is "*Funding from a diverse range of international and national sources* (…) *is required* (…)". Given the economic diversity of Asian nations, the main problem for some countries is their inability to fund actions to deliver the Targets whereas in others it is the absence of political will to fund actions. The majority of Asian countries fall in the former group and require external support to fund biodiversity conservation. The latter group of countries presents a catch 22situation because environmental agencies cannot obtain funding from their governments but at the same time these countries do not qualify for funding from international donors.

Key Message 8 states that "*Further research is vital to help further develop and refine these investments*". This message applies strongly to Asia which is generally characterized by large knowledge gaps, dependency of population on natural resources and inadequate funding for conservation activities. Knowledge with which to refine and target conservation investments is therefore of great importance. Only a very small number of Asian countries have highly advanced research capacities to develop this type of knowledge.

2.6 RESOURCE REQUIREMENTS

What evidence is there of resource needs at the project and country level?

There is indirect information available to answer this question for many countries in Asia as reported in the National Reports or NBSAPs. Some early National Reports or NBSAPs provide lists of conservation actions at the national level with categorized cost predictions, such as 'Improve existing legislation; less than 50,000 US dollars' (see, e.g., MNPRA 1999, GOG 2005). These types of cost predictions have not been repeated in subsequent reports, possibly indicating that they were not deemed reliable. For the State of Palestine, PEA (1999) defines sub-national conservation projects and gives project-level cost estimates. Budget estimates range between 800,000 US dollars for protecting traditional knowledge and property rights, and 2 million US dollars for the development and management of a protected areas network in the State of Palestine. Cost categories vary from 'Xerox machine' to 'Community training'.

Depending on the importance and existing pressure on major ecosystems, most countries have developed programmes with an estimated investment required. For example, Bangladesh has identified priority programmes such as Sustainable Ecosystem Management Programme, Community-based Fisheries Management, Coastal & Wetland Biodiversity Management Project, and Coastal Afforestation Programme among several others with specific investment estimates for each of these activities which total to US$ 360 million for a period of 2010-20. With a budget of US$ 10 billion over a ten-year period, India has launched the Green India Mission (GIM) with the objective of doubling the area for afforestation/eco-restoration to 20 million ha, improve ecosystem services, biodiversity and carbon sequestration in 10 million ha, and increase forest-based livelihood incomes for 3 million forests-dependent households. In similar regards, Nepal too has identified activities that include, among others, strengthening legislation, conservation of endangered species, develop eco-friendly rural tourism, domesticate NWFPs and explore marketing opportunities for poverty reduction for which an estimated US$ 86 million will be required. To combat desertification, India has developed a national programme with an estimated investment of US$ 20 billion.

There is available evidence on the costs of individual conservation projects and programmes but this is largely an indication of what resources are currently available rather than of the resources required to meet the Aichi Targets. An exception to this observation is provided by the ADB study on action plans for Sulu–Sulawesi Marine Ecoregion, which estimates costs that are over and above those that are currently being allocated for existing projects in the region.

For the priority programmes identified in Bangladesh (see section 2.5) have a total budget of US$ 360 million for a period of 2010-20. Similarly the Green India Mission (GIM) initiative launched for double area for afforestation has a budget of US$ 10 billion over a ten-year period while an estimated investment of US$ 20 billion is required to combat desertification in India. The resource requirements for a few initiatives identified by Nepal as listed in Section 2.5 are approximately equal to US$ 86 million. Again, these represent budgets of individual initiatives and, it is not possible to easily scale-up this type of existing information to provide estimates of regional resource requirements. Generally the observation can be made that current funding is insufficient to cover the resources required to meet the Aichi Targets.

The global Biodiversity Finance Initiative (BIOFIN) is managed by UNDP, in partnership with the European Union and the Governments of Germany and Switzerland aims to develop a methodology for quantifying the biodiversity finance gap at a national level, for improving cost-effectiveness through mainstreaming of biodiversity into national development and sectoral planning, and for developing comprehensive national resource mobilising strategies. 12 countries are currently involved in developing and piloting the new methodology, including Indonesia, Kazakhstan, Malaysia and the Philippines.

A case study in the West Bank provides project costs for water treatment and conservation for Palestinian households. An investment of 4,000 US$ per household will conserve water resources, benefit household savings and could stimulate the local economy. According to PCBS (2012) around 44.3% of households in Palestine are not connected to a centralized sewerage network. The investment required to provide these 326,000 households with small scale wastewater treatment systems is between 1.3 billion US dollars and 3.8 billion US dollars. Investments for water conservation (as opposed to sewage water treatment and re-use) in the State of Palestine may be considerably less. A diverter for gray water, i.e. water from showers and taps, can be installed for 700 US dollars per household (Nazer *et al.* 2010). Providing these installations for all 736,000 Palestinian households would require 515 million US dollars.

How does this evidence compare with the analysis presented in the HLP's report to COP-11?

Although quantitative evidence on the resource requirements is rarely available, the overall picture suggests that current funding is insufficient to achieve the Targets (or individual nationally set goals). This is in accordance with Key Message 3/26. A direct comparison of resource needs for Asia to the first phase of the HLP research is currently not possible based on available evidence.

What evidence is there for current allocations relative to needs?

Many Asian countries report a general lack of funding for conservation actions. For example, the National Report from Pakistan states that while Biodiversity Working Group has been formed in the country, it has not been able to meet frequently due to financial constraints. Similarly the Biodiversity Secretariat and the Biodiversity Steering Committee has remained dormant due to financial inadequacies. In addition, some rough estimates are also available. For example Afghanistan notes, "despite an expenditure of more than $70 million in recent years, Afghanistan will not be able to meet the CBD's target of reducing the rate biodiversity loss by 2010 or in the foreseeable future". Similarly, India has identified that the functional needs for wildlife and protected area management efforts for a period of 2008-13 would be approximately US$ 840 million, out of which the actual allocation is only half. The National Biodiversity Authority of India has been intensively working on Economic Valuation of Bio-resources for Access and Benefit Sharing as well. Nepal's national report also refers to unavailability of funds for the proposed US$ 86 million to be invested in priority projects. The extent of funding problems is rarely quantified in National Reports or NBSAPs.

Recent research supported by the Economy and Environment Program for South East Asia (EEPSEA), assesses the resource and funding gaps for protected areas in seven countries in South-Eastern Asia and China. The results provide evidence of substantial shortfalls between resource requirements and allocations, even for the existing scale of protected area networks.

In India, the Finance Commission of India has been very proactive in providing additional financial support to initiatives of biodiversity conservation. The 12th Finance Commission of India provided a grant-in-aid of INR 1,000 Crores (approximately US$ 166 million) for a five-year period (2005-09) to be distributed to different states based on the proportion of forest area to their geographical area. The 13th Finance Commission of India went a step further in this direction and provided a grant-in-aid of INR 5,000 Crores (approximately US$ 800 million) for a five-year period (2010-14).

What are the implications for the resources required to deliver the targets, individually and collectively?

Several of the suggested investments concern institutional and financial capacity for conservation actions. Implementing such investments could well deliver synergies between Targets. Setting up a biodiversity monitoring centre, for instance, is costly but expanding its monitoring activities may involve only marginal further investments. Stronger implementation of EIA's may prevent not just site-specific habitat loss, but also local pollution and species population decreases.

As many countries in Asia report inadequate funding to carry out conservation related activities, a potential area of funding can arise from incorporating conservation issues with other important policy agendas such as poverty alleviation, gender empowerment or provision of livelihoods. In this way, such activities can contribute to conservation efforts that lack adequate funding. For example, the Poverty Environment Initiative in Bhutan focuses on integrating environment, climate and poverty into Bhutan's policies, plans and programmes and budgets to achieve a greener, more inclusive and sustainable development path. In India, innovative mechanisms to address the funding gap are also addressed in few cases by development of Special Purpose Vehicles.

In addition, there is some potential to obtain funding from private and foreign sources through the introduction of conservation fees. For example, regarding the resource crunch to implement programmes for biodiversity conservation in Maldives, a recent study estimates that over US$ 18 million can be generated annually from such conservation fees, which is more than two-and-half times the current annual budget allocation and has a potential to fill in part of the funding gap.

One issue for West Asian countries with high per capita incomes is that they often do not qualify for funding from international donors (PCPB, 2006). In the absence of national funding, implementing conservation efforts or even conducting research becomes difficult. Consequently progress on the Targets is quite possibly more at risk in richer countries than in poorer ones. This situation needs to be addressed by either national governments, international donors or both.

2.7 POLICY ALIGNMENT AND DEVELOPMENT

How do the identified investment needs and the benefits they will achieve align with other policy agendas, such as the Post-2015 UN Development Agenda and the Sustainable Development Goals?

There is substantial evidence of the linkages between biodiversity conservation and sustainable use and poverty reduction. Many of the case studies highlight the economic and social as well as environmental benefits of achieving the various Aichi Targets. Some of the reviewed evidence explicitly examines the connections between conservation measures and poverty alleviation. Leisher *et al.* (2007) describe two case studies of marine protected areas in the Philippines and Indonesia and their respective impacts on social development indicators. It is observed that the MPAs contributed to increased fish harvests, better local governance, improved health, and benefits for women.

There are a number of international programmes that specifically promote the adoption of policies and measures to reduce poverty and encourage the sustainable use of natural resources and a healthy environment. Notably among these is the United Nation's Poverty-Environment Initiative (PEI), which is a joint UN Development Programme (UNDP) and UN Environment Programme (UNEP) effort to link poverty-environment issues with priority policy interests such as economic growth, job creation and poverty reduction.

National Reports and NBSAPs do not generally report relevance to international agendas such as the Millennium Development Goals (MDGs). However, indirect evidence of linkage and potential policy alignment of MDGs with Aichi Targets is available in other studies. Table 1 shows potential alignment of each MDG with relevant Aichi Targets. It is clear that delivering the Targets will contribute to MDG 7 (ensure environmental sustainability). It may be noted here that while linkages exist, achievement of MDG Targets are subjected to supporting policies from other Ministries as well as additional funding. For example, MDG 1 (eradicate extreme poverty and hunger) will require support from Welfare Ministries among other favourable factors.

For South Asia, this connection between conservation and sustainable use of biodiversity and poverty alleviation is more recognised. For example, the National Rural Employment Guarantee Act in India as discussed later in this Section has been envisaged to provide guaranteed employment in rural areas and thereby alleviate poverty. Further, part of the activities carried out as a part of this Act are designed for conservation or development of green infrastructure, thereby providing resilience against shocks which may impact the poor. Similar has been the case with community forestry in Nepal in which communities involved in forest conservation benefit from sustainable forest harvest, thereby decreasing poverty. Biodiversity conservation has also been incorporated in Nepal's Poverty Reduction Strategy Papers.

In addition to alignment with development agendas, there is also an important alignment with elements of the climate change agenda (UNFCCC 2010). Programmes and measures that have been developed to address climate change mitigation and adaptation may also be of relevance to the achievement of some of the Aichi Targets. This may particularly be the case for climate change mitigation policies designed to control land use change and degradation. Such policies align closely with those required for reducing rates of habitat loss (Target 5) and expanding protected areas (Target 11) among others. It is also likely to be the case that policies to promote ecosystem based climate change adaptation (e.g. restoration of mangroves for storm protection) will align with those to reduce habitat loss.

To what extent can we identify synergies and opportunities for joint delivery at the country and programme level?

The evidence for this Research Question is mostly reported in National Reports and NBSAPs. The collective evidence clearly indicates that there are potentially many synergies, although it often takes the form of lists that imply synergies rather than identifying precisely what they are.

Many of the countries in Asia belong to Low Income or Lower Middle Income level according to the World Bank. Biodiversity conservation thus will also need to factor in strategies to reduce poverty in order to be mainstreamed in national policy decisions. One such initiative by India called the Mahatma Gandhi National Rural Employment Guarantee Act (2005) is the largest social security scheme in the world which has created more than five million green jobs in activities such as afforestation, water harvesting, soil conservation and land development. With a total outlay of approximately US$ 6 billion in 2012-13, the scheme has also empowered vulnerable sections of society, with more than one-third of the jobs in 2012-13 allocated to women and more than two-fifth of the jobs allocated to other vulnerable sections. Such activities thus have the potential to deliver joint benefits of empowerment, poverty reduction, employment, creation of green infrastructure and biodiversity conservation.

In South Asia, the Hindu Kush Himalayas is a transboundary ecosystem and few initiatives have been developed to identify and utilize synergies for joint delivery in conservation of biodiversity in this ecosystem not only across programmes, but also across countries. Such joint programmes are imperative to address transboundary factors influencing biodiversity conservation. Similarly, South Asia Co-operative Environment Programme (SACEP) promotes regional co-operation in South Asia in the field of environment, both natural and human in the context of sustainable development and on issues of economic and social development which also impinge on the environment and vice versa; to support conservation and management of natural resources of the region and to work closely with all national, regional, and international institutions, governmental and nongovernmental, as well as experts and groups engaged in such co-operation and conservation efforts.

What are the implications for the overall resource requirements to meet the Aichi Targets, and the degree to which additional resources need to be targeted to them?

There is very little evidence on the additional resources required to meet the Aichi Targets based on the review but it can be assumed that additional funding is needed as individual countries may focus only on some of the Targets which are directly related to high priority policy agendas. For other Targets, it is likely that supplementary funds would need to be made available.

Damodaran (2009) recognizes that in the absence of large-scale budgetary support or self-generating income flows, it becomes difficult for externally-funded projects to be replicated in other locations. This is especially relevant where conservation efforts collapse as soon as external funding is discontinued. Taking the case of funding tiger reserves for India, a study suggests that debt instruments hold promise as enablers of conservation finance. Proposing the issue of 'tiger bonds' to meet the financial requirements of tiger reserves, the study suggests that the requitable amount on a tiger reserve bond of duration of 5 years with a coupon rate of 8% for an envisaged investment of US $18 per hectare would be US $34 per hectare. In light of inadequate funding to achieve all Aichi Targets, such innovative mechanisms may be required to develop a site-specific case for conservation finance and obtain the additional resources required to meet the Aichi Targets.

To what extent can improvements in governance, institutional and policy development at the country level contribute in a cost-efficient manner to deliver actions to achieve the Targets?

As discussed in section 2.2, many Asian countries have identified various social and institutional shortcomings as a challenge for delivery of the Targets. It is likely that investments in these areas are the 'low hanging fruit' that can help delivery of the Targets at relatively low cost.

While there is low evidence of specific improvements in this regard, National Reports and NBSAPs do point out the various gaps in social and institutional capacity, which if addressed, can contribute to achievement of Targets at lower costs. In addition, studies in the region have suggested that property rights institutions will have to be more egalitarian so that they represent the poorest of the poor and avoid unilateral appropriations of the commons to ensure that values of biodiversity are integrated into national accounting (Adhikari *et al.* 2004). In India, the National Environmental Policy (2006) seeks to extend the coverage, and fill in gaps that still exist, in light of present knowledge and accumulated experience for biodiversity conservation in the country. An important point to emphasis in this regard is it does not displace, but builds on the earlier policies.

Although it is generally assumed that protected areas are the most effective means for biodiversity conservation, Persha *et al.* (2010) have found that forest commons explicitly managed to provide livelihoods for local populations, also provide biodiversity benefits. Analyzing 59 forest commons in Bhutan, India and Nepal, the study suggests that a singular focus on protected areas risks ignoring resource governance approaches that can complement existing conservation regimes.

2.8 COST EFFECTIVENESS

How can the Aichi Targets be delivered at least cost, taking account of the synergies between the targets and the investments required, the sequencing of actions and the synergies with other policy agendas?

In this formulation, there is little direct evidence to answer this Research Question because the (potential) synergies between Targets have not been studied.

At the level of individual targets, there exists some evidence on cost-effectiveness of meeting them but this is again generally available only for specific and localised cases. For Target 5 for example, Becker *et al.* (2010) show that the costs of supporting populations of the Eurasian Griffon Vulture through feeding stations tends to be a cost-effective measure. Even a more expensive measure such as implementing a breeding programme can yield positive returns within a few years.

Schaldach *et al.* (2013) assess various options to achieve Target 7. Although the cost of the management options in their study is left implicit, the outcomes are assessed in terms of ecosystem service value and number of livestock. Their conclusion is that, under climate change, implementing a policy of very low grazing density is not the best choice due to indirect changes in land use patterns.

It is expected that synergies do exist between development agendas and Aichi Targets. While national programmes do not provide explicit mention of the same, it is fairly evident that developmental agendas may be jointly delivered with biodiversity conservation. This is especially important when resource managers are highly dependent on these natural resources have incentives for using them sustainably. As highlighted in Table 1 above, there is also an opportunity to harness synergies based on linkages that exist between MDGs and Aichi Targets.

What evidence is there of the cost effectiveness of different investments, taking account of biodiversity gain and contribution to the Targets relative to cost?

In this formulation, there is little evidence to answer this Research Question. Although National Reports list progress that has been made, such progress is often framed in terms of legislation passed or increases in numbers or areas of protected nature reserves. These are indicators for which there is no clear causal relationship with improvements in ecosystem and biodiversity trends.

In qualitative studies, the cost-effectiveness of actions depends on various conditions and the analytical assumptions. There is relatively limited available evidence on the cost-effectiveness of alternative investments in biodiversity conservation. Measuring effectiveness in terms of quantifying gains in biodiversity is scientifically challenging. Studies that do attempt to estimate cost-effectiveness tend to use proxy measures of the effects that are immediately observable, for example forest area (Liu *et al.* 2013). The case study on the effectiveness of a bird nest protection programme in Cambodia below provides an example of an attempt to quantify direct additional effects on biodiversity but also illustrates the resource intensity of conducting such cost-effectiveness analyses. The case study on forest fire prevention in Indonesia also provides example of a specific cost-effectiveness analysis, but in this case the effect is in terms of forest fire prevention.

What are the implications for the sequencing and/or prioritisation of investments in moving towards achieving the Targets?
There is little evidence to answer this Research Question. Although some National Reports prioritize actions, high priority actions are often allocated to various goals that relate to Targets. From section 2.2 it can be concluded that improving public awareness (Target 1), political will and enforcement (Targets 2 and 4) as well as research capabilities (Target 19) deserve attention. As many neighbouring countries have similar priority areas, there is potential for trans-boundary collaboration (e.g. harmonization of legislation) in carrying out such investments to increase cost-effectiveness.

In South Asia, a preliminary analysis of organizations and institutions working in area of biodiversity conservation suggests that many of their objectives and initiatives that relate to specific Aichi Target(s) have been grouped under short-term, medium-term and long-term goals for planning. The limited evidence suggests that the Targets have been classified across short term goals (Target 1 & 17), long term goals (5, 8, 12, and 15) and the rest of the Targets as medium term goals. Again, this differs across organizations based on their priorities and focus, but in some ways also reflects the amount of allocation versus investment needed and the time lapse after which we may see visible results.

2.9 BENEFITS AND COSTS

What does the evidence as identified above tell us about the balance between the benefits and costs of meeting the Targets?
There is a relative abundance of evidence on the benefits and costs of investments in biodiversity/ecosystem conservation/restoration in the region as a whole. Much of the available evidence relates to the costs and benefits of protected areas (Target 11) or conservation of specific habitats or ecosystems. There are also a number of cost-benefit assessments for raising public awareness of the value of biodiversity (Target 1).

On balance, most of these analyses find that the benefits of conservation outweigh costs (see Berg *et al.* 1998; Ninan *et al.* 2007a; Ninan *et al.* 2007b; Grieg-Gran *et al.* 2008; Emerton *et al.* 2009, van Beukering *et al.* 2003; van Beukering *et al.* 2009; Liu *et al.* 2013). It is not, however, always the case that the net present value of conservation or restoration is found to be positive. Zhongmin *et al.* (2003) and Su and Zhang (2007) find that the costs of restoration and conservation clearly outweigh the benefits. In the former case, this is due to the low population density in the vicinity of the restored ecosystem, and therefore low number of ecosystem service beneficiaries. In the latter case, the principal reason is that the wetland ecosystem assessed is close to Shanghai and so the opportunity cost of wetland is very high. These findings highlight the importance of local context and specific determining factors to the outcome of cost-benefit analyses. It is not always the case that conservation or restoration of ecosystems can be justified on economic efficiency grounds. As stated above, however, it appears that the balance of evidence for the region does show that the benefits do outweigh the costs.

It is likely to be the case that ecosystems that are currently intensively used will yield high benefits from investments in management and restoration if this leads to gains in the provision of ecosystem services. There is supporting evidence for this message in Asia based on a number of studies reviewed. A large proportion of the population in the region are directly dependent on natural capital not only for their livelihoods but also for subsistence. Any effort to conserve or restore these resources is therefore likely to have long-term benefits for the population.

It is important to note that there is considerable variation in the completeness of the cost-benefit analyses reviewed. Most of the analyses are partial in terms of the full set of benefits that are quantified and included in the analysis or in terms of the aggregation over the potential population of beneficiaries.

An important finding of several studies relates to the distribution of costs and benefits. Cost-benefit analysis results are often found to be locally negative but regionally or globally positive, which reflects local incentives for development or conversion and the need for financing mechanisms through which to alter incentives and compensate local 'losers' from conservation. Furthermore, it has been shown that the distribution of the costs of conservation fall disproportionately on poorer communities. An assessment by CARE International of the costs and benefits of protected areas in four countries, including the Philippines and Thailand provide evidence of this (CARE International, 2008). The temporal distribution of costs and benefits are also an important factor in influencing land use and conservation decisions. Van Beukering *et al.* (2003) show that short term gains from deforestation are more than offset by long term losses over a 30-year time horizon.

At a sub-regional level, there is little evidence to answer this Research Question for West Asia. There is some evidence to suggest that the benefits of actions to deliver the Targets outweigh their costs. The evidence also illustrates that the actual benefit-cost ratio will depend on local conditions and the range of benefits that is considered.

How can this evidence be used to make the case for the investments required?

In Asia, many National Reports, NBSAPs and research studies have clearly demonstrated that investments in biodiversity conservation activities in most cases leads to net positive benefits for society. However, in absence of such investments, the ecological processes of natural systems become degraded, which leads to decreasing societal welfare. For example, the case study on coral reef degradation in Sri Lanka discusses the economic benefits from coral reefs and how their destruction will impact various stakeholders.

Given the evidence that is available for West Asia, the argument that can be made is that more research, monitoring and enforcement of environmental laws are necessary. There is furthermore not enough scientific knowledge about the rate of environmental loss or its economic implications. Implementing such actions could benefit a range of Targets, which increases their benefit-cost ratio.

Most of the evidence on the net-benefits of biodiversity conservation is positive. Using this evidence to make the case for the investments required remains challenging, however, due to several factors. One is that the distribution of the benefits of conservation across beneficiaries is such that they are generally difficult to capture for resource management. Instead private incentives to pursue alternative uses of natural resources tend to dominate. In addition to societal cost-benefit analyses there is a need to develop (financial) mechanisms to incentivise resource users/managers. Furthermore, the benefits of conservation often occur beyond the time horizons that are relevant to decision makers. Cost-benefit analyses with short time horizons may be more realistic and convincing.

2.10 CONCLUSIONS

Overall conclusions

There is a substantial quantity of evidence on the benefits of biodiversity conservation in Asia. This evidence largely pre-dates the Aichi Targets and does not relate directly to the achievement of the Targets or to any other specific policy agenda. This evidence is predominantly for South-Eastern, Eastern and Southern Asia. There is relatively little evidence for Western and Central Asia. Much of the evidence on the benefits of biodiversity conservation is for ecosystem specific local or sub-national studies, which limits the possibility of providing a coherent overview of the range of benefits across the region and across the Targets.

Generally the benefits of biodiversity conservation are shown to be substantial and higher than the costs of conservation in most cases. Cases that find negative net benefits for conservation are due to either low local demand or extremely high opportunity costs of conservation. A common finding from cost-benefit analyses of conservation in Asia is that net benefits are often locally negative (i.e. local resource users lose out, particularly in the short term) but nationally or globally positive (i.e. beneficiaries that use natural resources indirectly gain from conservation). This has important implications for the funding and design of policies to provide incentives to local resource users.

There is relatively little quantitative evidence on the investment needs, resource requirements, policy alignment and cost-effectiveness of the Aichi Targets. Most available assessments remain qualitative and do not provide a basis for estimating quantitative answers to these questions. It is generally recognised that countries in Asia need to invest in stronger enforcement and institutional frameworks as a basis for implementing environmental management. The number of Government personnel assigned to environmental protection needs to be increased and capacities improved through training. Generally there is also a need for stronger political will for environmental conservation and enhanced public awareness of the benefits the environment provides. For most Asian countries (with the possible exception of those in Eastern Asia), there is likely to be a substantial gap between available and required resources for achieving the Aichi Targets. This has not been quantified at national levels but there are case study examples of large funding gaps.

There is some evidence that conservation investments may yield increasing returns to scale. For example, the unit area costs of marine protected areas (MPA) are found to decline substantially with the size of the MPA. If this observation holds for other types of conservation investment, it may be the case that scaling up efforts to meet the Targets can be achieved at lower unit costs than is otherwise implied by the cost data from relatively small-scale individual case studies.

Commentary, including caveats and limitations of the approach

The evidence base for Asia comprises of mainly local, sub-national or national level case studies. This presents a substantial challenge when attempting to extrapolate results or drawn general conclusions at a sub-regional or regional scale. We observe that the robustness of methods and the quantitative detail of results are generally higher for local case studies. Robustness and detail tend to decline with the scale of the assessment. We have a large number of high quality local case studies and a small number of less precise regional studies on which to base our conclusions. Attempting to draw general conclusions at the regional level from local scale assessments is likely to be unreliable given that many case specific factors are important in determining the outcome of an assessment. It is not necessarily the case that investment needs, costs and benefits will be the same across locations with different ecological and socio-economic characteristics.

Evidence gaps and future research priorities

There is little available direct evidence from which to draw conclusions regarding Research Questions 5 and 6 on resource requirements and alignment of the Aichi Targets with other policy agendas. Potentially synergies between the Targets themselves and (inter) national policy agendas are expected, in particular where conservation actions produce bundles of environmental benefits, but there is little evidence to quantify these synergies. In this report we speculate that there are likely to be many relevant synergies and point to a few national level examples (e.g. between the Aichi Targets and poverty alleviation policies). There is a need, however, for a more thorough assessment of potential synergies between policy agendas in order to efficiently coordinate actions, deploy resources and avoid duplication of efforts. This process in itself requires resources and it is likely that many countries in Asia do not have the capacity to undertake such coordination. It is also frequently the case in Asia, as elsewhere, that there exists institutional fragmentation within national governments. Responsibilities for different policy agendas are held by different ministries and not necessarily well coordinated. This is one possible reason why the overview of related policy agendas remains a knowledge gap and would benefit from future research.

In order to provide an overview of the range of costs and benefits across the Targets at a regional scale, for example to identify which Targets would deliver the highest net benefits, a more integrated modelling approach would be required. Future research could potentially use the evidence collected for this study as an empirical basis to estimate cost and benefit functions for each Target. Such an approach would enable case specific information to be scaled up to larger geographic scales while accounting for (spatial) variations in the characteristics of biodiversity, ecosystems, services and beneficiaries.

From a geographic perspective, there are particular knowledge gaps regarding the available evidence for Central and Western Asia. Generally speaking, Central and Western Asian countries know little about the state of their environments or what conservation measures should be introduced. There are very few studies on the benefits and/or costs of environmental conservation actions. Given the thin evidence base, it is very difficult to draw conclusions at the national level, let alone extrapolate to the regional level. Furthermore, much of the available information is qualitative and descriptive. Although inferences are possible, providing quantified conclusions is not. Analyses that employ an economic perspective are a new policy support tool here. To do more research that addresses these knowledge gaps is a clear priority for research in these sub-regions.

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3. AUSTRALASIA AND THE PACIFIC

Luke Brander, Nicolas Pascal, Neville Crossman, Thang Dang

3.1 EXECUTIVE SUMMARY

- There is a substantial quantity of evidence on the benefits of biodiversity conservation and sustainable use in Australasia and the Pacific. Most of these studies value a range of ecosystem services that have some link to biodiversity. Particular attention has been paid to the benefits of ecosystem services derived for coastal and marine resources.
- There are relatively few case studies that conduct cost-benefit analyses of conservation measures. Those that we reviewed all find that the benefits of biodiversity conservation outweigh the costs.
- The evidence base for Australasia and the Pacific comprises of mainly sub-national or national level case studies. We observe that the robustness of methods and the quantitative detail of results are generally higher for smaller scale assessments. This presents a challenge when attempting to extrapolate results or draw general conclusions at a sub-regional or regional scale.
- There is a marked distinction between the Pacific Island Countries (PICs) and Australia/New Zealand regarding the availability of detailed information on investment needs for biodiversity conservation. In Australia, required investments to meet biodiversity targets (that are partially comparable to the Aichi Targets) are described in detail for each of 56 Natural Resource Management regions. The investment strategies for each region are detailed documents on the resources and investment need to meet targets, including the costs of capital infrastructure and operation and maintenance costs to maintain that infrastructure, as well as labour requirements and other variable costs. For PICs the documentation on investment needs and resource requirements often lack detailed descriptions. Very few financial estimates have been made at a national scale.
- Evidence on the resource requirements of meeting specific biodiversity targets at the regional level is limited. A notable exception is an estimate of the costs of eradication of invasive alien vertebrates (Aichi Target 9) on small islands for a selection of countries in the region (Australia, New Zealand, French Polynesia, Northern Mariana Islands, Fiji). The total estimated cost of this measure is just over US$ 350 million.
- There are likely to be many relevant synergies between the Aichi Targets and other policy agendas (Research Question 6). There is a need, however, for a more thorough assessment of potential synergies in order to efficiently coordinate actions, deploy resources and avoid duplication of efforts. This process in itself requires resources and it is likely that many countries in the Pacific do not have the capacity to undertake such coordination.

3.2 INTRODUCTION

This report provides an overview of the research methods used, sources of evidence, coverage and gaps, and a selection of high quality case study evidence for the Australasia and Pacific region. The report provides a detailed overview of the evidence collected and uses this as a basis to answer each research question defined in the terms of reference.

The Australasia and Pacific region comprises 25 countries and territories.[9] The region is extremely diverse in terms of biodiversity, socio-economics, and underlying pressures and causes of biodiversity loss. For the purposes of managing the collection and screening of evidence, the region is divided into four sub-regions following those of the UN Statistics Division. These sub-regions and constituent countries and territories are:

- Australia and New Zealand: Australia, New Zealand, Norfolk Island
- Melanesia: Fiji, New Caledonia, Papua New Guinea, Solomon Islands, Vanuatu
- Micronesia: Guam, Kiribati, Marshall Islands, Micronesia (Federated States of), Nauru, Northern, Mariana Islands, Palau
- Polynesia: American Samoa, Cook Islands, French Polynesia, Niue, Pitcairn, Samoa, Tokelau, Tonga, Tuvalu, Wallis and Futuna Islands

3.3. METHODOLOGY

Research methods and sources of evidence consulted

The collection of evidence has been pursued through three channels: an open call for evidence, personal contact with regional experts by email, and searching online databases and other sites.

An open call for evidence has been circulated through regional and professional networks to request information relevant to the research questions. The response rate to the call has been very low.

Individual experts in the region (mainly personal contacts) have been contacted by email to request information directly and to further distribute the call for evidence. This has been a highly productive means of collecting information and reports that are not available online or are currently under development. This process of collection is on-going.

Extensive searches have been conducted of online databases of academic papers, research reports and other websites to identify and collect relevant evidence. The website of the Convention on Biological Diversity was accessed to obtain National Biodiversity Strategy and Action Plans.

For the purposes of managing and collating the collected evidence an Excel database has been developed in which to record summary information on each study/report/initiative. The database contains separate worksheets for references, summary of evidence, and sources of information. The main summary worksheet contain fields for information on: location; scale of study/assessment; Aichi Target(s) addressed; research question(s) addressed (benefits, investment needs, resource requirements, policy alignment, cost-effectiveness, benefits and costs); method(s) used; robustness; total or additional assessment (whether the assessment measures total benefits and/or costs of conservation or the additional benefits and/or costs of a specific additional conservation effort). This database is used to enable an initial organisation of information and screening before developing more detailed analysis. This screening is necessary given the large quantity of available evidence.

Overview of availability and robustness of evidence, methodological issues, evidence gaps, variations in extent and quality of evidence between questions

The database of collected evidence currently consists of 142 existing published papers and reports related to biodiversity conservation strategies. Specifically, the sources of information include:

- Academic papers in published journals
- National biodiversity strategy and action plans
- Studies from international research organizations or programs such as CBD (Convention on Biological Diversity), The Economics of Ecosystems and Biodiversity (TEEB) country studies, etc.
- Assessments of the biodiversity conservation strategies by NGOs

9 Following the geographical groupings of the UN Statistics Division http://unstats.un.org/unsd/methods/m49/m49regin.htm

- Country submissions to CBD on resource requirements
- Unpublished data and assessments by a range of the above stakeholders and initiatives

The database is organised using the four sub-regions of Australasia and Pacific. The current collection of evidence consists of:

- 71 for Australasia and New Zealand (50%)
- 30 for Melanesia (21%)
- 16 for Micronesia (11%)
- 16 for Polynesia (11%)
- 9 for Cross Sub-region (6%)

It is evident that the sub-regions of Australasia and Pacific are not equally represented. The majority of evidence is for Australia and New Zealand. This is due to both the relative wealth of information for Australia and New Zealand and the ease of accessing it online. We have found that evidence for Melanesia, Micronesia and Polynesia does exist but is generally accessible through email contacts rather than through online resources. An effort was made to collect more evidence from these sub-regions to balance the database in terms of the proportion of evidence among sub-regions.

In terms of the distribution of studies by country, as shown in Figure 1, we found the highest number of studies for Australia (47) and New Zealand (23). The number of available studies for individual Pacific island states or territories is relatively low, although there are a number of cross-country studies for this sub-region (14).

In terms of the scale of assessment of each item of evidence, the database records four categories of scale: local, sub-national, national to supra-national. The current collection of evidence consists mainly of the national scale assessment (59%).

We find that many of the collected studies address multiple Strategic Goals. The Goals are all covered well but there is relatively little information available for Strategic Goal D ("enhance the benefits to all from biodiversity and ecosystem services"). The numbers of studies that address each Aichi Target are presented in Figure 2. Again we observe that many studies address multiple Targets. There are a large number of studies that address Target 11. This reflects the strong interest in this region in establishing marine protected areas. The numbers of studies that address each Research Question are presented in Figure 3. A high proportion of the studies that we collected and reviewed address the question of benefits from biodiversity and ecosystem conservation and investment needs, albeit few that specifically make an assessment regarding the Aichi Targets per se. In contrast, we find very few studies that address the question of resource requirements or make a comparison between the costs and benefits of conservation.

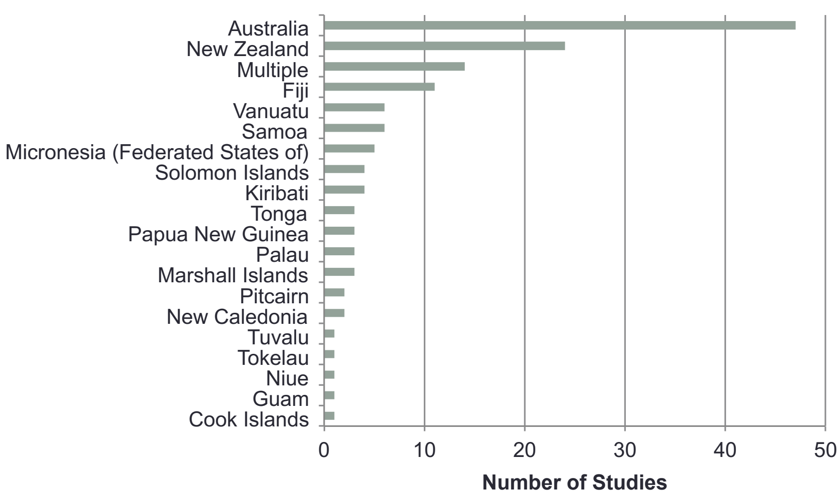

Figure 1: Number of studies by country

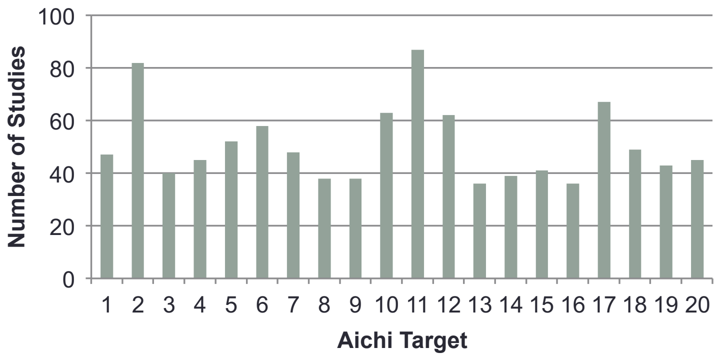

Figure 2: Number of studies that address each Aichi Target

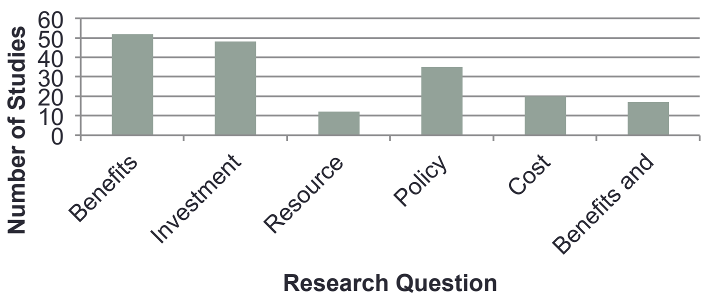

Figure 3: Number of studies that address each Research Question

3.4 BENEFITS OF DELIVERING THE AICHI TARGETS

The evidences of economic, social and environmental benefits from meeting the Aichi Targets are mainly described through several assessments of ecosystem services valuation. Ecosystem service valuation has been used in two distinct contexts: for supporting decision making and for raising awareness. These two contexts are described briefly below.

Ecosystem service valuation may be used in ex-ante choices over a given set of options by weighing the social and economic consequences of those options. Cost-benefit analysis (CBA) is the most common tools used in this category. The results of CBAs of biodiversity conservation in the region are addressed in section 3.9. Evidence of the benefits of conservation are presented here.

The reviewed case studies have addressed partially the benefits of Targets 3, 5, 6, 7 and 10 in some countries. For example, the livelihood choice between wild or cultured live coral and live rock trade for the aquarium trade has been assessed in Fiji (Lal and Kinch, 2005). In this study the financial net returns from wild coral, cultured coral, wild live rock and cultured live rock were compared to highlight the benefits of biodiversity conservation. In the same way a socio-economic assessment of fishing practices by fishers in Kiribati was conducted to review and assist the fisheries department to identify fishing methods that are considered to be destructive.

A study into the benefits of reducing the amount of water extracted for irrigation to leave more for river, wetland and floodplain ecosystems demonstrated that the costs borne by government to purchase water from irrigators are matched or potentially outweighed by the ecosystem service and economic benefits of healthier ecosystems. Also in Australia, the benefits of improved indigenous land and fire management in the vast northern sub-tropical savannah ecosystems (Heckbert *et al.* 2012) reduces fire risk and creates economic and ecosystem service benefits (Aichi Targets 12 and 15). These systems, traditionally adapted to low intensity fires, now experience more intense fires and substantial declines of local biodiversity. A carbon market creates a financial incentive to manage land to reduce fire intensity because doing so decreases emissions. Although arguably of most importance, the economic opportunities created by a carbon market and emissions reduction from better land management uses traditional knowledge to provide very important and needed income to Australia's economically marginalised indigenous communities (Aichi Target 18).

Regarding economic valuations that are conducted with the primary purpose of raising awareness and advocacy, this information indicates that marine ecosystems represent a resource of primary importance for the economies of many Australasian and South Pacific countries. Insular economies are particularly fragile, due to their relatively high dependence on natural resources, the risk of natural calamity, demographic pressure, poverty rates and low human capital capacity. Monographs and meta-analyses have been produced on the topic (Cesar, 2000; Ahmed *et al.* 2004; Brander *et al.* 2007). The number of economic valuation studies on coral reefs has increased rapidly to exceed one hundred by the mid-2000s (Brander *et al.* 2007). These numerous studies have, however, mainly concentrated on the United States (Hawaii and Florida), Southeast Asia (Philippines, Indonesia, Thailand, etc.) and the Caribbean (Jamaica, Saint Lucia, Trinidad and Tobago, Martinique, etc.). Few valuations were carried out in South Pacific, with the notable exception of studies on the value of Australia's Great Barrier Reef to the regional and national economy. For example, a study by Oxford Economics (2009) estimates the TEV of the Great Barrier Reef at AU$51.4 billion (US$ 45.6 billion), over a 100 year period and 2.65% discount rate. The principal values were from tourism (AU$20.2 billion; US$ 17.9 billion), non-use values (AU$15.2 billion; US$ 13.5 billion), and coastal protection values (AU$10 billion; US$ 8.9 billion). In an updated study, Rolfe *et al.* (2010) estimated the TEV of a 10% increase in protection of the Great Barrier Reef to be AU$6.3 billion (US$ 5.6 billion) over 25 years at 5% discount rate.

Since the mid-2000s a modest but growing number of ecosystem service valuations have been conducted in the South Pacific. ESVs have been carried out as a means to foster conservation and support decision-making concerning the sustainable management of coral reefs. They provide a strong message in support of the conservation and management of such ecosystems. They stem from the recognition of the dependence of human beings on the provision of coral reef services and the contribution of coral reefs to coastal and national economies. Studies with this perspective aim to provide an overall value of the coral reefs and generally frame valuations in terms of Total Economic Value, which allows the identification of economic agents and sectors that are associated with the components of the TEV. High TEVs are then used to make the case for considering coral reef conservation in the national decision-making process. Ecosystem service valuations are therefore intended to demonstrate the economic importance of coral reefs to stakeholders, especially when their behaviour is likely to influence the reef's condition.

Traditionally, TEV estimates expressed as absolute values are intended to serve an awareness raising or advocacy role. For coral reef ecosystems, TEVs have usually covered more than 15 services. TEV has been recognized as a useful way to compare and synthesize very different services (e.g. subsistence fishery can be compared with coastal protection). Where market exchanges have generated a value approximating zero, absolute TEV estimates can be useful to get the attention of decision-makers about the great value of ecosystem services not being actively managed. Decision-makers easily grasp that you can't manage what you don't measure. Managing form a portfolio of ecosystem services, those that are well reflected in markets as well as those that are not, is the take home message from absolute TEV estimates. Absolute TEV also provides guidance about the main stakeholders who benefit from the ecosystem processes. This is valuable information for decision makers to identify the socio-economic group potentially impacted by some policy.

In that perspective, South Pacific ecosystem service valuations have been used by a varied list of stakeholders:

a. Development banks, for which ecosystem service valuations intend to highlight "how conservation has helped the local or regional economy and the people who depend on the managed ecosystems" (e.g. the AFD cost-benefit analysis of community based marine managed areas in Vanuatu).

b. Environmental agencies and conservation NGOs that need to justify "why do we need conservation here?" when arguments regarding the pristine nature and uniqueness of ecosystems are considered insufficient (e.g. the valuation of mangroves to raise awareness of the role of these ecosystems in human well-being in Lal, 2003; or valuation of the costs of wild versus cultured live corals to inform public policy in Lal and Kinch, 2005).
c. Government planners to whom it is then suggested to incorporate "green" welfare accounting in their monitoring and planning activities, so as to change the compass, as is suggested by TEEB (2011), and just promoted, during Rio+20, in UNEP's "Inclusive Wealth Index" (UNU-IHDP and UNEP, 2012). An example of this application is the use of the World Bank natural capital accounting approach in New Caledonia (Brelaud *et al.* 2009).
d. Environmental government agencies that intend to assess and communicate the ecosystem services that their actions protect or improve. For instance, the results of the TEV in New Caledonia were used by the local environmental department to influence budget allocation.
e. Last, local stakeholders such as customary chiefs or MPA managers could use the results to highlight benefits for the local users and members of the community. For example, the Fiji and Vanuatu MMA valuation helped put forward benefits and equity distribution that, perhaps, were not perceived by the inhabitants. They were used also as a tool in the community for making trade-offs between the short and medium term.

Other studies value the preferences of users for ecosystems in a good ecological state, which is often carried out through stated preference valuation methods.[10] To our knowledge, only one study has addressed the non-use values of coral reefs in the Pacific SIDS for local populations (O'Garra, 2009). All other assessments of non-use values, through contingent valuation or choice experiment, have been estimated for high-income groups from Australia (see e.g. of Great Barrier Reef in Rolfe and Windle, 2010). O'Garra's results highlight that local communities were willing to contribute 3 hours of their time per week towards conservation, mainly for future generations (bequest value). In this study several challenging issues were raised such as time allocation conflict between communal and personal obligations, gender influence in decision-making and common property resource management by villagers.

3.5 INVESTMENT NEEDS

In Australia, investments to meet biodiversity targets are described in detail in the investment strategies written for each of the 56 Natural Resource Management regions responsible for managing biodiversity in Australia. Based on watershed boundaries, the 56 Natural Resource Management regions in Australia have developed integrated catchment management plans and investment and implementation strategies for the sustainable management of water, land and biodiversity. The investment strategies are often times long and detailed documents that provide at length the resources and investment need to meet targets, such as costs of capital infrastructure and operation and maintenance costs to maintain that infrastructure, as well as labour requirements and other variable costs. Each of the 56 investment strategies and catchment plans have specific targets that could be allocated to the 20 higher-level Aichi Targets. The Australian National Biodiversity Strategy provides 26 broad actions for meeting Australia's 10 biodiversity targets; but it's so broad as to be of little use in an investment needs analysis. New Zealand's National Biodiversity Strategy also provides high level targets and actions for protecting and improving biodiversity, but they are all qualitative and therefore it is impossible to estimate to investments required. However it is possible to map Aichi Targets to the investment priorities of the latest

10 See TEEB (2010), Chapter 5 "The economics of valuing ecosystem services and biodiversity" for a discussion of methods used for estimating monetary values for ecosystem services.

Table 1: Mapping of Aichi Targets to investment priorities in the Australian National Biodiversity Strategy (2011).

Priority	Sub-priority	Related Aichi Targets
Engaging all Australians in biodiversity conservation		
	Mainstreaming biodiversity	1
	Increasing indigenous engagement	14, 18
	Enhancing strategic investments and partnerships	4, 20
Building ecosystem resilience in a changing climate		
	Protecting diversity	5, 6, 11, 14
	Maintaining and re-establishing ecosystem functions	11, 12, 13, 15
	Reducing threats to biodiversity	7, 8, 9, 10
Getting measurable results		
	Improving and sharing knowledge	19
	Delivering conservation initiatives efficiently	3, 20
	Implementing robust national monitoring, reporting and evaluation	2

Table 2: Mapping of Aichi Targets to priority actions in the New Zealand National Biodiversity Strategy (2000).

Priority action	Related Aichi Targets
Better governance	3, 17, 20
Enhance community participation and learning	1, 14
Becoming smarter biodiversity managers	2, 4, 19, 20
Strengthen partnerships with Maori	18
Sustain indigenous biodiversity in privately managed areas and in freshwater environments	7, 8, 14, 15
Enhance protected areas and prospects for threatened species	5, 11, 12
Manage the marine environment to sustain biodiversity	6, 8, 10
Identify and manage biosecurity risks to indigenous biodiversity	9
Maintain the genetic resources of our important introduced species	13, 16

Australian National Biodiversity Strategy (Table 1) and the priority actions of the latest New Zealand National Biodiversity Strategy (Table 2).

For the PICS, the description of the investments and activities needed to deliver the Aichi Targets has been based on the individual analysis of the National Biodiversity Strategy and Action Plan of Fiji (1998), Kiribati (2007), The Federated States of Micronesia (2002), Niue (2001), Papua New Guinea (2007), Palau (2005), Samoa (1998), Solomon Is. (2009), Tonga (2006) and Vanuatu (1999). We can consider this selection of NBSAPs as representative of the PICS with a sample of countries from Melanesia, Polynesia and Micronesia. It should be noted that these NBSAPS predate the Aichi Targets and have not yet been updated to take these into account and adapt to national policies and priorities.

For this assessment, we adapted the NBSAP objectives to the Aichi Targets as far as possible. Apart from the Aichi Target nº15, not found in any NBSAP, all actions have been assigned to a group of Aichi Target. The most common areas covered in the NBSAPs are:

- **Thematic area:**
  - Agricultural Biodiversity
  - Island Biodiversity
  - Marine & Coastal Biodiversity
- **Cross-cutting issues:**
  - Invasive Alien species
  - Protected Areas
  - Public Education and Awareness
  - Sustainable Use of Biodiversity
  - Traditional Knowledge, innovations and practices
  - Benefit Sharing & Access to Genetic Resources
  - Human Resources and Capacity Building;
  - Research, Monitoring and Information Sharing;
  - Climate Change;
  - Waste Management;
  - Alternative Energy Use

Most of the NBSAP actions were included in the following thematic areas: Mainstreaming of Biodiversity; Species Conservation, Protected Area System; Management of Invasive Species; Financial resources.

Most of the identified actions are contained in the list of actions selected from the NBSAPs with minor adaptations to the local context. Nonetheless, specific actions due to the context of island, development countries and strong presence of community-based management (CBM) are introduced.

The main additional actions with community-based management reflect the fact that national budgets are usually small and face considerable demands to meet human development priorities such as health, education and food production. There is a strong reliance on public policies for local communities. The main specific activities related to CBM not described in the HLP report are:

i. capacity building training on the principals and benefits of environmental management,
ii. awareness, educational and training programme for landowning and Traditional Fishing Rights Owners (TFRO) communities
iii. Promote the sustainable management of indigenous forest including mangroves,
iv. Document 'taboo' and other traditional conservation and protection measures of marine resources,
v. Put in place legislation to protect recognised traditional fishing grounds,
vi. Integrate all management plans and protected area programs with community/resource owner participation activities including enforcement.

In the context of low-income countries, some of the PICS have required the implementation of basic infrastructure for waste management ("Develop and implement waste collection, storage and disposal programs for residential and commercial premises in the main urban centers") and the integration of nature conservation and development ("Encourage the replanting of trees for fuel wood and for raw material for cultural, social and economic purposes" and "Identify and implement appropriate programs to promote and support sustainable income generating activities at the community level and provide financial incentives and capacity building to assist in the development of these programs").

Other specificity of the region, for target 20, the development of a Conservation Trust Fund (CTF) is generally identified as a priority to be implemented. Nonetheless, in general for most of the NBSAPs analysed, we found few actions related to the development of payments for ecosystem services to generate revenue that could be used to assist agricultural and forestry best management practices. In the same way, no assessment of costs of new MPAs (Target 11) is identified.

Additionally, wetland banking, restoration of wetlands through the removal of dams, coastal dikes or new constructed wetlands, forest landscape restoration (including restoring functionality and productive capacity) and restoration of coral reefs are not listed as actions in most of the NBSAPs.

In addition to general assessments of investment needs for conservation and sustainable use of biodiversity in PICs, some specific assessments have been undertaken addressing individual Targets at the national level in detail. An example of a gap analysis for the Federated States of Micronesia (FSM) on the implementation of the Nagoya Protocol on access to genetic resources and the fair and equitable sharing of benefits arising from their utilisation (Target 16) highlights the need for mainly administrative and legal reforms to comply with the Protocol. The conclusions of this gap analysis note that the different states of FSM are at different stages of readiness to develop the necessary institutions and laws. It highlights the variations in investment needs within individual countries. Variations in investment needs are likely to be even greater between countries.

3.6 RESOURCE REQUIREMENTS

The estimates of resource requirements linked to the previous investments and activities are poorly described for the Pacific. To our knowledge, very few financial estimates have been made at a national scale (e.g. National Capacity Self Assessment Program – NCSAP). The majority of the evidences found are directed (i) to the management of coastal marine resources (Aichi Target 6, 10, 11 and 14), (ii) the eradication of alien species (Aichi Target 9) and (iii) the setup of conservation trust funds.

Similarly, to our knowledge, no estimates have been made in Australia or New Zealand on the resources (and investment needs for that matter) of achieving the Aichi Targets. However, despite the absence of National-scale estimates of resources (i.e. costs) and investment needs, there exist analyses at regional-scale of the costs of meeting biodiversity and conservation targets (Crossman and Bryan, 2010; Bryan *et al.* 2011). Although these analyses are not related to the Aichi Targets per se, the targets used in the analysis are comparable.

Adapting the results of the HLP to the Pacific we have summarized the required scales of investment, represented in Figures 7 and 8 (see Appendix 2). Results are based on qualitative expert assessments derived from the knowledge and experiences of the author in the region. One important point to take into account is that most of the PICs have modest public budgets (Figure 6) and an investment categorized as "low investment" in the HLP may become moderate to significant in the region. With this in mind, we derive the following results:

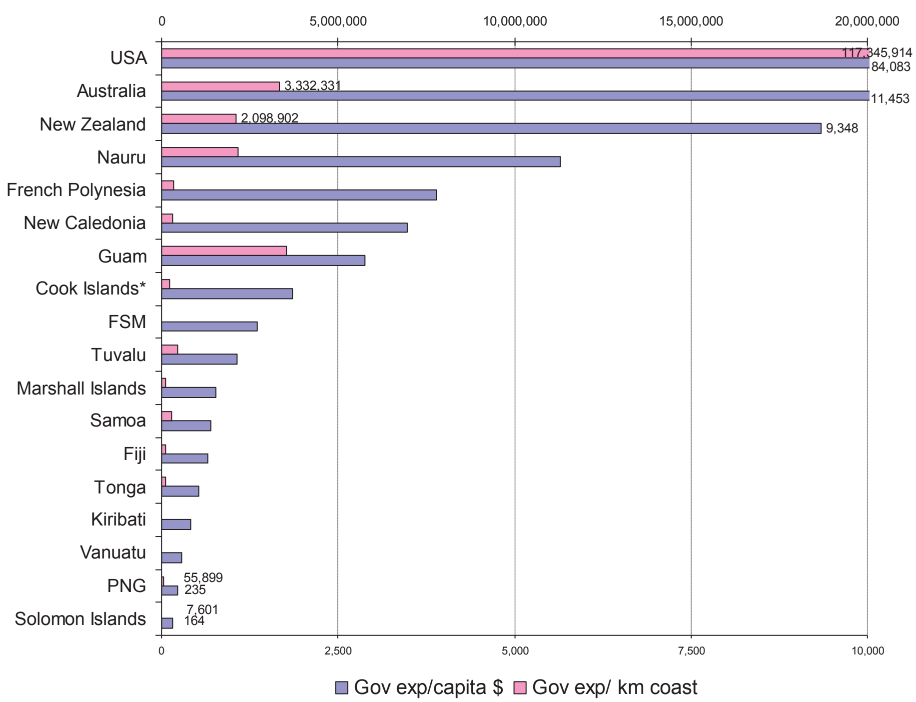

Figure 6: PICs public budgets (2008). Source: SPC statistics

The distribution of resource requirements for PICS reflects the remarks described below. The priorities for food security (fishery and agriculture management), the importance of coral reefs, and the control of invasive species are the main specificities of the Pacific islands. The management of water and pollution control is found to be the main priority for both world and PIC region but with different weight (from almost half of financing needs for the world to one third for PICs).

Significant investment required:
One priority for PICs is the food security management. The sustainability of fisheries (Target 6) in the Pacific requires significant investment as we are dealing with small-scale fisheries present in every village and large-scale fisheries such as pelagic fisheries covering millions of km^2 of EEZ.

The waste water management as well as pollution control will require significant investment in infrastructures, mostly non-existent today in the PICs.

Moderate investment required:
In agreement with the HLP report, the targets addressing biodiversity loss and ecosystem restoration (forest and mangroves mainly) will require important global investment. Nonetheless the extent of restoration is generally limited (small size impact, reduced development of industrial sector) and the needs may therefore be moderated for most of the PICs.

Targets under Strategic Goal C and specifically target 11 associated with establishing and maintaining protected areas will require moderate investment. The existence of co-management (through public and community partnerships) for many protected areas is a factor that lowers the costs of initial investments and recurrent expenditures (Pascal, 2012). The average cost of MPA co-managed with local communities in the Pacific is equivalent to US$ 2,000 per km^2 per year of managed area. When compared with other regional figures, these estimates are around 25% lower than the meta-analytical average cost estimates of Balmford *et al.* (2004) at US$ 2,698 per km^2 per year.

For many villages in the Pacific region, there will be also some substantial cost scaling through the establishment of networks of MPAs (e.g. FLMMA: Fiji Locally Marine Managed Areas network).

Low investment required:
In agreement with the HLP report, targets related to enhance national policies and regulations, provide capacity building and awareness of economic importance of Aichi Target are likely to be much less resource-intensive. These Targets mostly relate to Strategic Goals A and E, as well as Target 16.

The following table present the potential funding for activities contributing to Aichi Biodiversity Targets in Oceania. It is adapted from the HLP report on global assessment of resources for implementing the strategic plan for biodiversity 2011-2020 and includes most of the funding specificities of the PICs context.

3.7 POLICY ALIGNMENT AND DEVELOPMENT

Relevant global initiatives and partner conventions

There are a range of global initiatives that feed into and inform Aichi Target development and implementation processes. Under the auspices of the Rio Conventions and other MEAs, most of the PICs have signed on to most relevant global MEAs that address biodiversity issues. These include the Biodiversity Convention and its Biosafety protocol, UNCLOS, World Heritage Convention, Convention on International Trade in Endangered Species of Wild Fauna (CITES), Convention on Wetlands of International Importance especially as waterfowl habitats (the Ramsar Convention) and regional and global programmes. A number of enabling activities have been implemented and have already been concluded. The following parts have been adapted from the NBSAP of Solomon Islands, the NBSAP of Papua New guinea and a review of 14 NBSAP produced by the SPREP (Carter, 2007).

New programmes are also being implemented by national authorities, NGOs, bilateral partners and other stakeholders. For example, emerging from the CBD are a range of 'Programmes of Work' (PoWs) – one of which has particular relevance to the Pacific Region: The Island Biodiversity Programme of Work (IBPoW). This PoW outlines "a set of priority and supporting actions to implement the objectives of the Convention on Biological Diversity (CBD) in islands". It recognizes that "all islands, and Small Island Developing States (SIDS) in particular, rely on biodiversity for sustainable development, have close links between culture and environment, have special concerns and particular vulnerabilities, have limited land area, have high levels of endemism and extensive coastal and marine biodiversity". Emerging out of this, the Global Island Partnership (GLISPA) was launched in March 2006 to actively support implementation of the new IBPoW under the CBD.

Additionally there are a number of other global initiatives that emerged out of, and since, the Rio Summit that are of great relevance to Pacific islands and have connectivity to the issue of conservation and the sustainable use of biodiversity. Hence these initiatives inevitably have cross-over linkages with the Aichi and NBSAP development and implementation processes in the region. They include the: United Nations Framework Convention on Climate Change (UNFCCC); United Nations Convention to Combat Desertification (UNCCD); United Nations Convention on Law of the Sea (UNCLOS); Millenium Development Goals (MDGs); Stockholm Convention and Agenda 21.

United Nation's Poverty-Environment Initiative (PEI), which is a joint effort of the UN Development Programme (UNDP) and UN Environment Programme (UNEP), specifically promotes the adoption of policies and measures to reduce poverty and encourage the sustainable use of natural resources and a healthy environment. Currently no Pacific countries are covered by the PEI.

In the Pacific there are a number of regional initiatives and strategies that also have linkages to the conservation and sustainable use of biological diversity, and hence both inform – and are informed by – the national strategies and action plans being developed by Pacific member nations. These include:

- The Pacific Plan – In 2004 there was consensus to strengthen regional cooperation and integration amongst Pacific islands countries. This became manifest through the Auckland Declaration of April 2004 where Pacific Forum leaders agreed to the development of a 'Pacific Plan' with the goal to "Enhance and stimulate economic growth, sustainable development, good governance and security for Pacific countries through regionalism." Whilst management of the natural environment or biodiversity conservation are not central themes of the Pacific Plan, there is overt reference to 'Improved Natural Resource Management and Environmental Management' in the plans Strategic Objective no. 5, with initiatives being promoted for the first three years in: sustainable development, fisheries, forestry, coastal waters, waste management, energy, freshwater management, biodiversity and climate change.
- The 'Action strategy for Nature Conservation in the Pacific Islands Region' was developed by the Roundtable for Nature Conservation as a result of the 7th Conference on Nature Conservation & Protected Areas, held in 2002. Its mission is to 'protect and conserve the rich natural and cultural heritage of the Pacific islands forever for the benefit of the people of the Pacific and the world.' It builds upon the three pillars of sustainable development (environment, society and economy) and aims to provide guidance to a wide range of actors in the Pacific community, including governments, in the development of their plans and programmes for nature conservation. This strategy is currently in the process of review at this time, and a revised strategy for 2008-2012 is being discussed at the Alotau Conference in October 2007. This revised strategy has taken considerable guidance from the objectives and aims of the NBSAPs so far developed in the region, and the new objectives in the Action strategy have arisen from the key common themes prevalent in NBSAPs and the IBPoW.13

Additionally there are a range of further regional initiatives relevant to the conservation and sustainable use of biodiversity that are too numerous to discuss in detail here; such as the:

- Pacific Invasive Initiative (PII)
- Pacific Invasive Learning Network (PILN)
- Coral Reefs Initiative for the Pacific (CRISP)
- Locally Managed Marine Areas initiative (LMMA)
- Pacific Biodiversity Information Forum (PBIF)
- Sub-regional Micronesia Challenge

Regional support for both regional and national level programmes in the conservation and sustainable use of biodiversity is also provided by a number of inter- governmental organizations active in a range environmental and humanitarian issues as well as NGOs (from smaller scale local NGO initiatives to large scale BINGOs). These too have regional initiatives underway, including: IUCN Oceania regional programme, WWF South Pacific Programme, BirdLife International Pacific Programme, Conservation International Pacific Islands Program and Melanesia Program, UNESCO Man in the Biosphere Programme, Pacific operations.

The Pacific Plan recognises that development of PICTs is linked to the effective management of fish, and the habitats that support them. 'Development and implementation of national and regional conservation and management measures for the sustainable use of fisheries resources' is a priority of the Plan, and the recent 'Vava'u Declaration' reinforces the need for responsible and effective stewardship of the region's fisheries.

The evidence reviewed for this report includes studies that illustrate the linkages between biodiversity conservation initiatives and poverty reduction (Aichi Targets 2 and 18). Leisher *et al.* (2007) describe two case studies of marine protected areas in Fiji and the Soloman Islands and their respective impacts on social development indicators. It is observed that the MPAs contributed to increased fish harvests, better local governance, improved health, and benefits for women.

In addition to alignment with development agendas, there is also an important alignment with elements of the climate change agenda (UNFCCC 2010). Programmes and measures that have been developed to address climate change mitigation and adaptation may also be of relevance to the achievement of some of the Aichi Targets. This may particularly be the case for climate change mitigation policies designed to control land use change and degradation. Such policies align closely with those required for reducing rates of habitat loss (Target 5) and expanding protected areas (Target 11) among others. It is also likely to be the case that policies to promote ecosystem based climate change adaptation (e.g. restoration of mangroves for storm protection) will align with those to reduce habitat loss.

3.8 COST EFFECTIVENESS

There is little available evidence for the region on the cost-effectiveness of different conservation investments.

3.9 BENEFITS AND COSTS

Most of the institutions in charge of management or conservation of ecosystems in PICs are increasingly asked to demonstrate the effectiveness of their initiatives. To this end, policy makers often rely on cost-benefit analysis (CBA) of a project or policy. Although in practice not all of the benefits and costs are quantifiable, CBA provides a useful tool to assist in policy making. Clear identification of beneficiaries and losers of management measures contribute to the success of its implementation and support of stakeholders involved. Most studies reviewed for the Pacific Island Countries (PICs) have focused on the analysis of a similar selection of ecosystem services, namely the production of biomass for fishing, the presence of attributes for underwater tourism and energy absorption of wave for coastal protection. The case studies reviewed for Australia and New Zealand include a different set of ecosystem services (see for example the Murray-Darling case study). The main targets addressed have been 2, 7, 8, 10 and 11 (CBA of policy inaction on loss of ecosystem services; comparison of sustainable agriculture and fisheries (and aquarium trading) with business-as-usual; CBA of MPAs and PAs in terms of economic benefits to local stakeholders).

Most of the reviewed studies conduct ex-ante CBA, where the analysis is conducted for projects or policies under consideration, to assist the decision making. Some of the studies, however, have conducted ex- post CBA (e.g., Cesar *et al.* 2002; Pascal, 2011), where the analysis is conducted at the end of the project and assesses its usefulness. Although none of the studies value all the services provided by coral reefs and mangroves, they all find positive net benefits to protect or improve the ecosystems.

CBAs can be carried out from a variety of perspectives including: local people and communities, a single local business, a business sector, government at various scales or individual government agencies, and/or donor agencies and other investors. In general, the level of analysis should match the economic and ecological scales to the scale of the public good. Of interest here is whether it is more appropriate to study (therefore manage) a series or region of MMAs than an individual one. Typically (but clearly not always), MMAs in the region are small and are probably ecologically and economically dependent upon neighbouring reefs for fish productivity for consumption and for tourism. However, MMAs are not typically managed in groups, but by individual villages with unique customary rights regimes, creating additional analytical challenges to the researcher.

'Who' counts often has strong implications for 'what' counts and affects the dimensions of the analysis including: time scale, discount rate, distribution of benefits and costs across stakeholder groups, geographic scale, what factors/effects are considered endogenous and exogenous, what measures or indicators are appropriate (e.g., B/C ratio, IRR, ROI, NB) and which policy levers are available. In many PICS, it is also often not just a case of choosing between different activities based on maximizing economic welfare, but one of equitable distribution of income, an issue which economic welfare-based CBA ignores.

3.10 CONCLUSIONS

Overall conclusions

There is a substantial quantity of evidence on the benefits of biodiversity conservation in Australasia and the Pacific. Most of these studies value a range of ecosystem services with some link to biodiversity. Particular attention has been paid to the benefits of ecosystem services derived for coastal and marine resources. Generally the benefits of biodiversity and ecosystem conservation are shown to be economically significant. There are relatively few case studies, however, that conduct cost-benefit analyses of conservation measures to compute net welfare effects for society. Those that we reviewed all show positive cost benefit ratios.

There is an understandably marked distinction in the level of detailed information available regarding investment needs for biodiversity conservation between the PICS and Australia/New Zealand. In Australia, investments to meet biodiversity targets are described in detail in the investment strategies written for each of the 56 Natural Resource Management regions responsible for managing biodiversity in Australia. The investment strategies are long and detailed documents on the resources and investment need to meet targets, such as costs of capital infrastructure and operation and maintenance costs to maintain that infrastructure, as well as labour requirements and other variable costs. For PICS on the other hand, the main source of documentation on investment needs is the NBSAPS, which identify many investment requirements but often lack detailed descriptions.

The estimates of resource requirements linked to investments and activities are generally poorly described for the Pacific. Very few financial estimates have been made at a national scale. The majority of the evidences found are directed to the management of coastal marine resources and the eradication of alien species. Similarly, no estimates have been made in Australia or New Zealand on the required resources for achieving the Aichi Targets. However, despite the absence of national scale estimates of resource requirements, there are analyses at regional scale of the costs of meeting biodiversity and conservation targets, which are comparable to some of the Aichi Targets.

There is very limited evidence on the resource requirements of meeting specific biodiversity targets at the regional level. A notable exception is highlighted by the case study on the costs of eradication of invasive alien vertebrates (IAVs) on small islands. This provides an estimate of the costs of achieving Target 9 for a selection of countries in the region to be just over US$ 350 million.

Commentary, including caveats and limitations of the approach

The evidence base for Australasia and the Pacific comprises of mainly sub-national or national level case studies. This presents a challenge when attempting to extrapolate results or draw general conclusions at a sub-regional or regional scale. We observe that the robustness of methods and the quantitative detail of results are generally higher for smaller scale assessments. We have relatively few high quality local case studies and a large number of more general or qualitative national studies for which is it difficult to draw general conclusions at the regional level.

Evidence gaps and future research priorities

There is limited available detailed evidence from which to draw conclusions regarding Research Questions 6 on policy alignment of the Aichi Targets with other policy agendas. Potential synergies between the Targets themselves and (inter) national policy agendas are expected, in particular where conservation actions produce bundles of environmental benefits, but there is little evidence to quantify these synergies. In this report we speculate that there are likely to be many relevant synergies and point to a few national level examples (e.g. between water, land, carbon and biodiversity management in Australia). There is a need, however, for a more thorough assessment of potential synergies between policy agendas in order to efficiently coordinate actions, deploy resources and avoid duplication of efforts. This process in itself requires resources and it is likely that many countries in the Pacific do not have the capacity to undertake such coordination.

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4. EUROPE

Eduard Interwies and Stefan Görlitz, InterSus – Sustainability Services

4.1 EXECUTIVE SUMMARY

The objective of the present report is to support the second phase of the work of the High-Level Panel on Global Assessment of Resources for Implementing the Strategic Plan for Biodiversity 2011-2020 through collecting local, regional and continent-wide evidence on benefits, investment needs and resource requirements, policy alignment and development issues, cost effectiveness and benefit-cost ratios of reaching the Aichi Targets in Europe. Herein, the situation regarding the availability and quality of information presented the research team with significant challenges. Nevertheless, evidence could be collected that sheds light onto the benefits and costs that are connected to reaching or approaching Aichi Targets in Europe.

From the evidence collected regarding the **benefits** of reaching the Aichi Targets in Europe, there remains no doubt that increased biodiversity protection and sustainable use of resources would benefit all spheres of European (human) societies: private and public life, rural and urban populations, richer and poorer people, corporations and most economic sectors – some to a higher, some to a lesser degree, and not necessarily distributed equally (across the pan-European region, and across societies). It is furthermore clear from the evidence that these benefits are not only "nice to have", but represent significant components and functions of the socio-economic systems in Europe, with a real value existing in terms of Ecosystem Service provision, indirect and direct income (e.g. visitor spending in protected areas), and as a basis for jobs and job creation. The most significant monetary values, as identified by this report, stem from conservation and restoration activities. In terms of non-monetized benefits, the provision of jobs and the creation of new jobs are of great importance, as estimations speak of up to 200,000 new FTE jobs being created through the EU Biodiversity Strategy, and up to 16% of all jobs in the EU being dependent on the environment.

Although no comprehensive and "self-contained" overview of necessary **measures and investments** to reach the Aichi Targets in Europe (EU and non-EU) exists, several priorities for actions – i.e. actions most important for reaching biodiversity targets (see, for example, table 1 in Appendix 4 for a list of the EU biodiversity targets) – are identified, mainly for the EU:

- Ensure a better uptake and distribution of existing funds for biodiversity: reform of agricultural (and fishery) subsidies; longer timeframes for biodiversity funding; clearer targeting of funds for biodiversity, also at the national level; capacity building and decrease of administrative burdens.
- The latter point is of special concern for new Member States in Eastern Europe, lacking the experience in applying for EU funds.
- Reforming the agricultural subsidy system ("Greening" the CAP), and e.g. reallocating funds from the first to the second Pillar (the CAP reform 2014-2010 has been agreed, but the final text is not available as of December 2013).
- Completing the Natura 2000 network, and establishing management plans or similar instruments onsite, also to obtain data on the impacts and effectiveness of financing.
- Increase knowledge and awareness.

In the new EU Member States as well as in non-EU countries, the focus should be more on capacity building with regard to the uptake of financing opportunities, awareness raising and on measures towards conservation instead of restoration (given the large undisturbed/unfragmented areas left in many parts of Eastern Europe and Russia). Additionally, in the non-EU Eastern European countries (i.e. Belarus, Ukraine, the Russian Federation, Moldova, but to a certain degree also Serbia, Albania), much more basic activities are necessary: studies and surveys about the state of ecosystems and ES, the designation of protected areas (e.g. for inclusion into the Emerald Network); and many legal and compliance issues.

Similarly to the expected benefits, overall **costs or resource needs** are also not documented in a comprehensive and self-contained manner (i.e. directed towards reaching the Aichi Targets). Estimations exist, however, for aspects of biodiversity protection and sustainable use of resources, and range in the tens of billions of € (or US$) per annum for the EU, although the data is not fully compatible: if the sectoral estimations were to be added up, the resulting sum would easily exceed the more general calculations. With regard to non-EU countries, no estimation of the resource needs can be provided, as no information is available covering Belarus, Ukraine, Moldova, Russia or the Balkans. At the same time, due to less fragmented or disturbed ecosystems that still exist in some parts of Eastern Europe, the costs could be significantly lower in these countries, as less restoration measures would be necessary. Regarding Western European non-EU countries (Switzerland, Norway, Iceland), the dimensions of the resources necessary will be similar to those in the EU Member States.

Additionally, there are **significant overlaps with other policy fields**, especially in the EU. The implementation of the various environmental Directives – to which the EU Member States are legally obliged – would mean a significant step towards the Aichi (and EU) targets. This, naturally, does not reduce the costs for a better protection of the environment in Europe (or improve the cost-effectiveness of measures), but these significant overlaps certainly reduce the additional funds necessary for reaching the Aichi Targets. Nevertheless, it has to be stated that the implementation of the (legally binding) EU Directives also very much depends on political will – there are many exemptions included in the most important Directives (such as WFD and MSFD), prolonging the respective timeframe and thus potentially greatly decreasing the importance of the Directives for reaching the Aichi Targets (for example, if the timeframe extends over 2020).

Several EU Member States argue that the overall costs for reaching the WFD's goals will be significantly less in case there was more time available. This argument could not be verified in the context of this study, but the general statement that postponing action will increase costs seems to be disputable, at least among policy makers. Postponing action is certainly much more costly with regard to conservation of ecosystems or habitats (while for restoration in some cases the costs are lower if more time is available) – conservation measures are generally more cost-effective than restoration measures, as the latter are usually associated with very high costs (CBD 2012). Another very important, or even crucial, point for **cost-effective actions** is the reduction of negative incentives: on the one hand, these increase the pressure on ecosystems (and species), not only hindering, but actively contradicting the achievement of the Aichi (and EU) targets; on the other hand, they can (in case of spatially explicit subsidies) greatly increase the cost for conservation and restoration, because the entitlements connected to a certain lot of land will be priced into prices for land acquisition or compensation payments.

The evidence also demonstrates that the **benefits of measures** to protect biodiversity in Europe (both EU and non-EU) **certainly exceed the costs** associated with them if all environmental and societal benefits are taken into account. Furthermore, in some cases (especially the reform of subsidies), the raising of new funds would be necessary only to a limited extent, because a simple re-allocation of subsidies from harmful to biodiversity-friendly purposes could already make a significant difference.

4.2 INTRODUCTION

The objective of the present report is to support the second phase of the work of the High-Level Panel on Global Assessment of Resources for Implementing the Strategic Plan for Biodiversity 2011-2020. The first phase, i.e. the HLP's report to COP-11, included an assessment of the financial resources required to deliver the Aichi Targets on the global level. The second, present phase involves a bottom-up analysis of the benefits and costs of meeting the targets, based on a review of evidence at different geographical scales – regional, national and local – which will supplement the global level assessment. As far as possible, evidence was gathered to support an analysis of the inter-linkages between targets and with broader policy agendas, as well as the costs and benefits of meeting individual targets at the different levels.

The region covered by this report is Europe according to the UN Statistics Division[11], i.e. including the Russian Federation – together forming a huge and diverse landmass. Although Europe as a continent is considered to be relatively species-poor compared with equivalent regions in Asia and America, it covers several bio-geographical and climatic regions from the Mediterranean to the Arctic, leading to a multitude of ecosystems and species covered by the European Aichi obligations.

The status of biodiversity in Europe is, given the dense population levels, heavy industrialization and intensive agricultural activities, generally of concern, although certain populations and distributions of wildlife species are showing positive trends – i.e. some large carnivore species have recovered in Europe and are even migrating to countries or regions where they have been extinct for centuries. But, also in recent decades, the loss of biodiversity in Europe continues: farmbird populations, for example, decreased by 25% from 1990 to 2006, European common bird populations by 10%, and forest birds by 18%. The conservation status of over 40% of European bird species remains unfavourable, and the risk of extinction for birds has increased almost everywhere in Europe. Such trends are similar for many species of flora and fauna, and for many habitat types (EC 2009: 3 et seqq.; EC 2011: 6).

The pressures on biodiversity originate from intense economic development and connected land-use changes; overfishing, eutrophication, alien invasive species and climate change are additional major threats to European biodiversity. Although forest cover has generally increased in recent decades, the increased quantity does not necessarily mean an increase in the quality of habitats. At the same time, extensive agricultural land, grasslands and wetlands give way to a continued expansion of artificial surfaces and abandoned land – the loss of wetlands has slowed down to 3% in the last two decades or so, but Europe had already lost half its wetlands before 1990. Positive trends are generally recorded regarding freshwater pollution, which has decreased due to strict regulation, especially in the EU (EC 2009: 3 et seqq.; EC 2011: 6).

Due to its economic predominance in Europe, the European Union represents the most important individual player regarding biodiversity protection and sustainable use of resources in the pan-European region. To address the threats to biodiversity, the EU is committed to an "EU Biodiversity Strategy", called "Our life insurance, our natural capital: an EU biodiversity strategy to 2020", which outlines how the CBD's Strategic Plan for Biodiversity is – or should be – implemented by the EU. The Strategy is also the EU's "National" Biodiversity Strategy and Action Plan (NBSAP) in the CBD framework. The general objective of the EU's strategy is the "EU 2020 biodiversity headline target", which has three components:

- To halt biodiversity loss and the degradation of ecosystem services by 2020.
- To restore them in so far as feasible.
- To step up the EU contribution to averting global biodiversity loss.

In addition to the EU Biodiversity Strategy, the EU Member States have also developed their own

11 See http://unstats.un.org/unsd/methods/m49/m49regin.htm.

NBSAPs, further adding to the implementation of the CBD and related international agreements at national level through a wide range of national and sub-national policies and measures.

The second, equally important environmental policy of the EU with a distinct regard to biodiversity are the "Nature Directives", i.e. the Birds and Habitats Directives, which provide the legal basis for the Natura 2000 network of protected areas – a policy that directly addresses several of the more difficult-to-achieve Aichi Targets (e.g. regarding conservation and restoration). Since 2004, the network has been extended to all 13 new Member States and now comprises more than 26,000 sites, covering 751,150 km² (terrestrial), or an area representing nearly 18% of the EU27 terrestrial territory. Beside the "Nature Directives", several other Directives also tackle problems addressed by the Aichi Targets, especially regarding the sustainable management of agriculture, forestry and fisheries, the rehabilitation of ecosystems, and regarding pressure reduction (such as pollution control and prevention) (EC 2009: 3 et seqq.).

In the non-EU countries, such regionally coordinated (and mandatory) policies or Directives, naturally, do not exist (although the EU regulations exert a certain influence over possible future accession countries). Nevertheless, a similar endeavour as the Natura 2000 network exists in European non-EU countries as well, with similar goals and the future objective of creating a pan-European network of protected areas. This network is called the "Emerald Network", launched by the Council of Europe as part of its work under the Bern Convention (and regarded as one of the main tools for the Contracting Parties to comply with their obligations under the Bern Convention).

In order to describe the benefits and costs of reaching the Aichi Targets in Europe – or to present the gathered evidence – the report is structured as follows: in the section directly below (Section 4.3), the methodology is shortly explained, along with main data sources, reflections on data limitations and other methodological issues, and a table summarizing the "translation" between EU Biodiversity targets and policies, and the Aichi Targets. Section 4.4 describes the benefits of reaching the Aichi Targets, first in a qualitative, then in a quantitative manner. The section on benefits is followed by two sections on necessary investments (Section 4.5) and the resources required to meet them (Section 4.6). Then, evidence on the possible overlaps of meeting the Aichi Targets with other policy agendas is presented (Section 4.7), as well as on cost-effectiveness (Section 4.8) and cost-benefit comparisons (Section 4.9). The report is closed by general and specific conclusions, which also highlight implications of the data availability for research priorities.

4.3 METHODOLOGY

Research methods and sources of evidence consulted

To find evidence to answer the research questions (chapters 3 to 8), the research team followed a bottom-up approach, i.e. collecting evidence on local, national or regional (e.g. EU27, or a Regional Sea Convention) scales. The collected information was not aggregated but summarised, integrating case studies, to provide insights against the research questions posed.

The basic approach to answering the research questions was through a desktop research into current literature, the most recent (research) project reports, and national/regional reports under the Convention on Biological Diversity (e.g. Biodiversity Strategies and Action Plans). The most important sources covered were:

- The information submitted by EU Member States or published by the European Commission regarding the implementation of the program of work on protected areas (i.e. under the Birds and Habitats Directives).

- Both selected national reports under the CBD (updated NBSAPs of EU and non-EU countries), as well as the comprehensive reporting undertaken by the EC with regard to the EU's biodiversity targets.
- EU documents regarding the implementation of relevant environmental legislation (e.g. on the Water Framework Directive, Nitrates Directive etc.).
- CBD Documents regarding financing issues, also with regard to the GEF.
- Reports from independent research institutes, covering a wide variety of specific questions such as:
  - Several Reports by the IEEP (Kettunen *et al.* 2009; Gantioler *et al.* 2010; Hart *et al.* 2011; Tucker *et al.* 2013) with regard to costs and benefits of the Natura 2000 network and other land-use policies.
  - UK National Ecosystem Assessment (2011). The UK National Ecosystem Assessment. UNEP-WCMC, Cambridge.
  - ACTeon Environment (2012).Comparative study of pressures and measures in the major river basin management plans in the EU – Task 4b: Costs & Benefits of WFD implementation. Final Report to the European Commission.
  - ARCADIS (2011). Recognizing Natura 2000 Benefits and demonstrating the Economic Benefits of Conservation Measures – Development of a Tool for Valuing Conservation Measures. Report to the European Commission.
  - Reports from the BalticSTERN Research Network.
  - The TEEB Reports.

Overview of availability and robustness of evidence, methodological issues, evidence gaps, variations in extent and quality of evidence between questions

The main aim of the report has been to gather evidence on the research questions below, in terms of:

- Summarizing key findings and supporting evidence for each question, drawing on the range of evidence available for different countries and targets.
- Presenting case studies of the most interesting examples.
- Commenting on the extent, quality, sources and coverage of the available evidence and highlight key gaps.

In this regard, comprehensive answers have not been possible for all questions due to the fragmentary information available. Instead, the best evidence and examples available were identified, and gaps highlighted, in order to gain good evidence, examples, insights and different regional perspectives that will inform the global assessment.

Availability and Robustness of Evidence

Overall, the most reliable and comprehensive information available was information covering the EU27, mainly assessments (in the form of Impact Assessments, research reports, or policy/planning documents) on effects, costs and benefits of measures for implementing EU environmental legislation (including the EU Biodiversity Strategy and related targets), or on effects, costs and benefits of the legislation itself. Such information is issued mostly by the EC and research institutes/organizations. Information from non-EU countries was generally not readily available, especially regarding quantitative information on benefits and costs of reaching the Aichi Targets.

NBSAPs have mostly been less relevant, as in most cases, concrete, quantitative information on reaching the Aichi Targets was not included in these plans. Instead, the strategies mostly consist of national objectives and planned actions to reach these (with "translations" of the national targets/objectives to the Aichi Targets). Clear statements on costs – i.e. "reaching the Aichi Targets in country Y/reaching the Aichi Target 11 in country Y would cost X Euro" – or benefits were not found in any of the plans.

However, there was ample information available regarding local or regional examples and case studies – rarely in the context of reaching a certain Aichi Target, but covering costs and benefits of certain actions or measures, on different scales of governance. Herein, the difficulty lay not in finding case study examples, but in selecting the ones most reliant and appropriate, and in "translating" the actions into the Aichi framework (see below).

Hence, the information available can roughly be categorized into the following categories, according to the governance level:

- EU-level data on reaching certain targets/objectives (either EU environmental legislation or EU Biodiversity Strategy and related targets).
- Regional level data on costs and benefits of certain policies or measures (not related to reaching certain targets).
- National level data on reaching certain targets/objectives (in EU Members States (MS) either EU environmental legislation or EU Biodiversity Strategy and related targets).
- Local level data on costs and benefits of certain policies or measures.

Therefore, one major task in the context of this report was the "translation" of either different targets (mostly related to the EU Biodiversity Strategy and related targets, and EU environmental legislation) – or certain policies/measures – to the respective Aichi Target(s). A matrix providing some hints in this regard is provided below.

Regarding the robustness of data, many assessments of costs and, especially, benefits rely on methodologies that evaluate the monetary value of benefits provided by "ecosystem services" (ES, or "ecosystem goods and services", EGS). These methodologies vary in reliability, and all have minor or major methodological issues associated with their application, which have to be kept in mind when using the results of such studies for various purposes[12].

Methodological Issues – "Translation" of targets

As mentioned above, one major issue in the context of the present study was the "translation" of various targets, policies and measures to the respective Aichi Target(s). This is most relevant for the EU MS and esp. the EU Biodiversity Strategy and related targets, and the major EU environmental policies (of which most information was available on the Water Framework Directive and the Natura 2000 network/the Nature Directives). The following matrix provides an overview of the interpretation of the different policies in terms of reaching the respective Aichi Target(s), in full knowledge that many topics and targets could be interconnected in a multitude of ways. The table focuses on key linkages only and is intended to give a summary overview rather than definitive analysis of all potential links[13].

A point to note is the spatial coverage of the study. Usually, Europe is understood to be bordered in the East by the Ural mountains (i.e. including only a small part of the Russian Federation). In the current study, however, and due to practical reasons, the researchers also assessed information from the whole of the Russian Federation, which means an immense increase in spatial size, and a significant increase in population of the areas covered by the study. The point is mentioned here to assist in aggregating the evidence from the study (also with regard to the differences in size and population between Europe as a whole and the EU27). Table 2 contains the relevant information.

Methodological Issues – Currency Conversion

All monetary information in the current study has been converted to current US$ (as of 2013) in order to allow for better comparability. Based on the options laid out by UNDP (2013: 49) regarding this issue, currencies are converted using the conversion rate of the "baseline year", which in this case is the year in which the assessment/study was conducted.

12 For further information, see for example Brouwer *et al.* (2013).

13 For a comprehensive overview of the Aichi Targets, specific actions to reach these, and the possible linkages between targets and actions, see CBD 2012 (pages 141 et seqq.).

Table 2: Inhabitants and size of different parts of Europe

	Size (thousand km²)	Population (thousand inhabitants)
EU27*	4,324	503,605
Europe (Ural)	Approx. 10,180**	739,000
Europe and Russian Federation	Approx. 23,295**	772,000

Sources: CIA Factbook.

* Since 1st of July, 2013, Croatia is member to the EU (forming, effectively, the EU28). However, all assessed documents refer to the EU27 and the table lists the according figures.

** Different sources state different spatial sizes for Europe, due to the unclear geographical borders.

The conversion to 2013 dollars follows the Inflation Calculator provided by the US Bureau of Labour Statistics (http://www.bls.gov/data/inflation_calculator.html), which is based on the Consumer Price Index.

Evidence Gaps

Beside the issues named above – i.e. the lack of quantitative data regarding benefits and costs in the NBSAPs, and the general lack of "links" between specific actions/measures/investments and the Aichi (or EU) targets – the following evidence gaps are of the greatest importance:

- The missing link between the effects of an action, and the change this action will result in, in terms of reaching the Aichi or EU targets.
- The information regarding quantitative benefits of reaching the targets is very sketchy, i.e. an overall estimation does not exist. No report has been found that clearly addresses the economic implications of reaching the Aichi Targets, neither on the European, the EU, nor the national level.
- Regarding investment needs, the evidence gaps lie in the difficult translation of environmental policies at the EU or national levels to the Aichi Targets (so, the existing evidence is focussed on other targets/policy objectives than the Aichi Targets, and often does not establish the link).
- The evidence gaps regarding resource needs are relatively manageable in Western Europe, although uncertainties evolve when local, case study-like evidence is upscaled to the national or EU-scale. In Eastern European countries, mostly non-EU, the data gaps regarding costs are very significant (i.e. there is almost no data available).
- Information on the contributions and negative effects of the EU development, coherence and accession policies on biodiversity was not available, as well as information on cost-effectiveness. In the latter field – i.e. regarding the sequencing of measures – there is a lot of general information available, but no source that assesses the consequences of different approaches in a quantitative way (e.g. "measures a and b implemented before measures c and d lead to additional costs…").
- The evidence gaps regarding the ratio between costs and benefits mainly concerns the uncertainties of upscaling local level evidence to the whole of Europe.

Variations in Extent and Quality of Evidence between Questions

Naturally, evidence supporting the qualitative aspects of the questions – i.e. regarding the benefits probably connected to reaching the Aichi Targets, or the necessary actions/measures/investments – is much more easily obtainable than quantitative data. This, however, does not necessarily mean that the qualitative data is also "better" or "more accurate" – long lists of necessary actions/measures/investments without any information on the degree to which these will suffice for reaching certain objectives are often provided, but not very helpful. On the contrary, even if quantitative information might be more difficult to generate and might have generally more uncertainties attached to it, the links with the effects (of the actions/measures/investments investigated) are mostly included and at least allow for further conclusions.

The evidence is fairly strong with regard to investment needs and resource requirements (except for the non-EU Eastern European countries, see above); and the evidence situation for benefits is also quite good, although more reliant on anecdotal/case study-based evidence.

Relations between costs and benefits are treated in Cost-Benefit Analyses for the most part, conducted on a local or regional (e.g. sub-national) scale. Besides the challenge of transferring the results of such studies to a greater scale, CBA often involve methodologies that evaluate the monetary value of benefits provided by ES, which can, as mentioned above, include significant uncertainties. Not much data is available to better understand policy alignments and overlaps between environmental policies, and with regard to cost-effective combinations of measures, or "sequences".

4.4 BENEFITS OF DELIVERING THE AICHI TARGETS

What will be the economic benefits of delivering the Aichi Targets?

This section presents the benefits – also in terms of costs of inaction and incurred damages through inaction – on a qualitative basis; evidence is subdivided into general information on benefits linked to biodiversity conservation, target-specific information (i.e. benefits of reaching a certain EU or Aichi Target), and sector-specific information (i.e. linkage between biodiversity and job creation, or innovation potential).

"Benefits" consist of benefits provided (i.e. services that contribute directly and indirectly to human well-being), but also of damages (e.g. economic losses) that will be prevented through biodiversity protection and sustainable use of resources (i.e. reaching the Aichi Targets). The loss of biodiversity, though, is not as simply identified as the loss of whole ecosystems – instead, it forms "vital components" of ecosystems, and its loss/degradation can have far-reaching consequences at the local, regional and global level (EC 2011: 7 et seqq.). Some business sectors are especially affected, as they depend on biodiversity and/or ecosystem services. This includes fisheries, forestry (wood products), agriculture (dependent on services such as pollination, biological control, soil formation, water availability and genetic diversity), water supply, pharmaceuticals and cosmetics, chemicals, agro-food, and growing parts of the tourism sector (EC 2011: 8).

General Benefits of Biodiversity Conservation

"Biodiversity" – of species and ecosystems – is linked to most ecosystem services. The following table provides an overview of evidence found in the present survey (i.e. the table is not representative – if more sources on local examples were assessed, the amount of sources mentioning individual services could be different).

Target-specific benefits

Besides the evidence from European sources, the CBD High-Level Panel lists the benefits associated with reaching the individual Aichi Targets from a global perspective (HLP 2011: 46 et seqq.).

For reaching the EU Biodiversity Targets, the European Commission also provides a qualitative overview, depicted in the table below.

It is important to note the "wider" understanding of benefits in the table above, i.e. the inclusion of synergies with other policy fields (such as the Water or Marine Strategy Framework Directives) as "benefits". The EC expands on this analysis by also depicting the spatial scales on which the benefits are realized – using, however, a "narrower" understanding of benefits.

Impacts of biodiversity conservation on jobs

According to estimations, 2.5% to around 16% (depending on the definition of job sectoral allocation) of all jobs in the EU (probably EU27 in this case) are dependant on the environment, whether directly or indirectly (TEEB 2009: 24). A further

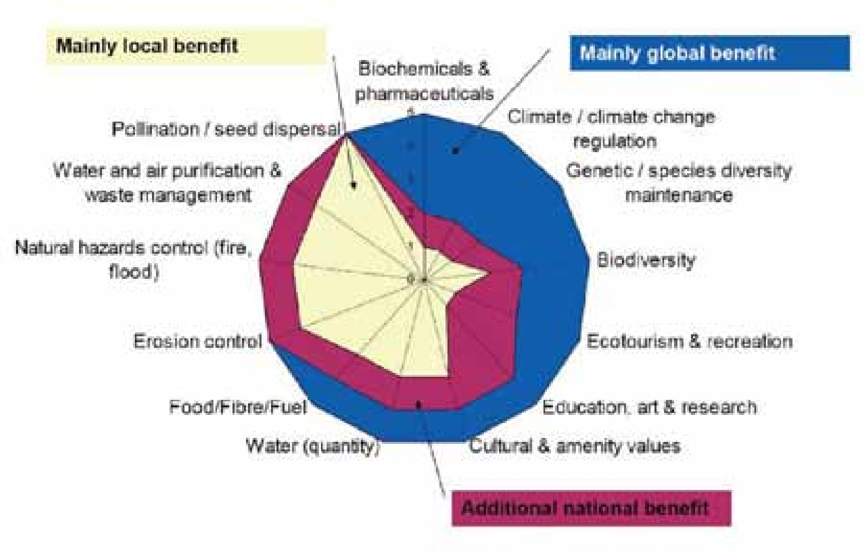

Figure 1: Spatial scales of benefits provided by biodiversity. Source: EC 2011: 9.

loss/degradation could therefore seriously impact the European labour market.

The Natura 2000 network alone is estimated to support a total of 4.5 to 8 million full-time equivalent (FTE) jobs through visitor's expenditures only (EP 2012).

An overall assessment of jobs (and "job skills") affected by the EU Biodiversity Strategy and its targets has been conducted by ICF GHK and several other research institutes (Jurado *et al.* 2012). The authors, although stating that the overall impact was difficult to assess due to overlaps between targets, estimate the number of FTE jobs that would be newly created at 200,000, and the number of "generally affected" jobs much higher. The table below depicts the results from this study:

Other sources describe other (qualitative) benefits in more detail:

- Impacts (of biodiversity conservation) on innovation potential, in terms of "man-made elements (such as green roofs, porous pavement, rain absorbing gardens, eco-ducts for wildlife crossings), innovative planning approaches, the design and application of urban elements enhancing biodiversity, all combinations of technologies enhancing ecosystem services, or finally the development of new organization methods, products, services and system innovations to better protect ecosystems" (EC 2011: 58 et seqq.; similarly: EP 2012).
- Increasing general resilience to climate change and enhancing adaptation: examples mentioned are wetlands and flood management, dune systems and coastal protection and upland forests and erosion/landslide prevention (see section 4.7 for more details) (EC 2011c: 4 et seqq.; UNDP 2013: 6; EU 2013: 2).
- Nature-based tourism is becoming an increasingly important subsector in many countries/areas. In Georgia, for example, there has been a progressive increase in visitation rates to Georgian protected areas over the last few years (from 5,669 people in 2005 to 303,686 people in 2011) (TEEB 2013: 25).

Regarding the social impacts of biodiversity policies, in this case green infrastructure, it is reported that urban green infrastructure would (beside the benefits already listed in table 4 above) "mitigate urban heat islands by cooling the air and shading buildings and surfaces", would have positive impacts on "social activity, improving community cohesion, developing local attachment and lowering crime levels, particularly in deprived communities" and increase urban air quality through capturing or filtering substances and pollutants such as PM1095, O_3, SO_2 and NO_x (EC 2011: 59 et seqq.).

What evidence is there of the nature, scale and value of these benefits, at national and international levels?

This section presents the benefits – also in terms of costs of inaction/damages through inaction – on a quantitative basis, as far as possible; evidence is, however, fragmented and available mostly on a case study basis (i.e. without relation to either the Aichi or the EU Biodiversity targets). The most comprehensive information relates to the creation of a European network of protected areas (i.e. Natura 2000 and Emerald Network).

Global level estimations of the benefits of protecting biodiversity (or the damages due to the failure of protecting biodiversity) reach into the hundreds of billions (Balmford *et al.* 2002/HLP 2011: 44 et seqq.) or trillions of Dollars per year (Braat/ten Brink 2008)[14].

Other estimations are targeted either at individual (local or national) projects (e.g. "Wetland restoration in Northern Wales"), at specific ecosystems (in a regional or national context, e.g. "the Swiss national forests"), or specific policies (e.g. "implementing the WFD"). These are listed below, categorized per ES or per ecosystem, and with the respective Aichi Target(s) most closely related to the projects/benefits identified. Remarks regarding distributional effects are to be found at the end of the section.

Ecosystems: Forests and woodlands

Related to Aichi Target(s): 5, 10, 11, 12, 13 (protection/conservation), 14, 15 (restoration), 7 (use/management).

The Swiss forests are especially attractive for sports and leisure activities; the Federal Office for the Environment conducted a study on their monetary recreational value. Based on data from an opinion poll in the whole of Switzerland, the study "provides information on the appreciation of recreation services by the Swiss population in the entire Swiss forest, using the travel cost method", resulting in a recreation value of CHF 10 billion/a [11.6 billion US$/a] (FOEN 2010: 90). Furthermore, the forests provide provisioning services, like game, mushrooms and berries. Even though these forest products are marginal for Switzerland's economy, they may be of local importance. For instance, the value of mushrooms collected in Switzerland's forests is estimated to be CHF 8 million/a [9.3 million US$/a] (FOEN 2010: 32).

According to another, more specific study, the Swiss Alpine forests (17% of forest area) provide a value of 2 to 3.5 billion US$/a in avalanche, rock fall and landslide protection (Tucker *et al.* 2013: 471 et seqq.).

Woodlands cover 12% of the UK's area, increasing carbon sequestration, which is valued 680 million £/a [1,109 million US$/a] (UK NEA 2011: 34). These are furthermore highly valued by people for social and cultural services (approximately 250–300 million day visits to UK woodlands per year), estimated to exceed a value of 1.2 billion £/a [around 2 billion US$/a], with the landscape value of woodland estimated at 185 million £ [318 million US$/a], and recreational visits valued at 484 million £ [830 million US$/a] (UK NEA 2011: 73).

Ecosystems: Wetlands, moorlands, bogs and fens

Related to Aichi Target(s): 5, 10, 11, 12, 13 (protection/conservation), 14, 15 (restoration).

Benefits provided by wetlands (in a general sense) are evaluated in the UK NEA and the UK's Biodiversity Strategy, providing some figures for water purification/provision, storm buffering and erosion prevention. Latter are estimated to reach 1.5 billion £ [2.5 billion US$] annually in England's coastal wetlands alone (DEFRA 2011: 8); other reports state a value of 4,600 £ per metre [9,567 US$/m] of coastal salt marshes "owing to reduced tide and wave impact, resulting in avoided costs for maintaining sea defences" (Tucker *et al.* 2013: 471 et seqq.; Rupp/Nicholls 2002). Other sources state that especially the benefits of the flood protection services that wetlands provide are very site-specific (i.e. depending very much on the population in the region – urbanization, income etc.). Locally, these benefits can be significant (for instance, the restoration of the original river landscape by means of wetlands and estuarine habitats restoration at the Kalkense Meersen Natura 2000

14 Further information on global level estimations can be found in the reports of the High-Level Panel.

site in Belgium has been estimated to provide flood mitigation benefits of between 640,000 and 1,650,000 €/a) [892,000 to 2.3 million US$/a] (EU 2013: 3).

70% of the UK drinking water "comes from upland areas, moorlands and heaths, getting purified naturally" (Tucker *et al.* 2013: 471 et seqq.; UK NEA 2011) – no value is provided for this, although rough estimates extracted from IEEP (Tucker *et al.* 2013) place the value of natural treatment (of water) for big European cities (Berlin, Oslo, Vienna, Munich) at 7-16 million €/a [9.4 – 21.4 million US$/a] (EU 2013: 5).

Ecosystem Services: Opportunities for recreation and tourism

Related to Aichi Target(s): no direct link; recreation and tourism in natural areas, however, is dependent on natural areas which are protected or restored; hence, indirect link to Aichi Targets 5, 10, 11, 12, 13 (protection/conservation), 14, 15 (restoration).

The Swiss 4th National Report to the CBD (FOEN 2010: 65) states that the Swiss National Parks have – in addition to the "ecological benefits" – positive direct and indirect economic effects. For example, tourism revenues generated directly by the Swiss NP in Canton Grison average 10 million CHF/a [11.6 million US$/a], with an additional 7 million CHF [7.9 million US$] in indirect benefits (employment and incomes). In Georgia, the recreational value that Georgian city dwellers would derive from visiting National Parks was estimated at 2.7 million GEL [2.27 million US$/a], and, according to survey results from 2000, the average WTP for entering a Georgian National Park was 21.50 GEL [17.60 US$] (TEEB 2013: 48).

Ecosystem Service: Pollination

Related to Aichi Target(s): 7 (use/management), 8 (reduced pollution), 9 (IAS – threatening bee populations), 12 (species conservation).

Insect pollination in the EU27 has an estimated economic value of 14 to 15 billion €/a [19.4 to 20.9 billion US$/a] (EU 2013: 3; EC 2011b: 4). On a national level in the UK, the total value of pollination services is estimated at 430 million £/a [715 million US$/a] (UK NEA 2011: 33).

In Switzerland, the pollination of cultural and wild plants as well as the production of honey, pollen and wax by honeybees is regarded as an "important contribution to the national economy", with a "pollination value of a single bee colony for the harvest of fruits and berries" of 1,250 CHF/a [1,459 US$/a], and an average honey production of 10 kg/colony/a (19,000 beekeepers with 170,000 colonies exist in the whole country) (FOEN 2010: 21).

Target: Invasive Alien Species

Related to Aichi Target: 9 (IAS), 12 (species conservation).

Around 11,000 alien species are recorded in Europe. Of these, however, only a small percentage, 10–15% , have become so common as to be considered "invasive", the others remain relatively restricted in range (Government of Finland 2011: 69). Nevertheless, in the EU27, annual damages through IAS are estimated to reach 12.5 billion € [17.3 billion US$/a] (EC 2011b: 6); other sources state the same figure for the whole of Europe (DEFRA 2011: 32). On a national level, damages reach 1.7 billion £ [2.8 billion US$/a] (in the UK; DEFRA 2011: 32).

Other topics

Regarding **green infrastructure** (such as "bridges" for wildlife, "soft coasts", or green urban infrastructure), it is reported that these would reduce traffic accidents involving wildlife, with estimated values at 42 million €/a in Switzerland and 150 million €/a in France) [69.7 and 249.4 million US$/a, respectively] (EC 2011: 58 et seqq.). In 2007, sea defence services by sand dunes ("soft coasts") have been calculated to be worth between 53 and 199 million £/a [96.8 to 359 million US$/a] in Wales, and in England, the soft coasts provide an estimated 3.1–33.2 billion £/a [5.5 to 59.8 billion US$/a] worth of capital savings in sea-defence costs (UK NEA 2011: 66, 76).
Related to Aichi Target(s): 5, 10, 11, 12, 13 (protection/conservation), 14, 15 (restoration).

The creation of **Marine Protected Areas** (MPAs) in Europe (including Natura 2000 sites) could generate 1.4 to 1.5 billion €/a [up to 2 billion US$/a] (specific benefits not specified) (EU 2013: 5). At the same time, several studies demonstrate the economic impacts of overfishing – in the Baltic in 2002, for

example, cod fishing represented a cost (damage) of 128.6 million US$ (167.3 US$ present value) compared with what could have been harvested with sustainable yields. Similarly, the North Sea cod fishery lost 254.1 million US$[15] (WWF-Germany 2002)
Related to Aichi Target(s): 5, 10, 11, 12, 13 (protection/conservation), 14, 15 (restoration), 6, 7 (use/management).

Freshwater Ecosystems: Depending on the percentage of water bodies in "good status", the benefits derived from reaching the WFD objectives are roughly estimated to range between 10 and 20 billion €/a [13 to 26 billion US$/a] in the EU27 (ACTeon Environment 2012: 46).
Related to Aichi Target(s): 4 (planning – if RBMPs are included), 10, 11, 12, 13 (protection/conservation), 14, 15 (restoration), 7 (use/management), 8 (pollution), 20 (resource mobilization).

Distributional Effects

Benefits of ES provision are not distributed evenly across societies (i.e. on a national scale), regionally (i.e. across Europe or the pan-European level) or sectoral (i.e. between economic sectors). However, there is no source specifically targeting this issue for Europe; the following section therefore represents a compilation of small bits of information and some overall conclusions based on them.

The TEEB Report (TEEB 2009: 25 et seqq.) primarily highlights the great importance of ES benefits for the rural poor, who "often rely directly on local ecosystem services and biodiversity for their food, shelter, income, fuel, health, quality of life and community" (TEEB 2009: 25). This is mentioned also explicitly in the TEEB Scoping Study for Georgia, which states that "nearly 47% of Georgia's population lives in rural areas and they are fully dependent on ecosystem services like water purification, erosion prevention, fuel wood provisioning" – 80% of Georgia's rural households use fuel wood extracted from nearby forests for heating and cooking (TEEB 2013: 20, 34). This is true for other Eastern European countries or regions as well (i.e. Moldova, parts of Belarus and Ukraine, but also parts of EU countries such as Romania or Bulgaria), and across the pan-European region; without doubt, also countries with large grassland areas/pastures and great numbers of shepherds/sheep (also in Western Europe) are certainly more dependent on biodiversity ES than others. Any reduction in the provisioning of the ES the rural populations are dependent on implies measurable losses in social welfare, e.g. the need to purchase substitutes for timber and non-timber forest products (TEEB 2013: 34).

- First conclusion: the loss of biodiversity and related ES will affect the rather poor Eastern European countries and their populations more than the well-developed EU or non-EU (Norway, Switzerland) countries.

Looking at the distribution across societies (i.e. on a national scale), it is clear that many ES benefit the society as a whole: fresh air, rainfall and pollination, to name a few. Others provide their benefits to private entities or individuals, e.g. in case the drinking water (purified in surrounding ecosystems) is provided by a private company, which did not invest in water protection measures before (and is paid by water users). Also, as the EC Impact Assessment on the EU's Biodiversity Strategy states, the "access to green spaces is unequally distributed across socio-economic groups, with poorer social groups having, in general, lower access, and given that green space could have positive influence on health conditions such as obesity, mental health, circulatory disease and asthma, more equal access to green space could also help reducing health inequalities between socio-economic groups" (EC 2011: 60). Similarly, green spaces or protected areas close to cities will benefit the urban population much more than the rural, as the latter has generally a more easy access to green areas in general. Also, the potential income from increased biodiversity protection and sustainable use of resources is not necessarily distributed evenly across societies. In the case of Georgia, for example, it is reported that the majority of local residents see little prospect that the development of tourism would improve their lives, as engaging in the tourism business requires capital investments which only already wealthy groups/families can afford. Hence, the development of tourism is associated with further

15 Methodology could not be verified in detail.

wealth and income creation for those groups/families that are already wealthy, rather than the development of the region in general (TEEB 2013: 26).

- Second conclusion: ES provision in many cases benefit the society as a whole; however, in plenty of other cases, the distribution is uneven, and can both tend towards benefitting poorer or discriminated groups of society, and privileged individuals/groups or private entities (such as companies).

Finally, there are economic sectors which are much more dependent on ES provision than others, including fisheries, forestry (wood products), agriculture (dependent on services such as pollination, biological control, soil formation, water availability and genetic diversity), water supply, pharmaceuticals and cosmetics, chemicals, agro-food, and growing parts of the tourism sector (EC 2011: 8; TEEB 2013: 13). These will be affected more severely by biodiversity loss (or would benefit to a greater extent from biodiversity protection and sustainable use of resources) than other branches of industry and services, such as smelting, mining etc.

- Third conclusion: economic (and public) sectors more dependent on ES provision would benefit to a greater extent from biodiversity protection and sustainable use of resources than other economic sectors.

4.5 INVESTMENT NEEDS

What types of investments and activities are needed to deliver the Aichi Targets and to secure these benefits?

A general overview of globally necessary investments/measures, which is not further detailed in this study, is provided by the High-Level Panel (including costs) (HLP 2011: 52 et seqq.). The following evidence is classified into EU-level and target-specific evidence.

EU level

On the EU level, the assessments of necessary investments/actions are focused on the EU Biodiversity Strategy (for a translation of EU targets to Aichi Targets, see section 4.3). At a general level, the existing EU policies that are of the most importance for reaching the targets are listed in the EC's Impact Assessment of the Biodiversity Strategy; these are the WFD and MSFD, CAP and CFP, the "Nature Directives", as well as the Soil Strategy, Climate Change policies and the legislation surrounding pollution prevention (EC 2011: 24).

The EP (2012) provides a general list of priority actions to reach or approach the EU Biodiversity targets: promotion of green infrastructure, eco-innovation and the adoption of innovative technologies in order to create a greener economy; increased assistance to public and private actors working to protect forest biodiversity in terms of species, habitats and ES under the new CAP; extended CAP eligibility for areas connecting Natura 2000 sites; minimum mandatory spending on environmental measures – such as agri-environmental measures, Natura 2000 and forest environment measures – and support for High Nature Value and organic farming; fisheries reserves (areas in which fishing activities may be banned or restricted) (EP 2012).

In the EC's Impact Assessment, the six EU targets are broken down into 20 main actions and many specific actions, which provide a general overview of the necessary actions at the EU level (EC 2011: 40 et seqq.):

- Action 1: Complete the establishment of the Natura 2000 network and ensure good management – specific actions: full establishment of terrestrial and marine network by 2012; further integration of species and habitats protection and management requirements into key land and water use policies; development and implementation of management plans or equivalent instruments which set out conservation and restoration measures in the protected areas; sharing

of experience and knowledge regarding the management of Natura 2000 sites.
Aichi Target(s): 5, 10, 11, 12, 13 (protection/conservation), 14, 15 (restoration), 7 (use/management), 19 (knowledge).

- Action 2: Ensure adequate financing of Natura 2000 sites – specific actions: provision of the necessary funds and incentives for Natura 2000, including through EU funding instruments, under the next multiannual financial framework.
Aichi Target(s): 3 (incentives), 20 (mobilize financial resources).

- Action 3. Increase stakeholder awareness and involvement and improve enforcement – specific actions: major communication campaign; improved cooperation with key sectors and development of guidance documents to improve their understanding of the requirements of the EU nature legislation and its value in promoting economic development; facilitation of law enforcement of the nature directives by the provision of specific training programs on Natura 2000 for judges and public prosecutors.
Aichi Target(s): 1 (awareness).

- Action 4: Improve and streamline monitoring and reporting – specific actions: new EU bird reporting system, further development of the reporting system under Article 17 of the Habitats Directive and improvement of the flow, accessibility and relevance of Natura 2000 data; establishment of a dedicated tool as part of the Biodiversity Information System for Europe.
Aichi Target(s): 19 (knowledge).

- Action 5: Improve knowledge of ecosystems and their services in the EU – specific actions: mapping and assessment of the state of ecosystems and their services in the national territories (by 2014), assessment of the economic value of such services, and promotion of the integration of these values into accounting and reporting systems at EU and national level by 2020.
Aichi Target(s): 2 (accounting/reporting), 17 (NBSAPs), 19 (knowledge).

- Action 6: Set priorities to restore and promote the use of green infrastructure – specific actions: development of strategic frameworks by Member States to set priorities for ecosystem restoration at sub-national, national and EU level; development of a "Green Infrastructure Strategy" which includes incentives to encourage upfront investments in green infrastructure projects and the maintenance of ES (examples: better targeted use of EU funding streams and Public Private Partnerships).
Aichi Target(s): 3 (incentives), 11 (connectivity), 17 (NBSAPs).

- Action 7: Ensure no net loss of biodiversity and ecosystem services – specific actions: development of a methodology for assessing the impact of EU funded projects, plans and programs on biodiversity; to "carry out further work with a view to proposing by 2015 an initiative to ensure there is no net loss of ecosystems and their services" (examples: compensation or offsetting schemes).
Aichi Target(s): 3 (incentives), 5 (loss of natural habitats), 12 (threatened species).

- Action 8: Enhance direct payments for environmental public goods under the EU CAP – specific actions: reform of CAP direct payments to reward the delivery of environmental public goods that go beyond cross-compliance (examples: permanent pasture, green cover, crop rotation, ecological set-aside, Natura 2000); improve and simplify the GAEC (Good Agricultural and Environmental Conditions) cross-compliance standards and consider including the WFD within the scope of cross-compliance.
Aichi Target(s): 3 (incentives); probably several others indirectly.

- Action 9: Better target Rural Development to biodiversity conservation – specific actions: integration of quantified biodiversity targets into Rural Development strategies and programs; collaboration among farmers and foresters.
Aichi Target(s): general protection and conservation targets; probably 3 (incentives), 7 (use/management).

- Action 10: Conserve Europe's agricultural genetic diversity – specific actions: uptake of agri-environmental measures to support genetic diversity in agriculture; development of a strategy for the conservation of genetic diversity.
  Aichi Target(s): 13 (genetic diversity); probably others.

- Action 11: Encourage forest holders to protect and enhance forest biodiversity – specific actions: management plans (also through incentives via rural development measures and the LIFE+ program); innovative mechanisms (e.g. Payments for Ecosystem Services) to finance the maintenance and restoration of ES provided by multifunctional forests.
  Aichi Target(s): 3 (incentives), 4 (plans), 7 (use/management); related also to protection and restoration strategies (targets 11-15).

- Action 12: Integrate Biodiversity measures in management plans – specific actions: inclusion of specific measures in forest management plans or similar instruments (examples: optimal levels of deadwood, wilderness areas, ecosystem-based measures to increase the resilience of forests against fires, specific measures developed for Natura 2000 forest sites and afforestation in accordance with diversity and climate change adaptation needs).
  Aichi Target(s): 4 (plans), 7 (use/management); related also to protection and restoration strategies (targets 11-15).

- Action 13: Improve the management of fished stocks – specific actions: maintenance and restoration of fish stocks to levels that can produce MSY in all areas in which EU fish fleets operate, including areas regulated by Regional Fisheries Management Organizations, and the waters of third countries with which the EU has concluded Fisheries Partnership Agreements; long-term management plans with harvest control rules based on the MSY approach; collect data to support implementation of MSY.

In more detail, the EC's Impact Assessment lists other specific actions related to fisheries and MSY: the "acquisition of additional information, planning and consultative decision-making processes involving a broader range of stakeholders/interest groups, and additional monitoring, control and surveillance". Also, communication of negative (short-term) impacts lower initial catches, and reduction of the size of the fleet) and positive (long-term) impacts (improvement of revenues for fishermen and significantly reduce the needs for government subsidies to the fishing industry) (EC 2011: 64).
Aichi Target(s): 4 (plans), 6, 7 (use/management), 12 (species conservation).

- Action 14: Eliminate adverse impacts on fish stocks, species, habitats and ecosystems – specific actions: introduction of measures to gradually eliminate discards, to avoid the by-catch of unwanted species and to preserve vulnerable marine ecosystems in accordance with EU legislation and international obligations; implementation of the MSFD including financial incentives through the future financial instruments for fisheries and Maritime Policy for marine protected areas (including Natura 2000 areas and those established by international or regional agreements) (examples: restoring marine ecosystems, adapting fishing activities, promoting the involvement of the fishing sector in alternative activities, and combating marine litter).

In addition, the FishSTERN Report (Blenckner *et al.* 2011) also states that more and more countries in the Baltic Sea area are "moving in the direction of more flexible quota management, where fishermen receive a certain share of the overall quota with the possibility to trade this share", which could also be an effective way of reducing pressure on fish stocks.
Aichi Target(s): 3 (incentives), 6, 7 (use/management), 11, 12 (conservation); possibly 14 (restoration) and 8 (pollution).

- Action 15: Strengthen the EU Plant and Animal Health Regimes – specific actions: integration of additional biodiversity concerns into the Plant and Animal Health regimes.
  Aichi Target(s): 9 (IAS).

- Action 16: Establish a dedicated instrument on Invasive Alien Species – specific actions: fill policy gaps in combating IAS by developing a dedicated legislative instrument.
  Aichi Target(s): 9 (IAS).

- Action 17: Reduce indirect drivers of biodiversity loss – specific actions: introduction of demand and/or supply side measures to reduce the biodiversity impacts of EU consumption patterns, particularly for resources that have significant negative effects on biodiversity; improvement of EU trade policy (integration of biodiversity concerns in trade negotiations and treaties); provision of "the right market signals" for biodiversity conservation, including work to reform, phase out and eliminate harmful subsidies at both EU and Member State level, and to provide positive incentives for biodiversity conservation and sustainable use.
  Aichi Target(s): 3 (incentives); probably all targets under Strategic Goal B (targets 5-10).

- Action 18: Mobilise additional resources for global biodiversity conservation – specific actions: significant increase of resources; improvement of the effectiveness of EU funding for global biodiversity by supporting natural capital assessments in recipient countries and the development and/or updating of National Biodiversity Strategies and Action Plans, and by improving coordination within the EU and with key non-EU donors in implementing biodiversity assistance/project.
  Aichi Target(s): 2 (integration into development), 17 (NBSAPs), 20 (resource mobilization).

- Action 19: "Biodiversity proof" EU development cooperation – specific actions: screening of EU development cooperation action to minimize any negative impacts on biodiversity, and undertake Strategic Environmental Assessments and/or Environmental Impact Assessments for actions likely to have significant effects on biodiversity.
  Aichi Target(s): unclear; many.

- Action 20: Regulate access to genetic resources and the fair and equitable sharing of benefits arising from their use – specific actions: proposition of legislation to implement the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization in the EU.
  Aichi Target(s): 16 (Nagoya Protocol).

Target-specific – Natura 2000/Emerald Network

Aichi Targets: 5, 10, 11, 12, 13 (protection/conservation), 14, 15 (restoration), 7 (use/management).

Various sources name specific actions necessary for fully implementing the Birds and Habitats Directives, and complete the Natura 2000 network (on a European scale). The named actions are: land acquisition; restoration of damaged habitats; infrastructure investments; designation of marine protected areas; management plans; better integration with CAP and CFP; minimum criteria for environmental inspections in the Member States; strengthening of the EU Network for the Implementation and Enforcement of Environmental Law (IMPEL); (legal) training programmes for regional and local authorities responsible for law enforcement and other administrative bodies responsible for implementation of the Birds and Habitats Directives; habitat management (EC 2011: 12, 22 et seqq.; EP 2012; EC 2011c: 4).

The Emerald Network, being in a much less developed state (only 37 designated areas in Switzerland; Council of Europe 2011), would additionally need more "basic" actions to get started. The Council of Europe lists several of these: adoption of guidelines on management for the Emerald sites and the monitoring of their implementation; update and amendment of the list of endangered natural habitats requiring specific conservation measures and of the list of species requiring specific habitat conservation measures for the whole pan-European region.

Target-specific – less negative incentives

Aichi Targets: 3 (incentives).

Incentives consist of "negative" and "positive" incentives. "Negative" incentives – i.e. incentives harmful to biodiversity, or contradicting to EU/Aichi Biodiversity targets – are in the focus of

European discussions since the failure of the first EU Biodiversity Strategy (the European Parliament states that "the inadequate degree to which biodiversity protection was integrated into other EU policies caused the failure of the first strategy"; EP 2012). Such incentives need to be greatly reduced, or reformed into providing "positive" incentives, especially since the latter type is presently much less "potent" (in terms of levels of funding)[16].

On a general level, the following actions are recommended by the TEEB Report (TEEB 2009a: 259 et seqq.) regarding the reformation of subsidy systems: "Governments should, in the short run, establish transparent and comprehensive subsidy inventories and assess their effectiveness against stated objectives, their cost-efficiency and their environmental impacts – bearing in mind that the size of a subsidy does not necessarily reflect the extent of its harmful effect. Based on these assessments, governments should develop prioritized plans of action for subsidy removal or reform, for implementation in the medium term (up to 2020). Windows of opportunity for earlier subsidy reform, arising within the existing policy cycles, should be proactively and systematically seized".

In the process of allocating CAP funds, the Member States have considerable flexibility in implementation, especially with regard to "moving" funds from Pillar 1 to Pillar 2 (and probably also the other way around – see footnote below). Although it could not be assessed in detail to which regard this happened in the individual Member States, in Germany, for example, the agricultural ministers at the "Länder" level[17] agreed to move 4.5% (220 million €/295 million US$) from Pillar 1 to Pillar 2 on 4th November 2013 (Agrarministerkonferenz 2013: 4).

Beside the CAP, the CFP provides significant subsidies, in this case to the fisheries sector. These are either issued as direct aid from the European Fisheries Fund, or indirect subsidies via e.g. the overall exemption from fuel taxes (EC 2011: 64). The payments offer no incentive to fish "sustainably", i.e. to MSY levels, avoiding by-catch and discards, etc., while at the same time creating or maintaining overcapacities and lower retail prices, artificially increasing potential revenue, thereby producing additional consumer demand for resources that are already under pressure (TEEB 2009a: 277 et seqq.; The Fish Site). A successful example of greatly reducing fishery subsidies is Norway.

Concrete actions necessary to reform European incentive policy are named by the Parliament (EP 2012), and consist of:

- Mainstreaming biodiversity protection and conservation in the development, implementation and funding of all other EU policies – including those on agriculture, forestry, fisheries, regional development and cohesion, energy, industry, transport, tourism, development cooperation, research and innovation.
- A reorientation of the CAP towards the provision of compensation to farmers for the delivery of public goods (crop rotation and diversification, permanent pasture and a minimum "ecological focus area").
- Measures aimed at eliminating discards of juvenile and under-sized fish or catches beyond quota [...] designed in such a way as to avoid providing any perverse incentives for the landing and commercialization of discards.
- Clear guidelines under the CAP Rural Development Regulation in order to ensure that afforestation does not harm biodiversity and to prevent the provision of financial support for the planting of invasive alien species.

In addition to the actions listed above, the French NBSAP lists the "reform of the tax system" and "eco labelling" as necessary actions to reform subsidies and incentives (Ministère de l'Écologie, du Développement durable, des Transports et du Logement 2010: 19).

Target-specific – research

Aichi Targets: 19 (knowledge).

As "biodiversity science is the necessary backbone for any kind of policy implementation" (EP 2012), improving knowledge is crucial for reaching the EU

16 Detailed information on incentives and subsidies, and their possibly harmful consequences, are to be found in the TEEB Report for National and International Policy Makers, chapter 6 (pages 259 et seqq.).

17 I.e. the German Federal States.

or Aichi Biodiversity targets. Specific actions consist of: better understanding and quantification of ecosystem restoration benefits; mapping and assessing ES in the EU; research into the state of marine ecosystems and fisheries resources (e.g. scientific data on fish populations) and on the sustainable management of ecosystems and natural resources (especially in the economically and socially vital sectors of agriculture, fisheries and forestry); improved monitoring and reporting; soil biodiversity and its importance in delivering ES (Tucker *et al.* 2013: 471 et seqq.; EP 2012; EC 2011b: 4).

The EEA (2010: 45 et seqq.) lists additional knowledge gaps (or research priorities): information on biodiversity (species, communities and genetic stock) in non-EU countries, on specific ecosystems (i.e. marine ecosystems. which are much less studied that their terrestrial counterparts); insight on adaptation strategies for specific ecosystems; optimal land-use strategies (consequences of habitat loss and land conversion); pan-European sustainable management indicators; benefits of green infrastructure.

Target-specific – awareness raising
Aichi Targets: 1 (awareness).

The European Parliament (EP 2012) lists concrete actions to be taken: a more comprehensive communication strategy in line with Aichi Target 1; organise biodiversity awareness and information campaigns for all ages and social categories, on the understanding that awareness campaigns for children and adolescents who are deeply concerned about this topic should be organized first and foremost in the school setting; education and professional training, particularly in farming, forestry and related sectors; available scientific data on biodiversity, examples of best practices for halting biodiversity loss and restoring biodiversity, and information on nature-based innovation and development potential be more widely known and shared among policy-makers and key stakeholders; expand and intensify training for beneficiaries of the EU Structural and Cohesion Funds, and for local, regional and national governments, in dealing with the complex European and national legislation aimed at protecting nature and increasing awareness of the importance of biodiversity loss.

Target-specific – pollution reduction
Aichi Targets: 8 (pollution).

A good overview of the actions necessary to prevent nutrient pollution is provided by the Nitrates Directive: use of crop rotations, soil winter cover and "catch crops" – fast-growing crops grown between successive planting of other crops in order to prevent flushing of nutrients from the soil; limiting application of fertilizers and manures to what is required by the crop, based on regular soil analysis; proper storage facilities for manure, so that it is made available only when the crops need nutrients; the use of the "buffer" effect of maintaining non-fertilized grass strips and hedges along watercourses and ditches; good management and restriction of cultivation on steeply sloping soils, and of irrigation (Secretariat of the Convention on Biological Diversity 2010: 61).

Where would these investments be best directed or focused?

In this section, the "priorities for action" are identified on the basis of the identified investment needs, under consideration of regional differences (mainly EU/non-EU).

In the EU, the necessary actions – "investment" – to reach the EU/Aichi Biodiversity targets are relatively clear and specified (see lists above), and financing instruments exist to address these. Nevertheless, the uptake of financial assistance to implement several of these measures is limited – for example, by the end of September 2009, the uptake of EU Cohesion funds allocated to biodiversity was lower than for other spending categories. At that time, the uptake for the two categories directly related to biodiversity ("promotion of biodiversity and nature" and "promotion of natural assets") was 18.1% and 22% respectively, compared to an average of 27.1% for all EU Cohesion Policy funding (CBD 2013c). Other problems related to financing or the uptake of financing possibilities include short timeframes of funding that do not allow for the continuity that is often needed to enable biodiversity-related projects to succeed, the lack of clear targeting of funds for biodiversity, the management of most EU funds at the national level (according to sectoral priorities, which do not always include biodiversity conservation as a primary concern) and limited capacity/knowledge in some Member States to apply for funds, as well as high administrative burdens in some cases (EC 2011: 15 et seqq., Kettunen *et al.* 2009).

Closely related to these financing issues is the reform of the subsidy systems for agriculture and fisheries, and the relocation of EAFRD[18] funding towards biodiversity protection (especially Natura 2000 sites) – as an example: the share of the EAFRD funding allocated to the protection of Natura 2000 between 2007 and 2013 sites was only 0.62%, although Natura 2000 agriculture and forest sites are also financed under agri-environmental schemes (EC 2011a: 17). A "greening" CAP reform seems especially important considering the timeline: the next CAP will determine agricultural and rural development funding until 2020, the target year for both EU and Aichi Biodiversity targets. Also, as a report by IEEP (Tucker *et al.* 2013: 465 et seqq.) states, the EU target 2 (consisting mainly of protection and restoration) will probably not be achieved if "certain regulations (CAP cross-compliance, WFD) are not implemented as intended", highlighting the importance of reforming the subsidies system.

There is furthermore no doubt about the linkages and overlaps between reaching the Aichi Biodiversity targets and the completion of the Natura 2000 network in the EU (Natura 2000 addresses the protection and restoration strategies of the Aichi Targets, as well as management and sustainable use targets). Due to a slow development of Natura 2000 management plans or equivalent instruments, there is a lack of concrete data on the impacts of funding, and a weak evidence base for financial planning (EC 2011: 15 et seqq.).

As "biodiversity science is the necessary backbone for any kind of policy implementation" (EP 2012), improving knowledge is crucial for reaching the EU or Aichi Biodiversity targets. The same holds true for awareness raising, especially in education. Both the increase of knowledge and the raising of awareness are also relatively low cost measures (in comparison to restoration and land acquirement, for example), and facilitate the later implementation of other measures.

From these points, several "priorities for action" – i.e. actions most important for reaching biodiversity targets (see, for example, table 1 in Appendix 4 for a list of the EU biodiversity targets) – are identified for the EU and its Member States:

- Ensure a better uptake and distribution of existing funds for biodiversity: reform of agricultural (and fishery) subsidies; longer timeframes for biodiversity funding; clearer targeting of funds for biodiversity, also at the national level; capacity building and decrease of administrative burdens.
- The latter point is of special concern for new Member States in Eastern Europe, lacking the experience in applying for EU funds.
- Reforming the agricultural subsidy system ("Greening" the CAP), and e.g. reallocating funds from the first to the second Pillar (the CAP reform 2014-2010 has been agreed, but the final text is not available as of December 2013).
- Completing the Natura 2000 network, and establishing management plans or similar instruments in the sites, also to obtain data on the impacts and effectiveness of financing.
- Increase knowledge and awareness.

As stated above, the focus in the new EU Member States will be more on capacity building with regard to the uptake of financing opportunities; awareness of the values of biodiversity for society, and knowledge about ecosystems and ES is generally slightly lower in Eastern than in Western Europe (FotE 2013). There could be a higher focus on conservation instead of restoration measures in Eastern Europe (and in countries belonging to the pan-European region, i.e. Russia, the Caucasus etc.; see TEEB 2013), due to the larger undisturbed areas still intact – e.g. the important, unfragmented grassland areas in Eastern Europe, compared to the highly fragmented agrarian landscapes in Western Europe (e.g. Germany, Netherlands). At the same time, in Western Europe the focus could be more on restoration than conservation.

18 European Agricultural Fund for Rural Development.

For the whole of **Europe**, Friends of the Earth Europe (FotE 2013) assessed the progress of European states towards several Aichi Targets, drawing conclusions regarding priority actions:

- Aichi Target 1: Although all EU Member States are working on awareness raising, only a few states have a comprehensive awareness raising strategy. Hence, a priority identified consists of comprehensive actions towards awareness raising, especially in Switzerland, Norway, Bosnia and Herzegovina, Serbia and Ukraine, and in Albania in terms of practical implementation.
- Aichi Target 3: In spite of the importance of this target, which is recognized by CBD Member States, there is not a single assessed country in which negative incentives have been phased out (the document goes so far as stating that this target "needs the most attention").
- Aichi Target 5: the conservation status of protected areas is still not in favorable condition in many PAs in most European states (56-100% in unfavorable condition), and more effort is needed "to stop the loss of habitats and achieve FCS for all these habitats".
- Aichi Target 7: An expansion of organic farming and sustainable forestry with undisturbed forests is needed in all of Europe. Organic farming is not yet widespread in South-Eastern Europe, although much traditional agriculture still exists there (with positive effects on biodiversity).
- Aichi Target 11: Regarding protected areas and the Pan-European network of protected areas, the fields in which action is most direly needed are the Emerald Network (no designation of any sites except in Switzerland; Council of Europe 2011, 2012), improved funding, and the establishment of management plans for protected areas (finalized only in the UK).
- Aichi Target 16: Only Norway ratified the Nagoya Protocol (in August 2013), Switzerland will follow at the end of 2013. The EU MS will ratify once the EU has formulated a community regulation, whose quality will be decisive for the question of whether target 16 will be reached.
- Aichi Target 17: Implementation of the NBSAPs also "leaves a lot to be desired", according to the document.
- Aichi Target 20: For most countries, there is no data available on how biodiversity spending relates to GDP per capita, but in most countries where data is available, the share is well below 0.1%. The document states that "given importance of stopping biodiversity loss, these small numbers are very worrying".

With regard to **non-EU countries**, there is little information about investment needs or priorities for action available – a comprehensive assessment of the most important investments/actions/ measures does not exist, and the NBSAPs do not contain any information on prioritizing measures, resource needs, a timeline, or other data which could be of use in the course of this study (this is true for the more important countries in Eastern Europe: Russia, Belarus, Ukraine; see below for the information that could be extracted from the Russian NBSAP). Basically, however, it can be stated that the situation surrounding biodiversity protection and sustainable use of resources is at a similar level in the Western European non-EU countries (i.e. Switzerland, Iceland, Norway) – Switzerland, for example, is part of the Emerald Network (see section 4.2), and the only country partaking which has designated it's protected areas. The major problems and priorities in these countries will probably be similar to the EU Member States, only lacking the EU-specific financial coordination mechanisms. In the non-EU Eastern (and pan-) European countries (i.e. Belarus, Ukraine, the Russian Federation, the Caucasian countries, Moldova, but to a certain degree also Serbia, Albania), the situation is completely different: much more basic activities are foreseen to be necessary here: basic studies and surveys about the state of ecosystems and ES, which are already existing in Western Europe, are mostly missing in non-EU Eastern Europe; the designation of protected areas (e.g. for inclusion into the Emerald Network); and many legal and compliance issues (UNEP 2011).

Which targets will these investments help to meet, and what are the synergies and overlaps between targets?

The targets the investments/actions help to meet are identified in section 4.5 above. However, the investments which impact many targets are outlined here, with short explanations, if deemed necessary.

- EU Biodiversity Strategy/Action 1: Complete the establishment of the Natura 2000 network and ensure good management (the same holds true for the Emerald Network): the underlying actions – full establishment of terrestrial and marine network by 2012, further integration of species and habitats protection and management requirements into key land and water use policies, the development and implementation of management plans or equivalent instruments which set out conservation and restoration measures in the protected areas, and the sharing of experience and knowledge regarding the management of Natura 2000 sites – help reaching the Aichi Targets 5, 10, 11, 12, 13 (protection/conservation), 14, 15 (restoration: through the integration of "conservation and restoration measures" into the management plans), 7 (use/management), 19 (knowledge: though the sharing of experience).

- EU Biodiversity Strategy/Action 8: Enhance direct payments for environmental public goods under the EU CAP (also accurate for other schemes to reduce negative incentives and shift these to biodiversity conservation): the underlying actions – the reform of CAP direct payments to reward the delivery of environmental public goods that go beyond cross-compliance (examples: permanent pasture, green cover, crop rotation, ecological set-aside, Natura 2000),and to improve and simplify the GAEC (Good Agricultural and Environmental Conditions) cross-compliance standards and consider including the WFD within the scope of cross-compliance – help reaching the Aichi Target 3 (incentives), but also several others indirectly, as the shifting of incentives could foster "Ecological Focus Areas" and organic farming, as well as water quality improvements (through the integration of WFD into cross compliance, or less fertilizer/pesticide application); hence, the protection/conservation goals could be supported indirectly, as well as the targets 7 (use/management), and 8 (pollution).
- Similarly, there is a number of EU Biodiversity Strategy Actions that are linked indirectly to several protection and conservation targets: Action 9 ("Better target Rural Development to biodiversity conservation"), Action 11 ("Encourage forest holders to protect and enhance forest biodiversity – specific actions: management plans"), Action 12 ("Integrate Biodiversity measures in management plans") and Action 17 ("Reduce indirect drivers of biodiversity loss") are among these.
- EU Biodiversity Strategy/Action 14: Eliminate adverse impacts on fish stocks, species, habitats and ecosystems: as one underlying action, the implementation of the MSFD is mentioned, which would have great consequences for Aichi Targets related to protection/conservation, and sustainable use of marine resources; additionally, as "nutrient input" is also a major pressure to be tackled by the MSFD, and because most nutrient input originates from terrestrial sources (mostly agriculture), the Aichi Targets 7 (sustainably manage agriculture) and 8 (pollution) would also benefit.

Other investments/actions are more difficult to attribute to specific Aichi Targets. The most important of these actions include the environmental legislation of the EU (especially WFD, MSFD and Natura 2000). Their possible contribution to the Aichi Targets is summarized in section 4.3 on methodological issues.

What Types Of On-Going Annual Expenditures Will Be Required?

Information on one-off and on-going annual expenditures is also contained in section 4.6 below.

Usually, "recurrent costs" (i.e. on-going annual expenditures) are mostly due to investments in conservation measures "for the maintenance and improvement of the conservation status of habitats of Community interest as well as the implementation of management schemes and agreements with owners and managers of land or water" (whereas the level of one-off costs depends pretty much on costs for infrastructure and land acquisition) (Hart *et al.* 2011: 28).

Other recurrent costs are due to training, education and awareness raising measures, as well as research/knowledge generation and sharing (EC 2011: 12, 22 et seqq.; EP 2012; EC 2011c: 4).

Hence, it can be concluded that the restoration and conservation targets (i.e. mostly 11-15) incur the highest levels of both recurrent and one-off costs, whereas the exact share between the two depends very much on specific circumstances (mainly how much land needs to be acquired, or on the level of infrastructure/technical measures necessary in case of restoring ecosystems). "Soft" measures – training, education and awareness raising measures, as well as research/knowledge generation and sharing – consist mainly of recurrent investments/costs.

The only comprehensive overview of one-off and recurrent costs that develop in a specific policy field was found with regard to Natura 2000. The following figure provides an overview for the costs associated with establishing the network:

How do the types of investments and ongoing expenditures identified compare to those identified in the first phase of the HLP research?

The above listed investment needs are to a large extent close to the needs the HLP set out in its first report at global level (as seen in HLP 2011). The key differences identified in this report are the following (based mainly on information from the EU, as other information was rarely sufficient to allow a comparison):

- Aichi Target 3, corresponding to EU actions 8 and 14: the EU proposals for concrete actions are much more specific than the HLP's, and targeted towards CAP and CFP; with regard to non-EU countries, in this case Russia, the reform of

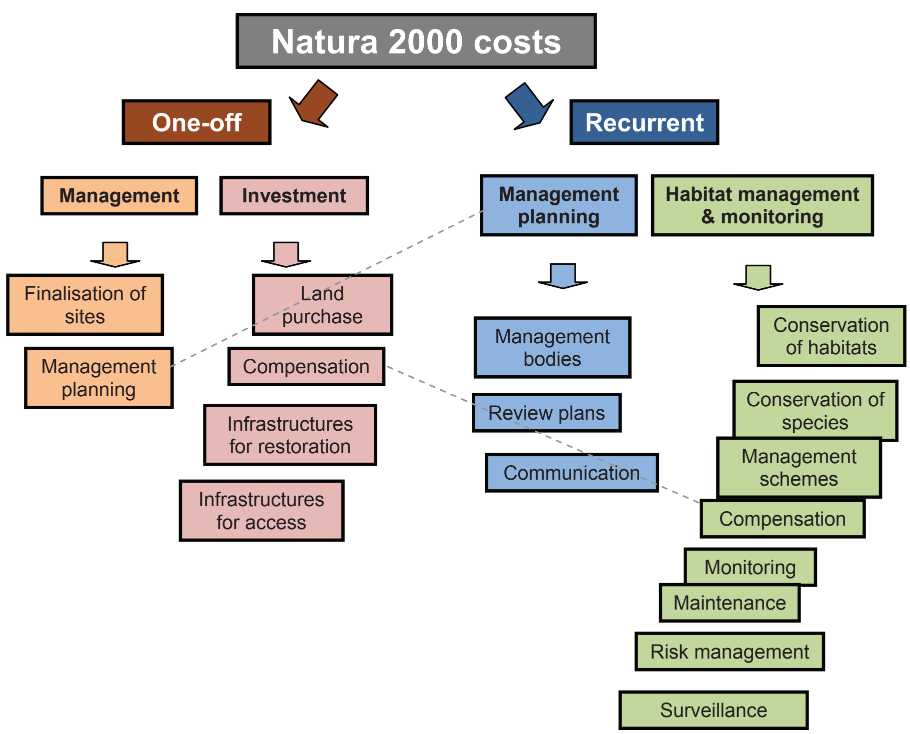

Figure 2: One-off and recurrent costs in Natura 2000 implementation. Source: Hart *et al.* 2011: 29.

negative incentives is not mentioned; instead, it is stated that in the current phase of development, the country has to rely more on regulations that incentives.

- Aichi Target 5 (forestry aspect): the HLP's actions "law enforcement" and "training and education of professional officers" are actions mentioned in East European countries' NSBAPs, and in the EU are issues only in the relatively new Member States (Romania, Bulgaria, for example); also, "financial incentives which counter illegality" seems not to be too much of a topic in the EU.
- Aichi Target 7 (agricultural aspect), corresponding to EU actions 8, 9, 10 and 17: similarly as above, the establishment of property rights, as proposed by the HLP, is not an issue in the EU countries, and the global measures are also not mentioned.
- Aichi Target 7 (forestry aspect), corresponding to EU actions 11 and 12: not in the focus of the EU specific actions is the HLP's "creation of products", with the exception of PES – but, for example, to develop "tourism products" is not mentioned.
- Aichi Target 8, corresponding to EU action 17 (but not 100% – a separate EU action to reduce pollution does not exist): the EU countries, at least the older Member States, all have sophisticated infrastructures regarding pollution control; as such, the HLP's actions "investments in urban stormwater retrofits" or "installation of best available technologies for stationary and mobile sources of pollution" are not mentioned, although in some Eastern EU MS and non-EU countries certainly still an important topic.
- Aichi Target 14, corresponding to EU action 17 (at least in parts): the HLP's "removal of subsidies and public support for harmful infrastructure such as dams and new road construction that destroy, fragment, or degrade ecosystems" is not mentioned in the EU targets, and was not found in other NBSAPs.

With regard to the share of one-off vs. recurrent investments, the HLP (2011: 12) suggests that "upfront investment needs tend to be greater than the resources required to fund ongoing activities", estimating the share to reach 60 to 70% of overall (global) resource needs over the 2013 to 2020 period. There is not such specific information available on shares in Europe, except from the Natura 2000 policy field: IEEP (Hart *et al.* 2011: 28) estimate that recurrent costs represent two thirds of the estimated overall figure (for Natura 2000), i.e. exactly the opposite of the HLP estimation: naturally, Natura 2000 does not represent the total costs of reaching the Aichi Targets in Europe/the EU – nevertheless, as protection, conservation and restoration measures tend to be the most cost-intensive measures, a significant share of overall costs could be represented by this figure; see section 4.6 for more details.

4.6 RESOURCE REQUIREMENTS

What evidence is there of resource needs at the project and country level?

Evidence is presented separately for the EU27, national levels, and sectoral policies.

EU27 level

Overall, the Impact Assessment of the European Commission (EC 2011: 58) states that the "costs and benefits of establishing green infrastructure and restoration projects (corresponding to Aichi Targets 10, 11, 12, 14, 15) have not yet been estimated at EU level". Instead, evidence is provided by citing case study examples. Other studies also tend to be site-specific, or focused on one particular environmental issue ("sector"), such as achieving favourable conservation status on Natura 2000 sites or meeting biodiversity targets in particular Member States, or treat more generic costs associated with maintaining High Nature Value (HNV) farming across the farmed landscape or addressing soil erosion and declines in soil organic matter (Hart *et al.* 2011: 1 et seqq.).

One overall estimation exists regarding the funds needed on all levels "to deliver the EU's environmental objectives using incentive-based measures": these are estimated to be 43 billion €/a (± 8.5 billion €) [60 billion ± 11.9 billion US$/a] (Hart *et al.* 2011: 3 et seqq.). There is, however, no link established to either the EU or the Aichi Biodiversity targets (i.e. an explanation what the "EU's environmental objectives" consist of – although it seems that environmentally friendly land management in agricultural and forestry areas seem in the focus – which would correspond to many Aichi Targets, especially 3 [which would be necessary to obtain the funding], 5, 7, 8, 10, and 11-15, and of course 20). However, the study also states that there is "very little literature on the anticipated costs of incentive policies to address these environmental needs" (Hart *et al.* 2011: 1), and only one study that analyzes the full range of environmental needs, that is for the UK.

Another IEEP study (Tucker *et al.* 2013: 465 et seqq.) assesses the costs of reaching the EU Biodiversity target 2 in the EU27 (corresponding to the Aichi Targets 8, 10, 14 and 15, but with important links to the protection targets as well, i.e. 11-13). The costs are depicted as "additional costs until 2020" (i.e. in addition to the costs of existing measures and others that are expected to be taken up until 2020 under a reference scenario: CAP payments, and funding of WFD and MSFD measures), and are broken down per "support action" or sectoral measures (see section 4.1):

- Support Actions 5 and 7[19] ("improving knowledge of ecosystems and their services" and "ensuring no-net loss of biodiversity"): tens of millions of €/US$ from 2010 to 2020.
- Measures that "treat the source of generic wide-scale pressures" (water/air pollution): WFD costs (but no additional ones), and of measures against air pollution and atmospheric deposition, which have not been estimated.
- Practical ecosystem management/restoration/re-creation measures (such as water management, grazing and removal of invasive species): 618 – 1,660 million €/a [829 – 2,226 million US$/a] in mainly arable and forest areas[20].

The report additionally notes, however, that if "certain regulations (CAP cross-compliance, WFD) are not implemented as intended, then either Target 2 will not be achieved or additional funding will be required".

Another study with a similar objective (Hart *et al.* 2011), but focussed on achieving EU target 2 in agricultural ecosystems only, estimates the total costs for maintenance, restoration and re-creation requirements on arable land, grassland and permanent crops to reach 29.2 billion €/a [40.7 billion US$/a] until 2020, a sum which exceeds the IEEP estimation by a factor of 3 (Tucker *et al.* 2013: 470).

Another source – Kaphengst *et al.* (2010) – focuses on ten policy areas "comprising the core aspects of biodiversity and ecosystem conservation within the EU" (Kaphengst *et al.* 2010: 113):

- Natura 2000, national (terrestrial) protected areas, species conservation, conservation and restoration of high nature value farmland, conservation and restoration of forest areas: roughly corresponding to Aichi Targets 5, 7, 10, 11, 12, 14 and 15.
- Wider environmental policy measures positively affecting biodiversity: impossible to attribute to specific Aichi Targets, as the formulation is very vague.
- EU strategy to combat invasive alien species: Aichi Target 9.
- EU research on biodiversity: Aichi Target 19.

19 Support Action 6 – promoting a green infrastructure – was not assessed due to double counting issues (IEEP 2013: 465).

20 It is stated that this figure is probably an underestimation, due to not taking into account significant cost factors, such as general ecological research and monitoring, development of strategies, policies and legislation, site wardening, regulatory enforcement and awareness raising on biodiversity issues, species-specific measures, land purchase requirements, and marine ecosystem maintenance and restoration measures (IEEP 2013: 469).

Policy	Estimated Annual Costs (€m)	Estimated Opportunity Costs (€m)	Share of opportunity costs over total (%)
A. Natura 2000 Network	5,772	2,069	35.8
B. National Protected Areas	1,280	459	35.9
C. High Natural Value Farming	4,370	3,390	71.7
D. High Natural Value / Semi-natural Forestry	4,500+	4,500	n/a
E. Species Conservation	2,841	1,697	59.7
F. Marine Protected Areas	235	n/a	n/a
G. Biodiversity Research	648	n/a	n/a
H. Invasive Alien Species	193	Negative	n/a
I. Correction for Overlaps between above Estimates	- 4722	-3696	-
J. Total	**10,617**	**8,419**	**n/a**

Note: n/a = information not available

Figure 3: Synthesis of costs incurred in EU biodiversity policy. Source: Kaphengst *et al.* 2010: 113.

The costs for these activities are estimated to reach 10.6 billion €/a [15.2 billion US$/a], and are depicted in figure 3 (probably, according to the authors of the study, a significant underestimation):

In this study, the costs are hereby divided into financial costs – defined as "real payments and expenditures for biodiversity actions (e.g. compensatory payments and management costs) that also include payments/expenditures for activities that are only indirectly associated with the action, but also have to be taken into account (e.g. administrative and transaction costs)" – and opportunity costs. However, the latter, which are also depicted in the table above, are opportunity costs internalized in existing expenditures (such as compensation payments and land purchases). Other, non-compensated opportunity costs – loss of output as a result of foregone development opportunities and lost opportunity to a range of sectors, such as fisheries and natural resource-based industries – are not quantifiable (see also Tucker *et al.* 2013: 78), and therefore not included in the report. Hence, the table above depicts the financial costs, and the part of the financial costs that are classified as "opportunity costs", as a share of the total financial costs (i.e. the 8.4 billion € in opportunity costs are a part of the 10.6 billion € overall costs).

Anecdotic evidence regarding several Aichi Targets or aspects of these were found in different studies:

- Aichi Target 3 (incentives): The EU Impact Assessment (EC 2011: 62) states that no additional costs are expected reforming the CAP payments ("greening" the first Pillar and introducing changes to the second Pillar), as only a redistribution of funds would be necessary. Furthermore, such redistributions would "also allow for a higher diversification of the agricultural sector, adding value to rural products and services associated with specific natural or landscape elements".
- The Impact Assessment also estimates the costs for aspects of Aichi Targets 1 (awareness) and 19 (knowledge) – an EU-wide campaign to "strengthen recognition of the multiple ecosystem benefits that derive from the effective management of the Natura 2000 network" would cost 350,000 € [489,000 US$], while the EU-level coordination of a new bird reporting system would cost around 400,000 € [558,000 US$].

National level

Regarding the data situation on the national level, there is only a single comprehensive study that addresses the full range of environmental needs – including synergies – of meeting an individual countries' future environmental land management requirements: Cao *et al.* (2009) assess the costs for meeting the **UK's** environmental targets for "biodiversity, landscape, climate change mitigation, flood risk management, farmland historic environment, soil quality, water quality, resource protection and public access". The study is based on the established UK targets and current agri-environment payment rates, and assumes management on all 16.2 million hectares of agricultural and forestry land in the UK. The total costs are estimated to reach 1,986 billion €/a [2,906 billion US$/a], which is three times the existing annual agri-environment budget. It is stated, furthermore, that costs are probably significantly underestimated (Hart *et al.* 2011: 1 et seqq., 25 et seqq.).

A study in the **Netherlands** (Overmars/van Zeijts 2010) assessed the area and budgetary requirements to fulfill the needs for biodiversity protection and sustainable use of resources in agricultural areas, according to the National Biodiversity targets. The assessed management practices consisted of those needed for the conservation of meadow and other farmland birds, and for wild flora. Management would be applied on either 159,300 hectares (core areas) or 377,900 hectares (across the farmed countryside), resulting in costs of 76 million €/a (476 €/ha/a) [109.5 million US$/a or 685 US$/ha/a] in the first case, and 232 million (616 €/ha/a) [334 million US$/a or 887 US$/ha/a] in the second (Hart *et al.* 2011: 30 et seqq.).

Examples from other countries include **Bulgaria**, where the costs of implementing the "National Biodiversity Conservation Action Plan" (a set of activities carried out during the 1999-2003 period – i.e. no relation to the Aichi Targets) were estimated to reach 44,355 million Lev (around 30 billion US$) (CBD 2013: 7). In **Moldova**, the implementation of the "Action Plan on Biodiversity Conservation" (implemented over a period of 10 years, from 2002 onwards) is estimated to cost 87 million Lei (18.7 million US$) in total, or 12 million Lei (2.6 million US$) per year, representing 0.14% of the national GDP. However, the expenditures on biodiversity conservation from all financing sources summed up to around 29 million lei (6.3 million US$), which represent 0.3% of the GDP (CBD 2013: 17 et seqq.).

In **Spain**, the budget requirements for proper implementation of the actions contained in the Strategic Plan (six years lifetime) are estimated to reach 750 million € [1,412 US$] – however, the underlying planning document seem to stem from 1999, and has no relation to the Aichi Targets (CBD 2013a: 20 et seqq.; CBD 2013d: 65).

With regard to **development countries and countries with economies in transition (i.e. countries eligible for GEF funding[21])**, a team of CBD experts estimated the costs for various activities to reach the individual Aichi Targets for the sixth replenishment period of the trust fund of the Global Environment Facility (2014 to 2018). The results are presented in the following table 6.

The same document also presents figures for selected (GEF eligible) countries (in the pan-European region: Russian Federation and Belarus) and targets. It is estimated that the financial needs for implementing the programme of work on protected areas (Aichi Target 11) in the Russian Federation and Belarus amount to 95 million US$/year and 4.5 million US$/year, respectively (CBD 2012: 182).

Sectoral policies

There are several studies estimating the resource requirements for completing (or otherwise improving) the **Natura 2000 network** in the EU27. For example, the EC appraises the costs to "reach favourable conservation status" in protected areas, and concludes that 5.8 billion € [8.1 billion US$] would be needed annually (comprised of one third one-off investments, two thirds recurring costs, a share which is highly influenced by spending for infrastructure and in some Member States by the budget allocated to land purchase) (EC 2011: 15; Hart *et al.* 2011: 28 et seqq.). This estimate is confirmed by Gantioler *et al.* (2010), setting the costs for all terrestrial Natura 2000 sites at 5.7 billion €/a [8.2 billion US$/a], or 63 €/ha/a [90.7 US$/ha/a] (Hart *et al.* 2011: 28 et seqq.). It is remarked, however, that this figure is probably an underestimation, as other studies assume much higher per hectare costs – 107 €/ha/a [186 US$/ha/a] based on the Markland Report (Markland 2002), or 128 €/ha/a [187.2 US$/ha/a] from BirdLife International (2009) (Hart *et al.* 2011: 28). However, per hectare values in assessed countries always vary significantly, e.g. from €14/ha/a

21 In the pan-European region, these include several East European countries (e.g. Albania, Belarus, Bosnia-Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Macedonia, Moldova, Montenegro, Poland, Romania, Serbia, Slovak Republic, Slovenia, Turkey, Ukraine) as well as the Malta and the Russian Federation, and countries in the Caucasus region (e.g. Armenia, Azerbaijan, Georgia) (GEF).

in Poland to more than €800/ha/a in Cyprus, Luxembourg and Malta (Hart *et al.* 2011: 29).

Gantioler *et al.* (2010) break down the costs for the management of the Natura 2000 network by land use – the biggest share (of the 5.7 billion €/a or 8.2 billion US$, see above) is allotted to agricultural areas (35%, or 2,025 billion €), closely followed by forestry (33%, or 1,915 billion €), "other terrestrial" sites (11%), inland waters (7% or 430 million €), wetlands and coastal ecosystems (both 6%), and marine ecosystems (1%).

The estimates cited in the IEEP study (Hart *et al.* 2011) for the **forestry sector** are not entirely consistent, although the reason for this may lie in differences in definitions: in one place, a study by Kaphengst *et al.* (2010) is cited to have calculated the costs for "the management of semi-natural forests in the EU27", or "HNV forestry" (it is mentioned that the definitions are vague), based on Gantioler *et al.* (2010). The costs associated with HNV forestry in the EU27 are estimated to be 1.5 billion €/a [2.16 billion US$/a] for 40 million hectares (37 € or 53.2 US$/ha/a), and expanded to cover all public and private forests in the EU27 (150 million hectares), to reach 4.5 billion €/a [6.5 billion US$/a]. It is stated, however, that this figure is probably an overestimation (Hart *et al.* 2011: 27 et seqq.).

A different aspect of forest management is the development of management plans. For a duration of ten years, the EC's Impact Assessment estimates the costs to be in the order of 10 to 60 €/ha [13.7 to 83.7 US$/ha] (depending on the size of the area) (EC 2011: 63).

Several estimations exist also with regard to **water management**. As described above, it is generally assumed that no additional funds over and above the necessary spending for implementing the water legislation of the EU (mainly WFD, UWWT and Nitrates Directives) are needed to reach the water-related aspects of the Aichi and EU Biodiversity targets (Tucker *et al.* 2013: 466[22]).

22 The IEEP study refers to the EU target 2. The practical ecosystem management measures contained in this target, however, are probably the costliest water-related measures of the EU Biodiversity targets.

One study, prepared in the context of the EC's Blueprint, estimates the costs of all WFD-related measures in the EU27 to reach 8-15 billion €/a [10.9 to 20.5 billion US$/a] (ACTeon Environment 2012: 46). Other evidence exists only on the national or sub-national scale: in the Netherlands, implementing the measures contained in the Programs of Measures (for the WFD; i.e. which theoretically should be sufficient to reach Good Status/Potential) could cost 2.3 billion € [3.2 billion US$] until 2015, and additional 1.9 billion [2.6 billion US$] from 2015 to 2017; in the UK's South West, South East and Anglian regions, the costs add up to 66/40/114 million £ annually [109/66.5/190 million US$/a]; in Belgium's Scheldt river basin, 171 to 845 million €/a [238.5 to 1,179 million US$/a], and in Catalunya (Spain) 6.3 billion € until 2015 [8.8 billion US$] (Hart *et al.* 2011: 40). These national/sub-national figures, however, are difficult to "translate" into Aichi or EU Biodiversity targets, as the degree to which the Programs of Measures reach the Good Status varies significantly across Member States.

Soil degradation is addressed as well, but cost appraisals vary in terms of necessary spending and definitions: the "annual costs of addressing soil organic matter decline" could sum up to 3.4 to 5.6 billion € [4.7 to 7.8 billion US$/a] (these costs were derived from regional studies scaled to the EU level and not from EU level assessments of soil organic matter decline; it is stated that these are probably an underestimation), other sources speak of 12 billion €/a [16.6 billion US$/a] to "halt soil organic matter decline", or up to 38 billion €/a [53 billion US$/a] to address erosion, soil organic matter decline, salinisation, landslides and contamination (Hart *et al.* 2011: 3 et seqq., 33, 44). The high variance is even more visible through the estimation of the Soil Thematic Strategy Impact Assessment (CEC 2006), providing figures to halt soil erosion: 0.7 to 14 billion €/a [1.09 to 21.8 billion US$/a].

Maintaining **HNV farmland** in all EU27 Member States is estimated to cost 16 billion €/a [22.3 billion US$/a] (assuming an average payment for HNV farming of 200 € or 279 US$/ha/a over an estimated HNV farmland area of 80 million hectares). Again, it is stated that this figure is probably an overestimation of the actual costs; other estimation are even higher, reaching 23 billion €/a [32 billion US$/a] (Hart *et al.* 2011: 3 et seqq.; 26), others lower, as the study by Kaphengst *et al.* (2010): 169 € or 243 US$/ha/a over an area of only 25 million hectares, to reach 4.37 billion €/a [6.24 billion US$/a] (Hart *et al.* 2011: 44).

Research activities are manifold, the best evidence regarding the costs of an assessment and mapping of ES on a national basis coming from the UK, whose National Ecosystem Assessment (UK NEA 2011) cost a total of 1.2 million £ [ca. 2 million US$] (but which relies on existing data) (EC 2011: 59).

The costs of effectively fighting **invasive alien species** in the EU27 are estimated to be in the range of 40 to 190 million €/a [55.8 to 265 million US$] (significantly less than the damages incurred by IAS) (EC 2011: 66).

How does this evidence compare with the analysis presented in the hlp's report to COP-11?

Because of the lack of EU- or Europe-level estimates regarding the overall resource needs, the study extracted all unit costs that could be obtained, to allow for comparison with the HLP's report to COP-11 (which is not presented here). The unit costs listed in table 7 below are mainly spatial (per hectare) values, but other "units" (such as "costs per study") were also included, to be compared with unit costs estimated, for example, from the report by the High-Level Panel (2011: 5, 33 et seqq., 52 et seqq.) and ICF GHK (Rayment 2012; Conway 2012).

One aspect of the HLP's estimation, however, should be highlighted here: in the High-Level Panel report (HLP 2011: 5), the following dimensions of financing needs are appraised:

- *Significant investment required*: For those targets specifically aimed at addressing the drivers of biodiversity loss and ecosystem restoration, the required total global investment over the period 2013 to 2020 is in the order of several hundreds of billions of (US) dollars. Targets in this group fall under Strategic Goals B and D (excluding Target 16).
- *Moderate investment required*: Targets associated with required conservation work will require total global investment over the period 2013 to 2020 in the order of hundreds of billions of (US) dollars for Target 11 (i.e. establishing and maintaining protected areas) and in the order of tens of billions of (US) dollars for the other Targets of Strategic Goal C.
- *Low investment required*: Targets related to improving and creating necessary enabling conditions are likely to be much less resource-intensive. For these Targets, the total global investment needs over the period 2013 to 2020 will more likely be in the order of billions of (US) dollars. These Targets mostly relate to Strategic Goals A and E, as well as Target 16.

Generally, the evidence found in this report points in the same direction, i.e. that the restoration strategies as well the actions addressing the drivers of biodiversity loss are among the most costliest of all measures, and that the "enabling" strategies are less resource-intensive. However, two "fields of action" may differ from this assessment:

- Actions to address the drivers "agriculture" and "fisheries" (which are heavily subsidized in Europe, especially in the EU) will not be costly on a macro-economic scale, as principally already existing funds would have to be relocated (while at the same time approaching target 3).
- Targets associated with required conservation work (especially target 11) is assessed as also belonging to the highest cost categories in Europe, since the establishment of protected areas/a system of connected protected areas is associated with high costs (mostly for land acquirement), and conflict over land use (considering the dense population levels in Europe).

What evidence is there for current allocations relative to needs?

As already stated above, the collection of expenditure data is incomplete in the EU Member States (no agreed methodologies as to how determine funding for biodiversity). Therefore, the exact amount spent on biodiversity remains difficult to assess (EC 2011: 15). The fourth CBD report of the EU exemplifies this by the following statement: "From the information received by the Member States, it is impossible to assess the level of direct financial contributions to national biodiversity conservation schemes (as a percentage of GDP)...The available information shows that substantial funding for national biodiversity in the EU is released through a range of European, national and sub-national programmes, ranging from dedicated nature protection schemes to rural development measures. It is not possible to ascertain whether financial support has increased since adoption of the BAP" (EC 2009: 48). For non-EU countries, the data situation is even weaker than in the EU (some information from Serbia and Russia was usable, see below).

Nevertheless, some data could be found regarding the EU level, which could be set in relation to the resource needs formulated above – the Rural Development Programme of the EAFRD allocated 20.3 billion € [ca. 30 billion US$] from 2007-2013 to agri-environment measures. In addition, 577 million € [872 million US$] were allocated specifically to Natura 2000 agriculture and forest areas. In the same time period, 2.7 billion € [4.07 billion US$] were allocated to the ERDF titles "the promotion of biodiversity and nature protection", 1.4 billion € [2.1 billion US$] to the protection of natural assets (which includes biodiversity projects), and 1.4 billion € [2.1 billion US$] to the protection and development of natural heritage (which also includes spending on biodiversity).

The estimated resources needed for completing the Natura 2000 network and reaching favourable conservation status are 5.8 billion €/a [8.1 billion US$/a]. The European Commission estimates that "if all financing instruments – i.e. all nature/biodiversity related funding under the cohesion policy as well as Natura 2000 payments and 20% of agri-environment funding under rural development policy – would be allocated to Natura 2000, then only 20% of financing needs would be covered" (EC 2011c: 7; EC 2011b: 9).

The study by IEEP (Hart *et al.* 2011: 3 et seqq.) relates the resource needs "to deliver the EU's environmental objectives using incentive based measures" (43 billion €/a, ± 8.5 billion; or 60 ± 11.9 billion US$/a) to EU budgetary allocations:

- The predicted current expenditure under agri-environment and other relevant measures operated through rural development policy: 13.5 billion €/a [18.8 billion US$/a];
- LIFE+ and Structural Funds (other funds focused on meeting environmental objectives associated with agricultural and forestry management through other funding programs): ca. 1 billion €/a [1.38 billion US$/a].

These figures include national co-financing of ca. 5 billion €/a [6.9 billion US$/a], the yearly EU funds therefore sum up to around 9.5 billion €/a [13.1 billion US$/a]; if the same co-financing ratio would be applied (average 64 per cent EU to 36 per cent Member States), the "proportion of the cost estimates presented here that would need to be sourced from the EU budget would come to approximately 27 billion €/a" [37.3 billion US$/a] (Hart *et al.* 2011: 3 et seqq.).

In European research, 330 million € [481 million US$] are allocated in the 7th Framework Program of the EU for Environment Research, and 30 million € [43.8 million US$] for fisheries and aquaculture projects (EC 2009**:** 4 et seqq.).

Some further evidence comes from national level reports and studies. For example, in **the UK** the total cost of meeting the countries' future environmental land management requirements (not including provision of advice for farmers) is estimated to be around three times the existing annual agri-environment budget (Hart *et al.* 2011: 1).

In **Serbia**, the funding allocated to managing the protected areas of the country are at only 25% of what is needed – a doubling of the spending would be necessary to cover basic functioning costs, a tripling for optimal functioning – in other words: the annual shortfall in protected areas financing in Serbia amounts to around 8.7 million US$ for basic costs (50% shortfall) and 24.7 million US$ for optimal functioning (75% shortfall) (Ministry of Environment and Spatial Planning of the Republic of Serbia 2011: 66).

In **Russia**, the total budget of the countries' actions addressed directly to the implementation of the CBD requirements amounts to no more than 270,300 billion rubles (4.5 billion US$) annually – 2.4 times less than required for maintaining the biodiversity conservation in the country, impacting mainly on protected areas, rare species conservation, practical implementation of information technologies, ecological education and setting up of the monitoring system for tracking the biodiversity status (i.e. several important enabling activities) (The State Committee of Russian Federation for Environment Protection 1997).

What are the implications for the resources required to deliver the targets, individually and collectively?

Although it was not possible to "paint the complete picture", the sections above made clear that most aspects of the various European biodiversity conservation policies (be it the overall EU's Strategy, the sectoral policies, the non-EU initiatives like the Emerald Network, or national initiatives/strategies) are seriously underfunded (see also FotE 2013).

It exceeds the scope of this survey to analyze fund raising or funding strategies. Nevertheless, a few conclusions could be drawn from the evidence above:

- Resources are extremely tight across Europe, and there is a great need for cost-efficient and effective actions.
- In this regard, enabling activities (e.g. awareness raising and knowledge generation and sharing) can lower the implementation costs of costlier protection and restoration measures (and help raising funds).
- Similarly, the evidence suggests that conservation strategies are normally more cost-efficient than restoration strategies (i.e. funds should be primarily made available for protecting yet undisturbed areas, e.g. in Eastern Europe, instead of restoring small, fragmented habitats in, for example, Western Europe).
- The polluter pays principle should be applied in raising funds from e.g. the private sector.
- A very important topic in Europe, especially the EU, is the reform of (mainly agricultural) subsidies – this would, in theory, be an almost no-direct cost action (in terms of state or EU budgets), with huge impacts (i.e. reducing negative impacts of the subsidies while promoting positive impacts at the same time).

At the same time, the uptake of financial assistance to implement measures is limited – for example, by the end of September 2009, the uptake of EU Cohesion funds allocated to biodiversity was lower than for other spending categories. At that time, the uptake for the two categories directly related to biodiversity ("promotion of biodiversity and nature" and "promotion of natural assets") was 18.1% and 22% respectively, compared to an average of 27.1% for all Cohesion Policy funding (CBD 2013c). Other problems related to financing or the uptake of financing possibilities include short timeframes of funding that do not allow for the continuity that is often needed to enable biodiversity related projects to succeed; the lack of clear targeting of funds for biodiversity; the management of most EU funds at the national level (according to sectoral priorities, which do not always include biodiversity conservation as a primary concern); limited capacity/knowledge in some Member States to apply for funds, and high administrative burdens in some cases (EC 2011: 15 et seqq., Kettunen *et al.* 2009).

Hence, the problem lies not solely in underfunding, but also in the uptake of the available funds (although probably to a much lesser degree).

4.7 POLICY ALIGNMENT AND DEVELOPMENT

As the international development agenda – e.g. the MDGs – is not of the same importance in Europe than on other continents, the focus of this section is mainly on the alignment between reaching the Aichi Targets and European strategies and policy objectives, and between the Aichi Targets and relevant EU environmental Directives and obligations (such as WFD, Habitat and Birds Directives, and the establishment of the Natura 2000 network), and their national implementation.

Summary and conclusions from this section regarding the meaning of policy alignment for cost-effectiveness are to be found in the next section.

How do the identified investment needs and the benefits they will achieve align with other policy agendas, such as the post-2015 UN Development Agenda and the Sustainable Development Goals?

The High-Level Panel states, "expenditure to meet the Aichi Biodiversity Targets should be recognised as part of wider investment needs for promoting sustainable development" (HLP 2011: 5). This is – in the EU and non-EU countries – recognized in most biodiversity strategies and/or action plans.

For example, the EU Commission (EC 2011b: 3) states that biodiversity conservation, including full valuation of "nature's potential", would contribute to a number of the EU's strategic objectives, namely:

- A more resource-efficient economy ("...by conserving and enhancing its natural resource base and using its resources sustainably, the EU can improve the resource efficiency of its economy and reduce its dependence on natural resources from outside Europe").
- A more climate-resilient, low-carbon economy ("Ecosystem-based approaches to climate change mitigation and adaptation can offer cost-effective alternatives to technological solutions, while delivering multiple benefits beyond biodiversity conservation").
- Leadership in research and innovation ("Progress in many applied sciences depends on the long-term availability and diversity of natural assets ...the innovation potential of ecosystem restoration and green infrastructure is largely untapped").
- New skills, jobs and business opportunities ("Nature-based innovation, and action to restore ecosystems and conserve biodiversity, can create new skills, jobs and business opportunities").

As mentioned by the EC's assessment of the contribution that biodiversity protection could administrate towards reaching other strategic objectives of the EU, there are important linkages between the climate and the biodiversity agendas, i.e. biodiversity protection contributes significantly to both climate change mitigation and adaptation policies or policy goals (EC 2011b: 3).

Furthermore, the EU is a party to several biodiversity-related international conventions, such as the Bonn Convention on Migratory Species (CMS), the Bern Convention on the Conservation of European Wildlife and Natural Habitats and the Convention on International Trade in Endangered Species (CITES). Latter has significant overlaps with Aichi Target 9 (IAS), whereas both the Bern and Bonn conventions overlap mainly with Aichi Target 11 (and the other conservation-related targets), and are implemented mainly by the EU Habitats and Birds Directives (EC – DG Environment).

The overlaps between "biodiversity conservation" (protecting valuable ES at the same time) and global development policies (such as the MDG) are manifold, as people in less developed countries – especially the rural poor – rely on ecosystems and ES for means of livelihood, health provision, food security, protection against natural hazards etc. Hence, biodiversity protection and the sustainable use of resources are not only the environmental aspects of sustainable development, but broadly linked to development as a whole (TEEB 2009: 31 et seqq.). The European Parliament (EP 2012), for example, demands to mainstream "environmental sustainability" into all foreign relations, to contribute to the MDGs. In Europe, "development" is not of the same importance as on other continents. Nevertheless, several East European countries do face serious development challenges, which thus also align well with the objectives of biodiversity protection and sustainable use of resources. Some evidence on this was obtained from Serbia, and regarding Belgian economic relations with East and South European (non-EU) countries.

Some information on the level of spending for development/cohesion policies positively related to biodiversity protection and sustainable use of resources inside the EU can be found in the Annexes to the EC Impact Assessment (EC 2011a: 17). In the financial period 2007-2013, the funds available under the umbrella of the ERDF and the Cohesion Fund were:

- €2,689 billion [4.06 billion US$] for the "promotion of biodiversity and nature protection".
- €1,137 billion [1.72 billion US$] for the "promotion of natural assets".
- €1,406 billion [2.12 billion US$] for the "protection and development of natural heritage".

Synergies between the Aichi Targets and EU sectoral policies

Significant overlaps exist between EU sectoral (i.e. environmental) policies and the Aichi Targets[23]. Among the most significant of these – which were already mentioned in several parts of the document above – are the Water Framework Directive and related water legislation (namely the "Daughter" Groundwater Directive, the Marine Strategy Framework Directive, the Nitrates and UWWT Directives, Drinking and Bathing Waters Directives).

Overall, if these Directives would be fully implemented, the water-related aspects of the Aichi Targets would probably be reached (i.e. pressure reduction: targets 6, 7, 8, probably 9 [IAS, which are a topic in the MSFD], 10; restoration: targets 14 and 15; and enabling/enhancing implementation strategies: targets 19 and 20). Several other targets, however, are also related to these Directives, such as 4 (plans for sustainable production and consumption) and 5 (reduce degradation and fragmentation; the WFD, for example, covers "groundwater-dependent" ecosystems as well) (see, for example, Tucker *et al.* 2013: 466).

Of similar importance are the Birds and Habitats Directives, which primarily tackle the conservation and restoration targets, i.e. the targets 5, and 11 to 15; through planning (e.g. Natura 2000 management plans), monitoring and research, and the obligation to raise the necessary funds, the targets 4 (plans for sustainable production and consumption), 19 (knowledge) and 20 (mobilize resources) would also be approached.

Other EU policies of importance are, of course, the CAP and CFP (target 3: incentives), as well as legislation that tackles pollution in a wider sense (e.g. IPPC/IED Directives, REACH; target 8), and the Soil Strategy and Climate Change policies.

With regard to the CAP, the issue is also not solely about aligning EU biodiversity and agricultural policies, but also ensuring policy coherence at the national levels. As Member States have great flexibility in implementing or allocating the CAP funds (e.g. moving funds from Pillar 1 to Pillar 2), it is also very much about aligning national biodiversity policies with agricultural policies, represented through the specification of the CAP payments at national/sub-national level.

It has to be noted here that the implementation of these (legally binding) Directives probably takes precedence over international obligations, even if legally binding, as the EU can start infringement procedures which can result in serious financial consequences for a non-complying EU Member State. It can be foreseen, however, that many Member States will fully exploit the given possibilities for exemptions and time prolongations (i.e. the WFD allows the objectives to be reached – or even permanently lowered – latest by 2027 for specific water bodies, and in some Member States, the conservation status is "unfavourable" in many Natura 2000 sites; FotE 2013).

23 From non-EU countries, no information was available in a summarized manner; research on national policies and environmental legislation was not possible within the framework of the current report.

Another very important issue regarding the synergies between biodiversity policy (in general) and other policy agendas is the contribution of the "protection of the environment" to general economic growth and job creation, highlighted in many publications and reports (e.g. the EC Impact Assessment, and Jurado *et al.* 2012). The special importance of this connection is that it is not about the direct benefits of meeting biodiversity targets themselves, but about the part biodiversity policies can play in reaching growth targets.

What are the implications for the overall resource requirements to meet the Aichi Targets, and the degree to which additional resources need to be targeted to them?

As said above, it can be expected that a full implementation of the said Directives will contribute greatly (or will even be sufficient) to reach the Aichi Targets. Although there is no concrete evidence on this matter, it can be assumed that a large part of the costs for reaching the Aichi Targets in the EU would be covered as well. One important point to note again, however, is that a significant share of the necessary resources is generally available, but needs to be allocated differently (for example CAP and CFP).

With regard to non-EU countries, although only scattered evidence is available, it seems that significant additional resources will be needed.

To what extent can improvements in governance, institutional and policy development at the country level contribute in a cost-efficient manner to deliver actions to achieve the targets?

In many European countries, the governance structures are highly developed (which does not necessarily mean that they are fully effective and efficient); and there are, of course, some non-EU countries in Eastern Europe that would probably significantly benefit from improvements in governance in terms of national biodiversity funding. There are examples in this report that demonstrate on a case study basis the need for improvements in governance – in EU and non-EU countries – and the possible impacts such improvements could lead to. These are listed below:

- Uptake of environmental funding possibilities (e.g. for agri-environmental measures and the EU Cohesion funds): short timeframes of funding; lack of clear targeting of funds for biodiversity; the management of most EU funds at the national level; limited capacity/knowledge in some Member States to apply for funds, and high administrative burdens in some cases.
- The "mainstreaming" of biodiversity protection and sustainable use of resources into wider policy realms (into development, implementation and funding), namely those on agriculture, forestry, fisheries, regional development and cohesion, energy, industry, transport, tourism, development cooperation, research and innovation: e.g. better integration into CAP and CFP, development of strategic frameworks by Member States to set priorities for ecosystem restoration at sub-national, national and EU level, integration of quantified biodiversity targets into Rural Development strategies and programs, integration of additional biodiversity concerns into the Plant and Animal Health regimes, and into development policies with non-European countries.
- Other governance improvements enhancing the effectiveness of funding: minimum mandatory spending on environmental measures, for example.
- The development and implementation of management plans or equivalent instruments which set out conservation and restoration measures in the protected areas/forests.
- Further development of the reporting system under Article 17 of the Habitats Directive and improvement of the flow, accessibility and relevance of Natura 2000 data.
- The development of a methodology for assessing the impact of EU funded projects, plans and programs on biodiversity.

- Improvement and simplification of the GAEC (Good Agricultural and Environmental Conditions) cross-compliance standards.
- More flexible management instruments in the fishery sector, such as flexible quota management.
- To reform and/or reduce "negative" incentives: more transparency in assessing the subsidies' effectiveness against stated objectives, their cost-efficiency and their environmental impacts.
- Many legal and compliance issues, mostly in East European non-EU countries (see as an example the case study on the Russian Federation).

4.8 COST EFFECTIVENESS

How can the Aichi Targets be delivered at least cost, taking account of the synergies between the targets and the investments required, the sequencing of actions and the synergies with other policy agendas?

Synergies and overlaps with other European policy agendas – mainly in the EU, but also in non-EU countries (e.g. Emerald Network) – have been treated in section 6 above; conclusions from this chapter are to be found in this section (7.3 below). This section, therefore, is focussed mainly on the "sequencing" of measures, i.e. the sequence in which investments are made.

Case studies support two notions:

- The importance of upfront planning.
- The importance of reducing negative incentives (especially spatially explicit subsidies) before starting restoration or conservation action.

Other sources confirm the notion that upfront planning through studies or well-informed strategies greatly reduce the costs of later practical (i.e. restoration, conservation) measures, and will, given the fact that they are relatively cheap in comparison to practical measures, play a great role in distributing resources efficiently at a later stage (Tucker *et al.* 2013: 465).

Also, the second notion is supported by the High-Level Panel (HLP 2011: 10, 14), stating that reforming "incentives in favour of sustainable use of biodiversity could greatly reduce the costs for halving the habitat loss".

The HLP similarly states that to "establish necessary frameworks and conditions (targets 1-4 and 16-20 under goals A and E) should reduce the costs for reaching other targets" – which is obvious with regard to financing, and confirmed by other sources (see above) with regard to knowledge base and planning.

What evidence is there of the cost effectiveness of different investments, taking account of biodiversity gain and contribution to the targets relative to cost?

Limited evidence could be obtained regarding this question, mainly because of one significant reason: there is no source at all available that consistently appraises the progress certain actions would make towards reaching the Aichi Targets.

One issue, however, could be confirmed over the course of the current research: that conservation measures – i.e. preventing the degradation of a natural or near-natural habitat – are generally more cost-effective than restoring an already degraded habitat to its natural state (see also CBD 2012). Evidence for this assumption comes from the implementation of the WFD (in which the restoration of regulated water bodies is extremely costly, or even "impossible" – in WFD terms: "disproportionate") and or mire/peatland restoration (restored peatlands also emit great amounts of methane for several years before the wetland starts to accumulate carbon again).

What are the implications for the sequencing and/or prioritisation of investments in moving towards achieving the targets?

Several conclusions can be drawn regarding the cost-effective achievement of reaching the Aichi Targets in Europe from the previous two sections.

Regarding policy alignment in the EU – and it potential accession countries in Eastern Europe – the implementation of the various environmental Directives of the EU would mean a significant step towards the Aichi (and EU) targets. This is not directly a cost-effectiveness issue – as the Member States and accession countries have to implement the Directives anyway – but these significant overlaps certainly reduce the additional funds necessary for reaching the Aichi Targets. Nevertheless, it has to be stated that the implementation of the (obliging) EU Directives also very much depends on the political will – there are many exemptions possible in some of the most important Directives (such as WFD and MSFD), prolonging the timeframe and thus greatly decreasing the importance of the Directives for reaching the Aichi Targets (for example, if the timeframe extends over 2020).

Prolonging the timeframe, however, is a point to note, as several Member States state that the overall costs for reaching the WFD's goals will be significantly less in case there is more time available. This argument could not be verified in the context of this study, but the general statement that "postponing action will increase costs" seems disputable, at least for specific actions and among policy makers. Postponing action, however, is certainly much more costly with regard to conservation of ecosystems or habitats (while for restoration in some cases the costs are lower if more time is available, see river restoration measures) – as shown above, conservation measures are generally more cost-effective than restoration measures, due to the high costs associated with the latter (see, for example, CBD 2012, or Förster 2009).

Another very important, or even crucial, point for cost-effective actions seems to be the reduction of negative incentives: on the one hand, these increase the pressure on ecosystems (and species), in cases not only hindering, but actively contradicting the achievement of the Aichi (and EU) targets; on the other hand, they can (in case of spatially explicit subsidies) greatly increase the cost for conservation and restoration, because the entitlements connected to a certain area/land will be priced into prices for potential/needed land acquisition or compensation payments.

4.9 BENEFITS AND COSTS

Generally, deriving a comparison of benefits and costs from the evidence listed in the previous sections is not possible in a methodologically sound and reliable way. The different assumptions regarding a specific measure, e.g. investment costs and which benefits it provides, the expected effect (impact) of the measure(s), etc. are too various and differ too much to allow for that. Instead, evidence for benefit-cost ratios is provided in the form of case studies that compare costs and benefits – mostly through Cost-Benefit Analyses – for a specific site or a specific, clearly defined package of measures.

However, it has to be mentioned here that most Cost-Benefit Analyses rely at least partly on surveys assessing the Willingness-To-Pay (WTP) of the concerned population, a methodology that has significant uncertainties attached, which can strongly bias the results of such assessments (see section 2 on methodology).

What does the evidence as identified above tell us about the balance between the benefits and costs of meeting the targets?

EU level/Europe

Evidence on cost-benefit comparisons in the EU or Europe-wide is exclusively sectoral – but, as stated above, not provided in a single study comparing costs and benefits. However, for two policy fields, the dimensions of benefits and costs can be derived from the evidence described in the sections on benefits and resource needs.

The benefits of the **Natura 2000** network of protected areas (and this is similarly true for the Emerald Network) "surely outweigh costs when taking all benefits into account" (Kettunen *et al.* 2009: 168). The latter, i.e. taking all benefits into account, seems important, however, as the study furthermore states that if only the benefits are taken into account for which monetary figures can be generated, the "overall socio-economic picture might not appear favourable to a site's conservation" (Kettunen *et al.* 2009: 168). In quantitative terms: the estimations for annual monetary benefits of the network range from 200 to 450 billion € [280 to 650 billion US$], figures that do not seem unrealistically high considering the 1.2 to 2.2 billion "visitor days" per year in Natura 2000 sites, with direct and indirect economic impacts reaching 50 to 85 billion €/a [69.7 to 118.4 US$/a]. Cost estimations range around 6 billion €/a (around 8.2 billion US$/a], although some sources state that this figure is an underestimation – nevertheless, even if the costs were double as high as estimated, the benefits would surely outweigh costs by a factor of 20 to 30.

Natura 2000 – connected Aichi Targets: 5, 10, 11, 12, 13 (protection/conservation), 14, 15 (restoration), 7 (use/management).

Regarding **freshwater ecosystems**, i.e. the implementation of the WFD, the benefits derived from reaching the WFD objectives are roughly estimated to range between 10 and 20 billion €/a [13 to 26 billion US$/a] in the EU27 (although very much depending on the percentage of water bodies reaching "good status"). The costs of all WFD-related measures in the EU27 – calculated in the same study (Kaphengst *et al.* 2010) – sum up to 8-15 billion €/a [10.9 to 20.5 billion US$/a]; hence, the benefit-cost ratio is probably positive or neutral, but unlikely to be negative.

WFD – connected Aichi Targets: 4 (planning – if RBMPs are included under this target), 10, 11, 12, 13 (protection/conservation), 14, 15 (restoration), 7 (use/management), 8 (pollution), 20 (resource mobilization).

Further evidence on the European or EU-level does not exist, except a statement from the European Commission (EC 2011d: 3 et seqq.) regarding benefit-cost ratios of measures to reach EU biodiversity target 2 ("Maintain and restore ecosystems and their services"), which says that "no aggregated estimates of benefits [are available], but project-based evidence of benefit-cost ratios in the range of 3 to 75 [exist]".

How can this evidence be used to make the case for the investments required?

As demonstrated, the benefits of measures to protect biodiversity in Europe (both EU and non-EU) certainly exceed the costs associated with them if all environmental and societal benefits are taken into account. This, however, is already known for some time, and large shares of necessary investments are still not being undertaken. Furthermore, in some cases (CAP and CFP, namely), raising additional funds wouldn't even be necessary/only needed to a limited extent, because a re-allocation from harmful to positive purposes could already make a significant difference. The conclusion that can be drawn from this is the need for strong political will to allocate the funds (or relocate in case of CAP and CFP subsidies).

Hence, the question at hand is not solely about how to use this evidence to make the case for the investments required – this is constantly done, and seemingly benefits in the hundreds of billions of €/a, or the possible creation of e.g. 200,000 FTE jobs are so far not sufficient enough arguments in many cases. Rather, increased political will needs to be created, e.g. through political pressure via civil society as well as via legal instruments (i.e. the implementation of EU Directives is obligatory, and non-implementation can cause infringement procedures).

4.10 CONCLUSIONS

Overall conclusions

The resources assigned to compile the present study, and the availability of data – on the one hand, a multitude of information (at least from the Western European countries and EU Member States, which is almost never targeted towards the main research questions) as well as on the other hand limited information, especially regarding non-EU-countries – presented the research team with significant challenges. Although it was recognized at the outset of the task that the aim of the study was neither to aggregate the collected information, nor investigate it in more detail (i.e. interpret it), sorting through the heaps of information and discarding the non-relevant information was very time consuming. The result is a review of data best suited to shed light onto certain benefits and costs that are connected to reaching or approaching the Aichi Targets in Europe. In the following, the conclusions that could be drawn from the evidence are collected.

Benefits

From the evidence collected regarding the benefits of reaching the Aichi Targets, there remains no doubt that increased biodiversity protection and sustainable use of resources would benefit all spheres of European (human) societies: private and public life, rural and urban populations, richer and poorer people, corporations, most economic sectors – some to a higher, some to a lesser degree, and not necessarily distributed equally (across the pan-European region, and across societies). It is furthermore clear from the evidence that these benefits are not only "nice to have", but represent significant components and functions of the socio-economic systems in Europe, with a real value existing in terms of ES provision (mostly slightly "abstract" monetary benefits), indirect and direct income (e.g. visitor spending in protected areas), and as a basis for jobs and job creation. Additionally, biodiversity protection, especially green infrastructure projects, has a great potential for increasing ecosystem resilience to predicted climate change impacts.

The most significant monetary values, as identified by this report, stem from conservation and restoration activities (Natura 2000 and Emerald Network, corresponding mainly to the Aichi Targets 5, 10, 11, 12, 13 [protection/conservation], 14, 15 [restoration], 7 [use/management]) – several studies estimate the annual value to range between 200 and 450 billion €/a [280 to 650 billion US$]. In terms of non-monetized benefits, the provision of jobs and the creation of new jobs are of great importance, as estimations speak of up to 200,000 new FTE jobs being created through the EU Biodiversity Strategy, and up to 16% of all jobs in the EU being dependent on the environment.

Thus, increased biodiversity protection and sustainable use of resources would benefit all spheres of European societies, although, as highlighted in section 4.4, these benefits are not equally distributed across the pan-European region, and across societies.

Investments and Resource Requirements

Although no comprehensive and "self-contained" overview of necessary actions/investments to reach the Aichi Targets in Europe (EU and non-EU) exists, several priorities for actions – i.e. actions most important for reaching biodiversity targets (see, for example, table 1 for a list of the EU biodiversity targets) – could be identified, mainly for the EU:

- Ensure a better uptake and distribution of existing funds for biodiversity: reform of agricultural (and fishery) subsidies; longer timeframes for biodiversity funding; clearer targeting of funds for biodiversity, also at the national level; capacity building and decrease of administrative burdens.
- The latter point is of special concern for new Member States in Eastern Europe, lacking the experience in applying for EU funds.
- Reforming the agricultural subsidy system ("Greening" the CAP), and e.g. reallocating funds from the first to the second Pillar (the CAP reform 2014-2010 has been agreed, but the final text is not available as of December 2013).

- Completing the Natura 2000 network, and establishing management plans or similar instruments onsite, also to obtain data on the impacts and effectiveness of financing.
- Increase knowledge and awareness.

Generally, it is assumed that the implementation of the EU's sectoral policies, especially the environmental legislation, would be sufficient for reaching most Aichi Targets, or at least approach them to a significant degree.

In the new EU Member States as well as in non-EU countries, the focus should be more on capacity building with regard to the uptake of financing opportunities, awareness raising and on measures towards conservation instead of restoration (given the large undisturbed/unfragmented areas left in many parts of Eastern Europe and Russia). Additionally, in the non-EU Eastern European countries (i.e. Belarus, Ukraine, the Russian Federation, Moldova, but to a certain degree also Serbia, Albania), much more basic activities are necessary: studies and surveys about the state of ecosystems and ES, the designation of protected areas (e.g. for inclusion into the Emerald Network); and many legal and compliance issues.

Similarly to the expected benefits, overall costs or resource needs are also not documented in a comprehensive and self-contained manner (i.e. directed towards reaching the Aichi Targets). Estimations exist, however, for aspects of biodiversity protection and sustainable use of resources, and range in the tens of billions of € (or US$) per annum for the EU, although the data is not fully compatible: if the sectoral estimations were to be added up, the resulting sum would easily exceed the more general calculations. With regard to non-EU countries, no estimation of the resource needs can be provided, as no information is available covering Belarus, Ukraine, Moldova, Russia or the Balkans. At the same time, due to less fragmented or disturbed ecosystems that still exist in some parts of Eastern Europe, the costs could be significantly lower in these countries, as less restoration measures would be necessary. Regarding Western European non-EU countries (Switzerland, Norway, Iceland), the dimensions of the resources necessary will be similar to the ones in the EU Member States.

Nevertheless, the overall cost dimension seems to be more or less clear: the costs for reaching the Aichi Targets (or EU biodiversity targets) would probably be in the tens of billions € or US$/a in the EU alone. The most expensive actions, as far as the evidence suggests, are conservation and especially restoration measures (Aichi Targets 11-15). A very important point in this regard is that many of these funds have to be allocated by EU Member States in any case for implementing other EU environmental legislation – independently of the biodiversity targets. The same is true for the reform of the subsidy system (CAP and CFP): basically no or only limited additional resources are required, as funds would mainly needed to be shifted between Pillars, or linked to more biodiversity-friendly management.

Hence, it can be concluded that reaching the Aichi Targets in the EU is more an allocation challenge than a resource challenge.

Additionally, there are **significant overlaps with other policy fields**, especially in the EU – the implementation of the various environmental Directives of the EU – to which the Member States are legally obliged – would mean a significant step towards the Aichi (and EU) targets. This, naturally, does not reduce the costs for a better protection of the environment in Europe (or improve the cost-effectiveness of measures), but these significant overlaps certainly reduce the additional funds necessary for reaching the Aichi Targets. Nevertheless, it has to be stated that the implementation of the (legally binding) EU Directives also very much depends on the political will – there are many exemptions possible in the most important Directives (such as WFD and MSFD), prolonging the timeframe and thus greatly decreasing the importance of the Directives for reaching the Aichi Targets (for example, if the timeframe extends over 2020).

Prolonging the timeframe, however, is a point to note, as several EU Member States argue that the overall costs for reaching the WFD's goals will be significantly less in case there is more time available. This argument could not be verified in the context of this study, but the general statement that "postponing action will increase costs" seems disputable, at least among policy makers. Postponing action, however, is certainly much more costly with regard to conservation of ecosystems or habitats (while for restoration in some cases the costs are lower if more time is available, see river restoration measures) – as shown above, conservation measures are generally more cost-effective than restoration measures, due to the high costs associated with the latter (see, for example, CBD 2012, or Förster 2009). Another very important, or even crucial, point for cost-effective actions seems to be the reduction of negative incentives: on the one hand, these increase the pressure on ecosystems (and species), in cases not only hindering, but actively contradicting the achievement of the Aichi (and EU) targets; on the other hand, they can (in case of spatially explicit subsidies) greatly increase the cost for conservation and restoration, because the entitlements connected to a certain lot of land will be priced into prices for land acquisition or compensation payments.

Hence, there are significant overlaps between other biodiversity-related policies (mostly in the EU), reducing the "additional costs" of reaching the Aichi Targets significantly.

Although it is disputed that postponing action would increase costs, at least in some policy fields (such as "conservation vs. restoration") this seems evident.

The evidence also demonstrates that the benefits of measures to protect biodiversity in Europe (both EU and non-EU) certainly exceed the costs associated with them if all environmental and societal benefits are taken into account. This, however, is already known for some time, and large shares of necessary investments are still not being undertaken. Furthermore, in some cases (CAP and CFP, namely), the raising of new funds would be necessary only to a limited extent, because simple re-allocation from harmful to biodiversity-friendly purposes could already make a significant difference.

Commentary, including caveats and limitations of the approach

The major limitations and methodological issues of the approach to the present study are the following:

- First, the information basis: contrary to all other continents, Europe has a supranational organization – the EU – that covers biodiversity topics on its own, in addition to local and national initiatives. The EU has the power for obliging legal action, especially with regard to environmental protection, resulting in a multitude of (additional) studies and reports with regard to the consequences of implementation on this level. Hence, on the one hand the data situation in Europe is much better than on other continents. On the other hand, however, the EU adds an extra level of analysis to the assessment – a level that does not cover the whole of Europe, but only a part, with completely different policy targets that need to be "translated" to the proper Aichi Target(s) – which complicates both the search for/the compilation of information as well as the proper interpretation of it.
- Second, and closely related to the point above, is the limited data situation in non-EU countries, especially in Eastern Europe, from where almost no quantitative information on the implementation of the Aichi Targets could be obtained. Additionally, it was not possible to search individual websites for national documents, due to the language barrier (many websites and documents are in Russian, for example).
- A third point is related to the methodological issues surrounding CBA and other quantitative cost-benefit assessments (see section 4.3 on more details).
- A fourth point is the conversion of national currencies to present value US$. As stated in section 4.3, the conversion to 2013 dollars follows the Inflation Calculator provided by the US Bureau of Labour Statistics, which is based on the Consumer Price Index, using the year of the respective study as "baseline year" for the conversion. However, in some cases the definition

of a baseline year was no easily possible, i.e. in cases in which a time span was being discussed (i.e. a source from 2010 stating that between 2007 and 2009 a certain amount of Euro has been invested). To cope with that, the original figures were not deleted but kept in the report.

Evidence gaps and future research priorities

Naturally, evidence supporting the qualitative aspects of the questions – i.e. regarding the benefits probably connected to reaching the Aichi Targets, or the necessary actions/measures/investments – is much more easily obtainable than quantitative data. This, however, does not necessarily mean that the qualitative data is directly of use – long lists of necessary actions/measures/investments without any information on the degree to which these will suffice for reaching certain objectives are often provided, but are not very helpful. On the contrary, even if quantitative information might be more difficult to generate and might have generally more uncertainties attached to it, the links with the effects (of the actions/measures/investments investigated) are mostly included and at least allow for further conclusions.

Besides, the evidence seems most robust and plenty with regard to investment needs and resource requirements; the evidence situation for benefits is also quite good, although more reliant on anecdotal/ case study-based evidence ("sketchy" data situation).

Relations between costs and benefits are treated in Cost-Benefit Analyses for the most part, conducted on a local or regional (e.g. sub-national) scale. Besides the challenge of transferring the results of such studies to a greater scale, CBA often involve methodologies that evaluate the monetary value of benefits provided by ES, which can, as mentioned above, include significant uncertainties. Not much data is available to better understand policy alignments and overlaps between environmental policies, and with regard to cost-effective combinations of measures, or "sequencing".

National Biodiversity Strategies and Action Plans have mostly not been very relevant, as in most cases, concrete, quantitative information on reaching the Aichi Targets was not included (instead, the strategies mostly consist of national objectives and planned actions to reach these, and "translations" of the national targets/objectives to the Aichi Targets)). Clear statements on costs – i.e. "reaching the Aichi Targets in country X/the Aichi Target 11 in country Y would cost X Euro" – or benefits were not found in any of the plans.

However, there was ample information available regarding local or regional examples and case studies – rarely in the context of reaching a certain Aichi Target, but covering costs and benefits of certain actions or measures, on different scales of governance. Herein, the difficulty lay not in finding case study examples, but in selecting the ones most reliant and appropriate, and in "translating" the actions into the Aichi framework.

Beside the issues raised above – i.e. the lack of quantitative data regarding benefits and costs in the NBSAPs, and the general lack of "links" between specific actions/measures/investments and the Aichi (or EU) targets – the following evidence gaps are of the greatest importance:

- The missing link between the effects of an action, and the change this action will result in terms of reaching the Aichi or EU targets.
- The information regarding quantitative benefits of reaching the targets is very "sketchy", i.e. an overall estimation does not exist. No report has been found that clearly addresses the economic implications of reaching the Aichi Targets, neither on the European, the EU nor the national level.
- Regarding investment needs, the evidence gaps lie in the challenging translation of environmental policies at the EU or national levels to the Aichi Targets (so, the existing evidence is focused on other targets/policy objectives than the Aichi Targets, and often does not establish the link).
- The evidence gaps regarding resource needs are relatively manageable in Western Europe, although uncertainties evolve when local, case study-like evidence is up-scaled to the national or

EU-scale. In Eastern European countries, mostly non-EU, the data gaps regarding costs are very significant (i.e. there is almost no data available).

- Information on the contributions and negative effects of the EU development, coherence and accession policies on biodiversity was not available, as well as information on cost-effectiveness. In the latter field – i.e. regarding the sequencing of measures – there is a lot of general information available, but no source that assesses the consequences of different approaches in a quantitative way (e.g. "measures a and b implemented before measures c and d leads to additional costs…").

Reflecting on the evidence gaps, future research priorities to support the implementation of the Aichi Targets are manifold – however, as only seven years are left until 2020, and considering the long time it usually takes for medium- or big-sized research projects to get started and finally deliver results, the research priorities proposed here are focused on short- or medium-term endeavors with a chance to deliver results in the next years. For example, research into the "links" between certain actions/measures/investments and the resulting progress towards the Aichi (or other biodiversity-related) targets is deemed to be a rather long-term project that would probably have little impact on the current implementation process.

Short- or medium-term research priorities include:

- In Eastern Europe non-EU countries, there is surely a great need for basic research into status and trends of biodiversity, in order to be able to identify and plan the most crucial conservation/protection measures.
- An improvement of the general data situation regarding costs and benefits of activities to protect biodiversity, i.e. in terms of pilot projects, would surely be helpful to convince policy makers and stakeholders of the economic benefits and necessities of biodiversity protection and a more sustainable use of resources.
- Of a similar effect could be the development of standards for CBA or other cost-benefit assessments, which would improve the reliability of such studies and possibly improve the acceptance of the results by policy makers.
- Research into the contributions and negative side-effects of the EU development, coherence and accession policies on biodiversity.
- Cost-effectiveness: Concrete (and quantitative) information on sequencing, for example, would certainly be helpful in progressing towards the Aichi Targets.

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5. LATIN AMERICA AND THE CARIBBEAN

Sara Hernandez and Jerome Kisielewicz, ICF GHK

5.1 EXECUTIVE SUMMARY

The Latin America and the Caribbean region is extremely rich in its biological resources and ecosystems, as well as in its diversity of cultures and economic and social conditions. The region's ecosystems provide a wide range of valuable services, which are vital for people, the economy and the region's development. Meeting the Aichi Targets will help to secure the delivery of these services, but requires substantial challenges to be overcome. This report presents the findings of a review of the benefits and costs of meeting the Aichi Targets in the region. It draws on a wide range of local, national and regional studies, publications of international and UN organisations, and relevant databases.

Benefits

- The evidence demonstrates the substantial value of the range of services delivered by the regions ecosystems, which help to maintain production of food and fibre, deliver vital regulating services at the global and local level, support tourism and recreation and deliver other unmarketed cultural services.
- A range of qualitative, quantitative and monetary assessments of benefits were found, for different ecosystems and at different spatial scales.
- However, the evidence is somewhat fragmented. Few estimates are available at country or regional level, and it is necessary to piece together evidence from a range of sources in order to understand the benefits of meeting the Targets across the region.
- The strongest evidence is available for particular Targets, especially those relating to the conservation and restoration of forests, wetlands, mangroves and coral reefs.
- There is strong evidence of the immense value of the services provided by the region's forests, especially through their role in regulating the global climate. Aichi Targets 5, 7, 11, 14 and 15 have an important role to play in maintaining these benefits.
- There is evidence of the need for urgent action to improve the sustainability of the region's fisheries, and the substantial benefits of delivering Aichi Target 6.
- The benefits of biodiversity conservation are strongest for low-income local communities due to their dependence on ecosystem services.
- Ecosystem services offer multiple benefits to a range of different stakeholders, and increasing recognition of the value of these services is providing new potential sources of revenues to invest in biodiversity conservation, including through private sector participation in PES schemes.

Investment needs

- A recent regional workshop reviewing progress towards the Aichi Targets in the LAC region provides some useful insights into overall investment needs. This found that countries have made strong progress in the achievement of some Targets (e.g. 11 – protected areas; 12 – species conservation) 17 – NBSAPs, 18 – traditional knowledge and 19 – science and technology).
- Countries have indicated a low level of achievement for targets 3 (incentives), 6 (sustainable fisheries), 9 (invasive species), 10 (preservation of coral reefs), 13 (genetic diversity), and 14 and 15 (ecosystem restoration. This suggests that greatest efforts need to be devoted to these areas. This has implications for investment needs, but low levels of progress also reflect other challenges such as political barriers.
- The evidence reviewed indicates that a priority in many countries is to create the enabling

conditions and institutional frameworks to achieve the Aichi Targets. These include development of appropriate governance and legal frameworks, incentive mechanisms, capacity and knowledge on which biodiversity action depends.

- Priorities differ across the sub-regions. In the Caribbean region, a high priority relates to the conservation of marine and coastal environments.
- In Central America and South America, a key priority is to develop sustainable financing mechanism to respond to multiple objectives (protected areas and sustainable agriculture, afforestation, reforestation and forest restoration).
- The Aichi Targets are interrelated and effective implementation will depend on timing and sequencing of actions to achieve optimal effect. In particular, investments in capacity building and appropriate institutional and policy frameworks will be important in delivering Aichi Targets 1-4 and 17-20 and in creating the conditions needed to deliver all other targets.

Resource needs

- In order to assess resource needs, we have analysed the current financing allocations in the region, sources of funding and available evidence of the resources needed to achieve the Aichi Targets.
- We only find evidence available on actions related to protected areas or areas which need to be cover to protect species and key ecosystems. These actions are related to Aichi Targets 11 (protected areas), 12 (species conservation), 10 (preservation of coral reefs) and 3 (incentive measures).
- The total annual conservation expenditures in the Latin American & the Caribbean region have been estimated to amount to an average of US$ 632 million per year (2001-2008), from which US$ 203 million were allocated to Central America, US$ 395 million allocated to South America and approximately US$ 33 million to the Caribbean countries.
- Most funding for biodiversity in Central America comes from international donors and bilateral cooperation. However, domestic resources account for the majority of funding in South America and the Caribbean.
- The total current funding for protected areas was estimated to amount to approximately to US$ 239 million per year in South America, US$ 141 million per year in Central America and $54 million per year in the Caribbean.
- There are significant funding gaps. For protected areas alone, it is estimated that funding will need to increase by 2 to 3.2 times on current levels in South America to meet identified needs, and by 1.5 to 2.3 times in Central America.
- Since countries in the region estimate that their progress towards Aichi Target 11 (protected areas) is ahead of that for other targets, the funding gap for other Targets may be greater than for Target 11.
- The resource needs have to be considered above the current financial allocations. The current allocations have not halted the continuous degradation of biodiversity in protected areas which makes necessary additional resources to reach optimal management.
- Resource requirements increase significantly if other activities, where progress has so far been limited, are considered (e.g. restoration of key ecosystems – Aichi Targets 14 and 15).
- The main sources of financial resources are government spending, international cooperation and fees from users. In some countries, the level of national investment is too low compared to other sources of finding. International funding can be more effective in those areas where the enabling conditions allow for progress in conservation activities, or where funds can be directed to areas that create those institutional frameworks.
- Though detailed quantitative evidence is limited, the findings largely support those of the High-Level Panel's report to COP11.

Policy Alignment and Development

- There is a strong connection between environmental degradation and the social economic conditions facing local populations.
- Providing secure and safe environmental conditions, and maintaining the delivery of key ecosystem services, contributes to the people's livelihoods and to development outcomes.
- Most of biodiversity conservation challenges in the Region are strongly related to poverty alleviation.
- Examples are given of biodiversity conservation initiatives that jointly deliver the Aichi Targets and positive development outcomes.
- Synergies and overlaps with other policy agendas mean that mainstreaming of biodiversity objectives is important, and this has implications for awareness, governance, capacity and co-ordination of delivery.

Cost Effectiveness

- Regional examples demonstrate that maintaining ecosystems and their services can save costs compared to allowing them to decline;
- The way that the targets are delivered – and the sequencing of overall delivery – will have an important influence on their overall costs.

Costs and Benefits

- Little evidence was found that directly assessed the costs and benefits of achieving one or more Aichi Targets. However, some studies provide evidence that the benefits of relevant investments in biodiversity and ecosystems can exceed the costs.
- The strongest evidence that the benefits of conservation exceed the costs relates to forest conservation, where studies have shown that the net benefits of conservation through REDD+ and other PES schemes widely exceed the opportunity costs, particularly through avoided CO2 emissions.
- Services delivered by the most important ecosystems in the region such as mangroves, tropical forests and wetlands are likely to amount to many hundreds of billions of dollars per year. The costs of securing these services have not been estimated at regional scale, but are likely to amount to tens of billions of dollars annually.
- This suggests that ecosystem conservation in the region is likely to deliver net benefits, and supports the conclusions of global studies examining the costs and benefits of conservation action.

5.2 INTRODUCTION

This report presents evidence on the costs and benefits associated with the implementation of the Aichi Targets in Latin America and the Caribbean. It presents the evidence found at the regional, national and local level, in response to the six main questions set by the High-Level Panel on Global assessment of resources for implementing the Strategic plan for Biodiversity 2011-2020.

The Latin America and the Caribbean region is extremely rich in its biological resources and ecosystems, as well as in its diversity of cultures and economic and social conditions.

The region comprises 50 countries divided into three sub-regions following those of the UN Statistics Division, as listed below:

- The Caribbean: Anguilla, Antigua and Barbuda, Aruba, Bahamas, Barbados, Bonaire, Saint Eustatius and Saba, British Virgin Islands, Cayman Islands, Cuba, Curaçao, Dominica, Dominican Republic, Grenada, Guadeloupe, Haiti, Jamaica, Martinique, Montserrat, Puerto Rico, Saint-Barthelemy, Saint Kitts and Nevis, Saint Lucia, Saint Martin (French part), Saint Vincent and the Grenadines, Sint Maarten (Dutch part), Trinidad and Tobago, Turks and Caicos Islands and United States Virgin Islands.

- Central America: Belize, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua and Panama.
- South America: Argentina, Bolivia (Plurinational State of), Brazil, Chile, Colombia, Ecuador, Falkland Islands (Malvinas), French Guiana, Guyana, Paraguay, Peru, Suriname, Uruguay, Venezuela (Bolivarian Republic of).

Each section presents a review of evidence across the region and illustrates this with case studies.

5.3 METHODOLOGY

Research methods and sources of evidence

This research has involved:

- An extensive web and literature review;
- An extensive search of international databases, especially EVRI;
- An analysis of resource requirements, using the data base used by Waldron *et al.* (2013)[24] available at www.pnas.org/lookup/suppl/doi:10.1073/pnas.1221370110/-/DCSupplemental.
- Contact with key experts, in order to signpost relevant evidence and collate case study information.
- The Environmental Valuation Reference Inventory™ (EVRI™) provided a useful source of evidence, particularly on benefits and their value. This database is intended primarily as a tool to assist policy analysts using the benefits transfer approach to estimate economic values for changes in environmental goods and services or human health. The database provided around 60 articles specifically targeting Latin America and the Caribbean. The most representative articles were selected for further analysis and served as basis for the identification of other articles.
- Another source of information was the Latin America Environmental Economics programme (LACEEP) network where some articles were used to illustrate some of the case studies.
- Publications of UNDP, FAO and TNC also served as key reference sources.
- Overview of availability and robustness, methodological issues, evidence gaps, variations in extent and quality of evidence between questions

Overview of availability and robustness, methodological issues, evidence gaps, variations in extent and quality of evidence between questions

Most of the evidence found does not directly refer to the Aichi Targets, but relates to biodiversity conservation initiatives more generally. Nevertheless, many studies provide relevant evidence on many of the actions relevant to the delivery of the Targets. It has therefore been necessary to link the evidence found as far as possible to the relevant Targets. This is straightforward for some Targets (e.g. Targets 9 – invasive species, 11 – protected areas, 13 – genetic resources and 16 – Nagoya protocol) which are addressed by specific policies. Other Targets present greater challenges, because of synergies and overlaps between Targets and the actions required to meet them.

The extent and quality of the available evidence varied between the research questions. Generally, while much evidence was found on the benefits of meeting the Targets and the investments required, there was less evidence on cost-effectiveness and the relative value of costs and benefits. Some evidence was found on financial needs and resource requirements, and, although there are significant uncertainties, this was generally found to provide a reasonable basis for the analysis.

24 Waldron A., A.O. Mooers, D.C. Miller, N. Nibbelink, D. Redding, T.S.Kuhn, J.T.Roberts, J.L. Gittleman. 2012. Targeting global conservation funding to limit immediate biodiversity declines. Available at: http://www.pnas.org/cgi/doi/10.1073/pnas

5.4 BENEFITS TO DELIVERING THE AICHI TARGETS

What will be the economic benefits of delivering the Aichi Targets?

The Latin America and the Caribbean region is extremely rich in its biological resources and ecosystems, as well as in its diversity of cultures and economic and social conditions. The region's ecosystems provide a wide range of valuable services, which are vital for people and the economy. The region also faces huge environmental challenges, which must be addressed if the Targets are to be met. Because of the strong links between biological conservation and poverty alleviation, delivering the Aichi Targets will play a key role in the region's development.

There exist no overall estimates of the total value of the benefits associated with biodiversity conservation in Latin America and the Caribbean. Many studies have attempted to evaluate these benefits and assess the value of ecosystem services, although most only consider a limited number of ecosystem services within a limited geographical area. In this section we focus on different studies analysing the economic value of different types of forests and the main ecosystem services related to carbon sequestration and water services. We provide evidence by sub-regions (South America, Central America and the Caribbean) and by type of ecosystems (forests, coral reefs and wetlands).

Benefits of Forest Conservation (Aichi Targets 5, 7, 11, 14 and 15)

Forest ecosystems are at the heart of most of the ecosystem services and the Latin America and Caribbean region is home the world's largest rainforest. About 40% of the world's remaining tropical rainforest is located in the Amazon. Neo-tropical rainforests are believed to be the most species-rich in existence. Forests deliver provisioning services (timber extraction and use of non-timber products), regulating services (climate regulation, hydrological services, nutrient retention, carbon sequestration, pollination and biological control) and cultural services (tourism, recreation). These are underpinned by supporting services such as habitat for flora and fauna, soil protection and conservation of water resources. Due to the diversity of types of forest, ecological services vary according to geographical scale, topography, and surrounding landscapes and land uses. Addressing the pressures caused by land based production practices requires the integration of sustainable management practices in agriculture, forestry and livestock production systems.

Forest preservation and water resources are strongly linked and there is a strong evidence of the positive effects of the former may on the latter. Forest conservation has positive effects on the quantity and quality of water resources. Whilst there is some evidence of the links between the quality of water and forest in good condition, there is less scientific certainty on the benefits of forest conservation for water supply, except for specific type of forests such as cloud mountain forests, due to their capacity to capture humidity in fog, and dry tropical forest which reduce the risk of floods under certain geological and hydrological conditions (Munoz-Piña *et al.* 2008).

Paramos ecosystems also provide regulation services of water resources. Changes in use of forest land for productive purposes are driving forces affecting forest condition and water ecosystems and their services. Deforestation is also explained by illegal logging and by the continuous degradation of soils and soil nutrients which lead to further clearing of forests. Due to the strong dependence for income generation in the use of forest resources and land, conservation of forest and aquatic ecosystems represents high opportunity costs for local communities that need to be compensated to make conservation effective. The weakness or the absence of clearly defined property rights of forest land contributes to deforestation and conflicts relating to access to natural resources. Recognising the value of environmental services, and designing mechanisms to pay for them, can help to address potential conflicts between poverty alleviation and environmental conservation, between local interests and global concerns and between present needs and those of future generations.

Carbon sequestration by forests

One of the key benefits derives from the carbon sequestrated by existing forests and the carbon sequestration potential associated with afforestation and reforestation projects. REDD+ offers an opportunity to capture the potential benefits of these schemes that are of interest for global users.

Benites (2006) developed a grid-based approach to determine the net benefits of carbon sequestration through afforestation and reforestation projects in eight countries representing more than 90% of the Latin American region. Based on individual geographic entities (50km × 50 km cells), the study identified the carbon sequestration costs for the different cells categories. This integrated the costs categories such as opportunity costs of agricultural activities and of timber activities. A price index was used to correct land prices and plantation costs in the different countries. Under reasonable assumptions regarding the land and timber price and based on a real interest rate of 5% and a carbon price of US$ 20, the cumulative carbon sequestration for 2000-2012 and 2000-2020 was estimated at 125 million tonnes of Carbon (MtC) and 337 MtC respectively. This represents a net benefits of US$ 1.1 billion (US$ – 2000) for the period 2000-2012 and US$ 2.3 billion (US$ – 2000) for 2000-2020, covering only 4% of the area suitable for afforestation and reforestation in the region.

Before the final set-up of REDD+, different studies attempted to evaluate the potential benefits associated with the implementation of these schemes for the Latin American Region. It was for example estimated that a 10% reduction in annual deforestation rates from these scheme would generate carbon savings worth more than US$ 600 million annually, with a carbon price of €US5/tonne, and up to US$ 2.5 billion at a carbon price of US$ 30/tonne. Other estimates of the scale of REDD+ financing vary from US$ 2 billion to US$ 33 billion/year. For Ecuador, the potential yearly income is estimated in $36 million, for Brazil $208 million, Venezuela $35 million, and for Bolivia, Peru, and Mexico just under $20 million each (Bovarnick *et al.* 2010).

In Costa Rica, the development of 21,000 plantations has sequestered a cumulative total of 1 million tonnes of carbon. The payment for environmental services (PSA) sought to sell carbon emissions reduction credits. FONAFIFO developed the certificate of tradable offsets which represent an externally certified 1-tonne net reduction in carbon emissions. The first impetus was given by the payment of US$2 million for 200,000 CTOs from the Norwegian Government and a consortium of Norwegian power producers. Costa Rica obtained a contract through the World Bank's BioCarbon Fund that enables the country to sell about 0.61 million tonnes of carbon dioxide equivalent by 2017 for activities related to planting trees in agroforestry systems, natural regeneration and commercial plantations (Pagiola 2008).

Temperate forest in Chile with multiple ecosystem services

Nahelhual *et al.* (2007)[25] estimated the economic benefits delivered by temperate forests in Chile. These include: production of timber, provision of nature-based recreation opportunities, maintenance of soil fertility, and water supply for human consumption. Based on secondary sources, the study first evaluated the benefits associated with different models of forestry exploitation (i.e., unsustainable harvesting – UH – and sustainable forest management – SFM) for different types of forest (secondary forest and old growth forest). The results showed that for secondary forests, SFM delivers higher benefits under all the scenarios considered. For old growth forest, UH produce larger benefits than SFM. However, if we also take water supply into account then SFM is more profitable than UH. Hence, as long as sustainable timber extraction is complementary with the provision of fresh water, SFM and forest conservation should be superior economic options for forest owners and managers than unsustainable extraction practices.

25 Nahuelhual, L., et al. 2007. Valuing ecosystem services of Chilean temperate rainforests. http://www.cepal.org/ilpes/noticias/paginas/4/31914/Nahuelhual_07_Eco_Services_Chilean_forests_GOOD.pdf

Table 3. Results produced by the natural capital GIS

Ecosystem Services	Mean value (US$/km^2)
Allspice production	14.40
Chicle production	40.80
Non-timber products	10,661.60
Medicine	97,834.40
Genetic material	524.40
Tourism	136.00
Carbon storage	99,913.60
Soil conservation	1,900.40
Flood control	1,321.20
Existence (CV)	209.60
Existence (PfB)	14,732.00
TEV	**227,288.4**

Source: Eade, J.D.O. and Moran, D. 1994. Spatial Economic Valuation: Benefits Transfer using Geographical Information Systems.

Ecosystem services delivered by Amazonian tropical forest

The Amazon provides a wide range of services for local communities as well as for the global population. Despite these crucial services, the Amazon undergoes massive deforestation. WWF published a report in 2009 to demonstrate the potential offered by marketing the ecosystem services supplied by the Amazon. The table below presents a number of significant ecosystem services provided by the Amazon forest and their related economic values, as far as they are known. As noted in the report, these different figures cannot be simply added together as they are based on different assumptions and the different services are not additional per se.

Forest conservation and protected areas: Belize

As part of the initiative of the Programme for Belize (PfB), initiated by international conservation agencies, a study[26] estimated the economic values of the Rio Bravo Conservation and Management Area. Rio Bravo contains about 100,000 ha of tropical rainforest, swamp/marsh and savanna, and is situated in the north west of Belize. The direct uses identified in the Rio Bravo are related to non-timber products (*Manilkara quianensia*, *Inga spp*. *Brosimum rubescens*), allspice and chicle, medicinal plants (*Agondra racemosa, Simaruba glanca, Bursera simaruba*) and genetic material and tourism. Other regulating services have been identified such as carbon storage, soil conservation and flood control. Rio Bravo represents one the most outstanding natural reserves in Belize which delivers substantial benefits through intrinsic and existence values. The survey estimated the existence value for Rio Bravo by transferring estimates of willingness to pay for comparable areas and by calculating the amount of money given to the Programme for Belize to maintain the ecological services over time.

The methodology used GIS to calibrate the economic values from alternative sites for transfer to the site under scrutiny. This was achieved by first mapping the "strength" or "quality" of the natural capital assets in the Rio Bravo, then using the GIS maps to re-calibrate benefit estimates from alternative sites. The results of this process are "economic value maps", showing the benefit value of natural capital assets in two-dimensions. In order to realise this

26 Eade, J.D.O. and Moran, D. Spatial Economic Valuation: Benefits Transfer using Geographical Information Systems. http://www.cepal.org/ilpes/noticias/paginas/4/31914/Eade_Moran_96_GIS_valuation_Belize.pdf

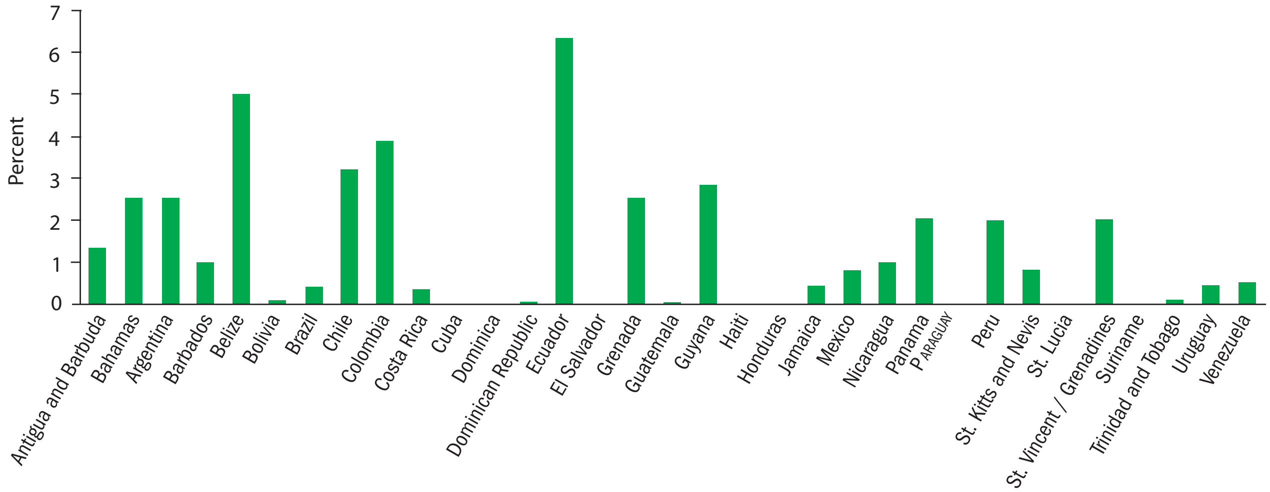

Figure 1. Percentage of the contribution of fisheries to GDP in LA & the Caribbean region

Source: Bovarnick et al. (2010)

exercise, 50 meters × 50 meters cells were used as basis geographical unit. The total economic value grid contained values ranging from US$ 43 to US$ 2,000 per cell. The TEV of the average cells is equivalent to US$ 687, equivalent to US$ 227,288/km^2.

Benefits of forest conservation for water services
Examples from Colombia, Mexico and Costa Rica demonstrate benefits in improving or maintaining water quality and quantity for downstream users by investing in natural ecosystems for biodiversity. The beneficiaries include water users such as water utilities, power production companies and bottle companies. By implementing sustainable land management activities in the hydrological areas, the landholder can also benefit through soil stability and conservation, and improvements in the nutrient cycle.

The scale of benefits ranges from local to global. The environmental benefits are strongly related to the eligibility and prioritization of areas being targeted by the payment system, to the payment level and to the stakeholder's participation.

SUSTAINABLE FISHERIES (AICHI TARGET 6)

Fisheries are of considerable importance to the economies of Latin American and Caribbean countries, and make an important contribution to sustaining livelihoods, jobs and local economies. However, the fish stocks in the region face considerable threats due to over-exploitation which in turn produces economic loss and depletes fish resources. In 1995, more than 57% of the fisheries in Latin America and the Caribbean were over-exploited and evidence suggests that the situation has worsened since then (Bovarnick *et al.* 2010).

Economic losses caused by inefficient and harmful practices include (Bovarnick *et al.* 2010):

- The loss of productivity due to discards of targeted species, bycatch of non-targeted species (including species of commercial value in other fisheries) and ghost fishing by abandoned gear. Discard rates vary substantially by fishery and by gear. In Peru, the average discard rate was about 83% but 81% in the industrial shrimp trawl. In Argentina, discarding is 15% overall, but 24% in the southern hake otter trawl fishery and 50% in shrimp trawls.
- The costs associated with fishing fleet overcapacity.
- The costs associated with inappropriate subsidies promoting fishing overcapacity and/or excess fishing effort. LAC is third in the world in terms of total subsidies for fisheries, at US$ 1.9 billion per year.
- The costs associated with illegal, unreported, and unregulated (IUU) fishing which contributes to resource depletion and impedes recovery of fish populations and ecosystems.

Table 4. Total wetlands area in Latin America and associated economic value

Wetland types	Surface (km^2)	Economic value (million US$ – 2000 value)
Mangrove	422,240	8.44
Un-vegetated sediment	92,230	104.78
Salt/Brackish marsh	17,070	3.13
Freshwater marsh	2,890	0.53
Freshwater woodland	10,100	6.12
TOTAL	**120,230**	**123**

Source: WWF. 2004. The economic value of the world's wetlands. http://assets.panda.org/downloads/wetlandsbrochurefinal.pdf

Conservation and restoration of wetlands (Aichi Targets 5, 11, 14)

Most of the existing studies indicate that wetlands valuation has tended to focus on a few ecosystem services such as recreation, coastal habitat-fishery linkages, raw material, food production and water purification. Other ecosystem services are less widely estimated, such as carbon sequestration, water supply (recharge of aquifers), climate stabilisation and regulation, erosion control and flood protection).

WWF (2004) reviewed 89 different case-studies analysing the value of wetlands for the different regions on the world. Using a value transfer approach, covering 5 different types of wetlands[27] and 10 different ecosystems services (flood control, recreational fishing, amenity/recreation, water filtering, biodiversity, habitat nursery, recreational hunting, water purification, materials and fuel wood), the study estimated the value of the wetlands in Latin America to be around **US$ 123 million per year** (US$ – 2000).

Wetlands cover approximately 40,000 km^2 in Central America, representing 8% of the total land area. They provide ecosystem services ranging from refuge for biodiversity to maintenance of water quality and climate change mitigation and adaptation. Annual primary productivity of some Central American wetlands equals or exceeds that of tropical rainforests. Despite these crucial services, wetlands are under continuous threats associated with population and development pressures, intensive deforestation and conversion of forest lands to agriculture.[28]

One study was conducted in the Terraba-Sierpe National Wetlands (HNTS)[29], located in the Osa Peninsula of Costa Rica. This natural park covers 1,570 km^2 and comprises a mosaic of ecosystems and land cover (wetlands, tropical forest, beach, lakes and ponds, mangroves and plantations/croplands). The contribution of each ecosystem/land cover to the following ecosystem services was estimated: Food Production, Recreation & Aesthetic, Habitat & Refugium, Raw Materials, Disturbance Regulation, Waste Treatment, Biological Control, Gas & Climate Regulation, Refugium & Nursery, Refugium & Wildlife Conservation, Water Supply, Water Regulation, Pollination, Soil-Formation, Erosion Control, Nutrient Cycling, and Genetic Resources.

The study combined GIS data and peer-reviewed studies conducted between 1978 and 2008 on economic valuation of main ecosystem services. It estimated the contribution of each of ecosystem service through benefit transfers methods, to give a lower and higher bound estimate for each one (Table 5, see Appendix 5). The authors estimated

27 This study used the estimation of surface was extracted from the CCRU (2003) Global Wetland database

28 Ellison, A.M. 2004. Wetlands of Central America. http://www.bio-nica.info/biblioteca/Ellison2004.pdf

29 Earth Economics. 2010. Nature's values in the Terraba-Sierpe National Welands: The essential economics of ecosystems services.

that the whole Terraba-Sierpa area provides annual benefits in the range **US$ 287 million** to **US$ 1,179 million per year** (Table 5)**.** Per hectare and per year, the contribution for each type of ecosystems/land cover was:

- Mangroves: $11,154–$33,929;
- Tropical forest: $1,669–$5,511;
- Wetlands: $1,731–$42,527;
- Lakes and ponds: $83–$23,425;
- Plantations: $8–$15;
- Beaches: $58,734–$214,215.

It is likely that these values are underestimates due to gaps in valuation data.

Coral reefs and mangroves (Aichi Targets 7 and 10)

Coral reefs provide a wide range of ecosystem goods and services which are of high value and of critical importance for the local and national economies in the Caribbean. Despite this high value, the extent and health of the Caribbean coral reefs have declined dramatically in the last decades and continue to be threatened by human activities (e.g., overfishing, ocean acidification and invasive tourism).

For the whole Caribbean region, Burke *et al.* (2008)[30] estimated that, in 2000, the Caribbean's coral reefs provided ecosystem goods and services with an annual net economic value of US$ 3.1 billion to US$ 4.6 billion. The ecosystem services valued are related to fisheries, dive tourism, and shoreline protection services. These figures represent conservative estimates of the value of coral reefs, as they only consider subset of the goods and services provided by coral reefs. Table 6 illustrates these different benefits together with the estimates of potential future decline in these values associated with the continued degradation of coral reefs.

In 2005, the World Resource Institute (WRI) initiated a project to develop and implement a national scale economic valuation methodology for coastal capital in the Caribbean.[31] Different valuation studies resulted from this project and others are still on-going.

Faller *et al.* (2010)[32] estimated the total economic value provided by coral reefs, sea grass and mangroves in Martinique. The study considered direct, indirect and non-usable ecosystem services such as fishing, and diving, the gross value added measure was used in the estimation. The replacement cost method was used to value protective and regulatory functions such as coastal protection. Budget estimates of spending on education and research were used to measure non-use values. On average, coral reefs are valued at US$ 2.3 million per km^2. As shown in table 7, sea grass is valued at US$ 2.8 million per km^2, and mangroves are valued at US$ 2.45 million per km^2. The valuation results suggest that mangroves and sea grass deserve the same protection as reefs to continue to provide crucial ecosystem services.

Burke *et al.* (2008) valued the ecosystem services related to reef and mangrove-related fisheries, tourism, and shoreline protection services in Belize. The total value of these services was estimated to be US$ 395-559 million per year. As a reference point, Belize's GDP totalled US$1.3 billion in 2007. Coral reefs and mangroves are highly interconnected habitats, physically supporting each other and providing habitat for fish species. For example, mangroves filter sediment and pollutants from coastal runoff, supporting the clean water favoured by corals. Many species important to fisheries and tourism rely upon both mangrove habitat and coral reefs for a portion of their life-cycle. As stressed in the report, this study did not directly evaluate the independent contributions of mangrove and coral reef habitats to the fisheries and tourism sectors, but assessed their collective value. To produce a rough estimate of the breakdown by habitat, the study examined the proximity of mangroves to coral reefs across Belize

30 Burke, L., and J. Maidens. 2004. "Reefs at risk in the Caribbean." Washington DC., USA: World Resources Institute.

31 More information about this project are available at: http://www.wri.org/our-work/project/coastal-capital-economic-valuation-coastal-ecosystems-caribbean

32 Failler, P., Petre E. and Marechal, J-P. 2010. Valeur économique totale des récifs coralliens, mangroves et herbiers de la Martinique. Available at: http://etudescaribeennes.revues.org/4410

Table 7. TEV from coral reefs, mangroves and sea grasses in Martinique (2010)

Ecosystem services		Coral reef	Mangroves	Sea grass
Direct ES	Fisheries*	0.28	0.034	-0.051
	Tourism activities	1.56	1.81	1.02
Indirect ES	Coastal protection	0.37	0.08	1.59
	Biomass (fish)	0.12	0.09	0.00
	Carbon sequestration	0.00	0.01	0.01
	Water purification	0.00	0.22	0.14
Non-usable ES	Cultural value	0.07	0.20	0.08
	Research and education	0.01	0.01	0.00
TOTAL		**2.34**	**2.45**	**2.81**

Values are expressed in million dollars/km^2/year. Exchange rate 1USD= 0.762 euros (2010).
* Includes both commercial and leisure fisheries
Source: Failler, P., Petre E. and Marechal, J-P. 2010. Valeur économique totale des récifs coralliens, mangroves et herbiers de la Martinique. Available at: http://etudescaribeennes.revues.org/4410

Table 8. Estimated coral reef and mangroves contribution to the Belizean economy

	Coral reef	Mangroves	Combined contribution
Tourism	$ US 0.1–0.12	US$ 0.15–0.18	–
Fisheries	US$ 0.01	US$ 0.01	–
Shoreline protection	US$ 0.08–0.13	US$ 0.28–0.39	–
Total per km^2/year	**US$ 0.19–0.26**	**US$ 0.44–1.02**	–
Total for all Belize/year	**US$ 268–370**	**US$ 174–249**	**US$ 395–559**

Note: Mangrove & reef fisheries and tourism values are not additional, as they include revenues that rely on both habitats.
Values are expressed in million US$/km^2/year unless indicated differently (US$ 2007).
Source: Burke, L., Cooper, E. and Bood N. 2008. Coastal Capital: Belize – The Economic Contribution of Belize's Coral Reefs and Mangroves.

to estimate the portions of fisheries and tourism values that (1) rely exclusively on coral reefs (2) rely exclusively on mangroves, and c) depend upon both.

Burke *et al.* (2008) estimated the value of coral reef-related tourism and recreation, fisheries and shoreline protection services in Tobago and Saint-Lucia. The economic impact of coral reef-associated tourism and recreation and fisheries is evaluated analysing the financial flows generated in these industries and their impact on the economy. The study did not only consider the direct benefits associated with tourism and fisheries activities but also the additional indirect economic impacts, driven by the need for goods to support tourism and fisheries (such as boats, towels, beverages, fuels, etc.). Shoreline protection services were evaluated using a modified avoided damages approach, where the value of a reduction in wave-induced erosion and property damage due to coral reefs is estimated. The study presented yearly economic benefits for Trinidad and St-Lucia and did not provide data per square km. The aggregated values were converted to per square km data by dividing them by the surface of coral reefs in both regions. As acknowledged in the study, estimates of reef surface are from different sources and vary. The maps used by the study were extracted from the Millennium Coral Reef Mapping Project [33] and national data sources suggesting that reef area is about 30 km^2 in Tobago and 33 km^2 in Saint-Lucia.

33 http://imars.usf.edu/MC/index.html

Sarkis *et al.* (2010)[34] estimated the total economic value of the coral reef located in Bermuda focusing on 6 key ecosystem goods and services such as tourism (strongly dependant on coral reef), fisheries (associated with reefs), amenity and surplus value of real estate (due to reef) and recreational, cultural, research and educational values. Using different valuation techniques, the total value associated with these ecosystems services was estimated at between US$ 488 million per year and $1.1 billion per year, with an average value of US$ 722.4 million per year. The GDP of Bermuda amounted to US$5.85 billion in 2007; the TEV of coral reefs represents thus 12% of Bermuda's GDP. In order to estimate the benefits value per square kilometre, they have been divided by the area covered by the study, namely 400 km^2.

A general overview of economic values is presented in Table 9. The benefits associated with the different services provided by coral reefs (and many other ecosystems) vary largely depending on local circumstances, ecological characteristics and their location.

Benefits of Nagoya Protocol (Aichi Target 16)

Aichi Target 16 concerns the implementation of the Nagoya Protocol, relating to access and benefits sharing for genetic resources.

The costs and benefits associated with delivering this target will vary from one country to the other depending on their legal framework with regard to the access to genetic resources and the fair and equitable sharing of benefits arising from their utilisation. A report published in 2012 but mainly based on country analysis made before the adoption of the Nagoya Protocol in October 2012 makes the following analysis of the situation in Central America, South America and the Caribbean:

> "Latin America and the Caribbean is an area of high biological and cultural diversity and similarly high activity on the access to genetic resources and the equitable sharing of the benefits (ABS). At the regional level, both the Andean Community and the Central American countries have ABS measures, although the latter are still in draft form. In addition to countries discussed below (Brazil, Colombia, Costa Rica, Peru, Panamá, México and Venezuela), several other Latin American countries are in various stages of creating and implementing ABS measures. Other countries with some ABS measure in place are Bolivia, Ecuador, Argentina (at the provincial level), and Guyana. There appears to be a lesser degree of activity in the Caribbean with some initiatives in Cuba (a general regulation for research on biological resources exists), Dominica (a draft ABS Law exists) and Saint Lucia (as part of a comprehensive biodiversity law)" (CISDL, 2012, p. 10).

Since the adoption of the Nagoya Protocol, 3 countries in Central America have ratified the Protocol: Honduras, Mexico and Panama.

The theoretical benefits associated with the implementation of the Nagoya Protocol and the Aichi Target 16 are multiple. However, the quantification of these benefits is a difficult task due to their scale and nature. The key benefits identified in the project documents and literature is detailed below.

From a socio-economic perspective, the implementation of the Nagoya Protocol will help to ensure that the benefits associated with the utilisation of the genetic resources of a particular country are equitably shared within this country, especially when the resources leave the country. The establishment of clear and transparent legal frameworks on the access and use of the genetic resources will also favour the advancement of research in the field of bioprospecting in Latin America and the Caribbean. This will generate major socio-economic benefits through the creation of direct employment in Latin-American based businesses involved in bioprospecting and bioassays, and through economic multiplier effects in related service industries. The new findings emerging from these bioprospecting activities will then benefit society as a whole and the country providing the genetic resources in particular. Support to the implementation of the Nagoya Protocol will also enable recipient countries to overcome the high transaction

34 Sarkis, S., Van Beukering P.J.H. and McKenzie, E. 2010. Total Economic Value of Bermuda's Coral Reefs: Valuation of Ecosystem Services. Available at: http://ipbes.unepwcmc-004.vm.brightbox.net/system/assessment/191/references/files/566/original/Total_Economic_Value_of_Bermuda_s_Coral_Reefs_-_Valuation_of_Ecosystem_Services_Technical_Report_2010.pdf?1364314252

costs which are associated with the establishment of a clear legal framework for ABS. As stressed by a UNEP funded project document, these transaction costs make the benefits sharing principles associated with the implementation of the Nagoya Protocol relatively elusive (UNEP, 2011).

From a pure social perspective, the implementation of the Nagoya Protocol will lead to the development of clear provisions on access to traditional knowledge associated with genetic resources. These will assist Latin American countries in strengthening the ability of indigenous and local communities to benefit from the use of their knowledge, innovations and practices. The Nagoya Protocol will also provide incentives for the promotion and protection of traditional knowledge by encouraging the development of community protocols, minimum requirements for mutually agreed terms and model contractual clauses related to access and benefit-sharing of traditional knowledge associated with genetic resources.

Finally, from an environmental perspective, the implementation of the Nagoya Protocol should help to increase the incentive to protect biodiversity.

Distribution of benefits

The evidence above demonstrates that achieving the Aichi Targets will benefit a wide range of individuals and sectors in society, at different spatial scales. For example:

- Local people will benefit from maintaining the provisioning services of ecosystems, such as food, fibre and fuel, but may also benefit in the short term from their over-exploitation or conversion;
- Individuals and business in the wider local community benefit from maintaining a variety of regulating services (including water purification and regulation, control of natural hazards and erosion, pollination) and cultural services (including recreation and tourism);
- The global community will also benefit substantially from the Targets, especially through climate regulation and the existence values of biodiversity.

For many of the Targets, a large proportion of the benefits accrue to the global community. This is especially the case for Target 5 (reducing the rate of deforestation), since the region contains a large proportion of the remaining global forest resource and maintains valuable stocks of carbon. Studies demonstrate the substantial global benefits of the conservation and sustainable use of forests.

In other cases, a much larger proportion of the benefits of achieving the Targets may be realised locally. For example, the protection of coral reefs (Target 10) delivers valuable benefits to local tourism and fisheries sectors, as well as delivering regulating services which benefit local communities.

Achieving the Targets will benefit a wide range of economic sectors, such as agriculture, fisheries, forestry, energy, water and tourism, by supporting their long term sustainability, but may reduce the output of some sectors such as forestry, fisheries and agriculture in the short term.

Poorer people will be the greatest strongest beneficiaries of the Aichi Targets, because they depend most directly on ecosystems for their livelihoods – through the provision of food, fibre, fuel and fresh water, and the essential regulating and supporting services that sustain them.

However, these dependencies may often lead local users to over-exploit or convert ecosystems in the short term, leading to the loss of benefits for the wider local and global community. PES schemes – in which the beneficiaries of ecosystem services compensate land managers for the conservation and sustainable use of ecosystems – have been successfully developed in the region, and have an important role in incentivising the delivery of the Aichi Targets and ensuring that the benefits are shared equitably.

5.5 INVESTMENT NEEDS

What types of investments and activities are needed to deliver the Aichi Targets and to secure these benefits?

Regional evidence highlights the need to build effective governance structures, in order to develop, implement, monitor and enforce the policies and actions needed to deliver the Targets, and this forms an important starting point in assessing investment needs.

Two main sources of evidence were found in assessing investment needs:

- Regional reviews of the state of implementation of the Targets and the scale of action required to meet them; and
- NBSAPs and other national and local initiatives which document specific priorities in each country.

Regional evidence

Some insights into investment priorities at the regional level can be developed from the findings of a workshop to analyse the level of progress in achieving the Aichi Targets.[35] The attending countries gave a summary of their progress towards achievement of the Aichi Targets since they were introduced in the Strategic Plan. Not all the countries of the region were represented in this workshop and the information shown here covers only a small part of the region.[36] Nevertheless, it provides a first view of how countries rate their achievements to date, and identify which Aichi Targets require more attention in the future.

The attending countries had the option to classify themselves in a range that goes from a low (0-30%) to a medium (30-65%) or high (65-100%) level of achievement of the Aichi Targets. The figure below presents the overall situation from the 12 countries that have provided this information.

Whilst it is difficult to generalize a trend for the entire region, it is clear that there are variations in levels of achievement between countries and between targets. Progress tends to be greatest in areas of traditional conservation activity (Targets 11 – Protected Areas; 12 – Species Conservation; and 19 – Science Base). However, the review also noted differences in levels of legal designation of protected areas and in their long term effectiveness, which also depends on awareness, involvement and support of local institutions and communities. The absence of financial mechanisms to support compensation schemes or to favour the flow of benefits to local stakeholders and communities is a potential risk for biodiversity conservation.

The region is quite diverse and the social and economic conditions also differ from one country to another. These differences impact on the capability of the country to reconcile development benefits with environmental objectives. To demonstrate the value of biodiversity conservation is one step to increase awareness, but it could be insufficient if no actions are taken to strengthen institutional capacity and coordination among and across public entities. That is the reason why the inclusion of biodiversity conservation into sectorial policies and the involvement of economic stakeholders are a priority in the region. Some countries have also stressed the necessity to work on programmes of environmental education, knowledge enhancement and sharing and communication. In the same way there is a need to enhance and reinforce strong collective institutions of local communities with emphasis on education and local development.

Some of the indicators that countries have put forward to measure their progress towards the Aichi Targets are related to the number of plans implemented for sustainable management of biodiversity in agriculture, forestry and fisheries. The number of plans implemented will depend on the level of

35 Taller regional para America Latina sobre la actualizacion de las estrategias y planes de accion nacionales en materia de diversidad biologica, Villa de Leyva, Colombia 2013.

36 LA&C countries attending the regional workshop: Argentina, Bolivia, Brazil, Chile, Colombia and Ecuador (South America); Costa Rica, Guatemala, Honduras, Mexico, Nicaragua and Panama (Central America); Cuba and Dominican Republic (Caribbean).

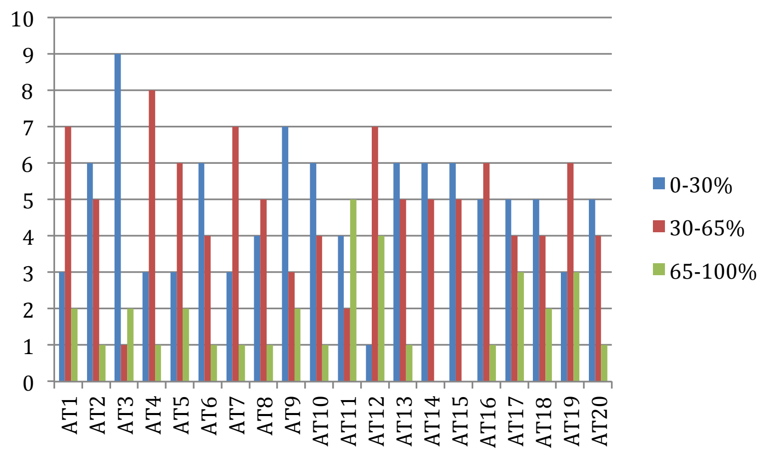

Figure 2. Countries' estimates of their level of achievement of Aichi Targets.* Source (UNEP-CDB 2013)

*This figure does not include information from Costa Rica, Colombia, Ecuador, Guatemala or Peru.

engagement of stakeholders and local communities as well as on the available technological options or alternative practices to enhance changes in production systems. Most of these elements require technical skills on the ground and appropriate mechanisms for transfer of know-how. Financial support is necessary not only to finance the changes (and compensate for opportunity costs) but also to enable local communities to take advantage of new business opportunities based on sustainable management of biodiversity.

Targets which present particular challenges for implementation – with six or more of the 12 countries reporting progress of 30% or less – include Targets 2 (biodiversity values), 3 (incentives), 6 (sustainable fisheries), 9 (invasive species), 10 (coral reefs), 13 (genetic resources), and 14 and 15 (ecosystem restoration).

It is clear that significant action and investment will need to be focused on these Targets. However, it is less evident whether the limited progress towards these Targets to date reflects the overall levels of investment needed, or other challenges such as political barriers to change. While the scale of investment needed is likely to be a significant barrier for some targets (e.g. the restoration targets 14 and 15), others may depend more on achieving the levels of awareness, institutional capacity and governance structures necessary to tackle conflicts and effect change. It is likely therefore that delivering the Targets will depend not just on the levels of investment allocated to them, but also on the careful targeting and sequencing of investments to create the right conditions for change. This is reflected in the views expressed by workshop participants, which highlighted the importance of activities that address the obstacles to the delivery of these Targets, including scientific, legal, and institutional and policy components, as well as general attitudes and awareness.

Financing needs to achieve the Aichi Targets from National Biodiversity Strategies and Actions Plans in the LA & the Caribbean region and country specific insights

This section analyses the financial needs from the perspective of the NBSAPs and other evidence from national or local projects. This analysis confirms the areas of main concern and the main investments made to fulfil the CBD's objective and therefore the Aichi Targets.

As well as the investments needed in land management and ecosystem restoration, the preceding regional review and the review of NBSAPs and national needs also highlight the importance of investments in creating the enabling conditions needed to meet the Targets. These enabling conditions require investments in:

- Awareness and attitudes towards biodiversity and its conservation

- Training and capacity building
- Legal frameworks and governance structures
- Scientific knowledge
- Financial frameworks and incentive structures.
- Monitoring, evaluation and enforcement mechanisms.

These enabling investments are often required at the project level, to support the effective delivery of conservation activities (Table 11).

Awareness and attitudes

Most countries in Latin America and the Caribbean highlight the need to increase awareness and enhance attitudes towards biodiversity conservation and ecosystem services among decision makers, stakeholders and the wider public. In many cases this is related to the observation that this lack of knowledge at policy level is one of the barriers identified for the implementation of conservation programmes. A convinced political class requires less time to put into effect the best legal, administrative, and regulatory measures to support environmental goals.

These types of investments contribute directly to Aichi Targets 1 (awareness raising) and 2 (integration of biodiversity values into decisions), as well as supporting the delivery of other targets.

Training and Capacity Building

Training and capacity development – for policy makers, administrators and stakeholders at the national, regional and local levels – play an important role in supporting the delivery of conservation actions, and crucially the integration of biodiversity considerations into a range of development, land use and sectoral policies and initiatives.

Legal frameworks and governance structures

For some countries, there is a need to review, adapt or enhance an appropriate legal framework in order to develop sustainable mechanisms to support the inclusion of conservation activities in the main sectorial policies or to support the environmental sector. Most often, countries build upon the existing structures and adapt or modify them in order to increase the cost-efficiency of policies. However, in other cases the investment might be more significant if completely new regulations, financing programmes or agencies need to be put in place.

Appropriate incentive structures and financial frameworks

Implementing conservation actions on the ground depends on putting in place appropriate financial structures and incentives to deliver the resources required. Finance is needed for a range of activities such as:

- Financing of change in land use management practices and restoration activities through PES schemes or other innovative financial mechanisms (e.g. water funds);
- Implementation of improved ecosystem management and sustainable land management practices;
- Development of sustainable forest management and REDD+ projects;
- Implementation of participative management plans and conservation agreements at local level;
- The creation and strengthening of protected areas (terrestrial and marine).

In the cases of the projects financed by GEF and the World Bank, these operational activities are often associated with the development of pilot projects at local level. Considering the local scale of these pilot projects, the scale of the necessary investment varies considerably from one project to another. Costa Rica is one country which has placed significant emphasis on creating the financial frameworks and incentive structures needed to deliver the conservation activities required.

Scientific knowledge

Scientific knowledge and evidence plays an important role in guiding biodiversity conservation actions, and assessing their effectiveness. As well as being central to Aichi Target 19 it therefore makes an important contribution to all of the other Aichi Targets. Some studies are necessary to identify priority areas and criteria of eligibility of the measures. Some economic analyses are needed to assess the payment level and demonstrate the most cost-effective measures compared to other alternatives. Data acquisition and indicators are part of the monitoring systems that are necessary to show the performance of the systems or readjust them when necessary.

Monitoring, evaluation and enforcement mechanisms

Monitoring, evaluation and enforcement play an important role across the Targets, in enhancing the effectiveness of conservation actions. Monitoring and evaluation are required to gather evidence of the effectiveness of conservation actions and to inform further adaptation. Enforcement mechanisms are necessary to ensure compliance, and are central to the effectiveness of legal measures, such as protected areas (Aichi Target 11) and species protection measures (Target 12). Enforcement is also needed to underpin incentive measures and PES schemes, including to prevent free-rider behaviour or problems of leakages or slippage (e.g. where payments support a particular portion of forest land but increase pressures in surrounding forested areas). Securing compliance is necessary to reduce the negative consequences of any breach of contracts but also to secure investments and investors who require legal guarantees.

Where would these investments be best directed or focused?

In the Caribbean region, the main priorities are related to the reinforcement of a national system of protected areas or the creation of protected areas (terrestrial and marine). This is the case for the Bahamas, Barbados, the Dominican Republic, and Grenada. Others have geared their actions to generate or expand sustainable management in agricultural activities; this is the case in Jamaica, Trinidad and Tobago. It is worth noting that preserving marine and coastal areas produces huge economic benefits to tourism and fisheries which are the main activities boosting the GDP of these countries. PES schemes and more supportive public funding programmes offer greatest potential to deliver positive change in the middle and upper income countries in the Caribbean.

In Central America, countries confirm the need to consolidate their national system of protected areas with emphasis on the implementation of strategies related to changes in agriculture and livestock production. Afforestation, reforestation and restoration will enhance benefits at the global level (carbon sequestration) and increase local benefits related to water supply and water regulation.

In South America, the main strategies aim to ensure sustainable financing mechanisms through payment for environmental services or water funds – in order to address drivers of deforestation and ecosystem decline. These strategies require protected areas management, sustainable agriculture and livestock production and restoration of key ecosystems.

Which targets will these investments help to meet, and what are the synergies and overlaps between targets?

The Aichi Targets are interrelated and effective implementation will depend on timing and sequencing of actions to achieve optimal effect.

In particular, investments in capacity building and appropriate institutional and policy frameworks will be important in delivering Aichi Targets 1-4 and 17-20 and in creating the conditions needed to deliver all other targets. These are all dependent on awareness raising (Target 1), scientific evidence (Target 19) and the integration of biodiversity values into development plans and sectoral policies (Target 2).

Investments related specifically to Aichi Target 3 will help to develop the economic incentives needed to deliver a wide range of Aichi Targets. The main priorities relate to the design and implementation of payments of environmental services (PES) and the establishment of water funds, as well as the reform of negative incentives such as fisheries subsidies. These initiatives aim to conserve forest resources and/or protect aquifers and watersheds, emphasising the linkages between forest resources and the provision of environmental services of water ecosystems.

Sustainable agriculture, forestry, aquaculture and fisheries (Targets 6-7) and effective protected areas (Target 11) will relieve pressures on ecosystems more widely and help in the delivery of other Targets such as 5 (ecosystem protection), 8 (pollution control), 10 (coral reefs) and 14-15 (restoration).

5.6 RESOURCE REQUIREMENTS

Current expenditures on biodiversity conservation

- Waldron *et al.* (2013) undertook a global assessment of funding resources provided by international donors, bilateral cooperation, domestic funding and other innovative financial mechanisms to achieve global conservation priorities. They found that global spending amounted to US$19.8 billion (2005 base dollars) annually between 2001 and 2008. They concluded that some countries experienced differences between the expected and the observed funding for biodiversity conservation. For instance, according to this study, finance for biodiversity in Trinidad and Tobago was lower than would have been expected considering the importance of biodiversity in its territory (with under-funding estimated at US$4.38 million per year).

Extracting from the Waldron *et al.* (2013) database (2001-2008),[37] total annual conservation expenditures in the Latin American & the Caribbean region amounted to an average of US$632 million per year, from which US$ 203 million were allocated to Central America, US$ 395 million allocated to South America and approximately US$ 33 million to the Caribbean countries.

Between 2001 and 2008, Central America received the equivalent of US$ 203 million annually for investments related to biodiversity conservation. Total aid received from international donors and bilateral cooperation represented 52% of the total funding, against 39% from domestic resources and 9% from special funds (trust funds and debt-swaps). Domestic funds include national public funding as well as payments from user fees that are reinvested in biological conservation in these areas. The situation varies across countries; some countries have developed the institutional capabilities to levy additional funds from beneficiaries of ecosystems services as well as ensuring a constant flow of resources from national expenditures (e.g. Mexico and Costa Rica which have set up tax systems to finance conservation activities). User fees[38] varied widely in their importance, ranging from 9% in Mexico to 75% in Honduras.

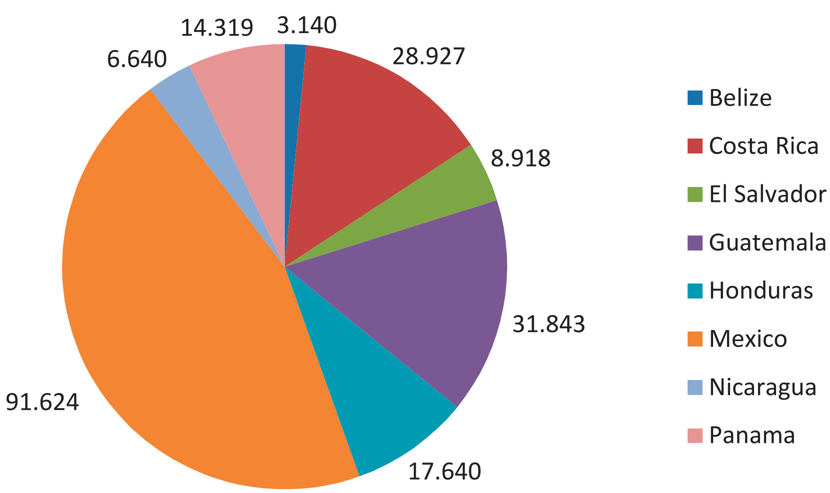

Figure 3. Total average annual spending in Central America (2001-2008) in US$ million (base 2005)
Source: Adapted from Waldron et al. (2013)

37 The database is available at: www.pnas.org/lookup/suppl/doi:10.1073/pnas.1221370110/-/DCSupplemental.

38 These figures are conservative due to investment by the main NGOs operating in these countries whose investments increase the domestic financial contribution.

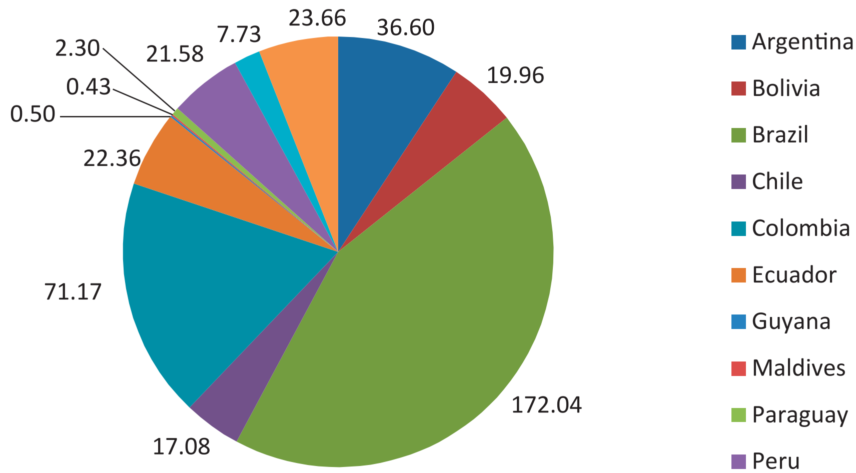

Figure 4. Total average annual spending in South America (2001-2008) in US$ million (2005 dollars base)

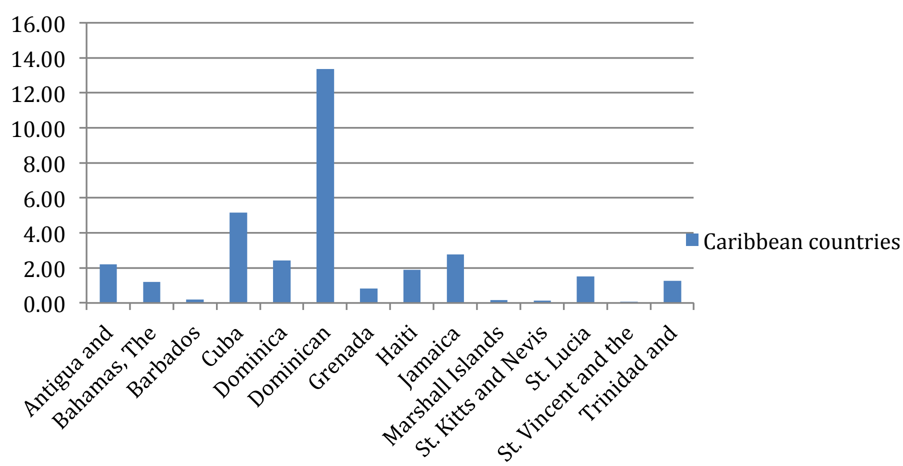

Figure 5. Total average annual spending (2001-2008) in the Caribbean

In South America, the situation was also found to vary between countries. For Ecuador, approximately 90% of the funding went to the Galapagos and almost 39% was estimated to be financed by user fees. The spending in the case of Brazil is underestimated, due to the non-inclusion of States' funding which might be considerable. Colombia has allocated important resources to finance areas collectively-owned by indigenous communities which are home the richest biodiversity in the country. This funding was not included in the analysis. In Bolivia, it was estimated that 95% of the domestic funds come from user fees against approximately 5% of public funding.

In the Caribbean, the average annual spending is lower than in the rest of the region. From US$ 33 million annually, one third of the total average spending of the Caribbean was financed by international donors; the rest was financed by domestic funds and other trust funds and debt-swaps. The Caribbean is strongly dependent on tourism, but the study found little accurate evidence of the use of the revenues from tourism in conservation activities.

Barbados, Grenada, Marshall Islands, St Kitts and Nevis and Grenadines were estimated to have lower levels of investment, ranging from US$ 60,000 to US$160,000 annually over this period.

Table 13. Resource needs for protected areas in Latin America (million per year, 2010)

Country	%PA	Current funding	RN basic Mgt	RN Optimal Mgt	Financial gaps to basic Mgt	Financial gaps to Optimal Mgt
Argentina	7.36	31.309	39.512	60.366	8.203	29.057
Bolivia	15.48	5.102	5.374	9	0.272	3.898
Brazil	8.71	133.415	302.573	471.731	169.158	338.316
Chile	14.93	9.194	17.974	26.754	8.78	17.56
Colombia	10.21	20.166	25.15	42.755	4.984	22.589
Ecuador	13.97	3.977	6.73	14.04	2.753	10.063
Paraguay	15.17	1.24	9.7	19.5	8.46	18.26
Peru	13.51	13.067	25.172	41.842	12.105	28.775
Uruguay	0.9	0.816	3.409	4.355	2.593	3.539
Venezuela	20.21	20.628	52.23	88.791	31.602	68.163
Total		**238.914**	**487.824**	**779.134**	**248.91**	**540.22**

RN basic Mgt: Resource needs to respond to basic management activities
RN optimal Mgt: Resource needs to respond to optimal management activities
Source: From Bovarnick et al. (2010)

Table 14. Resource needs for protected areas in Central America (US million per year, 2010)

Country	%PA	Current funding	RN basic Mgt	RN Optimal Mgt	Financial gaps to basic Mgt	Financial gaps to Optimal Mgt
Belize	24.62	–	–	–	–	–
Costa Rica	23	29.645	31.934	44	2.289	14.355
El Salvador	3.6	3.803	4.445	7.557	0.642	3.754
Guatemala	30.29	8.339	16.118	27.401	7.779	19.062
Honduras	21.75	4.122	6.618	11.251	2.496	7.129
Mexico	11.81	80.214	120.321	160.428	40.107	80.214
Nicaragua	12.96	5.314	19.546	43.321	14.232	38.007
Panama	19.05	9.506	19.88	33.796	10.374	24.29
Total		**140.943**	**218.862**	**327.754**	**77.919**	**186.811**

RN basic Mgt: Resources needs to respond to basic management activities
RN optimal Mgt: Resources needs to respond to optimal management activities
Source: From Bovarnick et al. (2010)

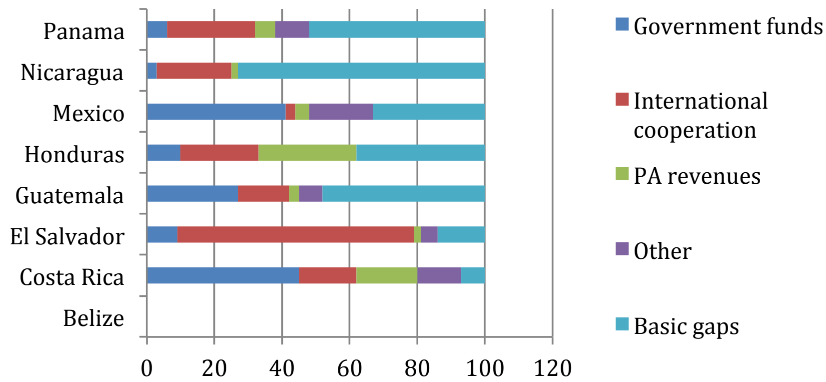

Figure 6. Financial resources and gaps as a percentage of financial needs under the basic scenario in Central America

Source: From Bovarnick et al. (2010)

Resource needs and funding gaps for protected areas

Evidence of gaps in current funding provision is given by a regional analysis of funding in protected areas (Bovarnick *et al.* 2010)[39]. The Latin America and the Caribbean region, containing 40% of the Earth's biodiversity, has 4,111 designated protected areas covering a surface of 500 million hectares of which 466 million are terrestrial and 34 million are marine. The survey assessed current funding for protected areas and compared it to the needs which are necessary to cover management activities under two scenarios: the first one estimated the resources needs to fulfil a basic management plans of protected areas and the second estimated the resources needed for optimal management. The main actions included in the management of protected areas relate to administration and planning (infrastructures, communication tools etc.), patrolling and enforcement (activities that reduce threats to protected areas), environmental education, research and monitoring, enhancement of local economic and social development compatible with conservation, mitigation and restoration and sustainable use of resources (tourism). "Basic management" refers to the level of funding required to operate key programmes to sustain the maintenance of ecosystem functions in protected areas, whereas "optimal management" refers to the ideal level of funding required to operate all the programmes to reach and sustain optimal ecosystem functions in protected areas.

For the whole region, total current funding for protected areas in South America and Central America was estimated to amount to US$ 380 million per year (table 13 and 14). Of this, funding in South America was estimated to amount to US$239 million per year and Central America to US$141 million per year. Financial gaps were estimated by considering current available resources and comparing these to the level of resources required under the basic and optimal scenario of management. The average annual expenditure in Mesoamerica[40] was estimated at US$ 4.59 per hectare per year and in South America at US$ 1.39/ha/year (Bovarnick *et al.* 2010).

For South America, the financial gaps were estimated to from US$ 249 million per year to US$ 540 million per year. In the case of Central America, the funding gap was estimated at between US$78 million per year and US$187 million per year.

This analysis suggests that funding allocated to protected areas would have **to increase by 2 to 3.2 times current levels in South America 1.5 to 2.3 times current levels in Central America in order to meet the estimated** management costs of protected areas.

39 Bovarnick A.J. Fernandez-Baca, J.Galindo and H. Negret. 2010. Financial Sustainability of Protected Areas in Latin America and the Caribbean: Investment Policy Guidance. UNDP-TNC.

40 Includes countries from Central America, Cuba and Dominican Republic.

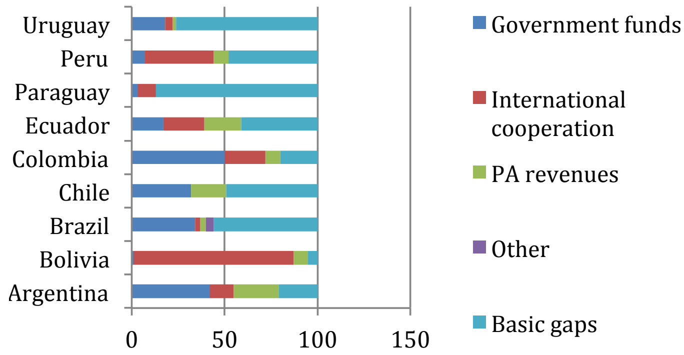

Figure 7. Financial sources and gaps as a percentage of financial needs under the basic scenario in South America
Source: From Bovarnick et al. (2010)

Bovarnick *et al.* also estimated the sources of funding for protected areas. Government funds were estimated to represent 60% of total current funding, international cooperation to provide 15%,revenues of protected areas 11%, and other sources (taxes, or funding for specific projects benefiting protected areas) the remaining 14%. Countries with an important contribution from government budgets are Venezuela, Colombia, Brazil, Chile and Mexico. Some countries are almost wholly dependent on international funding mechanisms. These include Nicaragua, El Salvador, Bolivia, Panama and Peru. Countries such as Ecuador, Honduras and Argentine receive approximately one third of their financial contributions from revenues generated by user fees.

For the Caribbean region, the analysis of resource needs was obtained by combining information from the NBSAPs and information provided by the CBD website on protected areas. For those countries where information was not available from these sources, we took as reference the current spending derived from Waldron *et al.* (2008) as we considered that the minimum resources needed to cover the current spending in significant areas of conservation. We found information specifically for Cuba in Bovarnick *et al.* (2010) in which it is indicated that the additional funding to operate a basic management in protected areas is approximately of US$7.7 million per year. Resource needs were estimated at US$54 million per year. This figure is quite conservative.

Section 5.5 above found that countries in the region estimated that their progress towards Aichi Target 11 (protected areas) was ahead of that for other targets. **This suggests that the funding gap for other Targets may be greater than for Target 11.**

Resources needed to deliver PES schemes

Payments for ecosystem services will play an important role in meeting Target 3 (biodiversity incentives) and in supporting the delivery of other targets, particularly those related to reducing habitat loss (Target 5), sustainable land management (Target 7) and ecosystem restoration (Targets 14-15).

Some evidence was found of the resources deployed by Costa Rica, Mexico and Colombia in developing and administering PES schemes (Table 16).

The figures show that many of the resources needed were invested to develop the institutional basis upon which the schemes have been based. This included substantial investments in data collection and management as well as studies to support the policy intervention, and capacity building measures.

Comparison with findings of HLP first phase report

The review found relatively little quantitative evidence of the resources required to deliver the Aichi Targets. There is therefore limited scope to make direct comparisons with the previous estimates in the first phase report of the High-Level Panel.

The evidence suggests that high levels of investment will be needed to deliver Targets 5 (averting habitat loss) and 11 (protected areas). This is in line with the findings of the first HLP report which identified these as the Targets requiring high levels of investment. However, no evidence was found on the overall costs of meeting Targets 8 (pollution control) or 14 (ecosystem restoration), which were also found by the first report to be among the most resource intensive targets to deliver.

The best evidence of costs at regional level relates to protected areas (Target 11). It is estimated that overall expenditures on the management of protected areas currently amount to $1.4 per hectare per year in South America and $4.6 per hectare per year in Central America, but that there is currently a significant funding gap which prevents optimal management being achieved. Estimates of optimal levels of expenditure on protected areas suggest an average resource requirement in the order of $4.6 per hectare per year in South America and $10.7 per hectare per year in Central America. These estimates are broadly in line with those used in the High-Level Panel's report to COP11 which estimated overall annualised resource needs (including investments and ongoing management costs) in a broad range of US$1 – 10 per hectare per year.

Other findings on resource needs also support the findings of the HLP report to COP 11, including:

- The importance of investment in governance, institutions, capacity and enabling policies, which, while it may not require very high levels of investment, plays an essential role in meeting the range of Aichi Targets;
- The significant gaps in funding that currently exist relative to resource needs, and are a key factor in constraining delivery of the Targets; and
- The synergies and overlaps between Targets, which need to be considered in assessing the types of investments needed and the levels of resources required.

5.7 POLICY ALIGNMENT AND DEVELOPMENT

Alignment between Aichi Targets and other policy agendas

The evidence on the benefits of achieving the Aichi Targets (Section 5.4) highlights the strong connection between environmental degradation and the social economic conditions facing local populations. Providing secure and safe environmental conditions, and maintaining the delivery of key ecosystem services, contributes to the people's livelihoods and to development outcomes.

Most of biodiversity conservation challenges in the Region are strongly related to poverty alleviation. Many of the examples highlighted in Section 5.4 make reference to the synergies with wider policies, in particular regarding the contribution to UN Development Agenda and Millennium Development Goals. Some evidence is available of the direct economic benefits of conservation activities. For example, protected areas support nature-based tourism and recreation. In Mexico, 5.5 million tourists visited federal protected areas in 2006, spending an estimated US$286 million. In Peru, more than 350,000 people visited protected areas in 2005, generating US$146 million of economic activity (Bovarnick *et al.* 2010).

The examples demonstrate how delivering the Targets will contribute to basic development needs, such as food security, the provision of clean water, social cohesion and the development of sustainable livelihoods.

Implications for delivery and resource requirements

The alignment with development goals and other policy agendas has important implications for the types of actions required to achieve the Aichi Targets, and for the resources required. In particular:

- The conservation and sustainable use of biodiversity in the region is closely linked to development and poverty alleviation. There is a need for better integration of biodiversity concerns into development plans and strategies (as required by Aichi Target 2);

- Biodiversity targets are closely linked to a range of sectoral policy areas, including agriculture, water, forestry, energy, fisheries and tourism. Achieving the targets cannot be met by biodiversity actions alone and requires biodiversity to be mainstreamed into these different policy agendas;
- These synergies have implications for the types of investments needed, and the resources required, and open opportunities for funding from a range of different sources;
- Synergies, overlaps and shared investment requirements can make it difficult to assess the resources needed to deliver the Targets. This may help to explain why expenditures and resource needs are best understood for core conservation actions, such as protected areas (Target 11);
- There are important implications for governance structures and institutional capacity. The need to mainstream and align biodiversity with other policy agendas requires greater awareness of needs and opportunities among a wide range of policy makers and delivery bodies, investment in training and capacity building, efforts to integrate biodiversity into plans and strategies, and effective co-ordination of delivery.

5.8 COST-EFFECTIVENESS

Overall, very little evidence could be found about how the Aichi Targets can be delivered most cost effectively in the region. However, there is some evidence that:

a. **Maintaining ecosystems and their services is likely to save costs** compared to allowing them to decline; and

b. **The way that the targets are delivered** – and the sequencing of overall delivery – **will have an important influence on their overall costs**.

Ecosystems provide key services cost effectively compared to man-made alternatives

Bovarnick (UNDP 2010) demonstrates that conservation actions, by maintaining ecosystems and their services, can be a cost effective means of addressing many of the priorities facing local communities and economies in the LAC region. In contrast ecosystem degradation can increase costs. For example, degradation of water systems often requires increased water treatment infrastructure and sediment removal machinery; soil fertility degradation requires inputs of fertilizer and other chemical products; reduced natural pest control requires increases in pesticide use, crop variation and management efforts.

The regulating services provided by ecosystems are also cost-effective in their ability to avert environmental damage and its costs on society. For example, forests, mangroves, coral reefs, wetlands and coastal ecosystems are important in providing protection against floods and natural disasters. Degradation of these ecosystems places increasing damage costs on society, as well as necessitating investment in man-made infrastructure such as flood defences. In Mexico, low-lying coastal areas are vulnerable to sea-level rise; by maintaining protected areas (the Girjalva-Mezcapala-Usumacinta Delta complex, Los Petenes and Sian Kaan Chetumal Bays), residents and communities received increased protection, especially in minimizing coastal erosion and reduced damage from storms and tidal surges.

Many of the benefits estimates in Section 5.4 are based on the avoided costs of ecosystem conservation. In Chingaza National Park, Colombia, the Bogota Water and Aqueduct Company saved more than US$ 15 million in treatment costs in 2004 by investing in watershed improvements. In Honduras, the cloud forests of La Tiga National park (23,871 ha) provide over 40% of the annual water supply to 850,000 people of Tegucigalpa.

Synergies between the Aichi Targets mean that delivering some Targets will increase the cost effectiveness of meeting others

For example, Section 5.4 demonstrated that fisheries subsidies are substantial in the region. Subsidy reform is needed not only to meet Target 3 but should also help to reduce the costs of delivering

Target 6 (sustainable fisheries) and 10 (coral reefs). It should also free up resources which can be used in marine conservation efforts. Marine Protected Areas have also been shown to be cost-effective means of improving fisheries management.

Section 5.5 (investment needs) highlights the importance of the enabling actions under Targets 1-4 and 17-20 in creating the conditions necessary for delivering the suite of Aichi Targets overall. Evidence from the region suggests that prioritising these Targets will help to reduce the overall costs of delivery of the Aichi Targets as a whole.

5.9 COSTS AND BENEFITS

Cost benefit analyses of investments in biodiversity and ecosystems

Little evidence was found that directly assessed the costs and benefits of achieving one or more Aichi Targets. However, some studies provide evidence that the benefits of relevant investments in biodiversity and ecosystems can exceed the costs.

The strongest evidence that the benefits of conservation exceed the costs relates to forest conservation, where studies have shown that the net benefits of conservation through REDD+ and other PES schemes widely exceed the opportunity costs, particularly through avoided CO_2 emissions (see Section 5.4).

Comparisons of benefits estimates (Section 5.4) and resource needs (Section 5.6)

Direct comparisons of the costs and benefits of meeting the Aichi Targets are problematic, because of gaps in the evidence, particularly matching the costs and benefits of particular Targets and actions on a consistent basis.

However, evidence in Section 5.4 suggests that the value of services delivered by the most important ecosystems in the region such as mangroves, tropical forests and wetlands are likely to amount to many hundreds of billions of dollars per year. The costs of securing these services have not been estimated at regional scale, but are likely to amount to tens of billions of dollars annually. This suggests that ecosystem conservation in the region is likely to deliver net benefits, and supports the conclusions of global studies examining the costs and benefits of conservation action.

5.10 CONCLUSIONS

Benefits

- The evidence demonstrates the substantial value of the range of services delivered by the regions ecosystems, which help to maintain production of food and fibre, deliver vital regulating services at the global and local level, support tourism and recreation and deliver other unmarketed cultural services.
- A range of qualitative, quantitative and monetary assessments of benefits were found, for different ecosystems and at different spatial scales.
- However, the evidence is somewhat fragmented. Few estimates are available at country or regional level, and it is necessary to piece together evidence from a range of sources in order to understand the benefits of meeting the Targets across the region.
- The strongest evidence is available for particular Targets, especially those relating to the conservation and restoration of forests, wetlands, mangroves and coral reefs.

- There is strong evidence of the immense value of the services provided by the region's forests, especially through their role in regulating the global climate. Aichi Targets 5, 7, 11, 14 and 15 have an important role to play in maintaining these benefits.

- There is evidence of the need for urgent action to improve the sustainability of the region's fisheries, and the substantial benefits of delivering Aichi Target 6.

- The benefits of biodiversity conservation are strongest for low-income local communities due to their dependence on ecosystem services.

- Ecosystem services offer multiple benefits to a range of different stakeholders, and increasing recognition of the value of these services is providing new potential sources of revenues to invest in biodiversity conservation, including through private sector participation in PES schemes.

Investment needs

- A recent regional workshop reviewing progress towards the Aichi Targets in the LAC region provides some useful insights into overall investment needs.

- This found that countries have made strong progress in the achievement of some Targets (e.g. 11 – protected areas; 12 – species conservation) 17 – NBSAPs, 18 – traditional knowledge and 19 – science and technology).

- Countries have indicated a low level of achievement for targets 3 (incentives), 6 (sustainable fisheries), 9 (invasive species), 10 (preservation of coral reefs), 13 (genetic diversity), and 14 and 15 (ecosystem restoration. This suggests that greatest efforts need to be devoted to these areas. This has implications for investment needs, but low levels of progress also reflect other challenges such as political barriers.

- The evidence reviewed indicates that a priority in many countries is to create the enabling conditions and institutional frameworks to achieve the Aichi Targets. These include development of appropriate governance and legal frameworks, incentive mechanisms, capacity and knowledge on which biodiversity action depends.

- Priorities differ across the sub-regions. In the Caribbean region, a high priority relates to the conservation of marine and coastal environments.

- In Central America and South America, a key priority is to develop sustainable financing mechanism to respond to multiple objectives (protected areas and sustainable agriculture, afforestation, reforestation and forest restoration).

- The Aichi Targets are interrelated and effective implementation will depend on timing and sequencing of actions to achieve optimal effect. In particular, investments in capacity building and appropriate institutional and policy frameworks will be important in delivering Aichi Targets 1-4 and 17-20 and in creating the conditions needed to deliver all other targets.

Resource needs

- In order to assess resource needs, we have analysed the current financing allocations in the region, sources of funding and available evidence of the resources needed to achieve the Aichi Targets.

- We only find evidence available on actions related to protected areas or areas which need to be cover to protect species and key ecosystems. These actions are related to Aichi Targets 11(protected areas), 12(species conservation), 10 (preservation of coral reefs) and 3 (incentive measures).

- The total annual conservation expenditures in the Latin American & the Caribbean region have been estimated to amount to an average of **US$632 million per year** (2001-2008), from which **US$ 203 million were allocated to Central America**, **US$ 395 million allocated to South America** and approximately **US$ 33 million to the Caribbean countries**.

- Most funding for biodiversity in Central America comes from international donors and bilateral cooperation. However, domestic resources account for the majority of funding in South America and the Caribbean.

- The total current funding for protected areas **was estimated to amount to approximately to US$239million per year in South America, US$141 million per year in Central America and $54 million per year in the Caribbean.**

- There are significant funding gaps. For protected areas alone, it is estimated that funding will need to **increase by 2 to 3.2 times** on current levels in South America to meet identified needs, and by **1.5 to 2.3 times in Central America**.

- Since countries in the region estimate that their progress towards Aichi Target 11 (protected areas) is ahead of that for other targets, the funding gap for other Targets may be greater than for Target 11.

- The resource needs have to be considered above the current financial allocations. The current allocations have not halted the continuous degradation of biodiversity in protected areas which makes necessary additional resources to reach optimal management.

- Resource requirements increase significantly if other activities, where progress has so far been limited, are considered (e.g. restoration of key ecosystems – Aichi Targets 14 and 15).

- The main sources of financial resources are government spending, international cooperation and fees from users. In some countries, the level of national investment is too low compared to other sources of finding. International funding can be more effective in those areas where the enabling conditions allow for progress in conservation activities, or where funds can be directed to areas that create those institutional frameworks.

- Though detailed quantitative evidence is limited, the findings largely support those of the High-Level Panel's report to COP11.

Policy Alignment and Development

- There is a strong connection between environmental degradation and the social economic conditions facing local populations.

- Providing secure and safe environmental conditions, and maintaining the delivery of key ecosystem services, contributes to the people's livelihoods and to development outcomes.

- Most of biodiversity conservation challenges in the Region are strongly related to poverty alleviation.

- Examples are given of biodiversity conservation initiatives that jointly deliver the Aichi Targets and positive development outcomes.

- Synergies and overlaps with other policy agendas mean that mainstreaming of biodiversity objectives is important, and this has implications for awareness, governance, capacity and co-ordination of delivery.

Cost Effectiveness

- Regional examples demonstrate that maintaining ecosystems and their services can save costs compared to allowing them to decline;

- The way that the targets are delivered – and the sequencing of overall delivery – will have an important influence on their overall costs.

Costs and Benefits

- Little evidence was found that directly assessed the costs and benefits of achieving one or more Aichi Targets. However, some studies provide evidence that the benefits of relevant investments in biodiversity and ecosystems can exceed the costs.

- The strongest evidence that the benefits of conservation exceed the costs relates to forest conservation, where studies have shown that the net benefits of conservation through REDD+ and other PES schemes widely exceed the opportunity costs, particularly through avoided CO_2 emissions.

- Services delivered by the most important ecosystems in the region such as mangroves, tropical forests and wetlands are likely to amount to many hundreds of billions of dollars per year. The costs of securing these services have not been estimated at regional scale, but are likely to amount to tens of billions of dollars annually.

- This suggests that ecosystem conservation in the region is likely to deliver net benefits, and supports the conclusions of global studies examining the costs and benefits of conservation action.

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6. NORTH AMERICA

Darren Long (WCS), Peter Coppolillo (Working Dogs for Conservation) and Spencer Phillips (Key-Log Economics, LLC)[41]

6.1 EXECUTIVE SUMMARY

An abundance of evidence exists on the investment needs, expected costs, and potential benefits of implementing and achieving the Aichi Targets in North America. This is particularly true for the U.S. and Canada. While some information exists in the English literature for Greenland, we expect more will also be available in Danish, as well.

Benefits

In both the United States and Canada a large portfolio of relevant case studies already exist to highlight a broad suite of economic benefits that are currently being realized through a diversity of conservation actions. However, many of these cases examine just one ecosystem-derived service and provide economic valuation for a single outcome. This almost certainly reflects the technical challenges of quantitatively characterizing biodiversity and ecosystem functions and of putting dollar valuation figures on the services provided by such functions. These "1x1" accounts of ecosystem services are clearly useful, but as the following example highlights, deeper insights emerge and higher-order benefits become more apparent when additional ecosystem functions, threats and benefits are considered together. The report features a deeper analysis of two case studies in particular – a long-term conservation effort on the Chesapeake Bay in the United States and progress over the past 20 years on increasing the percentage of protected lands in Canada – that provide evidence of how certain types of investments can and do augment implementation of multiple Aichi Targets. Smart and strategic investments can create both ecological and economic efficiencies towards meeting collective goals for biodiversity conservation across many Targets.

41 The authors wish to acknowledge the contributions from the following colleagues from the Wildlife Conservation Society who played valuable roles in crafting this document: Jane Carter Ingram, Justina Ray, Gilliam Woolmer, David Wilkie, Josh Ginsberg, Jodi Hilty, Ray Victurine and Todd Stevens.

Investment Needs

In this section of the report, we analyze the types of investments needed to implement the Aichi Targets in North America and recommend a ladder of prioritization aimed at achieving maximum returns. Here, we recommend that the High-Level Panel (HLP) consider investments in land protection as a highest priority, followed by investments that create sustainability by both removing certain harmful subsidies to reduce the impact of activities focused on the intensive use of natural resources or their extraction, and finally by considering a variety of investments aimed at creating better access to information that raises the influence of biodiversity needs within the marketplace. While recognizing that other types of activities may prove more effective in the developing world, in North America we recommend that lower priority be placed on investments aimed at creating national accounting systems and also those focused on facilitating institutional change, as these types of investments are likely to be costly and generate only nominal returns due to the political and structural barriers associated with each in this region.

Resource Requirements

In this section we examine what resources are necessary to achieve the Aichi Targets and, to the extent possible, explore which are available in North America. Our perspective on "resources" takes a broad approach, including economic, social and environmental capital into account. Throughout this section social resources are those embodied in human capital and the cultural context, including well-known components like level of education, rule of law and social cohesion, but also including relevant and narrowly targeted components such as consensus surrounding what is or isn't biodiversity, acknowledgement and acceptance of internationally recognized standards and measures for both biodiversity or economic wellbeing.

Policy Alignment and Development

Resources already dedicated for biodiversity and environmental conservation in North America are significant – in the billions of U.S. dollars per year. While these sums are encouraging, the resources dedicated to activities that pose threats to these investments (monies invested in extractive resource development, for example) are exponentially larger, and Government funds in particular could be spent more strategically. Specifically, investments in land and habitat protection at larger spatial scales and with enduring benefits will provide greater returns than investments in intensive management of individual species in small and often heavily-impacted natural areas. Also, existing policy mechanisms provide ample opportunities for implementation of the Aichi Targets, but conflicting policies and incomplete or ineffective implementation of existing policies have limited progress towards the Targets to date. Improvements in the implementation of existing policy and the removal of harmful or perverse incentives should be a higher priority than creating new policies. It is important to note that governance and participation in biodiversity-related decision-making is widely acknowledged and embraced in North America, but results vary widely in the extent to which it is actually accomplished.

Cost Effectiveness

We recommend that investments intended to achieve the Targets deliberately leverage existing synergies or create them where they are absent. In some cases this will mean investing in multiple or more comprehensive actions. In others, it might mean choosing a site, time frame or sequence of investments that is different than one might select if making investment decisions in isolation. As a corollary, we believe that decision-makers must recognize, but should not rely upon, synergies among biodiversity conservation, economic development, and governance objectives. While we do suggest a general prioritization and sequencing of investment types, the priority and sequencing needs to be flexible to take into account place and issue-specific information. Purchase of land to protect a biodiversity hot spot might not be the most cost-effective solution, for example, if the greatest threats to biodiversity are not conversion or mismanagement of a particular piece of the landscape, but rather degradation of the entire landscape due to pollution, invasive species or other factors. In such cases, addressing the true threats at a landscape scale would take priority over an investment in land protection.

Benefits and Costs

We suggest that the countries of North America may be able to maximize return on their biodiversity investments by prioritizing direct land conservation and habitat restoration over indirect methods like improving information, marketing of products and services jointly produced with biodiversity conservation and the like. This is not, however, to say that indirect methods may not prove valuable in particular contexts. We also believe that there is an opportunity in North America to exploit additional benefits from eliminating harmful subsidies. This action reduces (non-market) incentives for activities that exacerbate biodiversity loss. It also reduces government spending and/or frees up public resources for investment in other, more socially beneficial activities (including further biodiversity conservation).

6.2 INTRODUCTION

This report was commissioned by UNEP-WCMC on behalf of the High-Level Panel examining the resources needed to deliver the CBD Strategic Plan for Biodiversity 2011-2020. It presents the results of a study of the costs and benefits of conservation actions designed to help reach the goals set forth by the Aichi Targets for Biodiversity by the year 2020 in North America. For purposes of the report, the term "North America" will comply with the United Nations Statistics Division defined boundaries of the region, which includes the United States, Canada, Greenland, Bermuda, St. Pierre, and Miquelon[42]. Mexico, Central America, and the Caribbean islands fall outside the North America region are considered in another regional report covering Latin America and the Caribbean.

The Aichi Targets seek to establish tangible and quantifiable metrics by which to measure countries' progress toward the long-term protection of biodiversity. In this report, we explore how this globally comprehensive set of targets are, and can be, applied to North America.

Biodiversity is exceedingly complex. At its most basic level, the components of biodiversity fall into three levels of organization: genes, species and ecosystems. Each of these levels can be characterized by its composition (the particular species present, for example), structure (the relative abundances of each species, to use the same example), and function (the roles they fulfil in the ecosystems they occupy).

On top of this already significant complexity is an equally varied set of social, political, and cultural components that make up the human dimensions of the linked social and ecological systems in which the CBD operates. These human dimensions are the medium through which human actions may threaten biodiversity and the contexts in which the benefits realized from protecting biodiversity may accrue to human populations.

Thus, the goals of the Aichi Targets are to simplify this complexity within a set of robust indicators that can both guide the interventions that provide greatest benefit to biodiversity and human populations and also track meaningful progress. Similarly, the range of possible interventions to protect biodiversity include direct and proximate actions (e.g. on the ground enforcement and protection of habitats and/or species), as well as indirect and ultimate actions (e.g. establishing long-term incentives to reward sustainable practices and dissipate the pressures that drive overexploitation).

In this report we examine opportunities and challenges for implementation of the Aichi Targets in the North American context, recognizing that the scope of our analyses and case studies is necessarily limited. We have sought to compile a set of illustrative examples which highlight major issues facing successful implementation of the CBD in North America and the role of the Aichi Targets in guiding, tracking, and strengthening that implementation.

The report itself is structured as follows: Sections 6.2 and 6.3 provide the philosophical and methodological foundations for the report and our analysis of the North American context. Section 6.4 examines the benefits of achieving the Aichi Targets. Sections 6.5 through 6.8 address how the Aichi Targets can be achieved, required levels of investment (4), resource and policy needs, and the cost effectiveness of (sections 6.6, 6.7, and 6.8, respectively) for delivering progress toward the Targets. The final sections, 6.9 and 6.10, explore the bottom line, balancing costs and benefits and drawing preliminary conclusions for the way forward implementing the Aichi Targets in North America.

The greatest value of an ecological economics report such as this is to identify and illustrate examples of large returns, both realized and aspirational, on investments of conservation resources. Convergent with these concepts of high return on investment and maximizing impact, the report strives to identify potential efficiencies and synergies between investments that support implementation of multiple Targets simultaneously and offer various co-benefits for human livelihoods, as well. These are the research questions on which our team focused its efforts and where the reader will find the majority of content. Last, it is important to note that while we did not prejudge the conclusion that investments in biodiversity conservation make for sensible economic policy, we believe that the research presented below clearly supports the validity of such an assertion.

42 http://unstats.un.org/unsd/methods/m49/m49regin.htm

6.3 METHODOLOGY

Research methods and sources of evidence consulted

We focused on assimilating background information, conducted a systematic literature review of evidence supporting both current and potential implementation of Aichi Targets, and identified gaps in evidence for particular Targets. Through this process we drew on many different sources of evidence to compile and describe the range and types of data available for and relevant to the Aichi Targets. Resources we consulted were agency reports, publications and government web sites (e.g. Environment Canada, Parks Canada, United States Forest Service); peer-reviewed academic journal publications (e.g. Climatic Change, Ecological Economics), and a wide variety of 'gray' literature in the form of research reports produced by non-governmental organizations, especially nonprofit conservation organizations (e.g. Defenders of Wildlife, the Wildlife Conservation Society, Canadian Parks Council) and nonprofit economics think tanks (e.g. Earth Economics).

Our research team was led by Darren Long of the Wildlife Conservation Society (WCS); Peter Coppolillo, a consultant and Executive Director of Working Dogs for Conservation; and Spencer Phillips, a consultant and ecological economist from the University of Virginia. This work received input from a number of other colleagues, as well. WCS collaborators included Justina Ray, Gilliam Woolmer, Josh Ginsberg, Jodi Hilty, Carter Ingram, David Wilkie, Ray Victurine, and Todd Stevens.

We would like to give special recognition to the team of Sarah Smith from UNEP-WCMC, Matt Rayment and Mavourneen Conway both of GHK Consulting, for their dedicated support, wisdom, and guidance that helped to inform and improve the content of this report.

A note to the reader: All monetary figures in this report are represented in US dollars unless otherwise noted.

Overview of availability and robustness of evidence, methodological issues, evidence gaps, variations in extent and quality of evidence between questions

The authors were able to identify a relatively robust portfolio of case study evidence supporting the costs and benefits of biodiversity conservation at local and watershed levels, as well as a few smaller regional initiatives in both the United States and Canada. Information for Greenland was also reviewed and is presented throughout the report, but far less evidence is available overall for Greenland. This may reflect Greenland's smaller human population and lower overall biodiversity, but we should also note that our research was limited to English, and other relevant resources likely exist in Danish and Greenlandic. Citations are found throughout the document, as well as in the reference list at the end. Additional case studies were identified during our research, but were too numerous to detail within.

However, it is worth noting that no evidence was available for ecosystem services or biodiversity values aggregated for the entire North America region as a whole, creating difficulties in making assertions for the relative impact of localized case study examples at national or international scales.

6.4 BENEFITS OF DELIVERING THE AICHI TARGETS

What will be the economic benefits of delivering the Aichi Targets?

While an exhaustive list of all the known and potential direct economic benefits of implementing the 20 Aichi Targets for Biodiversity is beyond the scope of this report, we will provide a few examples of where and how biodiversity conservation is paying real and measurable economic dividends in North America.

One important caveat is that many of the benefit estimates described below accrue due to the nature of biodiversity conservation. In economics, we would say that biodiversity conservation, improved water quality, enhanced recreational experiences, and in some cases even higher productivity for commodity products are *jointly produced*. Just as the production of lumber also produces bark and sawdust, the production of (or policy and management actions taken to achieve) biodiversity conservation also produces water for drinking and industrial processes, pleasant scenery, nutrient cycling, and other ecosystem benefits. Indeed, biodiversity along with certain other attributes or characteristics of the earth's natural systems may be considered "critical natural capital" on which the production of many, if not all, ecosystem benefits depends (Farley, 2012; Ekins, 2003). This concept of "co-benefits" is referenced often in the first report of the High-Level Panel on Resourcing the Aichi Biodiversity Targets (2011, p. 5-48), particularly to the relationships of biodiversity conservation actions to sustainable development activity, the benefits of forests to reducing greenhouse gas emissions, and the ways in which the creation of protected areas helps to ensure the provision of valuable ecosystem services such as food production, fuel, and water regulation that support human health and important economic sectors such as agriculture, forestry, and energy production. The value of biodiversity conservation, per se, is inexorably linked to the value of other ecosystem service flows for more direct sustainable use and the correspondent co-benefits provided to human communities.

In both the United States and Canada a large portfolio of case studies already exist to highlight a broad suite of economic benefits that are currently being realized through a diversity of conservation actions. For instance: Knowler *et al.* (2003) calculate the per kilometer value of freshwater salmon habitat on the west coast of Canada to be between US$938 and $4,977; Batker *et al.* (2010) valued the ecological and storm protection services provided by southern Louisiana's Mississippi River Delta at between $12 billion and $47 billion annually; Schmidt & Bakter (2012) estimate the economic value of the 850,000 acre McKenzie River watershed in western Oregon, which supplies drinking water to over 200,000 people, at between $248 million and $2.4 billion annually; similarly Bakter *et al.* (2010) estimated the combined value of 14 different goods and services provided by nature within the Puget Sound basin surrounding the city of Seattle in northwest Washington at between $9.7 billion and $83 billion each year; Munn *et al.* (2010) found that recreationists spent over $38 billion on wildlife watching, fishing and hunting activities across just 13 southeastern U.S. states in 2006; Kroeger (2008) estimated the annual value of just two ecosystem services (water supply and carbon sequestration) provided by an 825 square mile swatch of south Florida wetlands at between $185 million and $302 million; and a report from the U.S. Bureau of Land Management details a process that used a number of economic models to quantify trends and values of ecosystem services and wildlife habitat to influence land-use decision making in southern Arizona (Bagstad *et al.* 2012).

These studies help to illustrate the significant economic impact of both wildlife and the myriad services provided by natural areas. Interestingly, some of these studies examine just one service and provide economic valuation for a single outcome. This almost certainly reflects the technical challenges of quantitatively characterizing ecosystem functions and of putting dollar valuation figures on the services provided. These single service-single outcome accounts of ecosystem services are clearly useful, but as the following example highlights, deeper insights emerge and higher-order benefits become more apparent when additional ecosystem functions, threats and benefits are considered together.

One case in particular from the eastern United States serves to highlight the economic benefits of biodiversity conservation as well as the many synergies and efficiencies that may be realized in implementing the Aichi Targets. This case is also an excellent illustration of some of the difficulties faced when attempting to reach shared goals for managing a wide array of impacts over multiple governmental jurisdictions (Target 4). The Chesapeake Bay watershed, which covers parts of New York, Pennsylvania, Maryland, Virginia, Delaware, and Washington, D.C. has been a major focus of conservation efforts for nearly 30 years. Strong evidence exists, including figures on economic benefits resulting from a number of actions for biodiversity conservation and applies readily to Aichi Targets 1, 2, 4, 5, 6, 7, 8, 10, 11, 14, 15, and 19.

The Chesapeake Bay is the largest estuarine system in the United States. Its massive 165,000km^2 watershed is home to more than 17 million people and comprises over 150 major rivers and streams. Two of the northeast United States' five largest commercial seaports are located on the Chesapeake at Baltimore, Maryland and Hampton Roads, Virginia. The Bay itself is more than 320 kilometers long from north to south, with a combined coastline longer than the entire west coast of the United States. The Chesapeake's brackish mix of freshwater and saltwater from the Atlantic Ocean makes it rich habitat for 2,700 species of plants and animals and a productive fishery that produces over 500 million pounds of seafood harvest annually. Primary catch species are blue crab, oysters, rockfish, striped bass, and American shad (Chesapeake Bay Program, 2013). In 2009, the annual economic value of the Bay's combined recreational and commercial fishing catch was estimated at $4.73 billion (Chesapeake Bay Foundation, 2012).

Historical land protection activities in the Chesapeake Bay watershed focused primarily on efforts to conserve open spaces, protect wildlife habitat, and to create recreational opportunities. Since 1990, a number of targeted land protection efforts have been focused on protection of forest resources and agricultural lands. Most recently, conservation actions in the watershed have primarily been aimed at improving water quality by reducing both point (industry) and non-point sources (primarily nutrient runoff and erosion from agricultural activities) to reduce pollution and sedimentation in the Chesapeake (Chesapeake Bay Commission report, 2010).

Such actions, however, can generate significant "co-benefits" in terms of climate regulation, recreation and other ecosystem services closely associated with biodiversity. In a soon to be published study the baseline economic value of Genetic and Medical resources, the Nursery and Refugium functions, and Biological Control in the Chesapeake system total more than $250 million per year (Phillips, in press).

To give a sense of the big picture economic impacts of water quality efforts, we learned that a study by the United States Environmental Protection Agency (EPA) concluded that every $1 spent on source-water protection saves an average of $27 in water treatment costs (Chesapeake Bay Foundation, 2012). To put this into perspective for the Chesapeake Bay watershed, the Chesapeake Bay Partners (comprised of six states and state agencies, 17 federal agencies, 25 academic institutions, and more than 30 non-governmental organizations) collectively spent $761 million on water quality improvements in 2010 alone for restoration of riparian areas, wastewater treatment, and control of runoff from agriculture, acidic mines, and chemical contaminents (ChesapeakeStat, 2013). Using the EPA's calculation for water quality spending, these $761 million in expenditures may have saved the Chesapeake Bay region $20.5 billion in water treatment costs during the year 2010, alone. Water quality spending numbers for the Chesapeake watershed are available from the years 2007-2010. Total spending over that period was $2.8 billion, potentially saving $76.2 billion in water treatment costs.

Taken out to a national scale, the World Resources Institute calculates that annual spending on clean water and clean air in the United States ranged between $26 and $29 billion during the decade from 1999-2099. The economic benefits of those investments ranged between $82 and $533 billion, an annual return on investment of at least 282%, and likely much higher (World Resources Institute, 2010).

The economic value of the Chesapeake Bay's wildlife habitat, natural resources, and ecosystem services are widely recognized. In its 2012 State of the Bay report, the Chesapeake Bay Foundation wrote that, "Restoration of Bay ecosystems not only improves the health of fisheries and other wildlife, but also the health of local, state and even our national economies. Ecological services like the filtering and storage functions of healthy, vegetated floodplains cannot be artificially duplicated. Restoring the health of streams and rivers feeding the Bay, and curtailing pollution entering those waterways, are the only long-term, permanent solutions saving the Bay". The findings of that report include detailed statistics on the financial value of the Chesapeake, estimating that, "in today's dollars, **the [Chesapeake] Bay is worth $1 trillion related to fishing, tourism, property values, and shipping activities**" (State of the Bay Report, 2012).

Also recognized are the monetary benefits realized from conservation activities in Chesapeake Bay watershed. A study in the journal of Ecological Economics compared the 1996 water quality of the Bay with what it would have been without the U.S. Clean Water Act regulations and estimated that the annual recreational boating, fishing, and swimming benefits of water quality improvements made from 1972 to 1996 ranged between $357.9 million and $1.8 billion (Morgan and Owens, 2001).

Other benefits quoted from the Chesapeake Bay Foundation's 2012 economics report include:

- Investments in agricultural conservation practices also lead to job creation and stimulate economic activity in rural communities. A study by the University of Virginia (Rephann, 2010) found that implementation of agricultural practices, such as livestock stream exclusion, buffers, and cover crops, would generate significant economic impacts. Every $1 of state and/or federal funding invested in agricultural best management practices would generate $1.56 in economic activity in Virginia. Implementing agricultural practices in Virginia to the levels necessary to restore the Bay would create nearly 12,000 jobs of approximately one year's duration.
- The commercial seafood industry in Maryland and Virginia equals $2 billion in sales, $1 billion in income, and more than 41,000 jobs per year;
- Pennsylvania residents spend $1.7 billion annually on boating;
- Pennsylvania's fishing industry brings in $1.6 billion annually;
- Recreational boating brings Maryland's economy $2.03 billion and 35,025 jobs per year;
- Wildlife watchers in Maryland, Virginia, and Pennsylvania spend almost $3 billion annually on trip-related expenses and equipment; and
- New, clean water-technology industries are creating new jobs for the communities within the Bay watershed.

Source: Chesapeake Bay Foundation, Economic Argument for Cleaning Up the Chesapeake Bay and its River, 2012

These numbers illustrate how progress toward Aichi Targets 1, 2, 4, 5, 6, 7, and 8 can have substantial, direct economic benefits for the areas where they are achieved. Notably, these are only economic benefits coming directly from the Bay itself. These achievements have also increased environmental capital and have produced many co-benefits through expanded livelihoods and quality of life, which are not captured by these figures.

The volume and diversity of the accumulated and ongoing conservation actions focused on the Chesapeake Bay impact the implementation of a number of Aichi Targets for North America and warrant a more detailed examination than the scope of this report allows. A few examples worthy of further investigation include the following:

A number of efforts have been undertaken to create public awareness of the economic and social values of the Chesapeake Bay (Target 1). One of the largest of those outreach efforts is run by the National

Aquarium in Baltimore, Maryland, which strives to educate its 1.6 million annual visitors (80% of whom live in the Chesapeake Bay watershed) about the fish and wildlife that inhabit the Bay. These educational opportunities spill out beyond the aquarium, as well. An article from the Bay Journal illuminates some of these activities, pointing out that through its involvement with the Chesapeake Bay Gateways Network, the National Aquarium, "promotes Bay stewardship through its exhibits and through a conservation program that has channelled more than 47,000 hours of volunteer energy into wetland restoration projects in places like Poplar Island and Eastern Neck National Wildlife Refuge. Aquarium educators present Bay-related programs in area schools and have helped students in Baltimore, Howard County, Washington D.C., and on the Eastern Shore [of Maryland] set up school ground nurseries for marsh grass" (Lutz, 2008). There is also some evidence that efforts to increase public awareness have indeed proven effective. A 1999 report from the Alliance for the Chesapeake Bay states that, "Increased knowledge about the Bay watershed from both students and the public was noted both as a success in itself and as a reason for other successes. Public support for cleaner Bay initiatives has resulted in measures, both regulatory and voluntary, which benefited Bay watershed restoration efforts" (Kier, L., 1999).

Much work has also been done in the Chesapeake Bay watershed to ensure that governments at every level, businesses, and stakeholders are working together to achieve sustainable production and consumption of the Bay's resources (Target 4). Beginning in 1983 with the "Chesapeake Bay Agreement", a series of cooperative plans were developed and signed by multiple partners at many levels of government, and updated every few years. The original agreement was updated in 1987 and 1992, then followed by the landmark Chesapeake 2000 Agreement. There have also been more than 25 cooperative management plans developed for protection of particular fisheries and water quality controls, memorandums of understanding between various governments to work together, as well as executive orders from U.S. President Barack Obama in 2009. These orders mandated the cooperation of federal agencies to achieve conservation and water quality goals for the Chesapeake and set a goal to put an additional 2 million acres of land under protected status by 2025 (Chesapeake Bay Program, 2013). However, while some progress has been made, these massive and resource consuming efforts at inter-agency and inter-jurisdictional cooperation have not yet proven wholly effective in reaching many of the conservation goals set forth by these shared agreements (State of the Bay Report, 2012).

Figure 1. Current Terrestrial and Marine Protected areas, Canada, 2012. Source: Environment Canada

What evidence is there of the nature, scale and value of these benefits, at national and international levels?

Evidence for the economic benefits of delivering the Aichi Targets at a national level can be found by examining both the current and potential impact of biodiversity conservation Canada. We will focus particularly on Target 11, which calls for meeting certain levels of direct protection for terrestrial and marine biodiversity.

According to Canada's Federal-Provincial-Territorial Biodiversity Working Group, a group formed by the Canadian Council of Ministers of the Environment after Canada's ratification of the UN Convention of Biological Diversity in 1992 and tasked with developing the Canadian Biodiversity Strategy, Canada holds, "approximately 30% of the world's boreal forest, 20% of the world's freshwater resources, the world's longest coastline and one of the world's largest marine territories" (Federal-Provincial-Territorial Biodiversity Working Group, 2013). Canada is also home to 25% of the world's wetlands, 15% of the world's temperate forests, and houses the 3rd largest area of glaciers (Eaner *et al.* 2010).

Due to the tremendous scale of its biodiversity resources Canada must be considered a major crux for the successful implementation of the Aichi Targets at a global level. While it is certainly a place of great opportunity, Canada's biodiversity is at considerable risk from a variety of extractive resource development (Kreutzweiser *et al*. 2013), governance (Hunka & McNeely 2012) and climate change-driven pressures (Ford & Pearce, 2010). Still, with vast areas of terrestrial and marine resources remaining unprotected, wise investments of resources and capital could have significant returns for biodiversity. Historically, however, Canada's conservative and extractive resource-focused federal and provincial governments have often prioritize mining and timber uses over biodiversity needs

Target 11 calls for protection of 17% of terrestrial and 10% of marine areas. The Canadian Environmental Ministry, also known as Environment Canada, calculates that at least ten percent of Canada's terrestrial and freshwater systems (1,003,818 km^2) are currently in protected area status that meets IUCN standards as "a clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values" (Environment Canada, 2013). These figures are actually slightly higher, however, as they account for publicly held lands and waters administered by federal, provincial or territorial governments but do not include a small percentage of privately

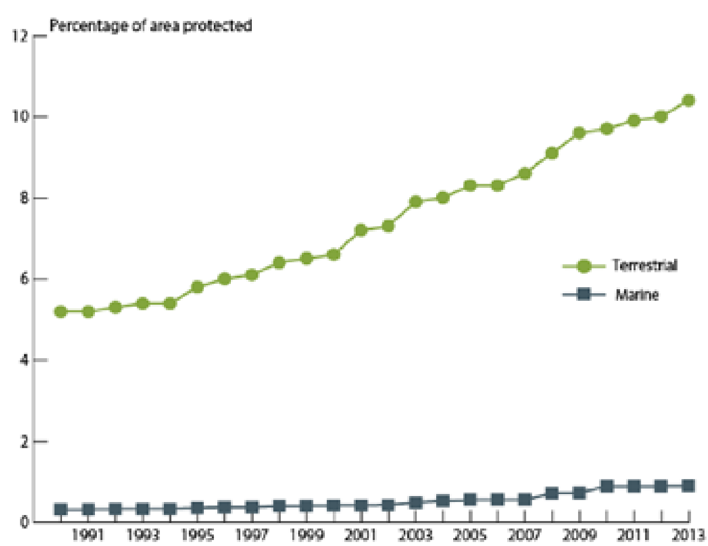

Figure 2. Trends in proportion of area protected, Canada, 1990 to 2012. Source: Environment Canada

held protected lands. Types and classifications of protected areas in Canada include, "national and provincial parks, national wildlife areas, migratory bird sanctuaries, wildlife reserves, and ecological reserves" (Environment Canada, 2013). The percentage of protected lands in Canada has increased significantly over the past two decades. From less than six percent of land protected in 1990, Canada had increased its protected areas to more than ten percent in 2012, adding more than 400,000 km^2 of land to protected status (Environment Canada, 2013).

As illustrated in Figure 2 below, Canada has made only incremental progress in protecting coastal and marine zones for biodiversity (less than 2% of these areas are currently under protection), but, as stated above, has shown a very positive trend in protection of terrestrial and freshwater resources.

Economic Benefits of Protected Areas

Besides a vast number of smaller, regional examples from around North America, there is also evidence for valuing the economic impact of implementing the Aichi Targets at a larger scale. In Canada, for example, much work has been done to quantify and aggregate the collective economic implications of protected areas governed at the federal, provincial and territorial levels.

According to a recent report commissioned by the Canadian Parks Council, besides contributing to the protection of biodiversity, conserving natural resources, and providing myriad ecosystem services,

Figure 3. Protected lands and intact forest areas of the Canadian Boreal

"Parks also generate economic activity, supporting tourism, providing sustainable jobs, generating tax revenue to governments and diversifying the economy, particularly in rural and remote areas of Canada. Parks are the focus of much of Canada's regional, national and international tourism activity. This report examines the economic impact of Canada's national, provincial and territorial parks and demonstrates that spending by park organizations and by visitors to parks has a substantial and recurring impact on the economy" (Canadian Parks Council, 2009).

What the report found, after exhaustive research across all Canadian provinces and territories, is that income, jobs, and taxes derived from management and visitation to parks and other publicly held protected lands constitutes a multi-billion dollar contribution to the Canadian economy annually. In the 2008-2009 fiscal year the combined total revenue amounts from visitor spending, spending for park operations (salaries, maintenance, etc.), as well as tax revenue generated by that spending amounted to US$4.98 billion in the fiscal year 2008-09, with visitor spending forming 85% of that total at US$4.23 billion (Canadian Parks Council, 2009).

Even while limiting the study to direct job and tourism revenues of protected areas (the authors did not consider the value of ecosystem services provided by protected areas, for example), the results were significant. This attempt at accounting for the fiscal impact of biodiversity conservation through protected areas is also a step in the right direction for beginning to integrate biodiversity values into national and local development and poverty reduction strategies and planning (Target 2).

However, with Canada's decentralized provincial, territorial and local-based land-use planning regimes it will be important to demonstrate the economic value of protected areas at every level. Some of this valuation work is already taking place. For instance, a recent report commissioned by the David Suzuki Foundation aimed at influencing land use planning and decision- making at both local and provincial scales, estimated the value of ecosystem services provided by the natural systems of southwest British

Columbia's Lower Mainland region at between $30 and $60 billion annually (Molnar *et al.* 2012, p.9).

Despite progress over the past 23 years, Canada still has a long way to go towards meeting the goals for both terrestrial and marine protected areas set forth in Target 11, which asks that, "By 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well-connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes."

Due to the factors of development, sprawl, urbanization and population density in many regions of the world, it is impossible to talk about conserving biodiversity without considering the people, towns and cities in close proximity to natural areas. It is likewise impossible to find vast natural areas that remain nearly untouched, undegraded, and fully intact, boasting a full suite of native species inhabiting fully functional and pristine ecosystems. In this respect, Canada is exceptional. Vast areas of terrestrial habitat, freshwater and marine resources, especially in Canada's boreal forest region and along its arctic coast remain are publicly held crown lands still without a level of protection sufficient to meet IUCN standards. The Canadian boreal forest area alone is nearly 5.7 million km2 in size. Progress is being made on protection of additional lands in the boreal and studies show that the Canadian boreal may also hold up to 22 percent of the world's sequestered carbon (Yale Environment 360, 2010).

Canada's continuing initiatives to create parks and protected areas will impact additional Targets and potentially create a high level of overlap and efficiency in implementing conservation actions that will affect multiple Targets at once. However, it is important to note that parks must be created with a focus on biodiversity values above other land use considerations in order to meet this goal. Efforts to further protect the Canadian boreal could quickly realize benefits that spill over to other Targets. Additional protections in this area could support implementation of Target 5 to reduce rate of loss of all natural habitats; Target 12, preventing extinction especially by protecting wintering and calving grounds for species such as woodland caribou (Magoun *et al.* 2005); Target 14, ensuring that ecosystems provide essential services such as carbon sequestration, storing greenhouse gases and helping to mitigate future climate change, (Natural Resources Canada – Canadian Forest Service, 2013); as well as Target 18, respecting and integrating traditional knowledge, innovations and practices of indigenous and local communities relevant for the conservation and sustainable use of biodiversity by involving Canadian First Nations people in decision-making processes governing use of their lands. However, according to a report submitted to the CBD ahead of COP-11 titled, "Aboriginal Peoples Perspectives on Canada's National 2020 Biodiversity Goals and Targets", Canada's native peoples have to-date been marginalized from such discussions (Hunka and McNeely, 2012). This is an area of governance where improvements must be made if progress toward meeting the goals set forth by all of these Targets and realizing the co-benefits of protected areas in Canada.

6.5 INVESTMENT NEEDS

What types of investments and activities are needed to deliver the Aichi Targets and to secure these benefits?

This section offers a broad perspective on the existing social and environmental capital required for delivery of the Aichi Targets, as well as the investments necessary to expand or create new capital as needed. Throughout this section, social resources are those embodied in human capital and the cultural context, including well-known components like level of education, rule of law and social cohesion, but also including relevant and narrowly targeted components like consensus surrounding what is or isn't biodiversity, acknowledgement and acceptance of internationally recognized standards and measures (whether of biodiversity or economic well-being). Environmental capital embodies the resources being conserved and their current states. In this sense, environmental capital is both the conservation target (i.e. what's being conserved) but also the raw material from which conservation is accomplished through the production of benefits to the social realm. This is an important consideration for this section because functioning intact ecological systems are more resilient and can more quickly provide benefits to stakeholders involved in conservation action.

This section begins with a consideration of the existing environmental and social capital relevant to delivering the Aichi Targets, followed by a discussion of strategic investments to expand the capacity for reducing direct pressures and promoting sustainable use and specific investments for delivery of the Aichi Targets (section 6.5)

4.1.1 Existing Social and Environmental Capital and Wider Investment Needs to Address Underlying Causes through Mainstreaming (Goal A) and Reduce Direct Pressures (Goal B).

Canada and the United States are ranked 2nd and 32nd, respectively, in terms of the size and intactness of (i.e. lack of human infrastructure within) wilderness (WCS & CIESIN, 2005). Environmental awareness is well-established United States. Environmental education is part of most state curricula, and there is a large constituency of civil society organizations augmenting this process. The major challenge in the United States is for environmental and conservation information to compete with contrary messages, whether directly or indirectly, often disseminated by organizations and corporations promoting consumerism and/or advocating for resource use. The discourse surrounding climate change in the United States is an extreme but illustrative example of this process. While there is broad convergence of opinion among scientists, the general public remains divided on the issue. This is largely because of the disparity in resources dedicated to outreach and communications about the benefits of biodiversity conservation versus its exploitive and unsustainable use. That said, even with a foundation of environmental awareness, significant room exists for expanding the general understanding of biodiversity, especially the non-species components of biodiversity, including most notably, the ubiquity and importance of ecosystem services and genetic diversity.

The requirements for creating environmental education that captures the complexity inherent in biodiversity seem overwhelming. However, better standards, digital tools and resources for dissemination and cumulative progress in environmental education are making this kind of enterprise more tractable. For example, building on the progress of the UN Decade of Education for Sustainable Development (2005-2014), the North American Association for Environmental Education (NAAEE) suggest a framework for environmental literacy (Hollweg *et al.* 2011). Such a framework could provide regionally relevant indicators for Target 1. What's more, scientific information is increasingly important to mainstream issues. For example, the proliferation of "infographics" and their dissemination through social media is contributing to a more data-savvy and data sensitive society, and more importantly, embracing data and data-literacy in day-to-day social discourse. Because so many North Americans have access to the internet, it is increasingly common for advocacy-related content to leverage data and provide links to sources, as in the graphic below.

Another important dimension of mainstreaming biodiversity concerns is their incorporation in national development plans. In the cases of the United States and Canada, these considerations may more strongly affect the development plans of other countries through bilateral assistance. In fact, in both of these countries' development decisions are mostly decentralized to the provincial and county levels in Canada and United States, respectively. This is not to say that national level policies do not have an impact on development decisions— they undoubtedly do, particularly in the context of environmental regulations— but development planning and site-based decisions are made primarily at these lower levels. Indeed, while the United States does not have a national development plan for itself, it does have a plan for the countries to which it allocates assistance ("Fact Sheet," n.d.). Notably, environmental concerns are largely absent from the U.S. Global Development Policy, which focuses on "Development, Diplomacy and Defence." Mainstreaming biodiversity values (Target 2) into U.S. foreign policy could therefore have significant positive effects in recipient countries. Mainstreaming biodiversity considerations into the development agendas of the more than 3,000 U.S. counties[43] is a more daunting enterprise. The United States has not completed a National Biodiversity Strategies and Action Plan (NBSAP), but in 2004 it submitted its National Report on Sustainable Forests (USDA-FS, 2004) in lieu of an NBSAP. While this report is limited to National Forests, which comprise just 8.5% of U.S. land area and are distributed mostly in the western half of the country ("United States National Forest," 2013), it does offer a roadmap for how sustainability is incorporated into national-level management.

Canada provides an interesting contrast to the U.S. case. Like the U.S., management of Canada's environment is spread among numerous federal and provincial agencies, but the Federal Sustainable Development Act (Environment Canada, Legislative Services Branch, 2013) mandates a "whole government" approach to sustainable development, which is laid out in the country's Federal Sustainable Development Strategy (Sustainable Development Office, Environment Canada, 2013). Greenland does not maintain an open data registry, but some Greenland data are available through Denmark's open data site (http://digitaliser.dk/).

Accounting and Reporting

As part of Canada's sustainable development process, a set of environmental indicators (Government of Canada, 2007) are updated every three years and are made publicly available online. These are part of **Canada's larger open data initiative** (http://data.gc.ca/eng), which compiles data at the national and regional levels. The United States does not compile environmental indicators in a single website, but government data are now required to be archived at the U.S. open data repository, **Data.gov**.

While useful, a major limitation of the Canadian and U.S. data repositories is that they do not specifically compile or tag data according to Aichi Targets. Both, however, provide application programming interfaces (APIs) that allow software developers to access the data sets in real time, so it is possible for a third party to compile the indicators and carry out reporting independently for a modest investment. Such an investment would represent an important step in U.S. participation in the Aichi process and the compilation of a NBSAP.

The ability to measure, and therefore track, trade and compensate for the value(s) of biodiversity is a major deficit in North America's resources available for accomplishing the Aichi Targets. As Swinton *et al.* (2007) point out, without quantification, markets to compensate for ecosystem services are impossible, as are individuals' abilities to claim financial harm when those services are compromised. This severely undermines the capacity to account for and report on trends in biodiversity related capital and it restricts the tools available to advocate for biodiversity. That said, while a comprehensive and centralized accounting and reporting system does not exist nationally, the components of such a system encompass many if not all of the data necessary for a reasonable picture of progress toward the Aichi Targets. For example, the aforementioned National Report on Sustainable Forests reports on 67 different indicators relevant to most of the Aichi Targets.

A coordinated approach to evaluating and exploring the Aichi Targets and how to reach them may have important synergistic benefits. For example, coordination among stakeholders and analysts examining climate scenarios has led to a common language whereby standardized data can be repurposed for different analyses and modeling. The establishment of "Representative Concentration Pathways" (Vuuren *et al.* 2011) allowed studies exploring these scenarios to be relevant and comparable to each other, which exponentially expands the utility, value and applicability of both the data and subsequent analyses.

43 Or Parishes and Boroughs as they are known in Louisiana and Alaska, respectively.

Goal B: Reduce Direct Pressures and Promote Sustainable Use

A great deal of data exists cataloguing the costs of individual pressures and unsustainable uses, but the challenge is compilation and comparability of those data. Far less information exists on the investments required to mitigate threats, largely because few organizations or government agencies practice activity-based accounting, and even fewer relate those costs to quantitative measures of threat reduction or ecological outcomes.

A viable strategy may be to adopt a standard set of threats (e.g. the "threats taxonomy" ("Threats Taxonomy," n.d.) developed through the Conservation Measures Partnership, which many U.S.-based international conservation organizations have adopted). In a manner similar to the IPCC climate scenarios and concentration pathways, a standard set of pressures and interventions could allow insights and synergies not otherwise available. It would also give funders and practitioners a common language for discussing, and more importantly, evaluating and reallocating among, biodiversity investments.

The issue of standardized data sets and definitions reaches beyond the accounting and reporting of pressures and monitoring sustainable use. The North American context lacks consensus definitions for important terms like: Natural, Degraded, Sustainable, Exotic/Invasive/Nuisance species, and for frameworks like ecosystem types and ecosystem functions. These definitions are mentioned here in the context of investments because they themselves are part of the social capital necessary for tracking and ultimately making progress on Aichi Targets. Furthermore, while many definitions exist and are currently used, establishing consensus around a commonly shared set of definitions rarely happens on its own. Significant resources should be dedicated to engaging all relevant stakeholders in the review, where necessary, creation and eventual adoption of these definitions.

Direct investments for Aichi Target delivery

Based on the discussion above, which considers the existing social and environmental capital, we now look forward to the investments that will leverage the existing for to successful delivery of the Aichi Targets. In North America four primary types of investments appear to have the greatest potential for positive progress toward target delivery. They are: 1) Direct Investment in Habitat protection; 2) improved information about biodiversity; 3)) improved institutions; and 4) investments in institutional change. Each is discussed in greater detail, below.

There are four primary types of investments suggested by the Aichi Targets for North America. They are:

1. Direct investment in biodiversity conservation through habitat protection and/or improvements in the management of conservation areas and of threatened species. This applies directly to Targets 5, 9, 11 and 12.

Examples of this type of investment include the purchase of land, interest in land, or rights to use land for the purpose of biodiversity conservation as well as investments in ongoing management to ensure that external influences (poaching, invasive species, impacts of incompatible land uses nearby) do not undo conservation achieved through that purchase.

Investment in sustainability, in which one would include elimination of perverse incentives generated by market and non-market institutions that drive habitat destruction and species endangerment in the first place, creation of positive market-based and other incentives for biodiversity conservation and improved ecosystem function overall. Such investments cover the widest range of targets, including Targets 3, 4, 6, 7, 8, 10, 13, and 18.

This type of investment includes the elimination of subsidies and other so-called "perverse incentives," whereby corporations, private citizens and even public agencies themselves receive higher monetary rewards for environmentally destructive practices, developments and economic activities. Subsidy elimination, properly understood and executed, should actually lead to outright economic benefits in the form of cost savings for government entities and the elimination of the "deadweight loss" of the subsidy itself. Funds currently wasted on subsidies for activities that harm biodiversity would be a source of funding for investment in other activities that protect biodiversity. For example, Losos *et al.* (1995) reported that the U.S. federal government lost an estimated $6.7 billion (USD, adjusted for inflation to 2012 dollars) in resources extraction, water and other subsidies on the federal estate. Further, the authors estimate that "approximately $177 million USD[1] [was spent on recovery efforts] for species that are endangered, in whole or part, from grazing, timber, hard-rock mining, water development, and/or recreation" (Losos, Hayes, Phillips, Wilcove and Alkire, 1995, p.450; see also Losos, 1993).[44]

In economic terms, these subsidies create a "deadweight loss" to society that is the result of a misallocation of money, time and effort toward the extraction of resources from natural areas when that money, time and effort would be better spent on some other activity.

Now, it is true that not every dollar lost to subsidies contributes directly to biodiversity loss – that is, some of the excess resource extraction might have negligible or no effect on biodiversity. It is also true, however, that every dollar lost to subsidies is a dollar not available for biodiversity protection or, of course, other ecologically, economically or socially beneficial programs. And, as noted below (under section 6.5), direct subsidies to resource extraction may be only a minor fraction of U.S. government spending that may have a negative impact on biodiversity.

Beyond elimination of subsidies, positive investments in sustainability include the creation or expansion of government and institutional purchasing preferences for the products or services such as food, fiber, housing, energy extraction, and power generation that are certified to be "sustainable" under appropriate, robust and scientifically valid criteria.

44 This number is adjusted for inflation to reflect what the cost would have been in 2012. The amount in 1992 was $4.5 billion USD.

Such investments could also be used to help, mandate or incentivize various production systems (fisheries, farms, broader ecosystem services) to operate in a more efficient and effective manner.

2. Investment in improved information about biodiversity and its value to people, communities and economies. Targets 1, 2, and 19 require this type of investment.

Such investments would address one of the fundamental limitations of traditional markets that leads to biodiversity loss: the lack of information available to economic agents and markets regarding the value of biodiversity. When the effects of human actions on biodiversity (and the subsequent impact of biodiversity loss on human welfare) are little known or poorly understood, the costs will be ignored in decision-making about consumption levels and production processes. Standard microeconomic theory holds that efficient resource allocation requires full information about the effects of production and consumption decisions (including on environmental outcomes). It follows, therefore, that improved information could or should lead to greater efficiency and less "deadweight loss" to society (Pearce & Turner, 1990).

3. Investments in improved institutions so that investments in sustainability have the chance to achieve their intended biodiversity outcomes. While institutional change is necessary for achieving all of the Targets (eliminating subsidies *is* an institutional change, for example) it is Targets 16, 17 and 20 that are explicitly about changing institutions (policies, practices, rules) as the means of achieving greater biodiversity conservation.

If one thinks about biodiversity protection as one would think about almost any other productive activity, one would expect further and further investments to produce smaller and smaller results. Biodiversity protection, in other words, can be said to be characterized by declining marginal returns. That means that each succeeding unit of investment is likely to result in less additional biodiversity conservation than the unit invested before it. It also means that to get the most cost-effective set of investments they should be prioritized, if not strictly sequenced, based on where the greatest gains per unit of investment can be realized.

Using such a criterion, the authors suggest that a high priority for investment, in North America should be land protection: placing public and private land or interests in land (i.e. conservation easements or deed restrictions) into management categories that correspond to higher levels of habitat protection to ensure sufficient habitat for biodiversity conservation. Such direct measures are likely to be the most cost-effective means of biodiversity conservation because the outcome is directly related to the investment.

A second set of priorities for investment should be in those of the "sustainability" type. Such investments can reduce, eliminate or reverse the negative impact of less sustainable economic activity on biodiversity. Within this category, the elimination of subsidies (Target 3) would be the top priority, mainly because doing so would both reduce harm to biodiversity and free up funds that could be directed to other investments including those within fishing communities.

Within this category, one would want to target the most destructive subsidies first. These would include any subsidy connected to the conversion from natural to less-natural habitat, such as:

- less-than-full-cost extraction of timber, minerals and water from public lands (e.g. U.S. timber program; 1872 Mining Law);
- subsidized flood, hurricane and other hazard insurance for homeowners who have built or purchased homes in areas valuable for biodiversity protection (coastal areas, wildland-urban interface, etc.);
- tax deductibility of mortgages on homes, especially homes that are not the homeowner's primary residence;
- harmful subsidies to fisheries and other marine and freshwater economic activities;
- agricultural subsidies that skew farmers' output mix and production decisions toward monoculture crops and/or and toward more energy-intensive agriculture.

As noted above as well as in the next section, such subsidies total in the hundreds of billions of dollars per year in the United States. In Canada, according to the International Monetary Fund, direct subsidies to the energy sector alone totaled $26 billion (USD) in 2011 – roughly 4% of the country's total government expenditure(Clements, B. *et al.* 2013; Wong, 2013). In addition to such direct subsidies, there are the further costs of remediating the harm done as a result of the subsidized activities.

Next, but still within the sustainability category, priority should be given to investments that reduce the impact of natural resource-based production systems (agriculture, fisheries, forest products). Support for consistent, rigorous and high standards for the certification and labeling of "organic," "sustainable," and other "green" products will help consumers make informed purchasing decisions that actually have on-the-ground benefits for biodiversity protection and other aspects of environmental, economic and social responsibility. There will also be needed investments in further regulatory efforts as a backstop to market-based or other approaches that rely on voluntary action.

Investments that improve information -- and the availability of information -- about the value of biodiversity would also be a priority. Arguably such investments would be necessary for the acceptance and effectiveness of any of the investments already listed (see discussion of synergies below), but on their own, investments in information would be so indirectly connected to biodiversity outcomes that they would not be prioritized as stand-alone investments. Greater awareness of the values of biodiversity, for example (Target 1), can lead to biodiversity conservation, but only after intermediate steps are taken that turn awareness into such actions as changing purchasing decisions, production practices for action to support elimination of harmful subsidies or secure the protection of habitat.

Changes in national income accounting (part of Target 2), while worth pursuing, need to result in reported data about biodiversity, then used in analysis and planning and finally translated into governmental and nongovernmental actions to protect biodiversity. In 1994, the United States Congress ordered the US Bureau of Economic Analysis to cease work on a then-promising program to develop environmental satellite accounts (Carson, 1994; Nordhaus & Kokkelenberg, 1999). As of this writing, nearly 20 years later, that decision has not been reversed, and according to the Bureau, there are neither funding nor plans for re-starting the program.

Canada, on the other hand, has had a system of environmental satellite accounts in place since the early 1990s (Statistics Canada, 2013). While the natural resource stocks covered in these accounts may reflect biodiversity conditions in Canada, biodiversity is not called out separately.

Therefore, there are challenges presented to achieving this Target in North America before 2020.

4. Finally, and similar to investments in increased information resources, are investments in institutional change. These improvements would support and enhance the effectiveness of other investments. But on their own such institutional changes as securing property rights to, and encouraging equitable sharing of, benefits from the exploitation of genetic information, or of promoting a more participatory strategic planning model to arrive at national biodiversity action plans is several steps removed from on-the-ground changes in land allocation and management that directly benefit biodiversity.

In summary, the evidence presented and referenced above suggests that investments should be focused on actions that directly secure habitat necessary for biodiversity conservation (Ferraro & Simpson, 2001), reduce subsidies and other incentives that destroy or degrade habitat (Friends of the Earth, Taxpayers for Common Sense, & R Street Institute, 2012; E. C. Losos, 1993; E. Losos, Hayes, Phillips, Wilcove, & Alkire, 1995) and that minimize the impact of consumption decisions and production-oriented land management practices on and around protected areas.

Which targets will these investments help to meet, and what are the synergies and overlaps between targets?

As suggested in the preceding section, significant synergies should be expected among the various types of investments. Information and institutional change may be necessary precursors to greater habitat protection, to the elimination of harmful subsidies, or for making changes in natural resource management practices. Indeed, one could characterize those as being institutional changes of their own. There are, however, two types of investments for which the synergies would be greatest and the returns most significant. These are direct investments in habitat protection and investments in sustainability. Within the latter category, elimination of harmful subsidies is likely to be most synergistic.

Habitat protection and reducing the rate of habitat loss (Targets 5 and 11) would be highly synergistic, cost-effective and high-return because they have the most direct connection to the intended outcome of biodiversity protection. Moreover, they are also likely to be highly productive in terms of co-benefits or joint products. Habitat that receives higher levels of protection will generally produce higher or more valuable flows of ecosystem services of many types. Esposito *et al.* for example, found that U.S. federal lands designated as wilderness (GAP category 1) provided a higher level of ecosystem services such as recreation, water supply, disturbance prevention and waste assimilation than other federal lands allocated to less protective management classes (GAP categories 2 or 3) (2011).

Subsidy elimination (Target 3) and the creation of market and non-market incentives to bring consumption patterns in line with biodiversity goals (Targets 3 and 4) will also be highly synergistic. First, such investments disrupt (or correct) the pattern of market failure that is responsible for the vast majority of biodiversity loss. As with habitat protection, correcting such market failures would increase protection for biodiversity and increase the supply of jointly produce ecosystem benefits. Elimination of energy subsidies (Target 3), for example, would slow the loss of habitat to energy development (Target 5), help limit greenhouse gas emissions and begin to slow the impact of climate change on vulnerable ecosystems (Target 10) and, by making less sustainable food, clothing, housing, etc. also less affordable, elimination of energy subsidies would reinforce or accelerate a move toward more sustainable production and consumption choices (Target 4).

Second, elimination of harmful, market-distorting subsidies would free up resources that could be used for other investments in biodiversity protection and in the most cost-effective economic development strategies. For the U.S. alone, the Green Scissors Report identifies "...nearly $700 billion in cuts from five different areas: energy, federal insurance, agriculture, transportation, and lands and water (Friends of the Earth, Taxpayers for Common Sense, R Street Institute 2012)." This represents nearly 20% of the U.S. federal budget and a huge potential for spending on positive programs, such as direct biodiversity protection, cleanup of toxic waste sites, education about the value of biodiversity, and economic development in under-resourced communities.

Third, investments that create or strengthen markets for sustainably produced goods and services will be synergistic in that they protect biodiversity (and direct ecosystem benefits) and that they expand economic opportunity in general, perhaps especially for people of lesser financial means. This will be true to the extent that more sustainable production systems are more labor-intensive as opposed to capital-intensive. In labor-intensive production systems, it is the laborer who owns the means of production and, assuming (perhaps heroically) less and less coercion or other pressure to accept low wages over time, workers should be able to command a fair share of the value of their contribution to the production process. And because the marginal utility of income (that is the satisfaction received from each additional unit of income) is higher at the lower end of the income scale, even modest improvements in wages of the poor could make a big difference in human welfare.

One final synergy worth noting is likely to occur within the realm of sustainability investments. One of the reasons that environmentally destructive subsidies are so harmful is that they make it that much harder for alternative, more sustainable production processes to compete. Eliminating the subsidies would level the playing field and ensure that firms, practices and perhaps entire industries that would otherwise not be viable are no longer limiting the economic development potential of a more sustainable economy.

Indeed, if the notion of subsidy is appropriately broad and takes in the implicit subsidies that exist when firms do not pay the full environmental costs associated with their operations, there could be few major industries that remain profitable (Trucost Plc & TEEB for Business Coalition, 2013). Policy changes that result in the internalization of external costs will force changes in practices that reduce those costs and/or the exit of firms from polluting industries that cannot change practices. Either way, impacts on biodiversity would be reduced, and opportunities for expansion by more environmentally efficient firms would proliferate.

The need for an integrated approach is illustrated in a nine-step prescription to save biodiversity (Roman *et al.* 2009). None of the steps or elements would be likely be effective alone, and all depend to varying degrees on each of the other steps. New understanding of the economic value of biodiversity will support the creation of reserve areas or changes in management to enhance biodiversity in urban and managed landscapes. Addressing issues of social justice will enable people and communities to more effectively realize the benefits of biodiversity conservation.

What types of on-going annual expenditures will be required?

For direct investments in the protection of habitat for biodiversity, the on-going expenditures will be operation and maintenance costs for reserve areas. These costs include, primarily, the cost of maintaining (minimum) infrastructure, and personnel costs for direct stewardship activities (land management, wildlife population monitoring, etc.), law enforcement (anti-poaching/anti-pollution), administration, and other activities.

In many cases, the elimination of subsidies can be considered as self-funding and elimination of a subsidy can produce more than a one-time benefit. Here, the cost savings would accrue year after year, for as long as the subsidy would otherwise have remained in place. However, it is important to recognize that in some cases there will trade offs where some members of society currently profiting from subsidies may lose economic or social benefits as a result of their elimination, such as when curbs on energy development increase costs for transportation, heating, or food, for example. It will be important to measure these tradeoffs, particularly as they impact poor, marginalized and underserved communities.

Ongoing expenditures related to programs to increase sustainability in the use and management of natural resources will include the transactions costs associated with certification and labeling programs. These transactional costs include the cost of creating, updating and enforcing certification standards. Additional ongoing costs would be that of any price premiums or purchase preferences offered by governmental entities, but in general, price premiums and preferences should be accomplished largely through the operation of the markets for these products.

How do the types of investments and ongoing expenditures identified compare to those identified in the first phase of the HLP research?

Other things being equal, such as the level of effort devoted to education or the number of hectares to be purchased and managed as a reserve, the net budgetary or fiscal outlay by governments, especially, should be lower than those estimated in the first report phase of the HLP research under the strategies we propose. This follows from the emphasis here on eliminating wasteful spending on subsidies that harm or threaten biodiversity. (See above and reference material including from Losos *et al.* (1995) and Friends of the Earth (2012). Subsidies were mentioned in the first phase report, but had not been enumerated or estimated.

In addition, taking a systems approach that enhances the delivery of multiple ecosystem services, such as biodiversity conservation and gas regulation through carbon sequestration, at once could yield further efficiencies, as noted in Busch (2013). While such an analysis is beyond the scope of this report, it may be a useful exercise as future researchers delve more deeply into the economic questions raised herein and an interesting experiment to model these costs under a hypothetical scenario where perverse and anti-biodiversity subsidies are eliminated across North America.

6.6 RESOURCE REQUIREMENTS

What evidence is there of resource needs at the project and country level?

In this section we examine what resources are necessary to achieve the Aichi Targets and to the extent possible, explore which are available in North America. We first examine the existing information on the financial costs for safeguarding biodiversity and then examine the potential and mechanisms for enhancing and equitably sharing the benefits accruing from biodiversity protection. The section concludes with a discussion of how this evidence relates to the HLP's COP-11 report, an evaluation of the current resource allocations against those required for Aichi Target delivery, and the implications for actual delivery of and progress toward the Targets.

Safeguarding Ecosystems, Species and Genetic Diversity

Genetic Diversity

The costs of protecting wild plant genetic diversity are largely unknown, but some information has been compiled for plant genetic resources for food and agriculture (PGRFA); see (Virchow, 1999, 2005).

While these estimates are limited, Virchow (2005, p.132) estimates that around $800 million was spent on conservation of PGRFA. Virchow emphasizes the low quality of the data used for these estimates, but they offer a starting point for wider consideration.

Estimating the costs of safeguarding the genetics of animal and other non-agricultural, non-plant species is even more problematic. First of all, many species, especially large bodied and high trophic level species, have already experienced a genetic bottleneck, so the genetic resources that remain are limited. The best example of this is the American Bison. Bison were infamously pushed to the brink of extinction, and as their numbers recovered many were crossed with domestic cattle. The result is that only two source populations, one in Yellowstone National Park and the other in Elk Island, Alberta, remain free ranging and free from domestic cattle genes (Hedrick, 2009). Individuals from these two source herds have now been used to start satellite herds, but most of the new herds are not free ranging and remain small. Other species that are locally rare may be less so when considered at a continental scale. Grizzly bears and wolves, both of which were included on the endangered species list in the United States remained abundant in Canada.

Species

Safeguarding species can encompass genetic diversity when it is considered a necessary part of each species' conservation. Because species are more widely recognized as conservation targets, reporting on species-level investment is more comprehensive than either genetic diversity or ecosystems. In 2012, U.S. Federal and State governments spent $1.71 billion on threatened and endangered species (USFWS, 2012). Of that amount, $1.62 billion came from the Federal government, and $85 million was spent by States. This disparity reflects the fact that when a species is listed under the U.S. Endangered Species Act jurisdiction for its management shifts to the federal government, specifically the U.S. Fish and Wildlife Service. These funds cover only expenditures on species federally listed as threatened or endangered, and additional $399 million and $433 million were allocated through the Pittman-Robertson and Dingell-Johnson funds, respectively (USFWS, 2013a, 2013b), both of which are generated by sales of sporting goods for outdoor recreation. These funds are just a portion of the total allocated by the federal government. It is also estimated that an additional $33 million is generated by hunting and fishing related activities (Munn *et al.* 2010). While these funds are not directly allocated to biodiversity conservation, they are quite relevant as economic incentives for conservation, particularly on private land.

Canada's analog to the U.S. Endangered Species Act is the Species at Risk Act (SARA), which has a very similar mandate. SARA spending in Canada for 2011-2012 was $CA[45] 93.9 million. Canada also spends an additional $CA 85 million on invasive species programs (Sustainable Development Office, Environment Canada, 2013). Also like the U.S. Endangered Species Act, Canada's SARA recognizes distinct population segments, which can be defined based on genetics, so while genetics are not necessarily an obligate part of the Act, it does have the capacity to cover genetic diversity as well.

Ecosystems

Both the U.S. and Canada also make significant investments at the ecosystem level. Similar to species-level investments, these funds come from numerous sources and are tracked separately from species and genetic investments, so it is possible that some elements are represented at multiple levels (e.g. land acquisition for a specific species), or that some investments (e.g. pollution reduction not tied to a specific species or ecosystem) may go uncounted. For the United States, Casey *et al.* (2008) estimate the 30-year costs of a comprehensive habitat conservation network as follows:

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45 In 2012 U.S. and Canadian dollars were virtually equal in value.

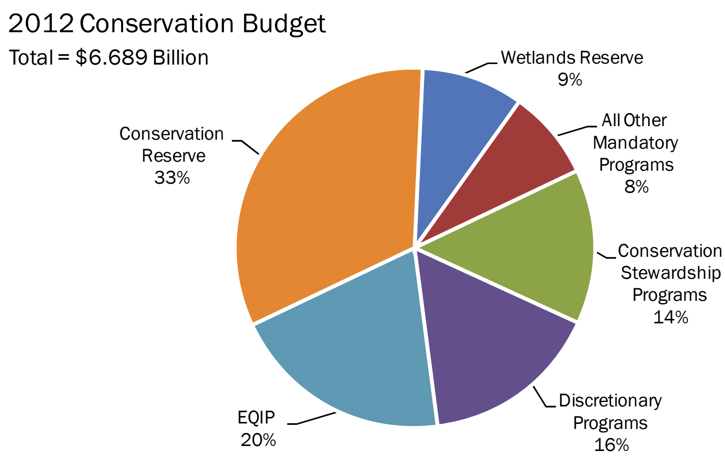

Figure 4. Breakdown of 2012 U.S. Department of Agriculture (USDA) spending allocations
Source: USDA, 2012

specific species or ecosystem) may go uncounted. For the United States, Casey *et al.* (2008) estimate the 30-year costs of a comprehensive habitat conservation network as follows:

> Our results show that over a 30-year period the undiscounted least cost option for protecting 12% of the continental United States is through land rentals/leases, at an estimated $219 billion. Fee-simple purchases with management costs would be nearly $927 billion. Easements, including initial one-time transactions costs, would amount to about $350 billion. However, if current landowners were paid to manage these same lands for biodiversity values, the cumulative undiscounted costs after 30 years would be about $135 billion. (p.4)

These numbers provide a point of reference for actual spending. Lerner *et al.* (2007) estimate spending on habitat conservation at $32 billion between 1992 and 2001 (p. 420). They point out that this figure not only falls short of the amounts needed for a comprehensive habitat protection system (estimated at $5.4-$7.7 billion per year), but also that the funds are often directed toward ongoing and short-term fee-based programs, rather than land acquisition. They argue that a more effective strategy would be to focus investments on one-time land purchases that would be more cost effective in the long term.

Canada also makes significant investments at the ecosystem level. Since 2006, over 85,000km^2 have been incorporated into conservation areas, including national parks, national wildlife areas, and marine protected areas (Government of Canada, 2010c). As part of this process Nahani National Park was expanded over six-fold and over $CA 230 million were invested in Canada's Natural Areas program and Marine Protected areas (ibid).

Greenland spent between US$11 million and $38 million during the period of 1994-2012 but these figures do not include funds allocated for "Protection of Biodiversity and Landscape", which were omitted from the official statistics. Nevertheless, these are significant expenditures for a country of fewer than 60,000 people. Greenland is also home to the world's largest protected area, Northeast Greenland National Park at 927,000km^2.

Another context in which governments allocate resources to ecosystem protection is through the enhancement of sustainability in production landscapes. In the United States, the U.S. Department of Agriculture spends nearly $7 billion per year on conservation programs. The largest share of these programs is the Conservation and Wetlands Reserve Programs (CRP and WRP, respectively), which comprise around 42% of the total conservation spending.

Reporting from government is only part of the picture, and while non-profit and private investments in conservation at all levels (genes, species

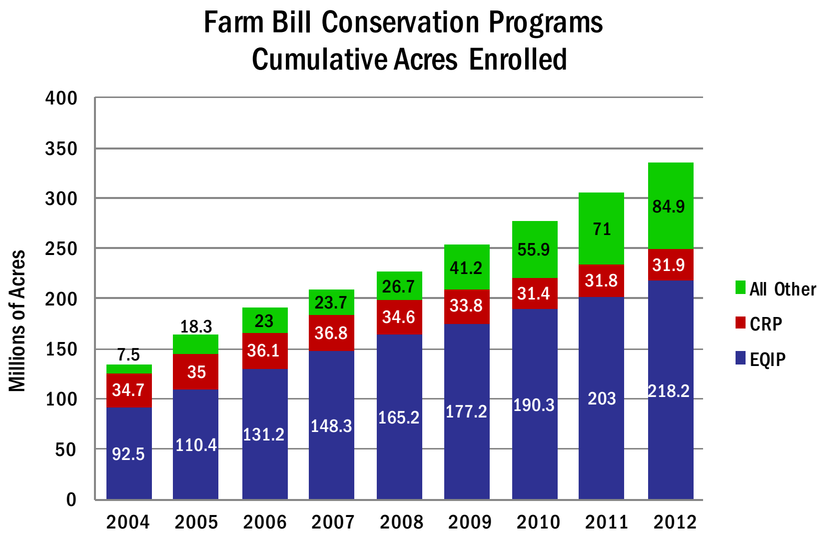

Figure 5. Acres enrolled in USDA programs have expanded the area they involve to over 300 million acres, or about 123 million hectares
Source: USDA, 2012

and ecosystems) are likely lower than government, they are certainly significant. Unfortunately, they are not tracked as government funds are, and a significant portion of nonprofits' funding comes from government sources, so simply adding non-profit expenditures to government figures would amount to double counting.

Descriptions of funding and the areas included in these programs are helpful for monitoring the implementation process, but they offer little insight into whether the interventions are improving environmental outcomes. Tracking progress toward quantitative goals is widely recognized as necessary, but consensus on how to measure progress and the specifics of indicators used is lacking. While contentious, the process of creating indicators is often worthwhile and important. What's more, better tracking and measurability can also open the door to market-based incentives for provision of ecosystem services (Kroeger and Casey, 2007). Lerner *et al.* (2007) also point out the need for tracking investments and acreage by species and habitat targets, so that year-to-year allocations can be adjusted and redirected toward the places and interventions where they are having the greatest impact.

Enhance Benefits to all from Biodiversity and Ecosystem services

Another benefit of quantitative monitoring of progress is that it forces stakeholders to be explicit about their intended outcomes. Too often, different stakeholders expect different outcomes from conservation and environmental interventions. Indeed, the equitable sharing of benefits begins at the program framing stage, rather than at the end. The U.S., Canada and Greenland all have indigenous/first nation populations and stakeholders from a range of socioeconomic conditions. Evaluating the extent to which benefits flow equitably from biodiversity and ecosystem services to disenfranchised communities is problematic because these benefits are largely unquantified. However, it is widely acknowledged that many of these benefits are disproportionately captured by larger corporations which are better positioned to both take advantage of existing legislation and policy and to influence management practices and future policy. In the policy discussion, below, we review the existing frameworks for ensuring participation and benefit sharing from biodiversity and ecosystem services along with stakeholders' perspectives on the extent to which these policies are realized.

How does this evidence compare with the analysis presented in the HLP's report to COP-11?

The evidence presented here is consistent with those of the High-Level Panel's report to COP-11, particularly with regard to the need for better data availability and comparability. Of all the "Key Messages" highlighted in the HLP report, none are contradicted here, but because the levels of development in North America are generally higher than in the rest of the world, the emphasis is more on successful implementation and allocations of resources, rather than on resource availability. Two of the key messages bear repeating here:

> Key Message 1: Implementation and delivery of the Targets requires the development of an appropriate and coherent political and institutional framework and strong political will, particularly at the national and regional level.

> Key Message 4: There are clear differences in the relative scale of investment required to deliver the various Targets. In addition, the investment needed to deliver a Target is not necessarily correlated to its importance.

These two key messages frame the discussion of the following sections.

What evidence is there for current allocations relative to needs?

Even though significant resources are available for environmental and biodiversity conservation, institutional frameworks either weaken or counterbalance the benefits of the resources allocated to environmental outcomes. Second, the enormous financial resources dedicated to endangered species conservation efforts, while necessary and important, divert resources from more effective land and habitat conservation endeavours.

The resources reviewed in this section demonstrate that significant financial and technical resources directed toward conservation in all three countries, but in all three cases, the efficacy of those expenditures is either unclear, or directly challenged by stakeholders (see section 6.7 below).

Another important issue arising from policy and resource discussions is that of funding. In much of the developing world, funding for conservation action is a limiting factor. Throughout North America, billions of dollars, if not tens of billions are spent directly on wildlife and conservation action every year. If environmental regulation is broadly included in this sum, it is even higher. Furthermore, eliminating the $700 billion in inefficient or perverse subsidies mentioned in section 6.5 would not only liberate enormous resources for conservation and other uses, but it would also reduce the negative pressures created by the subsidies themselves. Such an approach would make it possible to invest every year a sum on par with the U.S. government's financial bailout of 2008-2010. Clearly, improving the quality and thoughtfulness of public spending is as or more important than the overall amounts allocated.

Indeed, North American countries must begin to consider investments in the protection of biodiversity and ecosystem services as comparable to other public investments in various types of critical infrastructure such as roads, bridges, sewer, and water.

For example, according to Casey *et al.* "Overall, the cost of a national habitat conservation system is comparable with other large-scale infrastructure investments. Whereas the cost of such a system through fee simple purchases would be about $31.6 billion in year one, and $74.4 billion in year 30, it is estimated that urban building construction costs will reach about $1 trillion per year over the next 30 years. Annual Federal expenditures on transportation infrastructure are about $47.8 billion" (2008, p. 5).

What are the implications for the resources required to deliver the targets, individually and collectively?

In short, the resources allocated for activities consistent with and furthering the Aichi Targets are significant across North America. Unfortunately, weak or contradictory policies often counteract the benefits of the investments made. The following section provides examples of such policies and how a lack of alignment and weak implementation undermine progress toward positive environmental outcomes.

6.7 POLICY ALIGNMENT AND DEVELOPMENT

How do the identified investment needs and the benefits they will achieve align with other policy agendas, such as the post-2015 UN development agenda and the sustainable development goals?

Despite the United States' reticence to adhere to UN treaties or commit to international goals for biodiversity conservation, other extant U.S. policy and regulatory frameworks offer opportunities to meet the Targets. These may include the Endangered Species Act and accompanying Candidate Conservation Agreements (CCA's) for habitat protection; the Migratory Bird Act; the Clean Water Act; USFWS Landscape Conservation Cooperatives (LCC's); and the collective State Wildlife Action Plans for species conservation and habitat protection in all 50 U.S. states. In Canada, much of the policy and regulatory structures that impact biodiversity is made at the provincial, rather than national, level. Land held by indigenous First Nations tribes also represents opportunities for biodiversity conservation in the U.S. and Canada, perhaps even more so in the United States.

A variety of state, provincial and federal policies affect biodiversity in North America. Many of those policies mentioned elsewhere in the document were conceived for and operate directly on biodiversity and the exploitation of natural resources, but other policy instruments can have significant effects on biodiversity, even though they may have been originally conceived to affect other resources or economic processes, like agriculture, land use or human health.

What follows is an illustrative review of the diversity of policies indirectly affecting biodiversity.

The policies reviewed in this section clearly demonstrate that the strongest policy pathway to affect biodiversity is through land use. Interestingly however, these policies take different approaches, with some providing positive financial incentives, and others establishing disincentives or costs associated with negative behaviors. All have had significant impacts on biodiversity, but their efficiency and the resistance each has encountered varies considerably with the incentive structure established by each (Walls and Riddle, 2012).

One of the first such policies was conceived in the United States in the 1950s as a program called "Soil Banking." The program sought to maintain agricultural productivity by minimizing soil erosion. A key feature of the Soil Bank program was that the government would pay for improvements to land to would reduce or eliminate soil erosion on that parcel. For its first few decades the soil bank program was relatively small, primarily because most marginal areas we're not yet pushed into production, and grain crop prices were not high enough to make cultivation of marginal land economically worthwhile. In the 1980s grain prices and grain subsidies rose, creating an incentive to cultivate "edge to edge" on existing lands, and making it economically beneficial to push more marginal land into production. This transition precipitated a concomitant widening of the soil bank program: whereas the program originally protected the edges and erodible portions of high-quality farmland, it was now being applied to keep entire parcels of lower quality and more erodible farmland out of

Environmental Benefit	2004	2005	2006	2007
Reduced Nitrogen[1] (lbs)	452 million	456 million	471 million	480 million
Reduced Erosion (tons)	454 million	455 million	464 million	470 million*
Reduced Phosphorus[1] (lbs)	102 million	103 million	106 million	108 million
Sequestered Carbon Dioxide (metric tons)	47 million	48 million	49 million	50 million
Increased Duck Population	1,014 million	0.9 million*	0.9 million*	N/A

[1] Intercepted by buffers or reductions in amount leaving field. * Preliminary

Figure 6. USDA valuation of environmental benefits of CRP program. Source: Farm Service Agency 2008

production. This period saw a marked expansion of the Soil Banking program, which eventually became the Conservation Reserve Program (CRP) in the 1980s. While the actual acreage enrolled now varies from year-to-year CRP has by all accounts had an enormous impact, enrolling over 32 million acres (13.1M ha) of land or about 8 percent of all U.S. cropland in 2009 (Walls & Riddle, 2012).

Today, the CRP enjoys broad support from agricultural interests for whom it is a significant source of revenue, but as the program has grown the environmental benefits appear to outweigh the economic and agricultural benefits.

Furthermore, CRP has broad support in conservation circles, particularly sportsmen and bird hunters who argue that the program is essential tool for maintaining wildlife habitat. Indeed, the U.S. Department of Agriculture reports that:

- A 4% increase in CRP area led to a 22% increase in pheasant counts in and near the CRP lands;
- CRP programs have helped drive 30% increases in waterfowl production, which translates into over 2 million additional ducks per year in just three states (North Dakota, South Dakota and Montana);
- CRP enrolment has slowed the declines of other species at risk, including sage grouse, bobwhite quail and grassland passerine birds, all of which have faced serious declines in the recent past.

In contrast to the CRP's emphasis on voluntary adoption of positive incentives, the Clean Air and Clean Water Acts have traditionally operated on the other side of the cost-benefit equation, working within a regulatory framework to impose penalties for noncompliant polluting activities. Walls and Riddle (2012) argue that because the clean air and water acts operate outside of markets, producers, those controlling water in particular, will under supply wetlands and water resources, because there is no market mechanism to compensate them for the resources they supply. That said, the "no net loss provision" of the Clean Water Act which mandates mitigation when any wetland is destroyed, has in some years produced two new acres of wetland for each acre lost. (Kihslinger, 2008).

Another illustrative context in which policy can have strong indirect effects on biodiversity, is fire suppression. Like CRP and the Clean Water Act (which are focused on agriculture and the environmental benefits of water, respectively) fire management policies on U.S. public lands can have important effects for biodiversity, even though they are primarily concerned with the productivity of forestry practices and human safety. These influences come through two primary pathways. First, the U.S. Forest Service's decision whether or not to suppress fires has strong effects on the value of land developed adjacent to public land. Under the historical practice of fire suppression, lands adjacent to U.S. national forests had enormous amenity value without concomitant risk from fire, and development adjacent to protected areas has been faster than elsewhere (e.g. see Kramer and Doran, 2010). In recent years however, climate change, combined with large fuel loads from decades of fire suppression have driven up the cost of controlling fires (Headwaters Economics, 2009) and made some fires simply too intense to control. With decades of land development occurring in the "wildland-urban interface" or WUI, the forest service is now under tremendous pressure to suppress any fire that may threaten the WUI and the economic investments made there. This has enormous financial implications for the budgets of the U.S. Forest Service, which will soon be entirely consumed by fire-fighting activities if the current trends continue, [ibid]. Furthermore, because the service sector of many western U.S. economies is increasing, and growing numbers of people can work wherever they have access to an internet connection, pressure on the WUI and consequently on U.S. Forest Service budgets is increasing. Land development of this kind hardens the boundaries around the public land portion of many landscapes, which is particularly concerning in light of climate change and the already incomplete representation of habitat types on the U.S. protected area estate, which over represents high elevation, low productivity summer habitats and hardly covers winter and high productivity habitats.

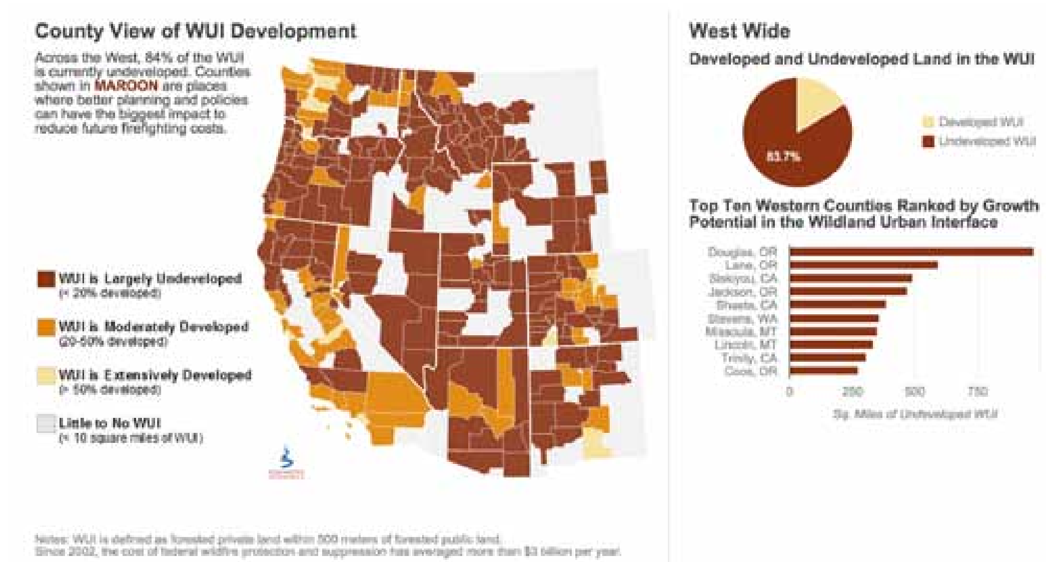

Figure 7. Development map of Wildlife Urban Interface (WUI) areas of the western U.S. Source: Headwaters Economics, 2009

Also worth mentioning is the importance of energy policy in North America. Energy policies have tremendous political importance, and pressure to keep energy prices low generally overwhelms the counterbalancing pressure for environmental regulation. Furthermore, the marriage of energy policy with agricultural subsidies has artificially increased perceived value of biofuels. This trend has driven up corn prices in particular, and by many accounts is leading to a reduction in CRP enrolment.[46] Maintaining the subsidies could have a devastating effect on CRP enrolment and undermine the positive environmental benefits outlined above.

In contrast to the developing world, where poverty reduction strategies are the primary vehicle for moving individual resource users away from subsistence exploitation of natural resources, the policies most strongly affecting North American natural resource use often apply to corporate actors and large-scale exploitation. Individuals' consumptive use of biodiversity is primarily for recreation (e.g. hunting) or through indirect effects on habitats (e.g. recreation like motorized or backcountry trail use, or for recreational development, like golf courses and sports fields). Similarly, agriculture is an increasingly centralized activity in the United States, with less than one percent of the population farming for their principal occupation (EPA 2013). The result is that corporate and large-scale family farms are more sensitive to economics than traditional small family farms were in the past, as family farms often incorporated livelihood components like land aesthetics, hunting and recreational opportunities or simple traditions. This suggests why voluntary, incentive-based programs (like CRP) may have been historically more successful than regulatory approaches. However, recent declines in the amount of land in rolled in CRP suggest that market based programs may also be vulnerable to forces outside of the program itself, particularly when economic decisions take precedence over social and environmental considerations. Furthermore, many resources and ecosystem services may prove too complex or variable to be monetized or managed in a market context, highlighting the need for regulatory approaches.

One related thread in this discussion is worth explicit mention: The centralization of agricultural and natural resource production by corporate and large farming interests means that an increasingly small minority of stakeholders derive a disproportionately large share of benefits from land, whether public or private. While each one of these large actors' shares is small relative to the collective benefits accruing to

46 An informative history of the U.S. Department of Agriculture's CRP program and an illustration of recent declines in enrollment is provided on the Ducks Unlimited website: http://www.ducks.org/conservation/public-policy/crp

the many smaller actors, these large producers have a disproportionate incentive to protect or enhance their interests through policy influence. In these cases, large-scale interests like mining, grazing, timber, or large-scale agricultural producers invest more heavily to influence government and land-use policies in their favor. This dynamic is driving a troubling trend toward privatization of public resources, which is particularly apparent in the western United States (e.g. see Schlager, 2009).

In summary, the diversity of policy approaches in place in the United States has provided a set of natural experiments comparing positive versus negative incentives for land uses that promote biodiversity. This brief overview highlights a number of conclusions:

- First, "non-biodiversity" policy instruments can have significant effects (both positive and negative) on biodiversity;
- Second, while the independent effects of each are significant and important, the interaction of policy instruments may have the most significant effects on biodiversity outcomes (e.g. CRP and biofuel subsidies).
- The changing actors in agriculture and natural resource extraction are fundamentally shifting the power dynamics that affect policies relevant to biodiversity and these changes could have significant implications for the use and future of natural capital in North America.

To what extent can we identify synergies and opportunities for joint delivery at the country and programme level?

Both ecosystems and the linked social-ecological systems through which we manage (i.e. conserve or degrade) biodiversity are highly interconnected. These linkages make it possible for interventions at one level or in one location to deliver benefits elsewhere. For example, protecting land sufficient for large and intact wilderness areas generally protects the ecosystem processes, ecological communities and species living there. Additionally, The production and value of regulating services may increase with spatial area (Barbier *et al.* 2008). When calculated, the values of regulating services typically comprise the total economic value of an ecosystem (TEEB, 2010). Furthermore, investments in maintaining regulating services may also support increases in provisioning and cultural services (Bennett *et al.* 2009; Raudseauppe-Hearn *et al.* 2010) and the provisioning of regulating services can be a useful indicator of overall ecological resilience (Bennet *et al.* 2009). Thus, by extension, reaching Aichi Targets that encompass larger spatial scales and higher levels of ecological organization (communities, ecosystems and landscapes) should provide the greatest number of additional and synergistic benefits accruing to other Targets.

One logical conclusion from an emphasis on large scale threats and processes might be to concentrate efforts around climate change, but climate and carbon emissions are fraught political territory in both the United States and Canada. Therefore, the synergistic benefits of any particular intervention have to be weighed against the political feasibility and consequences. If addressing climate change is polarizing to the extent that it will derail or undermine other efforts, and if that loss of efficiency is greater than the synergistic benefits, then climate – or any other politically charged issue – should be reconsidered in light of the net benefits.

Decentralization of U.S. and Canadian governance and implementation structures must also be considered in the context of synergies. Because circumstances may vary at lower levels of organization, top-down mandates for resource protection or more sustainable use or management are less feasible and for those that are implemented, they are less likely to be successfully carried out. Instead, a more powerful approach may be to provide incentives to motivate all actors, (whether individuals, local governments, corporations or non-profit organizations) to take positive steps toward achieving Aichi Targets.

What is clear from a review of the potential synergies in North America is that the diversity of policy instruments combined with governments' capacities to implement effective policy, offer significant potential for complementary initiatives.

What are the implications for the overall resource requirements to meet the aichi targets, and the degree to which additional resources need to be targeted to them?

The United States, Canada, and Greenland all have policy agendas capable of supporting significant movement toward the Aichi Targets. In each case, however, conflicting or poorly implemented policies undermine progress. Simplest among the three cases is Greenland, whose environmental policy was driven by Denmark until very recently. Increasingly however, Greenland is exerting its autonomy, apparent first through its mineral (Vahl & Jensen, 2013) and fisheries (Ramsden, 2013; Singleton, 2010) policies. With only four years of autonomy from Denmark, Greenland is developing its own style of governance, and clearly economic development and globalization are important drivers in its trajectory.

The United States and Canada, by virtue of their sizes and the decentralized nature of their environmental regulations, are more complex policy contexts. In both cases, environmental regulation and management (particularly abiotic elements like energy, climate and pollution) are most heavily weighted toward the federal level, whereas land management is mixed between state, provincial and federal entities, and wildlife is primarily decentralized to state, provincial and territorial levels.

Looking at the components of biodiversity, namely genes, species and ecosystems, both countries' frameworks for species level management (namely the Endangered Species Act and the Species at Risk Act) encompass genetic considerations for those species. Neither country has an endangered habitat or ecosystem policy, but Canada has stated its intentions to pursue representation of ecosystem types and ecological integrity (Wiersma & Canadian Council on Ecological Areas, 2006), which could accomplish the role of an endangered ecosystems act. The U.S. Endangered Species Act (ESA) does recognize the importance of habitat for listed species and both the ESA and the Migratory Bird Act recognize the role of species in their natural communities, making it possible (though not ever applied, to our knowledge) for community and ecosystem-level protection to come from these species-focused laws.

Both the United States and Canada explicitly state their intentions to engage stakeholders in participatory processes surrounding natural resource management, but both have been harshly criticized for failing to meet these obligations. The U.S. Forest Service's National Report on Sustainable Forests (USDA-FS, 2004) lists public participation as an "indicator" (Indicator #50, p. 64), but offers no specific metrics for evaluating that participation. Canada's (Government of Canada, 2010a) Federal Sustainable Development Strategy strongly embraces participation and ideals including "Build[ing] the jobs and industries of the future", "Mak[ing] Canada the best place for families", "Strengthen[ing] a united Canada in a changing world" and "Stand[ing] up for what is right in the world", but serious objections to Canada's commitment to transparency and stakeholder participation have come from a variety of sources (e.g. see Hunka & McNeely, 2012; Miller, 2012; Government of Canada, 2013). Perhaps even more troubling, Canada has policy instruments that preempt protected areas from restricting mineral development. The 1980 Canadian Mineral and Energy Resource Assessment mandates that consideration of mineral resources takes place prior to "withdrawal" of lands for park status (Canadian Forest Service, 2013.). This process elevates the interests of mineral development above all others in park planning and establishment. Furthermore, neither Canadian nor U.S. positions on participation specifies whether participation is intended as a means to promote equity, local empowerment or simply to engage relevant stakeholders for more effective conservation implementation.

While the resources allocated for conservation under the U.S. Government programs mentioned in this and the previous section are significant, it is clear that a more strategic allocation of resources could significantly increase their conservation impact. Unfortunately, many U.S. Departments and land and wildlife management agencies lack the authority to allocate resources strategically. Figure 8 illustrates this problem within the USDA.

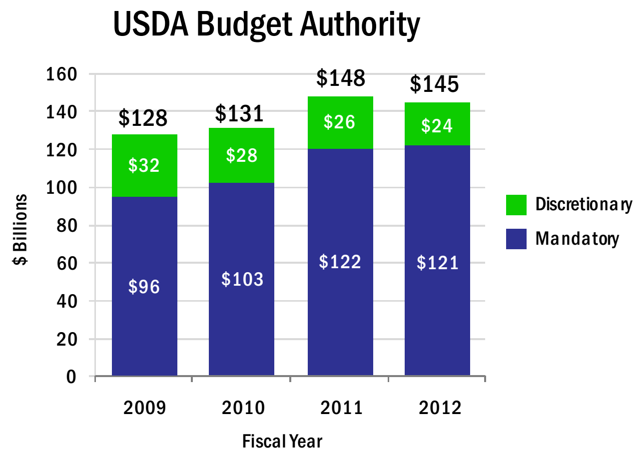

Figure 8. Breakdown of the U.S. Department of Agriculture's budget for 2012, where just 16% was allocated for discretionary spending.
Source: USDA, 2012

To what extent can improvements in governance, institutional and policy development at the country level contribute in a cost-efficient manner to deliver actions to achieve the targets?

As mentioned above, improved governance and more thoughtful use of public resources would go a long way in improving progress toward the Aichi Targets. Enhanced accountability to the public and a requirement to factor environmental capital into decision-making processes would represent major steps forward for the U.S. and Canadian governments, in particular.

Improvements in government accountability would also elevate the implementation of the CBD and Aichi process within the U.S. and Canada. Recognizing citizens' rights to benefit from biodiversity (Strategic Goal D) and to shape policy, planning and management (Strategic Goal E) and putting the interests of the public and environment would profoundly increase forward momentum toward the Aichi Targets.

6.8 COST EFFECTIVENESS

How can the Aichi Targets be delivered at least cost, taking account of the synergies between the targets and the investments required, the sequencing of actions and the synergies with other policy agendas?

As suggested by the answers to questions 4.1 through 4.3, above, it is likely that delivery on the Targets will be accomplished at least cost when, or perhaps if and only if, synergies between actions and policies are taken into account and leveraged. Attempting to purchase land for reserve areas where there are massive subsidies to the conversion of land from natural habitat to developed uses will only make the acquisition costs for the conservation reserve higher, thereby making the action less cost-effective. For example, subsidies to promote the use of ethanol to reduce fossil fuel emissions pushed corn prices higher and drove more marginal land into production just as the CRP program (discussed above) was working to reduce the amount of marginal land under cultivation. This phenomenon highlights the difficulties arising when interventions conceived to benefit one environmental objective may have a negative effect on another objective or on a another component of biodiversity. Similarly, one intervention may undermine the efficacy of another, for example, when strict enforcement creates social tensions that undermine community cooperation and goodwill, thus decreasing public support for conservation. Rather than simply dismissing these cases as bad policy, they highlight the inherent challenges from working in complex systems.

Similarly, and moving even farther from the direct effects on biodiversity, efforts to support more sustainable production and consumption will be less effective when unsustainable production, as indicated by the persistence of negative externalities of the production process, is allowed to continue. The providers of sustainably produced goods and services would be unable to penetrate markets dominated by unsustainable low-internal-cost producers.

We would therefore recommend that investments intended to achieve the Targets deliberately leverage existing synergies or create them where they are absent. In some cases this will mean investing in multiple or more comprehensive actions. In others, it might mean choosing a site, time frame or sequence of investments that is different than one might select if making investment decisions in isolation.

Note that while we suggest a general priority and sequencing of types of investments above, the priority and sequencing needs to be flexible to take into account place and issue-specific information.

Wilson *et al.* advocate and provide a framework for assessing threats and actions on a case-by-case basis (2007). The range of investments the authors consider does fall entirely within the realm of direct investment as described under Question 4, however, so the general priority and sequencing may still hold.

Moreover, such assessments may require significant time, new primary data, and specialized expertise to undertake, which would increase the costs of deciding what action to take. To the extent that the improving the "knowledge, science base and technologies" referenced by Target 19 includes the development and dissemination of decision support tools for biodiversity conservation, investments aimed at that Target would improve the cost-effectiveness of all other investments, in part by preventing some of those investments from being made in the first place.

What evidence is there of the cost effectiveness of different investments, taking account of biodiversity gain and contribution to the targets relative to cost?

A recent study published in *Land Economics* suggests that investments in biodiversity protection should be combined with payments for other ecosystem services (Busch, 2013). Specifically, the study finds a particular paradox in that by combining carbon payments (REDD+) with payments for biodiversity one can obtain greater climate benefit than one would obtain by paying the same amount on carbon payments alone (p. 657). This synergy is the result of the natural joint-production of biodiversity and carbon benefits along with some other features of markets and landowner/producer behavior. While Busch's study focuses on the experience of several tropical countries, the author contends that similar results would be obtained in such programs as the U.S. Conservation Reserve Program referenced above.

Moreover, Newbold and Siikamäki (2009 a,b) find that when cost-effectiveness is taken into account, one obtains "much greater biological benefits than those achieved by less systematic but commonly used approaches such as professional judgment or targeting based on only biological criteria." Considering "bang for the buck [dollar]" as a criterion, in other words, the "bang" is much bigger.

What are the implications for the sequencing and/or prioritization of investments in moving towards achieving the targets?

We believe that the sequencing and prioritization of investments is critically important to whether or not these investments are effective in the first place and certainly whether they will be successful at the least possible cost. To return to the example above, proactive investments in sustainable production and consumption will be far less effective without either first, or at least simultaneously, eliminating subsidies to unsustainable production and consumption (Losos, *et al.* 1995).

As also noted under section 6.5 direct protection measures should be prioritized over less direct strategies because such protection is likely to be more cost-effective at conserving the three components of biodiversity (see Table 1, above). Indirect strategies should then be considered means of reinforcing direct strategies and ways to directly pursue secondary goals, such as increasing equity and economic opportunity in areas rich in biodiversity. The importance of indirect strategies in addressing drivers of loss, and hence improving cost-effectiveness of direct action is also noted here.

That said, the fundamental implication from the evidence we have reviewed and broader lessons from more than a century of nature conservation is that narrow strategies focused on a single resource or a single ecosystem service are unlikely to be cost effective, and they may not be effective at all. In the language of one current debate in the conservation community, we cannot simply preserve *either* the stage on which the great play of evolution will continue *or* the actors (species) already on (or waiting in the wings) that stage. We need both (Rosner, 2013).

For truly cost-effective biodiversity conservation, it is important to hold, BOTH an emphasis on direct investments in habitat protection and management improvements AND an emphasis on eliminating or alleviating the systemic drivers of further habitat loss and degradation. Good conservation reserve design and habitat management can be undone by harmful subsidies and/or overexploitation of natural resources by people who see few other economic opportunities.

6.9 BENEFITS AND COSTS

What does the evidence as identified above tell us about the balance between the benefits and costs of meeting the targets?

As suggested above, environmental, economic and social co-benefits of meeting the targets can and should be considered along with the more direct benefits of biodiversity conservation. Because the Targets themselves overwhelmingly mention or point to such outcomes as sustainable use, poverty reduction, national socio-economic conditions, forest degradation, nutrient pollution, equitable management of protected areas, culturally valuable species, human health, carbon stocks and equitable sharing of benefits from the use of genetic resources, it is reasonable that any assessment of cost-effectiveness of strategies to reach the Targets would take into account outcomes and benefits other than those directly related to biodiversity conservation.

Moreover, many of the benefits and co-benefits of biodiversity conservation are external to traditional market transactions. These benefits are therefore not reflected in prices in the same way that, for example, the cost of acquiring land for a reserve area would be. The costs of biodiversity conservation, by contrast, often can be associated with some more readily identifiable market value, such as the price that same reserve area could fetch if converted to developed uses, or the amount of mineral, timber or other resources that could otherwise be extracted from a reserve area. This asymmetry means that, when measured by market values alone, the balance between the costs of biodiversity conservation and the benefits will tilt inexorably -- though misleadingly -- toward the costs. Extra effort, therefore, is essential to quantify the external, societal benefits so that the true balance can be evaluated.

The literature regarding the benefits of environmental improvement and methods, techniques and tools for quantifying those benefits in monetary terms is both vast and rapidly expanding. And, like the policies that should be informed by such analyses, the analyses themselves are becoming more holistic and integrated. Not quite gone, but certainly on the wane are the days when we would study the value of just one ecosystem service (recreation, water supply, etc.) affected by some action. This type of research may still be useful, however, if the purpose is to plug that value into a larger picture of the value of all ecosystem services and present those values in the context of specific policy or management decisions. It is therefore difficult to pull out the value of measures taken to conserve biodiversity from those taken to sequester carbon, those taken to reduce air and water pollution, or those taken to address problems of environmental injustice.

That said, studies that attempt to estimate the value of all ecosystem services consistently find that value to be several times the value of the human economy as indicated by standard measures like GDP (Costanza *et al.* 1997; Ten Brink, 2009; Trucost Plc, 2013). And as noted in Section 6.4 above, using the Chesapeake Bay case example, those ecosystem services most directly linked to biodiversity represent significant value. In another study, Southwick Associates estimate that:

> **The value of ecosystem services provided by natural habitat in the 48 contiguous United States[47] amount to about $1.6 trillion annually**, which is equivalent to more than 10% of the U.S. GDP [emphasis added] (2011).

Such measures really only scratch the surface because biodiversity is a fundamental part of the critical natural capital on which most or all ecosystem services value depends. Indeed, biodiversity is essential to so many stages of the production, delivery and enjoyment of ecosystem services, that it might not even make sense to try to segregate the value of biodiversity from the total value of those services. "Biodiversity can be a regulator of fundamental ecosystem processes, a final ecosystem service itself, or a good" (Mace, Norris and Fitter 2012, p 22}, which makes its valuation within the ecosystem services framework difficult. What is known with greater and greater certainty, however, is that "... biodiversity is even more important for maintaining ecosystem services than was previously thought" [based on previous studies that took a less holistic approach] (ScienceDaily, 2011; Isbell *et al.* 2011).

47 That is, excluding Alaska and Hawaii, states that may contribute far more to the value of ecosystem services from natural habitat, due to their size (for Alaska) and the unique habitats they contain.

How can this evidence be used to make the case for the investments required?

At a certain level, this question could be regarded as moot. That is, the fact that the targets exist in the context of the CBD suggests that a determination has been made that the benefits of achieving the targets are worth the costs of any and all actions required to achieve them, regardless of how high costs might be.

However, and as has been true in so many areas, an appeal to settled decisions may need repeated reinforcement with information about the net benefits of conservation action. As a practical matter, we therefore recommend that information about the full range of returns on conservation investments be included in any and all communication about those investments.

We further recommend that information about the economic value of biodiversity -- the benefits of achieving the targets -- be first expressed in two important contexts:

- Biodiversity value should be recognized as critical natural capital that is fundamentally related to all ecosystem service values, from food and water supply to raw material and aesthetic values.
- This value should also be compared or contrasted to direct and indirect public expenditures (subsidies) of development, resource extraction and other activities that threaten biodiversity.

The message needs to include the idea that biodiversity is (a) valuable on its own; (b) even more valuable as part of the process by which all ecosystem services are delivered to and enjoyed by people; and (c) undermined by wasteful spending on subsidizing resource extraction activities that, if eliminated, would free up financial resources for integrated biodiversity protection and appropriate economic development.

In addition to building the political will to make and sustain investments in biodiversity conservation in the first place, such communication will help to raise awareness of the benefits of biodiversity (Target 1) and will support a shift toward more sustainable production and consumption (Target 3). Consumers who understand the full value of biodiversity to themselves and to their communities may be more likely to make more sustainable consumption choices as well as to support policies designed to reduce pollution, ensure ecosystem service provision or the sustainable management of forests, fisheries and agricultural areas.

6.10 CONCLUSIONS

Overall conclusions

Based on our learning from this research, we urge that future investments in North American biodiversity conservation be considered and cast in the broad context of interconnected natural and human systems so that even individual or a series of smaller focused investments can be understood as contributing to solving part of a larger problem. Similarly, such an understanding of systems and context will make it clear that, in many cases, more than one part of the system will have to be addressed concurrently. This interconnection between natural and human systems is an important theme that should not overlooked. As featured in the Chesapeake Bay example from Section 6.4 above, the co-benefits to human livelihoods from activities designed to protect biodiversity are numerous, and in many cases, either offset or generate multi-billion dollar economic impacts.

Second, we believe strongly that the elimination of subsidies harmful to biodiversity and other forms of critical natural capital is essential both to get biodiversity-harming activities out of the way of biodiversity-protecting/restoring activities and to provide a major pool of resources that can be invested in protection, restoration, compatible economic development and other positive actions for people and ecosystems.

To this point, it is worth repeating that in the U.S. alone, nearly $700 billion per year could be saved by eliminating "wasteful and environmentally harmful government spending (Friends of the Earth *et al.* 2012)." To put this in context, the federal Land and Water Conservation Fund, which is a primary source of investment in land conservation in the U.S., is authorized at only $900 million per year, though more recently it has been funded at only half of that level. If even 1/700th of the estimated amount of funds wasted on "environmentally harmful" spending were saved, the difference could cover the entire annual cost of the Land and Water Conservation Fund. There might also be sufficient funds leftover to invest in additional biodiversity conservation across the U.S. accomplishing significantly more than is currently possible. This represents but one example of how reducing wasteful government spending associated with perverse subsidies and ineffective policies could yield significant funding for conservation.

Likewise, it has become evident from the research that, from a global perspective, Canada must be considered a major focal area and high priority for the successful implementation of the Aichi Targets at scale. We recommend that Canada, especially its vast areas of still unprotected boreal forestlands and marine areas vulnerable to extractive resource development, be considered as a significant opportunity for increased focus and attention of the High-Level Panel, as well as an area of high risk for loss of biodiversity on a scale that will have worldwide impacts. This risk is magnified by impending threats from extractive industry at scale not seen before and decentralized federal-provincial-local governance structures that fail to adequately balance the social and environmental impacts of resource extraction with the economic value of biodiversity. Increased infusions of international attention and resources, research, awareness building, and conservation efforts in Canada could create big wins for biodiversity and great strides towards worldwide achievement of the Aichi Targets.

As detailed in section 6.5 above, we also recommend that future investments for implementing the Aichi Targets, especially those focused in the public policy arena, support the elimination of subsidies and other "perverse incentives" for destructive environmental practices. Elimination of these harmful subsidies could create real economic benefits to governments at many levels in the form of cost savings and revenue. Funds currently wasted on subsidies to individuals and corporations could become a new and dedicated source of funding for investment in other activities that protect biodiversity for all citizens.

Finally, as noted in section 6.8, we recommend that actions taken toward improving the "knowledge, science base and technologies" (Target 19) include significant emphasis upon developing and sharing decision support tools for biodiversity conservation amongst many levels of government and nonprofit conservation practitioners. We believe that investments aimed at this Target will improve the cost-effectiveness of investments in other Targets, creating synergies that will likely preclude duplicative or unproductive use of limited conservation resources.

Evidence gaps and future research priorities

One significant gap in evidence that our team identified was the lack of large-scale and cohesive estimates for the value of biodiversity in North America. Many studies have attempted to estimate values of biodiversity or ecosystem services, sometime focused on specific species, at the local or even watershed-levels, but little evidence exists to support these valuations at a broader scale.

The researchers note that the results of this report, specifically those that highlight opportunities for future research falls squarely within the mission and skill set of the Intergovernmental Platform on Biodiversity & Ecosystem Services (IPBES). The U.S. lead for IPBES Dr. Doug Beard of the United States Geological Survey (USGS) noted in a recent presentation that an assessment for implementation of the Aichi Biodiversity Targets will likely be part of the 2014-2018 work plan developed for IPBES. This body of scientists may be an excellent partner for furthering the research begun in this report and the other regional research reports.

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APPENDICES

INTRODUCTION

This document contains the appendices of the compiled reports of six regional reviews undertaken in support of the second phase of the High-level Panel on the Global Assessment of Resources for Implementing the Strategic Plan for Biodiversity 2011-2020. The document can be downloaded from http://www.cbd.int/ts.

This report was compiled by Tristan Tyrrell (Secretariat of the Convention on Biological Diversity), and is based on a series of six regional reviews overseen by Sarah Smith (UNEP-WCMC) and Matt Rayment (ICF International). The contributions and feedback provided by members and observers of the High Level Panel on Global Assessment of Resources for Implementing the Strategic Plan for Biodiversity 2011-2020 are also greatly appreciated. Additional input was also provided by a number of staff at the CBD Secretariat, in particular by Ravi Sharma.

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OBJECTIVES AND APPROACH OF THE HIGH-LEVEL PANEL

In paragraph 24 of decisions XI/4, the Conference of Parties welcomed the findings of the first phase of the High-level Panel on the Global Assessment of Resources for Implementing the Strategic Plan for Biodiversity 2011-2020, and invited the High-level Panel, in collaboration with other relevant initiatives that could provide a more bottom-up approach, to continue its work with a broadened composition and to report back on the results of its work to the twelfth meeting of the Conference of Parties.

The aims of the second phase of the High-level Panel were to:

1. Develop an assessment of the benefits of meeting the Aichi Biodiversity Targets, examining both direct biodiversity benefits and wider benefits to society that result from the investments and policy developments required.
2. Assess the range of the costs of implementing the activities needed to achieve the targets, taking into account the further work proposed in the High Level Panel report to COP-11.
3. Identify opportunities to secure the benefits most cost effectively through actions in both the biodiversity sector and across economies as a whole that can mobilize / make better use of resources, to deliver greatest progress towards meeting the Aichi targets.

The second phase undertook a more bottom-up analysis of the benefits and costs of meeting the Targets, in part, through reviews of regional evidence covering each of the following regions: Africa, Asia, Europe, North America, Australasia and the Pacific, and Latin America and the Caribbean. The regional research was carried out between October 2013 and January 2014.

APPENDIX 1. AFRICA

Actions for each target were derived from the global assessments of individual targets made in 2012.

Target	Actions
1. Aware of the values of biodiversity	Research awareness and develop strategy
	Awareness raising activities – schools, public, policy makers
2. Integration of biodiversity into planning	National assessments of biodiversity values
	Raise awareness
	Develop procedures to integrate into policies, strategies and plans
	Implement in: ▪ national accounting ▪ land-use and development planning ▪ resource allocation (water, fisheries etc.)
3. Elimination of incentives harmful to biodiversity	Studies on incentives, develop action plans
	Raise awareness
	Remove/adjust harmful subsidies
4. Plans for sustainable production and consumption	Studies on production & consumption externalities
	Develop strategies and formulate national action plans
	Awareness raising
	Implement strategies such as new legislation, ecolabelling, effluent charges/taxes
5. Halving the rate of loss of all natural habitats	Review/research causes and develop strategies, with a focus on important/valuable habitat areas
	Awareness raising, training and education of conservation, agricultural and forestry extension officers and EIA practitioners
	Implement incentives to encourage off-reserve conservation measures Property rights, ecolabelling, payments
	Implement offset systems to ensure no net loss of development
6. Fish, invertebrates and aquatic plants are managed and harvested sustainably (including indigenous forestry)*	Research on ecological and economic aspects of resource harvesting, and effectiveness of management measures, and develop strategies
	Allocation and/or buyout of rights
	Monitoring and enforcement

Target	Actions
7. Areas under agriculture, aquaculture and (plantation)* forestry are managed sustainably	Research on the negative internal and external impacts of cultivation/culture practices, research and develop strategy to minimise
	Awareness and extension
	Adapt policy, legislation and institutions (property rights)
	Implement conservation measures & incentives removal of perverse incentives minimum standards and measures to treat effluent/return flows closed containment, multi-trophic aquaculture minimum tillage & soil conservation measures buffer zones around sensitive habitats fire management
8. Reducing pollution**	Research on better production and clean-up technologies
	Raise awareness
	Marine debris clean-up
	Introduce improved technologies/upgrade facilities change to biodegradable plastic production improve wastewater treatment capacity and stormwater systems reduce agricultural runoff install best available technologies for stationary and mobile sources of pollution
	Introduce incentive measures deposit-refund systems or taxes for packaging tradeable rights for effluent and emissions
9. Invasive alien species and pathways are identified and prioritized	Research and prioritisation of IAS and pathways
	Awareness and extension
	Control and eradication measures
	Prevention measures
10. Minimize the anthropogenic pressures on coral reefs and other vulnerable ecosystems	Integrated coastal zone management with marine protected areas
	Sustainable harvesting practices (Target 6)
	Integrated watershed and wastewater management

Target	Actions
11. Conservation of terrestrial and marine areas	Integrated conservation planning and develop economically defensible strategy for protected areas, buffer zones and connectivity corridors
	Expand protected area system and set up systems for conservation of buffer and connectivity areas [overlap with Target 5] acquisition of land conservation easements/contractual arrangements/stewardship agreements/fiscal incentives
	Improve PA management effectiveness, monitoring and enforcement
	Implement measures to gain co-operation of communities around parks shared benefits/compensation development/opportunities
12. Prevent extinction of known threatened species	Research and prioritisation of actions
	Education and awareness raising
	Protection and restoration of critical habitats and sites for threatened species (Targets 11 and 14)
	Control/eradication of invasive alien species (Target 9)
	Species reintroduction, recovery and management actions, including ex-situ conservation
	Measures to reduce illegal harvesting and trade appropriate legislation & penalties physical protection increased vigilance at borders international solutions to address demand
13. Minimizing genetic erosion and safeguarding genetic diversity	Identify socio-economically and culturally valuable species and develop conservation strategy [overlap with Target 11]
	Raise awareness and capacity
	Ex-situ maintenance and expansion of existing collections [overlap with Target 12]
	Encourage in-situ conservation by farmers
14. Restoring and safeguarding ecosystems	Research and prioritise ecosystem areas for restoration and safeguarding
	Removal of subsidies and public support for harmful infrastructure [Target 3]
	Establishment of protected areas and conservation initiatives [Targets 5, 7, 11]
	Removal of alien invasive species [Target 9]
	Restoration of degraded terrestrial vegetation, drainage systems and soils
	Restoration and reestablishment of coastal and marine systems (e.g. dune systems, mangroves and coral reefs)

Target	Actions
15. Enhanced ecosystem resilience	Overlap with many of the preceding targets [particularly Target 5, 6, 7, 8, 9, 10, 11]
16. Implementation of Nagoya protocol on access to genetic resources	Deposit the instrument of ratification, acceptance or approval
	Revise legislative, administrative or policy measures already in place or develop new measures
	Put in place institutional structures required for implementing the protocol
17. Implementation of national biodiversity strategy and action plan	Developing, updating and implementing NBSAPs – this will cover all the targets.
18. Traditional knowledge, innovations and practices of indigenous and local communities respected	National and regional level strategies
	Capacity building to foster participation of indigenous local communities
	Capacity building for implementation
19. Knowledge, the science base and technologies relating to biodiversity improved	Research [overlaps with most of the above targets]
	Implementation of monitoring and information systems [overlaps]
20. Mobilisation of financial resources	Develop and implement resource mobilization strategies

* Author's adjustment to the Aichi Targets to streamline lists of actions.
**Air pollution and carbon emissions not dealt with here.

Box 1. The growing tourism value of biodiversity

The wildlife-based tourism industry is now Botswana's second largest income earner after diamond mining, contributing 5% of the country's Gross Domestic Product (GDP) and 40% of employment in northern Botswana. Botswana's first Tourism Policy (1990) pursued a high value/low volume tourism strategy which has been very successful in the north. Tourism in the Okavango Delta has grown dramatically since the 1970s when it was almost non-existent. Visitors stay in luxurious photographic safari camps, hunting camps or fishing camps, all of which are temporary structures. Camp owners either pay a lease (a percentage of turnover) to the local government or to the communities, as well as royalties for hunting. Overall, the Okavango Delta area is estimated to generate a gross income of some $112 million, making a direct contribution of $40 million in terms of direct value added, about 2% of GDP. An estimated 81.0% of tourism value accrues to photographic tourism companies, 15.5% to hunting safari companies, and 3.5% accrues to communities through CBNRM arrangements. (Source: Turpie *et al.* 2006)

Box 2. The costs of environmental degradation

Blackfly outbreaks have developed along many **South African** rivers in the wake of dam constructions, irrigation schemes and inter-basin transfers (Nevill 1988, Myburgh and Nevill 2003, Rivers-Moore *et al.* 2008). Changing the natural flow of rivers to a more constant and perennial regime allows black-fly larvae to develop in ideal conditions throughout the year, resulting in populations reaching pest proportions in many areas (Rivers-Moore *et al.* 2008). Blackflies are disease vectors for a number of human diseases, and are themselves highly irritating due to their habit of crawling into hair, eyes, nose and mouth (Rivers-Moore *et al.* 2008). They are also carriers of livestock diseases, and can be such a nuisance to livestock that they inhibit feeding and mating, which results in production losses (Palmer *et al.* 2007). Recent work has evaluated the cost associated with black-fly outbreaks along the Orange River in the Northern Cape Province of South Africa (Palmer *et al.* 2007). In the case of the Orange River, costs were comprised not only of productivity losses and livestock (sheep) deaths, but also of tourism and labour loss, as well as the cost of the government-implemented control programme (Palmer *et al.* 2007). The costs incurred due to livestock death and loss of productivity came to $6.8 million. This means that a healthy lower order river has an estimated disease control value of R51,200/km (Turpie *et al.* 2012).

Identifying and Grouping Actions Required to Meet the Targets

Table 1. Integrated summary of actions required to meet Aichi Targets

Broad group	Category	Actions
Research and development		▪ Valuation of biodiversity ▪ Biodiversity and socio-ecological systems ▪ Priority areas and IAS for conservation action ▪ Indigenous knowledge ▪ Impacts of policy measures ▪ More efficient and cleaner production technologies ▪ Product development ▪ Monitoring and information systems ▪ Natural resource accounting
Develop strategies and plans	Integrated land and resource planning	▪ Integrated conservation and development planning (including prioritisation of conservation/restoration efforts) ▪ Integrated catchment, water and waste management ▪ Integrated coastal zone management
	Sustainable development strategies	▪ Strategies to reduce negative impacts of production and consumption ▪ Sustainable harvesting strategies ▪ Sustainable agri-, aqua- and silviculture strategies
	Enable implementation	▪ Update/revise policies, legislation and institutions ▪ Financing strategies
Awareness and capacity		▪ Educate children, users, public, policy makers, extension officers about values, trade-offs, strategies and management measures ▪ Capacity building to foster participation of indigenous local communities

Broad group	Category	Actions
Direct protection and management	Strengthen PA systems	▪ Acquire land ▪ Improve management and enforcement ▪ Conservation easements/contractual arrangements ▪ Measures to gain co-operation of communities around parks
	Ex-situ conservation	▪ Breeding programmes for endangered species ▪ Ex-situ maintenance and expansion of existing collections for genetic diversity
	Restoration and clean up	▪ Marine debris clean-up ▪ Control and eradication of invasive alien species ▪ Species reintroduction, recovery and management actions ▪ Restoration of degraded terrestrial vegetation, drainage systems and soils ▪ Restoration and reestablishment of coastal and marine systems (e.g. dune systems, mangroves and coral reefs)
	Border/port protection	▪ Prevention of alien introductions ▪ Monitoring for illegal trade
	Management of land and resource use	▪ Integrated catchment management (including agriculture, forestry, fire, water, pollution) ▪ Integrated coastal management ▪ Management of natural resource harvesting (forestry, fisheries, etc)
Indirect protection through standards and incentives	Correct incentives	▪ Removal of harmful subsidies ▪ Allocation of property rights (e.g. forestry, fisheries, pollution, grazing, water, wildlife) ▪ Financial incentives/measures (taxes/charges, subsidies/payments, deposit-refund, buyouts) ▪ Introduction of eco-labelling and other measures of recognition
	Certification & offset systems	▪ Definition of minimum standards and certification systems ▪ No net loss/offset systems
Improved technology and infrastructure		▪ Change to biodegradable plastic production ▪ Improve wastewater treatment capacity and stormwater systems ▪ Install better technologies for stationary and mobile sources of pollution ▪ Ballast water treatment

Box 3. Wealth Accounting and the Valuation of Ecosystem Services (WAVES)

WAVES is a global partnership that aims to promote sustainable development by ensuring that natural resources are mainstreamed in development planning and national economic accounts. The WAVES programme includes Botswana and Madagascar. Botswana was one of the first counties to pilot environmental and natural resource accounting, starting in the 1990s, with monetary accounts constructed for minerals, and physical accounts only constructed for minerals, water and livestock. Wealth accounts (more complete measures of wealth including natural capital values) show that whereas Namibia's per capita wealth has declined over the last two decades, Botswana's has increased dramatically over the same time period, probably due to reinvestment of mineral resource gains. This illustrates how more complete measures of wealth can give a better picture and help policy-makers to determine the levels of investment needed to maintain sustainable development, and guide long-term policy (Allebone-Webb *et al*. 2013). In Madagascar the first priority was developing macroeconomic indicators like adjusted net savings and adjusted net national income to assess whether Madagascar is building or depleting national wealth. The sectors that were identified for creating detailed accounts included the mining sector, fishing sector, tourism, and water (WAVES 2012). In addition to the funding provide by WAVES, Madagascar committed $500,000 in co-financing.

Box 4. Tourism development does not necessarily reduce pressure on resources

Zanzibar's population of 1.1 million is highly dependent on its marine environment, which accounts for 30% of GDP. Since 1985, the tourism industry has grown rapidly to become the mainstay of the economy. However, the impact of this development path on the marine environment and local communities, the stewards of the marine ecosystem, were not carefully considered. The marine systems upon which the economy depends are now seriously degraded and local coastal communities are suffering the consequences. While 47% of Zanzibar's GDP is from tourism, only 20% accrues to these communities, with most going to government in the form of fees and taxes (15%), to Zanzibaris from outside the fishing communities (12%) and to non-Zanzibaris (53%). Overfishing and destructive fishing practices are the main reasons for the degradation of Zanzibar's coral reefs and fish populations. However, given the open access nature of the fisheries and low levels of income, the fishing communities have little incentive to change their fishing practices (Schmidt-Soltau 2003). Greater involvement in, and income from, activities that depend on a healthy marine ecosystem is needed in order to change this situation (Lange and Jiddawi 2009).

Research and Development

Box 5. Importance of recognising traditional knowledge and beliefs in managing protected area systems

It is argued that traditional knowledge and beliefs can be key to the conservation of biodiversity when cultures are conserved. For example, in **Malawi**, villagers living in Chindozwa village on the northern end of Lake Malawi have long understood that trees call the rain that falls on their crops and feeds the lake, calling the fish back into the lake. They believe that trees need to be strategically kept in order to ensure rainfall and its flow. In addition, their fishing rituals require specific plants from particular vegetation types found around the village. Their beliefs and rituals give the villagers cause to monitor and conserve terrestrial and aquatic biodiversity. Concern over recent deforestation led the fishers to plant trees and undertake other conservation activities. A movement that began at the household level in 1988 consolidated in 2009 into CHI-MO (Chindozwa Home-based Initiative) and is rapidly expanding to neighbouring villages, various government offices and local NGOs (Nakayana 2010).

In **Ghana** the tendency to downplay link between traditional and scientific conservation approaches has been blamed for rendering most conservation initiatives fairly ineffective (Attuquayefio and Fobil 2005).

In **Kenya**, the Kivaa Hill is a sacred site that was once well protected but had become degraded. The African Biodiversity Network (ABN) helped to reinstate rituals at the site after 40 years, and the site was rehabilitated. The project worked to strengthen customary laws, including the stories, and revitalise the traditional cosmologies of the community. There were some challenges, however, in the form resistance from mainstream faiths, the slow pace of adoption by young people, and delays in conducting the rituals due to the changed lifestyles of elders who had the knowledge, but were not performing the rituals (CBD 2012).

Indeed, in most areas, the influence of foreign cultures has started to erode traditional beliefs with the result that this kind of protection has started to be less effective. In **Benin**, there are 2,940 sacred forests covering 18,360 hectares that are outside of official protected areas, and that have been preserved up till now largely because of traditional beliefs. However, this is now no longer the case, and an NGO has had to step in to protect some of these forests in partnership with traditional authorities and the Government, using more modern arguments about ecological services and social justice (CBD 2011).

Box 6. The importance of raising awareness for success of MPAs (Gabrié *et al.* 2010)

In **Senegal** the Narou Heuleuk Project was implemented to protect fishing resource and enhance biodiversity in four sites along the coast. In the end, only one MPA was established at one of these sites. The reasons for failure were given as lack of local community involvement, and lack of political commitment. This highlights the importance of raising awareness among decision-makers about the benefits of biodiversity conservation.

In **Tanzania**, in spite of having agreed to the creation of the Mnazi Bay MPA, local villagers have been reticent to cooperate, partly because of a number of unfulfilled promises but also because of political differences. Over the course of the project, this escalated into outright hostility and rejection of the MPA and its rules. Part of the reason for this was through to be the weak institutional context and management unit, and inadequate technical support for the project.

In **Mozambique**, the creation of the Quirimbas National Park project benefited from a favourable legislative environment, the political will to make the conservation sector a driving force of the economy, support of the local communities who wanted the park in order to conserve their resources and reduce conflicts with migrant fishermen, good technical support for the management unit and well-coordinated partnership between co-funding agencies. However, failure to involve the Ministry of Fisheries in the project led to a many problems that were only resolved after 5 years.

Box 7. Responsible investment

One of the ways of enabling sustainable development is if investors and fund managers could be persuaded to follow the Principles for Responsible Investment (PRI) (Lambooy and Levashova 2011). Responsible investment (RI) is investment that actively takes environmental, social and governance issues into account in investment decisions, with a view to driving the demand for sustainability in corporate decision-making. For example, the Nigerian banking sector has developed a set of Nigerian Sustainable Banking Principles under the stewardship of the Central Bank. All banks are now required to manage and mitigate the environmental and social risks associated with their activities and operations. In South Africa, mandatory disclosure of sustainability information is required for stock exchange listing, in compliance with the King Code on Corporate Governance (UNEP 2011). However, a survey of investors in South Africa showed that while investors appreciate the need for these considerations, knowledge gaps and lack of evidence hampers progress in this regard. Principal officers of pension funds generally concurred that the most important barriers were related to the belief that RI necessarily meant lower financial return. Asset managers and advisors generally suggested that their most important barrier was a lack of demand from customers (institutional and retail). Respondents indicated that more stringent legislation would drive further participation. However, this could be avoided by increasing demand **through investments in public awareness**. It is arguably in the African continent, where acute environmental, social and governance (ESG) pressures exist, that the benefits of responsible investment could have most impact (UNEP 2013).

Developing Plans and Strategies

Box 8. The Pangani River Basin Management Project (Source Cross and Förster 2011; Author).

The Pangani River Basin Management Project (PRBMP) was a project initiated in Tanzania by IUCN in order to generate technical information and develop participatory forums to strengthen Integrated Water Resources Management in the Pangani Basin. The aim of the project was to provide information to the Tanzanian government on the costs and benefits of different water-resource management strategies. This information is intended to guide decisions on a fair balance between water development on the one hand and protection of the river and its ecosystems on the other. The process involved the assessment of the value of water in different uses and the value of services provided by aquatic ecosystems. A tool was developed and applied to analyse the implications of alternative flow allocation scenarios for people living in different parts of the basin as well as the region as a whole. The whole exercise not only raised awareness among river basin managers of the tradeoffs involved in water allocation decisions allowing better decision-making, but also of the importance of monitoring water use in the basin.

Direct protection

Box 9. ICDPs – some successes and failures

In **Rwanda** it has been found that **c**ommunities who earned a high income from diversified agricultural lands were much less dependent on forest resources from the Nyungwe Forest Reserve than communities who earned a low income from agriculture, thus reducing pressure on the biodiversity of the forest. Although agroforestry systems cannot stand alone as conservation areas, they can buffer existing reserves and provide corridors for persistence and movement of species across landscapes. Such systems offer a useful means for combating species loss as a result of tropical forest fragmentation (Masozera and Alavalapati 2004).

The Ankeniheny-Zahamena Corridor (CAZ) is a new protected area that encompasses one of the largest remaining blocks of rainforest in **Madagascar**, within an area that includes multiple zones and land designations. In helping to establish the area, Conservation International (CI) put significant **effort put into developing partnerships**. This has ensured that the protected area now benefits from a broad alliance of diverse stakeholders that share a common vision. There has been emphasis on building the capacity of organizations and developing good, effective governance at a landscape scale. Incentives for conservation were introduced in the form of conservation agreements, grants linked to natural resource stewardship, and nature-based enterprises such as ecotourism. Another factor contributing to the project's success has been CI's sustained presence and investment in the corridor combined with a recognition that long term financial sustainability is a key element to success (Conservation International 2011).

Experience in the Mkuze Wetlands in **South Africa** shows that in spite of the correct rhetoric voiced by the conservation authority about combining conservation and community development there are gaps between this and the reality. For local communities to accept what is offered by parks, this must be regarded as the outcome of fair negotiations. Otherwise outcomes might be regarded as unfair and enforced from above, and therefore rejected outright. The risk increases if past relationships between conservation authorities and local people have been characterised by distrust, as across much of Africa. Investments to **promote transparent and fair negotiations** are thus a priority in any expansion of protected areas in Africa (Dahlberg & Burlando 2009)

In **Mozambique**, communities surveyed in MPA areas all agreed that marine resources were declining and that something needed to be done, but did not support MPAs as an appropriate measure to address the problem. The local communities felt that fishing by outside fishers, industrial and semi-industrial fishing, and poor law enforcement by government authorities were to blame, and that they themselves should not have to be excluded from these areas. They were not interested in proposed generation of alternative income-generating activities. There is a strong view that where parks are planned based primarily on conservation targets and for promotion of tourism, they are unlikely alleviate poverty, and may also have limited success in conserving biodiversity as a result. Park should be established with local communities, rather than being imposed on them (Rosendo *et al.* 2011).

Developing strong and strong and sustainable local institutions are essential to achieving long term success in the establishment of protected areas. This was the conclusion of a review of three protected area projects in **East Africa** (Bwindi Impenetrable National Park and Mgahinga Gorilla National Park Conservation Project, Reducing Biodiversity Loss at Cross-Border Sites in East Africa Project, and the Lewa Wildlife Conservancy Project)**.** Strong institutions provide the necessary continuity and fund-raising capability to consolidate and scale up the project activities after project closure. This is especially important when dealing with integrated conservation and development initiatives, which require many years before achieving significant livelihood benefits let alone global environmental impacts. Since the typical length of a GEF project (3-5 years) is insufficient time to develop sustainable community-based institutions and new conservation-compatible livelihood strategies, continued support is needed to consolidate and develop these (GEF Evaluation Office 2008).

Box 10. Fisheries, forestry and wildlife use

FISHERIES

In many African countries, the **industrial marine fisheries** have been overexploited through profitable relationships with foreign fishing fleets. South Africa is an exception to this, having excluded foreign fleets and having given priority to the management of these valuable resources. Industrial fisheries tend to be subsidised by governments in order to gain international advantage, encourage investment and generate employment. However, subsidisation of industrial fisheries is probably not as big a problem in Africa as it is in other parts of the world. One of the biggest problems in industrial fisheries is lack of information on stocks or reliable estimates of sustainable harvests, which arises because of the high resource requirements involved. Furthermore, because of the large capital investment in fisheries, there is also a political pressure to keep catch quotas relatively constant or above some minimum threshold, which can have negative consequences in years of low stocks.

Inshore coastal fisheries tend to be small-scale fisheries with simple technologies and easy access. These fisheries are of particular importance in terms of biodiversity and contribution to people's livelihoods. However, inshore coastal (and possibly some inshore lacustrine) fisheries are probably the most vulnerable because of the life history strategies of the species involved. Indeed, because of this and the open access nature of most inshore fisheries, these resources have been seriously overexploited throughout Africa. Inshore fisheries are not suitable for management as a social welfare system (i.e. managed for open access), and need to be better managed through property rights and regulation.

Inland river and floodplain fisheries also tend to be small-scale fisheries with simple technologies and easy access. Although heavily exploited, these are probably the most resilient of all the fisheries because of the fact that many of the targeted species are inherently adapted to extremely variable conditions. These fisheries are more suitable for management as a social welfare system, but measures need to be put in place to provide spatial or temporal refugia from fishing.

Africa's **lake fisheries** include industrial and small-scale fisheries on natural and man-made lakes. The fisheries of the larger lake systems have characteristics in common with inshore and pelagic marine fisheries. These fisheries have experienced problems from invasive alien plants and fish as well as from overfishing. The fisheries in the natural lake systems have been poorly managed and have had a very significant impact on biodiversity.

The highest priorities for intervention are probably the inshore coastal fisheries and certain industrial fisheries. Improved sustainability of fisheries in Africa will require:

- Expanding systems of no-take protected areas;
- Putting substantial effort into monitoring of fish stocks, determining sustainable yields developing management strategies that can cope with the underlying variability in fish stocks;
- Using buyouts to reduce effort in industrial fisheries;
- Limiting access and establishing LMMEs in coastal areas;
- Increasing regulation and enforcement; and
- Introducing certification systems.

FORESTRY

Forestry in Africa mainly comprises the commercial large- and small-scale exploitation of indigenous hardwoods, and the small-scale exploitation of indigenous trees for fuel and construction. As is the case with fisheries, these different activities require quite different interventions and management strategies. Plantation of exotic tree species for timber and pulp occurs on a much smaller scale.

Commercial timber harvesting generates important foreign income, but includes a large amount of exploitation by foreign companies, resulting in significant economic leakages. However, it also includes small-scale commercial producers. The commercial exploitation of forests in Africa is not well regulated and has been a disaster for biodiversity In certain areas where logging has opened up access to previously remote areas (Bennett *et al.* 2002). These problems are particularly severe in the tropical forest regions, but also extend to the dense woodland areas as far south as Zimbabwe and Mozambique. This area is one of the highest priorities for intervention.

The other main forestry activity is the **small-scale exploitation** of trees for fuel, most notably for charcoal production, as well for poles and timber for construction and crafts. This use is mostly for subsistence purposes and local markets, although there is

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considerable international trade in carvings (much of this informal). Unsustainable harvesting practices are rife through all the savanna woodland regions of Africa, and also coastal mangrove areas. While fuelwood harvesting is ubiquitous in rural areas and makes a significant impact, charcoal production is also fuelled by urban demands, and has much greater impacts. Most of this is by small scale producers who do not need major access routes to move their produce. Dealing with this problem is a major challenge and has received a lot of attention, particularly because of the impacts of deforestation on ecosystem services.

The main types of interventions required include:

- No-take protected areas;
- Better standards and regulation, monitoring and enforcement,
- Certification;
- Increasing processing efficiency;
- Addressing property rights and management capacity to achieve more sustainable use of forest resources through community forest management (CFM); and
- Introducing income-generating activities that require well-managed forests;
- Addressing urban and rural demands for fuel.

WILDLIFE

Sustainable use of wildlife is not explicitly mentioned in the Aichi Targets but is integral to several of the targets. Wildlife resources have been badly depleted outside of protected area systems, especially in communal land areas. However, they are relatively easy to reintroduce where this has not involved excessive habitat destruction, which contributes to the success of simple interventions. Apart from the strict protection required for addressing the illegal trade in high value wildlife parts (ivory, rhino horn, lion bones etc.) and live animals, the main type of interventions used to encourage sustainable use of wildlife are:

- Devolving property rights over wildlife to local communities and landowners;
- Enabling the development of tourism ventures that make wildlife conservation profitable on communal lands; and
- Encouraging the conversion to game farming on private lands

Box 11. Locally managed marine areas (LMMAs)

Studies from outside Africa suggest that locally-managed areas can be more effective than state-imposed MPAs. McClanahan *et al.* (2006) explored biological and socio-economic measures at four national parks, four co-managed reserves, and three traditionally managed areas in Indonesia and Papua New Guinea. Average size and biomass of fishes were higher than unmanaged areas in all areas under traditional management and at one co-managed reserve, but there was no difference for the other co-managed areas or any of the national parks. Traditional systems were designed to meet utilitarian community goals rather than fulfil the western concepts of conservation. The effective sites were able to exclude “outsiders” at a relatively low cost because of placement of the managed areas were near the village. Management effectiveness was positively related to compliance, visibility of the reserve, and length of time the management had been in place but negatively related to market integration, wealth, and village population size.

Village-owned marine protected areas have emerged on their own in parts of the world such as south-east Asia, but have seldom been established spontaneously in Africa, where inshore marine resources are largely subject to open access. Indeed, areas under traditional management in southern **Kenya** have been found to be lower in biological diversity and coral cover compared to other fished or fully-protected marine park or reserve sites established by the national government (McClanahan *et al.* 1997). There is a successful example in **Zanzibar**, however (Lange and Jiddawi 2009), and this may be a useful model that could be scaled up to other villages and to a larger scale LMMA. Many of the traditional forms of management are potentially compatible with national policies, but confusion and conflict occur concerning enforcement and its benefits. Discussions are required between traditional and national fisheries leaders to develop mutually-acceptable policies that augment and share the power of management (McClanahan *et al.* 1997).

On the southwest coast of **Madagascar**, recognising the need to combat a persistent decline in fisheries catch, the community formed the approximately 1000km^2 Velondriake LMMA. Temporary closures of octopus fishing areas resulted in increased catches and income, and as a result this management technique has become common along the coast north of Toliara, South West Madagascar. The LMMA has also led to extensive environmental educational campaigns, scientific research, and community-based monitoring. A local Malagasy law governing resource use, called a *dina*, is now in effect in the LMMA, which is a remarkable achievement considering the long-held, deep community tradition of open access. The success of the intervention is attributed to strong relationships between fishers, fisheries collectors, and the NGO, as well as its having followed a gradual process of beginning with demonstrable biological effects (Oleson 2011).

Box 12. Performance bonds, banking and offset systems

Performance bonds are essential down payments made by developers to cover possible damage costs or to undertake rehabilitation at the end of a project.

Biodiversity offsets are conservation actions taken by developers to compensate for residual, unavoidable harm to biodiversity caused by development projects. However, there are risks involved in offsetting, including that the offset doesn't deliver the intended benefits, it may cause disputes around the process of placing value on biodiversity, and it can cause disagreements around conservation priorities (Kuntonen-van't Riet 2007). An example of a mining **biodiversity offset** project comes from South Africa, where a coal-mine committed to rehabilitate degraded wetland areas offsite to compensate for the unavoidable impacts on biodiversity onsite. This was a new offset design in South Africa and challenges included the bureaucracy of government processes; worries about the long term sustainability of the offsite rehabilitated land because it was not owned by the mine; inability to find "like" wetlands, and so rehabilitated wetlands were not identical to what was lost; and rehabilitation costs exceeding original estimates, partly because long term maintenance and monitoring costs were not originally considered (Kuntonen-van't Riet 2007).

Wetland banking, is a system where developers purchase enough wetland credits to offset their impacts, and these credit purchases are deposited with a regional wetland bank that uses the funds to restore wetlands in other areas that provide ecosystem services as least as great as those developed (Talberth and Gray 2012). The costs include: (a) the price of wetland credits paid by private entities seeking wetland development permits, and (b) the costs public agencies incur in managing the permitting process and otherwise providing oversight for the banking programs (Talberth and Gray 2012). Globally, credit prices range from $22,356 to $404,000, with an average of $33,721 per hectare (Madsen *et al.* 2010). This is equivalent to about **$3000 to $30,000** per hectare per year (Talberth and Gray 2012). In addition, costs of managing wetland banking programs amount to about **$150 to $1,500** per hectare per year (Talberth and Gray 2012).

Costs of the actions required

Table 2. Some examples of awareness campaigns in Africa, and their costs. Source: Conway 2012, ABCG 2004, Crump *et al.* 2000

Name	Description	Cost (US$)
Cross River Gorilla Conservation in Nigeria and Cameroon: *"My Gorilla – My Community"*	The campaign targeted behaviour change to promote habitat conservation for the last remaining 250 Cross River gorillas that reside in Nigeria and Cameroon. The project involved engagement with local communities in dialogue and activities that promote the conservation of habitat and cessation of harmful activities. An Entertainment-Education drama (Linda's Joint) was also prepared for broadcast.	100,000 per year
Coastal Management in Ghana	Campaign involved developing a 52 episode radio soap opera (Biribireba), reaching up to 2.5 million people each week in six coastal districts of the Western Region of Ghana	150,000 per year
Sustainable Forestry in West Africa	Programme spread over 4 countries and 3 transboundary hotspots. Campaign included a 52-episode radio drama in 5 languages.	500,000 per year
Sustainable Forestry & Ape Conservation in Gabon: *"The Sustainable and Thriving Environments for West Africa Regional Development (STEWARD)"*	Campaign sought to turn Gaguie the Gorilla, the official mascot of the African Cup of Nations football tournament, into an ambassador for conservation through editorials in newspapers; distribution of over t-shirts, hats and stickers with conservation messages to fans; ten conservation-themed discussions on Gabon's primetime morning TV show; and arranging for Gaguie and his dance troupe to parade a banner stating "We all win when we protect nature" around the stadium before the final game of the tournament	100,000 per year

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Name	Description	Cost (US$)
Chimpanzee Conservation in Rwanda & Burundi: *"My Chimpanzee – My Community"*	Promoting the conservation of chimpanzees and their habitat in the Nyungwe-Kibira landscape in Rwanda and Burundi through the launch of a training workshop for program partners in March 2012 with broadcast set for January 2013	100,000 per year
Chimpanzee Conservation in Liberia & Sierra Leone: *"My Western Chimpanzee – My Community"*	Promoting the conservation of Western chimpanzees and their habitat in the Upper Guinea Forest Ecosystem in post- war Sierra Leone and Liberia	100,000 per year
Produce media materials	Produce 5000 posters and 3000 publications for Africa Biodiversity Collaborative Group (ABCG)	20,000
Hives of Hope event, South Africa	Developing two versions of Zulu beehive shaped huts, constructed of indigenous plants, to be created for COP 17. The Hive would be 10 metres high and designed as a place of rest and reflection, and to illustrate the intrinsic values of biodiversity.	240,000
"Yebo Gogga"	A week long arthropod exhibition that takes place annually at the Johannesburg Zoo. The show is based on demonstrator engagement and participatory experiments. The exhibition is aimed specifically at educating children and promoting interest in arthropods. The success of the exhibition has been demonstrated by increasing visitor numbers and visitor evaluation responses, as well as the level of media attention attracted.	16,500
"Every River Has its People" (ERP)–Okavango,	This SIDA-funded project has served to raise awareness of the management issues of the Okavango River basin among local communities in Angola, Botswana and Nambia as well as building capacity and sharing information.	2 million over 3 years for Phase 2

Box 13. Cost of establishing protected areas in Madagascar

With donor funding, the Malagasy government has invested $75 million in the formation of a protected area network over a ten year period, resulting in a total of 41 protected areas covering approximately 1.5 million hectares. This investment protects approximately 3% of the country from deforestation. The protected areas are attracting increasing numbers of visitors and are making a significant contribution to tourism development in Madagascar (Carret and Loyer 2003).

Box 14. Conservation agreements with private landowners in South Africa

In South Africa, state protected areas have been augmented by management agreements with private landowners. In the Western Cape, areas of the globally important Cape Floral Kingdom (CFK) biome are protected by means of contractual agreements with farmers. The CAPE project embarked on a long term programme to achieve this, at an estimated cost of US$80 million (Stoll-Kleemann and O'Riordan 2002). Within this area, a conservation corridor now covers 37% of the biodiversity-rich Agulhas Plain and approximately 40% of the area of this corridor is conserved through private landowners, mostly in the form of stewardship agreements and conservation easements (Cadman *et al.* 2010).

Box 15. Costs of effective management of terrestrial protected areas

Conservation in **island hotspots** and **South African fynbos** costs $2500–12,500 per km² per year, compared with $500 per km² required for the Guinean forests of West Africa and for Madagascar (Moore *et al.* 2004).

In the **Niger Delta – Congo Basin** Forest Region mentioned above, estimates have also been made for the costs of effective management of the existing protected area system of about 135,000 km² plus the additional 76,000 km² to be acquired. This would require an estimated $87 million a year for management (about $4/ha) (Blom 2004).

The Lewa Wildlife Conservancy (LWC) occupies 62,000 acres of land in **Kenya**. The GEF awarded LWC a grant of US$0.75 million for the period 2000 to 2003, with co-financing amounting US$3.193 million. The three outcomes - long-term capacity of Lewa to provide global and local benefits from wildlife conservation strengthened, protection and management of endangered wildlife species in the wider ecosystem strengthened, and community-based conservation and natural resource initiatives strengthened – were all considered well to fully achieved (CDC 2007).

Blom (2004) estimated the costs of establishing an effective protected area system of 76,000 km² in the Niger Delta – Congo Basin Forest Region (**Nigeria, Cameroon, Equatorial Guinea, Gabon, Central African Republic, Congo and the Democratic Republic of Congo**) to be in the order of $1 billion over ten years ($132 per ha), much of this for improved management of existing protected areas.

Box 16. Examples of restoration projects and costs

Range land restoration in South Africa. Ostrich production in the semiarid Little Karoo region of South Africa has had major impacts on rangelands in spite of specific legislation controlling stocking rates in order to avoid degradation. Herling *et al.* (2009) explored the restoration costs associated with shifting production focus from ostrich production to sheep production, a relatively conservation-compatible land use. Rehabilitation was not found to be financially feasible for private landholders because of the high costs of producing viable seedlings.

Forest restoration in east Africa. The Shinyanga region in central Tanzania had become severely degraded, with particularly negative impacts on forest resources. In 1986 the government started the HASHI project, which was instrumental in reviving the local people's traditional practices of conservation (called Ngitili), to create and restore forests in the region. By 2002 between 300,000 and 500,000 ha of Ngitili were restored. The economic value of a restored Ngitili is $14 per person per month, while national average rural consumption is $8.50 per person per month. The time needed to collect fuelwood, pole, thatch, water and fodder was reduced by several hours. Sukuma agropastoralists also pointed out that trees and catchment conservation improved water quality in the region, that restored woodlands provide fodder for oxen at the end of dry season - a critical time of the year. The HASHI program recognized the importance of the traditional practices of managing forests with enclosures, the Ngitili, and used the traditional knowledge of the Sukuma people as the basis for the restoration. This empowering approach was critical as it increased local people's ownership over, and capacity to manage their own natural resources. In order to protect and restore those goods and services, participatory planning including women's groups, youth, village government, and individual farmers, was essential in order to try to ensure equitable forest management and avoid elite capture. However, as the value of Ngitilis has risen, the powerful and rich have been trying to consolidate their own rights and benefits at the expense of the less powerful. The Ngitili case is an important example of trends which will become more common as REDD carbon schemes and other kinds of PES schemes come into existence: if resources acquire greater value, there will be greater competition for ownership of them. The response must be improved tenure and improved legal recourse for the poor, or we shall see much injustice and impoverishment as a result of these schemes (Barrow and Shah 2011).

Wetlands restoration in Cameroon. In Cameroon, the Waza Logone floodplain supports the livelihoods of some of the poorest people in the region but the ecosystem has become increasingly degraded due to adverse impacts of an upstream dam. Cost-benefit analyses shown that large-scale ecosystem restoration would have multiple long-term economic, social, and conservation benefits, but funding has been a challenge due to the tendency for donors to focus on forest-related projects in the country (Pauli *et al.* 2010). Flood release measures would cost between € 3–12 million to implement over a period of 5 years, and would thereafter generate incremental benefits of between € 1.4–2.7 million a year or € 3,050 per km² of land re-flooded.

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All of the re-inundation options identified had positive net present values over a 25 year period, of between € 6-8.4 million. The livelihoods of up to a third of the rural floodplain population, or 8,000 households, would be improved after re-inundation. On a per capita basis, this translated into up to € 53 added economic value per floodplain-dependent member of the population (Emerton 1948). Undertaking engineering works to reinstate the flooding regime could restore up to 90 % of the floodplain area, at a capital cost of approximately $11 million. The socio-economic effects of flood loss have been significant, entailing livelihood costs of almost $50 million over the years since the scheme was constructed. Local households have suffered direct economic losses of more than $2 million a year through reduction in dry season grazing, fishing, natural resource harvesting and surface water supplies. The economic value of floodplain restoration and return on investment will be significant. Adding just under $2.5 million a year to the regional economy—or $3,000 per square kilometre of flooded area—the benefits of reinundation will have equalled initial investment costs in less than five years. Investment in flood restoration measures shows an economic net present value of $7.76 million and a benefit-cost ratio of 6.5:1 (Emerton 1948).

Estuary restoration in South Africa. The St Lucia system is the largest and most important estuarine system in South Africa. and became the first World Heritage Site in South Africa in 2000. In spite of this, the system faces serious problems as a result of anthropogentic changes that have reduced the supply of freshwater and increased sediments loads flowing into the system. Of these, the artificial separation of the uMfolozi river from the St Lucia system in 1952 has arguably had the greatest impact on the diversity and abundance of the system's biota. Concerns about the deteriorating ecological status of the St Lucia and uMfolozi systems prompted the iSimangaliso Wetland Park Authority (iSimangaliso WPA), the statutory body responsible for the park and protection of its world heritage values, to make an application to the Global Environment Facility (GEF) for the necessary funds to investigate and evaluate potential solutions to the problems facing Lake St Lucia. This application was successful and iSimangaliso WPA was awarded a US$9 million grant to design and implement the most feasible option for improving the ecological functioning of the St Lucia estuarine system, among other development activities (Anchor Environmental Consultants 2013).

Watershed restoration. A study by Blignaut and Mander (2010), looking at five past watershed restoration and reforestation projects in South Africa, estimates that conservation in these areas has provided a monetary annual return equivalent to R116 to R220 per hectare per year over periods of about 30 years compared to equivalent estimated costs of watershed restoration totaling between R21 to R88 per hectare per year. These positive returns have been calculated by assigning assumed values to the ecological services provided by conserved watersheds, mainly the ability to regulate the local hydrological cycle, increase the base flow of rivers, reduce levels of soil erosion, sequester carbon, and prevent the loss of rainfall through non-productive run-off.

Eradication of alien invasive species for conservation of threatened species. In the Seychelles, costs were estimated with the aim of **restoring different islands** to a state where globally threatened birds could be safely translocated **(synergy with Target 12)**, which would open the way for natural colonisation of other native biodiversity. A number of elements were costed, but the activities most likely to be applicable elsewhere were restoration planning and habitat conversion. Restoration planning was estimated to cost US$73 to 372/ha, with an average of US$155/ha across all islands. The habitat conversion process is basically vegetation management with the longer-term objective of restoring a biotic community of existing species, density and composition, to one more suitable for supporting globally threatened birds. For habitat conversion, a clear priority is to select native woodland habitat because of the low treatment cost, ranging from about US$100 to just over 500 per ha. On the other hand, where islands have a dominance of habitat stocked mainly with coconut and other exotic species, the conversion costs will be extremely high, in the order of US$7,500–8,400 per ha (Henri *et al.* 2004).

Reintroduction of elephants in Central Africa. An investment operation for biodiversity conservation through savannah elephant protection in Central Africa is estimated at US$6 million. On the ground, the programme will focus its activities on the last savannah elephant populations found in Northern Cameroon and Southern Chad. Programme interventions will cover the Sena, Chari-Baguirmi and the Mayo Kebbi national parks in Chad, and Northern Cameroon. The key programme beneficiaries will be: (i) the wildlife conservation services of the Cameroon - Chad trans-border complex, whose response capabilities in the field will be strengthened, and trained personnel; (ii) national actors and all conservation stakeholders at the local level who will be sensitized in view of their involvement in fighting trans-border poaching in the programme area (population, opinion and traditional leaders, local and national elected officials, community radio network, civil society, etc.); (iii) central level wildlife conservation services in CAR and other services in charge of fighting wildlife crime; and (iv) Governments and ECCAS whose structures will be strengthened (African Development Fund 2013).

Box 17. Establishing a trust fund for financing protected areas

In **Uganda**, the Bwindi Impenetrable National Park (BINP) and Mgahinga Gorilla National Park (MGNP) cover 321km^2 and 33.7km^2 respectively, representing highly biodiverse afro-montane forest ecosystems in one of the most densely populated parts of Africa. A GEF/World Bank project was started in 1995 to establish a **trust fund** as a mechanism to support long-term biodiversity conservation in the parks, through provision of support to community development activities, research and monitoring, and park management activities. The GEF initially endowed the fund with US$4.3 million, after which USAID provided US$890,000 between 1995 and 1997, and Government of the Netherlands provided financing of US$2.86 million between 1997 and February 2003. At the end of the project the trust had therefore been successfully established and was operating effectively in working towards it conservation goals, however, the ability of the Trust to have long-term impacts on conservation in the ecosystem was undermined by the limited progress on developing the Trust's asset and fund-raising base (Conservation Development Centre 2007*b*).

Current Spending on Conservation

Table 7. Percentage area in protected areas, GDP and total average annual spending on conservation by African countries. Source: Waldron *et al.* 2013.

Country	% pa	GDP $bn	Total average annual spending US$mill	% GDP
Algeria	6.24	102.3	4.22	0.004%
Angola	12.06	32.8	0.061	0.000%
Benin	23.27	4.3	7.098	0.165%
Botswana	30.93	10.3	16.598	0.161%
Burkina Faso	13.85	5.2	5.989	0.115%
Burundi	4.85	0.8	2.127	0.266%
Cameroon	9.0	16.9	13.98	0.083%
Cape Verde	0.16	1.0	1.056	0.106%
Central African Republic	17.74	1.4	6.316	0.451%
Chad	9.39	5.5	3.687	0.067%
Congo	9.6	5.1	0.761	0.015%
Djibouti	0.05	0.7	0.002	0.000%
DRC	9.99	7.1	7.981	0.112%
Egypt	4.38	89.4	9.083	0.010%
Equatorial Guinea	14.02	3.2	0.081	0.003%
Eritrea	3.69	1.0	0.209	0.021%
Ethiopia	17.71	11.2	6.639	0.059%
Gabon	5.33	8.1	5.285	0.065%
Gambia, The	1.27	0.5	0.062	0.012%
Ghana	13.96	10.7	11.485	0.107%
Guinea	6.42	3.3	4.069	0.123%
Guinea-Bissau	26.93	0.3	2.273	0.758%

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Country	% pa	GDP $bn	Total average annual spending US$mill	% GDP
Ivory Coast	21.82	16.3	5.05	0.031%
Kenya	11.73	18.7	39.036	0.209%
Lesotho	0.49	1.5	1.95	0.130%
Liberia	1.44	0.8778	0.686	0.078%
Libya	0.11	38.8	0.027	0.000%
Madagascar	2.54	5.0	22.466	0.449%
Malawi	15.02	2.1	5.52	0.263%
Mali	2.34	5.3	3.367	0.064%
Mauritania	1.13	1.9	1.531	0.081%
Moldova	1.35	2.9	0.406	0.014%
Morocco	1.53	51.6	4.333	0.008%
Mozambique	13.76	6.6	13.287	0.201%
Namibia	13.92	6.1	31.367	0.514%
Niger	7.07	3.4	6.767	0.199%
Nigeria	12.59	99.0	19.12	0.019%
Rwanda	9.89	763.7	11.486	0.002%
Sao Tome and Principe	0.0	0.9	0.0	0.000%
Senegal	23.1	309.8	7.813	0.003%
Sierra Leone	4.3	0.7	0.684	0.098%
Somalia	0.53	0.3	0.0	0.000%
South Africa	6.7	277.2	111.036	0.040%
Sudan	4.18	0.4	3.014	0.754%
Swaziland	3.02	1.3	0.947	0.073%
Tanzania	26.36	12.1	30.641	0.253%
Togo	11.04	2.2	0.558	0.025%
Tunisia	1.27	28.7	9.295	0.032%
Uganda	8.51	8.7	24.477	0.281%
Western Sahara	6.49	-999	0.0	0.000%
Zambia	36.04	7.3	17.146	0.235%
Zimbabwe	7.01	2.00E+06	No data	No data

Synergies with Other Development Agendas

Table 8. Synergies between the Aichi Targets and the Millennium Development Goals

MDG	Synergies with Aichi Targets
1. To eradicate **extreme poverty and hunger**	The Aichi Targets reduce the rate of loss of biodiversity and resources, upon which many people depend for their livelihoods. These losses would be counter to achieving MDG 1. In addition, restoration efforts and some of the measures taken to bring about sustainable production (both industrial and agricultural), will create opportunities for the poor. An excellent example of this is the WfW programme.
2. To achieve **universal primary education**	In the long run, this will help to maintain the achievements under the Aichi Targets in a number of ways, and is fundamentally critical.
3. To promote **gender equality** and empowering women	The development activities such as agricultural intensification and community forest management will provide many opportunities for the empowerment of women.
4. To reduce **child mortality** rates	Indirectly, households that can meet their needs and healthier environments will contribute to reducing child mortality.
5. To improve **maternal health**	As above.
6. To combat **HIV/AIDS, malaria,** and other diseases	Maintaining ecosystem services help to address water quantity and quality, which will help provide rural and urban populations with access to clean water.
7. To ensure environmental **sustainability**	This MDG goal has direct overlap with the Aichi Targets, especially targets 4, 6 and 7, which aim to plan towards sustainable development in general, and achieve sustainable practices in the land- and resource-based sectors. The MDG goal was to achieve the latter by 2010. This was not achieved, but the Aichi Target continues to work on this. MDG7 also aims to halve the population without access to safe water and sanitation (mentioned above).

Relative Cost-Effectiveness of Different Investments

Table 9. Expected levels of cost-effectiveness of different types of investments required to meet the Aichi Targets

Types of investments	Expected level of B:C	Evidence or rationale
National assessments and accounting of biodiversity values	Very high	South Africa put more resources into coastal management after a simple assessment of coastal value. Also in South Africa, the Durban municipality started to invest more in natural capital after a very broad-brush valuation of its ecosystems using benefit transfer methods (Boon 2010). In Namibia, a relatively simple assessment of the value of investing in the protected area system led to a capital injection of $100 million (Turpie *et al.* 2012).

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Types of investments	Expected level of B:C	Evidence or rationale
Research on biodiversity and socio-ecological systems and their response to policy measures	High	Research is important for guiding priorities and strategy. For example, research has suggested that incentive programmes in rangeland areas may be a wasted investment compared to strict protection of lions (Packer *et al.* 2013).
Research traditional knowledge	Low	Evidence is lacking. However obtaining traditional knowledge can be difficult, the knowledge will pertain to a small number of species, when the knowledge is required, researchers will go for it. Ie the research would have better payoffs if demand-driven
Raise awareness among policy makers and public	Very high	This is similar to the first example, but broader, and includes raising awareness on the need for specific strategies, and to change preferences. In **Tanzania**, efforts to mainstream environment through effective communication helped bring about an increase of 800% in the budget for the Division of Environment. This was done by gathering evidence on the links between poverty and the environment, then using the media through TV, print and radio, and by targeting events where there was ministerial involvement. In **Rwanda**, the result of a similar effort has been an increased awareness across government sectors, as well as highlighting the underfunding of the environment in the government budget, which led to an increase in budget for the environment by 40% in 2007/08 (UNEP PEI 2008). In **Burkina Faso**, a valuation study of the Sourou Valley wetlands has been used to make an economic case improve their conservation, by showing that they were worth more than the region's agricultural outputs. The study also raised awareness of the usefulness of economic valuation tools in development planning (Somda and Nianogo 2010). In **Malawi**, a study on the value of sustainable resource use (Yaron et aol 2011) had an important impact on policy makers. The report was powerful in that it was written in a way that civil servants could relate to. The report contributed to the inclusion of natural resource management as one of the nine priority areas in the new Malawi Growth and Development Strategy II for 2011 – 2016) and an allocation of approximately US$ 50 million to environmental programmes over the next 5 years (UNDP-UNEP 2013).
Education campaigns	Low	A study in Madagascar showed that including environmental programs in the school curriculum had a large impact on environmental awareness among children. In rural Africa access to media is often limited, so school plays an important role. Environmental education appeared to be most efficient when it offered hands-on experience, such as tree planting, together with classroom theory (Korhonen and Lappalainen 2004). The implications are that, despite the lack of definite link between awareness and action, investment in school level environmental education is a crucial investment, particularly at a time when the audience is guaranteed. While crucial for their long term success, this will not have direct bearing on achieving Aichi Targets by 2020.
Capacity building	Medium	Building capacity is essential, but efforts can be ineffective, especially where this is taking place from a weak base. To be more effective, this needs to take the form of major training initiatives and mentorship programmes, rather than workshops, for example.
Extension services for agri-, aqua- and silviculture	High	Support programmes for CBNRM have succeeded in Namibia thanks to ongoing support, whereas have not been very successful in Botswana where there has been less support. The same logic would apply to introducing any new way of doing things.

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Types of investments	Expected level of B:C	Evidence or rationale
Integrate biodiversity into development planning	Medium	Important in theory, but efficiency is untested. In Tanzania, extensive efforts to do this in the water sector have not yet resulted in significant action. In Egypt a US$80,000 study of the values of ecosystem services and trade-offs associated with a transfer of water from the Nile river to the agricultural West Delta desert area provided strong arguments for decision makers to significantly reduce the scale of the project in an early stage of the planning process (Slootweg 2010).
Removal of harmful subsidies	Very high	The response to subsidies is often widespread, so the scale of the action can be large relative to the investment required to revise the legislation.
Provision for implementing the Nagoya Protocol	Low	While this meets social objectives, the impact on biodiversity may be small. Nevertheless, the investment is small.
Strengthen protected area systems (expansion and management)	High	Relatively high costs, but potentially high returns.
ICDPs	Low	Integrated conservation and development projects (ICDPs) have had limited success in addressing the often conflicting objectives of conservation and development. A study in Cameroon showed that contributing to poverty alleviation while maintain current animal population sizes will be extremely difficult and require long-term external financial support for anti-poaching, and that additional investment is needed in improving local environmental governance and controlling corruption (Sandker *et al.* 2012*b*).
Restoration (not including IAS removal)	Low	This is generally very costly compared with returns. Examples are St Lucia, restoration of wetlands, restoration of veld, restoration of thicket, restoration of forests. Can be worthwhile in conjunction with development objectives (employment). There is evidence that successful establishment of indigenous vegetation can suppress alien recruitment (Pretorius *et al.* 2008), and in cases where the costs of restoration are lower than the costs of follow-up IAS management then restoration is a cost-effective investment (Synergy with Target 14).
IAS control	High	Eradication of IAS from islands has proven an effective conservation tool, resulting in remarkable recoveries of endangered species and threatened island ecosystems. Over 1,100 successful IAV eradications have been implemented on islands worldwide (Turpie *et al.* 2012). For mainland infestations, control will only be achieved if enough resources are devoted to the problem (van Wilgen *et al.* 2012), and will be more cost-effective if treated early (Marais *et al.* 2008).
Ex-situ conservation	Low	This is always the last resort. There are already several effective institutions dealing with this.
Border protection	Medium	Current investments are badly ineffective. A very large investment needs to be made for this to be effective, but given what is at stake, this could yield good returns. In South Africa, the capture and sale of consignments of poached abalone destined for Asian markets

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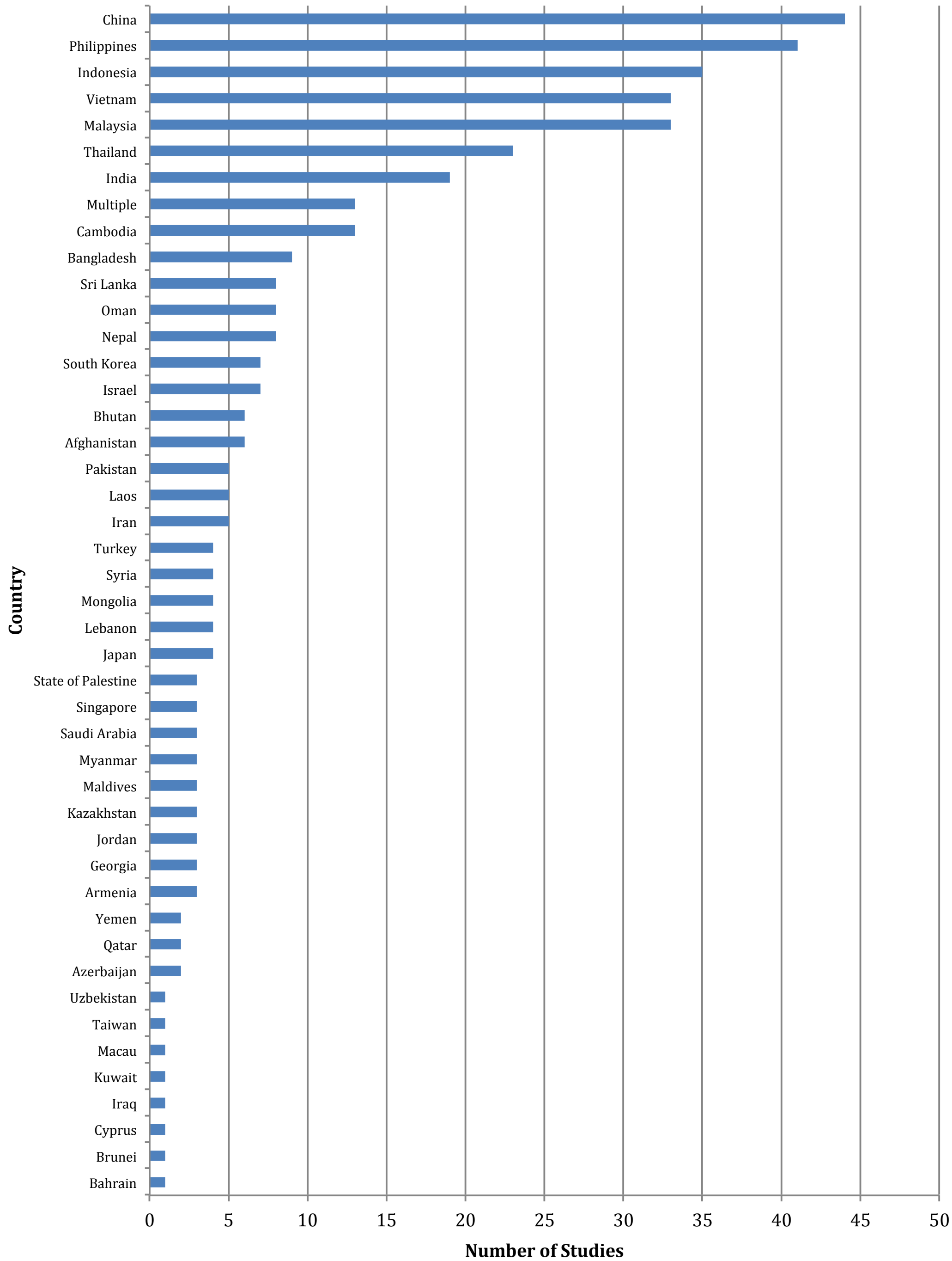
Types of investments	Expected level of B:C	Evidence or rationale
Sustainable harvesting of fisheries, forestry and wildlife	Medium	This is difficult to achieve especially in areas where poverty is high and institutions are weak, and requires considerable investment in stock assessment, property rights, management and enforcement systems. Efforts will need to be focussed where unsustainable harvesting activities pose the most threat. These actions include community-based management projects that focus on property rights. Privatization of control over use of wildlife has perhaps had more success in promoting biodiversity in the southern African region than any other policy measure (Muir-Leresche & Nelson 2000).
Sustainable agriculture, aquaculture and silviculture	High	Investments in methods and technologies are likely to meet development goals, but impact on biodiversity still debateable and likely to be successful in specific circumstances. Nevertheless, widespread nature of problem means successful interventions could have huge pay-offs. In Africa the focus should be on agriculture.
Clean up and reduce pollution	Low	These problems are localised, and cleaning up some of the main threats, like acid-mine drainage is prohibitively costly. Investment should be primarily in prevention.
Integrated management of areas and resources	Medium	Like integrated planning, this is very important in theory but remains largely untested.
Sustainable financing of protected area systems	High	This is a relatively small investment that can potentially yield high returns. In Namibia, revenues from animal sales and fines are being put in a trust fund that will fund certain park activities; In Zambia, park management has been outsourced to the private sector and this is proving very cost-effective.
Payments for ecosystem services and REDD+	Low	Up to now, numerous projects have been initiated in Africa. PES has been seen as a major opportunity for achieving conservation goals. For example, in an analysis of a conservation intervention in southeastern Madagascar indicated that, Ferraro *et al.* (2005) suggested that were the nearly $4 million of available conservation funds invested in annual payments conditional on the protection of forest, about 80% of the original forest could have been protected into perpetuity, whereas only 12-22% could have been protected through support of indirect incentives such as subsidizing capital acquisition in eco-friendly commercial activities. However, a more recent analysis of PES projects in Africa by Ferraro *et al.* suggests that few of these initiatives had ever got off the ground and none had yet achieved their goals.

Investment in Preparatory Actions

Box 18. Impacts of plastic bag legislation in southern Africa

The implementation of similar **plastic bag legislation** in South Africa and Botswana has had mixed results (Dikgang and Visser 2012). Until 2003 most retailers in the country supplied free thin disposable bags at checkouts. Widespread pollution was the inevitable consequence. To combat the problem, two key regulations were introduced in 2007: that shoppers should pay for packets, and increasing the minimum allowable thickness of the plastic used. These interventions aimed at curbing consumption and encouraging reuse by providing more durable bags. However, these policies had mixed impacts. In South Africa, consumption of these bags dropped initially but then recovered to original levels within four years, but now more plastic is entering the system because of the heavier gauge! This did not happen in Botswana, possibly because better pricing. This illustrates how well-intentioned policies can occasionally have unanticipated negative consequences, and that a total ban on plastic shopping bags is required.

APPENDIX 2. ASIA



Number of studies by country

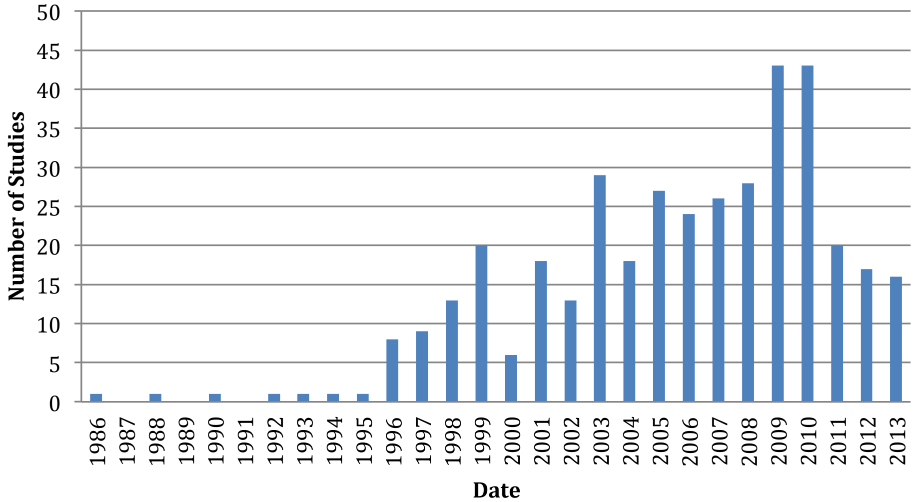


Figure 1: Number of studies by publication year

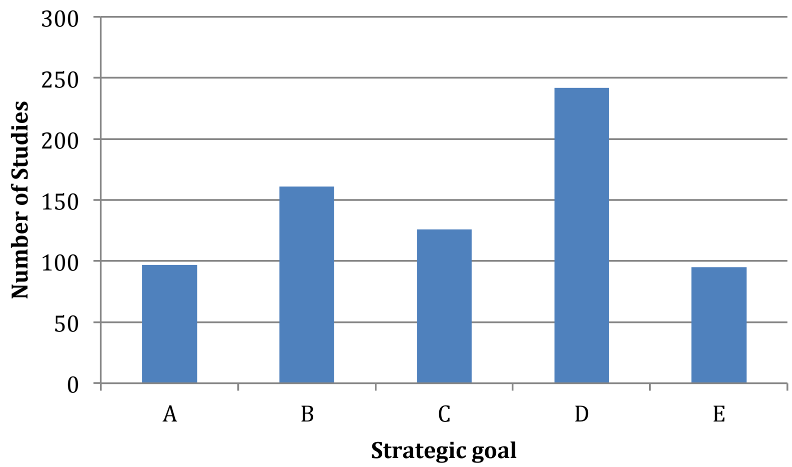


Figure 2: Number of studies that address each Strategic Goal

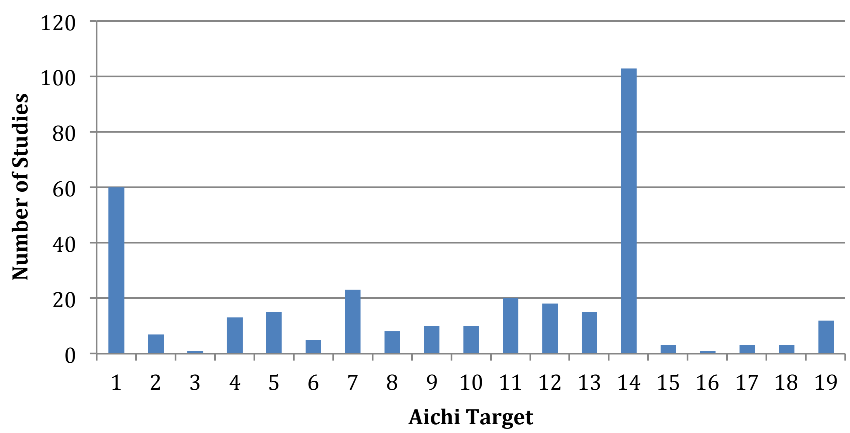


Figure 3: Number of studies that address each Aichi Target

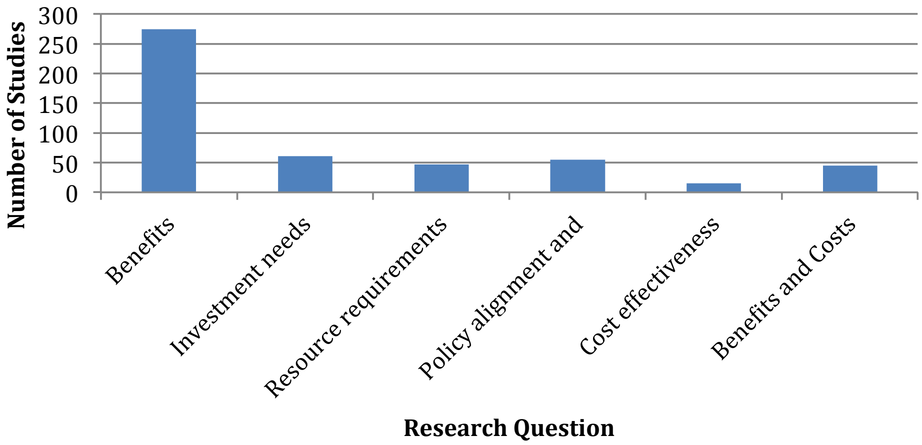


Figure 4: Number of studies that address each Research Question

Case study: Economic value of cedar forest relics in Lebanon

This case study provides information on the willingness to pay for forest restoration and conservation, with relevance to Aichi Target 1, 5 and 7.

The cedar forests in Lebanon have provided quality timber since ancient times. The high value of timber has led to the virtual extinction of cedar trees in the Mount Lebanon chain, and with it the loss of habitat for numerous (endemic) species. A national conservation project was started in the 1990's, but was never intended as a long-term source of funding.

Sattout *et al.* have assessed the willingness to pay for cedar conservation of both village and city residents, users and non-users. The mean willingness to pay was 42 US$ per year, but forest users put a higher-than-average value on the forest relics. Out of all respondents 60% indicated that recreational values were important and 40% used the forests to gather timber. Fully 80% of the respondents indicated that the cedars have existence and/or bequest value.

Source: Sattout *et al.* (2007)

Case study: Recreational value of an oasis in Oman

This case study provides information on improving farming incomes in Oman, with relevance to Aichi Targets 2, 7 and 14.

Oases provide lush environments suitable for agriculture and tourism in an otherwise arid region. The touristic attraction of oases depends on sustainable agriculture as farmers maintain the greenery as well as the (traditional) water systems. Farming incomes are dropping and consequently farms are being abandoned. This development combined with an overall increase in water scarcity poses a risk to the future of oases.

Zekri *et al.* (2011) have estimated the recreational value of the oasis at Misfat Al-Abryeen in Oman to be at least 366,500 US dollars per year. The local population, however, does not capture this value even though it would likely dwindle without their efforts. By levying a fee for access to the oasis, farmers' incomes could be raised by 6%-21% depending on visitor numbers and the entry fee.

Source: Zekri *et al.* (2011)

Case Study: Role of Incentive-based mechanisms to balance the distribution of benefits from biodiversity conservation

In India, as elsewhere, protected areas (PAs) have permanent resident populations who are historically dependent on forest resources for their livelihood. The Buxa Tiger Reserve (BTR), in the northern part of West Bengal, is one such reserve forest where villagers have been residing for more than a 100 years. With the creation of a national park, employment opportunities for the forest villagers, who were once treated as an important labour force during the commercial forestry regime, have drastically declined. To reduce pressure on forest resources at the BTR, the World Bank financed India Ecodevelopment Project (IEDP) was initiated with the aim to involve local people by supporting sustainable alternative income-generating activities. In consonance with the dominant view that livestock grazing in bio-diverse regions is destructive to nature, reduction in cattle populations and stall feeding of cattle have been included as reciprocal commitments under this project. A study assessing the viability of this strategy and exploring how far a reduction of cattle is acceptable shows that there is little impact on cattle populations after the project intervention. The study argues that as cattle are an integral part of the rural economy for marginalised groups in PAs like the BTR, where alternative employment opportunities are very limited, the reduction or removal of cattle may not be a viable option as it will adversely affect the livelihood of these vulnerable communities. A more pragmatic approach of rotational grazing would be fruitful for preservation of protected forest areas in countries like India. The findings highlight one of the basic problems associated with biodiversity conservation – that of mismatch between costs and benefits at various spatial scales. Often, biodiversity conservation leads to loss of access to natural resources on which local communities are highly dependent. Incentive-based mechanisms hold the key in such cases to balance the costs and benefits of meeting the Aichi Targets and influence decisions of resource managers.

Source: Das (2008)

Case study: WTP for crop genetic diversity in Nepal

The role of natural capital as a storehouse of genetic information is increasingly identified and acknowledged. This case study estimates the economic value of crop genetic resources based on rice farmers' willingness to pay and is relevant to the Aichi Targets 1, 2, 3, 7, 13, 14 and 18.

Crop genetic resources constitute an important aspect of biodiversity conservation, both because of their direct value to the farmers and due to their indirect global value. A study using the contingent valuation method documented the economic value of crop genetic resources based on the farmers' willingness to pay for conservation. A total of 107 households in Kaski, Nepal were surveyed in November 2003 and their mean willingness to pay was US$ 4.18 for in-situ and US$ 2.20 for *ex-situ* conservation per annum. Factors influencing willingness to pay for in-situ conservation included landholding size, household size, education level, socio-economic status, sex of respondent, number of crop landraces grown, and knowledge on biodiversity, whereas only landholding size and household size influenced the willingness to pay for ex-situ conservation. The respondents were willing to contribute more for in-situ than ex-situ conservation because of the additional effect of direct use and direct involvement of the farmers in in-situ conservation. This study supports the view that economic valuation of crop genetic resources can assist policy makers in formulation of appropriate policy mechanisms, raising public and political awareness of the importance of the issue, and helping to set conservation priorities.

Source: Poudel and Johnsen (2009)

Case study: Economic valuation of coral reefs at Phi Phi Islands, Thailand

This case study provides a quantification of the recreational benefits of coral reefs at Phi Phi Islands in Thailand. The aim was to raise awareness among local and national government decision-makers of the value of coral reefs and what would be lost if they were destroyed or not properly managed for long-term sustainability. The findings from this study are relevant to Aichi Targets 1 and 5.

The study applied two methodologies, the Travel Cost Method (TCM) and Contingent Valuation method (CVM) to estimate the economic value of coral reef related recreation. The TCM method revealed that the benefits from the recreational services of the Phi Phi islands for domestic and international visitors were estimated to be 8,216 million Baht (US$ 205.41 million) per year. This translates to about 249,720 Baht (US$ 6,243) per ha per year. The CVM method was used to measure broader values including people who value the reef without visiting it. The use and non-use values of Phi Phi's coral reefs were estimated to be approximately 19,895 million Baht (US$ 497.38 million).

Seenprachawong (2003)

Case study: Greenbelt's ecosystem services in the Seoul metropolitan area in South Korea

This study estimates the value of ecosystem services provided by the forest and cropland in Greenbelt, which is development restricted area for nature protection, for over twenty four million inhabitants in the Seoul metropolitan area.

The metropolitan area of Seoul covers 31 cities and districts including Seoul, Incheon, and Gyeonggi-do. In 2011, the Metropolitan area covered 11.8% (11,806 km^2) of national area. Approximately 25 million people, 49.3% of the national population, reside in the area. The metropolitan area has a gross regional domestic production (GRDP) of approximately 561 trillion Won (US$ 525 billion), which was 47.8% of the national gross domestic production (GDP). The Greenbelt of the Seoul metropolitan was designated to secure green space and to prevent the spread of the chaotic expansion of Seoul in the period between 1971 and 1976. The Greenbelt has sustainably provided ecological soundness and various benefits from its ecosystem.

This study followed the three-step approach suggested by TEEB to estimate the value of ecosystem services. For the first step, the land coverage of Greenbelt is reviewed and specific ecosystem services by land are analyzed, using the map of land coverage provided by the Ministry of Environment of Korea. A methodology to calculate the value of each ecosystem services and to estimate the value is derived in the second stage. At the third stage, the economic value (TEV) of ecosystem services is calculated with policy proposals.

The objective of this study is to estimate the value of natural assets and provide basic data to reflect its value for policy decisions in the Seoul metropolitan area through the assessment on natural resources and the valuation of ecosystem services in the Greenbelt are. This paper suggests the appropriate measures, which are helpful for conservation and management of the Greenbelt. The total economic values of ecosystem services of the Greenbelt are KRW 2,463 billion (US$ 2.3 billion).

Ecosystem Services	Total (Million Won)	Forest (Million Won)	Cropland (Million Won)	
			Paddy	Upland
Provisioning Service				
Food	267,567		94,003	173,564
Water	243,988	199,126	43,091	1,771
Raw materials	22,353	22,353		
Regulation Service				
Climate regulation	811,714	691,180	51,078	69,456
Air quality regulation	148,262	141,900	2,884	3,478
Erosion prevention	207,190	192,345	14,845	
Moderation of extreme events	149,685	63,337	70,549	15,799
Waste treatment	16,443	12,335	4,108	
Biological control	12,591	12,591		
Cultural Services				
Aesthetic value	88,339	52,789	18,625	16,925
Recreation & tourism	494,806	472,052	11,921	10,833
Total (Million Won)	**2,462,938**	**1,860,008**	**311,104**	**291,826**

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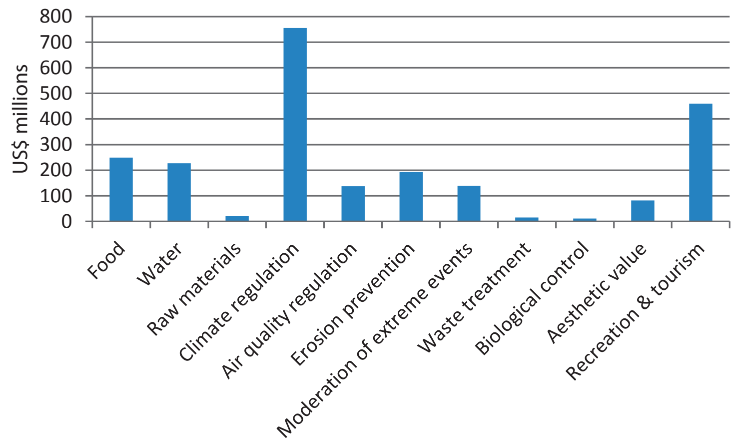


Figure 1. Annual value of ecosystem services from Seoul metropolitan area greenbelt (millions of US$)

Source: Ryu and Lee (2013)

Case study: Enhanced Marine Management, Malaysia

This case study describes the project "Conserving Marine Biodiversity through Enhanced Marine Park Management and Inclusive Sustainable Island Development", implemented by the Government of Malaysia (GoM) in partnership with the United Nations Development Programme (UNDP) Malaysia, and supported by the Global Environment Facility (GEF) and provides information on the benefits with relevance to Aichi Targets 1, 8, 11, 14 and 18.

The project covered three demonstration marine parks in Malaysia: Pulau Redang, Pulau Sibu-Tinggi, and Pulau Tioman. The total project financing incurred was approximately US$ 4.13 million. The project which ran from 2007-2013 was aimed at:

- Widening the existing development planning process in order to support marine ecosystem management as well as sustainable tourism through stakeholder involvement;
- Strengthening the capacity of the marine parks management system in Peninsular Malaysia and to ensure effective enforcement of marine park regulations at three project sites; and
- Enabling an influential advocacy framework for the conservation of marine biodiversity supported by a raised level of awareness of the importance and benefits of marine biodiversity.

The project result demonstrated the following benefits particularly linked to areas of awareness raising, pollution control, protected areas management and respect of traditional knowledge (Aichi Targets 1, 8, 11, 14 and 18):

- Awareness and livelihood impact: Through the project's awareness programs such as snorkel guide training, advocacy group set up resulted in greater ownership and appreciation of the biodiversity values of the MPAs among the local communities. In addition, direct training and programs such as business courses, English language courses, lessons to fix and maintain boats, training certificates that enabled the communities to be legally recognized as boatmen elevated their livelihood options and opportunities.

Pollution control: Awareness raising programs by the project and exchange visits brought about the inspiration and push for the local community to clean up their house reef which was then transformed into a site that could support snorkeling activities.

Protected areas management: The project included the development of protected areas management plan to support better management of MPAs. At the same time, the project raised the enforcement capacity of the Department of Marine Park.

Respect of traditional knowledge and involvement of local communities: The project developed mechanisms that enabled stakeholder participation and engagement at the local, state and national level. It enabled community perspectives to be channelled to decision makers and planners.

Sources: GoM, UNDP, GEF (2006)

Case study: Heart of Borneo – Investing in Nature for a Green Economy

This case study presents the benefits of the Heart of Borneo (HoB) project in relation to Aichi Targets 1, 4 and 11.

The Heart of Borneo rainforest accounts for around 30% of Borneo's land area and covers more than 22 million hectares of tropical rainforest across three countries: Brunei Darussalam, Indonesia (Kalimantan) and Malaysia (Sabah and Sarawak). It is the largest remaining expanse of tropical forest in Southeast Asia.

The tri-lateral Heart of Borneo Initiative was signed in 2005 by the three nations that share the island of Borneo. The initiative, which is facilitated by WWF, is an agreement to sustainably manage the area. It collects scientific data and uses community empowerment and capacity building tools to achieve its mission to protect the HoB rainforest from further destruction. The Heart of Borneo initiative works closely with local communities in many of its projects when collecting data about the ecology and traditional uses of the forest. Efforts are also being made to understand, recognise and protect the natural capital of the HoB by valuing and disseminating knowledge about the economic values of the HoB.

The HoB initiative presents insights into services of the HoB forests and the impacts of existing economic activities that are changing the landscape of the area. This includes timber harvesting, tourism, hydropower, palm oil production, freshwater fisheries, mining and local based forest industries.

Source: Heart of Borneo, Investing in Nature for a Green Economy: A Synthesis Report.

Case study: Economic valuation of Shadegan International Wetland in Iran

This case study provides estimates of use and non-use economic values of wetlands in Iran and is relevant to Aichi Targets 1, 2, 8, and 14.

Wetlands are among the most productive ecosystems on the earth. They produce various market and non-market goods and services, which have a significant role in human welfare. Despite the great opportunities from sustainable development, wetlands all over the world are under serious threat from a diverse range of unsustainable activities. One of the major reasons for excessive depletion and the conversion of wetland resources is due to the under-estimation of non-market values of wetlands in development decisions.

Shadegan International Wetland (SIW) in southern Iran is threatened by over-exploitation from commercial activities. SIW is a unique natural ecosystem with great national and international significance, designated under the Ramsar Convention. A study was conducted using the contingent valuation method to estimate the economic benefits of SIW from the view point of peoples' willingness to pay (WTP). The estimated mean WTP was US$ 1.74 per household as a one-time donation. The study concludes that the benefits of SIW to society could encourage managers to set priorities to ensure that the health of the ecosystem, its integrity, and its uniqueness would be conserved in a proper manner.

Another study using a choice experiment survey was also conducted to estimate the value of different non-market attributes of SIW. In addition to the overall model, users and nonusers preferences were estimated. Results indicated the respondents' positive preferences towards better conservation of SIW.

Source: Kaffashi *et al.* (2011); Kaffashi *et al.* (2012)

Case study: Making the economic links between biodiversity and poverty reduction: the case of Lao PDR

The case study highlights examples of the linkages between biodiversity, poverty reduction and socio-economic development in Lao PDR at the local and national levels. The linkages demonstrate that the value of biodiversity is of significant importance for the poorest and most vulnerable groups in the country. The case study relates to Aichi Targets 2 and 19.

The population of Lao PDR are highly dependent on biodiversity. It is estimated that more than 80% of the country's 5.5 million people live in rural areas. Besides rice farming, they also depend on harvesting wild plant and animal products for their day-to-day subsistence income.

A study was undertaken to understand the benefits of the Nam Et-Phou Loei (NEPL) Protected Area and its surrounding villages. Two thirds of the NEPL is located in the Viengthong District. The study reported that the economic value of forest product utilisation for villages in the Viengthong District is estimated to be worth more than US$ 1.12 million per year or US$ 313 per household. The study found that home consumption made up the bulk of the economic value with an average of US$ 229/household/year compared to cash income of US$ 84/household/year.

The study also reported that the value of forest use was highest for the households who live closest to the NEPL at an average of US$ 500 for villages located inside the PA, US$ 270 for households bordering the PA and US$ 160 for households outside the PA.

At the national level, biodiversity was estimated to be worth around US$ 650 million per year. This includes contributions from forests, wildlife, aquatic resources and agro-biodiversity. The analysis of the full value of biodiversity shows that biodiversity contributes directly or indirectly to three quarters of the country's per capita GDP, more than 90% of employment and almost 60% of exports and foreign exchange earnings.

Source: Emerton (2005)

Case study: Economic analysis of ecosystem services in the Mekong Basin

This study provides "Business as Usual" versus "Green Economic Growth" scenarios for ecosystem management and use over the next 25 years in the Lower Mekong countries (Cambodia, Lao PDR, Thailand and Viet Nam). An assessment of the economic implications of each scenario was also undertaken. This case study provides insights into Aichi Targets 1, 5 and 14.

The "Business as Usual" scenario reflects what will happen if current trends continue. The region's protected area (PA) system will be maintained at its current size, coverage and management categories but the areas of well-managed natural ecosystems contained in the system will be progressively degraded, converted and lost.

The "Green Economic Growth" scenario depicts what will happen if the region's PA system is expanded and re-categorised to include a more representative range of critical ecosystems and management systems, and if renewed efforts are made to better fund and conserve ecosystems and biodiversity outside PAs.

At the regional level, the net present added value from pursuing a Green Economic Growth strategy was estimated at almost US$10.5 billion over the 25 year period modelled. It was estimated that the value of extractive uses and harvested production was one third of the value at US$2.5 billion compared to regulating and supporting services of the ecosystems at around three quarters of the total value.

Emerton (2013)

Case study: Biodiversity Conservation in Korea's DMZ (Demilitarized Zone)

This case study of Korea's demilitarized zone (DMZ) provides evidence of the benefits to biodiversity of nature reserve areas, with relevance to Aichi Target 11.

Border areas, including DMZ (Demilitarized Zone), have been designated as a Nature Reserve Area under Article 2 of the Natural Environment Preservation Act. Having been uninhabited for over 50 years and used only for military purpose, the area has sustained a very unique ecosystem. First-grade areas in terms of preservation of ecological nature is estimated to be 84.31 km^2, comprising 0.1% of Korea's total land area. The eastern region retains an excellent forest ecosystem including the Yongneup wetland in Mt. Daeam. Lowland wetlands in the central and southern areas are expansive. Areas which had been arable land have long become fallow, and wetland vegetation developed unencumbered including the plant communities of willows (*Salix koreensis*), *Acer ginnala* plant, Alder trees (*Alnus japonica*) and *Phragmites japonica* Steud, offering unique landscape and important biotope.

Biological species of 4,432 were studied in the borderland region, among which 68 were designated as endangered including musk deer, long-tailed goral, otter, golden eagle, mute swan, bean goose, common Korean bitterling, Mongolia racerunner, *Echinosophora koreensis* shrub, Vesper Iris, and *Osmoderma opicum* beetle. Biological study on areas adjacent to the border is difficult since access to many areas are impossible because of military security issues, and more species are presumed to exist. Musk deer, long-tailed goral, and otter are typical mammals in this area. *Echinosophora koreensis* shrubs were known to be endemic species growing only in Pyeonganbuk-do and Hamgyeongbuk-do in North Korea, but were discovered in the border area of South Korea (Yanggu County, Gangwon-do), and designated as Natural Monument No. 372 on December 23rd, 1992.

Source: Ministry of Environment of Korea (2009)

Case study: Net Present Value (NPV) charge for forest clearance in India

In India, any user-agency seeking to divert forest land for non-forest purposes has to pay, besides other charges, a charge termed as "Net Present Value" of forest as compensation for the loss of ecosystem services from forests. The rates for this charge vary according to the forest canopy cover density and the type of forests across the country. To account for advancement in valuation methodologies and to reflect the scarcity value of forests, these rates have to be revised periodically. A study in this regard was recently carried out by Indian Institute of Forest Management for the Ministry of Environment & Forests, Govt. of India. The study estimated the unit area value of forests in different types of forests and for different forest canopy cover densities across the country taking into account economic value of 12 forest services, namely, timber, fuelwood, fodder, non-wood forest produce, bamboo, bioprospecting, carbon sequestration, carbon storage, pollination & seed dispersal, water recharge, water purification and soil conservation. The average recommended rates varied from approximately US$ 50,000 to US$ 16,000 per hectare (1 USD = 60 INR) for Very Dense Forest (canopy cover > 70%) and Scrub Forest (canopy cover < 10%) respectively. Based on these rates, the total economic value of ecosystem services emanating from India's forests is approximately equal to US$ 2.5 trillion (net present value for 60 years; rate of discount = 4%).

Source: Verma *et al.* (2013)

Case study: Nimr Water Treatment Plant at the Al-Nimr oilfield, Oman

This case study provides information on the multiple benefits of developing wetlands for the treatment of wastewater in Oman, with relevance to Aichi Targets 8 and 14.

Extracting oil reserves on land often produces vast quantities of "produced water", which is the wastewater that remains after the crude oil has been separated from the water that contains it. Produced water is typically disposed of by pumping it into deep (2 km) aquifers ("deep well disposal"). Since produced water can contain hydrocarbons as well as trace elements or metals and is often saline, this method of wastewater disposal poses a risk to underground water reserves and is becoming less acceptable.

Petroleum Development Oman (PDO) entered into an agreement with BAUER Nimr LLC to design, construct and operate an artificial wetland to treat part of the produced water of the Al-Nimr oilfield. The wetland came online in 2010. After a first oil-water separation process, the wastewater flows into a wetland that covers 350 hectares. Organisms living on the roots and stems of the plants break down the hydrocarbons and other contaminants. After the water has been cleaned, it flows into a further 340 hectares of evaporation ponds and disappears. At its current size the site can process 95,000 cubic meters of produced water per day, which is a sizeable share of the daily volume of water produced by the Al-Nimr oilfield.

For PDO, this natural approach to cleaning up its wastewater has several benefits. First, the wetland requires much less energy (<2%) and maintenance than the pumps needed for deep well disposal. Thus, the carbon footprint of the oil production process has been reduced significantly. Although the wetland requires an upfront investment, in the long run the reduction in energy costs is sufficient to offset the investment. Secondly, the wetland will in principle always function, unlike pumps that may break down. If a pump does break down, installing a replacement pump in the often remote oilfields can take days during which production is reduced or stopped. Such unwanted revenue losses are avoided by using the artificial wetland.

The Al-Nimr wetland has also been delivering ancillary environmental benefits. For instance, the wetland has quickly become a refuge for over 100 bird species. Species that have been sighted include the Egyptian Vulture (*Neophron percnopterus*), which has an endangered status, and the Bar-tailed Godwit (*Limosa lapponica*), which is near-threatened. For birds that migrate each year between southern Africa and the north of Asia, the wetland is a perfect stopover site in an otherwise arid and unwelcoming region.

The harsh desert climate and the salinity of the produced water have furthermore forced the adoption of a diverse set of plant species to stabilize the wetland for local conditions. Hence the Al-Nimr wetland presents a more diverse landscape mosaic than conventional reed-bed installations do. The wetland itself and the birds that live there provide training opportunities for Omani researchers from the newly-erected National Field Research Centre for Environmental Conservation (NFRCEC).

Furthermore the Al-Nimr wetland indirectly protects the local desert. Because produced water typically is oligotrophic, or nutrient poor, the wetland requires additional nutrients for the plants to grow. Adding artificial nutrients is not cost-effective for a wetland this size, so surrounding contractor camps and the local sewage treatment plant deliver their (excess) sewage to the Al-Nimr wetland, where it is fed into the system and is treated whilst providing valuable nutrients to the wetland plants and microbes. Much of this sewage may otherwise simply have been dumped in remote areas, locally damaging the vulnerable desert ecosystem.

Having passed through the wetland the water has a hydrocarbon content and levels of trace elements that are undetectable. Although the water is still saline, the purity of the water has prompted research into the potential re-use of the water – rather than letting it evaporate in a region that is characterized by water deficits. BAUER Nimr LLC is working with PDO and other Omani and regional institutes to identify plant species with agricultural potential that can cope with the salinity of the water. Initial studies have so far identified *Salicornia* and *Jatropha* (for biodiesel), several species of *Acacia* (for firewood and charcoal) and *Mangrove* (for restoration initiatives) as potentially interesting candidate crops. This research is in its initial stages, but could bring further benefits to Oman and other oil producing countries by reducing their water deficits, reducing harmful human activities, diversifying their economies towards sustainable agriculture and providing employment opportunities for local communities.

Sources: Muscat Daily (2013); Headley and Lisker (2013); Headley, pers. comm. (2013)

Case study: Reconstruction and development in Afghanistan – role of biodiversity conservation

This case study provides information on the role and estimated level of effort in biodiversity conservation and protected area management with reference to reconstruction and development in Afghanistan. Specifically, the case study is of relevance to Aichi Targets 5, 11, 14, 17 and 20.

USAID's Afghanistan Country Strategic Plan for 2005-2009 for Biological Diversity and Natural Resources highlights that despite years of conflict and drought, Afghanistan's terrestrial and aquatic habitats still support significant biodiversity, of both plant and animal species, despite two decades of war and conflict. The last two decades have seen deterioration in the institutions and financing for conservation management. An increase in poverty combined with a breakdown in law and order led to pressure on natural resources in many areas, from poaching and illegal logging to overgrazing. Deterioration of structures for water management has also contributed to degradation of wetlands and loss of wildlife.

Natural resource conservation is a critical component of reconstruction and development in Afghanistan. With over 80% of Afghans dependent on the country's natural resource base, long-term stability will be directly dependent on sustainable management of natural resources. And despite the isolation of rural communities in Afghanistan, issues here are not just a matter of local concern. Afghanistan plays a critical role on the global political stage, especially given the existence of nearby borders with China, Pakistan, Kashmir India, and the Central Asian states. This is a volatile region, and cultural dissolution can have regional and even global repercussions. If environmental conditions continue to degrade, people will no longer be able to carve a living out of the fragile steppe, desert, and mountains as they have for centuries. Poverty will spread, communities and cultural practices will dissolve, and rural migration will further dissolve cultural connections and negatively affect neighbouring communities and regions.

The Wildlife Conservation Society believes that protected areas must be the core of all nations' biodiversity conservation plans. These areas typically contain a higher diversity and abundance of plants and animals than landscapes managed primarily for economic use. Yet parks and reserves are always embedded in larger, human-dominated landscapes and are seldom sacrosanct. Regardless of how large or small a protected area may be, the plants and animals it contains are often threatened either directly or indirectly by human resource use activities.

Management of parks and reserves cannot, therefore, occur in isolation from the surrounding human-dominated landscape, but must take into account where and how human activities conflict with biodiversity conservation, and where conservation adversely impacts human welfare. As human populations continue to expand over the next 50 years, the incentive for over-exploiting natural resources within and outside of protected areas will likely increase and the need for biodiversity conservation tools that address human-wildlife conflict will become even more important.

Table. Costs of implementation for four component implementation strategies

Sr. No.	Objective	Estimated costs (US$)
1	Surveys and Analyses of Baseline Data of Wildlife and Wildlands in Afghanistan in the Landscape context	1,520,055
2	Strengthening Laws, Policies, and Institutions	1,041,536
3	Community-based initiatives	379,080
4	Building Capacity within Afghanistan's Environmental Sector	708,728

The total anticipated level of effort for 2006-2008 was estimated to be US$ 6.975 million. This is not a large amount of money and may reflect the availability of funds rather than any measure of resources required to meet biodiversity targets. The Afghan government recognises that "[it] will not be able to meet the CBD's target of reducing the rate biodiversity loss by 2010 or in the foreseeable future" as biodiversity conservation is simply not as high a priority as security, education and health. In addition, the war has eroded the institutional fabric of the country which needs to be restored first.

Source: WCS 2009; Stevens and Rahimy 2009

Case study: Conserving Sundarbans in Bangladesh

This case study provides information on the criticality of Sundarban mangrove forests for people of Bangladesh. Apart from shrimp production, mangrove forests provide life-sustaining services such as coastal protection and regulation of biogeochemical cycles among various others. The case study is directly relevant to Aichi Targets 3, 6, 7, 11, 14 and 20.

Bangladesh, favoured by a tropical climate, houses the world's largest stretch of mangroves forests (Sundarbans Reserved Forest) and plantations. Around half of the forests of the country occur in the coastal zone. People extract various goods and services from the mangroves and are one of the most critical livelihood sources for people of Bangladesh. Nevertheless the mangrove forests are depleting. Although the extent of the Sundarbans forest has not changed much, its decline is of a qualitative nature. Mangrove plantations are increasing in area but they are losing growing stock. To arrest this, Bangladesh has adopted several strategies.

The 'Sustainable Ecosystem Management' strategy has now been adopted instead of the 'Sustained Yield Principle'. Biodiversity conservation and enhancement has been taken as a key management goal. A zoning system is being developed for both production and protection purposes. The government facilitates alternative income for the local people by generating activities for the communities which are dependent on the forest. Different non-governmental organizations collaborate with the government in reducing the local people's dependence on the forest. Coastal plantations are erected to protect people from cyclones and to make the land more suitable for habitation. Through this greening of the coastal belt tree plantation is encouraged in coastal villages. Coastal embankments are being planted and leased to poor settlers in exchange for routine maintenance of the embankments. Plantations on newly accreted mud flats help in stabilizing the land, which can later on be settled by victims of erosion elsewhere. These adopted management measures do not only contribute to forestry resource management but also to the social, environmental and economic wellbeing of the coastal communities. These efforts are at present being integrated into an Integrated Coastal Zone Management (ICZM) project currently implemented in Bangladesh.

Another project supported by Asian Development Bank (ADB) known as "Sunderbans Biodiversity Conservation Project" has also been implemented to institute a comprehensive fisheries management system. At approval, the Project cost was US$ 82.2 million. ADB was to provide a concessionary loan of US$ 37.0 million and the Nordic Development Fund (NDF) was to provide a concessionary loan of US$ 4.5 million. The Global Environment Facility (GEF) was to provide grant financing of US$ 12.2 million. The Government of Bangladesh (GOB) was to finance US$ 16.1 million and the Palli Karma-Sahayak Foundation (PKSF) was to contribute the equivalent of $6.8 million of its own funds as a line of credit for microfinance. Local beneficiaries and NGOs were to contribute the equivalent of US$ 5.6 million. The cost of the Project was later revised to about US$ 77 million.

Source: Iftekhar and Islam 2004; Hoq 2007; ADB 2008;

Case study: Small scale wastewater treatment systems in the West Bank

This case study provides information on the investment needs to treat sewage in the West Bank, Occupied Palestinian Territories, with relevance to reducing water use and pollution and to Aichi Target 14.

In the Occupied Palestinian Territories connecting remote households to the centralized sewage network is economically infeasible due to the high capital costs. Only 6% of sewage is treated in centralized wastewater treatment plants and the remainder is collected in cesspits or septic tanks. Seepage and overflow are common and lead to uncontrolled flows of sewage. If septic tanks are emptied by vacuum trucks, the sewage may still be discharged into the environment.

In the West Bank, the Applied Research Institute Jerusalem (ARIJ) supplied 180 households with on-site small scale wastewater treatment and reuse systems (SWTP). The cost of imported systems was 45,000 New Israeli Shekel (NIS; USD 11,700 in 2010) whereas locally sourced systems with identical specifications cost 15,000 NIS (USD 3,900). This project ran for 40 months at a total cost of USD 1,170,000.

The project showed that households can save money by using SWTPs through the lower operating costs of SWTPs compared to frequent emptying of cesspits by vacuum trucks. Furthermore households faced lower water bills and were able to improve the yields from their gardens through more frequent irrigation. The environmental benefits include lower demand for water and less pollution. Challenges for a widespread adoption of SWTPs in the West Bank include the initial investment, which is too high for many households, and a general lack of awareness of the benefits of treated wastewater and the need to protect the environment.

Source: ARIJ (2012), UNDG (2012)

Case study: Comprehensive action plans of the Sulu-Sulawesi Marine Ecoregion: A priority seascape of the Coral Triangle Initiative

The Sulu-Sulawesi Marine Ecoregion (SSME) is rich in biodiversity and globally significant priority site of the Coral Triangle—the center of the world's highest concentration of marine biodiversity. An Ecoregion Conservation Plan (ECP) was developed to facilitate the realization of the four fundamental goals of biodiversity conservation in the SSME: representation, sustainability of ecological and evolutionary processes, viability of species and populations, and resiliency.

The governments of Indonesia, Malaysia and Philippines entered into a memorandum of understanding (MOU) on 13 February 2004 to adopt the ecoregion approach to ensure the effective protection and sustainable development of the SSME. Based on the MOU, a Tri-National Committee for the SSME was created. Subsequently, this led to the creation of three subcommittees, i.e. the Threatened, Charismatic, and Migratory Species Subcommittee; the Sustainable Fisheries Subcommittee; and the Marine Protected Areas and Networks Subcommittee.

As a follow up, work plans and action plans were developed to articulate the broad areas of activity based on the ECP. To further strengthen concrete actions on the ground at a tri-national scale, the action plans were converted into comprehensive action plans. The comprehensive action plan not only included activities at the country level but also captured transboundary actions towards sustainable management of the ecoregion. The plans estimated costing of priority activities and listed potential mechanisms that will allow the SSME to generate funds to support the plan.

The matrix below summarises the estimated cost of implementation by outcomes (US$) for the next four years from the development of the comprehensive action plans. The report noted that the costs considered for the implementation of the action plans are incremental. This represents costs that are over and above those that are currently being allocated for regular government meetings and existing projects in the region.

Source: ADB (2011)

Outcomes	US$
Outcome 1: Fisheries	65,196,460
Outcome 2: MPAs and Networks	17,413,980
Outcome 3: Species	53,724,320
Outcome 4: Model Seascape	5,740,650
Outcome 5: Climate Change	12,314,275
Total	**154,389,685**

Case study: Forest conservation in Armenia

This case study provides information on the current allocation relative to needs for forest conservation in Armenia, with relevance to Aichi Targets 5, 7, 11 and 15.

The decline of forest cover in Armenia accelerated dramatically in the period of economic transition that followed the demise of the Union of Soviet Socialists Republics (USSR). In ancient times around 40% of the country was forested, but by 2000 the percentage of forest cover had dropped to less than 10%. This decline presents a severe environmental and economic threat to a country that is a globally important centre for (agro-) biodiversity and where forestry and forest products contribute much to the gross domestic product (GDP).

Since ratification of the Convention on Biological Diversity in 1993, the Armenian government has worked hard to reverse the negative trends in natural and biodiversity conservation. In 1999 the Ministry of Nature Protection of the Republic of Armenia (MNPRA) noted a large funding shortfall for its biodiversity conservation programme. The 800,000 US dollar budget for forest conservation was estimated to cover about 20% to 25% of the actual costs of sustainable forest protection. The 2008 budget allocation of 1.38 million US dollars suggests there is still a significant problem of underfunding, particularly when accounting for inflation.

Source: MNPRA 1999; 2006; 2009

Case study: An assessment of forest management options for preventing forest fire in Indonesia

In Indonesia, uncontrolled forest fires have been identified as a key cause of habitat destruction. Partly as a result of the fires, Indonesia is currently losing nearly two million hectares of forest every year. The haze they produce causes significant pollution problems for people in the country and in surrounding nations. A study was carried out to identify policy options that would best address forest fire problems in a cost effective manner. The study relates to Aichi Targets 5 and 8.

Among the key problem identified was weak enforcement of forest conservation rules and regulations caused by a wide range of resource and institutional failures. Out of 20 policy options that were identified, nine were ranked as high priorities. Through key informant interviews, the total additional fund required to implement the nine high priorities was estimated at 91,684 million rupiah (approximately USD$ 8.185 million) or 315% of the existing status quo amount for land and forest fire management. The average value of the estimate was 7,546 million rupiah (approximately USD $673,719). Of the proposed policy options, the study recommended implementing all the top three recommendations. The improvements involve strengthening policy implementation in the field, putting in place an effective reward and punishment system and the establishment of an institution to monitor and record stakeholder compliance and violation.

Source: Luthfi and Udiansyah (2009)

Case study: A Cross-Country Analysis of Southeast Asia's Protected Areas: Fiscal and Resource Gaps

A study funded by the Economy and Environment Program for South East Asia (EEPSEA), involving seven countries in Southeast Asia (Cambodia, Lao PDR, Vietnam, Indonesia, Philippines, Thailand and Malaysia) and China was conducted to assess resource and financing gaps of protected areas (PAs) in the region. The assessment included detailed and comprehensive description and analysis of internal and external pressure brought upon the various PAs across countries in the region, their management responses (resource allocation), existing fiscal and fee structures, and assessment of the various options aimed at addressing the identified resource gaps. Key findings of the Philippines and Vietnam country studies are summarised below.

Philippines: (based on usable responses from 79 PAs out of a total of 238 PAs)
Based on a benchmark of 670 staff, the study estimated a shortfall of 411 staff in comparison to the existing staff of 259. An extrapolation of the staff gap per hectare indicated a shortfall of 1,478 staff for the entire PA network in the Philippines.

The study estimated that the existing operating expense was approximately US$ 1.08 million based on 2009 figures. In relation to a benchmark of US$ 3.4 million, the estimated operating expense gap was approximately US$ 2.3 million. Extrapolating the figures at the national level indicates a US$ 8.4 million shortfall for the 238 PAs of the Philippines.

The study proposed various measures to address the resource gaps and improve the operation and financial sustainability of the PAs. This included addressing legal and operational needs to enable the appropriate organization and staffing patterns of PAs, continuing capacity building programmes, establishing a transparent and adequate collection system, upgrading the general fee and charges using the cost recovery principle and 'willingness-to-pay principle', and allocating budget to individual PAs instead of lump sum appropriation to the regional office.

Vietnam: (based on 53 PAs out of 164 PAs)
The study estimated that the gap of full-time staff of PAs in Vietnam is around 65% to 67% of the existing number of full time staff. This translates to approximately 2,500 to 2,600 more staff that is needed for protected area management for all PAs in the country.

The gap in operation expenses was estimated to be approximately 118% to 132% of the existing expenses of the 54 PAs surveyed. Extrapolating the figures at the national level indicates a range of US$ 34.8 million to US$ 38.9 million in operation expenses gap for the total 164 PAs.

The study observed that the PAs in Vietnam vary greatly in terms of size and infrastructure. Investments into PAs need to consider the functions, geographical conditions and size of PAs. Almost 89% of the 53 PAs surveyed contain residents living adjacent to the PAs, indicating that conservation measures need to consider livelihood needs of the local communities.

Sources: Anda and Atienza (forthcoming); Pham (forthcoming)

Case Study: Incentive-based mechanisms to conserve India's forests and biodiversity

In a study conducted by Indian Institute of Forest Management for the Thirteenth Finance Commission of India, it was recommended that bioprospecting value of forests within each state, apart from three other factors – namely growing stock of forests, ratio of dense forest cover to total forest cover, and total carbon stock of each state should be taken into account while determining allocation of grant-in-aid to different states. This represents one of the many emerging mechanisms across India to incentivize states for conserving their forests and biodiversity recognizing that the benefits of conserving them far outweigh the associated costs.

Source: THFC (2010)

Case study: Costs of Marine Protected Area (MPA) management in the Philippines

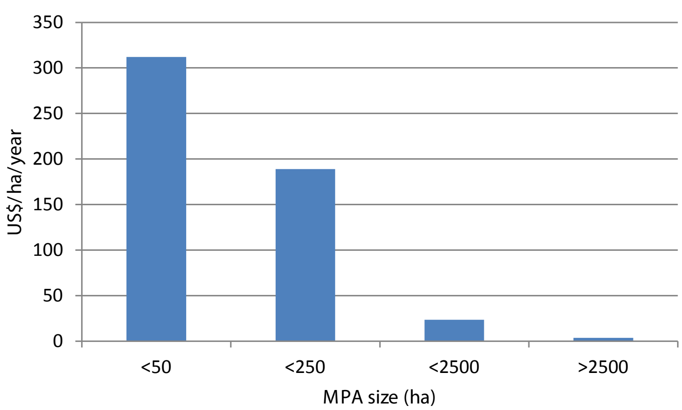
This case study provides information on the costs of marine protected area management (MPA) in the Philippines, with relevance to Aichi Target 11.

The costs of managing MPAs are highly variable depending on scale and requirements for enforcement and other interventions. The summary results of a review of MPA and MPA network management costs in the Philippines by size of MPA is presented in Table 1. The results show a very strong trend of decreasing average costs with scale. The difference in management costs per hectare between small MPAs (<50 ha) and large MPAs (>2500 ha) is almost a factor of 100.

For the CBD and Aichi Targets, this finding has potentially important implications for the optimal scale of MPAs. It may be the case that it is more cost-effective to establish a smaller number of relatively large MPAs in order to meet Target 11. The benefits of large scale MPAs would need to be assessed to check that they can deliver equivalent biodiversity benefits to a system of smaller more spatially distributed MPAs.

Table 1. MPA management costs in the Philippines

MPA size category (ha)	Average management costs (USD/ha/year)
<50	312
<250	189
<2500	23.4
>2500	3.52



Marine protected area management costs in the Philippines (US$/ha/year)

Source: UNDP-GEF (2013)

Case Study: Special Purpose Vehicles to address difference between current allocations and needs

In India, the hilly states are mandated to keep two-thirds of their geographical area under forests. While this leads to generation of life-supporting services to downstream areas in the country, this leads to huge opportunity costs for the states. As the services supplied to downstream areas by forests is often unaccounted in management decisions, a study was carried out to estimate the economic value of forests of one of the hilly states of India, Himachal Pradesh. The study found that the total economic value of Himachal Pradesh's forest is 2.61 times the value of the growing stock, 980 times the total expenditure incurred by the forestry sector of Himachal Pradesh and 2607 times the revenue realized by the forests annually. The total economic value of Himachal Pradesh's forests so estimated was approximately equal to US$ 21 million annually. Based on these estimates, in 2002, a special purpose vehicle called Compensation for Loss of Ecological Value (CLEV) was introduced in the state.

The case demonstrates the emerging development of special purpose vehicles in many South Asian countries, especially in India, to address the gap between current allocations and needs. May tourism destinations and cities have also developed such vehicles to collect taxes from tourism which are ploughed back for conservation of biodiversity which forms the backbone of tourism in such regions.

Source: Verma (2000)

Case study: Tropical forest conservation opportunity costs in Indonesia and Malaysia

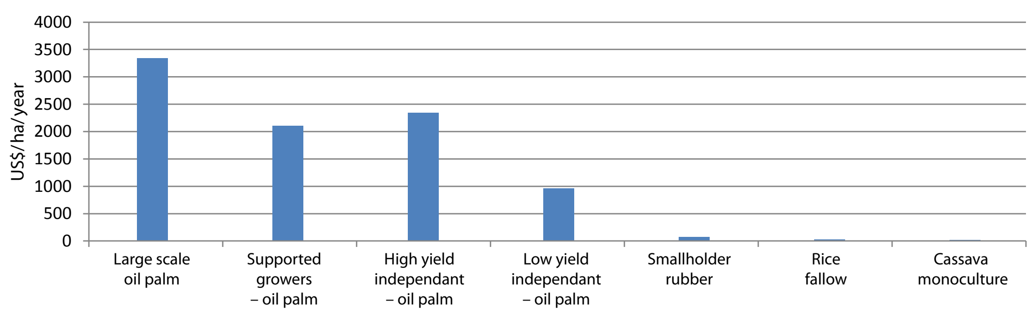
This case study provides information on the opportunity costs of conserving tropical forests in Indonesia, with relevance to Aichi Targets 7, 11 and 14.

The case study reports the opportunity costs of avoided tropical deforestation based on returns per hectare for different land-uses. This provides evidence on the returns to conversion of tropical forests or equivalently the required returns from conservation in order to be able to make the economic argument for protection of forests. This information can be compared to data on the value of benefits from tropical forests to identify where net returns from conservation may be greatest.

The implications for resource requirements are that land owners would need to be compensated for these opportunity costs in order to provide sufficient incentives to maintain natural forests rather than convert to these alternative land uses.

Table 2. Annual returns on land converted from tropical forest in Indonesia

Land use	USD/ha/year
Large scale oil palm	3,340
Supported growers - oil palm	2,100
High yield independent - oil palm	2,340
Low yield independent - oil palm	960
Smallholder rubber	72
Rice fallow	28
Cassava monoculture	19



Annual returns on land converted from tropical forest in Indonesia

Sources: Grieg-Gran (2008)

Case study: A Private Management Approach to Coral Reef Conservation in Sabah, Malaysia (Targets 11 and 20)

This case study demonstrates the mobilization of financial resources through private sector involvement related to the establishment and management of protected areas. The case study is linked to Aichi Targets 11 and 20.

The Sugud Islands Marine Conservation Area (SIMCA) was gazetted in 2001 under the Sabah Wildlife Enactment as a result of discussions between the Lankayan Island Dive Resort (LIDR) and key government agencies such as the Sabah Wildlife Department (SWD) and Sabah Parks. The establishment of SIMCA, a group of 3 main uninhabited islands incurred RM200,000 (US$ 63,500), which was funded by LIDR.

Reef Guardian, a private not-for profit organization set up by the parent company of LIDR was awarded a 30-year concession to manage SIMCA for a fee of RM 60,000 (US$ 19,000) per year by the Sabah Wildlife Department. The activities of Reef Guardian are significantly funded through the conservation fee of RM20/tourist/night (US$ 6.40) charged to all visitors to the resort. In addition, Reef Guardian receives RM35,000 (US$ 35,000) annually from LIDR for sub-leasing the three main islands in SIMCA. Reef Guardian also applies for conservation grants to fund its activities. The overall management of SIMCA is estimated to be around RM500,000 (US$ 158,800).

Reef Guardian and the Sabah Wildlife Department collaborate on enforcement operations whereby SWD train and certify Reef Guardian staff as Honorary Wildlife Wardens. The main duties of Reef Guardian are to monitor and enforce regulations, promote best practices for marine conservation and environmental conservation, and MPA enforcement. It has been observed that investments towards establishing the surveillance system, monitoring the reserve, enforcing regulations, training personnel, and undertaking conservation and outreach programs has shown positive developments particularly in terms of decline of illegal fishing and turtle poaching, while fish abundance and turtle nesting have increased.

From the study, important considerations for supporting a private management approach include:

- *Sustainable financing through tourism,*
- *Separation of diver resort and conservation management as two distinct bodies.*
- *Operating resources channelled back directly into conservation*
- *Collaboration with government agencies.*

In addition, the engagement of local communities/fishers related to the management of the marine conservation area was also highlighted to be an important consideration.

Source: Teh *et al.* (2008)

Case study: Biodiversity Conservation and Rural Livelihood Improvement Project in India

Biodiversity is the fundamental element of healthy ecosystems which provide livelihood to local communities. A project is currently being implemented in India by the Ministry of Forests & Environment that deals with this linkage. This case study is relevant to Aichi Targets 5, 14, 15, 18 and 20.

Biodiversity Conservation & Rural Livelihood Improvement Project (BCRLIP) aims at conserving Biodiversity in selected landscapes, including wildlife protected areas/critical conservation areas while improving rural livelihoods through participatory approaches. Development of Joint Forest Management (JFM) and eco-development in some states are models of new approaches to provide benefits to both conservation and local communities. The project intends to build on these models and expand lessons to other globally significant sites in the country to strengthen linkages between conservation and improving livelihoods of local communities that live in the neighbourhood of biodiversity rich areas as well as to enhance the local and national economy.

The project is funded by the World Bank's International Development Association (IDA), the Global Environment Facility (GEF) and contributions from Government of India, State Governments and beneficiaries, amounting to US$ 30.52 million (US$ 15.36 million from IDA; US$ 8.14 million from GEF; US$ 6.06 million from GoI and states; and US$ 0.96 million from beneficiaries), spread over six years. The potential activities to be supported under the project are:

- Demonstration of Landscape Conservation Approaches in two Pilot Sites.
- Strengthening knowledge Management and National Capacity for Replication of Landscape Conservation Approaches.
- Scaling up and Replication of Successful Models of Conservation in Additional Landscapes Sites.
- Coordination for Landscape Conservation.
- The project is to be implemented in six years (2011 to 2017).

Source: MoEF 2013

Table 10. Alignment of MDGs with Aichi Targets - adapted from Pisupati and Rubian (2008) and Unnikrishnan and Suneetha (2012)

#	MDG Goal	Potential policy alignment with Aichi Targets
1	Eradicate extreme poverty and hunger	Targets 1, 2, 4, 6, 7, 10, 13, 18, 19 (Awareness of values of biodiversity, poverty reduction strategies, sustainable production and consumption, sustainable harvesting, sustainable management, coral reefs, genetic diversity, local traditional knowledge, increase knowledge, status & trends)
2	Achieve universal primary education	Targets 1, 2, 7, 14 (Awareness of values of biodiversity, poverty reduction strategies, sustainable management, ecosystem services)
3	Promote gender equality and empower women	Targets 2, 7, 14, 15, 18 (Poverty reduction strategies, sustainable management, ecosystem services, ecosystem resilience, respect traditional knowledge)
4	Reduce child mortality	Targets 1, 2, 13, 14, 18, 19 (Awareness of values of biodiversity, poverty reduction strategies, genetic diversity, ecosystem services, local traditional knowledge, increase knowledge, status & trends)
5	Improve maternal health	Targets 1, 2, 6, 13, 14, 18, 19 (Awareness of values of biodiversity, poverty reduction strategies, sustainable harvesting, genetic diversity, ecosystem services, local traditional knowledge, increase knowledge, status & trends)
6	Combat HIV/ AIDS, malaria and other diseases	Targets 5, 7, 8, 9, 13, 14, 15, 18, 19, 20 (Reduction in habitat loss, sustainable management, pollution reduction, control invasive alien species, genetic diversity, ecosystem services, ecosystem resilience, local traditional knowledge, increase knowledge, S&T, increase in financial resources)
7	Ensure environmental sustainability	Targets 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 15, 18, 19 (Reduction in negative subsidies, sustainable production and consumption, reduction in habitat loss, sustainable harvesting, sustainable management, pollution reduction, invasive alien species, vulnerable ecosystems, protected areas, halt extinctions, ecosystem services, ecosystem resilience, local traditional knowledge, increase knowledge, status & trends)
8	Develop a global partnership for development	Targets 16, 19, 20 (Benefit sharing, increase knowledge, status & trends, increase in financial resources)

Case study: Initiatives demonstrating synergies across countries and programmes

International Centre for Integrated Mountain Development (ICIMOD) is a regional intergovernmental learning and knowledge sharing centre, based in Kathamandu, Nepal serving the eight regional member countries of the Hindu Kush Himalayas which includes India, Pakistan, Bhutan, Bangladesh, Pakistan, Afghanistan, Myanmar and China. Among the large number of initiatives undertaken by ICIMOD, many are specifically based on relevant Aichi Targets in the implemented region/country and often span across more than one country. Information on few of the important initiatives is given below.

ICIMOD Initiative	Relevant Aichi Target	Implemented in
Hindu Kush Himalaya Biodiversity Information Facility	Target 19	All member countries
Hindu Kush Himalaya Conservation Portal	Targets 12 and 14	All member countries
High Altitude Wetlands Initiative	Targets 11, 12, 14 and 15	All member countries
Innovative Livelihoods Options	Targets 2, 14 and 15	All member countries
Innovative Policy and Development Options for Improving Shifting Cultivation in the Eastern Himalayas	Targets 5, 7, 13, 14 and 15	All member countries
Strengthening Upstream-Downstream Linkages	Targets 1, 2, 3, 4, 5, 14 and 15	All member countries
Improving Livelihoods through Knowledge Partnerships and Value Chains of Bee Products and Services in the Himalayas	Targets 3, 4, 14 and 15	Bhutan, India and Nepal
Himalayan Climate Change Adaptation Programme	Targets 14 and 15	All member countries
Assessment of ecosystem services and livelihoods of the people	Targets 14 and 15	Bhutan and Nepal
Kailash Sacred Landscape Conservation	Targets 1, 2, 11, 14, 15, 18 and 19	China, India and Nepal
Gender mainstreaming in rangeland resources management	Targets 2, 3, 4, 5, 14 and 15	China, Nepal and Bhutan
Transect and transboundary landscape	Targets 1, 2, 11, 14, 15, 18 and 19	All member countries
Reduce emission from deforestation	Targets 1, 2, 3, 4, 5, 14 and 15	Nepal
Impacts of climate change on ecosystem services	Targets 11, 14 and 15	Bhutan and Nepal

These initiatives demonstrate the potential for synergies working across programmes as well as countries. Such initiatives are even more important in case the ecosystems and the factors influencing it are transboundary, as in the case of biodiversity conservation in Himalayas. Such programmes also have the opportunity to internalize biodiversity conservation with development agendas in low-income countries and hence address the funding gap for achieving the Targets.

Source: ICIMOD (2012)

Case study: Vulture conservation in Israel

This case study provides information on the cost-effectiveness of vulture conservation actions in Israel, with relevance to Aichi Target 12.

Several efforts are in place at the Gamla and Hai-bar nature reserves in Israel to support populations of the Eurasian Griffon Vulture (Gyps fulvus) in which, respectively, 38 and 18 vultures live (Becker *et al.* 2010). The sites have feeding stations that have a total (fixed and variable) annual cost of 19,552 US dollars (76,000 NIS). Israel also implemented a breeding programme that doubled the national number of breeding vulture couples from 70 to 140. This programme had a cost of 950,000 US dollars (3.7 million NIS).

The annual tourism value of the vultures was between 2.8 million US dollars (10.94 million New Israeli Shekel, or NIS) and 3 million US dollars (11.76 million NIS) for the Gamla nature reserve and between 1 million US dollars (3.91 million NIS) and 2.5 million US dollars (9.84 million NIS) for the Hai-bar nature reserve. Nationally, the economic value of the vulture population is estimated to be 34.4 million US dollars (133.6 million NIS). Although this study is subject to a number of assumptions, its results suggest that the benefits of managing the Eurasian Griffon Vulture outweigh the costs.

Source: Becker *et al.* (2010)

Case study: Grazing management in Jordan

This case study provides information on the cost-effectiveness of grazing management options in Jordan, with relevance to Aichi Target 7.

In the pursuit of higher living standards, the livestock density in Jordan has increased in the last years. In arid climates pressure from overgrazing can lead to desertification of vulnerable ecosystems. Climate change will put further pressure on Jordanian ecosystems through increasing temperatures and a decrease in precipitation.

Schaldach *et al.* (2013) simulate 24 different scenarios for grazing in Jordan, where the scenarios represent different combinations of assumptions about the climate, autonomous increases in livestock and management options. The management options reflect maximum grazing densities per area unit that range from 34% to 100%. The scenarios were assessed from several angles, including land use change and ecosystem service value.

Given equal climate conditions the nation-wide value of ecosystem services was the highest for the management option with low grazing density. This value was negative for some scenarios with the highest grazing density. It should be observed that due to low grazing densities, the total area of land needed to support all the livestock increased. Under a scenario of climate change – and reduced biomass productivity- the option of low grazing density was impossible to achieve due to insufficient suitable grazing areas.

Source: Schaldach *et al.* (2013)

Case study: Invasion of *Acacia saligna* in Israel

This case study provides information on the cost-effectiveness of measures to control an invasive species in Israel, with relevance to Aichi Target 9.

Acacia saligna was introduced in Israel in the early twentieth century to stop soil erosion and provide fodder in an arid climate. Since then the species has spread at a growth rate of almost 3% per year. Efforts to halt the invasion by *A. saligna* through integrated management and accelerated re-establishment of indigenous plants have been successful. It remains unclear whether it is economically optimal to contain the species or to eradicate it.

Lehrer *et al.* (2011) perform an economic valuation of use and non-use values of the Nizzanim nature reserve under two management regimes: containment or eradication of *A. saligna*. For both policies, actions such as clearing, uprooting, burning and sterilization were considered in various combinations and at various intensities. The costs of these action sets were then calculated using existing data.

The analysis showed that when only the benefits of visitors to Nizzanim nature reserve are considered, the costs of containment outweigh its benefits. For the eradication of *A. saligna* the cost-benefit analysis depends on the benefits that are included. If only use values are considered, the costs of eradication the invasive species from the reserve are higher than its benefits. When both use and non-use values are included in the analysis, then there is a positive net benefit of 71,000 – 140,000 US$ (depending on the eradication method).

Source: Lehrer *et al.* (2011)

Case study: Effectiveness of direct payments for biodiversity conservation, Cambodia

This case study provides information on the costs and effectiveness of direct payments for the protection of nests of endangered bird species in the Northern Plains of Cambodia, with relevance to Aichi Targets 3, 5, 12, 14.

This study analyses the effectiveness of a direct payment program that was established for nine globally threatened bird species in the Northern Plains of Cambodia. The program provided conditional payments to local people to protect nests, since most of the species were highly threatened by the collection of eggs and chicks. The program was initiated in 2003 by the Wildlife Conservation Society in collaboration with the Cambodian Ministry of Environment and Forestry Administration.

The annual cost of the program is $30,000, of which 71–78% were payments made to local people and 22–29% were monitoring costs. The average cost per protected nest ranges between $ 66-120 per year. The effectiveness of the program was evaluated for the period 2009-2011 through a system of monitoring protected sites and unprotected control sites. WCS monitoring staff collected monthly data on the location of each active nest, dates of laying, hatching and fledging, habitat type, nest characteristics, and the number of birds, eggs, and chicks present for each species on each visit. Nests were deemed to have failed if they became unoccupied prior to fledging. Monitoring staff investigated all cases of nest failure to determine the cause.

Protected sites are shown to have substantially higher nesting success rates than control sites. Over the course of the program it is estimated that more than 2,700 nests have been protected. Payments significantly improved the success rates of protected nests in comparison with control sites, leading to population increases for at least three species. The program was deemed to be a highly effective conservation intervention to protect highly threatened globally significant biodiversity, in a way that was rapid to establish, cost-efficient and delivered significant benefits to local people.

However, payments did not influence other threats to species, such as land clearance, and have failed to arrest declines in at least one species' population. The average payment per protector was a significant contribution to incomes in remote rural villages. However, the program only benefited a small proportion of people, causing some local jealousies and deliberate disturbance of nesting birds. The program demonstrates that direct payments can be a highly effective conservation tool in those cases where payments correctly target the cause of biodiversity loss. The results also suggest that it is important to consider how decisions over beneficiaries are made, especially in situations where property rights over biodiversity are unclear, if payments are to be socially acceptable. This has important implications for the design of payment schemes in conservation more generally.

Source: Clements *et al.* (2013)

Case study: Costs and benefits of forest conversion in Cambodia

This case study provides information on the relative costs and benefits of forest conservation or conversion in the Cardamom Mountains, Cambodia, with relevance to Aichi Targets 11, 14 and 20.

The case study is based on cost-benefit analysis (CBA) of two protected areas (wildlife sanctuaries) in the Cardamom Mountains, Cambodia. The analysis is based on market-based estimates of the revenues from immediate logging compared with on-going protection with sustainable forestry, agriculture, non-timber forest products and carbon storage values. The results are dominated by two high values: the value of immediate timber extraction, on the one hand, versus the value of carbon storage, on the other. The central estimates show that (over 25 years at a 10% discount rate) the value of the protection scenario exceeds that of the non-protection scenario by a small margin. This conclusion depends on a rather high value assumed for carbon storage: the carbon value from midpoint of IPCC Working Group III: USD 73-183 per tonne of carbon to achieve 'safe' levels. Actual carbon market values, and prices achievable for REDD+ projects, are not at this level. On the other hand there are important omitted values, notably global biodiversity conservation (non-use) values (which could be high for wildlife sanctuaries in tropical forests), and the costs/risks associated with deforestation's effects on erosion, flooding, and water quality/supply. The conclusion is that the protection of these areas may be globally optimal, but is locally costly: some financing mechanism will be essential to ensure on-going conservation. This case is an example of a CBA with quite a targeted aim: not so much to work out whether or not the areas should be protected, as to work out how much financing/compensation will be required in order for local communities to support the protected status.

Source: Grieg-Gran *et al.* (2008)

Case study: Costs and benefits of two protected areas in India

This case study provides information on the costs and benefits of two protected areas in India, Rajiv Gandhi National Park and Dandeli Wildlife Sanctuary, with relevance to Aichi Targets 11 and 14.

These case studies are cost-benefit analyses of protected areas in India, with a focus on the local costs and benefits. Global carbon values and biodiversity benefits are not included. This is not an omission as such, but rather a deliberate limiting of the scope of the CBA to a specific context, the impact on local people.

The Rajiv Gandhi case provides an example of how the total Net Present Value (NPV) may look positive or negative depending on the boundaries/stakeholder groups included, even at a very local scale. Tribal communities receive a large positive total benefit from the national park, however this is paid for by neighbouring coffee growers, turning the NPV negative overall. Extending this study to cover the national and global benefits from conservation in this zone, including non-use benefits for iconic biodiversity, would very likely show strong net benefits.

The Dandeli case similarly provides insight into the potential costs and benefits of biodiversity conservation to villagers living in and around a wildlife sanctuary, including their own valuations for biodiversity conservation. The study shows that the agricultural opportunity cost is almost twice as large as the benefits the villagers receive from NTFPs from the sanctuary. The villagers' values for biodiversity conservation balance this out to some extent, however the data available from this study shows that overall NPVs are negative from a local perspective. Hence there is a need to compensate villagers for the conservation. The study does not cover regional, national or global tourism and non-use values for conservation in this area; it seems likely that the inclusion of such values would show a positive NPV overall, and that it may be possible to use such a study to construct a case for national or international support to conservation in the area and compensation for local losses.

Sources: Ninan *et al.* (2007a); Ninan *et al.* (2007b)

Case study: Costs and benefits of water catchment conservation, Upper Tuul watershed, Mongolia

This case study provides information on the costs and benefits of water catchment conservation in the Upper Tuul watershed, Mongolia, with relevance to Aichi Targets 11 and 14.

This case study looks at the conservation of the Tuul basin, a catchment area of almost 50,000 km^2 from which Ulaanbaatar derives its water. Ecological conditions in the upper watershed have a direct link to the availability of surface water and groundwater downstream in Ulaanbaatar. A recent study shows that as the ecosystem is degraded and forest cover is lost; average runoff will increase and the river's mean annual maximum and low flows will be intensified. Diminished discharge would lead to a lowering of the groundwater table of between 0.24 metres (under a continuation of the status quo) and 0.4 metres (under a scenario of rapid degradation). In 25 years' time, daily water supply in Ulaanbaatar would be reduced by some 32,000 to 52,000m^3 respectively. In contrast, conservation and sustainable use of the upper watershed would protect current river flow and groundwater levels. Weighing up the gains (sustained water supplies to Ulaanbaatar) and losses (reduced land values in the upper watershed) conservation of natural habitats in the Upper Tuul is the most economically beneficial future management scenarios. The conservation and sustainable use scenario yields a net present value of USD 560 million over 25 years. This is higher than the net present values generated under either a continuation of the status quo or a scenario of rapid ecosystem degradation.

There is a clear conclusion that water supply function alone could justify the costs of conservation, but that for local people this would involve losses, and hence effective conservation is likely to require compensatory financing.

Source: Emerton *et al.* (2009)

Case study: Costs and benefits of ecosystem restoration, Ejina ecosystem, China

This case study provides information on the costs and benefits of water catchment conservation in the Ejina ecosystem, Gansu, China, with relevance to Aichi Targets 14 and 15.

The Ejina oasis is located in the Hei river basin of Gansu Province, China. Ejina lies in the lower reaches of Hei River, is situated south of Monogolia and western Inner Mongolia. With a current population of near 16 thousand, Ejina is one of the most sparsely populated districts in China.

Due to excessive water use, the Ejina ecosystem is becoming increasingly desertified, which has led to soil erosion and the occurrence of sand storms that may impact other parts of Northern China. In response the government and Hei River management bureau decided to implement a number of conservation measures to restore Ejina's ecosystem, including the restoration of natural vegetation to establish an effective ecological protective shield in Ejina. The estimated present value cost of this this restoration effort is approximately 400 million RMB (US$ 650 million) over 5 years.

The benefits of ecosystem restoration are estimated through a contingent valuation survey of local residents. Total present value benefits are estimated to be approximately 55 million RMB (US$ 9 million) over 20 years. The costs of restoration therefore greatly exceed the estimated benefits. The aggregated benefits are low because the ecosystem is located in a relatively sparsely populated region. It is noted, however, that the potential benefits to the populations of other districts are not estimated.

Source: Zhongmin *et al.* (2003)

Case study: Costs and benefits of conservation of Jiuduansha Wetland, Shanghai, China

This case study provides information on the costs and benefits of conservation of the Jiuduansha wetland, Shanghai, China, with relevance to Aichi Targets 5 and 14.

This case study was conducted on the Jiuduansha Wetland in Shanghai using three approaches to value the costs and benefits of conservation. The three methods are direct market valuation, replacement valuation and contingent valuation. The net present TEVs of three land use scenarios over one hundred years were evaluated. The results show that the "partial conversion into dry land" scenario is likely to be the optimal scenario for the well-being of the people in Shanghai when compared with the other two scenarios of "conservation" and "selective use". This outcome is due to the scarcity of land available for economic development in Shanghai and the resulting high opportunity cost of conserving the wetland. The authors conclude that wilderness areas that are located in highly developed economic regions are likely to be destroyed. They note, however, that "since some important benefits of natural ecosystems remain unknown and others are underestimated, we suggest that any land use decisions regarding the Jiuduansha Wetland should be conservative and cautious as converting wetlands into terrene (dry land) is an irreversible process."

Source: Su and Zhang (2007)

Case study: Costs and benefits of forest conservation, Leuser ecosystem, Sumatra, Indonesia

This case study provides information on the costs and benefits of alternative future scenarios for the Leuser ecosystem in Sumatra, Indonesia, with relevance to Aichi Targets 5, 11, and 14.

This case study describes the value of a broad set of ecosystem services provided by the Leuser forest ecosystem in Sumatra, Indonesia. Table 1 presents the estimated present values of of ecosystem services over a 30-year period. The timing of the flow of benefits under each scenario is presented in Figure 1. The case study highlights the distribution of ecosystem service benefits across different stakeholders and the trade-off between short term gains for some versus larger long term losses for others. The analysis shows that the net benefits of conservation outweigh the net benefits of deforestation in the long-run. Although the economic case for conservation is clear, there remain many challenges in protecting the Leuser ecosystem in terms of providing incentives for local people not to pursue short term private gains from deforestation.

Table 1. The economic value of ecosystem services in the Leuser ecosystem over a 30-year period (million US$)

	Deforestation scenario	Conservation scenario	Additional benefit of conservation
Water supply	1,059	2,487	1,428
Fishery	2,025	2,490	465
Flood prevention	1,622	1,860	238
Agriculture	3,512	3,991	479
Hydro-electricity	15	26	11
Tourism	25	139	114
Biodiversity	103	582	479
Carbon sequestration	0	1,217	1,217
Fire prevention	183	225	42
Non-timber forest products	161	391	230
Timber	3,308	0	-3,308
Total	**12,013**	**13,408**	**1,395**

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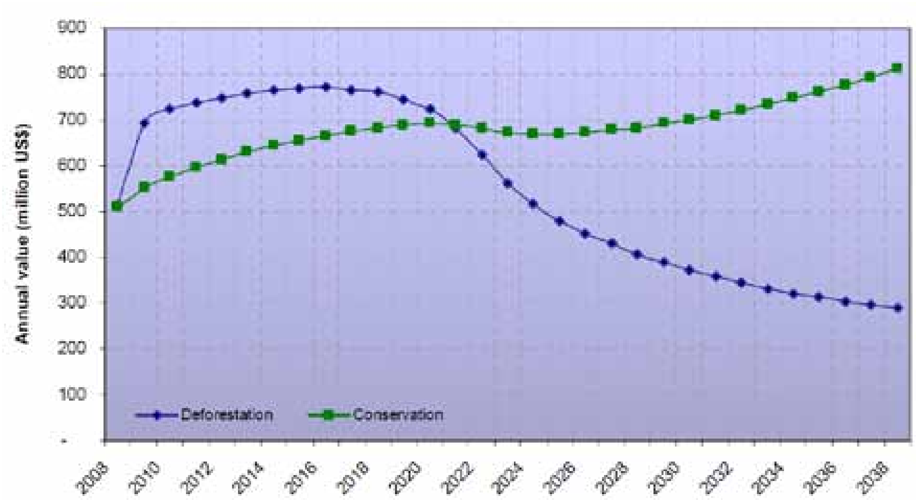

Figure 1. Net annual benefits of deforestation and conservation over time.

Source: van Beukering *et al.* 2003; 2009.

Case study: Economics of coral reef destruction in Sri Lanka

This case study provides information on cost-benefit analysis of coral reef destruction in Sri Lanka and is relevant to Aichi Targets 1, 2, 3, 7, 10 and 14.

Coral reefs are a resource of immense importance for a large number of people, especially the coastal populations of the developing world. Available information on coral reefs in Sri Lanka and Southeast Asia was used to evaluate the ecological services provided by coral reefs and to assess the long-term economic benefits derived from some of the ecosystem functions. The minimum economic value of coral reefs in Sri Lanka is estimated at US$ 140,000-7,500,000 per km^2 reef over a 20 year period. The economic consequences of coral mining were investigated and economic costs (US$ 110,000-7,360,000) were found to exceed net benefits (US$ 750,000-1,670,000) by as much as US$ 6,610,000 km^2 reef when analysed over 20 years in tourism areas. The highest costs were associated with decreased tourism (US$ 2-3 million) and increased erosion (US$ 1-4 million). However, in rural areas there is still a strong incentive for coral mining, because coral mining in the short-term perspective provides a more profitable business compared to fishing and agriculture. The results have implications for management and show that Sri Lankan legislation banning coral mining in the coastal zone is beneficial to the country's economic development.

Source: Berg *et al.* 1998

APPENDIX 3. AUSTRALASIA AND THE PACIFIC

Case Study 1a: Economic benefits of reducing water extracted for irrigation from the River Murray and leaving it in the system to improve wetland and floodplain health (Aichi Target 7)

This case study demonstrates the ecosystem service and economic benefits of more efficient and sustainable irrigated agriculture.

Background: Irrigated agriculture in the Murray-Darling Basin in south-eastern Australia has historically over-extracted water resulting in significant stress to the ecological health of wetlands and floodplains, particularly in the lower reach of the catchment. These ecosystems depend on regular wetting and flooding, which has been reduced in frequency and extent through the regulation of the river and the extraction of substantial volumes of water for irrigation. The Australian Government is implementing a series of reforms that reduce the amount of water extracted for irrigation, thereby leaving more water within the river system and increasing the frequency of wetland and floodplain inundation. The reforms centre on the voluntary surrender to the Australian Government of irrigators water rights through the water market, and Government investment in more efficient irrigation infrastructure on-farm and off-farm.

Results: Based on the work of CSIRO (2012), this case study demonstrates that more sustainable irrigated agriculture results in significant ecosystem service and economic benefits resulting from healthier wetland and floodplains that maintain biological diversity. CSIRO (2012) demonstrated that reducing the amount of water extracted for irrigation by approximately 25% is potentially worth AU$ 3 billion - AU$ 8 billion (US$ 2.7 – US$ 7.1 billion) in WTP estimates for improved habitat condition; AU$ 340 million (US$ 302 million) in improved amenity and aesthetic value of healthy wetlands; AU$ 120 million - AU$ 1 billion (US$ 106 – 888 million) in annual carbon sequestration value (assuming a carbon price of AU$ 23 (US$ 20) per tonne); AU$160 million (US$ 142 million) annually in improved tourism activity, and AU$ 18 million (US$ 16 million) annually in avoided water treatment costs.

Implications for CBD: Although water efficiency improvements in agriculture may require significant government investment (e.g. ~AU$ 9 billion (US$ 8 billion) in the case of the Australian Government), the ecosystem service and broader public good benefits could be worth the same or more from healthier water ecosystems that maintain ecosystem function and biological diversity.

Source: CSIRO (2012)

Case Study Box 1: Economic values of coral reef ecosystem services for four Pacific Island States (Aichi Targets 10, 14)

This case study provides information on the economic value of ecosystem services provided by coral reefs in Fiji, New Caledonia, Vanuatu and the Northern Mariana Islands, with relevance to Aichi Targets 10 and 14.

This case study is based on a recent review of the economic value of ecosystem services from coral reefs in the South Pacific by Laurens *et al.* (2013). This study summarises the results of the extant literature on the economic value of coral reef ecosystem services and examines how this information has and can be used in conservation decision making. Tables 1 and 2 summarise the values for different ecosystem services in terms of annual values per hectare and annual values per capita respectively. Three main ecosystem services explain over 80% of the sum of estimated values; these are tourism, coastal protection and coral reef fisheries in their different forms. They represent the key ecosystem services generated by coral reefs in the Pacific, regardless of social and ecological contexts. There is, however, substantial variation in the values of different ecosystem services across islands, reflecting important determining differences in socio-economic characteristics. For example, reef related fisheries are found to be economically important relative to reef related tourism in Fiji, whereas the opposite is true for the Northern Mariana Islands. It is therefore difficult to generalise the benefits of coral reef conservation without accounting for the socio-economic context of coral reefs.

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Table 1. Economic values for ecosystem services from coral reefs (US$/hectare/year)

	Fiji (O'Garra, 2012)	New Caledonia (Pascal, 2010)	Vanuatu (Pascal, 2011)	Northern Mariana Islands (van Beukering *et al.* 2006)
Subsistence fishing	336	46	147	-
Commercial fishery	257	45	88	106
Recreational fishery	-	55	-	72
Underwater tourism	-	20	-	1,595
Associated tourism	2	42	179	13,045
Coastal protection	350	394	38	2,782
Research and education	-	8	-	273
Bequest value	26	-	207	-

Table 2. Economic values for ecosystem services from coral reefs (US$/capita/year)

	Fiji (O'Garra, 2012)	New Caledonia (Pascal, 2010)	Vanuatu (Pascal, 2011)	Northern Mariana Islands (van Beukering *et al.* 2006)
Subsistence fishing	1,037	92	113	-
Commercial fishery	793	90	68	15
Recreational fishery	-	111		23
Underwater tourism	-	39		9
Associated tourism	7	81	137	1,913
Coastal protection	1,081	792	29	408
Research and education	-	15	-	40
Bequest value	79	-	159	-

Implications for CBD: Although not estimated in all studies, the majority of Benefit Cost Ratios (BCR) of MPAs are very attractive in terms of public investments (BCR > 2 on average). Results evidence the economic efficiency of implementing Aichi Target 10 and 14.

Sources: Laurans *et al.* (2013); O'Garra (2009), (2012); Pascal, (2010), (2011); van Beukering *et al.* (2006)

Case Study Box 2: The Economic Value of the Coral Reefs of Saipan, Commonwealth of the Northern Mariana Islands (Aichi Targets 1, 2 10 and 14)

At the core of the economic value of coral reefs on Saipan are the various ecosystem functions associated with these marine systems. These, in turn, translate into reef- associated goods and services (e.g. tourism, fisheries). The sum of these values forms the Total Economic Value (TEV), representing the entire economic importance of Saipan's marine environment, which was estimated at US$61.16 million per year. Market values make up 73% of the TEV, while the remaining 27% consist of non-market values. Due to uncertainties in the data and the analysis, the TEV may vary between US$42 million and US$76 million per year. With an annual value of US$42.31 million, the tourism industry is by far the greatest beneficiary of the services provided by coral reefs on Saipan. This economic importance is not reflected in the funds made available by the CNMI Government to manage the reefs.

The spatial dimension of interactions between the economy and coral reef is crucial in understanding their economic value. Generally, the beneficiaries of the reefs' goods and services are not spread evenly throughout Saipan, but vary from location to location. Therefore, Geographic Information System (GIS) tools were used to increase our understanding of this spatial variation in economic values. This helped us to recommend policy interventions more effectively. Although the average value of reefs per square kilometer amounted to US$0.8 million, the highest value per square kilometer was around US$9 million. This highest value category is predominantly comprised of the most popular diving and snorkeling sites. Having compared the distribution of reefs' total economic value and their anthropogenic threats, we conclude that, in general, the more valuable the reef, the poorer their condition and the greater their threats.

Implications for CBD: Even without computing Cost-Benefit Ratios, the high values of benefits produced by coral reefs for the local economy demonstrate the importance of public investment in Aichi Target 6, 10 and 14.

Source: van Beukering *et al.* (2006)

Case Study Box 3: The economic value of coral reef ecosystem services of New Caledonia

New Caledonia represents a very specific socio-ecological and economic context. A huge coral reef complex (more than 4,500 km^2 of reef and more than 20,000 km^2 of lagoon zones) is present with a low-density population (245,000 habitants). The men and reef interactions are much contrasted amongst the different cultural groups present in New Caledonia. In the same way, a part of the population has based its economy on services with a very high purchasing power and coexists with a population living on a non-merchant economy relying partly on subsistence agriculture and fishing.

The 2009 annual financial value of services generated by New Caledonia coral reef ecosystems and associated ecosystems (mangroves, sea grass and soft bottom) has been estimated in a consolidated value between €190-€320 million euro (US$250-$425 million).

The most important ecosystem service in terms of economic impact at the island level is the coastal protection against the waves and represents two thirds of the total value as avoided costs of flooding. It is followed by fishing (20% of the total value) and tourism (10%).

Focusing only on financial flows accountable in real GDP calculations, reefs create a wealth for New Caledonia that varies between €78-103 million Euros (US$100-137 million). Fishing ranks first (70% approx.), followed by tourism (28%) and research & education. The importance of subsistence and recreational fishing is significant (27% and 22% respectively).

The possible applications of the study were discussed in several meetings with local policy-makers. The valuation of compensatory measures for environmental impact, tradeoffs in environmental budget and the advocacy role seem to be the main ones.

Implications for CBD: Even without computing Cost-Benefit Ratios, the high values of benefits produced by coral reefs for the local economy demonstrate the importance of public investment in Aichi Targets 6, 10 and 14.

Source: Pascal (2011)

Case Study Box 4: Socio-economic Assessment of Fishing Practices by North and South Tarawa Fishers in Kiribati

The study reviews the fishing methods and practices used by the people of North and South Tarawa and highlight those which are considered to be destructive and analyses their economic and social consequences. The study provides a socio-economic evaluation of the current scenario and analyzes the consequences for coastal communities of Tarawa. This assessment suggests the need for a more effective fisheries management regime for Kiribati which in turn will require regulatory and policy change to reduce the level of fishing effort to achieve sustainable fisheries. A possible pathway for such changes is suggested to enable the communities, if they wish to adopt greater responsibility and governance over their fishing practices and livelihoods. The key findings of the study can be summarized as follows: (i) Use of multiple gillnets is becoming more widespread with splash method commonly known as te ororo by commercial fishers ; (ii) Coastal fisheries generally have no capacity or catch limits and is practically considered as an open access fishery; (iii) The cost of destructive te ororo over 26 years when 75% of the reefs would be damaged at current rate of exploitation is estimated to be US$68 million or about US$ 2.7 million annually; (iv) Fishing pressure could be reduced by imposing restrictions on fishing methods and areas, diverting effort to oceanic areas and in non-fishery sectors, mariculture and possible use of Fish Aggregation Devices and artificial reefs; (v) Careful formulation of an appropriate institutional framework that empowers the coastal communities to manage the fishery is essential; (vi) a wide consultation is necessary in the formulation and development of a comprehensive Fisheries Management Plan.

Implications for CBD: The high values of losses resulting from damaging coral reefs through unsustainable fishing practices highlight the need for public investment in Aichi Targets 6 and 10.

Source: Vina Ram-Bidesi and Satalaka Petaia (2011)

Case Study Box 5: Willingness to Pay (WTP) for conservation of Coral reef ecosystems and non-use values in New Caledonia (Aichi Targets 1, 2 and 10)

The study aims at: (i) Studying populations' preferences regarding New-Caledonian coral reefs and their management ; (ii) Estimating their general WTP for preserving coral reefs ; (iii) Quantifying non-use values (NUV) for coral reef in New-Caledonia.

In order to cope simultaneously with the two last objectives, the study focuses on estimating the WTP for preserving coral reef over time, which allows differentiating between use and non-use values. The later are defined as the WTP to preserve ecosystems beyond one's life-expectancy. This interpretation was put into practice through a Discrete Choice Experiment (DCE), where individuals have to choose between different scenarios involving a payment (around 5, 10, 15 and 20 US$) and the preservation of several CRE attributes for 20, 50 or 100 years, namely the quantity of animals fished, the health and richness of marine life, the coastal and marine landscapes and the areas of practice. In total, 550 face-to-face interviews were conducted in two different areas on the western coast of New-Caledonia with different environmental, cultural and socio-economic contexts: (i) One UNESCO world heritage area covering five districts in the southern Province ("Zone Côtière Ouest" or ZCO area); (ii) One mining area in the Northern Province covering three districts ("Voh Koné Pouembout" or VKP area).

For both areas, the average WTP for preserving New-Caledonian coral reef ecosystems for 20, 50 and 100 years are respectively around US$ 47, 61 and 71 (36, 47 and 55 €) per month and per household, leading to a total WTP that ranges from US$ 2.5 to 4 million per year when extrapolating to all the households present in both areas. Results show that NUV represent at least 25% of total WTP for preserving coral reefs during 100 years.

More broadly, the results show that the longer coral reef preservation is guaranteed over time, the greater is the satisfaction and well-being of New-Caledonian populations; mainly because of non-use values.

Implications for CBD: The importance placed on marine ecosystems by Pacific local populations may contribute to convincing policy-makers to invest in Aichi Target 10 and 14. In the same way, these arguments may be the basis of communication strategies of Aichi Target 1.

Source: Marre (2012)

Case Study Box 7: Nature's Investment Bank: how marine protected areas contribute to poverty reduction. Yavusa Navakavu Locally Managed Marine Area (Fiji)

This study assesses if four marine protected areas (in Fiji, Solomon Islands, the Philippines and Indonesia) have contributed to poverty reduction locally. The study sites were chosen because local experts believed they had contributed to poverty reduction and to be as different as possible from one another. The analysis is based on comparing the results of a survey of households with and without MPA against three sets of poverty criteria: opportunity (income, housing, luxury goods, fish catch, education, alternative livelihoods), empowerment (governance mechanism, community participation, benefits to women, access and rights) and security (health, social cohesion, cultural traditions). The study it provides an interesting take on the valuation of a reef conservation project. It does not consider costs and limits its analysis to qualitative assessments (qualitative scale questions).

Overall, because of the Navakavu MPA in Fiji, there has been an increase in abundance and size of fish and invertebrates as well as an increase in incomes since the MPA was established in 2002. The findings show a perceived positive relationship between conservation measures and assets. People are earning more net income now than before from the harvesting of marine resources. The qualitative assessment revealed that the Navakavu MPA has increased assets and opportunities. Incomes have increased and this is vital to the community. Fishing is the number one source of income followed by agriculture.

Implications for CBD: The results provide evidence of the economic efficiency of investing in nature conservation as a development tool for rural populations (Aichi Target 14 and 18).

Source: Leisher *et al.* (2007)

Case Study Box 8: Economic Valuation Of Mangrove Ecosystem Services In Vanuatu: Case Study of Crab Bay (Malekula Island) and Eratap (Efate Island)

This study objective is to produce the economic valuation of mangrove ecosystem services in Vanuatu. It is part of a project developed to address the main challenges to mangrove management and conservation. Specifically, the study contributes to the Aichi Target 2 as well as Target 15 and 18.

Based on the economic valuation of 9 ecosystem services (ES1 to ES9), the following results were found: (i) In Crab bay, mangrove ecosystems (136.5 ha) have produced in 2012 a total of US$ 586K). In Eratap, the mangrove (31.2 ha) was estimated to produce annually a value of US$ 266K. For comparison between sites this is equivalent to US$ 4,300.y-1.ha-1 in Crab bay and US$ 8,500.y-1.ha-1 in Eratap.

In Crab bay, the principal ecosystem services in economic terms are the value of carbon sequestrated (ES9), the proteins from subsistence fishery (ES1), the commercial fishery (ES2) and the wood extraction (ES4) summing almost 98% of the total value.

In Eratap, the principal ES are the value of carbon sequestrated (ES9), the revenues from tourism linked to mangroves (ES5), the avoided costs from coastal protection against flood (ES6) and proteins for subsistence fishery (ES1) for a total of 85% of the total value. Commercial fishery (ES2), wood extraction (ES4) and recreative fishery (ES3) are the other ES.

An important result of the study is the identification of social groups who are beneficiaries of ecosystem services in Crab bay and Eratap. The figure below summarizes this. The main beneficiaries are:

- Fishermen of the commercial artisanal fishery (300 in Crab bay and 50 in Eratap)
- Local families for whom fishing in the mangrove and in the reef is a source of regular protein (160 households in Crab bay and 80 households in Eratap)
- Local families benefiting from firewood and construction material (150 households in Crab bay and 45 in Eratap)
- Tourism entrepreneurs in Eratap proposing mangrove tourism (2 businesses, 800 tourists a year)
- Real estate owners protected from coastal flooding (2 tourism resorts in Eratap> 3,000 m2) as well as plantation owners (300 ha in Crab bay)
- The global community to benefit from carbon sequestration and biodiversity.
- Tourism entrepreneurs in Eratap whose business depends on the quality of water of the lagoon as well as beach formation (2 businesses, 21 jobs, 11,500 tourists a year).

In total, nearly 800 people depend on one or more of the mangrove ecosystem services in Crab bay and 400 in Eratap.

Implications for CBD: The results provide evidence of the social importance of investing in nature conservation through the implementation of Aichi Target 10, 14 and 18. In the same way, it demonstrates the benefits of Aichi Target 11 and 13 through the valuation of flood damage avoided.

Source: Pascal (2013)

Descriptions of investments and activities for the Pacific region

Target 1, 2, 3, 14, 18 and 19:

Investment and activity category for the Pacific region	Details of investments and activities for the Pacific region
Capacity building for all implicated stakeholders (from communities to government) on the main conservation tools (planning, EIA, EBM, etc.)	i. Develop and implement local capacity training programs for National, State and Municipal personnel involved in the formation and implementation of conservation related programs, including education and enforcement sectors. ii. Develop and implement capacity building training for local communities, resource owners and traditional leaders on the principals and benefits of (a) Environmental Impact Assessment (EIA) and (b) economic valuation of ecosystem services. iii. Provide and implement local training programs on community based conservation management approaches, methodologies and the development of sustainable income generating activities. iv. Provide training and capacity building for communities on their legal rights and appropriate procedures for reporting environmental offences. v. Develop and implement local capacity building and strengthening programs on alternative ecologically friendly industries and energy conservation and management.
TEEB and Green Accounting	vi. Undertake economic valuations of ecosystem services for terrestrial, aquatic area use. vii. Develop and implement mechanisms for the establishment of National and State “green” accounting programs, including incentives. viii. Encourage the Government to carry out a survey and/or feasibility study to assess the value of fisheries for comparison of benefits from foreign fishing vessels fishing in the country Exclusive Economic Zone
Education and public awareness campaigns	ix. Develop, promote and conduct public awareness campaigns and programs though media, workshops/seminars and information material for National and State government agencies, municipal councils and relevant targets groups including resource owners on the functions and benefits of conserving and sustainable utilization of the nation’s biodiversity. x. Integrate information on traditional knowledge and promote traditional practices that are important for the conservation and sustainable use of biodiversity into the education curriculum xi. Initiate a coordinated awareness, educational and training programme for landowning and Traditional Fishing Rights Owners (TFRO) communities emphasising the benefits of biodiversity conservation and its links with sustainable management of natural resources.

Target 4:

Promote and support research and pilot programs that develop partnerships between the government and private sector to develop ecologically sustainable industries.

Establish incentive based programs for "environmentally friendly" community development, including economic incentives and financial access for these activities.

Investment and activity category for the Pacific region	Details of investments and activities for the Pacific region
Sustainable production and consumption	i. Develop guidelines and protocols for the sustainable use of the nation's biodiversity through activities (e.g. eco-tourism, non-timber forest products and mariculture). ii. Promote the development of ecologically sustainable and economically profitable enterprises utilizing and conserving the nation's biodiversity and utilizing economic incentives (e.g. tax breaks) to promote expansion of these activities while removing all incentives for non-compliant industries. iii. Establish environmental certification "green products" for natural resource export by the private sector at sustainable levels (e.g. marine aquarium council certification and forest stewardship certification). iv. Discourage and reduce the use of unsustainable farming practices. This includes excessive machine tillage of farming lands, misuse of inorganic fertilizers and agrochemicals. v. Review and implement appropriate partnerships with communities to enable them to attain sustainable community level resource management; vi. Research the development of a sustainable logging industry. Approve the Code of Logging for the logging industry limiting the cut per year and technology to be used.

Target 5 and 10:

Undertake a survey of current status of biological resources, specifically those of subsistence and economic importance and those that are threatened or in need of some form of protection.

Investment and activity category for the Pacific region	Details of investments and activities for the Pacific region
Sustainable production and consumption	▪ Encourage the replanting of trees for fuel wood and for raw material for cultural, social and economic purposes ▪ Strengthen existing legislation and or introduce new ones to support effective EIA procedures as a means of regulating sand mining, land reclamation, coral quarrying, mangrove destruction and waste disposal ▪ Take action to reduce the number of small sites used to extract materials for road construction and concentrate this activity at a few well- chosen sites. ▪ Promote the sustainable management of indigenous forest including mangroves

Target 6 and 10:

Investment and activity category for the Pacific region	Details of investments and activities for the Pacific region
Management plans (Aichi Target 6)	i. Finalize, implement and enforce ecosystem management plans through legislation. Special enforcement actions are required to eliminate destructive practices (e.g. dynamite fishing). ii. Develop and implement a comprehensive inshore fisheries management plan, including assessment and monitoring of offshore reefs iii. Develop and implement management plans to conserve deep slope fishery with emphasis on the sustainable management of specific stocks of pelagic species iv. Ensure the enforcement of existing Whale Watching Operators and Guides Guidelines to minimized negative impacts of whale watching activities, anchoring of yachts etc on whale populations and environments. v. Put in place legislation to protect recognised traditional fishing grounds. vi. Review and update forest legislation and effectively enforce it to support the implementation of the national forest policy and NBSAP.
Ecosystem based approach activities for fishery (Aichi Target 6)	i. Increase the number of mooring buoys located within designate marine areas in each State for large vessels, especially the tuna fishing fleet. ii. Collaborate closely with local communities regarding the reporting and implementation of measures against algae bloom and outbreaks of crown-of-thorns. iii. Regulate the size of fishing nets that are being used for inshore fishing iv. Through legislation and enforcement eliminate all destructive harvesting practices (e.g. dynamite and fish poisoning fishing). v. Identify and secure funding to support the development and implementation of the tuna and billfish management plan

Target 7 and 13:

Investment and activity category for the Pacific region	Details of investments and activities for the Pacific region
Policy support activities (Aichi Target 7 and 13)	i. Eliminate unsustainable agro-biodiversity use. ii. Evaluate the usefulness and impacts of new biotechnologies. iii. Document and publish all research information and findings and maintain collections of information in each State. iv. Review existing land-use plans and resource maps and identify forest areas essential for biodiversity conservation and water catchment areas.
Incentives for good practices (Aichi Target 7 and 13)	v. Encourage traditional and sustainable farming practices using incentive schemes including provision of free-seedlings and technical advice vi. Establish incentives that encourage conservation and sustainable use of agrobiodiversity vii. Promote environmentally sound agricultural practices (e.g. organic farming, agroforestry and polyculture). viii. Identify, develop and establish botanical gardens featuring local endemic, endangered and threatened species.
Restoration of degraded sites	ix. Promote the replanting of trees along farm boundaries and the replanting with trees of degraded sites

Target 8:

Investment and activity category for the Pacific region	Details of investments and activities for the Pacific region
Awareness and capacity building for waste management	▪ Increase public awareness, education and acceptance of correct sanitation practices, waste disposal mechanisms and pollution programs. ▪ Develop and implement local capacity building and strengthening programs on correct waste management usage and disposal, including removal of hazardous waste products (e.g. machinery and toxic products) and recycling. ▪ Undertake surveillance of ships to ensure there is no discharge of waste or ballast and fine polluters.
Infrastructures and programs for waste management	▪ Technical assistance program will be developed and implemented to fund necessary infrastructure (e.g. water systems, refuse dumps, recycling facilities, sewer systems and treatments plants) to assure the health and welfare of all inhabitants. ▪ Develop and implement waste collection, storage and disposal programs for residential and commercial premises in the main urban centers. ▪ Develop and implement programs for reuse and recycling of wastes, both within and outside the country. ▪ Develop and implement waste management programs that prevent contamination of freshwater (including ground water lens and coastal marine environment) from dumpsites.

Target 9: invasive alien species

Investment and activity category for the Pacific region	Details of investments and activities for the Pacific region
Awareness campaigns and capacity building about invasive alien species	▪ Undertake capacity building training for quarantine personnel (National and State) on border control, quarantine services and the effective screening of new species introductions and necessary eradication of potentially invasive species. ▪ Develop and implement National and State public awareness programs for invasive species to prevent illegal introductions and encourage control.
Programs, policies and regulations on invasive alien species	▪ Further develop and implement National and State laws and screening processes for alien species introductions and genetically modified organisms to manage or minimize their impacts on the nation's biodiversity. ▪ Organize invasive species task force and develop rapid response plans in each State. ▪ Implement regional and international programs to protect native marine biodiversity on the high seas and all coastal ports. ▪ Support the Pacific Islands Ecosystems at Risk (PIER) Project and border control operation of the MAFF Quarantine Service particularly those targeting high priority invasive species.

Target 11:

- To develop and implement programs for the restoration of degraded aquatic and terrestrial ecosystems, prioritizing those of endemic, endangered and threatened species.
- Develop and implement conservation of biodiversity in important natural and cultural heritage sites throughout the nation.
- Identify critical coastal and marine areas vital as habitats and for the spawning and breeding of species of high economic, conservation, and or cultural importance and promote their strict protection as managed marine parks, reserves and or sanctuary areas
- Promote linkages between sustainable natural resource use and conservation area establishment

Investment and activity category for the Pacific region	Details of investments and activities for the Pacific region
Programs, policies and regulations for MPAs with a focus on co-management	▪ Further develop and implement management plans for the existing marine and terrestrial conservation areas within the nation. ▪ Identify, develop, design and implement management plans for new aquatic and terrestrial conservation areas ▪ Integrate all management plans and protected area programs with community/ resource owner participation activities including enforcement. ▪ Identify and conserve critical watershed areas.
Awareness campaigns and capacity building	▪ Further develop an appropriate information system (e.g.: Geographical Information System) to store and share information on ecosystems and conservation areas. ▪ Promote linkages with the tourism sector in the establishment, management and marketing of protected areas

Target 12:

Investment and activity category for the Pacific region	Details of investments and activities for the Pacific region
Programs, policies and regulations to avoid extinction of known threatened species	▪ Establish, maintain and update a threatened species list. ▪ Work with other countries to further develop and implement regional and international programs to protect migratory species (e.g. Turtles). ▪ Further develop and strengthen endangered species laws and regulations.
Specific activities	▪ Further develop State botanical gardens to house collections of native flora. ▪ Support and develop a monitoring program to evaluate the impact of coral bleaching and crown of thorns starfish on coral reefs.Investigate the potential and feasibility of developing captive breeding programs to prevent species extinctions.

Target 16:

Investment and activity category for the Pacific region	Details of investments and activities for the Pacific region
Programs, policies and regulations for bio-prospection	▪ Develop National and State bio-prospecting legislation. ▪ Develop benefit-sharing mechanisms for holders of knowledge and owners of resources utilized in bio-prospecting ▪ Establish a bio-prospecting-coordinating national expert panel.
Specific activities	▪ Develop a research permit process that include provisions for hiring local associates in order to assure that local capacity is developed and supported in conjunction with research on genetic resources.

Target 20:

Investment and activity category for the Pacific region	Details of investments and activities for the Pacific region
Programs, policies and regulations for conservation finance Capacity building	▪ Identify and implement appropriate programs to promote and support sustainable income generating activities at the community level ▪ Organize formal short training in proposal writing and fund raising planning for NGOs and government agencies. ▪ Develop and regularly update a database of all potential donor assistance programs and distribute to all relevant agencies within the nation.
Financing gap analysis	▪ Implement a National Capacity Self Assessment project to identify areas of capacity needs ▪ Develop long term financial plans for undertaking sustainable biodiversity management and conservation programs for the nation. ▪ Design and develop a network of relevant biodiversity agencies for documenting revenues and expenditures on biodiversity related activities.
Specific economic instruments development: conservation trust fund and other instruments	▪ Explore the feasibility of setting up a national funding mechanism for biodiversity conservation. ▪ Identify long term funding sources for the establishment of these funds for the implementation of the NBSAP and relevant biodiversity related activities within the nation. ▪ Explore and develop a program that introduces a user fee program for conservation areas to provide additional funding assistance for the management of these areas. ▪ Develop and support community based biodiversity-friendly NGO's. ▪ Promote the use of economic instruments such as permit and access fees for bio-prospecting, eco-tourism fees, EIA related levies, national lotteries and other gaming revenues to fund a national funding mechanism for biodiversity. ▪ Create opportunities for representatives of the private sector and conservation NGOs to sit on national coordinating committees dealing with different environmental issues.

The types of actions identified in HLP1 report

For targets 1, 2, 3 and 4 the HLP report described the following actions:

- Baseline survey of awareness (and future monitoring)
- National communication / awareness strategy
- 5 further specific awareness raising activities (a. mass media campaigns; b. training programmes; c. integration of biodiversity into education; d. workshops; and e. events);
- National assessments of biodiversity values through a programme of TEEB like studies in all countries.
- Actions to raise awareness of the values of biodiversity among policy makers, and to integrate them into a range of relevant policies, strategies and processes.
- Specific initiatives to integrate biodiversity into national accounting and reporting systems.
- National studies to develop inventories of biodiversity harmful incentives, set out the case for reform, identify and appraise reform options, and establish action plans for the removal or reform of these incentives.
- Policy actions to advocate reform proposals within governments, undertake legal analyses and impact assessments, develop and implement reform packages, and engage with affected stakeholders.
- Studies to identify and appraise options for positive incentives for biodiversity, and to develop action plans for their introduction.
- Capacity building measures and pilot projects to develop and test positive incentive measures.
- National level studies focusing on key impacts of consumption and production patterns on biodiversity
- National public procurement strategies designed to ensure that government purchasing helps to keep the impacts of use of natural resources within safe ecological limits

For targets 5, 6, 7, 11, 12, 13, 15, 16, 17 and 18, we find the HLP report identifies the following actions similar to ones detailed in the NBSAPs studied:

- Biodiversity inventories and monitoring system; Management: Improving national wetland inventory, monitoring and enforcement capabilities.
- Training and education of professional officers
- Law enforcement
- reducing fishing effort (investment or transition cost)
- improving fisheries management (operation or running cost).
- Global R& D into agroecosystem genetics
- Restructuring the production side of the agricultural market
- Encouraging integrated conservational agriculture
- Effective adaptation of policy and institutions: property rights
- Capacity building for aquaculture
- Create new protected areas
- Create new connectivity corridors
- Strengthen management effectiveness
- Control/eradication of invasive alien species; 4. Species management and recovery actions;
- Ex situ maintenance and expansion of existing collections; Developing approaches to create economic incentives for in situ conservation by farmers;
- Investments in traditional ecological knowledge (TEK) or the factual knowledge about ecological systems, processes and uses held by traditional and indigenous peoples.
- Deposit the instrument of ratification, acceptance, approval or accession of the Nagoya Protocol
- Developing and updating National Biodiversity Strategies and Action Plans (NBSAPs)
- National (and Regional) level strategies, including sui generis systems, for promoting/protecting traditional knowledge and the customary sustainable use of biological diversity and implementing standards adopted by the COP

Specifically for Target 8, the following actions are common:

- Increase in wastewater treatment capacity to cover populations living upstream of dead zones without access to sanitation.
- Reduction of nutrient runoff from upstream agricultural operations through the use of best management practices.
- Investments in urban stormwater retrofits for existing impervious surface areas and green infrastructure options

For Target 9, the following actions are common

- Control and eradication measures (including policy and legislation) to reduce existing IAS (including control of mainland IAS and eradication of priority IAS on islands)
- Measures (including policy and legislation) to prevent new introductions

For Target 10, the following actions are common:

- Integrated coastal zone management,
- Sustainable marine resource use (e.g. fisheries),
- Integrated watershed and wastewater management (target 8)
- Use of marine protected areas to conserve biodiversity, habitats and exploited populations.

Case Study Box: Gap analysis for the Federated States of Micronesia on the implementation of the Nagoya Protocol

This case describes a gap analysis for reaching compliance with the Nagoya Protocol on access to genetic resources and the fair and equitable sharing of benefits arising from their utilisation (Target 16) for the Federated States of Micronesia (FSM).

The study, commissioned by the FSM Department of Resources and Development, conducted a series of consultations workshops and meetings with key stakeholders about issues relevant to FSM's implementation of the Nagoya Protocol.

The analysis establishes baseline information regarding existing processes, rules and institutions at State and National Level relevant to FSM's implementation of the Nagoya Protocol, and then identifies key issues, gaps and recommendations. The gaps fall into two broad categories: knowledge and capacity gaps, and institutional gaps. To address knowledge and capacity gaps there will need to be training and capacity building addressing all of the relevant issues associated with implementing an effective national access and benefit sharing (ABS) regime. This might include building better local understandings of biotechnological research and it's purposes and methods; capacities for negotiating realistically to reach equitable mutually agreed terms (MATs); capacity-building in the fields of ABS policy and law (both international and domestic), as well as ABS-related intellectual property law.

The institutional gaps relate to FSM currently having no National Focal Point for the Nagoya Protocol, Competent National Authorities, or any ABS checkpoints. These institutions need to be identified (from among existing agencies rather than establishing new ones) and commence implementing the functions required of them by the Nagoya Protocol. There is also an absence of policy on ABS, and the development of policy should probably precede the development of administrative and/or legal regimes.

The nature of the investment needs identified in this gap analysis are therefore primarily of an administrative and legal nature. The analysis recognises that the different states of FSM are at different stages of readiness to develop the necessary institutions and laws.

Source: FSM Department of Resources and Development (2013)

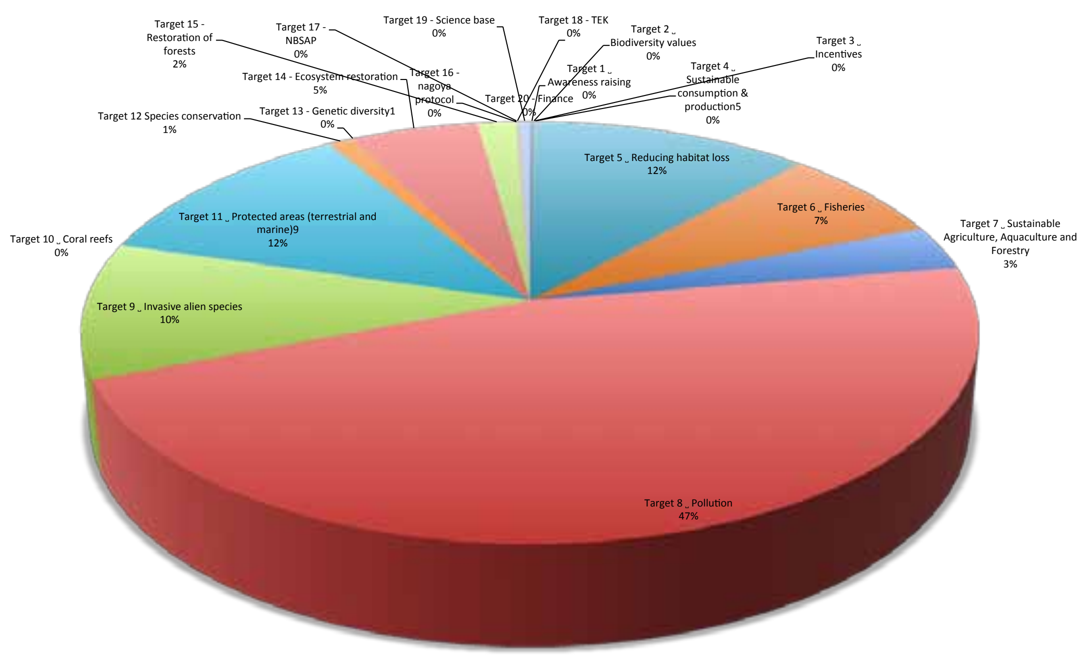

Figure 8: HLP report resource needs (world) (based on average values of 8 years of annual expenditures (incl. investment needs and recurrent expenditures)

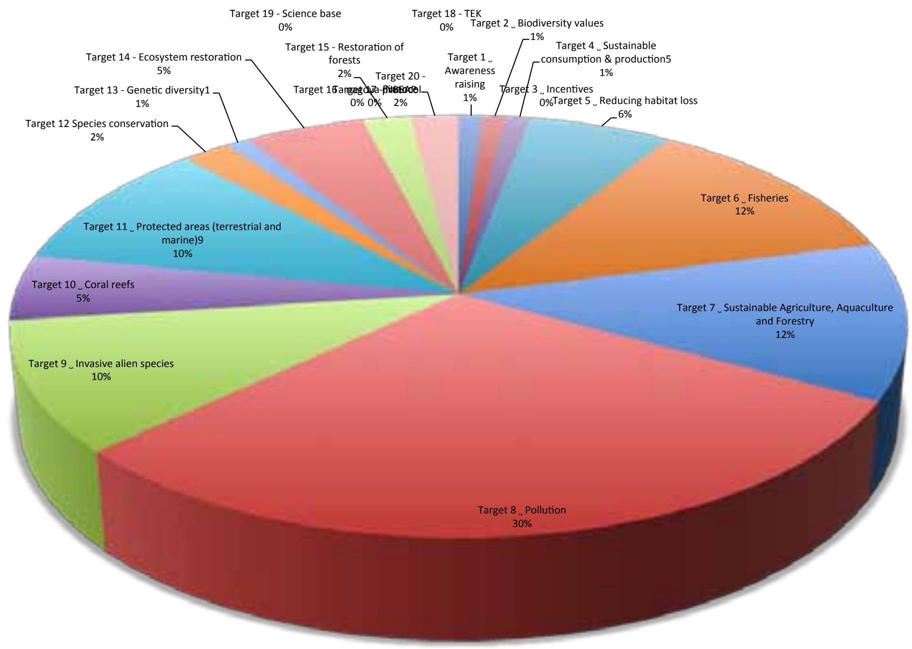

Figure 10: Resource needs (PICs): distribution of average values of 8 years of annual expenditures (incl. investment needs and recurrent expenditures) (based on expert assessment).

Table 1: Potential funding for activities contributing to Aichi Targets in Oceania. Adapted from the HLP report on global assessment of resources for implementing the strategic plan for biodiversity 2011-2020 (2012).

Target	Potential funding opportunities
1	Awareness raising campaigns with funding from private sector and overseas development assistance
2	Almost 60% of the countries in the region have not conducted any economic valuation of their ecosystem services at a national scale. Potential sources of funding include the TEEB (UNEP) and WAVES initiatives.
3	Most of the PICs provide very little incentives or subsidies to the private sector. The cost of reform options for negative incentives and development of action plans for reform is expected to be limited. For the implementation of positive incentives, the potential for PES schemes (e.g. for water sector, carbon, and biodiversity) should be assessed
4	Similar to target 1. Funding sources include the private sector and ODA
5	The main priorities for financing are the introduction of ecosystem offset options and the strict enforcement of EIA. These costs will be borne by national budgets allocated to government agencies. The potential of biobanking for countries with a mining sector or other industry has to be researched. Active offsetting and biobanking programs exist in Australia that could be used as templates (see box 9b)
6	Apart from traditional sources of financing through public investments and national budgets, the PICS are also relying on the co-management of resources with communities to decrease the costs of enforcement of fishery management (e.g. the cost per ha of MPA). Enabling conditions such as customary rights, local governance and ecological context are met in most of the PICs. Case study box 10 describes the investment needs for the Fiji network of MPAs.

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Target	Potential funding opportunities
7	The main costs are in the implementation of good practices and capacity building. When the industry is developed (quite uncommon in PICs) it may have a role to play in funding implementation of technologies that internalise the environmental costs of their operation. For most of the PICs, crop production and aquaculture (e.g. holothurian sp.) are of small scale and this limits the potential for financing from the private sector. As identified by the HLP, for capacity building and implementation of best management practices, there is a role for funding from GEF, the World Bank and other funding and development agencies, given the benefits for rural livelihoods.
8	Funding to implement effective waste control will come mainly from local public budgets and ODA as assistance to investments in infrastructure. Environmental taxes and charges, non-compliance fees and liability payments also offer potential funding sources.
10, 11, 12	The main financing options for Target 10 include public budgets and donors for the conservation and sustainable use of biodiversity and the maintenance of ecosystem goods and services. The establishment of dedicated national level Trust Funds for protected area management with initial financing from donors and supplemented through other mechanisms is identified as a priority (see box 11). Tourism User Fees revenues through direct user fees or business taxes are a potential solution for PICs with a developed tourism sector. Several countries have also included a hypothecated fee in their airport departure tax, which is set aside in a fund for conservation purposes. Revenue from this tax could go into a Conservation Trust Fund.
13	As identified by the HLP, in-situ and ex-situ conservation sources include multinational companies, national treasuries, and public-private partnership
14	Similar to target 5, well dimensioned offset compensation may reduce investment in unnecessary public and private infrastructure. Otherwise the cost of restoration should be assumed by the developer.
16, 17, 18, 19	In similar conclusions with the HLP report, these targets could potentially benefit from internal and external funding sources. The GEF is an important source of funding
20	Different options to be explored are described in the NBASP of the countries selected. From cost reduction through the enhancement of co-management with local communities and the development of non-public financial instruments are presented. The development of conservation trust funds for many PICs appears to be an option of current interest. Most of the PICS have acknowledged (but not quantified) important financing gaps in the implementation of their NBSAPs and relevant biodiversity related activities within the nation. In some cases, they identify long term funding sources for the establishment of these funds. They aim to use the CTF to strengthen and empower resource owners and communities to manage their own resources sustainably.

Case Study Box 9: National Fishery Agency of Papua New Guinea

National Fishery Agency (NFA) is disbursing financial resources to provincial governments for coastal fisheries development and management. Recognizing the challenges of trying to manage coastal marine resources using top-down approaches, and the lack of resources being allocated at the provincial level for fisheries, the NFA recently approved the allocation of 35 million kina (US$ 13 million) to the provinces. Each of the 14 maritime provinces will receive 2 million kina (US$ 0.75 million), and each of the 7 inland provinces will receive 500,000 kina (US$ 0.18 million). 38 Each of the provinces may submit project proposals to the NFA to get access to this funding. It will be important for the NFA to ensure that fisheries management is central to these projects, or else the funding may just go toward capital projects that enable further overharvesting and resource degradation.

Source: CCIF, 2013

Case Study Box 9b: Offsets and biobanking in Australia

Numerous legislative and policy instruments are in place and both the Federal (e.g. Australian Government, 2012) and State (e.g. Department of Environment and Climate Change, 2007) level in Australia requiring the offsetting of impacts to biodiversity from development. Through the EIA process, potential development impacts (e.g. clearing of native vegetation) are required to be offset by an equivalent or better amount through: i) protecting land; ii) improving security of land tenure; iii) improving management of existing biodiversity; iv) restoring degraded land, or; v) through indirect improvements such as making payments into a 'biobank' for future conservation work. To ensure the goal of no net loss to biodiversity is achieved, offsetting design and implementation must be supported by rigorous technical methods to calculate development impact and the improvement to biodiversity achieved by the offset (e.g. see Gibbons *et al.* 2009; Gordon *et al.* 2011). The offset should not occur if the impact is greater than what would be achieved by the offset.

The overall goal of offsetting programs is to create a market for biodiversity where buyers (e.g. developers) must purchase offsets from sellers (e.g. land owners), where the value of the transaction compensates the seller for costs associated with maintaining and improving biodiversity. There is an expectation that the market will provide a cost-effective way of protecting biodiversity by reducing direct public expenditure on protection as well as revealing the true cost of protection.

Case Study Box 10: Fiji Locally Managed Marine Area (FLMMA), Cost Analysis and Financing Framework

The Fiji Locally Managed Marine Area (FLMMA) Network has accomplished much in the past decade. According to the study which produced this report, approximately 102 LMMAs (with a total of 175 sites) are being pursued and/or have been established. Each LMMA is focused on re-establishing traditional community management practices and participating in a larger effort to share lessons and data on the management of their marine resources across the network of LMMAs in Fiji – as well as across the Pacific-wide LMMA network.

The efforts and achievements of the FLMMA network have prompted the Fiji national government to formally adopt the LMMA approach and to potentially recognize some LMMA areas as designated marine protected areas in the proposed Fiji national protected area system. This has effectively broadened recognition of the usefulness of LMMAs and has served to accelerate their use and adoption throughout Fiji.

A challenge, however, even for the existing LMMAs, is to secure the financial resources and other contributions necessary to cover the costs of the design, implementation and on-going and adaptive management of these marine areas – and to allow each to fully participate in the relevant learning efforts across the network. While most LMMAs currently do not receive outside assistance or funding (simply relying on community driven monitoring and adaptive management), many do rely on direct support and funding from international NGO partners, the government of Fiji, multilateral or private foundation and sector funders.

Using cost profiles calculated for each type of MMAs, the projected cost for the current 102 LMMAs and network costs range from US$ 467,312 in 2011 to US$ 562,382 in 2020. Currently donors provide almost all funding. Until significant new public funding and community contributions are realized, the financing needs will continue to need to be covered by donor grants and aid. But part of it should also be covered by a formal FLMMA trust fund.

The costs associated with all current as well as potential LMMAs (approximately 385 in total) would require capitalizing a Trust Fund of US$ 20-25 million.

This report reviews the most appropriate sources for securing necessary funding to successfully manage and expand the FLMMA network. As with all financial planning for conservation and managed area efforts, this study makes the very clear assumption that funding should derive primarily from the following sources:

- Community contributions (primarily in-kind, but also through community funds and other mechanisms);
- Government contributions (public financing); and,
- Donors (especially ODA and private foundations, the current source of most FLMMA resources, but also private sector).

Source: Conservation and Community Investment Forum, February 2011

Case Study Box 11: Phoenix Islands Protected Area, Kiribati (Aichi Targets 11, 14, 20)

This case study provides information on the long term resource requirements for the financing of the Phoenix Islands Protected Area, Kiribati, with relevance to Aichi Targets 11, 14 and 20.

The cornerstone of long-term sustainability of Marine Protected Areas (MPAs) and the benefits they generate is their conservation effectiveness and a sufficient and predictable flow of financing for MPA management. Traditionally, MPAs are funded through government budgetary allocations, bilateral and multilateral agencies, tourism, and charities. In recent years, increased attention has been given to identifying innovative national and international financial mechanisms for PAs to supplement these traditional sources and diversify revenue streams for MPA management. The Phoenix Islands Protected Area (PIPA), Kiribati was established to be self-sustaining and self-financing. The aim is to capitalize an endowment trust fund at a level that would generate an income stream sufficient to cover the operating and management costs of the trust, and the foregone revenues from fishing associated with the closure or restriction of activities within the PIPA region in Kiribati. The funding target is US$ 25 million, with an interim target of US$ 13.5 million by 2014, based on 25% of the PIPA area under no-take-zone area. The MPA receives the support of the "PAS: Phoenix Islands Protected Area (PIPA)" project (GEF: US$870,200, co-finance: US$ 1.7 million) implemented by UNEP.

Sources: Gobin (2012)

Case Study Box 12: Costs of eradication of invasive alien vertebrates on small islands (Aichi Target 9)

This case study provides information on the costs of eradicating invasive alien vertebrates (IAV) on small islands, with relevance to Aichi Target 9.

Eradication of IAV from islands has proven an effective conservation tool, resulting in recoveries of endangered species and threatened island ecosystems. Over 1,100 successful IAV eradications have been implemented on islands worldwide.

Island Conservation has developed a costing model for the eradication of invasive alien invertebrates based on the costs incurred in planning and implementing 37 successful vertebrate eradications on islands ranging in size from 6 hectares to over 400,000 hectares. The categories of cost include are: implementation, planning, non-target mitigation, additional costs associated with human inhabited islands, and isolation.

This costing model has then been used in combination with island specific data to estimate the costs of eradication of IAV on 496 islands, representing 38% of islands holding critically endangered or endangered species, and would provide protection for 19% of insular critically endangered or endangered species. The estimated costs for selected countries in the Australasia and Pacific region are shown in Table 1.

Country	Number of threatened species	Number of Islands	Total area of islands (km^2)	Estimated total cost (US$)
New Zealand	12	9	1,215	85,156,020
Australia	11	17	1,193	116,814,140
French Polynesia	11	19	513	83,969,466
Northern Mariana Islands	8	9	177	27,265,486
Fiji	4	16	291	41,808,496
Total	**46**	**70**	**3,389**	**355,013,608**

The costing model is designed to estimate costs across groups of eradication projects rather than provide specific costs for individual projects. It is recognised that there is simply too much variation in project costs between different islands depending on island specific contexts and characteristics and these can only be understood through detailed analysis at the project level.

Sources: Turpie *et al.* (2012); Keitt (2013)

Case Study Box 13: Resources for coastal management (Aichi Target 6, 10, 11 and14)

Coastal fisheries must compete with other important sectors for a share of public funds and in general have not received substantial funding from national fisheries agencies or subnational governments. National fisheries agencies tend to focus their efforts on export-oriented, high-value fisheries like tuna and bêche-de-mer. Funding that does flow to nearshore fisheries is typically spent on capital projects that will stimulate production and improve the value of fisheries landings, such as ice plants and port infrastructure. Improving capital infrastructure is not in and of itself a problem, but without strong fisheries management systems in place, it can spur further increases in fishing effort where overfishing is already occurring.

Subnational governments often have the discretion to allocate funding to fisheries and coastal marine management, but these allocations are typically very small. Even if local leaders believe coastal marine management is important, they often lack the technical capacity to secure the necessary resources through budgeting processes or the ability to manage coastal marine resources. The end result is funding flows that are based primarily on the prior year's budget rather than on a critical assessment and balancing of priorities.

Across the region there is growing acknowledgement of the need for marine conservation, as indicated by government commitments to reserves and the explicit discussion of sustainable natural resource exploitation in national development plans. Unfortunately, the translation of these commitments to tangible change on the ground has not been sufficient, especially for nearshore fisheries and coastal marine management. Marine reserve coverage has increased substantially across the region, but just a small fraction is managed effectively. In most countries, economic activities such as mining, forestry, and agriculture overshadow nearshore fisheries. Not only do they attract more attention from policymakers, but they tend to be promoted without concern for the impacts they can have on the coastal marine environment.

Case Study Box 13b: Costs of achieving biodiversity targets in South Australia (Aichi Targets 5, 7, 11, 12, 15)

Background: Achieving biodiversity targets and goals of protecting existing remnant native vegetation or restoring cleared areas to increase connectivity may require removal of degrading processes such as livestock and converting cropped areas to treed landscapes. But this can be costly, principally in the opportunity cost of changing land use from agricultural production to conservation uses. At present conservation land uses do not provide the same levels of income as agricultural land uses, although emerging carbon and biodiversity offset markets show some promise (Crossman *et al.* 2011). Targets for protecting threatened species and restoring degraded landscapes typically involve some quantitative area of new conservation land use implemented over some time period, for example 'increase the area of protected areas by 20% by 2020'. Smart spatial planning that selects the locations of greatest environmental benefit for meeting biodiversity and environmental targets at least opportunity costs is the focus of recent work in the Lower Murray region of south-eastern Australia (Crossman and Bryan, 2009; Bryan *et al.* 2011).

Results: In the absence of good spatial planning, Bryan *et al.* (2011) estimated that achieving six environmental targets for increasing native vegetation cover and protection and improving soil condition could cost about AU$350m annually if not strategically implemented. However, if the new land uses that meet the targets were located strategically to minimise costs for maximum environmental benefit, the total opportunity cost would fall to about AU$140m annually, an annual saving of $210m. The presence of a carbon market reduced the cost even further. The targets analysed were:

20% improvement in condition of remnant vegetation across all conservation significance levels through stock removal and conservation land management

- Increase vegetation cover of Ecological Vegetation Classes to 15% of pre-1750 extent
- 20% reduction in groundwater recharge from farming systems
- 30% native vegetation cover across each bioregion
- Reduction in land threatened by salinisation from 10% to 8% of total land surface
- Confine wind eroding land to 3% of land surface in dry years

Implications for CBD: Although the resources to meet biodiversity targets will be high, and compensation may need to be offered accordingly, intelligent location of actions to meet targets (e.g. new protected areas, re-vegetation that increases connectivity) could reduce the costs substantially, e.g. by 60% as demonstrated by Bryan *et al.* (2011).

Table: PICS memberships of international agreements (extracted from Carter, 2007).

	UNCCD	UNCLOS	UNFCCC	CMS	CITES	Ramsar	WHC	SC-POPS
Vanuatu	✓	✓	✓	✗	✓	✗	✓	✓
Fiji	✓	✓	✓	✗	✓	✓	✓	✓
Marshall Islands	✓	✓	✓	✗	✗	✓	✓	✓
Samoa	✓	✓	✓	✓	✓	✓	✓	✓
Cook Islands	✓	✓	✓	✓	✗	✗	✗	✓
Niue	✓	✓	✓	✗	✗	✗	✓	✓
FSM	✓	✓	✓	✗	✗	✗	✓	✗
Palau	✓	✓	✓	✗	✓	✓	✓	✓
Tonga	✓	✓	✓	✗	✗	✗	✓	✓
Kiribati	✓	✓	✓	✗	✗	✗	✓	✓
PNG	✓	✓	✓	✗	✓	✓	✓	✓
Nauru	✓	✓	✓	✗	✗	✗	✗	✓
Solomon Islands	✓	✓	✓	✗	✗	✗	✓	✓
Tuvalu	✓	✓	✓	✗	✗	✗	✗	✓

Acronyms: UNCCD (United Nations Convention to Combat Desertification); UNCLOS (United Nations Convention on the Law of the Sea); UNFCCC (United Nations Framework Convention on Climate Change); CMS (Convention on Migratory Species); CITES (Convention on the International Trade in Endangered Species); Ramsar (Ramsar Convention on Wetlands); WHC (World Heritage Convention); SC-POPS (Stockholm Convention on Persistent Organic Pollutants)

Case Study Box: Cost-effectiveness of combined carbon and biodiversity investments in Australian agro-ecosystems (Aichi Target 7, 12 and 15)

Background: Putting a price on carbon can generate demand for carbon offsets which in-turn could drive investment in tree-based carbon sequestration in agricultural landscapes. A risk is that carbon planting will be fast growing monoculture species that maximise the sequestration of carbon; these planting would have very little benefits for biodiversity. Using economic instruments such as species conservation banking or the trading of credits for creating biological diversity on private land, bundled with carbon offsets, could drive investment in planting of diverse species in locations that contribute to landscape conservation and restoration goals.

Results: Crossman *et al.* (2011) demonstrate that in the presence of a carbon market, direct payment to private landowners of between AU$7/ha/year to AU$125/ha/yr may be sufficient to augment the economic returns from a carbon market and encourage tree plantings in agricultural landscapes that contribute more to the restoration of landscapes and endangered species habitat than otherwise achieved by carbon monocultures. Crossman *et al.* (2011) also demonstrated that in the presence of a carbon market, the state of South Australia could achieve an ecological restoration target of 30% of agricultural landscapes covered by representative samples of biologically diverse vegetation with high connectivity and low fragmentation (i.e. 1.1 million hectares of biodiversity plantings) for a total investment of AU$1.8 billion. This may appear high, but the investment is inclusive of opportunity cost of removing land from agricultural production.

Implications for the CBD: Attaching biodiversity credits to carbon credits can lead to an efficient and cost-effective mechanism to restore degraded landscapes, sequester carbon and improve changes for threatened species.

Source: Crossman *et al.* (2011)

Case Study Box: Costs of macaque eradication, Angaur island, Palau (Aichi Targets 9, 12, 18)

This case study provides information on the costs of eradication of macaques on Angaur island, Palau, with relevance to Aichi Targets 9, 12 and 18.

Crab-eating macaques (*Macaca fascicularis*) were introduced to Angaur island, Palau from Indonesia in the early 1900s. The population is now approximately 2,000 and represents an immediate threat to economic livelihoods, traditional culture, human health, and Palau's unique biodiversity. Invasive macaques have caused severe environmental damage to the island of Angaur. A survey of Palau's avifauna conducted in 2005 found that 14 fewer species of birds occur on Angaur than on neighboring Peleliu. Even without additional human assisted introductions, macaques are expected to invade over 90% of Palau's terrestrial area, and impact all of Palau's key biodiversity areas. Endemic Palauan birds, reptiles, and plants would experience a heightened risk of extinction as macaques invade new islands.

Removal of the invasive macaques is a high conservation priority for Palau. Palau's National Biodiversity Strategy and Action Plan (NBSAP) calls for a prioritization of invasive alien species management, including the eradication of macaques. Significant political and community support for this project exists within Palau, particularly in Angaur where the strong support of the local community is driven by the critical threats invasive macaques pose to their livelihoods and culture.

The eradication of macaques from Angaur and elsewhere in Palau is deemed to be feasible but subject to a number of initial preparatory steps, including legal and regulatory requirements (e.g. allowing the use of firearms), technical (developing larger traps that can catch whole troops of macaques) and social (involvement of the local community and avoidance of harvesting toxic baits). The cost of eradication is estimated at between US$2 million and US$4 million using a combination of large cage traps, shooting and toxic bait.

Sources: Island Conservation (2013); Parkes and Fisher (2011)

Case Study Box. Smart conservation planning that maximise threatened species representation for least cost (Aichi Targets 12 and 19)

Background: Protected area networks historically have been an artefact of a number of factors exclusive of any predetermined effort to protect threatened species. For example, habitats protected for conservation purposes are often areas of poor agricultural potential, remote, or established for reasons not related to species conservation (e.g. for aesthetic reasons). The result is that a nation's protected area network may not sufficiently represent all habitat types and may not sufficiently protect threatened species. A study by Watson *et al.* (2010) quantified how well Australia's terrestrial protected area system overlaps with the geographic distribution of threatened species.

Results: Watson *et al.* (2010) demonstrate that the current configuration of protected areas in Australia was better than random at representing habitat ranges of Australia's threatened species. However, target levels of protection were met for only ~20% of species, and 12% of species occurred entirely outside of the protected area network. Spatial prioritisation demonstrated that in theory, a protected area network the same size as the existing Australian network (11.6% of the area of Australia) could meet representation targets for 93% of threatened species. Alternatively, representation targets for all threatened species could be met by increasing the existing network by 50% through the very strategic selection of areas to add.

Implications for the CBD: Continued investment in adding to existing protected areas is needed. But that investment can be maximally efficient, if supported by smart spatial conservation planning and strategic acquisition.

Source: Watson *et al.* (2010)

Case Study Box: Cost-benefit analysis of Marine Protected Areas (MPAs) in Fiji and Vanuatu

An appraisal of the economic benefits of community-based Marine Protected Areas (MPAs) has been conducted in 10 villages in Vanuatu and Fiji.

Community-based MPAs are considered among the main fisheries and coastal management tools adapted to the context of many Pacific countries, where intervention of government agencies is minimal and where community participation remains important. Governments, multilateral agencies and NGOs have supported community-based MPAs in the last 15 years and their number was estimated at more than 500 in the Pacific in 2007. Nonetheless, this support must now be improved with more stable financial funding and regulations adapted to this kind of management.

A bottom line analysis of their impacts on local development, poverty reduction and on world biodiversity as a public good was identified as a way to "inform & convince" decision-makers, budget-makers, local stakeholders and donors. The MPAs have been shown to generate benefits mainly improving the nature tourism attractiveness and maintaining the service of coastal protection as well as fishery productivity. Tourism business owners are the main beneficiaries (>60% of the total benefits in most of the cases) followed by village households.

The observed costs of community based MPAs are between US$ 1,500-10,000 per km^2 of protected area per year. The economic effects of MPAs have been estimated between US$ 110,000-530,000 per km^2 of protected area per year.

All the studied MPAs have produced positive cost benefit ratios (CBR) demonstrating that investments in marine reserves, in addition to avoid the risk of overfishing and participate in the conservation of coral reefs, is an effective means to contribute to local economic development. The ecological effects on fish populations and habitats in the MPA have produced concrete and tangible benefits both for the villages with MPA and the surroundings villages.

The level of CBR reflects a significant leverage of investments in MPAs for important impacts on tourism benefits (ES3) and costal protection values (ES5).

The economic value of ES in the study sites was between US$ 200k and US$ 1.9M per year per village. Cultural services with tourism revenues from divers, snorkelers, resorts and day tours comprise a large proportion of the total (>60% of the total) with almost 12,000 reef visitors per year in Vanuatu and 42,000 in the Fijian Coral Coast. In the study zones, the service of protection against coastal floods provides benefits for an important number of houses (>500 in some sites) and tourism buildings (>80,000 in some sites).

Case Study Box 6: Cost-Benefit analysis of community-based marine protected areas: 5 case studies in Vanuatu, South Pacific.

The study looks at the net benefits from five small marine managed areas in Vanuatu that include a protected area as one of their management interventions. These areas are presented as one of the main fishery and coastal management tool adapted to the context of many Pacific countries. The study considers direct, indirect and opportunity costs. Impacts on fishery and tourism are compared to villages without protected area (control sites) selected on their similarity with the study villages. In the study, each managed area is associated to a unique village, managed and adequately enforced by communities for at least five years with the reserve covering at least 10% of the fishing ground area. An appraisal of investment in community-based MPAs through a cost-benefit analysis (CBA) and return on investment (RoI) has been conducted in 5 selected villages in Vanuatu. Main impacts of MPAs on fishery, tourism, social capital, coastal protection service and bequest value have been assessed from 18 months in situ observations. As far as possible impacts have been compared to villages without MPA (control sites).

The results are: (i) the annual operational costs with effective enforcement are one of the lowest costs worldwide with values varying from € 900-4,000 per MPA (equivalent to a mean annual € 9-300 km^2 of protected area); (ii) the average Return on Investment (RoI) is 1.8 after 5 years (std=0.9) with a potential of 5.4 (std=2.5) after 25 years; (iii) not all the investments in MPAs have been recuperated after the first 5 years and for some of them the RoI stays close to 1 after 25 years of projections when main uncertainties on estimations are applied; (iv) each MPA has produced benefits mainly on rural tourism and fishery (56% and 26% of the total respectively), which represent both important sources of local cash incomes and proteins for the villages. Observed benefits on fishery sector were revealed through an increase in productivity for the principal gears (from 4% to 33% increase in the catch per unit of effort) and for both subsistence and commercial fishery. Benefits on tourism are present for the niche of rural tourism where the role of MPA in the choice of the site was estimated to vary between 40% to 75%; Impacts on social capital, bequest value and coastal protection service have been estimated to represent 20% of the total benefits of the 5 MPAs; (v) Observed benefits have represented an average of 7% of the total village Gross Domestic Income (GDI). Impacts have been assessed at a village level to take into account some characteristics of customary, community and subsistence economic specificities.

Source: Pascal (2011)

APPENDIX 4. EUROPE

Table 1:

Aichi Targets	EU Targets: 1. Fully implement the Birds and Habitats Directives	2. Maintain and restore ecosystems and their services	3. Increase the contribution of agriculture and forestry to maintaining and enhancing biodiversity	4. Ensure the sustainable use of fisheries resources	5. Help combat Invasive Alien Species	6. Help avert global biodiversity loss	EU Horizontal Issues (Partnerships and Knowledge Base)	WFD and MSFD (GES of fresh-water and marine ecosystems, through RBMP/PoMs)	Natura 2000 (Creation of a network of Pas)
1	X								
2						X			
3						X			
4							X	X	
5			X					(X)	X
6				X				X	
7			X	X				X	X
8		X						X	
9					X			X (MSFD)	
10		X		X				X (MSFD)	X
11	X							(X)	X
12	X							X	X
13			X						X
14		X						X	X
15		X						X	X
16						X			
17						X			
18							X		
19							X	X (monitoring)	
20						X		X (spending as legal obligation)	X (spending as legal obligation)

Sources: Biodiversity Information System for Europe; DEFRA 2011: 43 et seqq.

Table 3: Overview of ecosystem services and benefits linked to biodiversity (categorization of ES according to the TEEB Report).

	Example of benefit provided/lost	Number of sources mentioning the service/benefit	Quantitative evidence included in the report (Y/N)
Provisioning Services			
Food	Fisheries	>20	Y (cheese production in Croatia; Swiss forests; section 4.4)
Raw Materials		>20	N
Genetic Resources	Input for numerous industries (e.g. food/ medicines).	1	N
Medicinal Resources		5	N
Ornamental Resources		1	N
Regulating Services			
Influence on air quality	Improvement of air quality (e.g. through forests).	2	N
Climate regulation	Mitigation of GHG emissions; carbon sequestration; temperature and precipitation.	10	Y (carbon sequestration by forests in the UK; section 4.4)
Moderation of extreme events	Flood and drought mitigation.	8	Y (Swiss Alpine forests; section 4.4)
Waste treatment/water purification		11	Y (drinking water provision in Vienna, the UK; section 4.4)
Erosion prevention		13	Y (Muntanya de Montserrat Natura 2000 site; section 3.2)
Nutrient cycling		7	Y (water purification and nutrient cycling in Anne Valley, Ireland; section 4.4)
Biological Control	Pollination; pest control.	19	Y (pollination in the EU, UK and Switzerland; section 4.4)
Habitat Services*			
Lifecycle maintenance	Nursery service.	3	N
Gene pool protection (conservation)	Adapted species (drought/ flood resistance)	1	N

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	Example of benefit provided/lost	Number of sources mentioning the service/benefit	Quantitative evidence included in the report (Y/N)
Cultural Services			
Aesthetic information		>20	Cultural services are closely interlinked (Kettunen *et al.* 2009), and difficult to distinguish from another. However, tourism and recreational benefits are without doubt strongly connected to undisturbed natural ecosystems (such as provided by Natura 2000 and the Emerald Network).
Opportunities for recreation and tourism	Nature/Green tourism.	>20	
Inspiration for culture, are and design		>20	
Spiritual experience		>20	
Cognitive information (education and science)		>20	

Sources: Kettunen/ten Brink 2006: 1 et seqq.; TEEB 2009; UNDP 2013: 6; EP 2012; EU 2013: 2; EC - DG Environment[1].
*Habitat Services were not included in Kettunen/ten Brink 2006. Hence, the number of sources is lower.

Table 4: Benefits of reaching the EU Biodiversity Targets

EU target	Corresponding Aichi Target(s)	Environmental benefits	Economic benefits	Social benefits
1	1, 11, 12	Increased biodiversity and ES from Natura 2000 sites, better resilience to stressors such as CC. Synergies with WFD and MSFD.	Increased benefits from ES.	Increased employment in rural areas in the medium term.
2	8, 10, 14, 15	Maintained and enhanced ecosystem and ES, such as clean air and water, carbon storage and natural disaster control. Increased ecosystem resilience and reduced vulnerability to CC. Synergies with WFD and MSFD.	Increased benefits from ES. New investment opportunities for businesses and innovation potential. Climate mitigation benefits.	Multiple social benefits, both in urban and rural areas, such as positive impacts on health and quality of life, aesthetical and psychological benefits, reduced exposure to natural disasters, new job opportunities in restoration and conservation.
3	5, 7, 13	Maintaining and enhancing agriculture and forest ecosystems and their services, including carbon storage, erosions prevention, pollution control and water purification. Synergies with WFD.	New possibilities created for agricultural sector diversification; improving farmers income in Natura 2000 and HNV areas; increased competitiveness and diversification of the forestry sector.	Contribution to rural development in less favoured areas; new jobs.

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1 A good overview of ES provided specifically by Natura 2000 sites can be found in an IEEP Report (Kettunen *et al.* 2009: 16 et seqq.).

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EU target	Corresponding Aichi Target(s)	Environmental benefits	Economic benefits	Social benefits
4	6 ,7, 10	Increased and more sustainable levels of fish populations, maintained and enhanced marine ecosystems and ES. Synergies with MSFD.	Positive long-term impact on fisheries income. Increased efficiency of public spending.	Prevent negative effects on employment in case of a collapse in fish stocks.
5	9	Reduced pressure on species and habitats from IAS. Strong synergy effects with other targets, e.g. ecosystem restoration.	Reduced economic damage.	Reduced adverse impacts on human health, avoided negative employment consequences, enhanced cultural services and recreational activities.
6	2, 3, 16, 17, 20	Improved global biodiversity especially in developing countries. Increased ES such as carbon storage, water provision, purification and retention.	Economic benefits from biodiversity and ES, e.g. climate mitigation, increased crop yields through pollination in developing countries. Genetic biodiversity benefits in EU and developing countries (cosmetics and medication). Legal security for companies through ABS protocol.	Poverty alleviation. Decreased risk of social impacts of natural disasters. Health benefits. Improved livelihood of indigenous communities through sharing of traditional knowledge benefits.

Source: EC 2011d: 3 et seqq., Biodiversity Information System for Europe (adapted).

Case Study: Drinking Water Provision in the City of Vienna

The per capita consumption of water in Vienna is 150 liters per day - at 1.7 million inhabitants, an annual consumption of 93.075 million liters. About 95% of the annual water supply is derived from springs in the Rax, Schneeberg and Schneealpe mountains and from the Hochschwab mountain massif, requiring no or very little treatment before it can be used as drinking water. The Vienna City Constitution put Vienna's water and the forests surrounding the springs under protection orders to provide pure drinking water at any time (now comprised of 32,000 hectares of forest, pastures and meadows in which water protection has the highest priority).

The value of the clean drinking water provided by the ecosystems surrounding Vienna is not monetized, but establishing a technical infrastructure able to provide the same amount would certainly cost millions of Euro.

Source: EC 2011a: 56.

Table 5: Impacts of EU Biodiversity targets on EU labor market.

EU target	Corresponding Aichi Target(s)	Number of jobs created or sustained	Number of wider existing jobs affected
1	1, 11, 12	104,000 FTE jobs directly supported in Natura 2000 network. 174,000 FTE jobs including multiplier effects. 122,000 additional jobs compared to existing levels.	Existing jobs supported by Natura 2000 management estimated are 30% of total estimate.
2	8, 10, 14, 15	110,000 jobs supported in restoration of ecosystems/green infrastructure. Additional new jobs created in biodiversity offsetting.	Small proportion of the estimated restoration jobs are existing jobs. Implications for larger number of jobs in planning authorities through offsets and restoration activities.
3	5, 7, 13	11,250 additional FTE jobs through increased agri-environment activity. 3,000 additional FTE jobs in forest management planning.	A large proportion of existing 10.8 million FTE jobs in agriculture and 490,000 FTE forestry jobs will be affected, with implications for skills.
4	6, 7, 10	Up to 30,000 FTE fishing jobs lost by 2022. Net loss of 10,000–17,000 FTE jobs compared to a no-reform scenario. Opportunity for growth in employment after 2020. Broadly neutral effect on overall levels of employment in wider coastal communities.	130,000 existing FTE jobs in fishing will be affected by Strategy, with implications for skills.
5	9	Between 520 and 2,520 FTE jobs supported by IAS control programmes in total, including existing jobs. 250–2,250 new FTE jobs estimated.	Larger number of other existing jobs affected, including border and customs officers and pest control sectors, with implications for skills.
6	2, 3, 16, 17, 20	New jobs created in policy development and implementation.	Implications for skills requirements for larger numbers of existing jobs, including borders and customs officials, administrators in organisations dealing with genetic resources.

Source: Jurado *et al.* 2012: 98 et seqq.

Case Study: New Jobs Through Biodiversity in France

In France, it is estimated that restoration and green infrastructure would provide significant new job opportunities: the number of jobs (unclear whether FTE or not) that contribute to knowledge, management, protection and restoration of biodiversity would raise from currently 20,000 to 40,000 in 2020 “as a result of newly established biodiversity priorities”. Also, it is estimated that many jobs for “biodiversity specialists” will be created in the near future in large private companies like Autoroutes du Sud de la France.

Source: EC 2011: 60

Case Study: Benefits of Creating an European Network of Protected Areas (Natura 2000/Emerald Network)

Related to Aichi Target(s): 5, 10, 11, 12, 13 (protection/conservation), 14, 15 (restoration), 7 (use/management).

Ecosystem Services and corresponding benefits provided by the current or future (i.e. fully implemented) Natura 2000 network are considerable, although estimations vary. Whereas an IEEP Report (Gantioler *et al.* 2010), the European Parliament (EP 2012) and the most recent study by IEEP (Tucker *et al.* 2013: 471 et seqq.) place the value at 200-300 billion €/a [around 280 - 430 billion US$/a] (i.e. 1.7 to 2.5% of EU GDP), other sources estimate a value of up to 450 billion €/a [around 650 billion US$/a] (EC - DG Environment).

Other estimations aim at individual services/benefits of the network: IEEP (Tucker *et al.* 2013: 471 et seqq.) estimate the value of stored carbon (i.e. mitigated emissions of CO_2) between 607 and 1,130 billion € [around 812 - 1,513 billion US$] (stock value 2010). The Natura 2000 network is also very important for tourism and recreation: 1.2 to 2.2 billion “visitor days” per year are counted in the EU27, with direct and indirect economic impacts reaching 50 to 85 billion €/a* [70 - 118 billion US$/a] (EC 2011c: 4 et seqq.).

Based on WTP estimations, the benefits surrounding the recreational quality of the network are situated between 5 and 9 billion €/a [6.9 - 12.5 billion US$/a] (EC 2011c: 4 et seqq.).

Other estimations cover regional or national levels: The installation of the Lower Danube Green Corridor, spanning four countries (Bulgaria, Romania, Moldova and Ukraine) and 2,236 km^2, has made significant improvements to water quality, increased biodiversity, lowered risks from flooding and improved local livelihoods. These benefits are valued at 500 €/ha/a [697 US$/ha/a], and future earnings are estimated at 85.6 million €/a [119.2 million US$/a] (EC 2011a: 50). A 2006 assessment by the Dutch Institute for Environmental Studies estimated the benefits provided by Natura 2000 in the Netherlands to be around € 4,000/ha/a [6,223 US$/ha/a]. Recreation and tourism as well as wider ecosystem functions were important components of this value, as well as non-use benefits, whereas provisioning of raw materials was of lesser importance. The authors extrapolated the gross welfare benefits of all Natura 2000 areas in the Netherlands (1.1 million ha), deriving an estimate of around 4.5 billion €/a [around 6 billion US$/a] (EC 2011a: 50; Kuik *et al.* 2006). In France, as part of a wider economic and institutional assessment of the Natura 2000 network, several studies were carried out to determine the benefits arising from Natura 2000 across a range of sites. At the Natura 2000 site “Plaine de la Crau”, the overall benefits were calculated to be around 142 €/ha/a [around 190 US$/ha/a] (EU 2013: 6).

Plenty of examples stem from studies at the local level: in Belgium, in the Kalkense Meersen Natural 2000 site (around 1,000 hectares of grasslands, marshes, intertidal mudflats, river dunes and forests), the benefits associated with restoring the floodplain and extensifying grassland usage (improved water regulation and genetic/species diversity) are estimated to reach 15 million €/a [21.5 million US$/a]. In Croatia, the Telascica site (7,050 hectares of coastal lagoons, *Posidonia* beds, large shallow inlets and bays, reefs and even submerged sea caves, quiet beaches and a mixture of shallow coastline and rough cliffs) provides significant tourism benefits (2 - 5 million €/a, or 2.9 - 7.2 million US$/a), but functions also as carbon sink (4.4 - 8.2 million €/a, or 6.3 - 11.8 million US$/a) and centre for regional cheese production (valued 44 million €/a, or 63.3 US$/a). The Muntanya de Montserrat site (7,270 hectares of cliffs and rock formations close to Barcelona) attracts up to 3 million visitors annually, despite its small size. The estimated annual values, hence, are significant: 9-20 million € in carbon sequestration services [12.9 - 28.8 million US$/a] (forest cover 25%), 22-29 million € in erosion control [31.6 - 41.6 million US$/a], and 33.7 million € [48.4 million US$/a] in amenity and cultural values (probably closely connected to tourism and recreation) (all local examples: Arcadis 2011: 81 et seqq.).

* From the sources assessed, it is unclear if this last figure is already included in the estimation issued by IEEP and others (i.e. the 200-300 billion €/a) above.

Case Study: Water Purification Through an Integrated Constructed Wetland in Anne Valley, Ireland

Related to Aichi Target(s): 14, 15 (restoration), 19 (knowledge).

In Anne Valley (Ireland) an integrated constructed wetland was created instead of installing a traditional treatment plant. Not only is the wetland more efficient in clearing (mostly livestock) wastewater than a comparable traditional sewage plant, it also offers multiple benefits through the ES the wetland provides: water purification, fresh water, climate regulation and carbon sequestration, flood control, recreational aspects, soil formation and nutrient cycling, habitat for wetland flora and fauna. Farmers are quoted that they are only keeping their farming business due to the installation of this wetland, and the aesthetical value of the area has considerably increased. The (capital) costs for 1,750 population equivalents were 770,000 € + 165,000 € for scientific monitoring (over three years) [1.3 million US$ in total]. This sum includes costs for tourism facilities of 220,000 €, and maintenance costs are lower than for a traditional plant. This favourably compares to estimated costs of 1,530,000 € [or ca. 2.1 million US$] for an equivalent traditional plant.

The direct benefits of the wetland (replacement cost approach) reach 595,000 €/a [830,000 US$/a] (size of wetland and benefitting population unknown); per unit cost of treatment (population equivalents), costs are 340 € [474 US$].

Source: EC 2011a: 56

Case Study: Tourism and Recreation in the UK National Ecosystem Assessment

The UK NEA, published in 2011, provides a comprehensive overview of the state of the natural environment in the UK, and tries to evaluate the value of the countries' ecosystems and ES.

The UK NEA also focuses on tourism and recreation, stating that "ES are clearly crucial to the more than 3,000 million outdoor recreational visits which UK residents make each year". It is estimated that these visits generate a social value in excess of 10 billion £ annually [16.6 billion US$] (UK NEA 2011: 42). Additionally, several local examples are presented: Nature-based tourism in Scotland, for example, is estimated to provide about 1.4 billion £ [2.29 billion US$] in income annually with about 39,000 full-time jobs (UK NEA 2011: 64); seaside tourism to the UK's coasts - i.e. consisting of walking, birdwatching, boating and outdoor sports - is valued at 17 billion £/a [28.2 billion US$/a]; in Wales, seaside tourism accounted for 42% of domestic tourism spend (in 2005), supporting nearly 100,000 jobs and contributing 5 billion £ [8.3 billion US$] to income; the value of tourism to the Western Isles of Scotland is 49.9 million £ per year [83 million US$].

Source: UK NEA 2011: 76

Case Study: Subsidies in Switzerland and Germany

A study from 2001 (Rodewald/Neff 2001) comes to the conclusion that around "one third of all federal subsidies have a potentially degrading effect on biodiversity and the landscape". The authors therefore recommend to examine the whole Swiss system of taxes and subsidies.

A study commissioned in the context of the TEEB Report (Förster 2009) concludes that agricultural subsidies significantly increased the opportunity costs of peatland restoration in NE Germany - i.e. in some cases, the subsidies per hectare almost doubled the potential income derived from one hectare of arable land (in this case, meadows and fodder production worth 585 €/a [856 US$/a]; the direct payment per hectare adds another 300 €/489 US$ to that). This, in turn, significantly increased the price for acquiring the land (resulting in per hectare prices reaching 5,000 € (or 7,316 US$), which is very high for marginal agricultural land).

Especially the second study shows that such subsidies are clearly counteracting the Aichi Targets (in this specific case the restoration strategies).

Sources: Rodewald/Neff 2001; FOEN 2010; Förster 2009.

Case Study: Agricultural Subsidies in the EU (Cap)

The CAP represents a policy that includes both "negative" (i.e. that are harmful to biodiversity, i.e. counteracting the Aichi Targets) as well as "positive" incentives/subsidies. Without doubt, the CAP has resulted in widespread agricultural intensification in the EU, with well-documented (negative) impacts on biodiversity since the 1970ies (e.g. decline of the farmland bird index by 50% in the last 30 years or so, significant decline of non-crop plants and invertebrates) (TEEB 2009a: 273 et seqq.).

At the same time, a great number of rare and vulnerable species of EU importance are associated with semi-natural habitats and agricultural landscapes (such as High Nature Value farming systems). These - threatened by intensification/competition and abandonment - are also supported by CAP payments designed to support farming in disadvantaged areas or to support environmentally beneficial practices.

Even after the "Agenda 2000" reform of the CAP, which included gradual reductions in market price support, a decoupling of payments from the production (reducing the incentives for environmental harmful production patterns), and increasing reliance on direct payments, coupled with rural development programs and agri-environmental measures under the CAP's "second pillar", the TEEB Report states that "the sheer magnitude of support under the first Pillar gives reason for concern, because of the limits to decoupling"(TEEB 2009a: 259). Besides setting the wrong incentives, such direct subsidies are a barrier to conservation, as they inflate land prices encourage land conversion (see, for example, Förster 2009).

In the present CAP negotiations for the period 2014-2020, a further "greening" of the CAP (especially Pillar 1 payments) was vehemently demanded by environmental and civil society NGO. The most significant changes originally proposed by the EC consist of linking the direct payments under Pillar 1 to the "environmental performance", the creation of "Ecological Focus Areas", extending to seven per cent of the eligible area of arable and permanent crops, increasing the ambition of agri-environment measures in rural development programmes in Pillar 2 and strengthening of cross-compliance standards. These changes could have significantly improved the environmental performance of the CAP, through shifting funds from "negative" to "positive" incentives. However, the opposition to these plans has been very influential, and successful in "watering down" the environmental provisions (Matthews 2012).*

* As the negotiations were just coming to a close, the final agreed text was not available as of December 2013.
Sources: TEEB 2009a: 259 et seqq.; Matthews 2012.

Case Study: Reduction of Subsidies in the Norwegian Fisheries Sector

The case study example from Norway demonstrates that it is feasible to drastically reduce subsidies to a crucial economic sector, without destroying it. In the 1980ies, the subsidies paid annually reached 150 million US$ (amounting to approximately 70% of the value added in the industry), and were reduced consecutively to 30 million US$/a in 1994. Besides a decline in the number of active fishermen, such reductions were made easier by external factors, timing and measures that smoothed the transition to a more self-supporting industry - resulting in a present fisheries sector that is economically more healthy than at the time when the highest subsidies were being paid.

Such measures and factors included optional employment opportunities (which could be financially supported, as the reforms were undertaken during good economic times), other flanking social measures, and a slow transition, which helped fishermen to take steps to prepare for the changes. The political "window of opportunity" was the fall in oil prices in 1986 which convinced many of the need for significant reform.

Although the effect of the subsidy reform on fish stocks is difficult to ascertain (due to the natural variability of stocks, generally improved management regimes and the fact that Norway shares its stocks with its neighbors), it may have contributed to a increase in cod and herring stocks (+110% and +1,040%, respectively, from 1981 to 1996).

Source: TEEB 2009a: 281.

Case Study: Necessary "Actions" in the Russian Federation

The "National Strategy of Biodiversity Conservation in Russia" (Russian Academy of Sciences/Ministry of Natural Resources of the Russian Federation 2001) emphasizes the importance of the huge Russian territory for international biodiversity conservation. Around 65% of the territory is still virtually unchanged by economic or other human activities – a fact which signals the importance of conservation measures in relatively undisturbed countries/areas (the huge undisturbed areas are situated in the Asian part of Russia, the European part being more densely populated, urbanized and industrialized). The strategy also emphasizes that the Russian Federation is in a state of transition, and formulates the need to integrate the Biodiversity Strategy into the countries' development strategies towards sustainable development, and in other policy fields: economy, law, social insurance, culture, education etc.

Five major "fields of action" are named in the strategy, which highlight the difference to the status of biodiversity protection and sustainable use of resources in, for example, the EU Member States or Switzerland.

Legislation: the document describes the general situation as being "characterized by fairly well-developed legislation and poor implementation of the existing law". Hence, the a) improvement and systemization of existing legislation, the b) practical application of legislation and especially the c) enforcement of the law (compliance) are identified as priorities for action in this field.

Economic Mechanisms: being in a state of transition, the strategy states that the Russian economy needs to "ecologize", i.e. grow less dependent on resource-intensive industries, get more efficient (in terms of resource use per unit of production), and reform the taxation system towards a "unit taxation", establish markets for environmental friendly products etc.; at the same time, very advanced propositions for including biodiversity values/ES into national accounting etc. are named.

Management of Exploitation and Conservation of Biodiversity: the "orientation of the state management systems towards biodiversity" is described as a strategically most important "component of national wealth and security"; the point consists of priority actions like the establishment of state management bodies for nature protection at all levels of government (and other institutional changes); more public participation and cooperation with the private sector; transparency; integration of biodiversity issues into territorial planning, and adoption of river basin (or similar non-administrative) management approaches.

Formation of Public Consciousness - Education and Propaganda: as stated above - the general level of awareness and knowledge in the general population is pretty low; the priority actions are not much different from EU awareness raising measures (at least on the paper).

Finally, Research: knowledge gaps in biodiversity sciences are recognized as concern for immediate actions, which include an "Inventory of Biodiversity", studies on the evolution and dynamics of biodiversity in Russia, the development of a scientifically sound basis for monitoring and the protection of threatened species, and the elaboration of the scientific base for "sustainable use of biodiversity", among others.

Unfortunately, the Strategy does not contain any information on resource needs, a timeline, or other data which could be of use in the course of this study - the same is true for the Biodiversity Strategies of Belarus and Ukraine. Nevertheless, the prioritized actions described above highlight the differences in investment priorities in EU and Eastern European/pan-European non-EU countries.

Source: Russian Academy of Sciences/Ministry of Natural Resources of the Russian Federation (2001).

Case Study: Aichi Targets in the FishSTERN Report

The BalticSTERN Network's report "FishSTERN" represents a first attempt at an ecological-economic evaluation of fishery management scenarios in the Baltic Sea region, and provides hints regarding the impacts of different fisheries management scenarios on the Aichi Targets. Beside obvious reductions in fish landings (mainly of cod) in the "Ecosystem Health" scenario (benefitting Aichi Targets 4, 6 and 12, if cod stocks are classified as threatened), the report also hints at the connections between healthy cod stocks, the food web and eutrophication (which is a serious ecological problem in the Baltic Sea). Via this link, a sustainable fisheries management (of cod) would benefit the Aichi Targets 5 (prevent degradation of habitats), 8 (indirectly by tackling the consequences of nutrient pollution), and 10 (minimize pressures on vulnerable ecosystems).

Source: Blenckner *et al.* 2011.

Case Study: Freshwater Policies in the EU (Water Framework Directive)

The EU's Water Framework Directive - WFD - is the core European legislation tackling inland and coastal water quality issues (several other Directives are aiming at specific aspects of inland waters, such as the Bathing Water, Drinking Water, or Groundwater Directives). Specifically, the Directive aims at reaching the "Good Status" in all surface and groundwater bodies, by tackling the following pressures:

- **Water scarcity,** leading to over-exploitation, reduced "ecological minimum flows", and sometimes to desertification and salt-water intrusion in coastal freshwater zones. Quality improvements in this field would certainly benefit the Aichi Targets 5 (prevent degradation of habitats), 8 (pollution, i.e. salt-water intrusion and increased impacts from pollution due to low water tables), 10 (pressure reduction), and 11 (protection).
- **Pollution,** leading to degradation of ecosystems and populations, and eutrophication of inland and marine water bodies. Quality improvements in this field would certainly benefit - beside obviously target 8 - the Aichi Targets 5 (prevent degradation of habitats), 7 (management of agriculture), 10 (pressure reduction), and 11 (protection).
- **Morphological changes,** such as the building of dams, reservoirs and irrigation systems, which cause damage by changing water levels, placing obstacles in the way of the natural flow of the rivers and thereby destroying ecosystems or cutting off natural flood plains from water courses. Quality improvements in this field would certainly benefit the Aichi Targets 5 (prevent degradation of habitats), 10 (pressure reduction), and 11 (protection, and especially connecting habitats), 12 (species protection - e.g. European Eel), 14 and 15 (restoration).

Beside, the WFD obliges Member States to apply an integrated water-management planning system, based on natural river basin districts, crossing regional and national boundaries (Aichi Target 4), and to comply with strict monitoring guidelines (Aichi Target 19).

Source: EC 2010.

Case Study: "More Natural Management" of Agricultural Land in Germany

A study by Hampicke (2009) investigated the costs of reaching the German Biodiversity targets in agricultural areas, hereby focussing on the measures deemed necessary to achieve a "more natural management" of agricultural land, while increasing the number of "characteristic species, habitats and landscape elements of traditional cultivated landscapes that are not endangered currently but considered to be under pressure". Such a management regime would include the following measures:

- Maintenance of semi-natural landscapes and extensive grassland (grazing with sheep on neglected calcareous grasslands, and with suckler cows/young cattle on neglected delicate grasslands, mowing and hay production, scrub removal).
- Extensification of 10 per cent of the land under intensive grassland management.
- Protection of arable flora on low yielding arable land.
- 7% of land to be "structural elements" (woodland, hedgerows, strips of grassland along roads, water bodies, hedgerows etc.).

The author estimates that the management practices identified need to be implemented on 2.3 million hectares (15% of Germany's agricultural area), at annual cost of 1.5 to 1.8 billion € [2.19 to 2.63 billion US$] (including income foregone and additional costs, likely changes in productivity as well as the costs associated with additional labour, forage, built infrastructure etc.). Current funding available under EAFRD for similar management in Germany is €1.25 billion/a [1.83 billion US$] (regarding the uptake, however, see section 4.1 and 4.2).

- Per hectare, the costs are as follows:
- Semi-cultivated landscapes and traditional grassland: 500 €/ha/a [731.5 US$/ha/a].
- Extensification of highly productive grassland: 1,000 €/ha/a [1,463 US$/ha/a].
- Protection of wild field flora: 300 €/ha/a [439 US$/ha/a].
- Structural elements, arable land: 700 €/ha/a [1,024 US$/ha/a].

Sources: Hampicke 2009.

Case Study: Resource Requirements in Estonia

Estonia's planning document (from 1999) approached the costs of implementation via the amount of labour needed: 1,936 years of human labour or 277 conditional full-time workers annually (over a period of six years). The resulting cost are presented as the lowest limit, and reach 2.15 billion Estonian kroons (around 322 million US$ in 2013 value), of which the biggest share is attributed towards industry (implementation of energy conservation program, installation of electric filters in power stations, completion of the Vaivara dangerous waste deposit and collection centre, and similar activities).

Sources: CBD 2013b: 3 et seqq.

Table 6. Expert estimations of the costs for various activities to reach the individual Aichi Targets for the sixth replenishment period of the Global Environment Facility (2014-2018).

Aichi Target	Amount (US$/country) in 2014-2018 (four year period)
1	800,000
2	700,000
3	10,000,000
4	700,000
5	Only global information.
6	Only global information.
7	Only global information.
8	No estimations.
9	10,000,000
10	Only coral reefs assessed.
11	For the establishment of PAs: ▪ Terrestrial: 6.4 per hectare in four years. ▪ Marine: 1,253 to 2,315 per km^2*.
12	Only per project.
13	Only per project.
14	2,000,000**
15	For forest restoration: 300 US$/ha.
16	No estimations.
17	500,000
18	1,100,000
19	150,000
20	200,000

Source: CBD 2012.

*Depending on the size of MPA to be established, and other factors.

**For the development of sub-global assessments of ES in collaboration with indigenous and local knowledge holders.

Case Study: Costs of MSC Certification

The Marine Stewardship Council (MSC) is an international non-for-profit organization "set up to help transform the seafood markets to a sustainable basis. The MSC runs the only certification and ecolabeling program for wild-capture fisheries consistent with the ISEAL Code of Good Practice for Setting Social and Environmental Standards and the FAO Guidelines for the Eco-labeling of Fish and Fishery Products from Marine Capture Fisheries" (based upon the FAO "Code of Conduct for Responsible Fishing") (Marine Stewardship Council 2013).

MSC is funded by a combination of philanthropic contributions and logo license revenue (revised in April 2013, reducing overall participation costs for companies, and making the program more accessible for small businesses), i.e. the only cost s paid to MSC are for voluntary use of the MSC logo on a product. These costs consist of:

- a fixed royalty (applying to all voluntary logo uses using a scale depending on sales, with a maximum fee of 2,000 US$/a/company) and
- a volume royalty (applied "when a product is sold in a consumer-facing package bearing the MSC logo and is calculated on up to 0.5% of the net wholesale value" (Marine Stewardship Council 2013), with exceptions for small businesses, which do not have to pay the volume licensing fee).

Costs for certification/auditing are negotiated between the company wanting to achieve certification to the MSC standard and the independent certification company, so these vary. Typically, however, the consist of the following "stages" that have to be covered by the company:

- Pre-assessments: an optional step which could save money in the actual assessment, costing about 15,000 to 25,000 US$ per fishery depending upon the complexity of the fishery operation (number of stocks, gear types, jurisdictions, etc.).
- Full assessments: the initial full assessment is the core of the auditing, and, consequently, the most cost-intensive one - 75,000 to 150,000 US$ per fishery on average, but for highly complex fisheries this number can be higher.
- Annual surveillance audits: a monitoring exercise to ensure nothing significant has impacted the certification; costs are typically 15 to 20% of the price of the initial full assessment.

In addition to these costs, any company that handles fish in a way where there is opportunity for substitution or co-mingling also needs to perform audits of the traceability in the "chain of custody" - i.e. ensuring that products from a certified fishery sold as MSC-certified can be traced back to the exact fishery. These costs usually do not exceed 5,000 US$/year.

The MSC itself concludes that "the overall cost for most fisheries to become certified and maintain fishery certification ranges from fractions of a penny per pound to pennies per pound, when averaged over the five-year life of a fishery certificate (Marine Stewardship Council 2013).

Sources: Marine Stewardship Council 2013; MSC.

Case Study: Costs of Forestry Certification Schemes (FSC) in General and in Finnish Forests

There are both direct and indirect costs involved in setting up a certification program -large landowners may hold an individual FSC certificate and bear the costs themselves, or a group entity may address costs on behalf of group members. Regardless of the approach, the owner/organization must hire a third-party auditor and prepare for and participate in audits that occur every year (direct costs). The FSC Factsheet on Costs and Benefits (Forest Stewardship Council US 2013) state, direct (audit) costs "for an individual FSC certificate will typically start at about 10,000 US$ covering a five-year term for a relatively small owner with 2,500 acres and climb based on acreage and management intensity…" - up to around 35,000 US$ for forests 5,000 to 50,000 acres in size, or 120,000+ US$ for forests with sizes reaching millions of acres. These expenses then cover the certification body's time, travel and earnings for the initial audit and four annual checkups. The factsheet, moreover, also states that there are opportunities to get subsidies on the cost of certification audits, and that FSC certification costs are not higher than in other forestry certification schemes.

Indirect costs - or "compliance costs" - are more difficult to quantify, as they usually do not consist of direct payments "in cash". According to the Factsheet, they might consist of:

- retaining a percentage of trees to function for wildlife habitat rather than cutting everything that is saleable;
- setting aside buffers along stream channels or wetlands to protect water quality or reserving some areas to protect endangered wildlife and plants;
- using fewer chemical pesticides and tolerating in-growth of some natural herbs, shrubs or trees;
- fixing gullies so they don't wash out roads;
- communicating with neighbours about property boundaries or anticipated harvests;
- installing safety precautions like gates or signs when appropriate;
- getting a forest management plan and forest inventory;
- keeping records of harvests or a journal of management work.

An example from Finland can shed some light on some of these indirect costs: A review of the future of Finland's forest sector estimated the levels of funding needed annually for forest conservation within the administrative sector to reach 65 million € [87 million US$] (in 2005, the Ministry of the Environment spent a total of 49 million €/78 million US$ on the acquisition of land for protected areas and related compensation payments). An estimation from a different angle investigates the costs associated with PEFC forest certification *(Programme for the Endorsement of Forest Certification Schemes)* and FSC certification *(Forest Stewardship Council)*, promoting of forest biodiversity mainly through the conservation of features typical of valuable habitats, and retention trees and decaying wood left at forest regeneration sites (average number of retention and decaying trees left is at least 5 to 10 trees per hectare). The costs in privately owned forests in Finland (95% of commercially managed forests in Finland are certified under PEFC and FSC) amounted to 6.7 – 11.6 million € [10.7 - 18.6 million US$] annually, in the period 2005-2008.

Sources: CBD 2013b: 15; Government of Finland 2011: 75; Forest Stewardship Council US 2013.

Case Study: Costs of Measures to Stop the Decline of Farmbirds In The UK and EU27

On the basis of a "Farmland Bird Package", containing measures that provide the key ecological requirements of the most common arable farmland birds, the EU27 costs for stopping the decline of farmbirds was calculated by Winspear et al. (2010). First, on the basis of a scenario analysis, the costs for the UK were estimated (between 51 to 96 million €/a, depending on the scenario; a scenario resulting in 59 million € or 84.8 US$/a [or 1,352 €/1,945 US$ per km^2/a] was deemed most realistic), and extrapolated to the total arable area in the EU27. However, it is estimated in the study that such a level of intervention is "unlikely to be required in many other Member States, and especially those in Southern and Eastern Europe that have more extensive arable farming systems at least in some regions and where farmland bird populations are healthier", reducing the overall EU27 estimation to 854 million € [1,229 US$] annually.

Sources: Hart et al. 2011: 64.

Table 7: Overview of unit costs obtained from various studies

Subject	Ecosystem/Type of costs (if available)	Unit costs	Source
Ecosystem Conservation in Germany	Forests/only financial costs	170 €/ha/a [228 US$]	Wustemann *et al.* 2013 (313)
Ecosystem Conservation in Germany	Arable land/only financial costs	230 €/ha/a [309 US$]	"
Ecosystem Conservation in Germany	Grassland/only financial costs	980 €/ha/a [1,317 US$]	"
Ecosystem Conservation in Germany	Peatland/only financial costs	200 €/ha/a [269 US$]	"
Ecosystem Conservation in Germany	Dry habitats/only financial costs	450 €/ha/a [605 US$]	"
Ecosystem Conservation in Germany	Wetland/only financial costs	360 €/ha/a [484 US$]	"
UK targets for biodiversity and other environmental issues	ALL UK ecosystems	122.6 €/ha/a [179.1 US$]	Cao *et al*. 2009
Biodiversity protection in agricultural areas	Agricultural areas/arable land	476 to 616 €/ha/a [685-887 US$]	Overmars/van Zeijts 2010
Biodiversity protection in agricultural areas	Semi-cultivated landscapes and traditional grassland/ALL costs	500 €/ha/a [731.5 US]	Hampicke 2009
Biodiversity protection in agricultural areas	Highly productive grasslands	1000 €/ha/a [1,463 US$]	Hampicke 2009
Favourable conservation status	All terrestrial Natura 2000 habitats	63 €/ha/a [90.7 US$]	Gantioler *et al.* 2010
Favourable conservation status	(Not entirely clear)	107 €/ha/a [186 US$]	Markland 2002
Favourable conservation status	(Not entirely clear)	128 €/ha/a [187.2 US$]	BirdLife International (2009)
Favourable conservation status in Poland	(Not entirely clear)	From 14 €/ha/a	Hart *et al.* 2011
Favourable conservation status in Malta, Cyprus, Luxembourg	(Not entirely clear)	Up to 800 €/ha/a	Hart *et al.* 2011
HNV forestry	Forests	37 €/ha/a [53.2 US$]	Kaphengst *et al.* (2010)
Maintaining HNV farmland	Arable land/grassland	200 €/ha/a [279 US$]	Hart *et al.* 2011

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Subject	Ecosystem/Type of costs (if available)	Unit costs	Source
Maintaining HNV farmland	Arable land/grassland	169 €/ha/a [243 US$]	Kaphengst *et al.* (2010)
Restoration of forests in GEF eligible countries	Forests	300 US$ (one-off investment)	CBD 2012
EU Support Actions 5 and 7	n. a.	Tens of millions of € from 2010 to 2020	Tucker *et al.* 2013
EU-wide biodiversity awareness campaign	n. a.	350,000 € [489,000 US$]	EC 2011
Development of management plans in forestry sector	Forests	10 to 60 €/ha over ten years [13.7-83.7 US$]	EC 2011
Research into Ecosystem Services (National Study: UK NEA 2011)	ALL	1.2 million £ [ca. 2 million US$]	EC 2011

Sources: see table; own depiction.

Case Study: Costs of Nature Conservation in Switzerland

In Switzerland's budgetary planning, "nature conservation" is a part of the superordinate expenditure category "environment and regional planning", covering expenses for "biotopes, landscape protection, conservation measures within agricultural landscapes, Switzerland's National Park and other protected areas", both investment/financial costs as well as administrative costs (maintenance and personnel, for example). A recent study estimated the financial resources required for the protection and maintenance of biotopes of national importance according to legal standards (which could be interpreted as Aichi requirements), and concluded that the yearly sum allotted presently by the Confederation and the cantons covers not even half the amount of funding necessary (the amount required would be CHF 148 - 183 million/a) [172.4 - 213.2 million US$/a]. In addition, a one-time investment in restoration measures would be needed (700 to 1,500 million CHF) [815 - 1,748 million US$].

The study concluded that it is impossible to satisfy legal requirements with the existing level of funding.

Source: FOEN 2010.

Case Study: Belgian Export Credit Agencies

A concrete operational objective of Belgium's national planning document towards biodiversity protection (from 2006) is to take biodiversity concerns into account in providing financial support (loans, guarantees, insurance) for projects in Southern and Eastern Europe, through the Export Credit Agencies (which assist Belgian industries abroad). The projects supported by the Agencies - mainly infrastructure projects, such as dams and pipelines - can have very significant impacts on environment and biodiversity, which would need to be fully incorporated into any applications for support through the agencies - screening procedures "must ensure that activities that lead to irreversible damage to biodiversity are not promoted".

This issue is of relevance since also other EU countries maintain similar projects/agencies, such as the German Hermes export credit guarantees.

Source: CBD 2013c: 8.

Case Study: Investments in Environmental Polices in Serbia

"Development policy" in the context of several East European non-EU countries is very close to the policies oriented towards future accession to the EU (policy alignment). In Serbia, the "National Strategy of Serbia for the EU Accession of Serbia and Montenegro", contains one whole chapter that focuses on social and economic development (in terms of GDP growth) through direct investments based on sustainable development principles, including priority actions.

Nevertheless, the level of environmental investments in the Republic of Serbia is currently low, also compared to the level of spending in other EU accession countries presently and in the past (in Serbia, the percentage rose from 0.3% of GDP in 2001-2005 to approximately 0.4% in 2008; in other Central European accession states, the investments in environmental policies ranged from 1.5 to 2.5% of GDP in their respective pre-accession periods). The Serbian government plans to increase the allocations for environmental investments up to 1.5% in 2014, and 2.5% in 2017 (% of GDP), in accordance with the Sustainable Development Strategy.

Regarding financing, the EC introduced a new financial instrument for pre-accession assistance – IPA – for the budgeting period 2007-2013, which merged the previous pre-accession funds. Serbia has access to two IPA components, which amounted to 190 million € [277.5 million US$] in 2009.

Comparing the EU accession funds (190 million €/277.5 million US$ in 2009) to the level of spending for environmental issues that seem necessary for fulfilling the accession criteria (2% of GDP would amount to around 1.6 billion US$), and to the external debt, it is obvious that Serbia (and other countries in a similar position as well) would need much more substantial financial aid to be able to progress significantly in protecting their biodiversity (and reaching the Aichi Targets).

Sources: CBD 2013a: 17; Ministry of Environment and Spatial Planning of the Republic of Serbia 2011: 43 et seqq., 50; CBD 2013d.

Case Study: Peatland Restoration in North-East Germany

Up until the 1990's, in Mecklenburg-Vorpommern, a state in north-eastern Germany, 97% of peatlands with an area of about 300,000 ha were drained for agricultural purposes. After this period, the demand for land for cattle ranching and fodder production decreased, reducing the need for draining. Also, the high costs of maintaining drainage infrastructure and equipment raised questions about its economic benefit; furthermore, climate change predictions foresaw reduced water availability in the future. In response, the Ministry of Agriculture, the Environment and Consumer Protection of the state of Mecklenburg-Vorpommern formulated a "Peatlands Restoration Strategy", commissioned a study to assess alternative land use options for peatlands, and let the University of Greifswald analyze the economic potential of different land use options, using a modeling approach (with a model called GEST).

As a result, until 2008 almost 30,000 hectares of drained peatlands have been restored - at quite high costs, however, and needing very high initial investments (initial cost of restoration vary between 3,000 and 5,000 €/ha [4,364 to 7,274 US$/ha], very much depending on the price paid for land acquirement). Nevertheless, the benefits from the avoided carbon emissions (an average of 10,4 tCO_2-equivalents per hectare) outweigh these costs after only a few years.

Sources: Förster 2009; MLUV MV 2009.

Case Study: Evidence on Sequencing from Serbia and England

The Serbia NBSAP states that a "well-functioning biodiversity information system is a prerequisite for achieving a good nature protection paradigm", and the generation of basic knowledge about biodiversity and conservation status through a biodiversity information system is "an essential step towards increased and more effective biodiversity conservation". Hence, the development of an information system is crucial to supporting and informing the biodiversity policy and decision making.

Similarly, the UK's NBSAP also assumes a good evidence base to be prerequisite for "delivering the strategy effectively". The authors state that such a base would "help us make sure we are doing the right thing in the right place, and using our resources effectively, focusing on action that will have the most impact". It is furthermore said that actions to reduce pressures on biodiversity may be targeted at habitats, but be beneficial for priority species as well- an obvious conclusion, but one that highlights the difficulties in choosing which measures or actions benefit exactly which target(s), and which not.

Source: Ministry of Environment and Spatial Planning of the Republic of Serbia 2011: 78 et seqq.; DEFRA 2011: 7, 11.

Case Study: Wetland Conservation and Restoration in Finland

The Finnish NBSAP highlights that any new land use that would entail considerable changes to mires (such as peat extraction, drainage channels for forestry etc.) must be focused in mires and peatlands which have already been drained or whose natural state has otherwise been significantly changed (while conserving the not yet disturbed areas). At the same time, the plan states that the restoration of those mires in which "the natural state has been considerably degraded, but which are still considered most valuable in terms of nature conservation" is also vital to safeguarding the biodiversity of mire ecosystems. This, however, has yet only been done in some protected areas, and not on land that is not profitable anymore for other uses.

Source: Government of Finland 2011: 23.

Case Study: Baltic Sea Action Plan

In 2010, the research network BalticSTERN conducted two Baltic Sea-wide surveys, called BalticSurvey and BalticSUN, coordinated studies in nine Baltic Sea countries regarding public use of the Baltic Sea and people's attitudes towards the marine environment and towards responsibilities for improving the environment (over 9,000 interviews were conducted). The latter study, BalticSUN, building upon the results of BalticSurvey, then assessed how the public evaluates improvements in environmental quality (namely nutrient reductions). This was done by describing the state of the Baltic Sea in 2050 if no new measures to reduce eutrophication were undertaken (Business-As-Usual scenario), compared to a state where the reduction targets of the Baltic Sea Action Plan (BSAP) were reached, and asking the people about their WTP for these improvements. The following Cost-Benefit Analysis demonstrates that combating eutrophication in the Baltic Sea would provide large welfare gains to the people living in the Baltic region: the people in the nine countries bordering the Baltic Sea are willing to pay approximately 3,800 million € [ca. 5.5 billion US$] annually for a less eutrophicated Baltic Sea, while the costs would only amount to around 2,300 million € [3.3 billion US$] annually.

Source: BalticSTERN Secretariat 2013.

Case Study: Marine Protected Areas in the Uk

A study conducted by DEFRA in 2009 assessed costs (to the government for implementing and maintaining the marine conservation network as well as the costs to business from restrictions on activity) and benefits (including food and raw materials, nutrient cycling, climate regulation, sea defense, cognitive values/research spending and expenditure for education) of marine conservation zones in UK waters. It concluded that the conservation of UK's marine habitats has a positive net value (benefit-cost ratios ranging from 6.7 to 38.9), and that even after applying sensitivity analyses, the benefit-cost ratio would probably not drop below 1.

Source: EC 2011a: 52 et seqq.; Tinch *et al.* 2010.

Case Study: Cost-Benefit Assessments for Natura 2000 Sites in Scotland, France, Germany and Finland

Cost and benefit estimates for 7 representative Natura 2000 areas in Scotland, based on assessments of direct (management and policy) and opportunity costs, and evaluations of both use values (e.g. recreational use) and non-use values (assessed via a WTP study), were extrapolated over the total number of Natura 2000 sites. In a Cost-Benefit Analysis, it was calculated that the net benefits significantly overweigh the costs, at a benefit-cost ratio of 7:1 (over a period of 25 years), not including several additional values not assessed (social, cultural, educational, research, environmental services and health values).*

In **France**, as part of a wider economic and institutional assessment of Natura 2000, similar cost-benefit ratios were calculated: at the Natura 2000 site "Plaine de la Crau", the net benefits were calculated to be around 142 € ha/a [around 200 US$/ha/a], i.e. around seven times higher than the costs associated with the Natura 2000 site. In the **German** National Park "Bayerischer Wald", the total annual costs (borne by the public) add up to 12 million € [17.5 million US$], directly and indirectly supporting 1,139 FTE jobs. Additionally, every Euro invested publicly in the National Park is returned more than doubly by the spending of visitors.

In the **Finnish National Parks**, a total annual revenue of 70 million € [98 million US$] is generated, creating 893 person-years in employment; it is estimated in the study done by the Finnish Natural Heritage Services and the Finnish Forest Institute that each Euro of public investment to protected areas provides 20 Euro in return.

* In the TEEB study (TEEB 2009: 20), the benefit-cost ratio for Scottish Natura 2000 sites is stated to be 3:1; no further information listed, however.
Sources: EC 2011a (Annex 11); EU 2013: 6; Nationalparkverwaltung Bayerischer Wald 2008.

Case Study: National Biodiversity Strategy, Germany

A study conducted by Wustemann *et al.* (2013) evaluated the financial costs and benefits of implementing a set of measures based on the National Strategy on Biological Diversity in Germany (NBS) and the Quality Status Reports of the EU Habitat Directive. The set of measures consisted of land use changes for six ecosystems/land use types: forests, arable land, grassland, peatlands, wetlands and dry habitats (a total area of 8.8 million hectares). Besides the financial costs, the benefits of the implementation were calculated for the "maintenance of biodiversity", water purification and climate change mitigation (the former via a WTP survey, the latter two based on abatement and damage costs). The results of the study indicate that the implementation of the NBS would lead to significant financial costs (reaching 3.26 billion € or 4.68 billion US$/a from 2010 to 2020), but the benefits would exceed the financial costs of measures: the benefits of biodiversity maintenance were estimated at 9.25 billion €/a [13.3 billion US$/a], climate protection benefits at 311.5 million €/a [447.8 million US$/a] and water purification benefits at 382.3 million €/a [550 million US$/a]. Therefore, the benefits would exceed the financial costs with a benefit–cost ratio of around 3.

Source: Wustemann *et al.* 2013.

Case Study: River Elbe Floodplain Restoration

A study by Meyerhoff and Dehnhardt (2007) of the Technical University, Berlin, calculated the costs and benefits of restoration measures on the river Elbe (German part), through dike shifting, reducing agriculture impact and constructing fish ladders. The research combined a partial Cost-Benefit-Analysis based on a WTP study with avoidance cost approaches, engineering and land opportunity costs, and a statistical model of nitrogen retention. Several benefits - such as recreation and flood protection, climate change mitigation - were not valued. Eight scenarios were considered, and all benefit-cost ratios were above 1 (ranging from 2.5 to 4.1), even after applying separate sensitivity analyses.

Source: Meyerhoff/Dehnhardt 2007.

APPENDIX 5. LATIN AMERICA AND THE CARIBBEAN

Case study: Benefits of Forest Conservation in Guatemala

Guatemala contains 14 ecological regions, including montane ecoregions that are considered a high conservation priority at the regional level; the rainforest of the Sierra Madre, also a high priority; and Central American mixed forests, which are considered vulnerable to threats and categorized as a moderate conservation priority. Guatemala has faced increasing deforestation during the last two decades: between 1991 and 2001, the country lost 73,148 ha of forest annually equivalent to a rate of -1.43% per annum. The root causes of this deforestation trend were agricultural expansion and the unsustainable use of forests. In addition Guatemala faces desertification and droughts and is highly vulnerable to variations in climate.

South-eastern Guatemala is characterized by the presence of dry forests, which are considered one of the most threatened ecosystems in Guatemala and in Central America. The benefits of restoration of 3,500 ha are estimated to amount to savings of 95,544 tCO2e over 5 years. Forest conservation of 1,960 ha will bring avoided emissions of 413,114 tCO2e and additional revenues through reduction of emissions under REDD+ equivalent to US$619,672. Sustainable agroforestry systems covering 3,500 ha will contribute savings of 20,127 tCO2e.

Western Guatemala is characterised by a humid mountain landscape and is home to important extensions of Central American pine oak forests, which are considered to be the richest in diversity of coniferous trees at the subtropical level and with high levels of regional and local endemism. The humid montane conservation will bring avoided emissions 468,360 tCO2e representing revenues from REDD+ equivalent to US$ 702,540. The establishment of a biological corridor of 13,843 ha would yield emissions savings of 30,130 tCO2e.

Source: GEF project "Sustainable forest management and multiple global environmental benefits"

Table 1. Overview of annual benefits associated with different ES

Ecosystem services	Annual benefits (US$ - 2004)
SFM secondary growth forest	302/ha*
UH secondary growth forest	250/ha*
SFM old growth forest	367/ha*
UH old growth forest	462/ha*
Recreational service	1.6/ha to 6.3/ha
Maintaining soil fertility	26.3/ha
Water supply	235/ha

Source: Nahuelhual, L., et al. 2007. Valuing ecosystem services of Chilean temperate rainforests. http://www.cepal.org/ilpes/noticias/paginas/4/31914/Nahuelhual_07_Eco_Services_Chilean_forests_GOOD.pdf

* Net Present Stumpage value: Values calculated based on a 8% discount rate for a 60 years' time span.

Table 2. Overview of ES and associated economic values provided by the Amazon

Ecosystem services	Economic value (US$ – year not communicated)
Production of non-timber forest products	50-100 / ha / year
Production of timber, net present value of Reduced Impact Logging (not necessarily sustainable production)	419-615 / ha
Erosion prevention	238 / ha / year
Fire protection	6 / ha / year
Pollination of coffee plantations from forest (Ecuador)	49 / ha / year
Disease protection	Unknown
Carbon storage – damage avoided due to CO_2 emissions avoided	70-100 / ha / year
Carbon storage – value of total carbon stored in intact forest	750–10,000 / ha
Maintenance of biodiversity	Unknown
Cultural and spiritual aspects of the forest	Unknown
Existence value	10-26 / ha / year
Recreational and ecotourism use	3-7 / ha / year

Source: WWF. 2009. Keeping the Amazon Forests standing: a matter of values.
http://www.wwf.se/source.php/1229304/Keeping%20the%20Amazon%20forests%20standing.pdf

Table 3. Results produced by the natural capital GIS

Ecosystem Services	Mean value (US$/km^2)
Allspice production	14.40
Chicle production	40.80
Non-timber products	10,661.60
Medicine	97,834.40
Genetic material	524.40
Tourism	136.00
Carbon storage	99,913.60
Soil conservation	1,900.40
Flood control	1,321.20
Existence (CV)	209.60
Existence (PfB)	14,732.00
TEV	**227,288.4**

Source: Eade, J.D.O. and Moran, D. 1994. Spatial Economic Valuation: Benefits Transfer using Geographical Information Systems.

Colombia – Valle del Cauca – Water for Life and Sustainability (FAVS)

Valle del Cauca (Cauca Valley) is a highly productive and fertile region, with a huge number of sugarcane producers, an important export and domestic crop for the country. Sugarcane yields depend on the availability of water for irrigation, accounting for five to six irrigation cycles per year to maximise yields. Applying one less irrigation cycle per year would reduce sugar cane yields by 9% (10 tons/ha). Damages to the region's forest and the water resources threatening to reduce production might cost $33 million each year. The water funds aims to improve groundwater recharge and stabilize local water supply. If the investments are effective on the ground to increase groundwater recharge over a period of seven years, the expected benefits for crop production would be around $36.8 million yearly after the 8th year of activities. By using hydrological models and simulating the impact of the most cost-effective alternatives (Invest) of land uses to the greatest environmental benefits, the survey has estimated that according to the level of investment and the type of watershed, the reduction in erosion would be of 4% at the most conservative estimation to 5%-58% reduction in erosion for the best level of investment.

The water fund started to work in 2008 and has so far protected 11 sub-watersheds covering activities of conservation, restoration and/or best management practices implemented in 415,330 hectares. It has involved 1,491 families located in the upper side of the watersheds. The project has built 80 km of protected river fences, protected more than 87 headwaters, conserved over 250 hectares of land through restoration and natural regeneration, and converted more than 80 ha of critical land along streams to sustainable cattle ranching

Source provided by Aurelio Ramos, regional coordinator for LA&C of TNC

Mexico: programme of Payments for Hydrological services (PSAH)

The PSAH is providing economic incentives in areas of hydrological importance in order to avoid deforestation in areas facing severe water problems. The PSAH set up some eligibility criteria giving priority to forest conservation of cloud mountain forests, areas where aquifers were overexploited and watersheds with high water scarcity problems or areas of high flood risk, forest located in areas of influence of population of more than 5,000 inhabitants and finally, those forest areas within the perimeter of protected areas. Since the time the programme was launched in 2003 until 2006, the PSAH has protected around 598,100 hectares, around 879 contracts have been signed with landowners from which more than half are contracts agreed with collective landowners. Of the total forest area covered by the system, 11% was in high or very high risk of deforestation in 2003; this share increased to 28% in 2004 and fell again to 20% in 2005. Between 10% and 25% of PSAH resources have gone to areas with overexploited aquifers and less than 7% to the most overexploited.

The Mexican payment system requires water users to pay for the benefits of clean water resources. For this purpose, a fiscal instrument was created in the form of a fee on water use. The percentage earmarked was fixed initially to 2.5% of the total water revenues. Finally, it was decided to allocate a specific amount of money (~US$27.3 million) per year, which is very close to the proposed share. This amount of money is a proxy of the value of the environmental services provided by the programme.

The experience of the city of Coaltepec in the State of Veracruz brought some lessons on the possibility to depend on the willingness to pay for PSA preserving groundwater and superficial aquifers. Coaltepec is a city of 45,000 inhabitants and one of the main coffee production and trade in the region. Facing some water shortages, the mayor of the city asked the local authorities and the local water operator to add to the water invoice a donation equivalent to $ 1 peso (US$0.009) to be used in conserving forests. The first year, he received around US$ 9,100. With additional funds coming from the State, 500 hectares of forests have been preserved by paying the landowner the equivalent of US$90 per year per hectare.

Source Muñoz-Piña *et al*. 2008

Water services beneficiaries in Costa Rica

The total private sector agreements engaged with the FONAFIFO (National Fund for Forest Financing) amounted to approximately to US$ 560 mil per year (2004). The following companies are willing to pay for the water services they receive from the PSA.

- Energia global (hydropower company): from 1997 (5 year contract renewable) - US$40 mil per year to protect 2,493 hectares in the San Fernando watershed and Volcain Sarapiqui watershed.
- Compania nacional de Fuerza y Luz (hydropower company) : from 1998, 5 year contracts renewable - US$436 mil per year to protect 10,900 hectares of Aranjuez, of Lago Cote and Balsa watersheds.
- Hydro power Platanar – from 1999, 10 year contract renewable – US$39 mil per year to protect 1,300 hectares of Platanar watershed.

Other financial agreements have been signed by selling "environmental services certificates" which are standardized instruments to pay for the conservation of one hectare of forest in a specific area. The buyers are paying for a number of interested hectares. Among these buyers are agrobusiness companies (Azucares El Viejo, Las Costeña, Exporpac, Olefinas) and Tourisms companies (Desarrollo hotelero Guanacaste).

Source: Pagiola, 2006 and Saenz, 2008

Potential benefits and cost to the transition to sustainable management of fisheries

Yields
Depletion and fisheries collapse can incur high costs in terms of lost yields, as well as impacts on employment and other indicators.

By investing in maintaining or restoring natural capital and reorienting fisheries management toward maximum economic yield (MEY), net economic benefits will increase at MEY, even with slightly lower yields. For fisheries characterized by severe resource depletion, a shift from current state toward sustainable management will involve a temporary reduction in yields, but successful rebuilding will lead to increased yields over the long term.

Employment
As with production, restructuring national fisheries to be more economically efficient may require an initial reduction in employment, given that overcapacity (including labour capacity) is a major aspect of inefficiency in the sector. Temporary measures to prevent high unemployment, funded from gains in earnings, have buffered the transition. Addressing cases of chronic overfishing may lead to an increase in employment, sometimes in relatively short times. The costs of transition are likely to be lower in regions where the local economy is growing and alternative employment opportunities are already available. Such adjustments could create a more diversified employment (add-valued post-harvest processing for example) base and reduce overall vulnerability.

Fiscal Impacts
Sustainable management in fisheries needs investments in science and management capacity (including surveillance and control). At the same time, it implies reduction of inappropriate subsidies, which can release funds for investment in fisheries management. In addition, moving fisheries toward MEY generates increased returns on investment in the fishery, provides new opportunities for cost recovery, and improves the tax base. The net economic benefits of sustainable management of fisheries are likely to be higher if current subsidies represent a substantial fiscal cost and where the additional costs of management and control are offset by improvements in yields and a reduction in IUU fishing, both of which increase taxable business income.

Equity
In the near term, management changes are likely to create both winners and losers. Successful transition may depend on finding ways to limit economic hardship during the transition and mitigate costs to those who lose. Fisheries can be an essential source of food security, employment, and income; fisheries may provide a critical safety net for poor local communities. Mining the resource base may be an effective short-term strategy for individuals (and countries) to move out of poverty, but sustainable resource use is a necessary condition for fisheries to contribute to poverty reduction over the long run. The poor are disproportionately vulnerable to fisheries depletion and collapse because they lack economic alternatives; thus, they poor may benefit from the increased security of fisheries-based livelihoods associated with sustainable management practices. The distributional implications of fisheries management options, in particular changes to access rights, must be considered when developing under sustainable management strategies.

Source: Bovarnick *et al*. 2010.

Table 5. Values of ecosystems services in the Terraba-Sierpe National Wetlands

	MANGROVES		TROPICAL FOREST		WETLAND		LAKES AND PONDS		PLANTATIONS		BEACH	
Ecosystem services	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Food production	2.49	4,939.23	8.91	117.19								
Recreation & aesthetic	37.44	3,233.13	0.42	980.29	13.55	6,057.99	1.80	20,962.49			368.41	119,607.47
Habitat & refugium	313.31	332.12										
Raw material	22.41	1,973.13	64.01	1,502.10								
Disturbance regulation	2.39	12,675.09	5.32	5.32							58,365.09	94,607.88
Waste treatment	10,766.39	10,776.39	92.58	92.58	1,262.43	4,224.21						
Biological control												
Gas & climate change			32.81	58.58	12.09	12.09			8.19	14.64		
Nursery					2.55	8,125.20						
Wildlife conservation							62.67	1,574.76				
Water supply			11.26	11.26	0.19	20,352.99	18.23	887.96				
Water regulation			0.15	25.04	440.64	3,754.75						
Pollination												
Soil formation			10.64	10.64								
Erosion control			7.26	1,020.39								
Nutrient cycling			1,433.01	1,433.01								
Genetic resources			2.25	254.14								
Total value per ha	**11,154.43**	**33,929.09**	**1,668.62**	**5,510.54**	**1,731.45**	**42,527.23**	**82.70**	**23,425.21**	**8.19**	**14.64**	**58,733.50**	**214,215.35**
Total hectare/type of ecosystem	**13,328**		**45,420**		**6,751**		**182**		**6,060**		**863**	
Total value per type of ecosystem	**148,666,243.04**	**452,206,911.52**	**75,788,720.40**	**250,288,726.80**	**11,689,018.95**	**287,101,329.73**	**15,051.40**	**4,263,388.22**	**49,631.40**	**88,718.40**	**50,687,010.50**	**184,867,847.05**
Total low value	**286,895,675.69**											
Total high value	**1,178,816,921.72**											

Source: Adapted from Earth Economics (2010)

Table 6. Economic value and potential losses from coral reef degradation in the wider Caribbean

Ecosystem Good or Service	Estimated Annual Benefit (2000)	Estimated Future Annual Losses
Fisheries	US$ 312 million	Fisheries productivity could decline an estimated 30-45% by 2015 with associated loss of net annual benefits valued at US$ 100-140 million (in constant-dollar terms, standardized to 2000).
Dive tourism	US$ 2,100 million	Growth of Caribbean dive tourism will continue, but the growth rate by 2015 could be 2-5% lower as a result of coral reef degradation. Region-wide losses of net annual benefits are valued at an estimated US$ 100-300 million (in constant-dollar terms, standardized to 2000).
Shoreline protection	US$ 700 – 2,200 million	Over 15,000 km of shoreline could experience a 10-20% reduction in shoreline protection by 2050 as a result of coral reef degradation. The estimated loss in net annual benefits is estimated at US$ 140-420 million (in constant-dollar terms, standardized to 2000).
Total	US$ 3,112 – 4,612 million	US$ 350 – 870 million

Source: Burke, L., Cooper, E. and Bood N. 2008. Coastal Capital: Belize – The Economic Contribution of Belize's Coral Reefs and Mangroves.

Table 9. Overview of different valuation studies of coral reefs in the Caribbean region

Ecosystem services		Study 1† Martinique*	Study 2†† Trinidad**	Study 3‡ St Lucia**	Study 4[6] Bermuda***
Direct ES	Fisheries [a]	US$ 0.21	US$ 0.02–0.03	US$ 0.02–0.04	US$ 0.012
	Indirect impact from fisheries	–	US$ 0.004–0.008	US$ 0.002–0.005	–
	Tourism activities	US$ 1.56	US$ 1.45	US$ 2.77	US$ 1.015
	Indirect impact from tourism	–	US$ 1.93–2.86 [b]	US$ 2.01–3.09	–
Indirect ES	Coastal protection	US$ 0.37	US$ 0.6 – 1.1	US$ 0.85–1.51	US$ 0.665
	Biomass (fish)	US$ 0.12	–	–	–
	Amenity	–	–	–	US$ 0.017
Non-usable ES	Cultural value	US$ 0.07	-	–	US$ 0.091
	Research and education	US$ 0.01	–	–	US$ 0.006
TOTAL		**US$ 2.34**	**US$ 4–5.45**	**US$ 5.65–7.41**	**US$ 1.806**

* Values are expressed in million euros/km²/year. Exchange rate 1USD= 0.762 euros (2010).

** Values are expressed in million US$/km²/year (2006 US$).

*** Values are expressed in million US$/km²/year (2007 US$).

[a] Fishery include the different types of fisheries: commercial, leisure, etc.

[b] Indirect economic impact are benefits for both Trinidad and Tobago

† Failler, P., Petre E. and Marechal, J-P. 2010. Valeur économique totale des récifs coralliens, mangroves et herbiers de la Martinique. Available at: http://etudescaribeennes.revues.org/4410

†† Burke, L. et al. 2008. Coastal Capital – Economic Valuation of Coral Reefs in Tobago and St. Lucia. Available at: http://pdf.wri.org/coastal_capital.pdf

‡ Sarkis, S., Van Beukering P.J.H. and McKenzie, E. 2010. Total Economic Value of Bermuda's Coral Reefs: Valuation of Ecosystem Services. Available at: http://ipbes.unepwcmc-004.vm.brightbox.net/system/assessment/191/references/files/566/original/Total_Economic_Value_of_Bermuda_s_Coral_Reefs_-_Valuation_of_Ecosystem_Services_Technical_Report_2010.pdf?1364314252

Source: ICF GHK based on literature referenced in the studies.

Table 11. Enabling actions to support conservation delivery

Case studies	Training and education programmes
Argentina: Establishment of incentives for the conservation of ecosystem services of global significance (GEF project)	▪ Capacity building for design and implementation of PES schemes ▪ Training at different levels to support the up-scaling of the pilot PES.
Conservation of the Biodiversity of the Paramo in the Northern and Central Andes (GEF Project)	▪ Integration of topics related to the Paramo ecosystem in the curriculum of relevant schools ▪ Communication activities ▪ Advocacy activities ▪ Publications of technical reports ▪ Training to raise the technical knowledge among rural inhabitants and field professionals ▪ Organisation of workshops to exchange best practices among participants
Brazil: Rio de Janeiro Sustainable Integrated Ecosystem Management in Production Landscapes of the North-Northwestern Fluminense (GEF project)	▪ Dissemination of best practices through media campaigns ▪ Education through school programmes ▪ Training of local communities and project executors on natural resources management ▪ Technical training of recipients through field trips and field training

Guatemala NBSAP (2012-2020)

From the total budget for the NBSAP (approximately US$290.88 million), 37% will be invested in territorial institutions and coordination of actors, 17% in awareness and valuation assessment, 39% in sustainable landscapes and planning for conservation, 5% in the prevention of threats and 5% in the restoration of biodiversity and ecosystems services.

Argentina - Enhancing political will and knowledge

One of the crucial components of the Argentinean project "Establishment of incentives for the conservation of ecosystem services of global significance" is to train policy-makers and decision-makers at different levels about the relevance of ecosystem services, the existence of different land use practices with different environmental impacts and the development of PES schemes. This training element is not only present in the dedicated component of the project but also in the component aiming at supporting the development of a strong legal framework for the up-scaling of the pilot PES schemes at landscape level. From the analysis of the GEF financing of the Argentinian case study discussed above it appears that activities related to the development of the knowledge base at different decision-making level (outcome 1 and 2 of the project) is higher during the first year of the project (16% of the total budget) but then stay stays stable during the last three years of the project (from 12% to 8% of the total budget) (GEF. 2010. Request for CEO endorsement/approval – project 3623, p.7).

Antigua and Barbuda's NBSAP (2000-2010)

The Antigua and Barbuda's NBSAP have defined as the main priority: The sustainable use, protection and conservation of Antigua and Barbuda's biodiversity; the coordination of all efforts and activities involving the sustainable use, protection and conservation of this biodiversity; the enforcement of all policies, regulations and legislation affecting these efforts and activities; the knowledge and understanding of the processes governing biodiversity, and the information required to guide and coordinate the activities involving the sustainable use, protection and conservation of this biodiversity.

In the period from 2000-2010, Antigua and Barbuda have been making progress in most of the areas of the NBSAP but some areas are still considered as having a low level of implementation. There are related to:

- Establishing the appropriate user's fee for biodiversity conservation; increasing the training of staff and the number of staff in the forestry, agriculture, fisheries, and environmental divisions.
- Using the results of the Research Program, to develop appropriate management techniques and mechanisms to ensure sustainable consumptive use, and to preserve non-consumptive use values of biodiversity resources.
- Implementation of national regulations that address biodiversity management policies.

Bahamas NBSAP (2009-2010)

In order to achieve the overall objectives of biodiversity conservation, there are some obstacles that need to be overcome, such as:

- Lack of national capacity (e.g. technical skills, resources, equipment) to protect biodiversity;
- Lack of resources – manpower, technical skills, equipment and funding;
- Lack of a data management and information system to analyse trends;
- Lack of enforcement of environmental regulations;
- Lack of indicators for tracking progress for the implementation of goals.

Operational investments needs in Costa Rica

One of the key elements of the success of the Costa Rica payment system is its capability to raise the necessary financial resources to finance the payment system for environmental services. By law, FONAFIFO was authorized to create trusts, to issue securities and bonds, to negotiate projects and to receive grants or credits (Saenz 2008). From the beginning, Costa Rica had benefited from grants provided by international donors such as the World Bank and the bilateral technical cooperation with USA (AID), and then with the Netherlands, Sweden and Finland under a SWAP agreement, supplemented by other donations (Ecomarkets and Mainstreaming Market Based Instruments for Environmental Management projects from GEF and the Huetar Norte Forest Program from German aid agency, KfW) (Pagiola 2008). These latter donations enabled the securing of biodiversity conservation activities in protected areas or in areas of strategic concern for preserving biodiversity.

FONAFIFO also receives finance from the government budget, in particular through the collection of 3.5% of fuel tax revenues and 40% of timber tax (Art. 43 of the Forest Law 7575). This latter flow of revenue has never been collected due to some challenges that must be dealt with.

Costa Rica has made progress in securing financial resources over the long term by collecting payments for ecosystem services from beneficiaries of watershed conservation schemes, including hydropower, beverage and water utility companies.

Regarding mitigation of CO_2 emissions, Costa Rica was able to sell carbon emission credits through the emission of Certifiable Tradeable Offset (CTO) which represented an externally certified 1-tone net reduction in carbon emissions. The first impetus was given by the payment of US$2 million for 200,000 CTOs from the Norwegian Government and a consortium of Norwegian power producers. Costa Rica obtained a contract through the World Bank's BioCarbon Fund that enables the country to negotiate sales of about 0.61 million tonnes of carbon dioxide equivalent (tCO2e) by 2017 for activities related to planting trees in agroforestry systems, natural regeneration and commercial plantations (Pagiola 2008).

Regarding the final expected ecological services which are related to the provision of scenic beauty for recreation and ecotourism, the potential buyers are concentrated on the tourism sector (hotel and recreation companies) and are quite scattered and diverse. No contract has been signed between these stakeholders despite the country being one of the finest destinations in Central America for its landscape and biodiversity.

In institutional terms, the three Forest Laws were enacted (Ley de reforestation N° 6184 in 1977, Ley Forestal N° 7032 in 1986 and Ley Forestal N° 7575 in 1996) improving the national capabilities of the country to capture financial resources, besides the national provision, to be used to feed the payment systems. In particular, the Law enacted in 1996 has changed the justification for payments from support for the timber industry to the provision of environmental services (Pagiola S. 2008). The creation of the ministry in charge of the environment (Ministerio del Ambiente y Energie, MINAE) in 1986 as well as of the National Fund for Forest Financing (Fondo Nacional de Financiamiento Forstal, FONAFIFO) in 1996 have contributed to establishing a sustainable and effective payment system and officially have established the national program for payments for environmental services.

Investment in social capital in Mexico

Mexico represents an interesting case in which the national payment for environmental hydrological services was established to benefit Mexican ejidos and communities (landowners holding collectively the forest land). The efficiency of the payments in preserving the forest land depend on the size of the group, the quantity and quality of resources and the costs and benefits of cooperation. The more profitable conservation of forest is for local communities the more local communities are ready to invest in maintaining cooperation in the management of the collective forest. In order to ensure compliance with the contracts obligations, there is a need to invest in social capital and cooperation practices among the ejidos.

Colombia - Data and information collection and R&D

Colombia (Water Fund Cauca Valley, South-western Colombia). One of the key components of the project is to use scientific tools to help decision-makers and investors to obtain a greater return of investment in the identified conservation areas. With the support from the Natural Capital Project (encompassing Stanford University, University of Minnesota, TNC, WWF) and the international Center for Tropical Agriculture (CIAT), the project has used hydrologic models to identify priority areas for conservation using land use alteration scenarios; it has proceeded to a cost analysis of investment alternatives, using different activities that would be developed to identify which alternatives were most cost-effective and finally, it has prepared an investment portfolio with medium and long terms goals for the fund

(FAO, 2013).

Links between sustainable agriculture (AT7) and other Aichi Targets

The Dominican Republic has as its main priority to engage in activities for sustainable land management in the upper *sabana Yegua* Watershed, which is related to **Aichi Target 7**. To achieve this objective it is necessary to solve problems related to insufficient and inadequate policies both at local and national level and the limited institutional capacity and cross-communication between different national agencies. It also requires working to increase social capital and knowledge on alternative methods of agriculture. Finally, to compensate for the costs of changing agricultural practices, there is a need to ensure appropriate resources for incentives measures (**AT 3**).

In **Brazil,** has an initiative to promote sustainable integrated ecosystems management in production landscapes of the North-North western Fluminense (NNWF), which is related to Aichi Target 7. As in the Dominican Republic example, this area is suffering from insufficient human institutional capacity and weak community organisations at the local and state level, from a limited number of sustainable land management plans adapted to the specific agro-ecological conditions to the (NNWF) area (AT4), insufficient systematized data and information for decision-makers to incorporate ecosystems-level considerations into production activities (AT 19) and the need to ensure the financing of incentives measures (AT 3). Increased awareness of ecological and environmental issues (AT 1) will be important in underpinning changes in both policy and practice.

Table 12. Examples of funding allocation in GEF projects.

Aichi Target	Type of financial needs	Funding allocated to the project	Problem solving
Dominican Republic: Demonstrating Sustainable Land Management in the Upper Sabana Yegua Watershed System (GEF project 2512)			
AT7 +AT4	Adaptation of policy frameworks Administrative costs	US$635,880	Insufficient and inadequate policies both on local and national level
AT 5	Training and technical advice and implementation	US$2,125,400	
AT3	Operational cost: Incentives measures for local farmers	US$554,800	Lack of access to finance and ensure long term financing for securing best practices
Brazil: Rio de Janeiro Sustainable Integrated Ecosystem Management in Production Landscapes of the North-Northwestern Fluminense (GEF project 1544)			
AT7+ AT4	Adaptation of local policy and Administrative costs and organisation	US$1,168,000	Low institutional capacity + development legal ramwork for ecosystem management and PES schemes
	Adaptation of local policy	US$164,000	Development legal framework for ecosystem management and PES schemes
	Administrative costs: negotiation and cooperation	US$618,000	Support community organisation and strengthen local institutions
	Administrative costs: R&D and technical assistance	US$406,000	Lack of technical skills and knowledge
	Administrative costs: training of staff for project management	US$562,000	Lack of skills of technicians
AT 1	Administrative costs: training and environmental education	US$350,000	Increase awareness and knowledge on environmental issues
AT3	Operational costs: incentives	US$8,532,000	Financial support for sustainable natural resource management

Management costs of protected areas
Recurrent costs: ▪ Human resources: salaries for park director, managers, park guard, scientists, community liaison officers, tourism specialists and financial specialists. ▪ Maintenance: office, vehicular maintenance, path maintenance. ▪ Utilities: water, electricity and communications. ▪ Basic equipment: GPS devices, boots, uniforms, machettes and torches. ▪ Capital costs: ▪ Infrastructures, capital equipment and vehicles, and other investments related to tourism activities. ▪ Professional services for R&D and training. *(Source: Bovarnick et al. 2010)*

Table 15. Estimated resource needs in the Caribbean (US$ million per year)

Caribbean countries	%PA	RN in CDB PA
Antigua and Barbuda	0.79	4.340
Bahamas, The*	0.54	7.000
Barbados	0.07	0.550
Cuba**	16.43	7.732
Dominica***	3.7	2.420
Dominican Republic	25.95	9.286
Grenada	0.15	9.717
Haiti***	0.11	1.90
Jamaica***	7.43	2.77
Marshall Islands***	0.62	0.16
St. Kitts and Nevis*	0.77	3.443
St. Lucia	2.04	3
St. Vincent and the Grenadines	1.23	0.48
Trinidad and Tobago	9.6	0.875
Total		**53.679**

* Resource needs from NBSAP
** Resource needs based on Bovarnick *et al.* (2010)
*** Resource needs indicated in Waldron *et al.* (2013)

Resources Needed To Deliver Pes Schemes

Examples of Innovative financial mechanism (AT 3)
Colombia, Water fund in Cauca valley, Southwestern Colombia Valle del Cauca (Cauca Valley) is a high productive and fertile region, with a huge number of sugarcane producers, an important export and domestic crop for the country. This region lies in a very rich hydrological system containing important watersheds supplying water to 900,000 people residing in the cities, including the city capital Cali. This region is quite sensitive to climate factors causing water scarcity during the summer. A **water fund** was implemented to improve water problems and sustain the local sugar industry.
Costa Rica, National programme of payment for environmental services Costa Rica experienced in the 1970s the highest rate of deforestation. More than 55,000 hectares of forest were disappearing per year, leaving the country with barely one third of its forest cover (31.1%) in the total territory; in the 1980's this trend continued and the forest cover reduced to only 26.1% of the national territory. The main national environmental policy aimed at reversing the deforestation rate and increasing the forest cover up to 40% of the national territory. This positive trend has been driven by the implementation of a national **programme of payment for environmental services (Pagos por Servicio Ambiental, PSA)**
Mexico, National payment for environmental hydrological services Mexico estimated its rate of deforestation at 1.3% per annum in the 1990s. While deforestation was unequally distributed among the diversity of types of forest and forested areas, the common feature explaining the continuing erosion of forests was the illegal logging and the conversion of forested land into agriculture and cattle ranching. The implementation of the **national payment for environmental hydrological services** has combined forest conservation and protection of water services.

Table 16. Comparison of financial needs for the implementation of PES programmes in Colombia, Mexico and Costa Rica.

Resources needs typology	Costa Rica	Mexico	Colombia (valle del Cauca)
Political will, capacity building and knowledge	High transactions costs. High investment in getting political consensus and ensure local cooperation and commitment	Design of the policy took two years (2001-2003). Strong support from academia for surveys, data collection, stakeholder consultation, technical advice from international experts in areas of hydrology and forest sciences. Financing came from the World Bank and a bilateral cooperation with France.	Strong institutional settings engaging in strategic partnerships and negotiations that raises around US$7.3 million.
Adaptation of political framework	US$110 million. More than 10 years in getting political consensus to implement PES and structure FONAFIFO		
Data and information and R&D	Important part in the design of the eligibility criteria, of the payment scheme and the targeted areas and population.	This is an on-going financial need to readjust the eligibility criteria and avoid rent seeking behaviour.	Important part of the design of the water funds (hydrological models, simulation tools, cost-effective strategies). Use of INVEST, SWAT, ECOSAUT.

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Resources needs typology	Costa Rica	Mexico	Colombia (valle del Cauca)
Administrative measures	Strong technical support	Strong technical support	US$1.8 million (initial allocation to cover operational costs, the technical secretary's salary and the necessary funding for conservation projects)
Operational activities	US$15.5 million per year (2004). Fonafifo has benefited from public resources (3.5% of the revenues from fossil fuel sales tax), Grants from international donors and private-public agreements	US$ 27.3 million per year, from 2004. Mainly using a fiscal instrument.	US$1.4 million (2013): US$0.1 million of the first water fund project; US$0.6 million in the second proposal cycle and US$0.7 million in the second proposal cycle
Monitoring, evaluation and enforcement mechanisms	Approx. US$ 30,200 per year. Water users, beneficiaries of water services, are contributing up to 7% of the administrative costs of FONAFIFO.	Use of images by satellite as a way to ensure compliance. Most cost-effective way compared to the monitoring on site targeted by the payment.	US$300,000 (TNC and CENICANA - top level research centre associated with the local sugar industry)

Source: ICF GHK (2013)

Alignment Between Aichi Targets and Other Policy Agendas

Table 17. Positive linkages between protected areas, poverty reduction and millennium goals.

Dimensions of poverty	Protected areas goods and services	MDGs
Economic opportunities Income generation, housing, food, alternative livelihoods, education and acquisition of new skills	▪ Subsistence, livelihoods and nutrition	▪ Goal 1: Eradicate extreme poverty and hunger (direct contribution) ▪ Goal 2: Achieve universal primary school (indirect contribution)
Empowerment Governance mechanism, community participation, benefits to women, children and young, access and rights	▪ Human and ecosystems health, traditional healthcare ▪ Social and cultural governance ▪ Drinking and irrigation water, hydropower and erosion control	▪ Goal 3 : Promote gender equality (direct contribution) ▪ Goal 4: Reduce child mortality (indirect contribution) ▪ Goal 5: Improve material health (indirect contribution) ▪ Goal 6: Combat major disease (direct and indirect contribution)
Security Health, social cohesion, cultural traditions, maintenance of natural resources	▪ Reduce and mitigate natural disasters ▪ Reduce and adapt climate change	▪ Goal 7: Environmental sustainability (direct contribution) ▪ Goal 8: Global partnership for development (direct and indirect contribution)

Source: Bovarnick *et al*. (2010)

Table 18. Social and economic benefits and the corresponding Aichi Target

Country	Project and Aichi Targets	Social benefits	Economic benefits	Corresponding MDGs
Argentine	▪ Establishment of incentives for the conservation of ecosystem services of global significance (AT 3, AT 5,AT 12, AT 7AT 15, AT 11, AT 14)	▪ 14,000 families have improved access to potable water ▪ Profitability for poorest communities no quantified ▪ Equity in contracts assignment ▪ Capacity building	▪ 1,000 producers (farm products and tobacco) were able to irrigate some 19,000 hectares. ▪ Increase of local income	▪ Goal 7: Environmental security ▪ Goal 1: Eradicate extreme poverty and hunger ▪ Goal 2: Achieve universal primary school ▪ Goal 3 : Promote gender equality
Colombia	▪ Water fund in Cauca valley, South western Colombia – local project (AT 3 AT 11,AT 14, AT 5 ▪ AT 15)	▪ Food security ▪ Environmental education ▪ Capacity building for sustainable production ▪ Stakeholders participation ▪ Social cohesion ▪ Indirect payments in the form of materials and training (supply fences and seeds, etc.)	▪ Avoid costs of water dependent industry estimated at US$300 million per year. ▪ Avoid costs of water shortage for irrigation estimated to (9% of yields reduction, 10 tons/has).	▪ Goal 7: Environmental security ▪ Goal 1: Eradicate extreme poverty and hunger ▪ Goal 2: Achieve universal primary school ▪ Goal 3 : Promote gender equality
Ecuador	▪ Water fund in Ecuador – local project (AT 3, AT 11,AT 14, AT 5 ▪ AT 15)	▪ Environmental education program for children – 30,500 children. ▪ Food security ▪ Improve agriculture management ▪ Capacity building	▪ Increase of employment in conservation activities ▪ Increase in income from rural conservation projects (hired, trained, and salaried 11 park guards). ▪ 200 families engaged in community development projects in rural basins.	▪ Goal 7: Environmental security ▪ Goal 1: Eradicate extreme poverty and hunger ▪ Goal 2: Achieve universal primary school ▪ Goal 3 : Promote gender equality
Dominican Republic	▪ Demonstrating Sustainable Land Management in the Upper Sabana Yegua Watershed System (AT 7 AT 11, AT 15, AT 14)	▪ Increase awareness about land degradation ▪ Improved access to medical services and education ▪ Technical assistance and training to local farmers ▪ Increase capabilities in governance	▪ Increase in local employment ▪ Increase in access to income	▪ Goal 7: Environmental security ▪ Goal 1: Eradicate extreme poverty and hunger ▪ Goal 2: Achieve universal primary school ▪ Goal 5: Improve material health

Cost Benefit Analyses of Investments in Biodiversity and Ecosystems

Costs and Benefits of Protecting the Mbaracayu Forest Biosphere Reserve, Paraguay

Ecosystem service values for the Mbaracayu Forest Biosphere Reserve (approximately 3,000 sq. km.) in eastern Paraguay were assessed using a forest cover map of the biosphere reserve (Naidoo *et al.* 2006). Six forest cover types were mapped using landsat imagery and ground data. Five ecosystem services were valued. For bushmeat, the economic value was mapped by integrating biological information on important game species, forest type classes of the Biosphere Reserve, and prices of domesticated meat in the region's primary market town. For sustainable timber harvests, data from research on standing marketable timber from various species in the Reserve were used. The calculated average per-tree value was US$6.87. For bioprospecting, a value transfer of previous data assessing the WTP of pharmaceutical companies for the potential of tropical forests to contain precursors to new marketable drugs was used. For existence value, data from a synthesis of global economic values of forest ecosystems were used. A household WTP of US$5/ha/annum for existence value was adopted. Carbon storage was valued based on the value of avoided emissions of carbon that is currently stored in aboveground biomass. Benefits transfer was used for services where site-specific valuation information did not exist. A zero opportunity cost was adopted for the core of the Biosphere Reserve.

Spatially explicit estimates of opportunity costs of conservation per hectare of forest were calculated as the probability that a given parcel would be converted from forest to an agricultural land-use type, multiplied by the expected net benefits from that land-use type, and then summed over all land uses. Conversion probabilities were estimated based on past patterns of forest conversion to known agricultural land uses. Net economic benefits of the various types of land uses were derived from regional estimates.

The opportunity costs of conservation in the Mbaracayu Forest Biosphere Reserve varied from US$0 to US$927 per hectare or an average of about US$60/ha. Variation was related to a number of factors such as land tenure, slope and soil type. The economic values (NPV in US$/ha) associated with five forest ecosystem services across the Reserve ranged from US$2/ha to US$1,045/ha. By type of service, the average economic values were as follows: carbon storage - US$378; sustainable timber harvest - US$27.60; existence value - US$25; bushmeat - US$15.59; and bioprospecting - US$2.21.

Whether a particular forested area passed a spatial cost-benefit test for conservation was dependent on how many of the five ecosystem services were included. When considering only ecosystem services that were the most local or private in nature (i.e., bushmeat, timber, and bioprospecting for pharmaceutical products), only forests in the core protected area and indigenous reserves had benefits that exceeded opportunity costs. After existence value was added, 19% of forests outside of the core protected area would pass a cost-benefit test, but most of these still lie in indigenous reserves. Finally, when carbon values were added to the local services, ecosystem service values of virtually all forests (98%) exceeded the opportunity costs of conserving them.

The study also assessed the costs and benefits of three potential corridors for improving connectivity to the core protected area in the landscape. When all five ecosystem services were considered, benefits of all three corridors greatly exceeded costs (Table 20). When only services accruing locally were considered, however, benefits were less than opportunity costs for all corridors. The results also showed that the cost benefit ratios varied for the three different corridors, especially because of variations in the estimated costs.

Source: Naidoo *et al*. (2006)

Table 20. Comparison of the Costs and Benefits of Three Hypothetical Corridors Connecting the Core Protected Area of the Mbaracayu Forest Biosphere Reserve with the Large Indigenous Reserve to the West (2005 US$)*

	Benefits: All	Costs	All Benefits – Cost	Benefits: Local	Local Benefits – Costs
Corridor 1 (FA** - 1,182 Ha)	1,784,010	115,175	1,668,835	25,220	-89,955
Corridor 2 (FA - 874 Ha)	1,594,440	84,531	1,509,909	22,486	-62,045
Corridor 3 (FA - 1,139 Ha)	1,484,940	37,153	1,447,787	28,153	-9,000

Source: Naidoo *et al*. (2006)

* Cost and benefit figures are net present values using a 20% discount rate

** FA - forest area

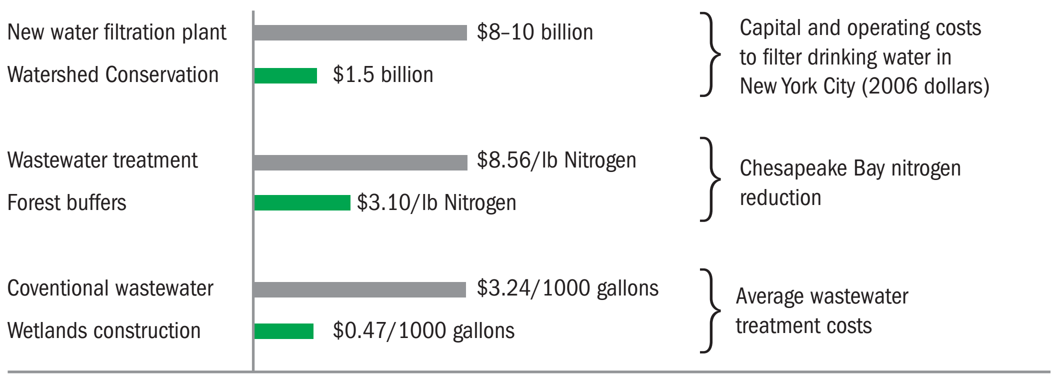
APPENDIX 6. NORTH AMERICA

Case study: Saving money by saving a watershed, New York City water treatment

One of the first and most widely known examples of a municipality using a cost/benefit analysis to calculate the value of services provided by natural ecosystem processes versus mechanized processes is that of the New York City Municipal Water Finance Authority. The case study is also one of the first examples of a successful payment for ecosystem services (PES) venture in the United States.

As New York's famous water quality began to drop in the 1990's water managers discovered that the culprit was increased development in upstream rural areas of the Catskill Mountains, the city's watershed. Their analysis demonstrated that the option of paying for land protection activities within the watershed to achieve water quality was far less expensive than their previously preferred alternative, which was the construction of a new and expensive water treatment facility, estimated to cost between $8 billion and $10 billion for initial construction and $250 million annually for operation and maintenance.

Instead, New York City has committed approximately $1.5 billion (averaging $167 million per year) for payments to land owners for the restoration of native habitat and the establishment of permanent conservation easements on the forestlands and open spaces around City reservoirs. Additional benefits of the choice to restore and preserve forestland in the watershed include carbon sequestration and outdoor recreational opportunities for citizens (Hanson et al., 2011).



Watershed protection is less expensive than building new "grey" infrastructure

Source: Hanson, Craig et al. 2011 Forests for water: exploring payments for watershed services in the US south. World Resources Institute Issue Brief, Issue 2, Pp15.