REGIONAL RESEARCH TO INFORM THE HIGH LEVEL PANEL ON GLOBAL ASSESSMENT OF RESOURCES FOR IMPLEMENTING THE STRATEGIC PLAN FOR BIODIVERSITY 2011-2020

FINAL REPORT FOR ASIA REGION

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United Nations Decade on Biodiversity

CONTENTS

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.

MAIN REPORT

1. 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.[1] 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. METHODOLOGY

2.1 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

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

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 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.

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

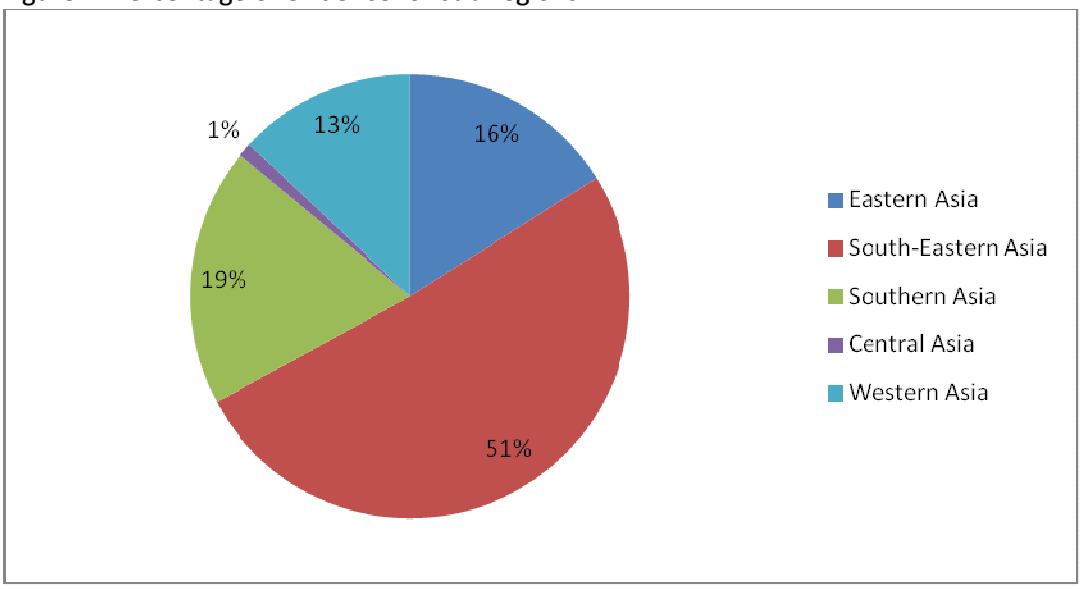
The database of collected evidence consists of 392 existing published papers and reports related to biodiversity conservation strategy. Specifically, the sources of information include:

- 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

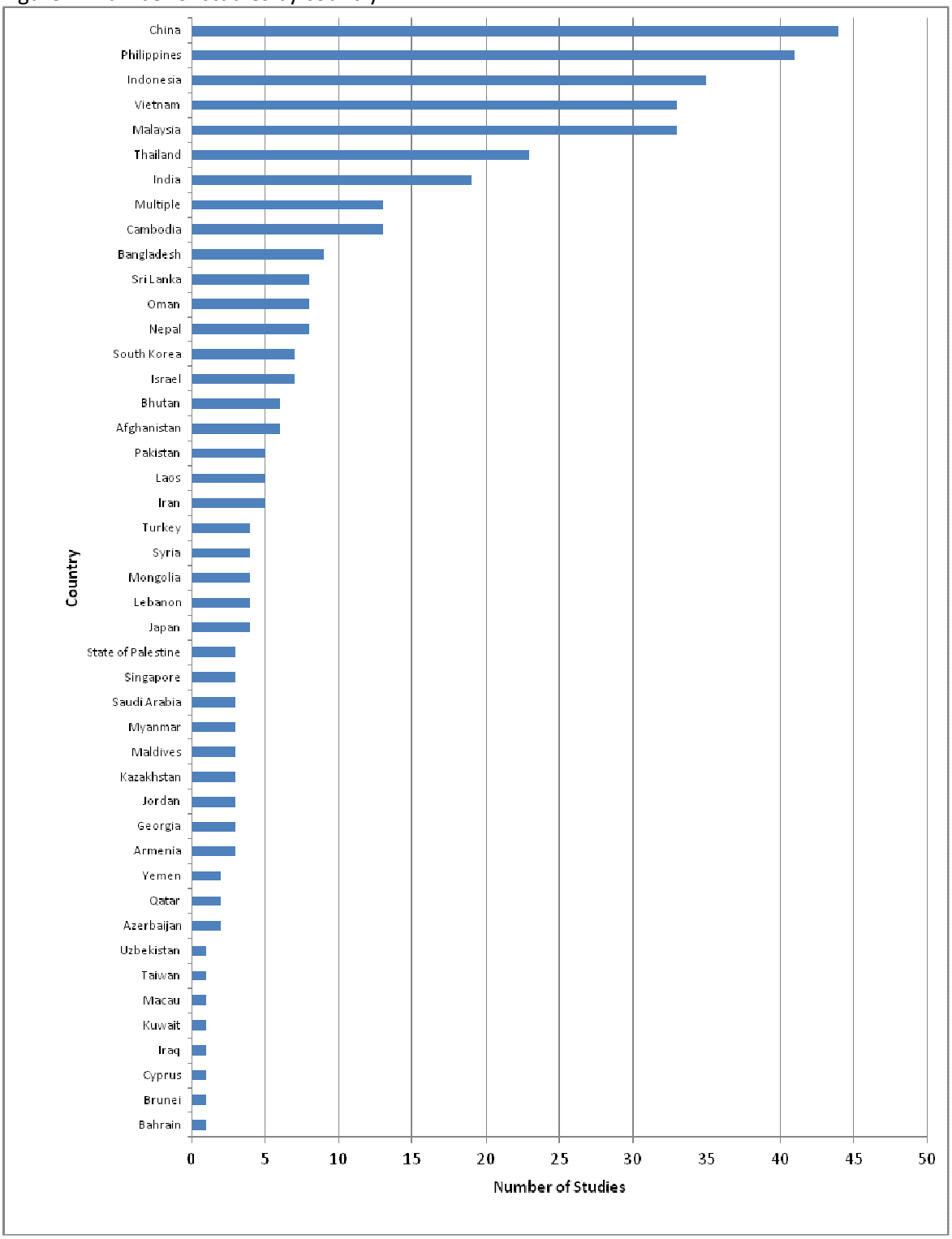
Figure 1: Percentage of evidence for sub-regions



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. The number of studies by country is presented in Figure 2.

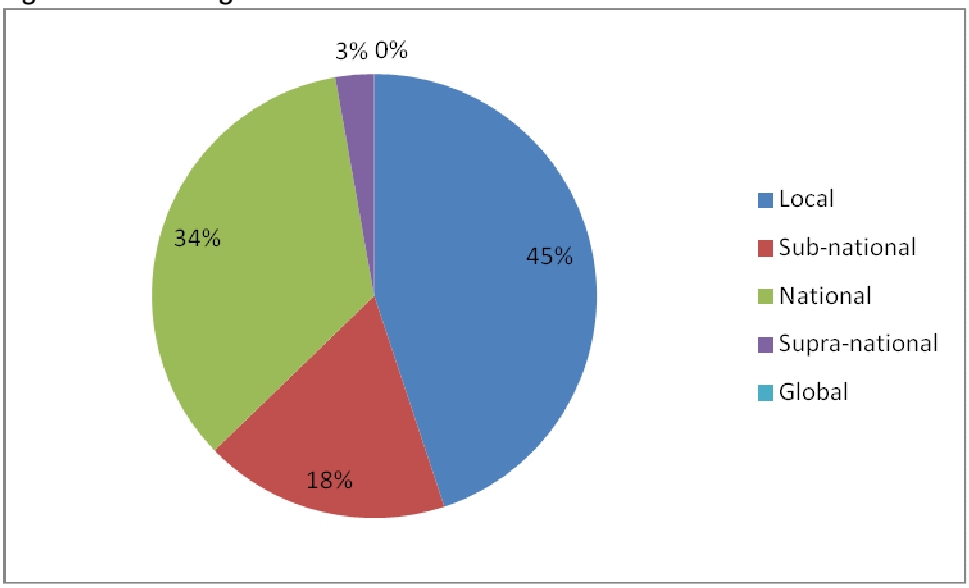
Figure 2: Number of studies by country



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%). Information on percentage evidence in each scale is illustrated in Figure 3. 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, sub-national and national level evidence.

Figure 3: Percentage of evidence at each scale of assessment



Regarding publication dates, Figure 4 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 4: Number of studies by publication year

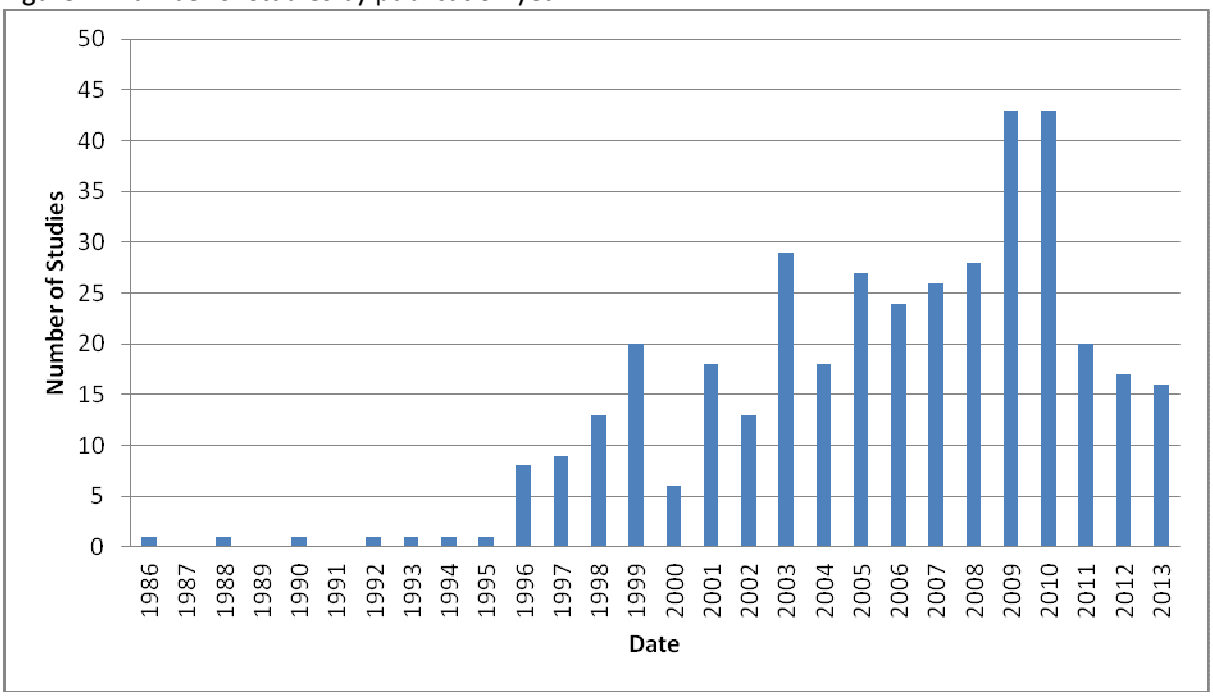


Figure 5 presents the number of collected studies that address each Strategic Goal. We find a reasonable quantity of evidence addressing each Strategic Goal but with significantly more for Strategic Goal D ("enhance the benefits to all from biodiversity and ecosystem services"). This reflects the very 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 6. 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 7. 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 3). 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 4-6, 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 7). Note that an individual study may address multiple Strategic Goals, Aichi Targets and Research Questions.

Figure 5: Number of studies that address each Strategic Goal

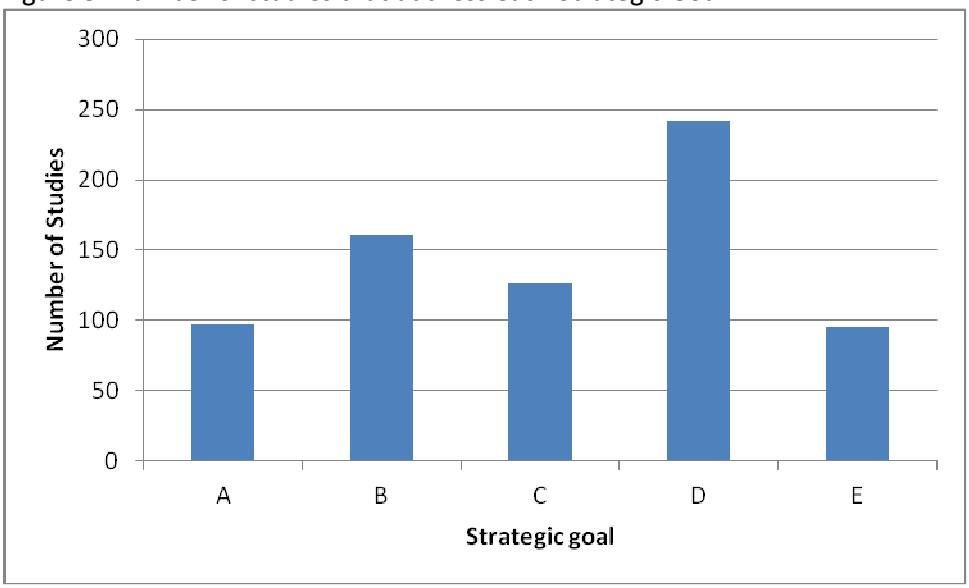


Figure 6: Number of studies that address each Aichi Target

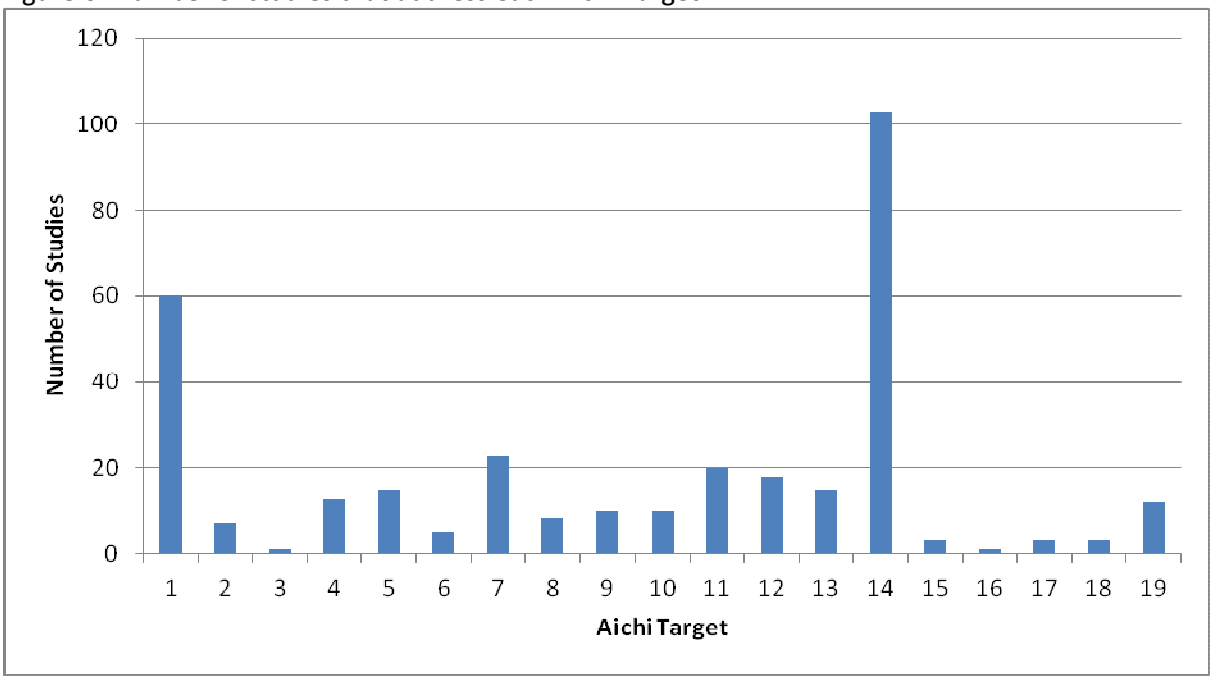
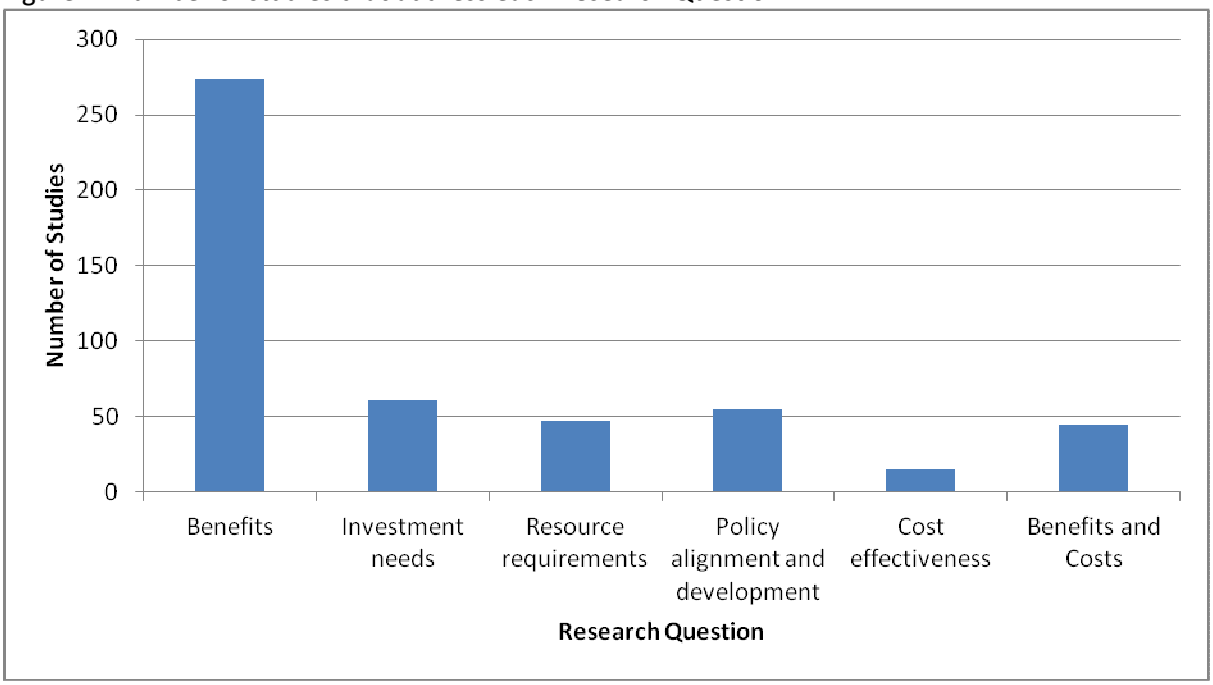


Figure 7: Number of studies that address each Research Question



3. BENEFITS OF DELIVERING THE AICHI TARGETS

3.1 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).[2] Many do so in the context of tourism (Sayan *et al.*, 2011; Seenprachawong, 2003 – see case study box below) or agriculture (Zekri *et al.*, 2011; Poudel and Johnsen 2009 – see case study boxes below). 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 (see case study box below).

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 – see case study box. 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 a similar magnitude as direct recreational uses – see case study box. 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.

Case Study Box: 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)

[2] 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.

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 7.2).

Case Study Box: 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)

Section 2.2 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 (see for example case study box on Lao PDR in section 3.2). 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$ 1000 to more than US$ 6000 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 (see case study below demonstrating the distributional dimension of biodiversity conservation). 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.

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)

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$ 1000 to 2500 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$ 1000 to 1500 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. The case study by Poudel and Johnsen (2009) attempts to estimate farmers' willingness to pay for conserving crop genetic diversity in Nepal (see Case Study Box).

Case Study Box: 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 Box: 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 was estimated to be approximately 19,895 million Baht (US$ 497.38 million).

Seenprachawong (2003)

Case Study Box: 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**

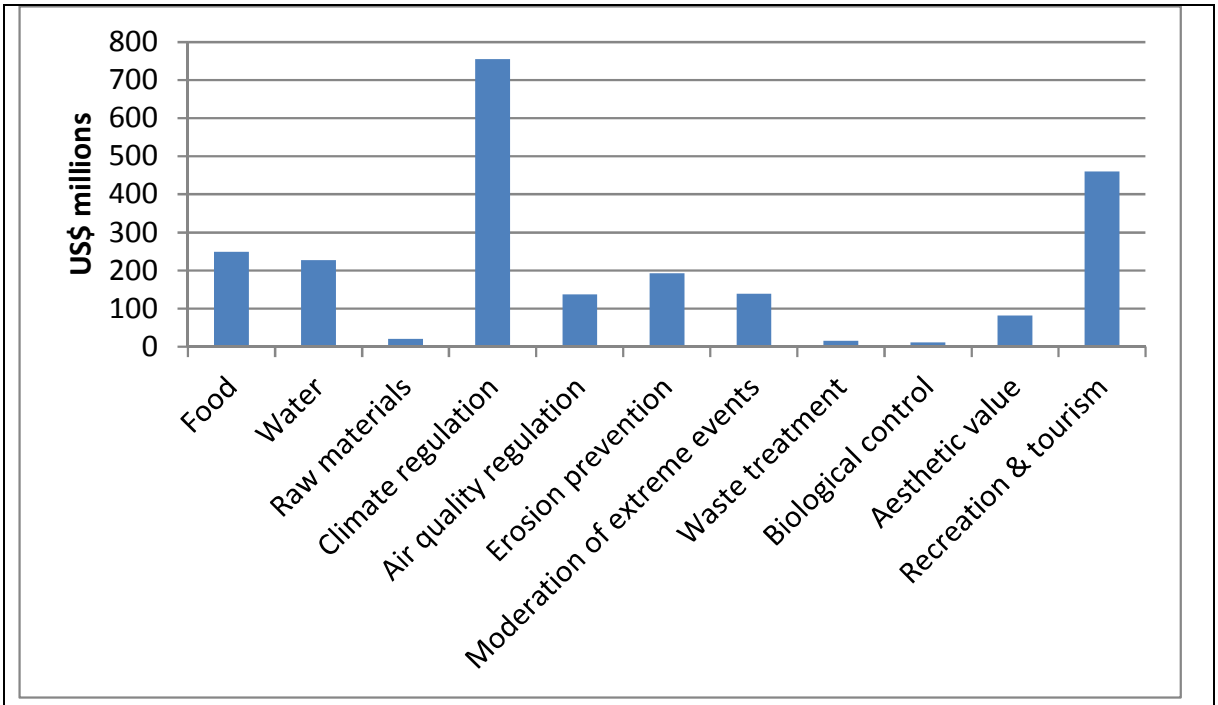


Figure 1. Annual value of ecosystem services from Seoul metropolitan area greenbelt (millions of US$)

Source: Ryu and Lee (2013)

3.2 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 (see case study boxes below). 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 (see case study boxes on Lao PDR and Mekong sub-region). 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 (see case study boxes below) 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.

Further case study evidence on the benefits of biodiversity conservation measures are provided in section 8. For South-Eastern Asia in particular there are a large number of studies 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/.

Case Study Box: 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; an
- 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):

a) 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.

b) 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.

c) 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.

d) 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 Box: 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 Box: 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 Box: 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 Box: 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 Box: 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 Box: 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)

4. INVESTMENT NEEDS

4.1 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.

4.2 Where would these investments be best directed or focused?

Section 3.2 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.

4.3 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, as in the case study below, has many other environmental benefits.

Case Study Box: 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)

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.

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

Referring back to section 4.1, 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 in section 4.2, 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).

4.5 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 8).

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.

5. RESOURCE REQUIREMENTS

5.1 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 (see case study boxes below) 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 (see case study box below).

For the priority programmes identified in Bangladesh (See Section 4.1) 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 4.1 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 case study for Afghanistan below and additional case studies in section 5.3 make this point.

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.

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;

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.

Case Study Box: 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 Box: 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.

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**

Source: ADB (2011)

5.2 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.

5.3 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, but the case study below shows that national funding shortfalls may be as high as 80%.

Case Study Box: 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

The case study on forest fire prevention in Indonesia below presents an example assessment of the disparity between current allocations and required resources to provide necessary conservation management.

Case Study Box: 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)

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. A summary of the initial findings for the Philippines and Vietnam are presented in the case study box below. The results provide evidence of substantial shortfalls between resource requirements and allocations, even for the existing scale of protected area networks.

Case Study Box: 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)

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 1000 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 5000 Crores (approximately US$ 800 million) for a five-year period (2010-14). The following case-study discusses how biodiversity concerns were recommended to be factored into the allocation formula for the 13th Finance Commission recommended by a study.

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)

5.4 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. Below are two case studies from India – one demonstrating the use of a Special Purpose Vehicle for forest conservation while the other seeks to demonstrate the linkage between rural livelihoods and biodiversity conservation, thereby making funding available for conservation.

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.

Case Study Box: Costs of Marine Protected Area (MPA) management in the Philippines

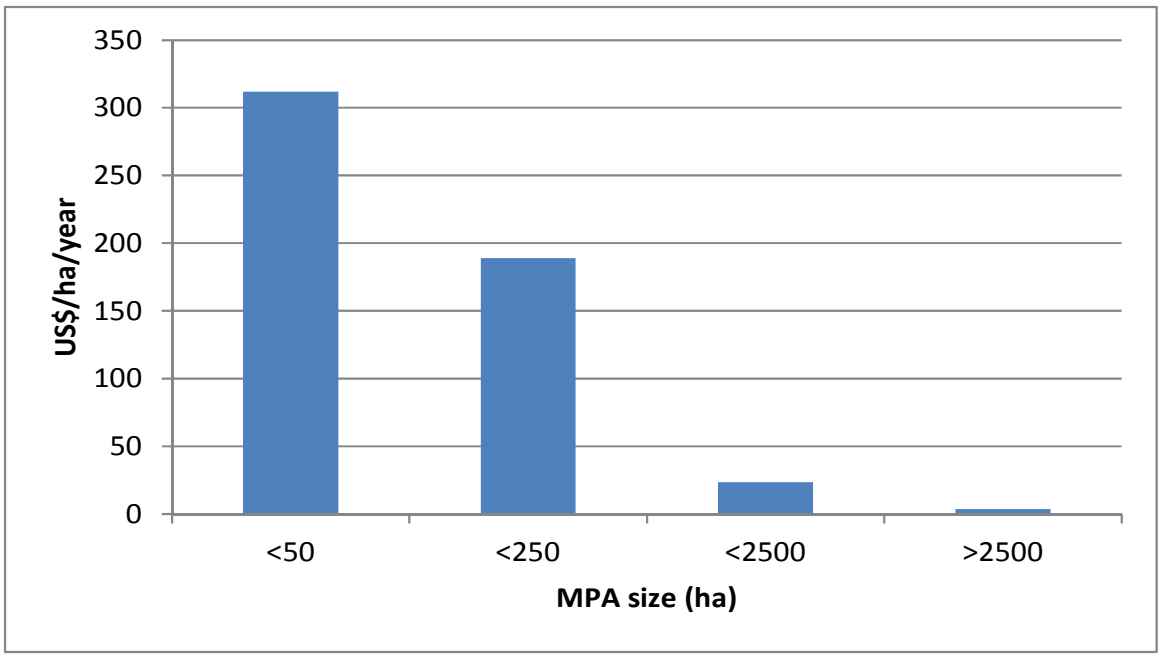
This case study provides information on the costs of marine protected area management (MPA) in the Philippines, with relevance to Aichi Target 11.

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 Box: Tropical forest conservation opportunity costs in Indonesia and Malaysia

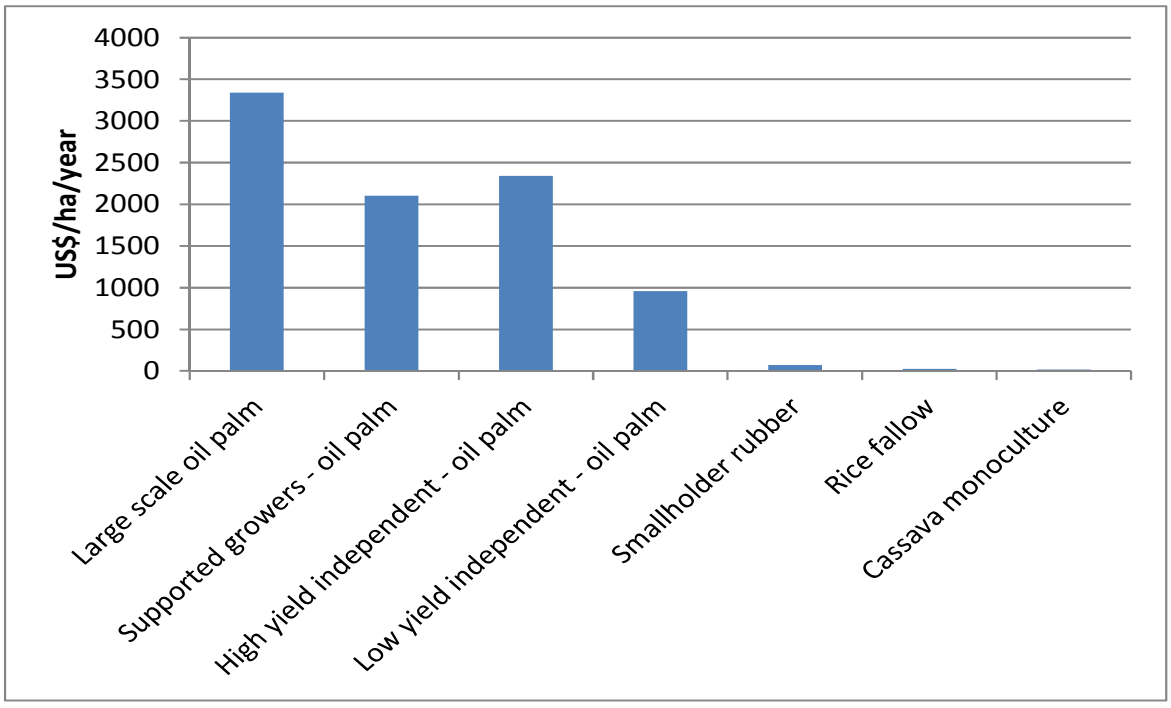
This case study provides information on the opportunity costs of conserving tropical forests in Indonesia, with relevance to Aichi Targets 7, 11 and 14.

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 Box: 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 unhabituated 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:

(a) Sustainable financing through tourism,
(b) Separation of diver resort and conservation management as two distinct bodies.
(c) Operating resources channelled back directly into conservation
(d) *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:

1. Demonstration of Landscape Conservation Approaches in two Pilot Sites.
2. Strengthening knowledge Management and National Capacity for Replication of Landscape Conservation Approaches.
3. Scaling up and Replication of Successful Models of Conservation in Additional Landscapes Sites.
4. Coordination for Landscape Conservation.

The project is to be implemented in six years (2011 to 2017).

Source: MoEF 2013

6. POLICY ALIGNMENT AND DEVELOPMENT

6.1 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 presented in Section 3 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 Section 6.2 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.

Table 1. Alignment of MDGs with Aichi Targets - adapted from Pisupati and Rubian (2008) and Unnikrishnan and Suneetha (2012)

MDG #	**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	Targets 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 15, 18, 19 (Reduction in negative subsidies, sustainable production and consumption,

	sustainability	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)

6.2 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 (see case below). 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.

Case Study Box: 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)

6.3 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.

6.4 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 2.1., 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.

7. COST EFFECTIVENESS

7.1 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.

Case Study Box: 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)

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.

Case Study Box: 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)

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.

7.2 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. As the case study below shows, the benefits of combating an invasive species can outweigh the costs but not under all conditions.

Case Study Box: 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)

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 (section 5.3) also provides example of a specific cost-effectiveness analysis, but in this case the effect is in terms of forest fire prevention.

Case Study Box: 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 2700 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)

7.3 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 2.1 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.

8. BENEFITS AND COSTS

8.1 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).

A selection of case studies that perform some form of cost-benefit analysis of conservation decisions are presented in the case study boxes below. 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 off-set 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.

8.2 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.

Case Study Box: 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 Box: 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 Box: 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 km2 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 Box: 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 Box: 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 Box: 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*

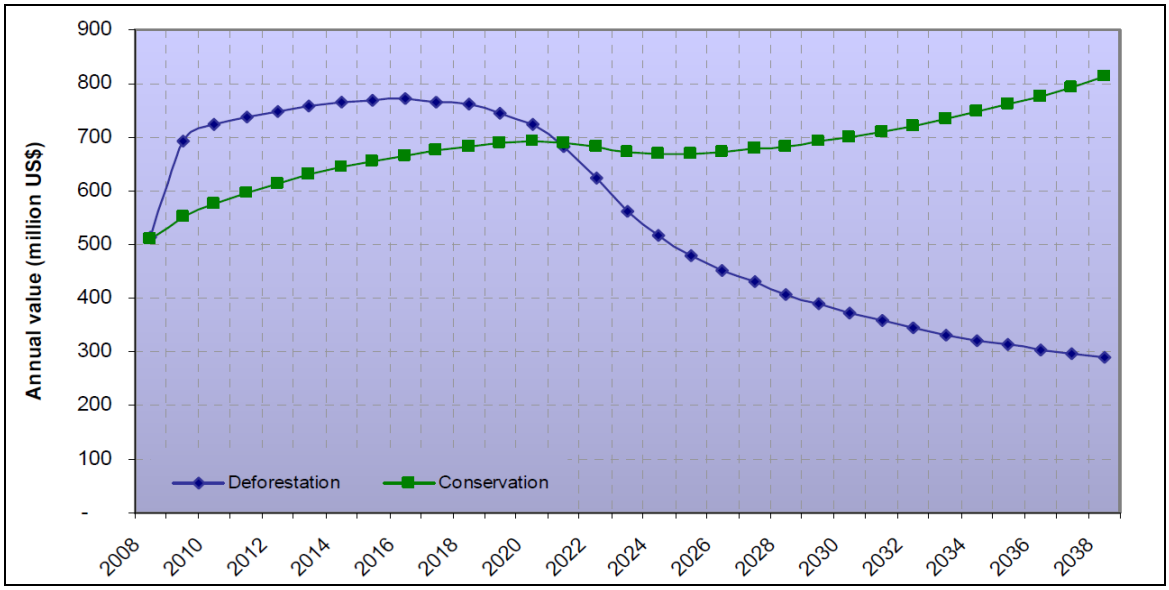


Figure 1. Net annual benefits of deforestation and conservation over time.

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

9. CONCLUSIONS

9.1 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.

9.2 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.

9.3 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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