Best practice guidance for biodiversity-inclusive impact assessment

A manual for practitioners and reviewers in South Asia

CBBIA-IAIA

Capacity-building for good practice in biodiversity and impact assessment

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Capacity-building for good practice in biodiversity and impact assessment

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भारत सरकार
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FOREWORD

Countries in South Asia face the daunting challenge of meeting the development needs of a growing population from a shrinking natural resource base. Achieving a balance while doing this requires better understanding and recognition of conservation and development imperatives by all stakeholders, including governments, business and conservation communities.

Biodiversity conservation in isolation cannot ensure the conservation of all valued ecosystems and wildlife as maintaining biodiversity requires more than just protecting wildlife and their habitats in nature conservation reserves. It is also about the sustainable use and management of all natural resources and safeguarding the life-support systems on earth. Society needs mechanisms for determining how to realize synergies between biodiversity conservation and economic development. Ecological and economic valuation tools offer some techniques to help in this decision-making process. It is the right time to make conscious and serious efforts in retooling the Environmental Impact Assessment (EIA) as a planning and decision tool to tackle the root causes of biodiversity decline, foster a high quality of environment for current and future generations and promote economic security through sustainable development in all key sectors. This is the central thinking that is reflected in India's National Environmental Policy adopted in 2006 and has been the guiding principle for reengineering of the environmental decision-making process recently undertaken in India.

Contd…2/-

जहाँ है हरियाली।
वहाँ है खुशहाली।।

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: 2 :

The publication of the ***Best practice guidance for biodiversity inclusive impact assessment: A manual for practitioners and reviewers in South Asia*** is very timely and reflects a positive effort of the institutions involved in its preparation in translating the need to make EIA a more integrated and effective development planning tool.

This guidance document has appropriately departed from the narrow focus of evaluating impacts on biodiversity as generally undertaken in traditional EIAs to prescribing steps for retooling the Impact Assessment for mainstreaming biodiversity through integration of both ecological and economic valuation tools. Such an approach should help in achieving positive outcomes from development initiatives that would ensure biodiversity conservation and also help achieve the Millennium Development Goals. The *Guide* has also tried to provide a comprehensive coverage of generic elements of good practices that appear to be internationally accepted and widely applicable to countries targeted in this *Guide* in South Asia.

For Environmental Impact Assessments to be widely respected and applied to improve decision making, the ecological-economics interface that is encouraged in this guide is appropriate, needed and a desired departure from the traditional approaches. This makes this guidance different and relevant for responsible decision making.

I am confident that the information and guidance provided in this *Guide* will assist EIA practitioners and reviewers in the five relevant countries in South Asia to design and implement processes that will be seen to promote an integrated approach and eventually contribute to a full consideration of the ecological, economic and social aspects of development proposals at all levels of decision-making.

(Prodipto Ghosh)

Dated : 22.5.2007

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Foreword

In South and Southeast Asia, rapid development coupled with high population growth remains a continuous challenge to biodiversity conservation efforts. In the last decade, for instance, Asia has been experiencing high rates of economic growth. But this development has come at a heavy cost in terms of biodiversity loss and poverty exacerbation. Against this backdrop, it is crucial that government institutions, civil society organizations, academia and the private sector join hands to conserve the integrity of nature.

A project of the International Association for Impact Assessment (IAIA), "Capacity Building in Biodiversity and Impact Assessment" (CBBIA) is just such an initiative. Under this project, the *Environmental Impact Assessment Practitioners and Reviewers Guide* has been developed by the Wildlife Institute of India and the World Conservation Union (IUCN) to assist institutions in South Asia to protect biodiversity. This guide will provide effective guidance for Environmental Impact Assessment (EIA) practitioners and reviewers on the integration of biodiversity in development practices.

In order to tap into this opportunity, it is important not only to work with the regional contact group but also engage decision makers, including politicians and those responsible for public policies. At the same time, there is a need to move upstream from EIA and address challenges at higher levels of decision-making and development policy planning.

In conclusion, I thank all partners of CBBIA Asia – Wildlife Institute of India, Dehra Dun, Central Environment Authority, Sri Lanka and Mekong Wetlands Biodiversity and Sustainable Use Programme, Lao PDR – for their contribution and look forward to continuing collaboration between IUCN and IAIA.

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CBBIA's regional activities in Asia were coordinated by IUCN, IAIA's implementing partner in the region. This guide is the result of collaboration between IUCN and the Wildlife Institute of India (WII). We take special pride in the role of these agencies in leading the process. We express our sincere gratitude to Ms. Aban Marker Kabraji, Regional Director, IUCN - Asia and Shri P.R. Sinha, Director Wildlife Institute of India for their leadership.

We thank Ms. Nikhat Sattar, Head, Regional Emerging Programme, IUCN Asia and Mr. Ahmad Saeed, Project Focal Person, CBBIA-IAIA (Asia) Project for steering the project in Asia and lending their valuable support in accomplishing the task of delivering this output under the project.

It would have been impossible for us to undertake this professionally challenging task without the professional support of Dr. Jo Treweek, Technical Project Manager, CBBIA-IAIA Project who has been a constant source of guidance and advice to us all throughout.

Administrative support provided by Rita Hamm, Bridget John and her team at the International Association for Impact Assessment (IAIA) Headquarters in Fargo, USA, made our task easier in many ways.

This manual is based on the contributions of many agencies and impact assessment professionals who shared their valuable experience by responding to the needs of the situation assessment surveys in five target countries in South Asia. Although it is not feasible to acknowledge the contributions of each individual here, we place on record our higher gratitude for their rich and varied experience and professional insight which motivated us to make a beginning on this task.

We specially acknowledge the contributions of the following officials and EIA professionals from Bangladesh, India, Nepal, Pakistan and Sri Lanka who participated in the deliberations in the inception meeting of the CBBIA-IAIA (Asia) Project held at Colombo, Sri Lanka during 23rd to 24th December 2005 and subsequently in the Contacts' Workshop held in Islamabad, Pakistan during16th to 19thFebruary 2006:

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Acronyms

ADB	Asian Development Bank
BSAP	Biodiversity Strategies and Action Plan
CBBIA	Capacity Building in Biodiversity and Impact Assessment
CBD	Convention on Biological Diversity
CEA	Central Environmental Authority
CITES	Convention on International Trade in Endangered
CPCB	Central Pollution Control Board
DEC	Department of Environment and Conservation
DFID	Department for International Development
DoE	Department of Environment
EAC	Environmental Appraisal Committee
EBI	Energy and Biodiversity Initiative
EC	Environmental Clearance
ECA	Environmental Conservation Act
ECR	Environment Conservation Rules
EIA	Environmental Impact Assessments
EMP	Environmental Management Plan
EPA	Environment Protection Act
EPR	Environment Protection Rules
FAO	Food and Agriculture Organization
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GEF	Global Environment Facility
GIS	Geographical Information System
GoB	Government of Bangladesh
GoI	Government of India
GoP	Government of Pakistan
GoSL	Government of Sri Lanka
HAP	Habitat Action Plans
HDD	Horizontal Directional Drilling
HMGN	His Majesty's Government of Nepal
HYV	High Yielding Varieties
IAIA	International Association for Impact Assessment
ICMM	International Council on Mining & Metals
IFC	International Finance Corporation
IIED	International Institute for Environment and Development
IPIECA	International Petroleum Industry Environmental Conservation Association

IUCN	International Union for the Conservation of Nature
MDG	Millennium Development Goals
MEA	Millennium Ecosystem Assessment
MMSD	Mining Minerals and Sustainable Development project
MoE&F	Ministry of Environment and Forests
MoES&T	Ministry of Environment, Science and Technology
MoP&E	Ministry of Population and Environment
NBWL	National Board for Wildlife
NCS	National Conservation Strategy
NEA	National Environmental Act
NEB	National Energy Board
NGO	Non Governmental Organization
NMDC	National Mineral Development Corporation
NSW	New South Wales
NTFP	Non Timber Forest Product
OCM	Open Cut Method
PE/RC	Preventive Expenditure and Replacement Costs
PEAP	Pakistan Environmental Assessment Procedures
PEPO	Pakistan Environmental Protection Ordinance
RDA	Road Development Authority
RNIP	Road Network Improvement Project
SAP	Species Action Plan
SEA	Strategic Environmental Assessment
TEV	Total Ecosystem Value
ToR	Term of Reference
UN	United Nations
UNCCD	United Nations Conference to Combat Desertification
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCC	United Nations Framework Convention on Climate Chang
WA EPA	Environmental Protection Authority of Western Australia
WBCSD	World Business Council for Sustainable Development
WCPA	World Commission on Protected Areas
WII	Wildlife Institute of India
WRI	World Resources Institute
WSSD	World Summit on Sustainable Development
WTO	World Trade Organization
WWF	World Wide Fund

SECTION I

1 BACKGROUND

Capacity Building in Biodiversity and Impact Assessment (CBBIA) is a global project managed by the International Association for Impact Assessment (IAIA) and funded by the Netherlands Ministry of Foreign Affairs till 2007. It provides practical, demand-driven support for development of capacity for integrating biodiversity and impact assessment in Southern Africa, Central America and Asia. In Asia IAIA-CBBIA has been implemented by IUCN in partnership with the Wildlife Institute of India (WII). It has set out to share information and experience and support capacity building, through transfer of knowledge, institution-building and networking in five South Asian countries - Bangladesh, India, Nepal, Pakistan and Sri Lanka.

In all the five countries targeted for capacity building in EIA in South Asia, the situation assessment surveys conducted as part of the CBBIA – IAIA (Asia project) repeatedly highlighted two key challenges: lack of awareness of the value and importance of biodiversity, and, when the value is appreciated, lack of knowledge on how to ensure that biodiversity is mainstreamed in EIA for making good decisions for achieving better outcome of economic development in different sectors for greater benefit to society. This guidance manual is a specific outcome of this perceived need to overcome the capacity constraints for promoting biodiversity inclusive impact assessment as a mainstreaming tool for harmonizing the economic development goals with the conservation of the rich and varied biodiversity wealth of the region. This guidance manual for biodiversity inclusive EIA is targeted both at EIA practitioners and reviewers in all the above five countries identified under the project.

2 INTRODUCTION

2.1 The importance of biodiversity, ecosystems and ecosystem services

There is growing recognition globally of the vital importance of biodiversity and the role it plays in sustaining lives, livelihoods and economies. Natural assets such as fertile soils, rivers, minerals and particularly biodiversity resources (forests for shelter, timber, and climate regulation; plants and animals for food, medicines and research; resources for commerce including fisheries, non wood resources such as fibre, fuel and fodder) account for a very significant proportion of national wealth in Asia - 25 per cent in South Asia (World Bank, 2006). Largely spurred by these assets, over the past decade South Asia has been the second fastest-growing region in the world after East Asia with economic growth averaging over 5%. As a result, many development indicators have significantly improved – notably GDP, exports, food security, nutritional status, employment, and indices of poverty.

With growing recognition of the importance of biodiversity in sustainable development, greater focus is being placed on its conservation spurred by the Convention on Biological Diversity (CBD) and the resultant national policies and legislations in South Asian countries. Biodiversity, essentially the diversity of life on earth, is more formally defined as “the variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems" (CBD, 1992). Two points become important from this: first, that it refers to variability at all levels, from the genes to entire ecosystems; and second, that the focus is not the total number of species or genes or ecosystems, but on the diversity and variability within and among them.

The CBD definition of biodiversity provides meaningful insight into its vital importance. Essentially biodiversity is the basis for the ecosystem functions and processes which provide essential ecosystem services to support human well-being (Millennium Ecosystem Assessment, 2005). Ecosystems are defined as dynamic complexes of plant, animal and micro-organism communities and their nonliving environment interacting as functional units. The interaction of these functional units generates ecosystem services, which are defined as the benefits that ecosystems provide for human well-being. The services provided by ecosystems range from concrete harvestable goods such as timber, fish and water to more abstract regulating services such as pollination of crops, flow regulation for water supply and flood control, carbon sequestering, maintenance of biodiversity and so on. Clearly at the extreme, loss or degradation of ecosystem services threatens human survival.

In general, loss of biodiversity diminishes the rate and capacity of ecosystems to produce ecosystem services. Some species play a particular role in generating ecosystem services that enhance human survival and well-being. For example, pollinators such as bees make it possible for most crops to reproduce. Other species, such as ladybugs and dragonflies are natural controls for pests. Loss of key species can therefore translate directly into loss of the services they provide. Loss of biodiversity in a few cases can also make ecosystems less stable and more vulnerable to extreme conditions and catastrophic events, such as floods and droughts. It also tends to make ecosystems less productive.

Ecosystem services can be broadly categorized as *provisioning services*, *regulating services*, *cultural services*, and *supporting services* (Figure 1). More precisely, provisioning services cover natural resources and products derived from ecosystems, and represent the *flow* of goods. Regulating or supporting services are the actual life-support functions ecosystems provide and are normally determined by the size and quality (the *stock*) of the ecosystem. Cultural services refer to the non-material benefits obtained from ecosystem services such as spiritual and religious fulfilment.

Ecosystem services are not only of direct value to humans, they offer indirect benefits by supporting and promoting the natural resource base upon which livelihood and economic activities are founded. The Millennium Ecosystem Assessment framework has played an instrumental role in examining and revealing the relationships between biodiversity, ecosystems and ecosystem services, and the relationship between ecosystem services and the multidimensional nature of human well-being (Figure 1).

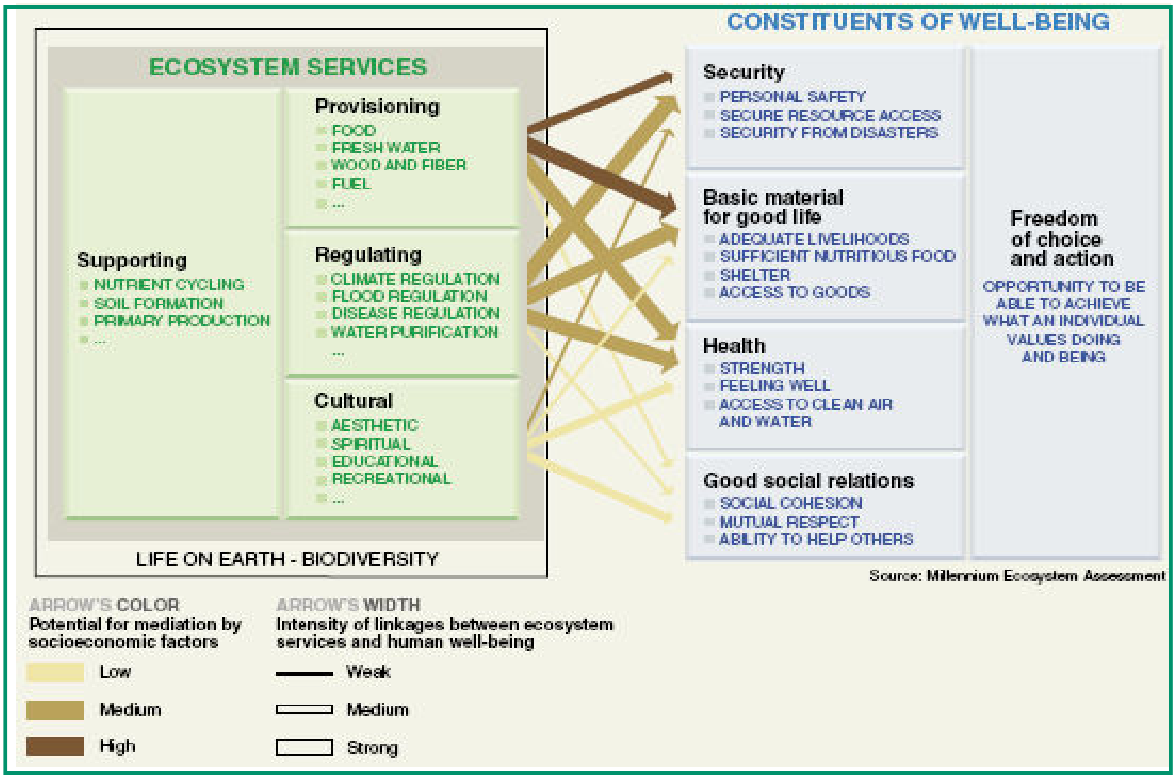

Figure 1 The Millennium Environmental Assessment (MEA) framework

Through the provision of ecosystem services, the MEA reveals that biodiversity is an essential component of human well-being and contributes positively to human security, providing basic materials for good life, good health and good social relations. The concept of biodiversity and ecosystem services is increasingly seen filtering into mainstream development agendas. For example, the Millennium Development Goals (MDGs) - agreed to by 189 nations at the United Nations Millennium Summit in 2000 – provide a consensus-based framework for integrated approaches to sustainable development and poverty alleviation. The links between biodiversity and these MDGs for sustainable development are increasingly clear (Table 1).

Table 1 Links between international Millennium Development Goals (MDGs) and biodiversity

Goal	Links to biodiversity resources and ecosystems services
Eradicate extreme poverty and hunger	• Biodiversity and ecosystem services are essential to the productivity (of agriculture, forests, and wetland) and conservation of biodiversity resources is critical because power to purchase commercial products is restricted and alternate livelihoods are scarce to come by. • Using biodiversity equitably and sustainably is fundamental to strategies and actions to eradicate/reduce poverty and to achieve sustainable development. • Improvements to core productive assets e.g. soils, water, trees and natural vegetation is necessary for reducing under nutrition among vulnerable communities (Scherr, 2003).
Achieve universal primary education	• Time spent on collecting water and fuel wood by children, especially girls, can reduce time at school and deny opportunity of education. • Education will improve the human resources capital, encourage alternative income options and thereby reduce dependence on biodiversity resource based subsistence.
Promote gender equality and empower women	• When biodiversity and ecosystem services are degraded or destroyed, the burden falls disproportionately on women and girls, who are forced to travel farther and spend more time in the search for drinking water, fuel wood, and other forest products. • This increased burden limits their opportunities for education, literacy, and income-generating activities. • Women are more exposed to impacts of indoor air pollution by burning of fuel wood, and suffer additional physical burden due to lack of secured access and rights to resources (e.g. water, fodder).
Reduce child mortality	• Under nutrition, unhealthy environment and agents of disease (malaria, dengue fever, and other insect- and water-borne diseases) are the underlying causes of child mortality that have links with degraded ecosystems.
Improve maternal health	• Much of the primary sources of traditional medicines and protein for improving the maternal health are available from the biodiversity resources.
Combat HIV/AIDS, malaria and other diseases	• There is a relationship between biodiversity loss and the emergence and spread of new and more virulent disease organisms including SARS, Ebola, malaria, and the HIV pandemic, that have resulted from human impacts on habitats and wildlife – including inter alia ecosystem change, the bush meat trade and the wildlife trade. • Biodiversity plays a crucial role not only in providing medicines to deal with issues of health and nutrition, but healthy ecosystems play a significant role in dealing with diseases like malaria and others (Chivian, 2002). • Some plants have been found to significantly boost the immune system without the side effects of expensive anti-viral drugs.
Ensure environmental sustainability	• Water availability is directly linked to the conservation of biodiversity in integrated ecosystems and larger landscapes for watershed management. • Ecosystem depletion and species extinction reduce the capacity to respond to future stresses such as climate change.
Develop a global partnership for development	• Conversion of land rich in biodiversity for industries and large scale infra structure projects can erode resource base for food, medicines and livelihoods, pollute environment, increase health risks and affect livelihoods of communities challenged by poverty. • Destroying habitats, which support wildlife, therefore undermines the capacity of governments to generate income from tourism and support projects, which could eradicate poverty, improve maternal health, and reduce child mortality. • Maintaining biodiversity and the integrity of critical ecosystem functioning will require global partnerships. Mainstreaming biodiversity conservation in business is already being encouraged for bridging conservation- development divide and for striking global partnerships for development.

Source: *modified from DFID, EC, UNDP and The World Bank (2002)*

2.2 Why do ecosystems degrade?

Despite the tremendous importance of ecosystem services, ecosystems that generate them are progressively being lost and degraded due to their inadequate conservation and ineffective management. While there is greater awareness in South Asia of the need to conserve and manage biodiversity and ecosystems, the loss and degradation continues unabated due to direct impacts such as increased pollution, habitat loss, conversion to alternative uses, over harvesting, and modification.

What has been discovered is that often the underlying causes of biodiversity and ecosystem loss and degradation are economic and financial in nature (Emerton & Bos, 2004). Thus a key question that arises is that if ecosystem services are so important for humans and underpin many economic and livelihood activities, why is there a bias toward their destruction rather than their retention? The general findings, stemming largely from economics literature, point out that people often have an incentive (either direct or indirect) to extract/use resources in such a way as to degrade and damage ecosystems (see for example Pearce, 1992).

One of the key reasons why biodiversity and ecosystems continue to be degraded and lost is that the impacts of their loss especially in ecological and economic terms is not fully appreciated by both users and economic decision makers (see Figure 2 on the variety of economic values of

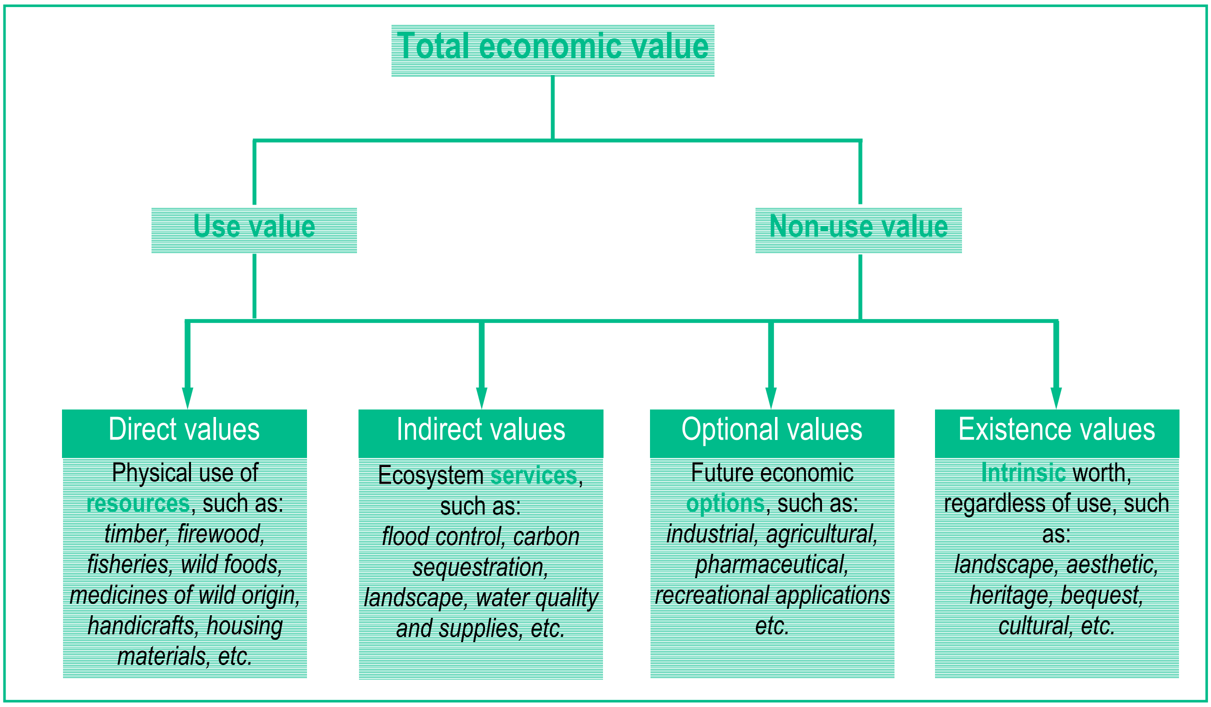

Figure 2 Total economic value of ecosystems

ecosystems). The reality is that many of the ecosystem services generated by ecosystems and biodiversity miss detection because they are not traded in markets and therefore do not come with a price tag (IUCN, 2007). Thus, they remain underappreciated and undervalued and people have an incentive to overuse and damage ecosystems and biodiversity. Because of this, it is difficult to determine what people lose when ecosystems and biodiversity become degraded or is lost in contrast, how people benefit from improvements to ecosystems and biodiversity. In this setting of undervaluation and partial information, investments in the maintenance of a diversity of ecosystem services is often traded-off for seemingly more 'productive', singular and sectoral land and resource management options which appear to yield much higher and more immediate profits. At the same time conservation decision makers and planners have traditionally paid little attention to economic values – as a result it has often been hard to justify or sustain ecosystems in economic terms, or for them to compete with other, often destructive, investments and land uses.

2.3 What can be done?

It is becoming increasingly clear that conservation and development decision makers and planners are missing the conceptual and practical tools that can harmonize the interests of conservation, growth and human well-being. It is also apparent that ecosystem economic values have to be increasingly articulated, better understood and progressively more integrated into decision-making. Understanding biodiversity and ecological impacts through ecological assessments, and translating these impacts through economic valuation of ecosystems can be a harmonizing and potent tool for placing ecosystems on the agenda of conservation and development planners and decision-makers and, ultimately, ensuring that essential ecosystem services are maintained for the benefit of local and national livelihoods and economies in South Asia. By expressing the values of impacts on ecosystem services in monetary terms, direct comparisons can be made with other sectors of the economy when investments are appraised, activities are planned, policies are formulated, or land and resource use decisions are made. When properly measured, the Total Economic Value (TEV) of ecological functions, services and resources frequently exceeds the economic gains from activities which entail ecosystem conversion or degradation. Although a better understanding of the economic value of ecosystems does not necessarily guarantee their conservation and sustainable use, it at least permits them to be considered as economically productive systems, alongside other possible uses of land, resources and funds.

In effect, economic valuation of biodiversity and ecosystem impacts can provide information which can be used to make better and more informed choices about how resources are managed, used and allocated. Economic arguments and indicators exert a major influence over these choices, and decision-makers need to be able to balance the relative gains from different activities and investments, including those that are concerned with conservation as well as those that lead to ecosystem modification, degradation or conversion.

For these obvious linkages between ecosystems structure and functions; ecosystem services and their societal benefits; development goals and policies and their impacts on resource use and decisions; ecologists, economists, social scientists, environmental managers, and policy analysts are increasingly interested in incorporating biodiversity (both ecological and economic) values in assessing impacts of development imperatives and investments. Figure 3 brings together the Millennium Ecosystem Assessment (MEA) and Total Economic Value (TEV) frameworks to provide a pathway for integrating both biodiversity and economics into impact assessment. In this sense economic valuation would reveal the imposed costs of biophysical impacts and would thus allow comparison of the synergies and trade-offs between and among ecosystem services and the constituents of well-being.

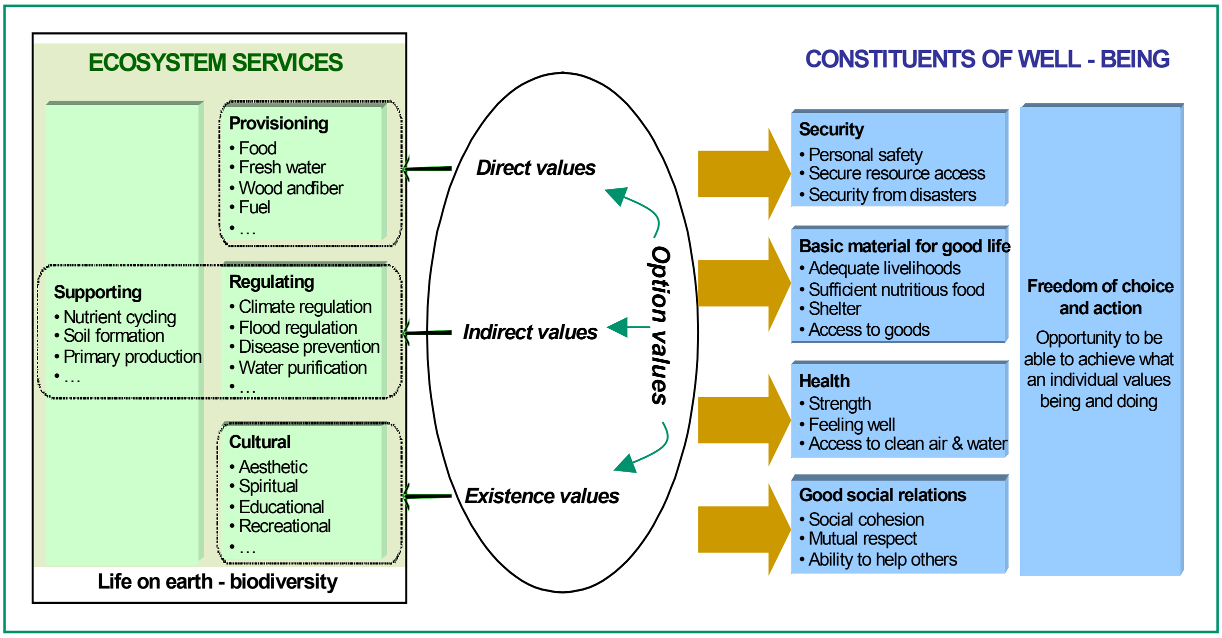

Figure 3 **Valuation provides a mechanism for assessing trade-offs between and across ecosystem services and constituents of human well being** (Modified from Millenium Ecosystem Assessment, 2005)

2.4 Why the guide?

In light of the growing recognition of the importance of and the pervasive threats to biodiversity, there is an increasing need to come up with practical tools to assist South Asian governments to mainstream biodiversity into their development processes. South Asian governments' prime development objectives are sustainable economic growth, improved livelihoods and poverty reduction.. As a pathway to sustainable development, South Asian governments have demanded the development of practical mainstreaming tools and the much needed capacity to implement their development agenda (IUCN & WII, 2006).

Whether at project or strategic level, impact assessment is one way to raise the profile of biodiversity in planning and decision-making. Environmental Impact Assessments (EIA) has been used for some time in most countries within the region as a tool to better integrate environmental concerns in development projects. For a variety of reasons, however – whether due to lack of awareness, capacity or clear legislative frameworks - biodiversity concerns tend to be neglected. This conclusion was reinforced by needs assessment conducted in the region through IAIA-CBBIA (IUCN, 2005). Nevertheless, EIA is widely recognized as a 'mainstreaming tool' with potential to improve the integration of biodiversity considerations in planning of developments in all key economic activities. The principles of in-situ and ex-situ conservation advocated in Articles 8 and 9 of CBD and Article 14 of the

CBD provide a strong case for promoting biodiversity-inclusive impact assessments (http://www.biodiv.org/convention/convention).

Several initiatives at the global level have been initiated to build capacity for conducting biodiversity inclusive impact assessment at the regional levels. The evolution of SEA is the most striking feature of the past decade in the development of the larger field of EIA. Guidance is now becoming available for developing countries to support local practitioners in the design and implementation of appropriate country specific EIA and SEA arrangements and in addressing emerging demands for a more integrated approach to decision-making in support of sustainable development (UNEP, 2004).

The Convention on Biological Diversity's Conference of the Parties decision IV/10 acknowledges that 'economic valuation of biodiversity and biological resources is an important tool for well-targeted and calibrated economic incentive measures' and encourages Parties, Governments and relevant organizations to 'take into account economic, social, cultural and ethical valuation in the development of relevant incentive measures'.

As a planning and decision-making tool, biodiversity-inclusive impact assessment helps in identifying drivers of changes in biodiversity values; evaluating the significance of such changes (including economic costs); and in avoiding or reducing conflicting claims of established values and functions of biodiversity. It is in this light that assessments of many different values of biological diversity and evaluation of their importance make biodiversity conservation different from traditional nature conservation. Biodiversity conservation entails a shift from a reactive approach to protecting nature from the impacts of development to a proactive response for ensuring ecological sustainability of resources for society and the long-term sustainability of economic development initiatives.

Environmental impact assessment (EIA) in South Asia has shown a number of shortcomings with regard to the incorporation of biodiversity in the past (Lohani, 1997; IUCN, 2005). Consideration of only selective components of biodiversity, inadequate scoping of biodiversity issues, poorly reflected cumulative impacts, problems of defining significance of biodiversity impacts, and almost no attention given to valuation of ecosystem services are among the more apparently recognized shortcomings in EIA.

Traditionally, Environmental Impact Assessment (EIA) has resulted in production of an independent report setting out the environmental impacts of a proposed development project, but with little explicit linkage made with economic parameters. There have been considerable discussions among various stakeholders involved in project processing, financing and implementation on how to measure the economic importance of expected environmental impacts.

2.5 About this guide

This *guide* seeks to respond to the challenge of building capacity of EIA professional in South Asia by providing practical guidance for promoting biodiversity inclusive impact assessment for improving development effectiveness.

The guide aims to demonstrate that valuing biodiversity using ecological rationale and economic evaluation techniques, and incorporating these values into the decision-making process can be the most powerful way to demonstrate the importance of biodiversity conservation to the broader public and to build adequate safeguards for its protection as a part of development processes and actions.

This generic guide has been structured to additionally focus on enhancing capacity to integrate biodiversity in assessment of impacts of development projects in key sectors *viz.* oil and gas, road transportation and mining in which South Asian countries are currently making huge national and foreign direct investments for rapid economic development.

The guidance aims to share a wide range of good practices through illustrative examples, draw emphasis on useful information through text boxes, case examples and notes, and also guide the user to other guidance sources.

How is this guidance different?

Unlike most existing guidance documents that generally provide “one-size-fits-all” guidance this guide has been consciously designed to provide ‘start to end’ procedures for identifying entry points for mainstreaming biodiversity in impact assessment.

The guide is a unique attempt to integrate guidance on ecological and economic valuation into the traditional EIA framework for mainstreaming biodiversity with the objective that such an approach can provide a pivotal contribution in re-tooling impact assessment for planning sustainable projects in the South Asian countries.

In essence, the focus on the concept of ecosystem services in this *guide* provides a pathway for ecologists, environmental scientists, economists and sociologist to collaborate under a unifying term and thus facilitate the integration of biodiversity and economics into impact assessments. Ecologists, for example, can reveal the impact of proposed development interventions on the status of biodiversity and land, which allows collaboration with, for example, hydrologists to understand the relationship between the status of biodiversity and land and changes in the provision of important water services. The information generated allows economists and sociologists to assess changes to economic and livelihood values as a result of changes to the provision of water services.

Approaches suggested for biodiversity inclusive assessment are flexible and the guidance is aimed at sharing good practice and principles that are relevant in the regional context and can be adopted in the context of country circumstances and regulatory frameworks.

The recognition of the fact that biodiversity information is vital both for good assessments and sound decisions has been central in designing the guide to present exclusive guidance sections for practitioners and reviewers.

Who should use this guidance?

This guidance is aimed primarily at EIA professionals and consultants charged with the responsibility of conducting impact assessment in countries in South Asia, officials in government departments, EIA agencies and regulatory bodies involved in the review of EIA and for decision makers who wish to seek advice on providing good decisions. Trainers and teachers who are contributing to the development of a pool of EIA professionals, will find this guidance manual useful as a knowledge base for improving the conceptual understanding of the importance and relevance of including biodiversity in impact assessment and for gaining familiarity with 'how to' approaches for improving the EIA practice for biodiversity.

How should this guidance be used?

This guide is not intended to serve as a blue print for designing impact assessment reports. It is essentially to be used as suggested framework guidance for applying to assessment of impacts of developments in diverse circumstances and in different countries. The use of guidelines is most likely to vary from country to country, from organization to organization, amongst institutions, and according to specific social, economic, ecological, and political contexts. The guide is aimed to present a "menu" of best practices for identifying entry points for mainstreaming biodiversity in impact assessment framework. It provides a detailed guidance on various tools for conducting ecological and economic assessments for improving the integration of biodiversity considerations in environmental assessment. It guides the users to the application of these tools both, to different scales of development and to different stages in impact assessment. The guidance advocates that not all of the tools presented in the guide can be made universally applicable to biodiversity valuation in all sectors and at all scales of developments. The choice of tools for valuing biodiversity would be dictated by the nature of associated threats and the importance that biodiversity conservation and protection of ecosystem services would command in impact assessment and the rigour of the assessments required for delivering expected outputs for decision-making. The intention is to introduce the readers to best practice principles and approaches for factoring biodiversity in impact assessment, provide them with a range of methodological options, and guide them to additional sources of information. This guide thus not only seeks to serve as a knowledge base and a practical tool kit for enhancing capacities of practitioners for conducting biodiversity inclusive impact assessment but also promotes the flexibility for innovative efforts to adapt the guidance to ' fit for purpose' .

Quick guide to contents

The guide is organized into five main sections. Using the quick guidance to information provided below, the reader can easily access the relevant information contained in different sections of the document.

What to find?	Where to find?
What is importance of biodiversity and ecosystem functions for the well being of human society and how is the achievement of Millennium Development Goals linked to biodiversity? What is the current status of biodiversity and what are the major causes of its decline in Asia? What is the scale of development in the key sectors and how does these threaten biodiversity What can be done to reverse the negative trends of development? What is the role of EIA and what kind of guidance is needed and where can we find this?	Section – I and 2
Is there an acceptable framework for conducting EIA? Why should we integrate economic evaluation with ecological evaluation approach for retooling EIA for mainstreaming biodiversity?	Section – 3 and 4

How can a practitioner integrate ecology and economics in each step of biodiversity inclusive impact assessment and for assessment of developments in oil and gas, road and mining sectors?	Section – 4
Why EIA reports should be reviewed and what is the best way to do it?	Section – 5
Where is more information available?	Appendix

SECTION II

3 SOUTH ASIA: AN OVERVIEW

The preceding section highlighted the need and urgency of developing guidance for mainstreaming tools for biodiversity. This section reviews the South Asian context for using Environmental Impact Assessment as a tool against a background of declining natural heritage and ecosystem services. It is necessary to consider the factors responsible for biodiversity decline and to review current regional economic development priorities. This provides the basis for identifying enabling legislations and other mechanisms for strengthening conservation amidst development.

3.1 Status of biodiversity

Occupying a major portion of the Indo-Malayan realm and a smaller portion of the Palae-arctic and Afro-Tropical realm, the South Asia region includes five of the fourteen major ecological regions called biomes. The biological wealth of the region, as determined by diversity in the latitude, altitude, climate, topography and rainfall patterns, accounts for nearly 15.6% of the global floral and 12% of the faunal diversity (Figure 4).

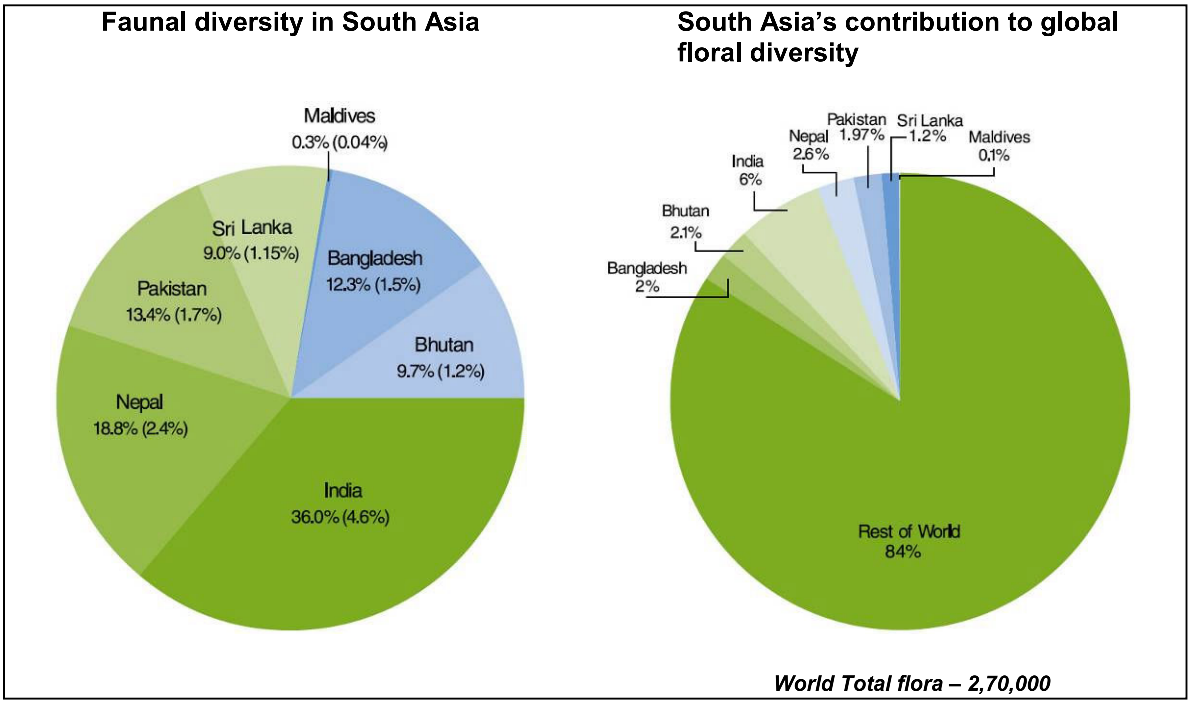

Figure 4 Faunal diversity in South Asia and its relative contribution to global diversity (Source: UNEP, 2001)

The region's geographical expanse and topography include several diverse ecosystems which harbour a rich variety of plant and animal species – the Sunderbans, the largest contiguous mangrove swamp in the world, in India and Bangladesh; magnificent coral reefs and atolls in the Lakshadweep-Maldives chain of islands; the Thar desert and arid areas in north-west India and southern Pakistan; high altitude cold deserts in the upper Himalayas and Deosai plains in Kashmir; two rich biodiversity hotspots in the eastern Himalayas (Nepal, north-eastern India, and Bhutan) and the Western and

Eastern Ghats of India and Sri Lanka; and the dense and virtually untouched virgin forests of Bhutan and Sinharaja in Sri Lanka.

The animal diversity of the region comprises 998 species of mammals, 3,801 birds, 1073 reptiles, 376 amphibians and 342 species of freshwater fish. The floral diversity accounts for 39,875 species of flowering plants, 66 conifers and cycads, 764 ferns and 6,652 higher plants (UNEP, 2001). Forests cover an area of approximately 7,71,37,000 ha (WRI, 2006) of the total land area (4,122,97,000 ha) of the region - i.e. 18.6% of the land area of South Asia is under forests, which accounts for approximately 2.93% of the world's forest cover. The wetlands in South Asia extend to 1,34,161 km^2 and include floodplains, marshes, estuaries, lagoons, tidal mudflats, reservoirs, rice paddies, saline expanses, freshwater marshes and swamps. Table 2 presents the biodiversity status of different countries in South Asia at a glance in terms of protected areas and species.

Table 2 Biodiversity status of different countries in South Asia

Biodiversity \ Country	Bangladesh	India	Nepal	Pakistan	Sri Lanka
Total land area (km^2)	144000	3,287,590	147,181	803,940	65,610
Phyisiographic/biogeographic zones	12	10	7	2	4
Land area under forest (km^2)	10040	649590	58283.676	20230	18850
Number of Protected Areas*	11	607	25	225	77
Land area under Protected Areas (km^2)	660	156,666.03	28553.114	91701.21	9700
Number of wetlands	12	137	17	48	41
Number of Ramsar sites	2	25	4	19	3
Total number of species of higher plants	5000	47000	5188	5910	3771
Total number of species of mammals	131	422	181	174	90
Total number of species of birds	604	1228	860	668	441
Total number of species of fish	735	5749	185	986	478
Total number of species of amphibians	23	232	43	22	56
Total number of species of reptiles	113	521	100	177	162
Number of endemic plant species	8	5150	341	380	927
No. of endemic animal species	0	17612	161	57	185
Total number of endangered plant species	106	152	2	2	284
Total no. of endangered animal species	33	205	22	19	147

Source: *Anon. (2006a); Anon. (2006b); Anon. (2006c); Murthy (1994); Anon. (2000); Anon. (2002a); Groombridge & Jenkins (1994); WRI (2006); FAO (1995); IUCN (2006); Rodgers et al. (2000); MoE&F (1990); IUCN (2000;) Ramsar Convention on Wetlands (1971), Department of Wildlife Conservation, Sri Lanka, At www.dwlc.lk/cgi-bin/template.pl?pa:%20%3E%20 Protected%20 Areas*

3.1.1 Threats to biodiversity

The loss of biodiversity is an issue which is high on the political agenda in South Asia as much as in other parts of the globe. On the regional scale, increasing population in most countries within the region (Bangladesh, India, Nepal, Pakistan and Sri Lanka); vulnerability to natural disasters such as floods and cyclones; poverty and declining productivity of terrestrial and aquatic ecosystems are the most important challenges in most of the South Asian countries. The most obvious consequences associated with these environmental trends are loss of biodiversity and tremendous pressure on the natural ecosystems for meeting food, shelter, energy, fodder requirements and other basic subsistence needs. One important reason that biodiversity continues to be lost and degraded is that its economic value is not fully appreciated by both users and policy makers. An underlying reason for this is that prices for many goods and services provided by biodiversity and ecosystems do not exist or are often undervalued and thus policy decisions fail to reflect their true value. The region has witnessed rapid escalation in incidents of poaching, trading and smuggling of wild flora and fauna due to increased demand and commercial value of wildlife and their parts. Coupled with these factors are the rapid commercial developments with diversification in urbanization and industrialization that have led to significant losses of habitats and biodiversity resources of the region. The diversity and magnitude of environmental threats faced by different countries is outlined in Table 3.

Table 3 Biodiversity threats

Threats	Country	Bangladesh	India	Nepal	Pakistan	Sri Lanka
Habitat loss	Conversions for development site		■			
	Deforestation (for agricultural expansion, creation of settlements)	■	■	■	■	■
	Shifting *(Jhum)* cultivation	■		■		
	Change in land use pattern and land use conflict		■		■	
	Destruction of fish breeding areas	■	■	N/A	■	■
	Draining/filling wetlands					■
	Destruction of coastal ecosystems due to mining for gems and rare earths		■	N/A	N/A	
	Hill slope cultivation and associated silting of water bodies		■	■	■	N/A
	Upstream withdrawal of water/salinization downstream	■				
	Clear felling for plantations and housing of industrial establishments	■				
	Land take for civic infrastructure and urbanization	■	■	■	■	■
	Destruction of terrestrial habitats by extractive industries		■	N/A	■	■
	Fragmentation of contiguous habitats by linear developments (road, rail, pipeline)	■	■	■	■	
	Forest fire	■	■	■	■	■
	Soil erosion			■		
	Introduction of alien and invasive species	■	■	■		
Over harvesting of resources	Removal of food, fuel and fodder	■	■	■	■	■
	Commercial harvesting of non wood resources	■	■	■	■	■

Threats \ Country		Bangladesh	India	Nepal	Pakistan	Sri Lanka
	Over grazing	■	■	■	■	■
	Indiscriminate collection of medicinal plants		■	■		
	Hunting/trafficking in wildlife					
	Unregulated logging	■	■	■		
	over harvesting of fish	■	■		■	
	Destructive fishing gear/trap			■	■	
	Coral extraction		■	N/A		■
	Encroachment into the natural forests		■	■	■	
Productivity decline	Indiscriminate breeding of livestock	■		■	■	
	Indiscriminate introduction of High Yielding Varieties (HYV)					
	Introduction of hybrid species	■	■			
	Vulnerability to natural disasters (floods droughts earthquakes) and disease	■	■		■	
Tourism related threats	Pollution, increased dependence on natural resource and disturbance to natural areas		■	■		■
Pollution	Disposal of untreated industrial wastes/					
	oil spillage from ships					
	Indiscriminate use of pesticides /fertilizers	■	■		■	
Poverty and lack of livelihood	High dependencies on biodiversity resources for subsistence and livelihoods	■	■	■	■	■
Lack of appropriate legal and policy support	Conflicting sectoral policies		■	■		
	Conflicting and incomplete legislative measures					
	Legal instruments and policies do not conform with conservation science					

■ - High; ■ - Medium; - Low

Source: *Based on information from state of environment reports, official websites and published information (see reference list)*

For an overview of country specific information on status of biodiversity and existing threats to environmental resources, the users of guide should refer to Appendix – I (Appendices 1a to 1e).

3.1.2 Biodiversity conservation efforts in South Asia: Country level agreements and legislations

Several initiatives at the global level have been significant in mainstreaming biodiversity in regional conservation initiatives. A summary of South Asia's regional efforts for biodiversity conservation through different multilateral agreements, national legislations and policy guidance is presented in Table 4.

Biodiversity is already a part of the legal and policy framework of countries in the region. Commitments of these countries to global initiatives for biodiversity conservation and environmental protection are also reflected in country specific legislations (Appendix – II).

Table 4 Adherence of the countries in South Asia to Multilateral Environmental Agreements (MEA) relevant to biodiversity conservation

Convention / Country	Vienna Convention (1969)	Montreal Protocol (1987)	Convention on Biological Diversity (1992)	UN Framework Convention on Climate Change (1992)	CITES (1973)	World Heritage Convention (1972)	Ramsar (Wetlands) Convention (1971)	Basel Convention 1989)	Convention on Conservation of Migratory Species (CMS) – Bonn Convention (1983	Convention to Combat Desertification CCD) (1974)	UN Conventions on the Law of the Sea (1982)
Bangladesh	1990(A)	1990(A)	1995	1994(R)	1982(E)	1983	1992(E)	1993(A)	2005 (S_1) MT-IOSEA*	1996(R)	2001(S)
India	1991(A)	1992(A)	1994	1993(R)	1976(E)	1977	1982(E)	1990(S)	1983 (S_1) SIBE**	1996(R)	1995(S)
Nepal	1994(A)	1994(A)	1994	1994(R)	1975(E)	1978	1988(E)	1996(A)	-	1996(R)	1998(R)
Pakistan	1992(A)	1992(A)	1994	1994(R)	1976(E)	1976	1976(E)	1994(A)	1987 (S_1) SIBE**	1997(R)	1997(S)
Sri Lanka	1989(A)	1999(R)	1994	1993(R)	1979(E)	1980	1990(E)	1992(A)	1990 (S_1) MT-IOSEA*	1999(R)	1994(R)

*MT-IOSEA = MoU on the conservation and management of marine turtles and their habitats of the Indian ocean and South-east Asia (01.09.2001)
**SIBE = Memorandum of Understanding (MoU) concerning conservation measures for the Siberian crane (01.07.1993)
A= Accession E= Entry into force R= Ratification S= Succession S_1= Signatory

Source:

WCPA, IUCN (1998). *Regional Action Plan for Protected Areas in South Asia.* World Commission on Protected Areas - South Asia, New Delhi.
UNEP (2006). *Secretariat of the Basel Convention, United Nations Environment Programme*. Website: http://www.basel.int/ratif/convention.htm
Anon. (2006). *Parties to the Convention on the Conservation of Migratory Species of Wild Animals*. Website: http://www.cms.int/pdf/en/party_list/Partylist_eng.pdf
UNEP (2004). *United Nations Environment Programme, Ozone Secretariat.* Website: http://ozone.unep.org/Treaties_and_Ratification/ratif_status.asp
UNCCD (2006). *United Nations Conference on Combat Desertification.* Website: http://www.unccd.int/regional/asia/menu.php
UNFCC (2006). *United Nations Framework Convention on Climate Change*. Website: http://unfccc.int/parties_and_observers/parties/non_annex_i/items/2833.php
UN Conventions on the Law of the Sea (2006). Website: http://www.un.org/Depts/los/reference_files/status2006.pdf
Contracting Parties to the Ramsar Convention on Wetlands (2006). Website: http://www.ramsar.org/key_cp_e.htm
UNESCO (2006). *UNESCO World Heritage Convention*. Website: http://whc.unesco.org/en/list/
CITES (2006). *The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)*. Website: http://www.cites.org/eng/disc/parties/alphabet.shtml

3.2 Sectoral developments

The countries in South Asia have realized that fostering private sector growth is a key to reducing poverty and sustaining growth. Consequently, the economic development in most South Asian countries is being fuelled by developments in some key sectors. This guidance focuses on three of these sectors-roads, mining and oil and gas, all of which are priority sectors in all the countries in the region, involve huge investments and invariably have a large ecological footprint.

3.2.1 The road sector

All countries in South Asia have massive road development plans, funded by both national governments as well as donor agencies. The investment in road sector ranges from US$ 0.35 million in Sri Lanka to US$ 4.5 billion in India (Table 5) the details of road network development in the 5 South Asian countries are provided in the Appendix – III. While the need for road infrastructure development deserves a high priority for all countries in the region from the socio-economic standpoint, their negative impacts on the biological environment can be significant. This greatly necessitates the careful planning and implementation of road projects with due considerations given to biodiversity conservation.

3.2.2 The mining sector

Buoyed by increasing global demand for minerals and the availability of amazingly attractive sources of reserves in less-developed and more remote parts of the world, the international mining industry has expanded rapidly in the last three decades. The focus of much of the expansion in the mining sector in South Asia is in India, Pakistan and Sri Lanka (Table 6).

India has opened Foreign Direct Investment (FDI) and also formulated guidelines for aerial bioprospecting, leading to a spurt in mining activities in biodiversity rich areas. Pakistan has a large number of mineral deposits and several mega mining projects are in the pipeline. In Sri Lanka, although the mining industry brings high economic benefits, it is seen as a major source of environmental problems and threats to biodiversity. Details of developments in mining sector in different countries of South Asia are provided in Appendix - IV.

3.2.3 The oil and gas sector

Owing to its strategic importance, oil and gas has seen a radical restructuring and launching of new initiatives to explore and exploit oil and natural gas reserves and establish petroleum refineries and pipelines in three countries in the region namely – India, Pakistan and Bangladesh. Although state of the art technology is being used in this sector for exploration and transportation, the negative impacts on the environment, particularly on coastal and marine ecosystems are likely to be more significant. The size of the Indian oil and gas industry is estimated to be US$ 90 billion (Ministry of Petroleum, Govt. of India 2002). In Pakistan, an investment of US$ 1 billion is being planned in this sector (Pakistan Energy Year Book, 2005). In Bangladesh, an investment of US$ 300 million has been made on oil and gas sector. The details of developments in this sector are provided in the Appendix – V.

Table 5 Summary of developments in road sector in countries in South Asia

Road	Bangladesh	India	Nepal	Pakistan	Sri Lanka
Total length (Km)	300,000	3851440	37281	258,000	100,530
Paved roads (Km)	63811	2411001	8573	157975	78802
Unpaved roads (Km)	216500	1440439	7332	97881	18485
Expressways (Km)	-	200	-	960	-
National highways (Km)	3570	66,590	7535	9031	11,658
State/Regional highways (Km)	4323	1,37,711	-	-	1500
District roads (Km)	13678	-	-	-	-
Rural roads (Km)	250,000	26697	20,000	180000	15,000
Roads through forests (Km)	-	130346	4144	4800	-
Investment (Million USD)	449.10	47830	1500	279.38	0.35

Table 6 An overview of developments in mining sector in South Asia

Mining	India	Pakistan	Sri Lanka
Minerals mined	90	58	19
Area of mines (Km^2)	10,406.165	926.58	30 – 35
Economic value (Million USD)	16600	11.43	70

Source:

CIA (2006). (URL: https://www.cia.gov/cia/publications/factbook/geos/ce.html)
Proceedings of the Contacts' Workshop conducted in Islamabad during 15th – 19th February 2006 under CBBIA – IAIA (Asia) Project.

Bangladesh
Roads and Highway Department, Bangladesh. (URL: http://www.rhd.gov.bd/ Default.htm)
The World Bank (2006). (URL: http://web.worldbank.org)
GoB (1999). *Roads In Bangladesh: The Next Millennium.* Roads and Railway Division, Ministry of Communications, Government of People's Republic of Bangladesh.

India
Department of Road Transport and Highways, Ministry of Shipping, Road Transport and Highways, Government of India. (URL: http://morth.nic.in/brs.htm)
National Highways Authority of India, Government of India. (URL: http://www.nhai.org/ roadnetwork.htm)
IBEF (2006). *Road.* (URL: http://www.ibef.org/attachment /investment%20opportunities %20in%20roads%20sector.pdf)
Ministry of Mines, Government of India. (URL: http://mines.nic.in/)

Pakistan
National Highways Authority (2006), Pakistan. (URL: http://www.nha.gov.pk/info/ HNetwork.asp)
Khakvani (2006)
Pakistan Economic Survey 2005 - 2006.

Sri Lanka
Road Development Authority (2006), Sri Lanka. (URL: http://www.rda.gov.lk/road %20statis.htm)

Table 7 An overview of developments in oil and gas sector in South Asia

Oil & Gas	Bangladesh	India	Pakistan
Oil production (Barrels per day)	6813	846000	66079
Oil consumption (Barrels per day)	91000	2630000	350000
Proved oil reserve (Million barrels)	28	5600	308
Natural gas – production (Million cubic feet)	463000	996000	988810
Natural gas – consumption (Million cubic feet)	463000	1089000	988810
Natural gas - proved reserves (Million cubic feet)	5000000	38000000	34000000
Pipeline length (Km)	2604	19837	12258
Refineries	1	18	5

Source:

CIA (2006). (URL: https://www.cia.gov/cia/publications/factbook/geos/ce.html)

Proceedings of the Contacts' Workshop conducted in Islamabad during 15th – 19th February 2006 under CBBIA – IAIA (Asia) Project.

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NationMaster.com (URL: http://www.nationmaster.com/)

Ministry of Petroleum & Natural Gas, Government of India. (URL: http://petroleum.nic.in/petstat.pdf)

Pakistan Energy Yearbook 2005, HDIP.

Oil and Gas Journal (2006). (URL: http://www.ogj.com/)

3.3 Environmental Impact Assessment (EIA) in the region

Most developing countries in Asia have recognized the importance of EIA as a component of development planning. Countries in South Asia also have established legal and policy frameworks for environmental protection and environmental management. For more detailed country specific information on laws, policies, and processes that define each country's institutional framework for promoting EIA as a tool for influencing development decisions, the users of the guide are advised to refer to Appendix – VI and VII.

3.4 Strategic Environmental Assessment (SEA) in the region

The level of awareness about the concept and prospects of Strategic Environmental Assessment (SEA) is currently limited in the region but this is gradually increasing as some countries are acquiring the experience of conducting SEA in response to the requirements of the development projects financed by international donors. As the current decision-making process and policy directives do not really provide the foundation to support the effective implementation and enforcement of SEA, most countries are accepting more responsibility for the environmental impacts that result from their development activities and have accordingly developed Environmental Impact Assessment (EIA) in the last two decades as a management tool for addressing project level impacts.

Experience from operational SEA systems from which lessons of implementation can be drawn, indicate that there is significant potential for developing SEA in South Asia. A beginning is already being made in these countries to apply some type of strategic planning to developments in transportation and water resource sectors. The strategic level assessments of Nepal´s forest plan (Khadka *et al.*, 1996), Pakistan´s water and drainage programs, Sri Lanka´s city and tourism plans, India's road development programmes and river linking proposals and the development of National Conservation Strategy in most countries (Rahman, 2005) are increasingly providing triggers for popularizing SEA and building capacity for SEA. Another interesting example of a recent SEA application is the Palar Basin planning in Tamil Nadu state of India, where serious water resource issues (scarcity, competition across sectors and regions, sustainability) are inextricably intertwined with environmental (industrial and domestic pollution and natural resources management) issues. SEA is being used as a tool to analyze these issues and identify interventions at policy and project levels to contribute to overall economic, environmental and social improvement. In Nepal, SEA is still a nascent stage.

Considering that SEA would have to be first institutionalized through policy directives and legislative provisions within countries for becoming an effective planning tool in the context of the region, efforts of building capacity for integrating biodiversity in SEA will have to wait until the applications of SEA is fully institutionalized through reforms in policy and legislative directives. The focus of this guidance document is thus limited to mainstreaming biodiversity in impact assessment.

SECTION III

4 GENERIC EIA FRAMEWORK

This short section is intended to provide a generally accepted and familiar framework for conducting EIA as adopted around the world. The purpose is to provide practitioners a useful construct for the thought processes which might be needed to re-frame EIA as an integrated tool for merging ecological and economic evaluation of biodiversity and mainstreaming it as a development issue.

4.1 Generic framework for EIA

Screening

'Screening' is the process of evaluating the need for EIA. The screening mechanism seeks to identify projects with potentially significant adverse environmental effects and determines the level of details to be incorporated in the environmental analysis.

Scoping

'Scoping' stage defines key issues that should be included in the Environmental Assessment and determines the scope, depth and Terms of Reference for the EIA study. This is a very important step both in identifying the impacts and controlling the size of the EIA. Effective scoping enables:

- defining the boundary of the EIA study
- consulting with relevant stakeholders to identify full range of concerns
- focusing on key issues that characterize the existing environment in the baseline studies
- reviewing the types of alternatives to be considered
- exercising the option of cancelling or drastically revising the project should major environmental problems be identified.

Methodologies for scoping may range from interviews to use of checklists, matrices and network diagrams for visualization of sources and receptors of impacts and identifying which of these impacts require attention in the study.

Assessment

This stage forms the central part of an EIA. The objective of this phase is to identify how the activities of the proposed development will impact on the various components of the environment. The assessment stage involves:

- Characterization of the baseline situation in the absence of the activity against which future impacts can be assessed and allows exploring alternative of location, design, scale, technology and timing for project implementation.
- Prediction of impacts aims to identify the magnitude and other dimensions of identified change in the environment with or without the project, based on the baseline.

Ideally a full year of baseline data is desirable to capture seasonal effects of many environmental phenomena. Short-term data monitoring should be also undertaken in parallel with long-term collection to provide conservative estimates of environmental impacts. Many tools and methods are available to identify different types of impacts (direct vs. indirect impacts; short-term vs. long-term impacts; adverse vs. beneficial impacts; cumulative impacts). **It is Important to concentrate on "big- ticket" factors.**

Economic evaluations techniques are also applied at this stage to evaluate the environmental impacts. The most commonly used methods of project appraisal are cost-benefit and cost-effectiveness analysis. Preventive Expenditure and Replacement Costs (PE/RC) also represent methods to value change in output that results from the environmental impact of the development.

Impact evaluation

This step outlines the conclusions of the impact assessment study by addressing the key question - *how important is the impact*?

Impact evaluation actually calls for very careful considerations of the most important impacts and their accurate measures in terms of magnitude, extent and significance. The step also involves evaluation of the impacts for all possible alternatives, so that a well-balanced final decision can be reached regarding the fate of the project.

The evaluation step must provide answer to question – *is the proposal technically feasible, economically and financially viable and legally permissible?*

Impact evaluation is greatly dependent on the quality of the scoping that is done earlier on the project and the quality of baseline information generated subsequently.

The following formal and informal approaches can be used to conduct impact evaluation:

- Qualitative approach.
- Quantitative approach.
- Ranking, rating or scaling approach.
- Weighting approach.
- Weighting-ranking/rating/scaling approach.

Mitigation

The step is recognized as a problem solving stage that helps in seeking better ways of doing things by minimizing the severity of negative impacts and enhancing the project benefits. This stage essentially involves developing strategies and options based on the following hierarchy: avoid - reduce - remedy - compensate - enhance.

The outcome is generally drawn into an Environmental Management Plan (EMP), or mitigation plan which guides implementation of the proposed mitigation measures.

Reporting

This step involves integration of the findings of impact assessment and mitigation studies into a document. The nomenclature for the document is wide ranging as is reflected by the following terms that are in use in different parts of the world:

- Environmental Impact Assessment report (EIA report).
- Environmental Impact Statement (EIS).
- Environmental Assessment report (EA report).
- Environmental Effects Statement (EES).

The elements of a typical report are however consistent and contain information on the following aspects:

- Executive Summary.
- Introduction.
- Description of the project including analysis of site selection and alternative sites.
- Description of baseline conditions (biophysical and socio economic).
- Description of impacts.
- Significance of impacts.
- Evaluation of alternatives.
- Environmental management or, mitigation plan.
- Summary and conclusions.
- Monitoring plans, including contingency plan.
- Annexes (glossary, explanation of acronyms, ToRs and a list of persons consulted).

Review

This step in the EIA process determines whether the EIA report is an adequate assessment of the project related impacts and is of sufficient relevance for quality of decision-making. The process often includes review of the EIA report by specialists and public prior to finalization and decision-making to:

- Ensure whether it is of an acceptable standard.
- Improve rigour of the assessment if needed.
- Ensure that relevant information is captured and reflected for good decision-making.

Decision-making

This stage refers to final decision with regard to approval or refusal of the project. The final decision to proceed with the project is generally backed by stipulated conditions defining the conditions for the project to proceed and also stating the requirements for compliance of safeguards proposed in the EMP. Similarly, the decision to reject the project usually states whether the project can be revised and resubmitted.

The specific procedures of decision-making in different countries and regions are however governed by country level EIA legislations and operating directives for decision-making.

Monitoring

The monitoring stage corresponds with a 'EIA follow up' and involves monitoring for compliance of measures stated in EMP, enforcement and auditing and reporting back the results to regulatory bodies for timely interventions, including revoking clearance that has been granted if it is established that the conditions stated for incorporating safeguards are not being complied with.

4.2 A conceptual framework for integrating biodiversity, ecosystem services, economics and livelihoods into impact assessments

In order to improve the basis for biodiversity-inclusive impact assessment, IAIA-CBBIA has developed a conceptual framework that seeks to demonstrate how, where and when biodiversity and economics can be meaningfully integrated with the steps of a generic EIA process as outlined in the previous section. This conceptual framework seeks to understand the relationship between the biophysical status of ecosystems, the links it has with provisioning of ecosystem services as well as the links the two have with economic and livelihood uses and benefits for different groups. This framework seeks to overcome three specific shortcomings in the way that biophysical, economic and livelihood studies are usually accounted in EIA. The problems are that such studies deal with the different elements of ecosystem assessment in isolation from each other, use overly-complex, time-consuming and expensive field and analytical techniques, and often fail to link the focus and findings of assessments to real-world needs and conditions (World Bank, 2004).

The challenge is to devise an assessment methodology which could address the above problems, yet be credible enough to decipher the relationships between ecosystem land and resource use and ecosystem services, and the different conditions and drivers that affect ecosystems biophysical status. Such relationships are extremely complex, concern both biophysical and economic-livelihood elements, and involve a series of interactions among them.

The conceptual framework set out here is designed to address these challenges by providing an integrated tool to assess biophysical and economic-livelihood linkages in ecosystems, in order to point to project outcomes which are economically and financially sustainable and at the same time help maximize both ecosystem services and livelihoods benefits. The framework lays emphasis on economic valuation, carried out in a way that incorporates information about both biophysical and livelihood linkages. It thus aims to ensure a sound economic, distributional and biophysical basis to the design of tools for ecosystem considerations. The framework uses ecosystem services as a unifying term for integration.

The integrated assessment framework also seeks to address the need to optimize the benefits of using the best scientific techniques given the constraints of financial, data, time and skills likely to be faced. It provides practical advice on choosing the appropriate methodology and conducting an integrated assessment study. And finally it stresses the need for a multidisciplinary team as well as the importance of the collecting and using of ecological and ecosystem services data so as to enable understanding of its functioning.

Figure 5 provides guidance on mainstreaming biodiversity through integrated ecological and economic assessment tools in the traditional EIA framework.

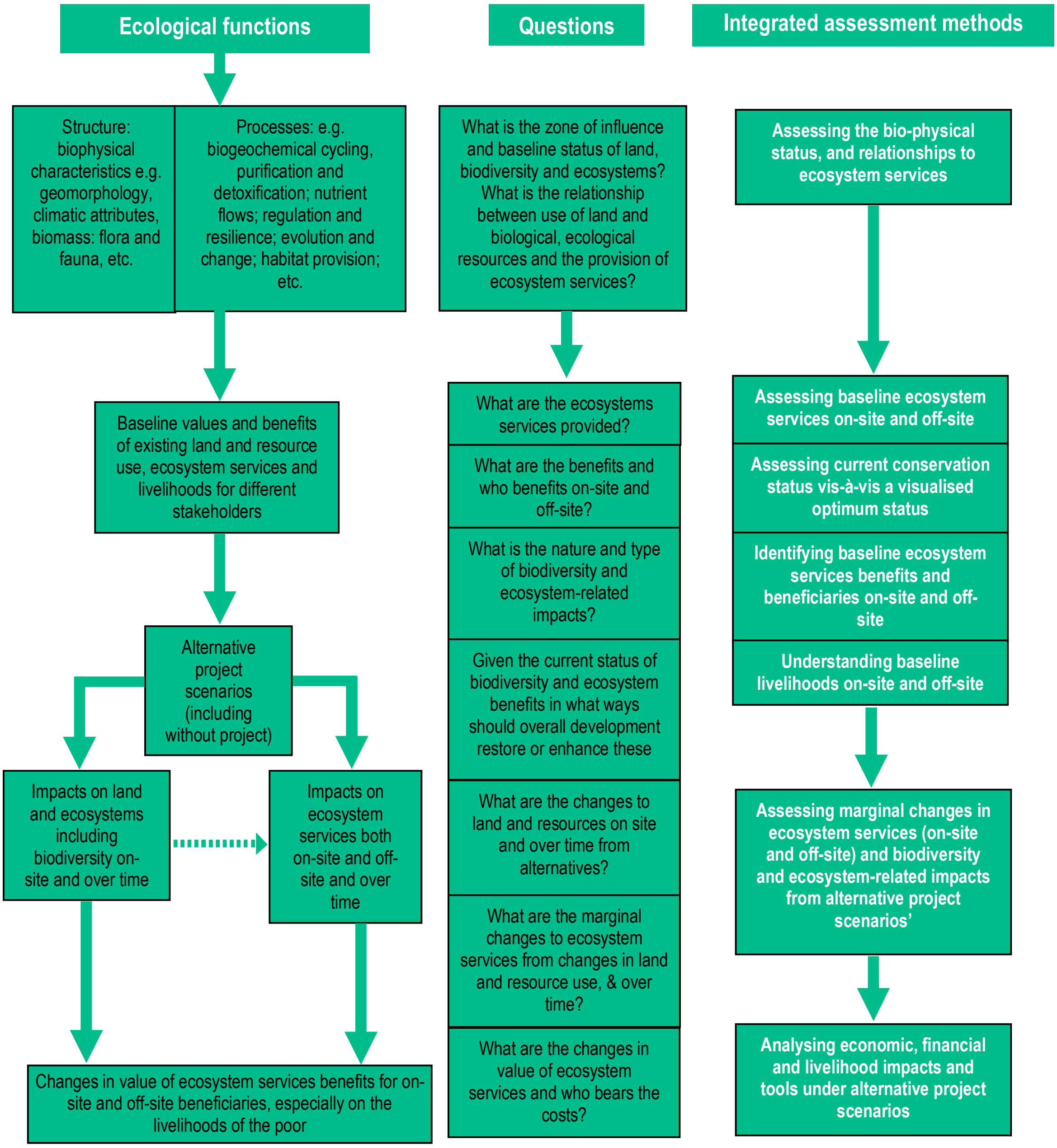


Figure 5 Framework for integrated ecosystem-economic-livelihood impact assessment

SECTION IV

5. PRACTITIONERS' GUIDE FOR BIODIVERSITY INCLUSIVE EIA

This section of the manual presents the argument for mainstreaming biodiversity in impact assessments and provides practitioners with a 'how to' guide for including biodiversity in EIA and integrating it with the general EIA framework set out in the previous section.

As the direct drivers of biodiversity loss (e.g. over-exploitation, habitat change, pollution, invasive alien species and climate change) intensify and the links between economic development, human well-being and environmental integrity become more apparent, the conservation of biodiversity emerges as an utmost and urgent priority for all countries in the region. EIA has received worldwide recognition as a planning tool to address the biophysical, social and environmental impacts of development. Although the generic EIA approaches have addressed biodiversity issues, these have often failed to address functional relationships within biological systems and between biophysical and socio-economic systems. As a result, EIA has often been deficient in terms of providing clear criteria for assessing impact significance and in incorporating prescriptions for positive planning for biodiversity in economic development pursuits.

Recognizing fully well that knowledge of critical biodiversity issues in the appraisal of a given project is an essential prerequisite for sound decision-making, biodiversity-inclusive impact assessment emerged as a harmonizing tool for addressing biodiversity-related concerns in planning of development projects, programmes and policies. The initial attempts to popularize the concept were made by Bagri *et al*. (1997) and Treweek (1999). The publication of Biodiversity and Environmental Assessment Toolkit by the World Bank (2000) subsequently suggested a more formalized framework for promoting biodiversity in the impact assessment practice. The review of experience and methods of integrating biodiversity in national EIA process supported by Biodiversity Planning Support Programme (BPSP), jointly-implemented by the United Nations Development Programme and the United Nations Environment Programme (Treweek, 2001) was perhaps the first effort that highlighted the need for developing a more integrated framework for including biodiversity in EIA. These earlier initiatives were followed by some disparate and limited initiatives of developing sector specific guidance by EIA professionals (Byron, 2000; Rajvanshi *et al.,* 2001; EBI, 2003a; ICMM, 2005).

A still stronger momentum for consideration of biodiversity in impact assessment came from the important lesson that " *the objectives of the Convention on Biological Diversity will be impossible to meet until consideration of biodiversity is fully integrated into other sectors" (Hague Ministerial Declaration from COP VI to* WSSD, 2002) and the provisions of the Article 14 of the Convention on Biological Diversity (CBD) that defines impact assessment as a key instrument for achieving the conservation, sustainable use and equitable sharing of biological resources. The endorsement of Voluntary Guidance on Biodiversity-Inclusive Impact Assessment by the CBD in 2006 (Slootweg *et al.*, 2006 and http://www.biodiv.org/doc/publications/imp-bio-eia-and-sea.pdf) and the IAIA guiding principles (IAIA, 2005) on biodiversity-inclusive impact assessment provided the strongest impetus for mainstreaming the goals of biodiversity conservation into economic sectors and development models, policies and programmes.

These global directives have set the stage for adopting the 'mainstreaming' concepts for creating compatibility between biodiversity conservation and development priorities in the regional context. Section 4.1 that follow, provide step by step guidance on identification and prioritization for mainstreaming biodiversity in the traditional EIA framework while integrating ecological and economic evaluation tools.

5.1 Suggested framework for biodiversity-inclusive EIA

5.1.1 Screening

The screening mechanism seeks to identify those projects with potentially significant adverse effects on biodiversity components and ecosystem services. The outcome of the screening process is the development of a ***screening criteria*** and a ***screening decision***.

Screening criteria

The screening criteria for biodiversity can be evolved based on the following:

- legal triggers, including legal requirements of existing and future legislation for biodiversity conservation
- location of project in biogeographically important zones and conservation areas as per legal provisions (e.g. Western Ghats, Protected Areas, World Heritage Sites)
- location of project in areas known to be habitats for threatened species, or in other ecologically sensitive areas (Box 1)
- biodiversity values including valued ecosystem components and services of the project site
- review of activities in entire project cycle for determining drivers of change of biodiversity (e.g. *harvest or removal of species, habitat diversion, fragmentation and isolation, external inputs such as emissions, effluents, or other chemical, radiation, thermal or noise emissions, introduction of alien, invasive or*

Countries are generally guided by national EIA legislations and processes that define categories of projects depending on the potential of damage for which EIA is mandatory. In **Bangladesh**, the industries and projects are categorised as 'Green', 'Orange a', 'Orange b' and 'Red' with 'Green' signifying least 'Red' indicating the most significant impacts. In **India**, EIA reports for 'A' category projects that have greater potential to impact environment are evaluated by Central Government in the Ministry of Environment and Forests and 'B' category projects are evaluated by the State Environmental Impact Assessment Authority. The provisions of EIA legislation in **Nepal** differentiate between Schedule - I category projects requiring Initial Environmental Examination (IEE) and Schedule – II project requiring full EIA. In **Pakistan**, whether a project requires an IEE or an EIA is defined in the regulations under two separate schedules: Schedule I and II which is based on the nature and magnitude of projects and the anticipated level of impacts arising from them. The EIA process in **Sri Lanka** is mandated only for 'prescribed' projects for which environmental clearance is to be obtained based on an IEE/EIA study by designated Project Approving Agencies (PAA) before they can be implemented.

BOX 1 Criteria defining ecologically sensitive areas

Ecologically sensitive areas are those that support one or more of the following elements of biodiversity:

- Rare ecology, e.g. endemic or Red-Listed species.
- Charismatic species, such as elephants, or spectacular landforms.
- Species with restricted ranges (e.g. Snow leopard).
- Critical environmental services, such as watershed protection or evolutionary functions.
- Sites of reintroduction of endangered species.
- Areas of exceptionally high species diversity e.g., Western Ghats.
- Particularly fragile habitats, e.g. mountain ecosystems or wetlands.
- Areas with important provisioning, regulating and cultural services (e.g., pastures, fuel wood for indigenous people, watershed).
- Other natural heritage assets, such as sacred sites, etc.

genetically modified organisms, or change in ecosystem composition, structure or key processes).

An underground mining project may not have the same screening decision as above ground mine because the drivers of change would not be the same (destruction versus temporary disturbance).

Type of screening decision:

- EIA required (with levels of assessment).
- EIA not required (with justification).

Guidance provided by The Netherlands Commission for EA (Slootweg *et al.*, 2006) for framing pertinent questions to conduct screening for biodiversity impacts using ecological and economic considerations can be appropriately adopted for screening decisions.

Level of diversity	Conservation of biodiversity	Sustainable use of biodiversity
Genetic diversity	***Would the intended activity result in extinction of a population of a localized endemic species of scientific, ecological, or cultural value?***	***Does the intended activity cause a local loss of varieties/cultivars/breeds of cultivated /domesticated plants and animals, and what are the economic and livelihood impacts?***
Species diversity	***Would the intended activity cause a direct or indirect loss of a population of a species or pose threat?***	***Would the intended activity affect sustainable use of a population of a species and economic and livelihood impacts?***
Ecosystem diversity	***Would the intended activity lead, to loss of (an) ecosystem(s), or impair ecosystem services that create challenges for conservation***	***Does the intended activity affect the status of biodiversity and sustainable utilization by increasing destruction or exploitation of resources that benefits society and its well being***

Economic concerns

The application of economic logic should occur early in the project cycle. The following economic considerations should be integrated at the screening stage and ideally project proponents should have these questions answered when submitting a proposal for a project:

- Does the project identify all the economic aspects of the project including cost benefit analysis?
- In particular, does the intended project identify biodiversity impacts and treat them as part of the project and does the project identify what causes these impacts and what are their socio-economic effects?
- Does the project take into account current use of site as pastures, area for fire wood and NWFP collection, fishing and water harvesting that may be diverted leading to local overuse of residual forests accelerated degradation and deprivation of dependent communities.
- If so, has the intended project properly costed or valued biodiversity impacts including local use by people in economic terms and appropriately incorporated these into the economic cost benefit streams of the project?
- Does the intended project highlight the net benefits of undertaking the project greater than the alternative scenarios such as "no project" scenario?
- Does the intended project identify the distribution of costs and benefits? That is, who gains and who loses and by how much?
- Does the project provide to compensate the affected local people by allocating some of its outputs (e.g. water for irrigation, thermal-hydro power) or otherwise invest in better livelihood of the project affected persons?
- Does the intended project identify how costs can be avoided, benefits increased or more equitably distributed? Does the intended project identify how much it will cost to avoid costs and increase benefits?

5.1.2 Scoping

The scoping stage defines key issues which should be included. This section explains how to carry out scoping from a biodiversity perspective, including identification of whether uses and values of biodiversity should be a key consideration in the EIA.

Outputs

- Understanding of the proposal and those activities which might affect biodiversity as well as local people who depend upon biodiversity.
- Preliminary understanding of stakeholder requirements.
- Scope of work or Terms of Reference that include important biodiversity impacts.
- Identification of alternative solutions that avoid, mitigate or compensate adverse impacts on biodiversity.
- Appropriate expertise identified and a suitably qualified team assembled.
- Ensure that the EIA will result in an Environmental Impact Statement which will be useful to the decision maker to evaluate the project for ecological and economic sustainability.

Guidance for scoping

- ***Legislative requirements, international conventions***

  Scoping is not currently mandatory under the provisions of EIA legislation in some countries (e.g. Bangladesh and Pakistan. Recent amendment in India's EIA legislation (MoE&F 2006b) has made scoping mandatory for all projects. The Terms of Reference for EIA are determined based on information provided in the Questionnaire (referred as Form 1) of the EIA Notification issued as an amendment to earlier Notification. Some of these are directly relevant for integrating biodiversity in EIA (Box 2). Countries with no formal requirement for scoping can use this guidance for improving upon the practice of EIA.

- ***Country level guidance can provide a good starting point for scoping***

  Sri Lanka already has guidelines in the form of Guidance no.2 issued by CEA. The legal basis for scoping in Nepal is laid down under Rule 4 of the Environmental Protection Rule, but the integration of biodiversity conservation concerns in ToR for EIA could be ensured only recently through a policy directive issued in January 2006.

BOX 2 **Information sought from developers for scoping process in India under the amended EIA legislation**

Project actions that may cause:

- physical changes to land use, land cover or topography including increase in intensity of land use
- introduction of alien species
- loss of native species or genetic diversity
- increase in use of natural resources for construction or operation of the project especially non renewable (land, water and energy source).

Developments which may:

- have potential for cumulative impacts of planned activities on areas protected under international conventions and national or local legislation or for their ecological, landscape, cultural or other related value
- affect areas which are important or sensitive for ecological reasons - wetlands, watercourses or other water bodies, coastal zone, biospheres, mountains, forests
- affect areas used by protected, important or sensitive species of flora or fauna for breeding, nesting, foraging, resting, over wintering, migration
- affect inland, coastal, marine or underground waters
- affect areas containing important, high quality or scarce resources (ground water resources, surface resources, forestry, agriculture, fisheries, tourism, minerals).

- ***Scoping should be a participatory exercise.***

The provisions for conducting public hearing exist in most countries in the region but the process of public involvement continues to be fraught with problems (i) meetings are conducted at short notices and in areas fairly remote from proposed sites of the project limiting the participation of local people and allowing dominance of people likely to benefit from the project. (ii) The information about the project is not communicated to the public in advance to become aware of its consequences. Specific measures that are effective in overcoming some of the problems and made mandatory under legal provisions in India is the faciliatation of public consultation of the project feasibility report at an identified location in three different offices within the district, ensuring minimum period of notice for public hearing; video recording of the proceedings of the public hearing and the mandatory use of public hearing report for review and finalization of ToR for EIA.

Who should be involved in scoping?

Scoping should be carried out in consultation among the developer, the competent regulatory authority, relevant state level agencies and, ideally, the public.

- Relevant federal and state ministries (Mining, Industry, Transport, Health & Welfare, Water Resource, Forest & Environment, Finance etc.) Private and public sector organizations representing developers.
- Planning commissions.
- Local government bodies.
- NGOs and community interest groups.
- Local people.
- Gender issues should be considered **(Box 3).**
- Team of specialists including an economist for identifying linkages between development goals and targets and distribution of benefits to society without compromising the biodiversity values.
- For biodiversity inclusive EIA, scoping should additionally involve people dependent on biodiversity resources in the areas affected by a proposal. They may also be a good source of traditional knowledge) **(Box 4)**.
- Financial institutions.

- ***Scoping should benefit from traditional knowledge.***

Article 8(j) of the Convention on Biological Diversity addresses the need to "respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity" and to "encourage the equitable sharing of benefits arising from the utilization of such knowledge, innovations and practices" of these groups. With a view to implementing Article 8(j) of the Convention, the Conference of the Parties, through various bodies established under the Convention, is also in the process of developing guidelines with regard to use of traditional knowledge for the conservation and sustainable use of biological diversity in a range of contexts for example, ecosystem approach, in situ conservation, biodiversity monitoring and environmental impact assessments (CBD, 2001). This obviously highlights the need to integrate traditional knowledge in EIA practice in South Asia where the traditional knowledge is abundantly available.

BOX 3 **Gender issues in India** (Source: ADB, 2006)

The EIA of West Frontier Province Road Development Sector of Pakistan was conducted by ADB. The study of the Peshawar–Torkham sub-regional connectivity project highlighted that the section of the expressway from 22–27 km (following the existing highway) will pass above several villages. The local people in this area were concerned about the privacy of their women and family. It was apprehended that the road users will be able to see down into the houses and this may be interpreted as an invasion of privacy. Planting or roadside barriers were recommended in order to shield the view of the villages from passing vehicles and additionally serve as sound barriers.

BOX 4 **Importance of incorporating local knowledge in impact assessment in Myanmar**
(Source: Steinmetz *et al.*, 2006)

Local people should be considered as part of the problem analysis team as they can help better in identifying solutions through improved partnerships that incorporate local knowledge into problem diagnosis. In Thung Yai Naresuan Wildlife Sanctuary (3622 km^2) in western Thailand adjacent to Myanmar, local people were asked to assist in wildlife status assessment to determine factors and magnitude of decline over time. To accomplish this, species names were written on large charts in the local language. Next to each name were three unfilled circles that participants filled in according to the proportion of the population that remained. For example, species that had not declined were represented by three fully filled-in circles; those completely extirpated were represented by three unfilled circles. Participants separated into village focus groups for this exercise, reviewing individual opinions to reach a consensus on percent decline. The participants were then, asked to identify the processes or events (i.e., impacts) that had caused the population changes for each species. They provided six major impacts: commercial poaching, subsistence hunting, and civil war in Myanmar, road building, mining, and hydropower development. Village focus groups scored the severity of each impact for each species, from zero (indicating no impact) to five representing critical impact.

For a scoping exercise, biologists must appreciate the need to interact most constructively with local people

Notions of gender (the socially constructed roles and characteristics assigned to men and women in a specific culture), class, caste, ethnicity and age are integral to understanding the social relations and decision-making processes concerning access to, and use and management of natural resources. Participation of women in scoping would be useful in visualization of several impacts that need to be reviewed for. The feminization of agriculture, marketing of non wood produce and handicrafts made from biodiversity resources in some parts of India and other countries in the region and involvement of women in collection of resources such as water and fuel wood have a direct link with development induced changes in biodiversity for the benefit of resource security, environmental services and reduced physical burden.

Scoping requires a reasonable understanding of project-related activities and of biological/ecological receptors to aid the EIA study in determining **what action or processes of the proposed development will affect which ecosystem component or function**.

The primary steps in this process are:

- Reconnaissance of the area with the relevant multidisciplinary team for careful review of the project feasibility report and the design plan for determining project type, activity, region and nature of effect.
- Review of alternatives that have been explored by the proponent.
- An exhaustive review of literature for improving the basic understanding of the biodiversity profile of the area and review of public hearing reports. Practitioners must carefully apportion the relative time and effort required to be spent on desk studies. This should obviously be proportional to the complexity of the project, the ecological sensitivity of the site proposed for development and the rigour of assessment that is required. Many a times, a well spent time on generating information from secondary sources makes the task in field simpler and less time consuming and at the same time can help avoid duplication of efforts of generating baseline data.

- Identify "important biodiversity areas" for conducting a more focused study on impacts, and identify the affected human population under consideration as well as the distribution of groups (poorest, poor, least poor).
- Likewise identifying localities, water courses, water bodies used by people for subsistence, income supplementing (pastures, fisheries, non wood forest products etc.)
- Based on field visits and discussions, scoping should determine the spatial and conceptual boundaries of the analysis.
- Define survey approaches and collection methodologies to gather baseline information.

A great deal of work has been done by many ecologists and biodiversity experts around the world to develop criteria for building common understanding of biodiversity issue that need to be considered in the scoping exercise. This was specially needed as it is almost impossible to study all components and functions of the receiving environment. Some EIA experts (Treweek, 1999) have referred to the term 'focusing' for a step distinct from 'scoping' which is aimed at refining the scope of work by developing 'what to measure' approach while others consider "focusing' as part of the scoping stage (Bagri & Vorhies, 1997; UNEP, 2002; Slootweg & Kolhoff, 2003; IAIA, 2005; Slootweg *et al.*, 2006). Although formalized procedures for 'focusing' are not documented in a single place, ample practical guidance based on sound ecological principles and biodiversity conservation priorities at the global level is now available to evolve criteria for identifying important biodiversity areas, ecosystem components and values that may be relevant to focus on 'what to measure and where to measure'. Countries in the region can adapt this guidance (Box 5 to 8) to address the biodiversity priorities in the national, regional and even transboundary context.

BOX 5 **Attributes which may be selected as Valued Ecosystem Components(VECs)** (Source: Treweek, 1999)

- Abiotic components or environmental media such as water or air.
- Bio-geographic units, landscape units or 'eco-regions'.
- Habitats.
- Species.
- Populations or communities.
- Individual organisms (especially if protected species are affected).
- Functional groups of species (guilds).
- Ecosystem functions.
- Special sites (e.g. protected sites)

BOX 6 **Areas with "important biodiversity" as defined by IAIA** (Source: IAIA, 2005)

- Support endemic, rare, declining habitats/species/ genotypes.
- Support genotypes and species whose presence is a prerequisite for the persistence of other species.
- Have important seasonal uses or are critical for migration.
- Support habitats, ecosystems and species populations that are vulnerable, threatened throughout their range and slow to recover.
- Support particularly large or continuous areas of previously undisturbed habitat.
- Act as refugia for biodiversity during climate change, enabling persistence and continuation of evolutionary processes.
- Support biodiversity for which mitigation is difficult or its effectiveness unproven including habitats that take a long time to develop characteristic biodiversity.
- Are currently poor in biodiversity but have potential to develop.

BOX 7 **Possible valued ecosystem processes**
(Source: Treweek, 1999)

- Nutrient cycling (can affect system productivity and species composition).
- Energy flow (affects ability of systems to 'support' component species).
- Productivity (affects ecosystem function and species composition).
- Eutrophication (a form of increased productivity with implications for species composition).
- Succession (knowledge of patterns of succession is important for predicting community change over time).
- Colonization (can be key in maintaining populations).
- Dispersal (can be key in maintaining populations and is also important with respect to ability to recover following impact).
- Competition (altered competition has implications for species composition and patterns of succession).
- Assimilative capacity (can affect ability of a system to absorb or recover from pollution, for example).
- Various population processes.

BOX 8 **Criteria for selecting species as VECS**
(Source: Treweek, 1999)

- Public visibility/appeal (charismatic and emblematic species).
- Economic importance.
- Protected status.
- Rarity.
- Endangerment/conservation status.
- Susceptibility and/or responsiveness to defined impact (indicators).
- Representativeness of responses of guilds (guild indicators).
- Umbrella species.
- Important ecological role (e.g. position in food chain, keystone species).
- Availability of consistent survey methods.
- Expediency/tractability for survey.

Scoping requirements for economic evaluation of the project

It can be useful to produce a balance sheet to draw attention to areas where ecosystem benefits can be maintained and/or enhanced and where mitigating measures or alternative reforms are most needed in order to maintain or improve the *status quo*. The sheet should also reflect the positive and negative ecosystem consequences that have immediate implications for the people of the country, such as changing levels of pollutants that threaten human health, and those with less immediacy, such as biodiversity loss or increases in greenhouse gases. A balance sheet offers a means of depicting environmental costs/losses and benefits/gains of a particular measure. The balance sheet makes clear what environmental choices are being made, both directly and indirectly. Such a balance sheet can inform decision-making (though it cannot make the decision as to whether a project should go ahead).

The following are the generic criteria for socio-economic scoping that should be applied as part of the primary steps accomplished by a multidisciplinary scoping team:

(i) *Based on field visits and discussions scoping, determine the spatial and conceptual boundaries of the analysis.*

(ii) *Identify biodiversity impacts and their relationships to the project.*

(iii) *Identify the human population under consideration as well as the distribution of groups (poorest, poor, least poor).*

(iv) *Define survey approaches and collection methodologies to gather baseline information.*

(v) *Quantify biodiversity impacts and organize them according to importance (keeping in mind resilience, coping and adaptability at both the ecosystem and livelihood levels).*

(vi) *Choose economic valuation techniques (see section on assessment) for valuing select biodiversity impacts and ascertain data requirements (this data also feeds into the analysis of distribution of costs and benefits).*

The scoping phase of the EIA study is critical as it controls both, the quality of baseline information and the vigour of assessment. Scoping should therefore be treated as a serious exercise and must adopt best practices to ensure that the EIA team of specialists and experts are able to perform good focussing that ideally helps to 'count the best and leave the rest' for developing the scope of work for including biodiversity in impact assessement (Box 9).

BOX 9 **Good scoping practices** (Source: Anon., 2005)

- Make early site visits in order to ensure that matters related to important biodiversity and ecosystem values and conservation sites are identified at an early stage.
- Establish appropriate consultation arrangements with interested parties including the competent authority.
- Conduct the scoping exercise in a systematic manner using scoping check lists and matrices and producing a Scoping Report where appropriate.
- Develop a consensus on baseline survey requirements, prediction methods and evaluation criteria with appropriate bodies, including planners and decision makers.
- Review the costs and benefits of development choice, alternative options including the options of no development.

The starting point for **scoping** is to identify which activity or event (impact source) will affect which specific components of biodiversity resources, species, habitats and ecosytem services (impact receptor). A **checklist** can act as a 'prompt' for the practitioner and provide a structured approach for a follow up by identifying clearly the issues that would have to be addressed in the EIA. Guidance for developing a generic checklist of potential impacts linked to different phases of a typical project lifecycle is presented in Table 8. Issues for inclusion in EIA would be specific to a project, type of landscape, characteristics of ecosystem components and the conservation priorities of the country where the project is proposed. The practitioner will have to identify the issues as a part of the scoping exercise and make entries relecting the decision about the issues to be included in EIA.

Table 8 Example of checklist that can be used for scoping

Phase	Stage	Examples of sources of potential effects	Issues for inclusion in EIA
Pre Consent	Site selection	Potential changes in land use that may affect wildlife habitats (and thereby conservation prospects), resource crisis for dependent communities and increased conflict	
	Site investigation/ exploration	Physical impacts to site from exploratory activities involving movement and use of equipment for drilling and testing.	
	Environmental surveys	Disturbance and other impacts resulting from sampling and surveys.	
Pre Construction	Site acquisition/ requisitioning	Abandonment of normal land use once land is acquired, neglect or removal of trees and destruction of other habitat components.	
	Advance mitigation	Earth moving, planting and other mitigation works in advance of commencement of main construction.	
	Site preparation	Permanent and temporary land take, earth moving, soil stripping, overburden removal and disposal, increased access and physical disturbance, water abstraction and drainage works, fencing.	
Construction Stages	Construction	Storage and handling of materials, construction activities, earth moving, soil and sub soil compaction and stripping, blasting, drilling, piling, water abstraction and drainage works, tunnels, culverts, labour camps, resource use, access by vehicles, accidental spillages, noise, vibration, light, disruption of access to public and wildlife habitats	
	Restoration of construction works	Translocation from other sites, seeding, turfing, planting and cultivating, use of equipment, local resources, vehicular access, storage of materials, movement, soil and sub soil handling, testing and site investigations/surveys.	
	Commissioning	Inspection, testing, repairing, altering, moving and otherwise modifying project, often at short notice.	
Operation	Operational phase	Gaseous and particulate emissions, noise, vibration, disturbance, effluents, light, water abstraction and discharges, vehicular access and parking, increased vulnerability of local flora and fauna to threats.	
	Monitoring	Frequent use of site for monitoring, natural resource use investigations, surveys etc., repair, maintenance, replacement, emergencies (foreseen and unforeseen), maintenance and repair as project progresses in time,	
Decommissioning and Restoration	Decommissioning	Run-down in outputs, changes in balance of emissions and effluents, changes in noise and disturbance, light, water abstraction and discharges, fluctuations in outputs and activity.	
	Demolition/removal	Storage and handling of materials, demolition activities, earth moving, soil compaction, blasting, drilling, water abstraction and drainage works, tunnels, culverts, access by vehicles and equipment, compounds, parking, accidental spillages, noise, vibration, light, disruption to public access and resource use	
	Restoration	Translocation from other sites, seeding, turfing, planting and cultivating. Compounds, use of plant and equipment, vehicular access, storage of materials, movement, soil and sub soil handling, testing and site investigations/surveys.	
	After Care	Testing and site investigations/surveys, continuing effects of translocation from other sites, seeding, turfing, planting and cultivating.	
	Ongoing management	Restrictions on after use of land and ongoing management options as a result of project having occurred.	

Matrices are also a useful tool for scoping. They offer greater advantage in determining the focus of the study by providing a link between project actions and impact indicators for a practitioner to 'pick and chose' the indicators relevant for a more focused study. Such a matrix also highlights the linkages which are not clearly understood so that the study can address these and any impacts that are unknown. Box 10 presents an example of matrix used by Rajvanshi (1999) in conducting impact assessment of oil and gas pipeline projects in India, developed specifically to review biodiversity related impacts. The matrix not only helped in preventing omission of important issues and identifying the areas of expertise needed for building up the team but also helped in better visualization of time, methodology and ideal season for study of impacts on migratory species or breeding biology of specific bird species.

BOX 10 **Example of a matrix used for focusing on most relevant impacts of oil and gas pipelines on wildlife species and their habitats**

- ■ Negative impact
- ▒ Positive impact
- □ Actions and indicators are unrelated
- ? Impact unknown

ACTIONS / INDICATORS	Habitat quality	Habitat size	Habitat intactness	Wetland quality	Bank vegetation	Faunal group number	Species diversity	Nesting sites	Breeding sites	Mitigatory movements	Home range	Local extinction	Rarity	Species mortality	Noise pollution	Land pollution
Acquisition of land		■														
Clear felling of forest	?	■	■			■	■	■	■	■	■	?	?			
Withdrawal of water from water bodies	■		■	■	■	■	■		■	■			■			
Obstruction of river flow			■	■	■	■	■	■	■			■	■			
Trenching for pipe laying	■		■				■		■	■						
Blasting in rocky terrain	■					■		■		■					■	
Movement of equipment	■									■	■					
Movement of vehicles	■		?						■	■				■		
Construction of storage sheds	■	■	■							■	■					
Setting up of labour camps	■	■	■				■									
Welding of pipes															■	
Hydrotesting of pipes				■	■			■	■							
Post construction monitoring																▒
Compensatory afforestation	▒	▒					▒									

Criteria for reviewing alternatives for least impacts during scoping

One of the essential components of a good scoping exercise is the review of all possible alternatives and options to see whether they would have greater or lesser, or different environmental effects. These alternative options may be for route alignment (for a road or pipeline) choice of technology (e.g. manual versus mechanized mining); or design features (e.g. wildlife crossings designed on nature engineering principle in the construction of a roadway through forest); mitigation options (e.g. livelihoods and resource security for community likely to be displaced by a mining project). The review of alternatives also controls the scope of work. A project located in a sensitive area would have a more focussed and much larger scope of work compared to others (Box 11).

BOX 11 **Benefits of reviewing route alternatives for optimising on time and effort during an EIA study**
(Source: Rajvanshi *et al.*, 2006)

The authorities of Bharat Petroleum Corporation Limited envisaged laying a 740 km long cross country pipeline from an existing terminal at Manglya in Central Indian state of Madhya Pradesh to another terminal located in the state of Haryana for meeting the demand of the northern region for petroleum products. Several route alternatives were reviewed before finalising the proposed route of pipeline. The finalised route reduced the demands on forest land in a linear stretch from 80 km to 18.6 km and avoided routing of the pipeline through sensitive habitats and important protected areas including the National Chambal Sanctuary that harbours the endangered species of *gharial* crocodile (*Gavialis gangeticus)* and Gangetic dolphins; the Ranthambore National Park which is famous for tigers and Keoladeo National Park which is a designated World Heritage Site. The final route was aligned through degraded patches of forest that are intensively modified due to biotic interferences. The proposed pipeline route also avoided river crossings in ecologically important zones. The selection of least impacting option obviously had significant cost implications but it simplified the scope of EIA study, facilitated early report submission and avoided delays in clearance which could have led to financial losses due to cost over runs.

This approach is commensurate with global good practices for optimising project benefits by reducing ecological risks.

Sectoral approaches for identifying issues in scoping exercise

Oil and gas

The process of scoping for assessment of impacts of oil and gas sector should consider biodiversity issues in all stages -pre bid, exploration, development, operation and decommissioning phases of the project lifecycle.

For positive planning to minimize impacts on biodiversity, several factors presented in Figure 6 can be considered to evaluate the relative importance of impacts of different pipeline route alternatives.

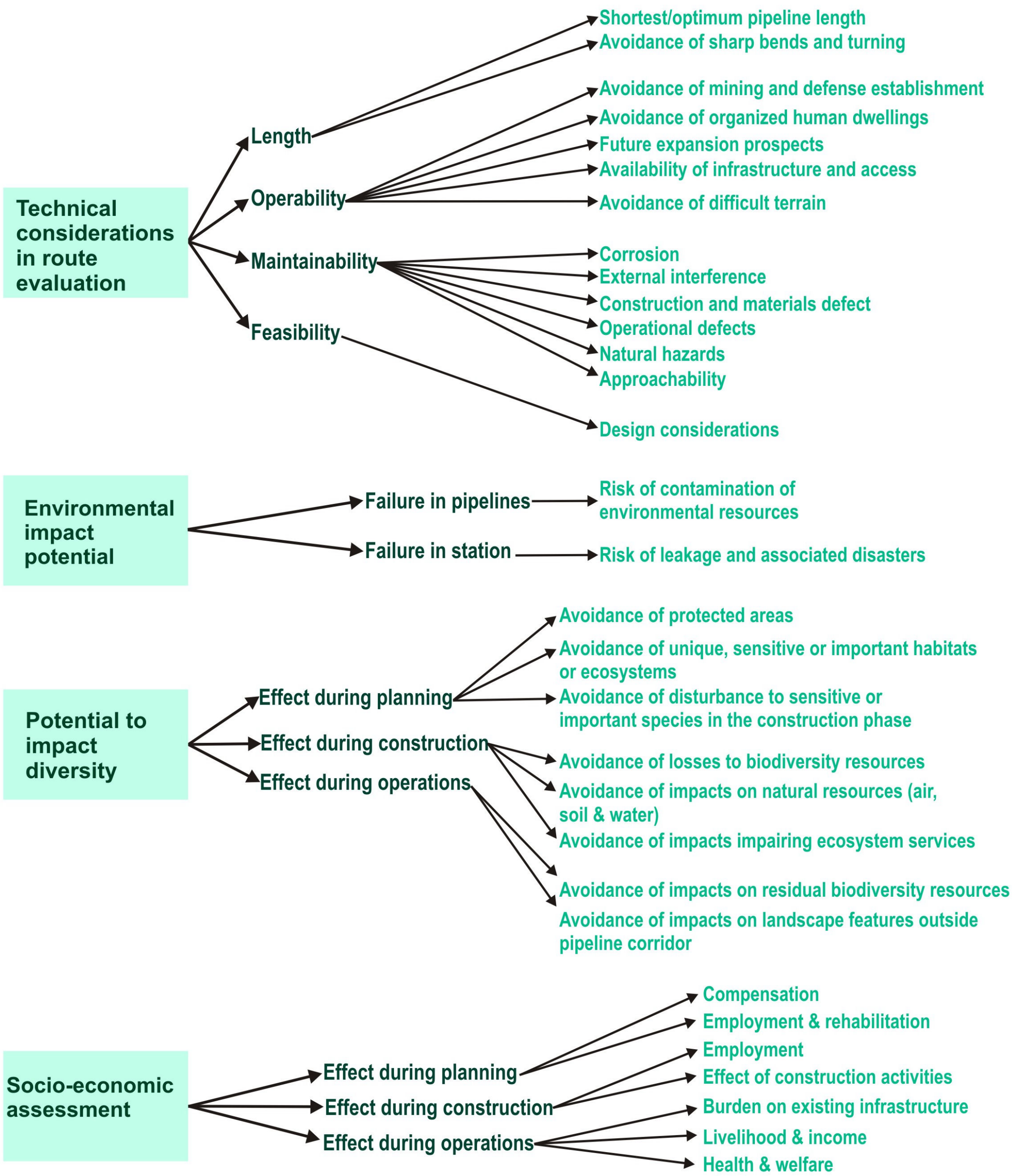


Figure 6 **Factors and criteria considered in evaluation of route alternatives**
(Source: After Dey, 2002 & WII, 2006a)

Mining

For developing scope of work for biodiversity inclusive assessment of mining projects, it is important to appreciate the many different factors that can influence the nature and magnitude of biophysical impacts. Ecological disturbance directly related to mining varies widely with the stage of mining lifecycle, methods of mineral extraction, location of the mine and requirements of other infrastructure.

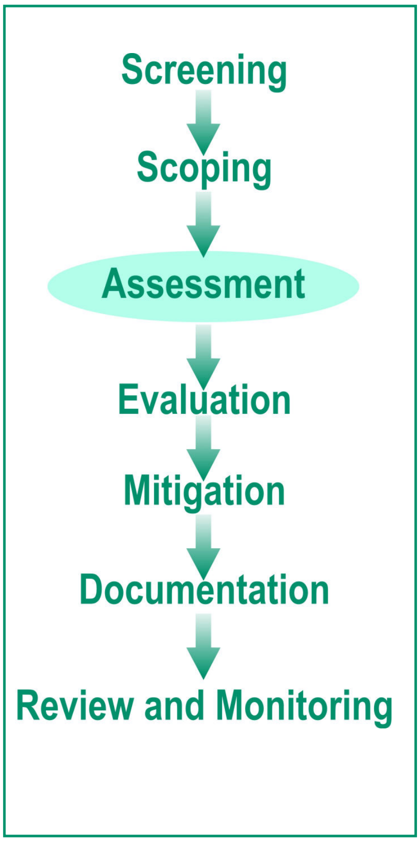
The typical lifecycle of a mining operation consists of a number of simultaneous or sequential phases and activities. For example: processing, development (including verification of the quantity and quality of ore and its amenability to various extraction and processing methods), construction, operation, product stockpiling, mineral processing, waste management, rehabilitation and eventualy, closure. This typical life span of a mine can vary from less than 1 year to 25 years and well over 100 years. Different environmental interactions and possible impacts are usually associated with each of the phases of a mine's life span. The impacts associated with each mining phase have the potential to drive environmental change in several different ways and at various scales.

- The mining size and location of infrastructure including surface facilities – haul roads, ore dumps, transport and service corridors for final products (e.g. railway lines, conveyor belts) may pose concern to biodiversity.
- Typical surface mining methods include: strip mining and open pit mining (often used in limestone, bauxite, copper and coal), as well as dredge, placer and hydraulic mining in riverbeds, terraces and beaches. These activities always disrupt the surface and this, in turn, affects soils, surface water and near-surface ground water, fauna, flora and all alternative types of land.
- For open cast pit mining operations in ecologically sensitive areas, up-front assessments should be longer and more intensive.
- Underground mining, room and pillar mining (often used in coal mines) or block caving and long wall mining methods are likely to have less severe impacts on terrestrial ecosystems.
- The assessments of offshore mining operations in intertidal, sub-tidal ecosystems are likely to have greater potential for ecological impact and therefore must aim to be more focussed to address issues linked to coastal ecology. Proposals for renewal of lease to work in existing mine will be less focused in scope than those seeking clearance for new lease.
- All types of terrestrial impact ecosystem services, especially hydrology and awailing of resources by local communities. This aspect hence needs to be examined both from ecological and economic considerations.

For quick guidance on developing scope for identifying potential biodiversity impacts associated with a mining project, Figure 7 should provide helpful clues.

POTENTIAL IMPACTS	MINING ACTIVITIES	**Exploration and construction**	Early stages of exploration	Exploration drilling	Access road construction	Land clearance (for construction, etc.)	Obtaining construction materials	Construction related infrastructure	**Construction of ancillary infrastructure**	Roads, rail & export infrastructure	Pipelines for slurries or concentrates	Energy/power & transmission lines	Water sources, wastewater treatment	Transport of hazardous materials	MINING ACTIVITIES	**Ore processing and plant site**	Plant site, materials handling, etc.	Extraction and waste rock storage	Rock blasting and ore removal	Mine dewatering	Placer and dredge mining	Ore stockpiling	Pyrometallurgical processing	Hydrometallurgical processing	Use and storage of process chemicals	Tailings containment/disposals
Impacts on terrestrial biodiversity																										
Loss of ecosystems and habitats																										
Loss of rare and endangered species																										
Effects on sensitive or migratory species																										
Effects of induced development on biodiversity																										
Aquatic biodiversity & impacts of discharges																										
Altered hydrologic regimes																										
Altered hydrogeological regimes																										
Increased heavy metals, acidity or pollution																										
Increased turbidity (suspended solids)																										
Risk of ground water contamination																										
Air quality related impacts on biodiversity																										
Increased ambient particulars (TSP)																										
Increased ambient sulfur dioxide (SO_2)																										
Increased ambient oxides of nitrogen (NO_x)																										
Increased ambient heavy metals																										
Social interfaces with biodiversity																										
Loss of access to fisheries																										
Loss of access to fruit trees, medicinal plants																										
Loss of access to forage crops or grazing																										
Restricted access to biodiversity resources																										
Increased hunting pressures																										
Induced development impacts on biodiversity																										

Figure 7 **Identification of potential impacts of mining projects** (Source: ICMM, 2005)



5.1.3 Impact assessment

This section of the guide is aimed at providing guidance on the use of ecological and economic valuation tools for predicting impacts on biodiversity values and ecosystem services. The practitioners are presented here with a wide range of choices of ecological and economic assessment tools to choose from in dealing with diverse situations and different type of information to serve as a baseline for initiating impact assessment.

The assessment stage for mainstreaming biodiversity involves:

- *Development of a biodiversity baseline against which any changes in biodiversity status, benefits and ecosystem services can be compared.*
- *Prediction of impacts affecting those important features and resources, which meet or exceed a defined threshold value, with reference to ecological processes and functions as appropriate.*
- *Review of the project, design, objectives for intended economic benefits without compromising on ecological sustainability and equitable sharing of resources for future security and well being of local communities.*

Outputs

An objective and transparent determination of the consequences of the project in all its stages in terms of local, national and regional policies and priorities relevant to biodiversity conservation.

The results of good assessments should be able to facilitate the quick and smooth transition to the next stage in the EIA process by clearly defining the nature of impacts (Box 12) and likelihood of their occurrence (with and without alternative scenarios).The soundness of the predictive phase in impact assessment guides the process of establishing the 'significance' of the predicted impacts and also aid in determining if all, some or none of the predicted impacts can be mitigated.

Box 12 Types of impacts

- direct or indirect
- positive (beneficial) or negative (harmful)
- temporary or permanent
- short, medium or long-term
- one-off, intermittent or continuous
- immediate or delayed
- avoidable or unavoidable
- reversible or irreversible
- localised or widespread
- small or large
- individual or cumulative.

Guidance for profiling biodiversity and ecological values

Development of a biodiversity baseline requires considerable efforts of collating and compiling relevant ecological data and desk study of spatial data and secondary information. This should be followed by a reconnaissance of the area to set the targets for detailed field surveys.

To exemplify, if the EIA study is targeted to evaluate species specific impacts of a typical project, the assessment should be able to provide information on:

- areas of habitat that may be lost (including breeding, feeding, refuge areas)
- habitual routes that may be severed (number and relative importance to maintenance of mobility in the landscape)
- number of individuals likely to be killed in the context of proportion of population to be disturbed
- quality of remaining habitat for key species for planning for long term solutions for conservation of the species
- ecosystem functions lost or impaired etc. (e.g. seed dispersal of plant species of economic importance).

The links between biodiversity and socio-economic features of the project area must be also carefully identified either based on outputs of earlier conducted socio-economic studies or by integrating this component in the ecological surveys.

> Good outcomes for biodiversity depend on input from ecologists at all stages in the decision-making and planning process, from the early design of a project through to its implementation.

Determine realistic zone of influence

As activities are likely to differ throughout the lifetime of a project in a specific sector, identification of key activities associated with construction, operation (best and worst-case operating conditions), decommissioning and restoration as appropriate should be the starting point for conducting assessments. The project activities may be confined to a specific area but in a number of cases, these activities may influence a larger area/zone and therefore both from ecological and economic standpoint, there is a need to determine the realistic zone of influence. As far as possible, the location of infrastructure and the distribution of the related activities should be mapped to identify landscapes, habitats and ecosystems and resources along with the effected human population (both on and off-site because of the nature of ecosystem services) and links with them within the zone of influence.

The purpose of this is to determine and define the spatial and conceptual boundaries of the impact assessment – the scope and limits of the assessment. In order to understand the impacts of different project scenarios, however, there is a need to first understand what is the baseline regarding biophysical status, linkages to the provision of ecosystem services, economic benefits and the distribution of benefits. Thus the determination and definition of the spatial and conceptual boundaries serves a key role as this will be the basis of developing and establishing a biodiversity baseline against which any changes in biodiversity status, ecosystem services and economic and livelihood benefits can be compared.

The preparatory phase should begin with integration of all relevant information using topographic data, site map, remotely sensed data, biodiversity profile (based on secondary information, local knowledge and, reconnaissance) and where possible, developing GIS based overlays for 'with' and 'without' project scenarios for initial visualization of worst case and best case scenarios for biodiversity. With the delineation of the impact zones for different scenarios, it is possible to undertake refining of methodologies and planning of schedules for conducting more intensive studies. Examples pertinent for adopting this approach of evaluating 'least impacting' alternatives include proposals of dams with variable height options or different routing of roads through forest areas to ensure least damage to habitats of endangered species and minimal disruption of movement corridors of large mammals.

Determine - what to measure?

The starting point for any assessment is to determine which ecological features or resources within the zone of influence are both of sufficient value to be included in the assessment and are vulnerable to significant impacts arising from the project. The determination of value should make use of the guidance in previous subsection 'scoping'. Knowing exactly which biodiversity components to choose from different options may pose difficulties. Similarly, deciding what attributes or features are best to consider is difficult unless performance can be linked to ecosystem functions and biodiversity conservation objectives. The fundamental purpose is to assess the relationship between baseline biophysical status, and the provision of related ecosystem services. This step of the framework seeks to answer the basic question of what, if any, ecosystem services are delivered by the land use and land cover characteristics of a given ecosystem baseline scenario. This biophysical assessment will be important in the later steps to compare the baseline scenario with project alternative scenarios that involve changing land and resource use in a given ecosystem, and attempts to establish how these will impact on ecosystem services.

This obviously necessitates the use of indicators that could be **ecological** (e.g. absence, presence, distribution and abundance of organisms, and size of populations as a measure of ecological state of environment); **evaluative** (indicators that can be correlated with factors perceived to be of value e.g. measure of habitat quality to estimate the conservation value of a site); **performance-related** (they providing the means to judge performance in achieving the aims of a strategy or plan (e.g. CBD 2010 targets or the Millennium Assessment targets); **economic** (providing a measure of economic sustainability and community well being (e.g., income from biodiversity goods and services, food security, shelter).

The objective is to use a limited number of robust indicators, so that the key conclusions are apparent. The challenge is to strike a balance - the number of indicators should be small to minimize data collection requirements without over-simplifying the analysis. Ideally (see Box 13) indicators should:

- Be responsive to an identified assessment question and provide information useful to a management decision.
- Provide information that is relevant to societal concerns about ecological condition.

BOX 13 **Criteria for effective indicators** (Source: Millennium Ecosystem Assessment, 2005)

An effective ecological indicator should:

- Provide information about changes in important processes.
- Be sensitive enough to detect important changes but not so sensitive that signals are masked by natural variability.
- Be able to detect changes at the appropriate temporal and spatial scale without being overwhelmed by variability.
- Be based on well-understood and generally accepted conceptual models of the system to which it is applied.
- Be based on reliable data that is available to assess trends and is collected in a relatively straightforward process.
- Be based on data for which monitoring systems are in place.
- Be easily understood by policy-makers.

There are various characteristics that can be used to identify ecological resources or features likely to be important in terms of biodiversity. These include:

I. Ecosystem components (genes, species and populations), of 'importance' and established conservation values (for criteria refer box 5 to 8 in subsection on 'Scoping') to be included in the assessment.

Conducting genetic studies *per se* for determining impacts of the development projects at the genetic level is both extremely difficult and not feasible within the time frames in which EIA studies are generally conducted. The biodiversity inclusive assessments must therefore attempt to addressing the risk of genetic erosion specially for highly threatened or legally protected species in the wild; varieties/cultivars/breeds of cultivated plants and domesticated animals and their relatives; species which are limited in numbers and/or have highly separated populations (rhinoceros, tigers, etc.); ecosystems that may become isolated and obstruct gene flow (this applies to many species that depend on construction of so-called eco-ducts across major line infrastructure). Introduction of living modified organisms that can transfer transgenes to legally protected varieties/cultivars/breeds of cultivated plants and/or domesticated animals and their relatives is another useful indicator for the evaluation of impacts at a genetic level.

Selection of species for representing biodiversity should generally take into consideration animal or plant species that have restricted distribution ranges; occupy specialized habitats (e.g. Himalayan musk deer); are endemic to an area (e.g.), locally distinct sub species (giant squirrel in Western Ghats); are already vulnerable on account of existing threats to its habitats; have small isolated populations (e.g. lions in India) and are rare or uncommon, either internationally, nationally or locally. The species selection can be best guided by a list of nationally protected species under country law as these would represent species that command highest conservation priority at the local level. Additionally, the policy documents like Biodiversity Action Plans should be useful in prioritizing species recommended for conservation action. For a globally and regionally important species, IUCN Red List should serve as a good guide to species selection. Experience suggests that significance of species specific impacts of development projects have been the exclusive factor guiding the environmental decision-making (Box 14).

BOX 14 Examples of species specific issues in impact assessment

1. The Indian wild buffalo is an endangered species listed in Red Data Book (IUCN, 1994). It is found in four relict populations in Bastar district of Chattisgarh in India. One of the populations is found in Bhairamgarh Sanctuary. The ecological impact assessment of the Bodhghat hydropower project proposed in Bastar identified that the flooding of the river bed grasslands during the water release at the peaking hours (8 pm and 11 pm) would be one of the direct impacts of the project on wild buffaloes in Bhairamgarh Sanctuary. It was feared that the loss of foraging habitat of wild buffaloes in summer when such river bed grasslands offer critical food resource would cause significant impacts on wild buffalo populations. These threats to species conservation posed by the project proposal led to the rejection of the project even after substantial progress was made in the construction activities (Rajvanshi, 2002).
2. On the directives of Ministry of Environment and Forests, Govt. of India, stand alone biodiversity assessments have been conducted by the Wildlife Institute of India to complement the EIA studies that were found lacking in full integration of impacts of mining projects on lions. Based on these subsequent studies, final decision on renewal of lease for limestone mine could be taken (Jhala et al., 2005).
3. Significance of impacts of iron ore mining on elephants and their habitats in Singbhum forest area in Bihar state was reckoned as a major factor in the evaluation of proposals for grant of fresh lease to iron ore mine in the elephant rich area (MoEF unpublished sources).

II Ecosystems and habitats that merit high conservation importance

These include habitats that are critical for survival of rare and endangered species; or perform critical functions such as routes for migration, dispersal and genetic exchange of wild species; serve as buffer areas of designated conservation units such as national parks and habitats suitable for reintroduction of species in alternative habitats (Box 15).

BOX 15 **Example of special studies commissioned for evaluating impacts of oil and gas development on turtles in Indian ocean** (Source: WII, 2006b)

The east coast of India is the only known globally important Olive Ridley sea turtle breeding congregation site in the offshore waters and the largest *arribada* (mass nesting) site. These turtles are also known to be the global source population of the Ridley turtles. The breeding season of turtles coincides with the fishing season and calm sea situation from October to April. The area is also a potential repository of the black gold (oil and gas) and therefore of great economic interest to oil and gas companies, both national and international, for exploration and economic development.

Sea turtles fulfill important ecological functions in marine environment in that they transport energy from highly productive marine habitats such as the seagrass beds to energy poor habitats such as sandy beaches and the energy derived from sea turtles and their eggs facilitates animal and plant populations in terrestrial habitats, away from the nesting beach through the processes of depredation and detritus recycling.

There is a need to devise an environment management strategy in which the seismic activities associated with oil and gas exploration by the industry are planned and executed outside the season, when mating aggregations of male and female turtles and the laying females are associated with the nesting beaches. Similarly, the effects of seismic discharges on behavioural aspects of a range of marine species also need to be taken into account during the oil exploration.

In a landmark development in August, 2006, the Directorate General of Hydrocarbons (DGH), which is the Oil Regulator in India, has agreed to sponsor a 3-year satellite telemetry study for determining the offshore distribution, mitigation and movement of Olive Ridley sea turtles along the east coast of India at a total cost of US $ 77,000. Using 70 Satellite Link Time Depth Recorder Transmitters (SLTDRs) on male and female Ridleys and observational studies, this endeavour would generate vital information on reproductive congregations and trace the precise movement patterns in the coastal waters and will also provide data on their biology and critical marine habitat requirement during breeding and non-breeding seasons. This information will be used in planning and executing seismic operations so that ‘no or least damage’ occurs to the marine environment and the Ridley turtles.

Indicators of habitat structure provide an assessment of the combination of factors, including land fragmentation, reduction of habitat and other biotic factors that could be a possible reason for thinning of species due to changes associated with the specific activity or stage in lifecycle of the impacts of development projects. Other evaluative indicators such as habitat size, quality and integrity can help establish the factors affecting the functional role of the habitat components or ecosystem (e.g. cover value for ground dwelling herbivorous species; canopy contiguity for arboreal species using the canopy for gliding between habitats across road or rivers; migratory corridor for large endangered species of mammals; wetlands function and quality for migratory species; quality of coastal habitats utilized by endangered species of turtles for breeding).

Assessment of magnitude and nature of impacts on habitat features and functions thus provide adequate guidance for determining the significance of impacts to suggest a ‘no go’ option or alternatively, suggest appropriate mitigation strategies for timely action for conservation (Box 16 & 17).

BOX 16 **Impact of a highway on habitat of Malabar giant squirrel** (Source: WII, 1998)

The Mumbai Pune Expressway was proposed to divert about 60% of the existing traffic of the National Highway (NH-4) that connects Mumbai with Pune in Maharashtra State of India. The alignment alternatives were evaluated in terms of gradient, construction cost, feasibility and environmental acceptability. The alternatives however ignored the fact that the section of the highway passes through the Western Ghats, one of the two biodiversity hotspots located in India. The focused assessments for biodiversity identified that the expressway alignment is a home to a large number of highly endangered species that are protected under the federal law. The most significant impact of the expressway alignment that was identified was the disruption of the contiguity of canopy cover for Malabar giant squirrel due to land take and deforestation activities on the road alignment. The mitigation planning focused on securing the link in canopy cover through the construction of tunnels in vulnerable sections along the expressway route. A series of 11 tunnels were constructed to ensure habitat connectivity on either side of the expressway. Similarly, underpasses over natural drainage channels were constructed along lower slopes and valleys, which are the key habitats for this endangered species.

BOX 17 **Weak EIAs leading to inadequate mitigation**

Unocal, the global US-based energy company, is planning to lay the 26 km long pipeline through the Lawachhara Reserved Forest to connect the Moulvibazar gas field to the national grid in Bangladesh. Lawachhara National Park, a 1250 ha forest patch, is part of the West Bhanugachh Reserved Forest. It is a home to diverse plant species, Hoolock Gibbon, a threatened primate species, as well as many species of birds.

A gas explosion at Magurchhara occurred in 1997 following a similar kind of development undertaken by predecessor of Unocal. This resulted in severe ecological imbalance of the area as the water streams got silted with earth that had fallen from nearby hillocks. This created a concern among environmentalists and conservation groups, who feared that the installation of the pipeline will destroy wildlife habitat and biodiversity of the Reserved Forest.

Given that the project had a high potential of impact, this project merited a detailed EIA. Instead, only an Initial Environmental Examination was conducted which was also found to be weak and lacking in incorporating adequate ecological safeguards and in incorporating the views of the local people who inhabit the area in Magurchhara Khasi Punji and the Lawachhara Khasi Punji (villages) and who suffered enough damage from the earlier incidence of explosion (Press clipping. New Age, June 7, 2004).

III Landscape features

Many landscape features such as rivers with their banks, waterfalls, river delta, mudflats, sand dunes, caves, and site characteristics that may be altered by the proposed developments serve as unique or specialized habitats.

IV Ecosystems critical for maintaining ecological services

Tools and techniques for ecological assessment

Field surveys should be designed to inventory biodiversity in the study area defined at the scoping stage, using standard learning resources and identification guides. For sites where the presence of protected or rare plant species is the main issue of interest, a detailed survey of the species distribution and abundance would be more appropriate than undertaking a general survey of the plant communities present. For animal species, methods specific for different groups should be used as appropriate. It is beyond the scope of this guide to discuss survey techniques and the user is referred to Appendix – VIII for a list of guidance sources. Good survey practices must however ensure adequate geographic coverage and appropriate timing, duration and frequency of survey for capturing important lifecycle events, processes and phenomenon (e.g., breeding and nesting, migration, fruiting, flowering). The field surveys should also take into account availability of existing information, types of habitats affected, types of potential impacts and significance of seasonal variations for assessment of impacts. At a global level birds and amphibians are emerging as relatively reliable indicators of ecological change and habitat characteristics. Literature also suggests the use of fish communities for assessment of biotic integrity (Karr, 1981). However it is important to select indicators that match the biodiversity context for the proposal.

It is presumed that Practitioners will have basic map-reading skills and be familiar with use of ecological models. In some cases (and depending on resources), GIS and remote sensing techniques may be useful to analyse spatial data for prediction of impacts. Detailed advice about these techniques is not provided here. Several existing agencies in South Asia can provide useful contacts for information on varied aspects of biodiversity. Information about the mandate, role, achievements and outputs of key institutes in South Asia will be soon loaded on the website of the Wildlife Institute of India (www.wii.gov.in)

Guidance for integrating ecological, economic and livelihood aspects

The integrated assessment methodology presented in Section 1 requires consideration of how biodiversity can be sustained as the basis for provision of ecosystem services and the support of livelihoods. The fundamental concept is to understand the relationship between the biophysical status of ecosystems (and biodiversity), the provision of ecosystem services and links to economic and livelihood uses and benefits for different groups. In such a framework, the assessment process provides pathways to deciphering how ecological impacts manifest and culminate in economic and livelihoods impacts. The economic and livelihoods aspects, as part of the integrated assessment methodology, are provided below for the practitioners in easy to follow steps.

I Identifying baseline ecosystem services benefits and beneficiaries on-site and off-site

In this step, the provision of relevant ecosystem services from ecosystems as determined through assessment process so far are linked to the benefits and beneficiaries of ecosystem services both on-site and off-site. Therefore, in this step main uses and users of ecosystem services are identified for impact assessment. By selecting the main benefits and beneficiaries, the data requirements can become less onerous, and the valuation can be focused and more meaningful for decision-makers.

Data requirements

Information required for valuation of benefits needs to consider all inputs and outputs for main benefits from economic activities that are either *directly* or *indirectly* supported by the ecosystem services. This will include:

- Economic costs of the inputs (e.g., labour-time, materials, physical assets)
- Prices of the outputs (products such as fish, non wood forest products including medicinal herbs, fuel wood, timber, etc.).

- On the inputs, a distinction needs to be made between purchased inputs (e.g., tools, hired labour) and non-cash inputs (e.g., use of their own or family labour and borrowed tools).
- Similarly, distinction must be made between outputs that are marketed (e.g., rice sold at the local market) and those that are non-marketed (e.g., fish eaten at home).
- Information is required on the producer prices, the final market prices and the transportation and other intermediary costs of marketed products.
- For non-marketed products, it may be necessary to know their rates of consumption, and it may be helpful to obtain information on the market price of any substitute or alternative product.

In this step the appropriate valuation techniques should be selected and applied. Although, some general guidance on economic valuation is presented in Box 18, the detailed guidance for determining the total economic value of ecosystems using specific valuation methods, data needs and the analysis of the applicability, strength and weaknesses of each valuation method is presented later in this section. There are many sophisticated techniques, such as contingent valuation and hedonic pricing, which are being applied all over the world to value ecosystem services. These techniques however, may not always be appropriate in developing countries. Although alternative approaches are available, some of these may yield extremely inaccurate valuation estimates. Care must therefore be exercised in choosing a technique which is theoretically sound but which is also appropriate to the circumstances where it will be applied.

BOX 18 Some general guidance on economic valuation

- Start with the most obvious and easily valued ecosystem services. First select the benefits that have direct use values and can be valued by market prices. When market prices cannot be used directly, participatory environmental valuation (see below) or surrogate market prices should be used. Then move to more advanced valuation techniques such as effect on production and others.
- Look at both the benefit and cost sides. A clear distinction should be made between benefits and costs, as these will be the baseline from which changes are measured. For instance, the value of a regulation structure should include, from the cost side, the capital operations and maintenance costs; and from the cost avoided side, the benefits of reduced flooding downstream.
- All assumptions in the economic analysis should be stated clearly.
- Detailed financial and economic analysis should be carried out to determine net values, and to which economic actors.

Outcome

- This step provides information about the value of ecosystem services in different uses and for different users.

II Understanding baseline livelihoods on-site and off-site

This step helps to understand the baseline livelihoods status and on-site and off-site livelihood benefits to local communities that are ecosystem services dependent. Box 19 provides an example of link between livelihood benefits and the development proposal. For this step, detailed data is collected on livelihood assets and strategies *via* questionnaires and individual/group interviews. This should include both quantitative and qualitative information on the type, output and seasonality of livelihood activities at different times and for different groups. Care should be given to cover a representative sample of the population, which includes different socio-economic groups and pays particular attention to more marginal members (the poor, landless, women and unemployed).

BOX 19 **Example of impacts on resources of economic importance** (Source: Shiva & Jafri, 1998)

The aromatic scent distilled and extracted from the *Kewra* (*Pendanus fascicularis*) flowers is in high demand in perfumery industry. This makes *Kewra* a perennially lucrative source of income for the local people inhibiting the site that was initially proposed for Tata's steel plant at Gopalpur in Orissa State of India. The collection of flower and distillation provides livelihoods to thousands of families in the region. It was anticipated that the proposal of a steel plant of Tata Iron and Steel Company (TISCO) would lead to an estimated loss of 3.6 million flowers annually valued at 400,000 USD. This vibrant natural self sustaining real economy will perish once TISCO succeeds in acquiring 500 acres of land for the steel plant.

Data requirement

- Off-farm and migration income sources.
- Total agricultural land area
- Land cultivated under different crops in different seasons.
- Quantity of agricultural production per crop per season, including quantity consumed and sold.
- Livestock size and annual sales of livestock per annum.
- Livestock products, including quantity consumed and sold.
- Other types of livelihood and income generating activities, quantity produced and sold.

A combination of statistical records and participatory assessment techniques can be used to determine the size of the population, their socio-economic composition, main livelihoods, and social and economic relations within the ecosystem and in terms of linkages with ecosystem services. Detailed interviews should yield information on land and resource tenure; social relations; livelihood and coping strategies; cause of vulnerability and stress; and perceptions of changes in livelihoods and ecosystem management over time.

Participatory environmental valuation techniques can be used to calculate the economic value of ecosystem (provisioning) services to local livelihoods for different local groups, and to quantify the relative worth and importance of different livelihood components. This involves ranking and quantifying the relative importance of different livelihood components in terms of a locally-important wealth indicator which is convertible in monetary terms by undertaking to:

- List main ecosystem products and their uses by local communities.
- Derive the quantity of ecosystem products collected in different seasons.
- Agree on an indicator of value that is relevant to the household/village, which can be easily translated into cash amount and has local and individual value.
- Rank the ecosystem product according to their economic importance, and relative to the locally important indicator of value.
- Deriving a price of each product in relation to the indicator value.

Distributional analysis should be carried out to assess the magnitude and composition of household livelihood values for different community members at different times, and to assess the contribution of ecosystem resources to livelihoods. Qualitative information can provide an analysis of the social, cultural and institutional underpinnings of ecosystem, land and resource use and management.

Outcome

This component provides an understanding of the nature and dynamics of livelihood assets and strategies in the select on-site and off-site areas. Quantified baseline information about the livelihood benefits for different socio-economic groups is expressed as monetary values, and against this, change is measured.

III Assessing changes in ecosystem services (on-site and off-site) under alternative project scenarios' biodiversity and ecosystem-related impacts

This step begins by defining alternative project scenarios for the impact assessment. These scenarios are defined by a combination of analysis of present situation and proposed project interventions, as well as consultation with experts and stakeholders. The implications of each of these alternative project scenarios for the ecosystem land and resource status, land and resource use options, changes to the provision of ecosystem services and economic and livelihood benefits should also be determined. In general, there should at least be four (Figure 8) alternative project scenarios defined: which at the least should include with and without project scenarios.

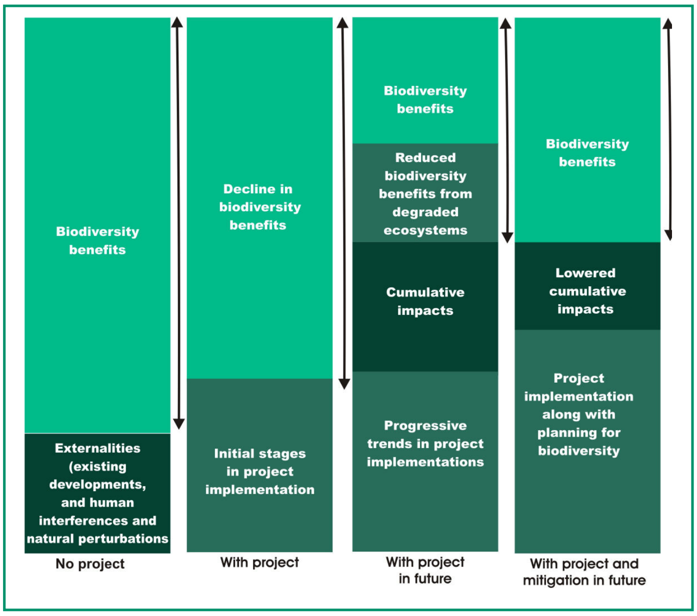


Figure 8 Change in biodiversity benefits

Detailed assumptions about biophysical, socio-economic and institutional variables, and their likely change over time, are then made and listed for each scenario, based on consultation with local communities and experts and stakeholders. Ascertaining a baseline is integral to modelling alternative project scenarios. The key question when modelling the scenarios is – *to what extent the provision of ecosystem services will be impacted by plausible land and resource changes ?* The results from this assessment feed into the next step.

Outcome

- Assessment of changes in biophysical status and the changes in the provision of ecosystem services.

IV Analysing economic, financial and livelihood impacts and tools under alternative project scenarios

In this step, the changes to the provision of ecosystem services under alternative project scenarios to different uses and users are economically valued. A simple spreadsheet model can be compiled which describes the baseline situation in terms of the relative benefits of baseline biophysical status and provision of ecosystem services and benefits for different groups. This brings together the information gathered via the biophysical, economic and livelihood assessments. The spreadsheet model should set an appropriate time frame to model cost and benefit streams over the next years in order to establish the net present value of this scenario: overall, and for each of the main stakeholder groups (economic actors, ecosystem services dependent communities, etc.).

The spreadsheet model should then be applied to yield a net present value for each of the alternative project scenarios, taking into account the changes in costs and benefits implied, and in their distribution, including changes in:

- ecosystem services arising from changes in land use and land cover, as reflected in changes in the value of ecosystem services availability and use
- benefits for different groups (including changes in livelihood benefits)
- negative impacts from potential overuse by local dependents of the residual areas within the affected areas leading to enhance degradation.

For each of the alternative project scenarios, a gap analysis should be carried out to weigh up the relative costs and benefits for different groups, and between upland land and resource users and ecosystem services users.

Outcome

This analysis points to the overall costs and benefits of alternative project scenarios for different groups, and highlights the incremental cost or benefit of changing the biophysical status of a particular ecosystem. This permits analysis of the relative financial and economic worth of different options of project scenarios. Gap analysis of the magnitude, extent and discrepancy between costs and benefits for different groups points towards cases where economic or financial compensation/transfers may be needed, or enabled, to better or more equitably balance the costs and benefits of changes to the biophysical status to support a desired project outcome.

Overview of valuation methods[1]

There has been increasing emphasis and evolution of economic valuation techniques to quantify the diversity of ecosystem economic costs and benefits (or economic values) and expressing these in monetary terms. While the techniques for valuing environmental products and services dates back to the 1970s, these techniques only began to enter into mainstream environmental economics and become widely applied to biodiversity and ecosystems and their components towards the end of the 1980s. Over time, several manuals and overviews of the application of economic valuation techniques to ecosystems (Dixon *et al.*, 1994; Munasinghe, 1994; CNPPA, 1995; Phillips, 1998), and their goods and services (Aylward, 1991; Barbier, 1991; Winpenny, 1991; Pearce, 1992; Spurgeon & Aylward, 1992; Pearce & Moran, 1994; Bann, 1997; Barbier *et al.*, 1997; Rietbergen-McCracken & Abaza, 2000;) have been produced. These publications outline a wide range of methods for valuing both market and

[1] This sub-section is modified from Emerton & Bos (2004).

non-market ecosystem products[2] and services, the most often used of which can be broadly categorized into five main groups (Figure 9).

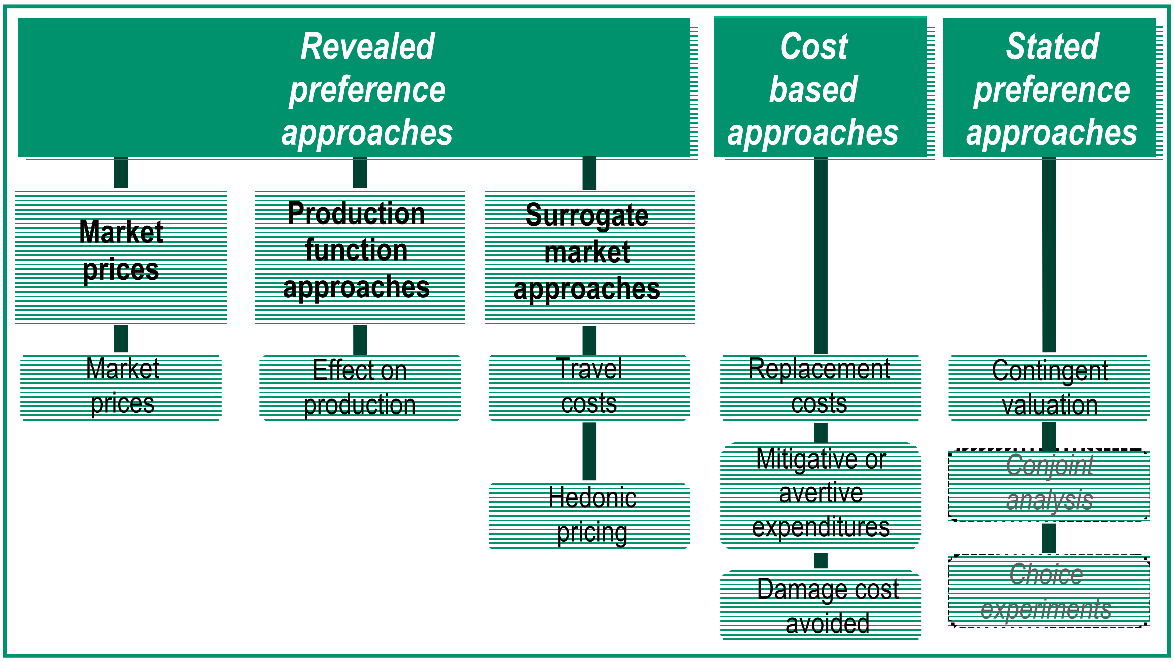


Figure 9 Categories of commonly used ecosystem valuation methods (Source: Emerton & Bos, 2004)

At a generic level, a key distinction that is made between these different valuation methods is between techniques that produce estimates based on market prices and those that estimate economic values. What that means is that market-based approaches – using market prices - are normally easier to apply and are less time consuming, but only estimates derived from stated preference approaches can in theory be said to represent the true economic value, which includes consumer surplus[3]. The market-based approaches use only the market price for an ecosystem product and do not capture the actual willingness to pay.

- **Market prices:** This approach uses the market price of ecosystem products and services.
- **Production function approaches:** The production function approaches are used to estimate the economic value of ecosystem products or services that contribute to the production of commercially marketed goods. It is applied in cases where the products or services of an ecosystem are used, along with other inputs, to produce a marketed good
- **Surrogate market approaches:** These approaches, including travel costs and hedonic pricing, look at the ways in which the value of ecosystem products and services are reflected indirectly in people's expenditures, or in the prices of other market goods and services.
- **Cost-based approaches:** These approaches, which include the damage cost avoided, replacement cost, and substitute cost methods are related methods that estimate values of ecosystem services based on

[2] Ecosystem products in this document cover provisioning services as defined by the MA.
[3] Consumer surplus is the difference between the price consumers are willing to pay and the actual price. If someone is willing to pay more than the actual price, their benefit in a transaction is how much they saved when they didn't pay that price

either the costs of avoiding damages due to lost services, the cost of replacing ecosystem services, or the cost of providing substitute services.

- **Stated preference approaches:** The contingent valuation method is referred to as a "stated preference" approach, because it asks people to directly state their values, rather than inferring values from actual choices, as the "revealed preference" methods do. The most well-known technique is of course contingent valuation, while less commonly used stated preference valuation methods include conjoint analysis and choice experiments.

For the specific purpose of valuing regulating, supporting and cultural ecosystem services some methods are better suited than others. As illustrated in Figure 10, the methods most widely used when assessing watershed services and carbon sequestration fall under the categories of production function and cost based approaches whereas biodiversity conservation including landscape beauty and recreation often make use of the travel cost and contingent valuation methods.

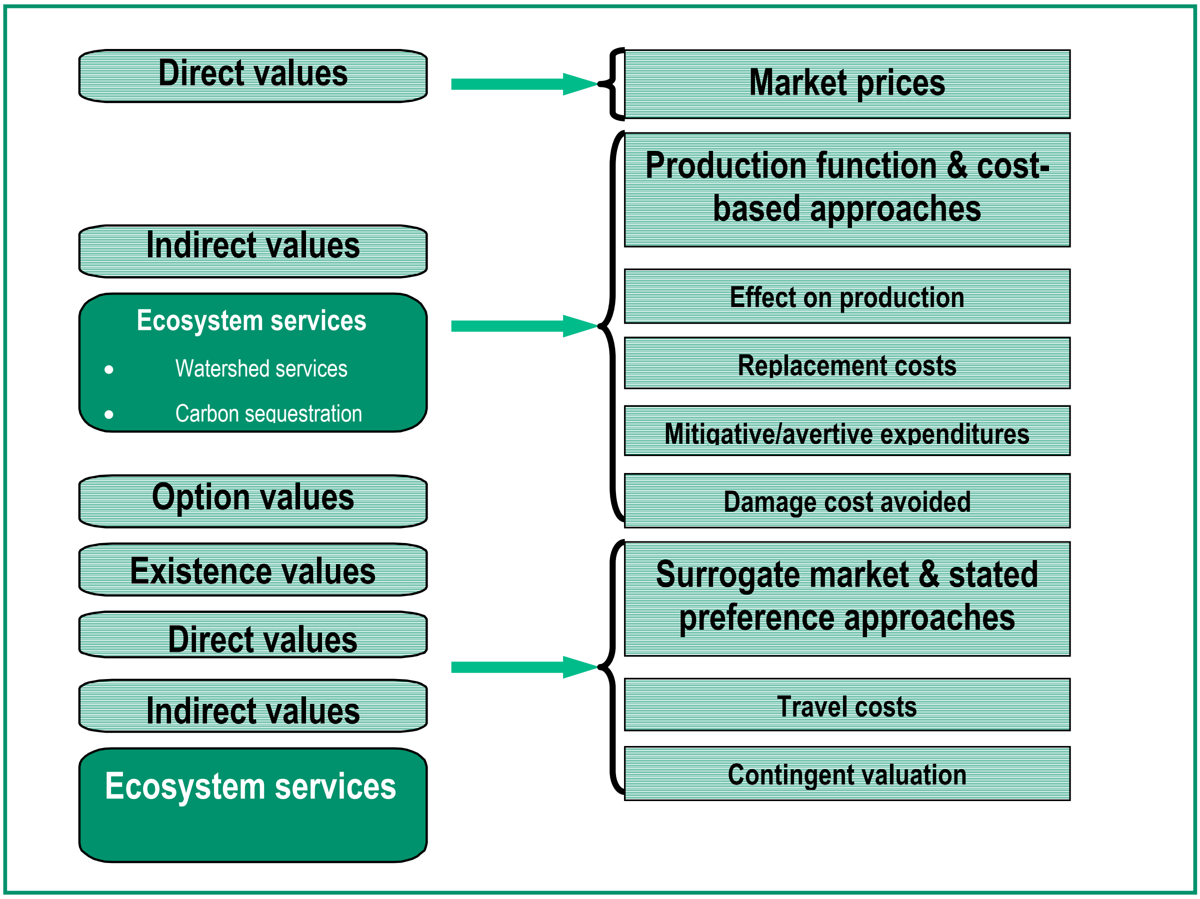


Figure 10 Linking valuation methods to ecosystems goods and services
(Source: Emerton & Bos, 2004)

The following methods that are best suited for valuing ecosystem products and services are presented in more detail.

Revealed preference approaches

i. Market price

The simplest, most straightforward and commonly used method for valuing any ecosystem product or service is to look at its market price: how much it costs to buy, or what it is worth to sell. In a well-operating and competitive[4] market these prices are determined by the relative demand for and supply of the good or service in question, reflect its true scarcity and equate to its marginal value[5].

In theory, market price techniques are applicable to any ecosystem product or service that can be freely bought or sold. They are particularly useful for valuing the resources and products that are harvested from ecosystems, for example timber, fuel wood, fish, or non-timber forest products (Box 20).

BOX 20 **Using market prices to value fuel wood and fodder use in Pakistan** (Source: Khalil,1990)

This study used market prices to value the goods yielded by mangrove ecosystems in the Indus River Delta, Pakistan. Fuel wood and fodder use rates by adjacent villagers were assessed and quantified, and values were ascribed according to prevailing commodity prices (kerosene and purchased fodder) in local markets. The study showed that daily household use of mangrove wood is about 4.5 kg, economic value of mangrove fuel wood is estimated to be USD 3,70,571.81 per year, fodder consumption per animal unit is 3.82 kg/day, of which 1.22 kg are mangrove leaves, price of mangrove fodder averages Rs 1.25 per kilo, annual value of mangrove fodder at about USD 42,162.84.

ii. Effect on production techniques

Even when ecosystem goods and services do not themselves have a market price, other marketed products often rely on them as basic inputs. For example, downstream hydropower and irrigation depend on upper catchment's protection services, fisheries depend on clean water supplies, and many sources of industrial production utilize natural products as raw materials. In these cases it is possible to assess the value of ecosystem goods and services by looking at their contribution to other sources of production, and to assess the effects of a change in the quality or quantity of ecosystem goods and services on these broader outputs and profits.

Effect on production techniques can thus be used to value ecosystem goods and services that clearly form a part of other, marketed, sources of production. Effect on production techniques rely on a simple logic, and it is relatively easy to collect and analyse the market information that is required to value changes in production of ecosystem dependent products (see above, market price techniques).

The most difficult aspect of this method is determining and quantifying the biophysical or dose-response relationship that links changes in the supply or quality of ecosystem goods and services with other sources of production. For example, detailed data are required to relate deforestation to a particular rate of soil erosion, consequent siltation of a hydropower dam and reduced power outputs.

[4] A market can be said to be competitive when there are a large number of buyers and sellers, there are no restrictions on market entry, buyers and sellers have no advantage over each other, and everyone is fully informed about the price of goods in current transactions.
[5] Marginal value is the change in value resulting from one more unit produced or consumed.

Specifying these kinds of relationships with confidence usually involves wide consultation with other experts, and may require situation-specific laboratory or field research, controlled experiments, detailed modelling and statistical regression.

iii. Travel cost techniques

Ecosystems often hold a high value as recreational resources or leisure destinations. Even when there is no direct charge made to enjoy these benefits, people still spend time and money to visit ecosystems. These travel costs can be taken as an expression of the recreational value of ecosystems. We can use this technique at the whole ecosystem level, taking into account all of its attributes and components in combination, or for specific goods or services such as rare wildlife, opportunities for extractive utilization of products such as fishing or resource collection, or for activities such as hiking that are related to its services.

Travel cost techniques depend on a relatively large data set. Quite complex statistical analysis and modelling are required in order to construct visitor demand curves. Basic data are usually collected via visitor interviews and questionnaires, which make special efforts to cover different seasons or times of the year and to ensure that various types of visitors from different locations are, represented (Box 21).

BOX 21 **Using travel cost method to value Dhaka Zoological Gardens in Bangladesh**
(Source: Shammin, 1999)

The travel cost method was applied to value Dhaka Zoological Gardens in Bangladesh. This was done by administering a questionnaire to visitors which collected data on origin, distance travelled, income and expenses. Several demand curves were constructed using regression analysis to describe the relationship between travel costs and number of visits, yielding information on willingness to pay per visit. The results showed that:

1. People's average willingness to pay (WTP) for the services and attributes of Dhaka Zoo = Tk. 300.64/per visitor/day
2. Average number of visitors per day = 11,743
3. Total number of visitors per year = 4,286,195
4. Yearly revenue from gate ticket = Tk. 21,430,975
5. Yearly WTP by consumers based on this study = Tk. 1,288,601,665
6. Yearly WTP by consumers for the features and services per acre of land in the zoo = Tk. 6,021,503

Cost-based approaches

i. Replacement cost techniques

It is sometimes possible to replace or replicate a particular ecosystem good or service with artificial or man-made products, infrastructure or technologies. For example, constructed dykes can replace the protection services provided by mangrove forests, sewage treatment plants can replace wetland wastewater treatment services, and many natural products have artificial alternatives. The cost of replacing an ecosystem good or service with such an alternative or substitute can be taken as an indicator of its value in terms of expenditures saved.

Data collection is relatively straightforward, and usually relies on secondary information about the benefits associated with a particular ecosystem good or service and alternatives that are available to replace it. In most cases this can be ascertained through expert consultation and professional estimates, supplemented with direct observation (Box 22).

BOX 22 **Using replacement costs techniques to value wetland water quality services in Nakivubo swamp, Uganda** (Source: Emerton *et al.*, 1999)

This study used replacement cost techniques to value the wastewater treatment services provided by Nakivubo Swamp, Uganda. Covering an area of some 5.5 km^2 and a catchment of over 40 km^2, the wetland runs from the central industrial district of Kampala, Uganda's capital city, passing through dense residential settlements before entering Lake Victoria at Murchison Bay.

The study looked at the cost of replacing wetland wastewater processing services with artificial technologies. Replacement costs included two components: connecting Nakivubo channel to an upgraded sewage treatment plant which could cope with additional wastewater loads, and constructing elevated pit latrines to process sewage from nearby slum settlements. Data were collected from the National Water and Sewerage Corporation, from civil engineering companies, and from a donor-funded water supply and sanitation project that had been operating in a nearby urban wetland area. It also took into account the fact that some level of intervention would be required to manage Nakivubo more efficiently for water treatment, mainly through extending and reticulating the wastewater channels that flow into the swamp. These costs were deducted when wetland benefits were valued. The study found that the infrastructure required to achieve a similar level of wastewater treatment to that provided by the wetland would incur costs of up to US$2 million a year in terms of extending sewerage and treatment facilities.

ii. Mitigative or avertive expenditure techniques

When an economically valuable ecosystem good or service is lost, or there is a decline in its quantity or quality, this almost always have negative effects. It may become necessary to take steps to mitigate or avert these negative effects so as to avoid economic losses. For example, the loss of upstream catchment's protection can make it necessary to de-silt reservoirs and dams, the loss of natural predators requires the extensive use of pesticides, and the loss of ecosystem flood control may require the construction of flood control barriers. These mitigative or avertive expenditures can be taken as indicators of the value of maintaining ecosystem goods and services in terms of costs avoided (Box 23).

BOX 23 **Using mitigative or avertive expenditure techniques to value wetland flood attenuation in Sri Lanka** (Source: Emerton & Kekylandala 2002)

This study used avertive expenditure techniques to value the flood attenuation services of Muthurajawela Marsh in Sri Lanka. Muthurajawela is a coastal peat bog which covers an area of some 3,100 hectares, running alongside the Indian Ocean between 10 - 30 km north of Colombo, Sri Lanka's capital city. One of its most important functions is its role in local flood control.

The study first involved investigating the biophysical characteristics of the marsh, and their relationship to local flooding patterns. Data were obtained from hydrological surveys, which estimated the maximum water storage capacity of the marsh at 11 million m^3, with a maximum discharge of 12.5 m^3 per second and a retention period of more than 10 days. Analysis of historical rainfall and streamflow data found that during the rainy season large volumes of water enter the wetland system, from rainfall, through run-off from surrounding higher grounds and via floodwaters from the Dandugam Oya, Kala Oya and Kelani Ganga Rivers. Muthurajawela buffers these floodwaters and discharges them slowly into the sea.

The value of these services was calculated by looking at the flood control measures that would be necessary to mitigate or avert the effects of wetland loss. Consultation with civil engineers showed that this would involve constructing a drainage system and pumping station, deepening and widening the channels of water courses flowing between the marsh area and the sea, installing infrastructure to divert floodwaters into a retention

Data collection and analysis is relatively straightforward, and usually relies on a combination of interviews, surveys, direct observation and expert consultation.

iii. Damage cost avoided techniques

Ecosystem services frequently protect other economically valuable assets. For example, the loss of catchments protection services may result in increased downstream siltation and flooding, which leads to the destruction of infrastructure, settlements and agriculture. Such damage costs can be taken to represent the economic value of ecosystems in terms of expenditures avoided (Box 24).

Data collection is for the most part straightforward, usually relying on a combination of analysis of historical records, direct observation, interviews and professional estimates. Predicting and quantifying the likelihood and impacts of damage events under different ecosystem scenarios is however usually a more complex exercise, and may require detailed data and modeling.

BOX 24 Using damage cost avoided to estimate the value of Anolis Lizard role in pest control in the Antilles (Source: Narain & Fisher, 1994)

The Anolis lizard plays an important part in pest control for export crops in the Antilles because it feeds on insects. The market price of lost agricultural output to pests in the absence of services provided by the Anolis lizard was calculated in order to assess its value in terms of damage costs avoided.

Stated preference approaches

i. Contingent valuation techniques

Absence of prices or markets for ecosystem goods and services, of close replacements or substitutes, or of links to other production or consumption processes, does not mean that they have no value to people. Contingent valuation techniques infer the value that people place on ecosystem goods and services by asking them directly what is their Willingness to Pay (WTP) for them or their Willingness to Accept (WTA) compensation for their loss, under the hypothetical situation that they could be available for purchase (Box 25).

BOX 25 Using contingent valuation to estimate the value of Kenya's elephants (Source: Brown & Henry, 1989)

Contingent valuation was used to estimate the value of Kenya's elephants. A survey was administered to visitors to major National Parks and lodges asking such questions as "Would you be willing to pay $100 (or more, or less) to contribute towards elephant conservation?" and "How much would the cost of your safari have to be reduced by if elephant populations decreased by a half?". Tourist consumer surplus accruing from viewing elephants was thus calculated.

Contingent valuation methods might for example ask how much people would be willing to see their water bills increase in order to uphold quality standards, what they would pay as a voluntary fee to manage an upstream catchment in order to maintain water supplies, how much they would contribute to a fund for the conservation of a beautiful landscape or rare species, or the extent to which they would be willing to share in the costs of maintaining important ecosystem water services.

This valuation technique requires complex data collection and sophisticated statistical analysis and modelling, which are described in detail elsewhere (Carson & Mitchell, 1989).

Most contingent valuation studies are conducted via interviews or postal surveys with individuals, but sometimes interviews are conducted with groups. A variety of methods are used in order to elicit people's statement or bids of their WTP/WTA for particular ecosystem goods or services in relation to specified changes in their quantity or quality. The two main variants of contingent valuation are:

- Dichotomous choice surveys, which present an upper and lower estimate between which respondents have to choose.
- Open-ended surveys, which let respondents determine their own bids.

More sophisticated techniques are also sometimes used, such as engaging in trade-off games or using take it or leave it experiments. The Delphi technique uses expert opinion rather than approaching consumers directly.

Appendix – IX provides the summaries of the usefulness of different valuation methods based on their reliability, ease of application and relative strengths and weaknesses.

Sectoral approach

Developments in all the three sectors – transport; oil and gas and mining are often pioneer economic activities in relatively undeveloped areas, and can trigger more and diverse ecological, economic and social impacts, including habitat use, resource quantity and quality, migration, spontaneous settlement, and infrastructure development that can cause biodiversity losses through secondary impacts.

This guidance recommends that for developments in any of the sectors, changes in ecological structure and function are important and robust indicators for prediction of primary and secondary impacts and their study through selective elements indicated in Table 9 must be attempted. This provides the basis for understanding how biodiversity is likely to respond and for determining whether it can be sustained as the basis for provision of ecosystem services and values to people affected by a proposal. Table 9 summarizes key aspects of ecological structure and function to consider (based on UK experience).

Table 9 Ecological structure and function to be considered when predicting impacts (Source: Modified from Oxford, 2001)

Habitat use	Territory, home range, hunting/foraging grounds; shelter and roost sites; nesting and breeding sites; corridors for migration and dispersal; stop-over sites
Ecological processes	Population structure, reproduction rates and strategies; competition; predation; seasonal behaviour; dispersal and genetic exchange; vegetation structure, composition and functions (cover, food); colonization; succession; competition; and nutrient-cycling. Anthropogenic - grazing, cutting, lopping, burning, clearing for agriculture, encroachments for settlements, collection of non wood forest produce, introduction of exotics, weeds and genetically modified organisms and disturbance from trek paths.
Historical context	Natural range of variation over recorded historical period, perturbations (floods and storms, disease infestation
Ecological relationships	Functional role in the food webs, predator-prey relationships, herbivore-plant relationships, herbivore-carnivore relationships, adaptation and habituation to disturbance.
Ecological role or function	Decomposer, primary producer, herbivore, parasite, predator, pollinator, habitat quality indicator, charging of water table keystone species.
Ecosystem properties	Fragility and stability, carrying capacity and, connectivity, patchiness and degree of fragmentation source/sink Numbers in a population or meta-population, minimum viable populations. Sex and age ratios.

One of the most conspicuous secondary impacts of land clearing and anthropogenic activities associated with developments across all sectors is the invasion of the site by weeds (Box 19). Such impacts have major implications on land productivity and future biodiversity status.

Secondary impacts of developments in all the three sectors present a larger challenge to the business community, conservationists and society as a whole. For mainstreaming biodiversity in impact assessment, a good strategy would be to assess key primary, secondary and tertiary impacts associated with different phases or lifecycle stages of the proposed project for subsequently evaluating the significance of such impacts using a well laid down criteria for assigning significance which is presented in subsequent sub section.

Overview of potential impacts of roads projects on biodiversity

For a more focused study of impacts of projects in road sector, Tables 10 provide an overview of the potential biodiversity impacts that need to be assessed for positive planning for biodiversity.

Table 10 Summary of road development activities and associated ecological impacts (Source: Rajvanshi *et al*., 2001)

Project activities	Ecological impacts	Impacts on wildlife
Design • Selection of route and design, • Land consumption	• Loss of wildlife and habitat and/or community welfare • System of tradeoffs often invoked	• Tradeoffs in the absence of up-to-date technical information about the biodiversity resource(s) to be traded undermines conservation efforts
Construction • Clearing of vegetation • Rehabilitation and resettlement of property, resources, and people • Establishment of associated work, supporting infrastructure and construction camps • Resource harvesting by project labourers (fuel wood and food) • • Water impoundment • River and stream diversion and channelization • Reclamation of pools, ponds, and other wetlands • Extraction of water for construction • Transportation of raw materials, machinery and labour to project site • Mining, quarrying or dredging for raw material • Excavation and filling • Blasting, rock cutting and drilling • Road surfacing and construction of underpasses and culverts • Restoration of exposed areas through planting and land stabilization • Transportation of waste generated during construction and waste management at dumping sites	***Changes in vegetation and ecology*** • Reduced plant cover and species diversity • Adverse changes in species composition • Disruption of succession and nutrient cycling. • Invasion by exotic species • Increased pressure on natural resources • Changes in faunal number and diversity ***Water quality and hydrology*** • Modification of surface and ground water flows • Shifts in water balance due to extraction of water for construction • Degradation in the quality of receiving waters due to increased sedimentation load and pollutants in surface runoff ***Soil characteristics and productivity*** • Compaction of soil • Loss of productive soil • Decline in porosity and permeability to water • Destabilization of slopes and erosion in mountainous terrain • Generation of tipped material due to imbalance between volumes of earth cut and filled • Displacement of soil on dunes in desert ecosystems • Loss of wet soils in riparian and marsh lands during construction of channels and under passes	***Habitat Loss, Fragmentation*** • Habitat loss, disruption or fragmentation • Habitat modification • Decline in species sensitive to sedimentation • Decline in prosperity of flow-dependent ecosystems ***Barrier effect*** • Obstruction of daily and migratory movements • Under-utilization of habitat and resource competition ***Induced threats*** • Increased accessibility to pristine areas • Increase in hunting and poaching incidences • Increase in probability of induced fire • Increase in human-wildlife conflicts • Increase in resource exploitation
Operation • Movement of vehicles • Transportation of goods and finished and raw industrial products • Road maintenance	• Wildlife population depletion ***Air quality*** • Pollution due to emission of NOX, SOX, PM10, CO and HC • Pollution due to combustion of fuels, re-entrainment of road dust and material transformation ***Noise pollution*** • Movement of traffic and the sound of horns and signals at crossing induce significant noise pollution	***Safety hazards and health impacts*** • Vehicle-animal collisions • Decline in animal health due to air, water and noise pollution • Competition for dwindling resources ***Long-term impacts on population/biodiversity*** • Increase in in-breeding and decline in size and population • Reduction of genetic diversity • Local extinction of species • Changes in animal behavior

The transportation projects, must consider the following five categories (Figure 11) of primary ecological effects:

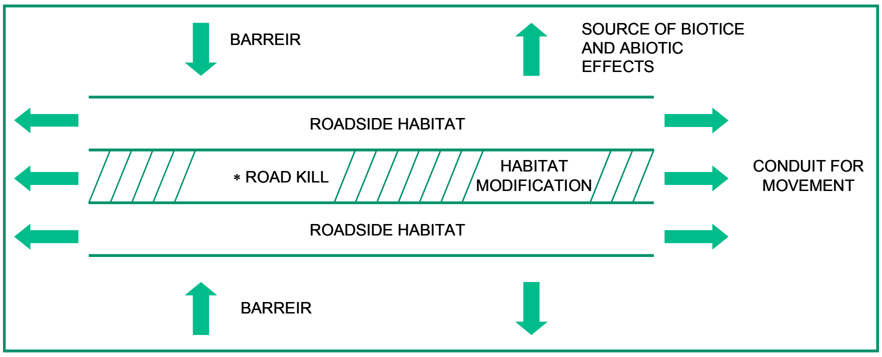


Figure 11 Schematic representation of wildlife impacts of road projects (after Van der Zande *et al.,* 1980)

Habitat modification, loss and fragmentation - that contribute to the reduction of overall habitat size and fragmentation due to infrastructure.

Disturbance – resulting in pollution of physical, chemical and biological environment, noise related stress that consequently affects habitat suitability and utilization patterns for many plant and animal species.

Corridor function - Road verges and roadsides serve as movement corridors for wildlife. These beneficial effects of infrastructure are a major challenge to planners and biologists, especially with upgrades and major expansion of highways already in all countries in the region.

Mortality - Deaths due to collision of animals with speeding vehicles on road sections (of proposed roads and upgrading existing roads) through wilderness areas pose a significant threat to many endangered species that already have dwindling population.

Barrier effect – One of the most recognized impacts of a road is the barrier effect for most vertebrate species, as the road tends to create movement barriers that restrict the animals' range, make habitats inaccessible and can finally lead to an isolation of populations. The assessment should take into consideration the several factors that contribute to barrier effects (Figure 12). These factors will also guide the choice of indicators, and the timing of the study.

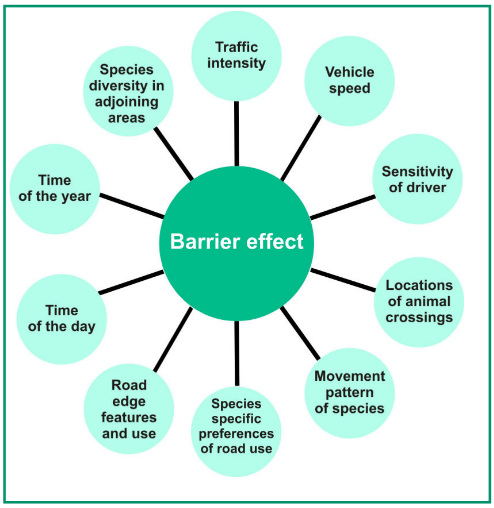


Figure 12 Factors controlling the barrier function of roads

Secondary impacts of roads are also very diverse and significant (Table 11). Impacts that specially merit assessment are those resulting from developments along the road and from increased accessibility to areas designated for conservation of biologically diverse ecosystems and protected species. The case example in Box 26 presents a range of impacts of an existing highway on species and habitat functions.

BOX 26 **Impacts of a highway on large mammals** (Source: Vasu, 2002)

NH-37 river that runs almost the entire east-west length of Assam state in India passes along the Southern boundary of Kaziranga National Park (KNP). It is the main arterial highway on the South bank of the Brahmaputra. During floods, the animals from the core area cross over the highway to the high lands of the Karbi Anglong hill forests on the South. Some sections of the Highway serve as movement conduit for animals from Kaziranga National Park to the Karbi Anglong hills. In recent years, the highway has attracted lot of ribbon development and this has strained the tenuous corridors that link the KNP core area to the Karbi Anglong hills (shown as re stars on the map). Ribbon development, heavy traffic and increased access have become the biggest threats to the Kaziranga ecosystem. Over the years this has resulted in countless deaths of endangered wildlife species including tigers. In addition the, large mammal movement particularly of elephants is severely hampered year round. The presence of highway has also severely affected protection efforts by KNP authorities as poachers find it easier to mingle with the traffic while indulging in transportation of illegal products extracted from forests becomes easy.

Oil and gas sector

Table 11 provides an overview of the range of potential biodiversity impacts from oil and gas projects.

Table 11 Potential impacts of oil and gas projects on biodiversity (Source: Shell, 2002)

Project stage	Project activity	Potential biodiversity impacts
Exploration: seismic, drilling, etc.	**Onshore** • Provision of access (airstrips, temporary roads) • Set up and operation of camps and fly camps • Use of resources (water, aggregate) • Storage of fuel • Clearing of lines and layout geophones • Shot hole drilling • Use of explosives • Closure of shot holes, mud pits, camps and access infrastructure • Mobilization of drill rig • Drilling operations • Well testing/flaring	• Footprint impacts to habitats/flora • Disturbance of fauna • Noise impacts on animal populations • Physical disturbance of soils and watercourses • Contamination of soils, surface and groundwater • Landscape modification, visual impact
	Marine • Vessel mobilization and movement • Vessel emissions and discharges • Seismic operation • Anchor rig/lower legs • Use of chemicals • Mud and cuttings discharge • Fuelling and fuel handling • Blow-out risk	• Impact on fish • Disturbance of marine mammals • Disturbance of sediment and benthic populations • Contamination of sediment • Impact on seabirds, coastal habitats, etc. in event of oil spill
Construction	**Onshore** • Set-up and operation of construction camps • Provision of construction access • Resource use (water, timber, aggregate) • Import of heavy plant and machinery • Vehicle movements • Earthmoving, foundations, excavation • Storage/use of fuel and construction materials • Generation of construction wastes	• Temporary and permanent loss of habitat and component ecological populations due to temporary and permanent footprint • Soil erosion and reduction in productivity • Contamination of soils, surface and groundwater • Damage to cultural heritage
	Marine • Mobilization and movement of vessels • Vessel emissions and discharges • Anchoring, piling	• Disturbance to sediment, benthic fauna and other seabed flora and fauna • Loss of seabed habitat • Disturbance to marine mammals
Operation/ Production	**Onshore** • Footprint • Visible presence • Import and export of materials and products • Product handling, storage, use of chemicals and fuel • Solid wastes arising • Liquid effluent • Emissions to atmosphere • Noise • Light	• Long-term landtake effects on ecology • Effects on landscape and visual amenity • Soil and groundwater contamination • Effects on water quality, aquatic ecology and resource users • Effects on air quality, ecology and human health • Global warming
	Marine • Direct footprint • Chemicals storage, handling and use • Emissions to atmosphere • Operational noise, helicopter supply and standby vessel movement • Discharges to sea • Oil spill risk • Light	• Loss of seabed habitat • Interruption of fishing effort • Disturbance to seabirds and marine mammals • Effects on water quality and marine ecology • Effects on air quality and global warming • Risk to marine and coastal resources in event of spill

The oil and gas project must additionally consider the following category of impacts:

Although the physical impacts from drilling for oil can be relatively small, they can be severe indeed when projects have poorly designed access and transport strategies. 'Getting to' hydrocarbon reserves and 'getting out' oil and gas to markets from and across, areas that are often priorities for conservation, are activities that present the greatest risks to biodiversity.

The following considerations are recommended to improve the practice of assessment of impacts of development in oil and gas sector:

- Upstream biodiversity risk assessments to the earliest stages of project.
- Overlaying oil and gas projects with priority conservation sites is a first step in upstreaming biodiversity into project risk analysis.

  This is extremely important as high degree of coincidence of areas known for their biodiversity value and those with known mineral and hydrocarbon reserves already occurs in different parts of the world (Box 27). The increasing incidence of oil and gas development threatening high biodiversity areas will only accelerate as the energy companies will intensify their prospecting efforts into remote and hitherto unexplored areas, many of which are currently protected or candidates for protection.

BOX 27 Location of oil and gas development and associated infrastructure in sensitive areas

- West-East pipeline in China crosses six state and provincial protected nature reserves, twelve locations in the Great Wall of China (a UNESCO Cultural World Heritage site), and passes close to four important state-protected cultural heritage sites.
- The Sakhalin II Project threatens the environment with a proposed undersea pipeline to be trenched through the benthic feeding habitat of the critically endangered Gray Whale and spawning areas of endangered salmon species in the coast of Far East Russia.
- The gas exploration blocks of Shell Bangladesh Exploration (Bangladesh) Ltd overlap with Sunderban Reserved Forest, located in close proximity of the World Heritage Site
- Sites of Cairn Energy's, proposed operations for exploring gas reserves in India overlap with habitats of many endangered species in protected areas.

- **For assessment of the impacts of oil and gas transportation pipelines, the width of the pipeline corridor are important determinants of spatial dimensions of impacts and the key impact receptors**

- **Land use within the pipeline corridor determines the nature of impacts on biodiversity**

  Many pipelines are routed across habitats that harbour threatened or endangered species or unique wetlands and federally protected species. If disturbed by construction activities, these could adversely affect wildlife populations that rely on these sensitive habitats. It is important to identify cause and affect relationships to be able to propose effective mitigation measures that can avoid some impacts by rescheduling activities or proposing alternatives of routing. On the contrary, during operation of the transmission pipeline, the portion of the land atop the pipeline is typically maintained as a grassland community to facilitate inspection. Shrub communities on utility rights-of-way can provide a source of browse and have been found to increase the abundance and diversity of wildlife species in adjacent wooded areas (Lunseth, 1987; Hanowski et al., 1993).

- **The assessment must focus on the following issues to provide an overview of impacts on all the different levels of biodiversity (Table 12)**

Table 12 Issues and impacts leading to biodiversity loss from oil and gas development (Source: Anon., 2006d)

Issue	Potential impact	Biodiversity loss
Access roads	Aggressive invasive species	Genetic diversity
Introduction of alien species		
Opening new areas	Unsustainable logging	Species diversity
Immigration		
New settlements	Habitat destruction	Ecosystem services
Cultivation		
Hunting, poaching & gathering of NTFPs	Pollution	
Local commerce		
Pipeline and shipping spills and leaks		

Mining sector

Table 13 provides an overview of biodiversity impacts of mining projects that need to be assessed for positive planning for biodiversity. The information provided in Table 13 can also be useful for narrowing down the issues during the scoping phase for detailed assessments.

Table 13 Illustrative examples of mining activities and biodiversity impacts (Source: ICMM, 2005)

Activity	Examples of aspects	Examples of biodiversity impact
Extraction	Land clearing	Loss of habitat, introduction of plant disease, siltation of watercourses
Blasting	Dust, noise, vibration	Smothering stomata, disturbance of fauna
Digging and Hauling	Dust, noise, vibration, water pollution	Disruption of watercourses, impacts on aquatic ecosystems due to changes in hydrology and water quality
Waste Dumping	Clearing, water and soil pollution	Loss of habitat, soil and water contamination, sedimentation, acid mine drainage
Processing/ Chemical use	Toxicity	Loss of species (fish kills, for example) or reproductive impacts
Tailings Management	Land clearing, water pollution	Loss of habitat, toxicity, sedimentation, water quality and stream flow
Air emissions	Air pollution	Loss of habitat or species
Effluent discharges	Water pollution	Loss of habitat or species, reduced water quality
Building workshops and other structures	Land clearing, soil and water pollution	Loss of habitat, contamination from fuel, waste disposal
Waste disposal	Oil and water pollution	Encouragement of pests, disease transfer, contamination of groundwater and soil
Building power lines	Land clearing	Loss or fragmentation of habitat
Provision of accommodation	Land clearing, soil and water pollution, waste generation	Loss of habitat, sewage disposal and disease impacts, pets, disturbance of wildlife
Activity	Examples of aspects	Examples of Biodiversity Impact
Roads and rail	Land clearing	Habitat loss or fragmentation, water logging upslope and drainage shadows down slope
Population growth	Land clearing or increased hunting	Loss of habitat or species, stress on local and regional resources, pest introduction, Clearing
Water supply (potable or industrial)	Water abstraction or mine dewatering	Loss or changes in habitat or species composition

As mining is a highly profitable industry in some countries in South Asia on account of huge reserves of many different metallic and non metallic minerals, it is obvious that mineral resources will continue to hold the promise of exceptional long-term social and economic benefits for countries like India and Sri Lanka in the region. At the same time, the negative legacy of past practices has created a deep level of mistrust of the industry in conservation circles and environmental NGO's and have questioned the industry's role in society's wellbeing and transition to sustainable development. The challenge for the industry is to help make the transition to sustainable development through good impact assessment practices. The EIA studies must aim to review the following key impacts:

(i) Direct land take and loss of vegetation cover in the mined area and other parts directly affected by associated activities such as deposition of tailings, or consequences such as subsidence.

(ii) Pollution affects, especially on aquatic systems, aggravated by leachates and downstream flow from tailing dams.

(iii) Impacts due to access associated with mining (roads, railways, pipelines, power lines etc.), which permit illegal hunting, habitat fragmentation and alien invasions.

(iv) Secondary effects of human immigration in association with real or perceived livelihood opportunities (e.g. on water supplies, illegal hunting, harvesting of vegetation, alien invasions, illegal land settlements).

(v) Impacts on other biodiversity values from noise and visual intrusion, arising from both mining and secondary activities, including transportation.

For assessments to be more meaningful, following considerations should be central in designing a biodiversity inclusive impact assessment of a mining project:

- **The scales of assessment should be appropriate for different types of mining operations**

  The scale of assessment must be governed by the following considerations:

  i *Potential for significant impacts is greater where mining locations are proposed in remote and biodiversity-rich ecosystems that were previously unexplored and undeveloped for minerals.*

  ii *It is also important to recognize that many existing mining operations have active exploration phases aimed at extending probable and proven reserves. These proven reserves justify renewal of mine life by many years. Such a mine with long life undergoes many expansions in area and capacity, generating a sequence of events that can be the equivalent of several new mines.*

  iii *Underground mines typically have a smaller footprint associated with ore extraction and processing when compared to open pit mines that progressively deepen and widen, increasing the areas disturbed each year and offering few opportunities for early rehabilitation.*

- **Cast the net wide for reviewing biodiversity issues beyond the mine site and beyond the obvious interfaces between biodiversity and mining**

  Mineral product chains are complex and hard to follow. Mines are often located at the headwaters of watersheds and may cover more than one watershed. Overburden stripping or removal and disposal of waste rock (that is, non-ore bearing or of non economic ore grade) can also occupy large areas of land and create additional potential impacts on biodiversity through contaminated runoff. The wetland, riparian or aquatic biodiversity may be affected by effluent discharges to watercourses that either support biodiversity or are located adjacent to wetland or riparian areas of high ecological value. The assessments must assess potential threats to linkages of habitats to *adjacent habitat in order to determine probability of species colonizing other habitats as mining activities proceed (Box 28). This would be very useful in monitoring species' use of habitats outside the mine for developing strategies for adaptive management of sites in future.*

BOX 28 **Impacts of iron ore mine discharge on riverine habitat use by elephants in India** (Source: Singh & Chowdhury, 1999)

The Singhbhum region in Bihar state of India holds 25% of the total haematite ore reserve in India. The mine overlaps with the forested areas that form the major elephant habitat in Southern part of the Bihar Province. The study commissioned by WII aimed to assess the influence of the mining operation on the water quality of the Koyna river flowing through the mining area and the utilization of the riverine habitat by the elephants. The study area comprised of the catchment of the Koyna River that received the waste discharge from the mine and the processing plant. Various physico-chemical parameters were recorded along the sections of the rivers receiving regulated and unregulated discharges. Principal Component Analysis segregated the key parameters that differentiated between the water quality in sections receiving regulated and unregulated discharge. The main difference was reflected in changes in turbidity and Total Suspended Solids (TSS) in the two sections.

Patterns of use of the riverine habitats by elephants and their dispersion, distribution and occupancy were recorded using dung dispersion. The results of the study indicated that the river quality had a significant influence on use of the riverine habitat by the elephants. The section of river receiving regulated discharge showed an increase of 300% use by elephants over the section receiving unregulated mine discharge. No change in habitat use was noticed in river sections that served as control.

- **Impact assessments must consider seasonal variations**

  As many species' habitat requirements vary significantly between winter and summer, assessments should identify these seasonal aspects for recommending the scheduling of activities with due consideration of habitat use by rare and threatened species.

- **Assessments must consider cumulative impacts**

  These occur where mining projects are developed in environments that are influenced by other projects, both mining and non mining. This would be a good approach to recommend preparation of integrated conservation plans based on the concept of bioregional planning to safeguard biodiversity values impacted by isolated projects in a larger landscape.

- **Direct biodiversity impacts increase with associated infrastructure development**

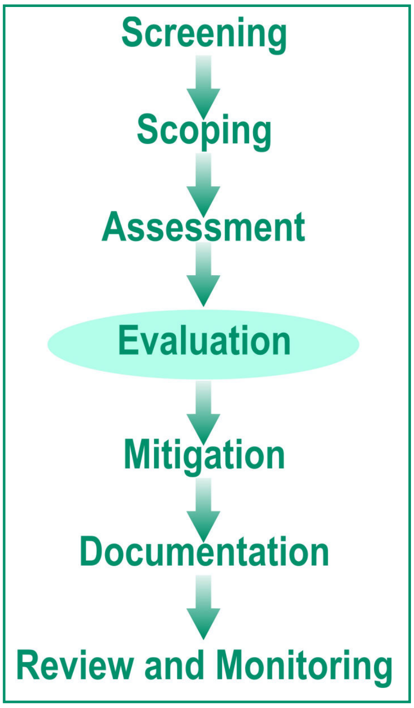
  The construction of access roads and other linear project infrastructure (such as dedicated rail lines, pipelines for transport of slurries or concentrates or power transmission lines) can have a significant impact on biodiversity. It may result in the isolation or fragmentation of habitats, which can have a significant impact on biodiversity. Interruption to the natural linkages between populations of plants and animals can create significant, sometimes irreversible changes. It may also results in habitat fragmentation, whereby separated smaller areas are less resilient to change.

- **Consider societal interfaces with biodiversity:**

  Biodiversity may have a variety of important uses or values to local communities or others, ranging from the aesthetic to a strong dependence for subsistence or livelihoods. Land clearance may significantly affect the users of biodiversity, most notably through diminishing the resource base of dependent communities. Relocation of people whether from sites of dams, mines or other forms of mega development projects can result in significant socio economic impacts. When communities are subject to resettlement as a result of land clearance, their displacement to alternative locations may result in additional pressures on biodiversity in the vicinity of the relocation site. The relocation may also alter livelihood options, deny access to traditional biodiversity resources and affect the resource availability for subsistence dependents .Experience suggest that in most cases, development projects necessitate involuntary relocation and where relocation is voluntarily accepted by project affected persons, the relocation programme fail to comply with conditions laid down and approved by project *approving authority s for avoiding any negative impacts on local communities . The issue of relocation of people from the project sites (in this context the mining sites) therefore deserves to be dealt with utmost sensitivity. The resettlement guidelines published by international donor agencies (World Bank, 1988 ; ADB,1998) along with specific rehabilitation policies formulated by specific countries (and also for states within the country as in India) should form a starting point to development strategies for developing rehabilitation plans that duly acknowledge and address the biodiversity and local concerns.*

- **The assessment of threats to biodiversity and the development of conservation or enhancement proposals must involve all key stakeholders**

- **Assessment should also identify opportunities for biodiversity enhancement**
  The importance of abandoned mines to bats is well documented (McAney, 1999) Similarly, the creation of lakes in many mine voids and reservoirs of large hydroelectric projects offer opportunity of creating alternative habitats.



5.1.4 Impact evaluation

The evaluation stage aims to:

- Identify impact that, by its magnitude, duration or intensity alters an important biodiversity function, characteristics or ecological feature and services.
- Assess sensitivity of the ecological features to provide a benchmark against which changes can be evaluated to determine the vulnerability of species or ecosystem characteristics and functions.
- Determine the overall significance of the anticipated impacts of proposed projects including the economic costs and benefits.
- Recommend impacts that essentially need to be managed through impact reduction measures.

Outcome

Evaluated information and supporting arguments enable decision makers to review project proposal.

Evaluation approaches

The steps required in impact evaluation are summarized in Figure 13 and are described in greater detail in subsequent pages.

For the purpose of highlighting the important impacts on biodiversity benefits, functions and characteristics that require implementation of mitigation measures, it is important to determine the significance of individual impacts associated with proposed development proposals. The evaluation framework provides a clear understanding of stages involved in building up the

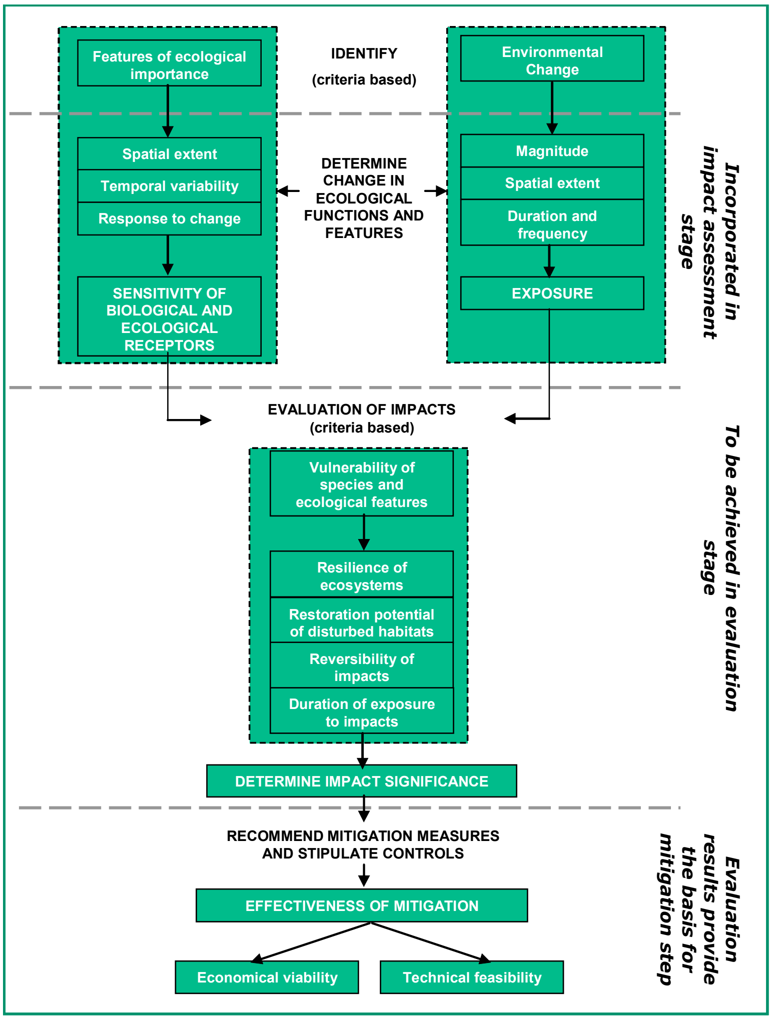


Figure 13 Framework for evaluation process

essential prerequisites for assessing the environmental change and the sensitivity of the receptors to predicted change for the analysis of the seriousness of implications.

Estimating and categorizing the significance of an impact is the stage that probably incorporates the greatest degree of subjectivity in evaluation and that can readily influence the perception of different stakeholders and thus the conclusions drawn from an EIA study. It is therefore important for practitioners to be more objective and where possible, adopt thresholds to significance which are based on scientific rationale and which can be repetitively used with confidence and conviction. Nothing can undermine the benefits of precise predictions than the evaluation of impacts against inadequately defined, inconsistent and very subjective criteria.

A fair amount of guidance that can be highly effective in assisting practitioners in assigning significance of ecological impacts is now included in EIA guidelines or regulations of many countries and international organizations (Canter & Canty, 1993; Hilden, 1995; Canter, 1996 ;), though little is available for Asia. Based on available guidance the following criteria are suggested for determining adverse impacts:

- loss of rare or endangered species
- reductions in species diversity
- loss of critical/productive habitat
- transformation of natural landscapes
- toxicity impacts on human health
- reductions in the capacity of renewable resources to meet the needs of present and future generations
- loss of current use of land and resources for traditional purposes by aboriginals and other forest dwellers
- fore-closure of future resource use or production.

The Asian Development Bank (1994) uses the following checklist of questions to evaluate donor-funded projects:

- Will the project create unwarranted losses in precious or irreplaceable biodiversity or other resources?
- Will the project induce an unwarranted acceleration in the use of scarce resources and favour short-term over long-term economic gains?
- Will the project adversely affect national energy to an unwarranted degree?
- Will the project result in unwarranted hazards to endangered species?
- Will the project tend to intensify undesirable rural-to-urban migration to an unwarranted degree?
- Will the project tend to increase the income gap between the poor and affluent sectors of the population?

Many of these questions are also relevant for EIAs with a focus on biodiversity.

Many ecologists have also attempted to assign a level of relative importance to conservation of species, landscapes and ecosystems for evaluating the significance of impacts based on conservation importance of the receptor organisms or their habitats. The earliest works that offer excellent guidance for developing criteria used in assessing wildlife conservation potential are those suggested by Ratcliffe, 1977; van der Ploeg & Vlijm 1978; Margules & Usher, 1981. These criteria (Box 29) have merited global acceptability and can be easily adapted to local situations.

Treweek (I999) drew on these to derive the criteria presented in Box 30 for application in Impact Assessment as opposed to nature reserve selection.

BOX 29 **Class of criteria and number of times used in 9 different studies** (Source: Margules & Usher, 1981)

Class of criteria	Number of schemes
Diversity	8
Rarity	7
Naturalness	7
Area	6
Threat of human interference	6
Typicalness or representativeness	4
Educational value	3
Amenity value	3
Recorded history	3
Scientific value	2
Uniqueness	2
Wildlife reservoir potential	1
Ecological fragility	1
Position in ecological unit	1
Potential value	1
Replaceability	1
Management consideration	1

BOX 30 **Examples of relevant questions for guiding the evaluation of impact significance** (Source: Treweek, 1999)

- Will the loss or redistribution of habitat affect the long-term viability of associated species?
- Will carrying capacity, stress thresholds of assimilative capacity be exceeded?
- If this habitat is destroyed, will associated species find alternative habitat?
- If this habitat is destroyed, will remaining habitat be adequate to support associated species?
- If this habitat is destroyed, can it be replaced using current technology and within a reasonable timeframe?
- Will ecosystem resilience or stability break down?
- Will predicted population reductions for a species result in loss of long-term population viability?
- Will significant, irreversible loss of biodiversity occur?
- Will reduced generic diversity result in reduced ability to withstand environmental change in future?
- Will the loss of one habitat type be more damaging that loss of another?
- Will the post-development state of an ecosystem be significantly different from its pre-impacted condition?
- Should any losses of ecosystem components or functions be mitigated or compensated for and if so, which ones?
- Will proposed mitigation measures guarantee the maintenance of natural resources within acceptable limits, i.e. will the residual condition of ecosystems (post-impact and taking account of mitigation) be acceptable?

Criteria adopted by Rajvanshi (1999) in the determining conservation significance of wildlife species and habitats in India for the purpose of evaluating the significance of impacts of sectoral developments further establish the universal applicability of earlier recommended criteria (Box 31).

As these criteria take into account the fragility of the habitats and the ecosystems and also provide a qualitative measure of the restorative potential of the area likely to be impacted, they are extremely helpful in the assessment of **sensitivity** and **vulnerability** of the features of interest that are both relevant for evaluating the impact significance.

The practitioners are recommended to use this guidance to familiarize themselves with the existing criteria, and develop innovative skills for retooling the criteria relevant for impact evaluation in different situations.

BOX 31 **Criteria for determining conservation significance of biodiversity rich areas** (Source: Rajvanshi, 1999)

Criteria	Index for importance value of criteria
Size of habitats *(Based on total area of sub habitats)*	• Small • Medium • Large
Naturalness	• High biotic disturbance • Moderate disturbance • Undisturbed
Diversity *(Based on presence of habitat sub type)*	• Low • Medium • Large
Faunal groups *(Faunal group numbers)*	• < 2 • 3 to 5 • > 5
Rare/endangered /endemic species	• Locally rare/endangered/endemic species present • Regionally rare/endangered species present • Wildlife Act protected species present
Fragility *(Based on ecological sensitivity of the habitats and species)*	• Small • Medium • Large
Existence value *(Based on recognition of the wildlife habitats)*	• Local • Regional • International
Conservation status	• Man made ecosystems • Protected/Reserved forests • National parks/sanctuary
Restoration potential *(Based on past history and documented information)*	• Low • Medium • High

From the economic perspective, the evaluation process should incorporate mechanisms to evaluate potential risks in promoting economic growth through the project by harmonizing objectives of economic development with biodiversity conservation; review trade offs for the economic and ecological benefits and to also identify residual impacts that pose potential challenge to benefit from business. The outcome of evaluation should provide opportunities to decide upon options for promoting biodiversity and livelihood offsets to compensate for residual impacts. A good evaluation approach should:

- identify the critical effects on market incentives and opportunities which result from the proposed changes to a trade measure
- identify induced changes in the economic behaviour of producers, consumers and intermediaries, and hence effects on the production system
- evaluate the dynamic nature of these effects, to identify short and medium term adjustment effects, and longer term outcomes once the production and economic systems have adjusted to the changed trade measure
- assess the significance of linkages from the effects on production relationships to sustainability impacts, e.g. changes in employment, investment, production system, environmental quality,

natural resource stocks, biodiversity, level and distribution of household income, gender balance of paid and unpaid labour, prices of essential goods and services, livelihood opportunities, poverty levels etc., and interactions between these effects

- assess the impacts of the change in the trade measure on sustainable development processes, and hence on economic growth rates and corresponding long term dynamic effects on ecological, economic and social environments
- evaluate inter-linkages between the measure being assessed and other components of the trade policy or agreement, and their influence on the impacts identified.

Other informal approaches for evaluation of project impacts are presented in Box 32. In general South Asian countries, being developing countries, tend to focus on economic growth and poverty reduction imperatives. In this sense, when links between project objectives is juxtaposed with Millennium Development Goals and poverty reduction, decision-makers take greater notice of impact evaluation. This was the case in Pakistan with the integration of environment in Pakistan's Poverty Reduction Strategy paper.

BOX 32 Informal approaches for impact evaluation

- Opinions of qualified decision makers in municipalities, or ministerial departments.
- Opinion of specialists (environmentalists, ecologists, economists, hydrologists, engineers, social scientist and urban planners).
- Past experience of evaluating similar projects.
- Public opinion (Public hearing reports are mandatory requirements in many countries in the region and these are helpful in evaluating the significance of project related impacts).
- Compatibility of the proposed project with the Government's development policy in general.
- Link between project objectives and Millennium Development Goals (biodiversity conservation; livelihood security and eradication of poverty).

Sectoral approach

Evaluating the relative importance of habitats supporting a mix of species along the roadway or within the pipeline corridor is often a major requirement for determining impact significance and recommending protective measure. Practitioners should be able to develop criteria for scale weighing of the importance of different habitats based on diversity and conservation importance of biodiversity features. Box 33 provides an illustrative example of scale weighing techniques developed for evaluating the relative importance of habitats *en route* linear developments including roads and pipelines. These techniques based on scoring values are simple and can be improvized for other species subjected to similar analysis in developments in different sectors.

BOX 33 **Determining relative importance of wildlife habitats and the significance of impacts of an oil pipeline for proposing mitigation measures for avoidance of impacts** (Source: WII, 1994a)

The example presents the outputs of the evaluation of the aquatic diversity and relative conservation importance of the riverine habitats in five different rivers within the corridor of an oil pipeline proposed between Haldia and Baruani townships of West Bengal in India. The objective of the evaluation of the relative wildlife values of the five different perennial rivers (Rupnarayan, Damodar, Ajoy, Kiul, Harohar and Ganges) in the zone of river crossing was to evaluate the conservation significance that the aquatic habitats in different rivers commanded so that definite choices could be made between technology options - Open Cut Method (OCM) or Horizontal Directional Drilling (HDD) for laying the pipeline across rivers to avoid or minimize disturbance to endangered species and their habitats. For each river, the scores were assigned to provide a measure of species diversity within a faunal group. The wildlife value of the riverine habitat was determined based on sum total of score for all faunal groups represented in the river. The conservation value of the habitat was represented by the score that incorporated the level of endangerment or rarity of species within each river. The Conservation Significance Factor (CSF) finally provided the wildlife values of different rivers in relative terms by taking into account the conservation value of species (Table A). In Table B, the information on relative levels of disturbance associated with several ongoing activities helped in establishing high impact on a river like Damodar which is more vulnerable to disturbance during routing of the pipeline. This placed greater urgency for avoiding impacts on ecology of the river by recommending HDD technique which involves far greater investments in laying pipeline across Damodar River as opposed to the cost involved in adopting the traditional Open Cut Method.

Table A Score for wildlife values with Conservation Significance Factor (CSF) for major rivers

Faunal groups	CSF value	Rupnarayan		Damodar		Ajoy		Kiul		Harohar		Ganges	
		Wild-life value	Wild-life value with CSF	Wild-life value	Wild-life value with CSF	Wild-life value	Wild-life value with CSF	Wild-life value	Wild-life value with CSF	Wild-life value	Wild-life value with CSF	Wild-life value	Wild-life value with CSF
Fishes	0	2	2	1	1	2	2	1	1	1	1	2	2
Turtles	5	1	5	0	0	1	5	0	0	1	5	1	5
Crocodiles	5	1	5	0	0	0	0	0	0	0	0	1	5
Migratory waterfowl	5	0	0	1	5	1	5	0	0	1	5*	1	5
Aquatic mammal (Dolphin)	10	1	10	1	10	0	0	0	0	0	0	1	10
Total		**5**	**22**	**3**	**16**	**4**	**12**	**1**	**1**	**3**	**11**	**6**	**27**

Score: ***Fish**: 1=<5 Spp.; 2=6 – 10 Spp.; 3 =>10 Spp.* ***Turtle**: 0=Absent, 1=Present*
***Migratory water fowl**: 0= Absent, 1=Present* ***Aquatic mammals**: 0=Absent, 1=Present*
***Conservation Values** ranging between 0 – 5 for different species depending upon the degree of their endangerment.*
***Conservation Significance Factor** = Conservation Value * Wildlife Value*

Table B Evaluation of the significance of the impacts of the proposed pipeline on wildlife values of the major rivers

Rivers	Wild-life values	Wildlife values with CSF	Disturbance level	Impact level	Technology option for river crossing
Rupnarayan	5	22	0	Low	OCM
Damodar	3	16	4	High	HDD
Ajoy	4	12	2	Low	OCM
Kiul	1	1	9	Low	OCM
Harohar	3	11	0	Low	OCM
Ganges	6	27	3	Low	OCM

The significance of impacts of mining projects is greatly influenced by the following:

- The location of mining projects in highly fragile zones which are vulnerable to erosion (these pose the greatest challenge for restoration or in wildlife areas commanding high conservation significance).
- The spatial and temporal dimensions of mining activities affect productive potential of wildlife habitats and lead to reduced capacity of renewable resources to meet the needs of present and future generations.
- Mining in pristine areas pose the greatest challenge to conservation of gene pool of rare and endangered biodiversity resources.
- *Ex situ* conservation activities that aim to protect certain species outside their natural habitat – such as in zoos, herbaria and botanical gardens offer opportunities of rehabilitation and not the restoration of ecosystem degraded by mining activity. *Ex situ* conservation is however no substitute for *in situ* conservation which also ensures continuation of evolution of biota and their ecosystem environment.

Good practices in impact evaluation

- Give a clear and transparent summary of the positive and negative impacts of project on biodiversity resources and benefits and of different option where applicable.
- Indicate the benefits and costs of the project to society.
- Impacts should be given in qualitative, quantitative and monetary forms where possible and be proportionate.
- State clearly any critical assumptions and uncertainties.
- Show clearly any distributional effects on landscapes, ecosystem functions and specific biodiversity resources associated.
- Show how different options compare against the criteria of significance for impacts on biodiversity.
- Indicate the criteria adopted for evaluation of impacts on biodiversity components.
- Present the argument for the decision choice by highlighting the significance of impacts and the variations in impacts associated with different alternatives where applicable.
- Highlight trade-offs.

5.1.5 Impact mitigation

The purpose of mitigation is to identify measures and options that safeguard biodiversity and ecosystem services (Figure 14). Mitigation is both a creative and practical phase of the EIA process that aims to:

- Develop measures to avoid, reduce, remedy or compensate significant adverse impacts of development proposals on biodiversity and well-being of the community/communities affected.
- Enhance beneficial effects and lower costs for biodiversity conservation as an outcome of development where possible.
- Create opportunities to benefit biodiversity and human well-being.
- Ensure that mitigation options adhere to the criteria of optimality especially economic.

Outcome

- Positive planning for biodiversity and well-being in the developed environment.
- Better opportunities for business through positive outcomes for biodiversity conservation and sustainable livelihoods.
- Improved well-being of affected local communities.
- Optimization of biodiversity and economic returns to address Millennium Assessment Goals.

Approach

Mitigation includes any sustained action(s) taken to reduce or eliminate adverse effects, whether by controlling the sources of impacts, or the exposure of biological and ecological receptors to them. The effectiveness of the outcome is essentially governed by sound planning and application of precautionary approaches. With growing realization of the importance of mitigation stage as a ‘problem solving’ stage in impact assessment, increasing efforts are being made to encourage positive approaches and good practices. In this sense, economic analysis provides important insights into mitigation through its focus on optimality.

The main aim of *economic* evaluation is to provide information that will assist decision makers

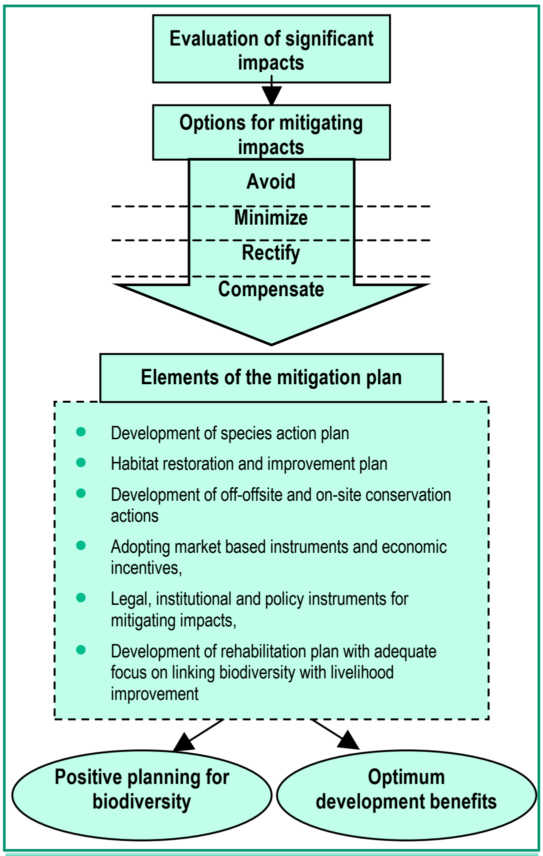


Figure 14 Upstreaming biodiversity in the mitigation step

A five point approach to planning mitigation for biodiversity

- *Adequate information back up and expertise.*
- *Avoidance of harm.*
- *Mitigation to minimize unavoidable harm.*
- *Compensation to offset residual harm.*
- *New benefits.*

towards optimal use of available resources to maximize the well-being of the community. A resource is anything that is capable of affecting human well-being. Thus, from an economic perspective, the term *resource* includes biodiversity, ecosystems and ecosystem services. The mechanisms linking resources to community well-being has been the integration of MA and the TEV frameworks in the introduction section of this guide, and involves direct use, indirect direct use, and non-use (such as the preservation of natural ecosystems, species or special areas) and future optional uses and non-uses.

Economic techniques such as Cost-Benefit Analysis (CBA) and Cost Effective Analysis (CEA) can be helpful in identifying the most economically optimal mitigation measures. Once the appropriate mitigative measures are identified and incorporated into the project proposal the costs and benefits of these would be reflected in the economic analysis undertaken of the proposal. While often the inclusion of biodiversity and ecosystem services costs and benefits changes the balance sheet substantially, it is important to point out that economic evaluation will provide one vital criterion for decision-making through the optimal use or non-use of biodiversity, ecosystems and ecosystem services that maximizes well-being of the community. Thus the decision criterion is anthropocentric but crucial in highlighting both the benefits and costs of development. While the integration of biodiversity and ecosystem values would help in making optimal choices, there may be instances where economic and ecological criteria might contradict. For example, building a road through an ecologically important protected area might not pass under ecological criteria but might pass under economic criteria as the impact on community's well-being would be minimal and mitigation measures to reduce, rectify and compensate the impact on community are the more economically optimal options. Clearly a trade-off would have to be made in such a case and decision-makers would have to understand both the ecological and economic merits and demerits of such an intervention.

Hierarchy of mitigation options

The sequence of considerations designed to help manage adverse impacts on biodiversity includes:

Avoidance

Some environmental challenges have no 'technical fix'. If the biodiversity values are likely to be influenced by the project's design, location and dimension, the project proposal must aim to avoid significant impacts through one or more of the following options:

- *Sensitive design*

Impacts can be sometimes avoided by selecting relatively least impacting design alternatives like changes in dam height (Box 34) or route alternatives in case of linear development projects e.g. road, rail, pipeline and transmission lines (Box 35) or by planning the route of new alignments through existing corridors.

- *Opting for superior technology*

Appropriate technological choices can be very effective in reducing the physical disturbance to land and prevent spatial impacts. For example, a drilling innovation that has allowed companies to save money and minimize the footprint of their mining operations in sensitive ecosystems is the slim hole technology, which allows workers to drill narrower wells and thus use less materials and equipment. Slim hole drilling rigs have enabled oil companies to cut costs and impact because they use significantly less and smaller equipment, produce less waste, require fewer crew members, and have a smaller footprint. Slim hole rigs are also much lighter than conventional rigs, allowing for easier transport by helicopter, and making exploration in remote areas more feasible.

BOX 34 **Lowering the dam height to reduce the number of oustees of the Pak Mun dam project, Thailand** (Source: Wicklin III, 1999)

Environmental studies completed in January, 1982, indicated that the reservoir that would be created for impoundment of water for Pak Mun Project at the elevation of 113 m MSL would require approximately 4,000 households to be relocated. Based on the additional studies conducted in the year 1985 an alternative design was selected at an elevation of 108 m MSL that would reduce the number of people to be relocated from 20,000 to 1,500. Also, the dam alignment was moved 1.5 km upstream to avoid inundation of a scenic rapids area. The changes reduced power benefits by one third and reduced reservoir length and surface area by more than half, but represent examples of the first principle of World Bank policies on environmental impacts and resettlement.

BOX 35 **Proposed expressway from Colombo to Matara in Sri Lanka** (Source: Withanage, 2004)

The concept of the proposed expressway from Colombo to Matara was introduced by the Road Development Authority (RDA) and the Ministry of Highways of Sri Lanka in the late 1980's as a part of the network of new highways proposed to cater to the increasing transport demand of the country. The six lane expressway is about 130 m wide and 127 km long. The trace traverses through four Districts (Colombo, Kalutara, Galle and Matara). The EIA studied two alternative routes that were the original RDA trace and the combined trace. An Environmental Impact Assessment (EIA) study was carried out to evaluate the environmental impacts of the proposed project and to compare the reasonable alternatives in terms of environmental consequences, and to propose mitigatory measures in order to avoid or minimize negative impacts. The EIA report was prepared in accordance with the TOR given by the Central Environmental Authority (CEA), Sri Lanka. The Central Environmental Authority (CEA) granted approval to the above project in 1999.

The proposed expressway route was to be traversed through the following important wetland areas.

i. Weras River

ii. Bolgoda Lake Wetland Area.

iii. Madu River (Ramsar Site)

iv. Koggala Lagoon Wetlands

Significant negative impacts on these wetlands were identified during the EIA evaluation period. According to the comments made by the Technical Evaluation Committee who reviewed the EIA report, several deviations were made to the proposed trace of the expressway. Finally, the Central Environmental Authority's approval stipulated the following conditions for compliance:

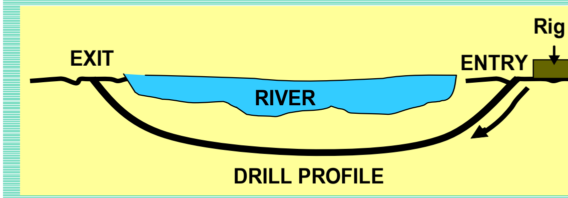
i. The proposed expressway trace should avoid the Weras River/ Bolgoda lake wetland area. (In order to achieve this it was specifically mentioned that the RDA should adopt the original trace and not the combined trace at this point).

ii. In addition, another condition stipulated that the express way should avoid the Madu River (a Ramsar site) & Koggala lagoon wetlands. (The approval did not indicate which trace should be adopted by RDA).

In order to comply with these conditions of avoiding Madu River and Koggala lagoon wetlands, the expressway trace had to be shifted from the combined trace which was earlier granted approval by the Central Environmental Authority. The new trace of the expressway in this area is between the combined trace and the original RDA trace.

Similarly, Horizontal Directional Drilling (HDD) is a method of installing underground pipes and conduits from the surface along a prescribed bore path. HDD techniques are typically used when crossing large water bodies, roads, congested areas, and other environmentally sensitive areas to mitigate potential impacts on water quality and important ecosystem components, such as fish and fish habitat and aquatic animals (Box 36).

BOX 36 **Horizontal Directional Drilling (HDD) technology** (Source: BPCL; WII, 1993 & 1994a)



For laying pipeline across major rivers in India, HDD was recommended as a measure to avoid impacts on several endangered species like the mugger crocodile and Gangetic dolphin.

- *Nature engineering solutions*

Given the incredible feats of engineering accomplished over the years by civil engineers, collaborative partnerships between biologists and engineers have generated practical solutions to many technical problems related to use of developed areas by animals. Relatively greater levels of success in nature engineering initiatives have been achieved in planning of transportation projects through sensitive habitats to avoid impacts. There are many examples of very practical design features of roads and highways that have been made sensitive to the need of providing passages for safe movement of species (McKinney & Murphy, 1996; van Bohemen, 2004).

- *Development choices*

This involves making choices between development alternatives that can avoid impacts on biodiversity rich areas or the scarce and important resources (e.g., choosing between wind power and hydropower to avoid impact of creating a reservoir for hydropower generation; making a choice between the run of the river scheme and traditional damming of river for hydropower generation).

- *Siting considerations*

For avoidance of impacts on areas that are not able to withstand the pressure from development activities, practitioners should exercise one or more of the following options:

- *Avoid adverse impacts on designated sites and protected species*

The validity of ‘no go’ zones recognizes the inappropriateness of development in rare, fragile and unique ecosystems that have well recognized significance for conservation. A general understanding of the ‘no go’ zones has emerged based on several guidelines (WWF, 2002; EBI, 2004; IFC, 2004) that have been developed in the context of sectoral developments around the world. The exclusionary criteria for designation of ‘no development’ zones providing additional controls in different countries (Box 37) have also been developed based on legal and policy directives for safeguarding biodiversity resources of the country.

BOX 37 **Examples of some high conservation value sites that should be considered as 'no-go' zones for development**

- Protected areas, biosphere reserves beyond core areas, Ramsar sites not under I-IV.
- Proposed protected areas in priority conservation areas.
- Sites that maintain conditions vital for the viability of protected areas that support the 'jewels'.
- Centres of plant diversity.
- Areas officially proposed for protection based on local and national priorities.
- Area of known high conservation value, (these may include sites of degree of endemism, rarity, vulnerability, representative ness and ecological integrity.
- Areas where there is a lack of knowledge of biodiversity.
- Areas where operations will reduce populations of any recognised critically endangered or endangered species, or significantly reduce the ecological services provided by an ecosystem.
- Areas recognised as protected by traditional local communities.
- Critical fish breeding grounds.
- Areas where there is a serious risk of soil, watershed, pollution, knock-on effects such as land invasion.

To safeguard the critically important 'eco-sensitive' zones in India, the Ministry of Environment & Forests, Government of India, has enacted special notifications under Environmental (Protection) Act (1986) for regulating development in different areas including (i) Matheran and surrounds; (ii) Mahabaleshwar- Panchgani region; (iii) Pachmarhi region; (iv) Taj Trapezium zone; (v) Dahanu taluka; (vi) Numaligarh; (vii) Aravalli range; (viii) Doon valley; and (ix) Murud-Jangira district. The regulation on Aravali and Doon Valley prohibit mining in all areas falling within ecologically important Aravali hill ranges and the fragile mountain ecosystems in the Shivalik area respectively. While the development in and around the natural world heritage site, Kaziranga National Park has been regulated through the notification covering the Numaligarh area, the regulation on Taj trapezium protects Tajmahal, the cultural world heritage site. The coastal and marine resources in India have been provided enhanced protection under the Environment (Protection) Act, 1986 through regulatory framework for coastal zone regulation and notification of a National Coastal Zone Management Authority to conserve the coastal ecosystems and to buffer them from incompatible uses. The preparation of Coastal Zone Management Plan has been made mandatory for all coastal areas in the Coastal Zone States. These provisions have however been implemented only with 'mixed' success.

Currently, Nepal is also devising a national policy which involves setting aside of particular river basins, or portions thereof, from hydropower development.

- *Avoid locally distinct biodiversity species through observations of suitable setback distances*

Building setbacks, sometimes justified to protect specific development site features such as floodplains, natural habitats, can be helpful in avoiding impacts on critical habitat components supporting unique or endangered biodiversity (Box 38).

BOX 38 **Restriction of oil exploitation activities to defined zones outside Sunderbans in Bangladesh**

In Bangladesh, seismic survey was planned by Indian Oil Corporation in an area adjoining the Sunderbans for exploring the potential gas reserves. Considering that the Sunderbans and its adjoining area is among the largest mangrove forests and a designated World Heritage Site, rich in wildlife represented by a large array of plant and aquatic life (including 21 reptiles, 20 mammals and 110 birds), an impact assessment study was conducted to assess the impacts of seismic survey on biodiversity. It was established from the study that the seismic activity in the northern part of the block would pose major disturbance to rich habitat of important wild life species including the endangered Bengal tiger. As an outcome of the study, more than half the block has been made off-limit for the survey, including the total Sunderbans Reserve Forest and a 10 km buffer zone.

Source: Shaikh Abdur Rashid, Ministry of Power, Energy & Mineral Resources, Government of the People's Republic of Bangladesh

- *Avoid adverse impacts to priority habitats and species based on national priorities*

Countries in the region are already prioritizing their biodiversity resources. The species commanding high priority for conservation at the national level deserve to be essentially protected by avoiding of impacts.

A non-governmental organization undertook an exhaustive biodiversity assessment in India over a period of over two years from 1996 to 1998. This exercise – the Biodiversity Conservation Prioritization Project (BCPP) – resulted in a nationwide prioritization of sites, species and strategies for biodiversity conservation. Priority taxa were selected at a national workshop, depending on the availability of expertise in the country. Subsequent analyses were based on IUCN criteria, but were also revised through consultative workshops.

- *Timing of project activities (to avoid nesting, fawning, breeding period)*

Biodiversity issues are mainly related to disturbance of sensitive features (e.g., denning or nesting sites, important winter range) and timing (disruption of wildlife during critical periods; e.g., mating, nesting). Applicants should contact regional wildlife biologists to seek guidance on specific species or habitats and confirm the timings of different lifecycle events to avoid and mitigate impacts.

- *Adopting a precautionary approach*

'Precautionary Principle' provides an important policy for promoting preventive approaches for avoidance of threats to biodiversity if there is a lack of clear evidence of a threat or the damage that may occur. This principle has been widely incorporated, in various forms, in international environmental agreements and declarations (Box 39) and has been encouraged through further amendment national legislations.

The principle of biodiversity-inclusive" impact assessment (IAIA, 2005) advocates application of the Precautionary Principle in any situation where important biodiversity may be threatened and there is insufficient knowledge to either quantify risks or implement effective mitigation. Application of the precautionary principle recognizes that the merit of delaying development consent until the best available information can be obtained through consultation with local stakeholders/experts and/or new information on biodiversity can be consolidated. Its use promotes action to avert risks of serious or irreversible harm to the environment in such cases (Cooney, 2006). The Principle in a way provides an 'escape route' to anticipate and prevent threats to the environment and 'buy time' for developing appropriate and effective mitigation (Box 40).

BOX 39 Triggers for 'Precautionary Principle'

Rio Declaration, 1992, Principle 15

In order to protect the environment the Precautionary Approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.

Convention on Biological Diversity, 1992, Preamble

[W]here there is a threat of significant reduction or loss of biological diversity, lack of full scientific certainty should not be used as a reason for postponing measures to avoid or minimize such a threat.

Convention on International Trade in Endangered Species of Wild Fauna and Flora, Resolution Conf 9.24 (Rev CoP13)

The Parties shall, by virtue of the precautionary approach and in case of uncertainty; both as regards the status of a species or the impact of trade on the conservation of a species, act in the best interest of the conservation of the species concerned and adopt measures that are proportionate to the anticipated risks to the species.

Good practices dictate that precautionary measures should be proportionate to the risk that is to be limited or eliminated and should involve affected party in the decisions for maintaining transparency as much as possible. Finally, precautionary measures should be seen as provisional in nature and be developed on a case by-case basis (Box 41).

BOX 40 Application of precautionary approach in a development decisions for a diamond mine in India

The Panna Tiger Reserve (PTR) and the Gangau WLS are affected by diamond and white sandstone mining. The government owned diamond mine of National Mineral Development Corporation (NMDC) is located at Majhagawan just outside the Panna Tiger Reserve of the Hinouta range and encroaches on Gangau sanctuary in the state of Madhya Pradesh in India. Mountains of solid waste material from the opencast mine, pre- and post-treatment are dumped on the surrounding forest land, encroaching on both PTR and the sanctuary. Slurry from the mine also feeds into the Kaimasan stream carrying the sludge to the Tiger Reserve. There are also significant biotic pressures on the area for firewood and fodder from about 1000 workers of NMDC. NMDC is fully aware of the conservation importance of the Panna Tiger Reserve. For the grant of the clearance to the proposal for renewal of mine lease for next thirty years, the National Board for wildlife and the Environmental Appraisal Committee of the Ministry of Environment and Forests, Govt. of India, upheld the opinion that the impacts of the mining operations on the biodiversity values of the tiger reserve under the earlier lease period are not adequately documented to ascertain the nature of impacts and their implications for conservation. Until such a time till a detailed scientific study is conducted to provide assessment of the impacts of diamond mining on the tiger reserve, the decision on grant of lease has been put on hold. The study is to be conducted by Wildlife Institute of India (WII) under the funding support from NMDC to generate the much needed information on biodiversity that will help support conservation through better mitigation planning to reduce the footprint of the mining operation on the Tiger Reserve.

Considering that Panna diamond mining is Asia's largest diamond mine that has been generating huge economic returns for the country and has been providing livelihood to local community, the key stake holders (conservation community, management of the PTR, mining company, Ministry of Mines and Ministry of Environment and Forest, (Govt. of India), are exploring the options of reducing the future lease term to 15 years with stringent measures for mitigation that are to be stipulated based on the proposed studies (Source: official communications between WII and NMDC).

BOX 41 **Avoiding construction of an irrigation tunnel project through Pench Tiger Reserve in India as a precautionary measure to safeguard important biodiversity values** (Source: Rajvanshi, 2006)

The construction of 2.88 km of underground tunnel through the Pench Tiger Reserve has been proposed for utilization of water from reservoir in PTR for irrigation benefits to 10 tribal villages. The construction of the tunnel would require diversion of 15.79 ha of forest of which 4.56 ha is a part of a Tiger Reserve. As diversion of land area from protected areas for any non forestry purpose requires the permission of the National Board for Wildlife (NBWL), the environmental appraisal of the project was conducted by a team of experts nominated by NBWL to assess the implications of diverting the land from Pench Tiger Reserve for construction of the tunnel.

Considering that PTR commands great ecological significance as it represents the floral and faunal wealth of Satpura Maikal range and supports sizable population of breeding tigers and harbours other important species such as four horned antelope, gaur (Indian bison), leopard, hyena, chital, flying squirrel, mongoose, the team had several round of consultations with the project authorities, local communities, project beneficiaries and conservation groups to explore the alternative that would significantly lower the impacts on biodiversity. One of the alternatives that were suggested to reduce the temporal impact was the reduction in construction time for the tunnel from proposed two years to four months. The project authorities felt that further reduction in construction time would not be feasible given the terrain and the technology involved.

The second alternative to reduce the physical disturbance in the area was to further extend the length of the underground tunnel to locate the tunnel exit point outside the boundary of Pench Tiger Reserve. This alternative was acceptable to project authorities despite the additional cost implications for the project authorities. The reconnaissance of the areas outside the boundary of the Pench Tiger Reserve was undertaken with an objective to locate a suitable location for the tunnel exit. The results of the survey revealed that extending the tunnel length to locate the tunnel exit point outside the boundary of Pench Tiger Reserve would induce major impacts on the ecology of the area falling within the proposed Mansingh Deo Sanctuary. Based on these observations, it was felt that the project had significant potential to induce major and irreversible negative consequences for the biodiversity values of the PTR and would greatly undermine the prospects of conservation of a sanctuary that is yet to be established. The decision finally recommended 'no go' action.

Minimization

Minimization is essentially aimed at reducing the footprint of development when material considerations outweigh the potential adverse effects of a proposed development on biodiversity. This step is usually applied during impact identification and prediction to limit or reduce the degree, extent, magnitude, or duration of adverse impacts. There are many different ways in which project impacts can be minimized:

- ***Decreasing the spatial/temporal scale of the impact***

The spatial and temporal impacts can be decreased by controlling or regulating access to biodiversity rich areas during construction or operation; using existing infrastructure and route corridors for new developments to the extent possible. This strategy can avoid vegetation clearing and greatly reduce the demands on land for right of use in sensitive areas especially for development of roads, pipelines and transmission line. Construction of new haul roads should be discouraged in mining operations where possible and requirement of land for over burden should be determined by careful phasing of extraction and planning of fill of inert material.

- ***Promoting bio-friendly technologies***

Many innovative trials are improving the technological products that can significantly avert threats to biodiversity. In the Netherlands, La Farge has successfully developed roof tiles that can provide roosting space for sparrows whose number is on the decline due to rapid urbanization.

The impacts of injury to fishes and even their mortality when flowing through the turbines of hydroelectric projects can be addressed by designing "fish friendly turbines (Box 42).

BOX 42 **Creation of fish passage under Pak Mun project, Thailand** (Source: Bizer, 2000)

A component of the mitigation plan for the Pak Mun Project in Thailand included the installation of fish passage facilities to enable passage of 120 species of fish from the Mekong River into the Mun River for spawning. Predominant species included cyprinids (carp) and ictalurids (catfish). The selected design for the ladder included a vertical slot with submerged orifices. Monitoring of the utilization of the facility indicated only a small fraction of the fish species and numbers are able to move from the tail water to the impoundment. Review of the design indicates that the openings of the orifices were approximately 15 cm X 15 cm and the width of the vertical slots were less than 20 cm. Head width and/or body depth of most migrating adult fish are generally greater than 20 cm. Consequently, only the smaller fish were able to pass through the openings.

- ***Timing of work and reducing duration of construction related activities in sensitive environment***

Many of the impacts can be minimized by timing of in-stream work to avoid disturbance to the aquatic species sensitive to siltation or reducing considerably the duration of activities involving earth work and other construction related operations to a minimum during the laying of a pipeline or a road through sensitive habitats (Box 43). Coordinating the timing of mining and dredging activities can also help in avoiding impacts on movement patterns and disturbance to sensitive animal and plant communities.

BOX 43 **Time reduction in laying pipeline through hoolock gibbon habitat in Bangladesh** (Source: Mr. Imaduddin, Petro Bangla)

A major gas field was discovered in the NE of the country, which required development for meeting the gas supply. The development required laying a transmission pipeline through a reserve forest (Leuwachhera) which is ecologically sensitive and home to endangered hoolock gibbon among other wild life. The alternative to the pipeline was a very costly and roundabout detour. To keep ecological disruption to a minimum, the mechanical work was all done away from the forest, while the trench digs and pipe laying was done very quickly. This resulted in a minimum disruption to the wildlife habitat, and the restoration was done to its original level. Since the pipeline is underground and requires no maintenance, there are no anticipated impacts on ecology of the area. The cautionary part remains in the unlikely event that the pipeline is damaged by human or natural reason, which may require man and machine intervention.

- ***Landscape and urban planning***

This form of mitigation is aimed to provide an appropriate fit within the physical landscape and to build upon the existing landscape character where possible. Planning measure for landscape level impacts is more relevant in the context of mining operations that are planned by different companies in isolated pockets within a larger landscape. An integrated restoration plan will have greater merits than the 'patch work' by independent mine owners for restoring the ecosystem values of smaller areas within the landscape level. Practitioners involved in conducting impact assessment of several mines within the same landscape should emphasize the development of integrated conservation plans. The plan should clearly define the stakeholder, their collective responsibility and financial liabilities depending both on the scale of development and the anticipated impacts.

> In India, the proponents seeking authorization for new mining proposal amidst the cluster of other operating mines in the landscape are generally required to provide a statement of consent to make contributions in integrated conservation plans already being implemented by operating mines before their proposal is considered for environmental clearance.

- ***Rescue (relocation, translocation)of impacted species and habitat components***

This represents examples of translocation of plant/animal/habitat component from sites of disturbance to other suitable sites of known occurrence and distribution (Box 44 and 45);

BOX 44 **Relocation of an endangered pitcher plant species** (Source: Environmental Protection Department ,Government of Hongkong, 1997)

The North Lantau Expressway in Hong Kong is a 12.5 km-long dual three-lane expressway with a driving speed limit of 100 km per hour connecting the urban areas of western Kowloon to the new Chek Lap Kok Airport. The expressway takes the form of a linear structure along the northern coast of the Lantau Island built on hillsides and partially on reclaimed land. The construction involved excavation of 6.3 million m^3 of soil and rock and the removal of 10 million m^3 of dredged material from the surrounding sea bed, and a further 14 million m^3 of marine sand fill and 4 million m^3 of seawall rock form the roadwork. This is the first highway on the island. During site clearance of a slope in Tung Chung, a protected species of pitcher plants (*Nepenthes mirabilis*), was observed by the resident environmental staff on routine site inspection. Through liaison meetings with concerned parties, the pitcher plants were transplanted away from the damage sites.

BOX 45 **Translocation of aquatic species** (Source WII, 1994b)

The construction of a dam on river Narmada in India has major implications on the habitat of several endangered aquatic species. The study conducted by WII predicted that the conversion of a free flowing river ecosystem into a reservoir would result in direct impacts of total loss of the habitats of smooth coated Indian Otter from the submergence zone of the dam. As part of the mitigation planning for rescuing of the otter, that are likely to be impacted by the construction of the dam across river Narmada, habitat condition in alternative locations were assessed. The mitigation plan was finally developed suggesting rehabilitation strategy using capture and translocation method for the impacted populations. For *mugger*, the crocodilian species to be impacted, by the dam construction, the restoration measures recommended captive rearing and release in other suitable rivers that have recorded distribution of *mugger* crocodile in Central India.

- ***Restoration or remediation measures***

There may be situations where some damage to biodiversity is unavoidable, making restoration or remediation necessary (e.g. Box 46). The objective of ecological restoration is to re-establish a functional ecosystem of a designated type that contains sufficient biodiversity to continue its maturation by natural processes and that can encourage wildlife species to immigrate back into the areas. The removal and storage of top soil for restoration of wetland and terrestrial habitats and collection of seeds to ensure a supply of locally adapted native seeds for restoration are some of the examples of restorative approaches adopted at mine sites. The two attributes of biodiversity that are most readily attained by restoration are species richness and community structure. A number of successful restoration, rehabilitation and conservation efforts have been successfully applied at projects throughout the world (Johnson & Putwain 1981; Sengupta 1993; Perrow & Davy 2002). This option attempts to rectify the damage to ecosystem to restore it to its pre-existing condition but this is strictly not the case as some aspects of the pre-existing ecosystem cannot be fully restored. These should be identified and accepted as exceptions. On-site restoration measure has been termed as in-kind (as the historic type of ecosystem is restored) and onsite (as the restoration occurs at the same location where the historic ecosystem was damaged).

BOX 46 **Restoration of mine sites for revival of local benefits** (Source: Pandey *et al.*, 2005)

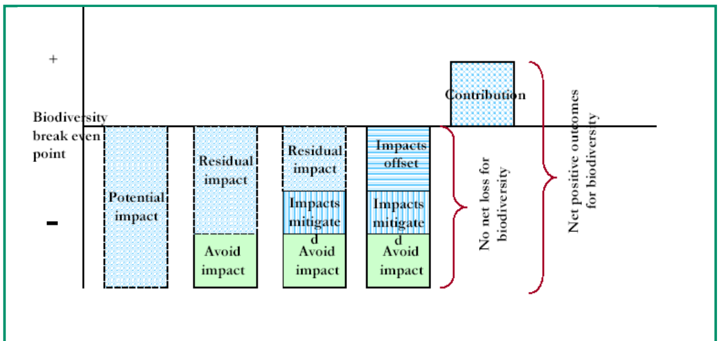
The state of Rajasthan in India presents evidence for the existence of one of the most advanced examples of ancient mining and accompanied deforestation to be found anywhere in the world. Mining continues to be an important economic activity contributing to 2% of the State Domestic Product and providing at least a 1.76 % share to the regular employment pool in Rajasthan. However, economic benefits of mineral extraction also accompany ecological, economic and social costs. Overburden dumps and mined out areas present ugly picture of natural and cultural landscape.

Realization that, mine wastes can be transformed into an opportunity for learning, adaptation and productivity enhancement for sustainable livelihoods through ecological restoration is leading to the development of innovative strategies for mine spoil restoration that is aimed at creating a multifunctional ecosystem in mine waste dumps. Considering that the state of Rajasthan is a water scarce area, dredging and sediment removal from traditional tanks and ponds is now being recommended to be used to prepare the substratum over the mine wastes for direct seeding. The mined out pits will also create enhanced decentralised water storage capacity for wildlife and people, by facilitating access or pumping out arrangements.

The strategy combines the concomitant revival of traditional water harvesting systems, ground water recharge, enhanced biomass production and an adaptation to random recurrence of droughts in Rajasthan.

Compensation

This approach recommends adopting measures that "compensate" for the residual, unavoidable harm to biodiversity and peoples resource areas caused by development projects, so as to try at least to offset the harm. Such compensation measures are aimed to at least ensure 'no net loss in biodiversity'; but may contribute to a positive planning for biodiversity and may even lead to creating win-win situations" (Kuiper, 1997; Vägverket, 2002; ten Kate *et al*., 2004). Compensation for lost resources may be "in-kind" (e.g. replacing wetlands for lost wetlands) or "out-of-kind" (e.g. construction of a fish hatchery for lost fish spawning areas). Compensation may be onsite (e.g. restoration of forest area within the forest belt cleared for a mine, or for developing infrastructure for transportation of oil and gas); or offsite (e.g. strengthening conservation of species threatened by a proposed development at another site) or off-site offset through a third party where, a developer purchases biodiversity credits or pays a third party to provide an offset *ex ante*. Compensation measures may be adopted during the planning process to develop 'like for like options for developing long term conservation benefits for offsetting the impacts on biodiversity. Compensatory measures may also be implemented after the construction of the project by utilizing funds from the project generated revenue stream or from local, national or international funds. The concept of 'biodiversity offset' is an emerging concept as compensation measures to achieve a biodiversity break even point (Figure 15). At present, there is no universally accepted definition for offsets. A working definition to explain the concept defines offsets as environmentally beneficial activities undertaken to counterbalance an adverse environmental impact, aspiring to achieve 'no net environmental loss' or a 'net environmental benefit' (WA EPA, 2004).



(Source: ICMM, 2005)

Figure 15 The concept of biodiversity offset

The following are the approaches for developing offsets against loss or degradation of biodiversity, ecosystems and ecosystem services:

I Conservation actions

- ***Establishing corridors through securing the conservation management of land that provides biological corridors between protected areas.***

Ecological engineering solutions for creation of passages for species across new roads and for restoring lost biological corridors certainly represents an important strategy for offsetting impacts of species isolation, mortality and habitat fragmentation by existing roads. For detailed guidance on nature engineering solutions, practitioners need to refer to the existing guidance sources (McKinney & Murphy, 1996; Cuperus *et al.*, 1999; van Bohemen, 2004).

- ***Upgrading protection in non designated areas for enhancing protection to endemic and endangered species and enlarging areas under existing PAs.***

This approach follows the precept of conservation science that advocates strengthening of conservation efforts by placing land into protected areas and nature reserves for reducing its vulnerability to threats or strengthening ineffective protected areas by improving the conservation status of certain neglected zones. Examples in Box 47 illustrate the biodiversity benefits of such offset approaches.

BOX 47 **Examples of offsets aimed at improving conservation prospects by creating PAs**

1. A conservation project in the Succulent Karoo in South Africa provides an example of a collaborative approach to conservation at the landscape level. The Succulent Karoo is the only semi-arid biodiversity hotspot and is home to 6356 plant species, 40 % of which are endemic. Yet only three percent of its 116 000 km^2 is protected. Anglo Base Metals operates a zinc mine in one of the most biologically important, yet unprotected, areas in the Karoo and has plans to begin operation of a second area. With the intention of minimizing the damage of its activities on biodiversity, the company joined with conservation groups, communities, farmers, tourist operators and government agencies in a landscape-scale conservation planning process. The approach, Systematic Conservation Planning, identified conservation outcomes based on identifying a set of options for meeting scientifically set conservation targets. An outcome of the study is a proposal to establish a protected area that will be nested within a much larger multi-use landscape with other parts being managed extensively for grazing and a third area being located for more intensive development activities, including mining. A feature of the protected areas is that multiple landowners, including the mining company, control the land. This provides the window for the company to contribute to biodiversity conservation, not simply by reducing its impact but also in terms of making a measurable positive contribution to the protection of biodiversity (Maze 2003; Driver *et al.,* 2003).
2. In June 1999, BP Petronas Acetyls, a joint venture between BP and Petronas, partnered with the Malaysian Department of Fisheries and the World Wide Fund for Nature Malaysia to create the Ma'Daerah Turtle Sanctuary in the state of Terengganu, Malaysia. BP has three petrochemical plants in Terengganu and there are significant oil and gas reserves off the east coast of the state. Terengganu is home to about 70 percent of Malaysia's turtles and the sanctuary is an important nesting habitat for three species of marine turtles and the painted terrapin. It is the first turtle sanctuary to be funded by the private sector and the second largest sanctuary in Malaysia (EBI, 2003b)

- ***Building partnerships for enhancing biodiversity conservation in habitats on private land***

There are a many business organizations that have shown a strong interest in pursuing partnerships with conservation organizations to capture opportunities for the conservation of high priority areas (Box 48 and 49).

BOX 48 **Logging company's willingness to help in inventorying biodiversity**

In Arboria, the logging companies have extended the existing system of commercial inventorying (which constitutes the baseline) to include a comprehensive inventory of the remaining biodiversity to assist Forest Department in profiling of the biodiversity of one of the mega diversity 'hot-spot' countries and provide the basis for the design of conservation measures in the medium and long term (Source: Kumari & King, 1997).

BOX 49 Examples of partnerships between business groups and conservation organizations

Contribution of an oil company for conservation planning in Indonesia

Indonesia's Papua Province (formerly called Irian Jaya) on the western half of the island of New Guinea is the site of BP's proposed Tangguh Liquefied Natural Gas (LNG) facility. Papua Province also is home to around 54 per cent of Indonesia's exceptionally rich biodiversity. This area was selected for one of BP's conservation projects for 2002—it is the focus of part of BP's Biodiversity Action Plan (BAP) for Indonesia. The Papua Province parts of the BAP aims to contribute to world-class conservation projects in partnership with external organizations such as governments, conservation groups, local communities, educational institutions and private enterprise. The plan currently includes eight elements covering a broad spectrum of programmes and publications. For example, BP is working in partnership with The Nature Conservancy (TNC) and others to develop a conservation training and resource Centre and to develop a locally owned management plan for the old growth mangrove nature reserve, located 80 kilometres east of the planned LNG facility (Source: IPIECA , 2000).

Contribution of a mining company in conservation of forest biodiversity

An innovative approach is presently underway in the State of Tamil Nadu in India. Here an earlier set up alumina refinery was fed from a leased out mine located in the state of Karnataka. Upon expiry, the mining lease was not renewed and the concerned company had to source the ore from within Tamil Nadu. Having located in a mine site in a degraded forest area in Eastern Ghats, the State Forest Department agreed toconcur in leasing on a condition. The company was asked to buy out and hand over to the State Forest Department a private estate in the highly biodiverse Kalakad Mundanthurai Tiger Reserve in the Western Ghats. This private estate harbours pristine evergreen and moist forest. The company has consented to this condition in lieu of the need to raise compensation afforestation over twice the mining lease area. It is in the process of buying out the said private forest nearly twice the size of the sought out alumina mining lease area (Source: *Pers com.* Mr. C.K. Sridharan, PCCF, Tamil Nadu).

- ***Creation of another kind of regional ecosystem to replace one which was removed from a landscape that became irreversibly altered.***

This option is important for restoring natural areas in an urban context where, for example, original ecological or hydrologic conditions cannot be restored or *where an altered environment can no longer support any previously occurring type of regional ecosystem.* Examples of such forms of measures is the creation of lake ecosystems in mined out voids where the ratio of excavated ore to waste is so low that there is not enough volume of overburden for backfilling of void. With the management of such artificially created water bodies on scientific principles as wetland ecosystems, they can become excellent habitats for a wide variety of wetland birds including the migratory species. There are some excellent examples of such wetlands providing fishery resources to local communities as a goodwill gesture of the company for compensating for some losses of biodiversity resources in the developed sites. Box 50 provides examples of mine voids converted to wetlands.

BOX 50 Conversion of mine voids into wetlands

1. Sesa Goa is the largest private sector exporter of iron ore in India producing 9 million tons of iron annually for clients in Europe. The company has a full fledged team to plan, monitor and implement environmental management. The pit in Sanquelim mine in Goa has been converted into a pisciculture pond. The fishery resources are being used by local communities. The overburden dumps are planted with native species of economic value (Source: Sesa Goa pers. comm.).
2. The mine void created after the mining of limestone from the mines of limestone from the mines of M/s Narmada Cements in Amreli district of Gujarat state of India has been developed into a wetland which is being visited by several migratory birds (Source: WII, 2005).

- ***Safeguarding unprotected areas by entering into agreements with local communities as custodians of biodiversity.***

BOX 51 **Opportunities for benefiting biodiversity conservation from oil and gas development** (Source: EBI, 2003b)

In 1994, Statoil began construction on the Euro piped natural gas pipeline from Norway to Germany. The pipeline included a 619 km offshore segment from Norway that comes ashore in the Lower Saxony Waddensea National Park and continues for 48 km. Finding an acceptable landfall for the pipeline to come ashore in the park was a major challenge. Planning of the pipeline, in consultation with German authorities, began nearly a decade before construction. A total of ten alternative landfall locations, and 12 variations of those, were developed for review by the authorities. After a lengthy planning process, a route that includes a 2.6 km tunnel under the tidal flats was chosen for crossing the park. The route was expected to have temporary, but still significant impacts on the natural environment. To offset the effects, Statoil, in keeping with German law, constructed a 17 ha biotope with ponds and sand dunes close to the pipeline metering station, on land that was previously an extensively used agricultural field with a relatively poor flora and fauna. The area has since developed into a habitat for a number of rare and threatened species of plants.

- ***Restoration of biodiversity for biodiversity-dependent livelihoods***

Mitigation options for upstreaming biodiversity in development scenarios should take into account local community gains and, at the very least; there should be no net losses to the local community. No investment should take place unless there are mechanisms in place for ensuring that the project creates prospects for local people's involvement in arrangements that secure alternatives for *status quo* biodiversity benefits enjoyed prior to granting of development consent (Box 52). In developing measures for compensating biodiversity losses, for example, through the creation of additional buffers around existing PAs or creation of a new PA by purchasing land, the costs to biodiversity dependent communities associated with this measure such as foregone uses (use of areas for hunting, collecting forest products, or as a source of new agricultural land) must be considered.

BOX 52 **Compensating opportunity costs and foregone benefits in mitigation planning** (Source: Kramer, 1996)

The example of Mantadia National Park, a newly established area in the eastern rainforest of Madagascar, is presented as a case example. It was estimated that the mean value of losses for the local villagers who are dependent on the forests within the park for their livelihood was $91 per household per year. A survey concluded that on an average, a compensation of $108 per year and per household would make households as well off with the park as without. However, there are few cases in which actual compensation of residents living near protected areas was given. The conclusion is that opportunity costs to local residents must be taken into account in the establishment of protected areas and that these costs might have to be compensated for the project to be sustainable in the long run.

II Innovative approaches and measures for compensating and offsetting biodiversity, ecosystem and ecosystem services

The underlying rationale for compensating and offsetting losses to biodiversity, ecosystem and ecosystem services in mitigation planning of development proposals recognizes that such resources are both ecologically and socio-economically valuable. There is therefore growing interest in developing innovative approaches and measures, some using the logic of the market to compensate such losses (DEC, NSW, 2006). The real rationale for compensation emerges from a principled foundation, namely the proverbial "polluter or damager pays principle". Simply put, those that inflict damage on biodiversity, ecosystems and ecosystem services should compensate those who bear the costs of damages through monetary and/or non-monetary payments. Empirical evidence suggests that it is the poor who are most dependent on biodiversity and ecosystem services for their livelihoods and health and suffer most when ecosystem services deteriorate. Innovative measures and approaches need to be inherently pro-poor to benefit this target group. While these innovative approaches and measures are discussed here under compensation, they are equally applicable to minimizing and reducing impacts aspects. Biodiversity offsets and other approaches and measures are discussed below:

- ***Compensation through project revenues***

Compensation for biodiversity, ecosystems and ecosystem services can be designed through the revenues of the project in monetary or non-monetary forms made by those whose actions modify biodiversity and ecosystems in a way that is perceived to be harmful to the ecosystem services (Box 54). Such measure can be either in cash or in-kind (for example, through social programs to compensate target groups for deteriorating income or access opportunities related to ecosystem services) or both. In-kind measures should also consider the thorny ***property rights*** issues of local communities. Often local communities have no or unclear, vague rights over land occupied by biodiversity and thus those who damage the resources do not have to compensate those who suffer damages. Compensation measures should seek to both enhance the access of local communities to biological and ecosystem resources or to increase their ownership of such resources.

- ***User fees, charges, taxes and royalties***

As the polluter or damager pays principle suggests, it is possible to impose on the project beneficiary user fees, taxes and charges or a combination depending on the circumstance. There is a growing need to explore and integrate these economic measures into environmental management plans, for example through the imposition of a tax for securing funding for compensation, minimization, rehabilitation and restoration efforts. Taxes, user fees and charges, for example, can be levied on resource extraction, such as mineral, petroleum resources and hydropower, and on discharge of effluents into water sources. The advantages of these measures are that they not only raise revenues but also provide incentives to users to curb and minimize damage through optimum use of resources. There are a few example of using taxes, user fees and charges for conservation of biodiversity, ecosystems and ecosystem services, however, the challenge would be to use the revenue generated for compensation (see Box 53).

BOX 53 Funding for conservation from finance generated from tax and fee

One of the more spectacular examples of using royalty money for social and environmental programs, as well as a broad range of other governmental services was established as part of the agreements between the US Federal government and the State of Alaska as part of the compensation for constructing the Alaskan Oil Pipeline. Royalties, together with taxes, paid by the oil companies for use of the pipeline are used to fund the majority of the Alaska State Government and a portion of the payments are contributed annually to a permanent investment fund. In 1999, over US$1.2 billion (approximately 20% of the state's total revenue) was paid to the state by the oil companies with an additional US$1.4 billion (about 22% of the state's revenue) (State of Alaska, www.alaska.com) contributed by the US Government for use of the State's resources. Consequently, the environmental management agencies are able to implement a variety of management programs through funding received under the allocation process during the annual budgeting process.

- ***Bond and funds for mitigating impact risks***

Environmental bonds are economic instruments that aim to shift responsibility for controlling pollution or damage, monitoring and enforcement to project beneficiaries who are charged in advance for any potential damage. As opposed to governments picking up the tab for clean up or restorations of damages, environmental bonds shift the burden of payment to project beneficiary and thus provide incentive to minimize pollution and damage. Environmental bonds can be instituted by the government for compliance with environmental rules and presumptive charges based on engineering or statistical output-waste coefficients. Environmental bonds can ensure that the project beneficiary takes adequate measures to minimize damage caused to biodiversity and ecosystems by their activities; clean up and restore residual damage in the most cost-effective manner; and have adequate funds available for clean up and restoration if the project beneficiary fails comply.

Environmental funds are financial instruments used for managing financial resources and disbursing these for initiatives that help conserves biodiversity. One of the unique characteristics of environmental funds is that they are instrumental in building local capacities, while leveraging additional funding for conservation. Together with their focus on long-term biodiversity financing makes them an excellent example of a sustainable financial product. Environmental funds can be an important focal point for channelling financial resources generated from other listed innovative mechanisms, donor funding and government allocation. It is important, however, to bear in mind that the effective and efficient management and operation of an environmental trust fund requires a certain level of government capacity be built for this purpose.

In terms financial arrangements, environmental funds can be set up as endowments, sinking or revolving funds or any combination of the three. Endowment funds, for example, invest the entire funding raised and use the interest earned to finance conservation activities. Revolving funds are set-up to disburse and replenish funds on a periodic/annual basis, for example, annual earmarked revenues from government budgets, pollution charges, payments for ecosystem services, etc. can be allocated to replenishing revolving funds. Finally sinking funds are meant to disburse their entire funds over a defined time period, for example, 5 years. Environmental funds can be used to finance many initiatives including impact mitigation, research, data collection, monitoring, short-term or long-term training, public awareness and pro-poor conservation and development.

- ***Labelling and certification***

Labelling and certification is an innovative measure to create a link between the demand and supply side of the market and establish an advantage for those who preserve biodiversity by labelling their products. Such scheme additionally also provide reputational benefits to business groups. The advantage of this type of measure is that it provides the project proponent with an incentive to minimize impacts. Furthermore, the increase in marginal revenues from labelling schemes can be used to secure funding for compensation, rehabilitation and restoration efforts. For information on labelling scheme which is already being implemented in India refer to Box 54.

- ***Tradable rights, offsets and concessions***

In this context, these measures are essentially the rights to trade uses of biodiversity and ecosystem services. From the 'sellers' perspective, in this case the local community or communities or the state, trade away the rights to ecosystem resource use for compensation. From the buyers' perspective, it can be either (a) an opportunity to 'off-set' transactions, or (b) a buyer with a conservation objective who buys the rights in order not to utilize them (e.g. the conservation concession concept). Tradable rights, offsets and concessions are trading instruments for counterbalancing the harm to (endangered) biodiversity, ecosystems and ecosystem services by monetary and non-monetary payments, creation of ecologically comparable area(s) managed for biodiversity and ecosystem services, and foregoing uses of rights to use ecologically important areas through purchases.

BOX 54 **Eco-labelling scheme**

To increase consumer awareness, the Government of India launched the eco-labelling scheme known as `Ecomark' in 1991 for easy identification of environment-friendly products. The criteria follow a cradle-to-grave approach, i.e. from raw material extraction, to manufacturing, and to disposal. A product is examined in terms of its proven contribution in saving non-renewable resources including non-renewable energy sources and natural resources compared with comparable products.

An earthern pot has been chosen as the logo for the Ecomark scheme in India. The familiar earthern pot uses a renewable resource like earth, does not produce hazardous waste and consumes little energy in making. Its solid and graceful form represents both strength and fragility, which also characterises the eco-system (CPCB, Ministry of Environment & Forests, Govt. of India, http://www.cpcb.nic.in/index_ecomark.htm).

Although experience from around the world (Earthwatch *et al.,* 2002; World Bank, 2003; EBI, 2004; IUCN & ICMM 2004; ten Kate *et al.,* 2004) provide ample evidence of the applications of biodiversity offsets, practitioners must recognize that offset approaches have inherent risks of being misused as a universal antidote to weak enforcement of regulatory controls and implementation of conservation measures in natural area. The application of offset approaches must adopt good practice principles (Box 55) that have been laid down based on global experience and trials with offsets (ten Kate *et al.,* 2004).

BOX 55 **Good practice guidance for developing biodiversity offsets**

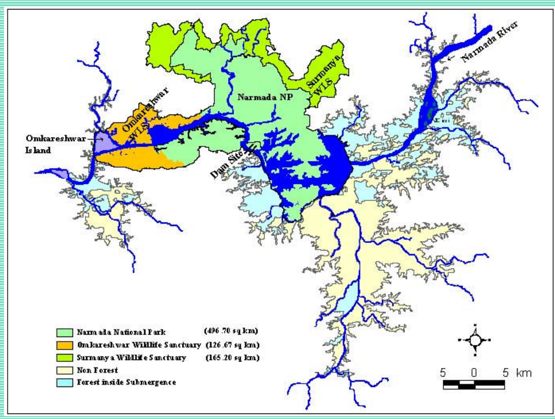
- The application of offsets should be necessitated in the context of only those developments that are legally appropriate and federally authorised, and where the developer has first used best practice to avoid and minimize harm to biodiversity.
- Offsets are no substitute for "no go" areas.
- Offsets are not a project negotiation tool.
- Offsets must not reward on going poor environmental performance.
- Offsets should follow the principle of 'like for like or better' and therefore must result in a net conservation benefit.
- Offsets should follow the mitigation hierarchy.
- An environmental offset package should address both direct offsets and contributing offsets.
- Biodiversity offset should represent a conservation benefit that would not be possible without the investment companies' contribution and must overcome impacts of temporal gap between project impacts and offset benefits.
- Offsets must have local context and must be sensitive to indigenous people's rights.
- Should be convincing and the impacts should be quantifiable.

- ***Enhancement***

Enhancement options are aimed at providing new benefits for biodiversity. When a negative change in quality and quantity of a biodiversity resource, diversity and function occurs, one means of addressing the new effects is to establish enhancements that minimize or alleviate these effects. Such enhancements use technology, natural materials and policy interventions to alter or modify habitat conditions. By so doing, non desirable habitat conditions can be offset to the greatest extent possible by improving resource condition through improved management, better conservation practices, and higher level of protection. Examples of enhancements include using sustainable drainage schemes so that drainage infrastructure also acts as biodiversity habitat; landscaping in additional areas so that planting within them forms a wildlife corridor and habitat link between areas of habitat adjacent to the site; creating new protected areas for protection of endangered species (Box 56), changing water flow conditions to meet the habitat needs of particular species Apart from improving the quality of the development and its environment generally, enhancement options offer the advantage of improving the sustainability of the project and its compliance with planning policies.

BOX 56 **Project analysis and conservation approaches for mitigation planning** (Source: Rajvanshi *et al.,* 2002)

Submergence and diversion of forests and concomitant loss of floral and faunal diversity with attendant human aspects are some of the major impacts of Narmada Sagar dam constructed across river Narmada in Madhya Pradesh state of India. EIA studies conducted in the area confirmed that the wildlife species (floral and faunal) and vegetation associations found in submergence area were not unique to the project area. The mitigation measures proposed for the restoration of the lost biological values included creation of Protected Areas (PAs) to include parts of the forest and the river ecosystem adjoining the project area.



Restoration of some of the aquatic vertebrate species and the delineation of a substantial area of the contiguous forest that has conservation values similar to those that are being lost in submergence is the underlying philosophy of the mitigation planning for this project.

Creation of three new PAs - Narmada National Park (496.70 km^2), Surmanya Sanctuary (126.67 km^2) and Omkareshwar Sanctuary(119.96 km^2) comprising of a total area of 743.33 km^2 under Protected Areas, has been recommended to fulfil the twin objectives of conserving wildlife in remnant areas and providing sustenance to forest dependent communities (see figure in inset). The alignment of the proposed PA boundaries that include a part of the reservoir ecosystem, the largest forest island, the draw down areas and contiguous forests, lend some special features to the PAs and at the same time provide a good mix of habitats with concomitant floral and faunal values. By appropriate management interventions in the fringe forests and the draw down areas, the overall habitat values would be enhanced over a period of time.

The role of economist in mitigation planning for biodiversity, ecosystems and ecosystem services

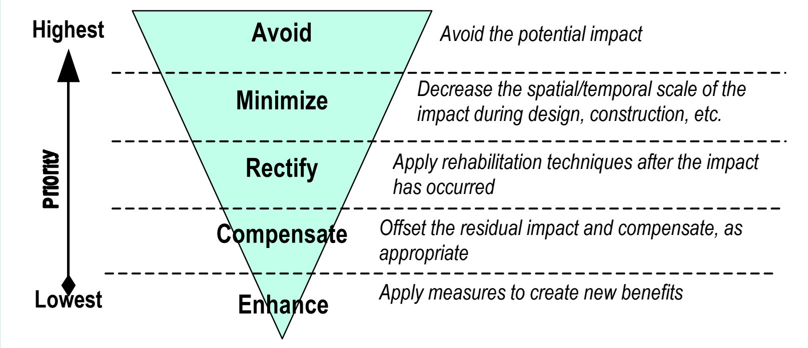
Implementation of innovative approaches and measures for minimizing, reducing and compensating impacts require professional expertise of an economist. It is not only important to demonstrate and determine the economic value of biodiversity and ecosystem services, it is also crucial that these values be captured through innovative approaches and measures for the potential financial support for conservation and enhancement of biodiversity and ecosystem services (Hagler-Bailly Canada, 1998; Aylward, 1999; Vorhies, 1999). The key role of the economist in mitigation planning for biodiversity, ecosystems and ecosystem services can be summarized as follows:

- Assessing the economic value of biodiversity and ecosystem services costs and benefits, identifying who benefits and who bears the cost of biodiversity and ecosystem service provision and the distribution of these between users, beneficiaries and cost-bearers.

- Identifying current disparities in biodiversity and ecosystem services cost and benefit distribution, in order to determine where there is potential to capture benefits or charge beneficiaries in order to generate financial resources, and where there are needs to compensate or fill current financing gaps.
- Designing actual mechanisms to capture benefits offset costs and improves the financial equity and sustainability of the mitigation management processes. For this, both non-market and market-based financing mechanisms that target important ecological areas and poor local communities need to be worked out.
- Establishing the institutional, policy and management conditions required to set in place pro-poor financing mechanisms as a part of mitigation management plan, through the development of concrete financial strategies and plans for implementation.
- On-the-ground piloting of selected pro-poor financing mechanisms.

Setting priority for mitigation: Hierarchy of mitigation measures

As a general rule, mitigation should follow a hierarchy presented in Figure 16. Impacts on biodiversity should be first avoided wherever possible, minimized where they cannot be avoided, and mitigated where there are residual impacts. During the development phase of a project, there should be a rigorous assessment of all options including 'do nothing'. Offsets may be useful in mitigating residual impacts, and preference should be given to on site offsets that are aligned with local, regional, national and international conservation strategies and goals and that may at least lead to 'no net loss' but should be aimed to bring a net positive benefit for biodiversity conservation. These distinctions should not be very rigid and opportunities for creative mitigation should be sought at all stages of EIA and project planning.



(Modified from UNEP 2002 and Rio Tinto, 2004)

Figure 16 Hierarchy of biodiversity mitigation measures

Incorporating mitigation measures in Environmental Management Plan

The Environmental Management Plan (EMP) that incorporates the mitigation plan for biodiversity as part of the EIA report must clearly reflect the ecological impacts, economic objectives of various mitigation measures that are proposed and possibly the stage at which these should be implemented and by whom with possible indcations of risks and contraints. Development of a biodiversity action plan (BAP) is a possible mechanism by which the objectives and targets for biodiversity conservation can be achieved. The BAP can either be a stand-alone plan or be integrated into the Environmental Management Plan. Similarly, Conservation Plans should incorporate Species Action Plans (SAPs) where the mitigation is targeted for protection of a specific species and Habitat

Action Plans (HAPs) should target habitats of rare and endangered species. These BAPs, SAPs and HAPs should set out targets for the conservation and enhancement of particular species or habitats, measures needed to essentially achieve them and in the allocation of responsibilities for implementing various measures. Table 14 provides a format for adapting good practice approach for development of EMP.

Table 14 Mechanism for generating financial support for developing offsets to compensate the impacts of developments in road, mining and oil and gas sectors

Sector	Economic impacts	Financial mechanisms for offsets	Stage of implementation	Implementing organizations	Constraints in using environmental mitigation or compensation
Road					
Mining					
Oil and gas					

Sectoral approach

Roads

Road construction is often at odds with objectives for biodiversity because the construction and improvement of roads can lead, directly or indirectly, to several irreversible biodiversity losses and degradation of natural habitats. However, many potentially serious conflicts between road projects and biodiversity conservation can be avoided by careful routing and sensitive design. Where some natural habitat loss is inevitable, appropriate mitigation measures may be helpful in positive planning for biodiversity. In order to improve planning for biodiversity and mitigating the unavoidable ecological impacts of roads, management agencies and researchers around the world have evolved best practice guidance. The practitioners are advised to refer to Table 15 for list of guidance documents relevant for assessment of biodiversity impacts of road projects.

Table 15 Existing guidance on mainstreaming biodiversity in road projects

Patricia A. White and Michelle Ernst (2007). ***Second nature: Improving transportation without putting nature second.***
http://www.transact.org/library/reports_pdfs /Biodiversity/second_nature.pdf (last accessed on 2007).

This report showcases innovative programs and partnerships pioneered by state and local agencies across the nation to more effectively coordinate transportation, land use, and resource planning and investments. The case studies demonstrate how transportation agencies can both improve project delivery and better protect environmental and cultural resources. The report concludes that goals can be achieved by planning early in the process for biodiversity conservation, by integrating environmental knowledge into transportation plans, and through better coordination among agencies.

Byron, H (2000). ***Biodiversity Impact – Biodiversity and environmental impact assessment: A good practice guide for road schemes.*** **The RSPB, WWF-UK, English Nature and the Wildlife Trusts, Sandy, Beds.**

This good practice guide has been developed to improve the consideration of biodiversity in development decision-making by providing best practice guidance on the treatment of biodiversity impacts in Environmental Impact Assessments (EIAs). The guide provides a detailed approach for road schemes based on an in-depth analysis of recent road EIAs. Part I of this guide provides an introduction to biodiversity and explains the need to consider it in detail in EIAs. It discusses the concept of biodiversity, how biodiversity differs from the traditional concepts of ecology and nature conservation, the UK biodiversity process, why biodiversity must be considered in EIAs, and current treatment of biodiversity in road EIAs. Part II provides detailed technical guidance for considering biodiversity in road EIAs. Over-arching principles are explained and advice given on how to deal with biodiversity in different stages of the EIA process. This guidance is particularly relevant to consultants and ecologists carrying out EIAs, and decision-makers evaluating the detailed content of EIAs.

Rajvanshi, A., Mathur, V.B., Teleki, Geza C. and Sujit K. Mukherjee (2000). ***Road, sensitive habitats and wildlife: Environmental Guidelines for India and South Asia*****. Wildlife Institute of India, Dehradun and Canadian Environmental Collaborative Ltd, Toronto, 2001, 215 pp.**
http://www.wii.gov.in/publications/eia/index.htm

The Guideline defines a basic step-by-step process that permits practitioners to incorporate wildlife and wildlife habitat conservation principles into road and rail planning. The authors have presented these steps in the context of basic wildlife biology and conservation concepts in order to provide a realistic backdrop to the wildlife-road transportation relationship. The Guide presents more than 75 accounts of actual project experiences across India and South Asia and provides six case studies that highlight lessons learned.

Sarah Barnum (2003). *Identifying the best locations along highways to provide safe crossing opportunities for wildlife.* Report No. CDOT-DTD-UCD-2003-9. Colorado Department of Transportation.
http://ttap.colostate.edu/Library/CDOT/CDOT-DTD-UCD-2003-9.pdf

This document is primarily a manual to aid highway planners and designers in managing wildlife crossing of roadways. The handbook describes the highway and landscape variables that highway planners/ designers should consider when choosing the best locations for mitigation that helps medium and large-sized mammals cross highways safely.

Best practice guidance for mitigation of road related impacts has been focused under the following broad headings:

Highway design

Designing of crossing structures that incorporate safe crossing and that guide animals to those locations that facilitate maximum utilization of habitat in a given landscape are the main mitigation techniques that are employed in road projects. Appropriately designed and suitably located culverts of varying sizes, underpasses and fences provide effective mitigation to overcome barrier effects of roads.

A growing body of literature exists with respect to wildlife crossing structure design, location and function. From elevated highways to the smallest culverts, crossing structures incorporated into transportation infrastructure provide an important function in wildlife ecology. Numerous methods to mitigate variety of impacts on vertebrates have been discussed by Yanes *et al.*, 1995; Land & Lotz, 1996. The efficacy of the different type of crossing structures is linked to their management, design, and placement into the landscape. According to Rodriguez *et al.*, 1996, the most significant factor affecting the use of culverts by fauna is the location of the underpass and the degree to which they connect suitable habitat patches. The structure of the surrounding landscape and the species in question are the other important considerations in designing of crossing structures and identifying crossing locations. The following aspects need to be specially considered in developing strategies for a highway design:

- Use habitat suitability as the primary indicator of crossing activity.
- Consider how landscape structure interacts with habitat suitability to either increase or decrease the level of use of an area of suitable habitat by a particular species.
- Consider how the design of the existing highway interacts with habitat suitability and landscape structure to influence crossing behaviour.
- Synthesize the information by mapping the landscape and roadway features/conditions known to be associated with crossing or to be attractive/repellent to the species present.
- Use these maps to identify the most likely crossing locations.
- Animals are more likely to cross highways at certain locations at both the landscape and the local scale. Quantitative as well as visual analyses of the patterns created by the distribution of track records along the roadside serve as reliable basis for mitigation planning.

Effective wildlife corridor design

Some corridors provide little resources to the animal other than passage to isolated fragments; others incorporate enough natural habitats that may encourage animals to use corridors for foraging or even reproduction requirements (Gibeau *et al.*, 1994; Rosenberg *et al.*, 1997). Seasonal movements in topography and latitude can be fostered by the existence of corridors. There is enough evidence to suggest that effective corridors can provide an important refuge for an animal, providing both a path with high visibility and escape terrain (Saunders *et al.*, 1991; Gibeau *et al.*, 1994). The two key questions that should be helpful in planning wildlife corridors are:

How much habitat is actually affected by a new road?

To what extent is biodiversity reduced in the areas adjacent to roads?

Managing impacts

Biodiversity loss and environmental damage can be considerably reduced when planners and road construction agencies site roads adjacent to existing railways, pipelines, or transmission lines; practice sound road engineering; maintain good drainage and natural water flows; minimize roadside habitat loss; and exercise care in the siting and design of borrow pits, construction camps, and other complementary facilities.

Maintaining safety

Increasing the use of signage to make drivers aware of wildlife in the area and reducing speed limits in wildlife areas are common approaches for preventing mortality resulting from road hits. The safety of sensitive species is of particular concern as mortality of an individual can have a much greater impact on the population (Ruediger, 1996).

Minimising unavoidable impacts

Use of conservation banking in concert with large-scale conservation plans to mitigate unavoidable impacts of transportation must be adopted as a practice.

Collaboration between planners and conservation community can produce significant net environmental benefits-a win-win outcome. Direct adverse impacts of road works on biodiversity can be significant but are generally simpler to avoid or mitigate because they are more under the control of road construction agencies, contractors, and concessionaires. Environmental rules for contractors, including transparent penalties for non-compliance, must be incorporated in bidding documents and contracts.

Mining

The obvious sites of mineral explorations are the areas that have viable ore bodies. The occurrence of these ores is invariably located in high biodiversity regions (WRI, 2006). As the mining activities are likely to expand in future with the discovery of new mineral resources and the development of new mining and metallurgical technologies, there will be a greater onus on mining companies to ensure that they create a smaller footprint by sound and effective mitigation planning. Today, both onsite and offsite opportunities are being pursued by leading companies to enhance their contributions to biodiversity conservation. A number of companies have established partnerships with conservation groups, and these are beginning to deliver real on-the-ground conservation outcomes.

The impacts associated with simultaneous or sequential phases and activities of a typical lifecycle have already been discussed in evaluation section earlier in this document to help identify critical issues that surround mining projects. The range of best practice guidelines that already exist for mining activities (Table 16) should prove helpful to practitioners in building on existing experience and in understanding the range of perspectives on future options.

Table 16 **Existing guidance on mainstreaming biodiversity in mining projects**

Brodkom, F. (2001). *Good environmental practices in the European extractive industry: A reference guide*. IMA-Europe. Brussels.
http://www.eurogypsum.org/Pages/publication2.html

One of the main aims of this Guide is to play a key role in explaining how the extractive industry operates by using a series of "real-life" case studies, which illustrates a number of "good practices" employed by the industry. These case studies show how practical and cost-effective approaches or environmental protection are implemented. The guide intends to review the practices of the extractive industry, during all the steps of extraction and processing right up to the delivery of the material to the user. It also covers the maintenance and restoration of sites.

English Nature, Quarry Products Association and Silica & Moulding Sands Association (1999). *Biodiversity and minerals – Extracting the benefits for wildlife.* Entec UK Ltd., U.K.
http://www.quarrying.info/natureconservation/pdf/biod.pdf

This is a guide for planning, operating, restoring and managing mineral sites for biodiversity in U.K. Among several opportunities that are discussed here, many are relevant to every type and size of mineral site.

Sweeting, Amy R. and Andrea P. Clark (2000). *Lightening the Lode – A guide to responsible large-scale mining*. CI Policy Papers, Conservation International, Washington, DC.
http://www.conservation.org/ImageCache/CIWEB/content/publications/policy_5fpapers/papers/lighteningthelode_2epdf/v1/lighteningthelode.pdf

This paper reviews both the potential negative effects of large-scale metal mining on sensitive environments and cultures, and a range of technologies, practices and strategic approaches for both minimizing negative impacts and increasing the positive contribution of mineral development to conservation and community development. Although this guide is not meant to be a definitive guide to responsible mining, it does offer an important starting point for discussion and action on how all stakeholders can work toward "lightening the load" of mining on sensitive ecosystems and cultures throughout the world.

Koziell, I. and E. Omosa (2003). *Room to manoeuvre? Mining, biodiversity and protected areas.* IIED and World Business Council for Sustainable Development (WBCSD), London, UK.
http://www.iied.org/mmsd/mmsd_pdfs/manoeuvre.pdf

This paper provides a brief analysis of some of the dilemmas surrounding the issue of whether or not to mine in or around areas of valuable biodiversity. The information contained in this document has been taken from the debates and written material compiled under the 'Mining and Biodiversity' process of IIED's Mining Minerals and Sustainable Development (MMSD) project.

Most of these guidelines provide generic guidance on water quality management; investigating alternative locations for infrastructure and waste disposal sites, the adoption of different mining and beneficiation technologies, the use of cleaner production technologies, recycling of water and specific materials, pollution control measures, rehabilitation and landscaping, and the acquisition of additional property to compensate for habitat loss. Beneficial working methods that relate indirectly to biodiversity also have their own merits in reducing environmental impacts. For example, measures to reduce the noise and dust impacts associated with mineral transportation may have knock-on benefits for biodiversity. Reducing the amount of airborne dust that is generated by routing haul roads away from areas of biodiversity value may also help reduce noise impacts as the various biodiversity components will serve as acoustic barriers.

Guidance for improving the overall prospects for biodiversity includes:

- Adopting responsible practices with respect to biodiversity management both at the initial stages of project development and during subsequent phases of mineral exploration to reduce the footprint as the lifetime of the project gets extended.
- The mitigation strategies for unique biodiversity must respect 'no go' areas and follow the traditional hierarchy of first avoiding the impacts of mining projects.
- Stakeholder engagement has an important role to play in developing an understanding of the interfaces between mining and biodiversity and in assessing potential negative impacts. When developing mitigation measures or biodiversity conservation initiatives, attention must be given to respecting cultures, customs and values; to recognizing community perceptions; engaging local communities as stakeholders; to participating in the social, economic and institutional development of communities.
- Development of biodiversity offsets has become an established practice for compensating impacts of mining projects. Although several innovative approaches have been developed for offsets, these should be approached with caution (discussed in Box 55) to ensure that their full beneficial potential is achieved in practice.

For upstreaming biodiversity in mining projects, the following are some of the measures that need to be incorporated in specific stages of the lifecycle of a mining project:

Exploration stage

- Limiting land clearing by using technologies and mining practices that minimize habitat disturbance (for example, avoidance of biodiversity rich areas between mineralized blocks where possible to conserve biodiversity habitats and species. These can be shown in the site layout and design along with landscaping scheme prior to the grant of planning permission).
- Avoiding road building wherever possible by using existing tracks–if roads are to be constructed, use existing corridors and build away from steep slopes or waterways.
- Using lighter and more efficient equipment to reduce impacts on biodiversity.
- Positioning drill holes and trenches away from sensitive areas.

- Capping or plugging of drill holes to prevent small mammals from becoming trapped.
- Removing and reclaiming roads and tracks that are no longer needed.
- Using native vegetation to re-vegetate land cleared during exploration.

Construction stage

Construction often represents the period of greatest environmental and social disruption during the mining project cycle. Impacts of vegetation clearing in substantial areas of land for accommodating project facilities and related infrastructure; construction of access roads and other linear project infrastructure including dedicated rail lines, pipelines for transport of slurries or concentrates or power transmission lines; influx of large numbers of workers associated with the construction of mining projects; disruption of water regimes and changes in hydrology; contamination of soil and water due to accumulation of waste material or tailings should be factored into the design of mitigation measures. Development of Environmental Mitigation Plans (EMPS) should incorporate the elements of Biodiversity Action Plan (BAP), Species Action Plan (SAP) and Habitat Action Plan (HAP) discussed earlier as may be applicable in addressing biodiversity conservation concerns associated with construction phase of the mining project.

Ideally, accountability for biodiversity management should be allocated to a natural resource manager to ensure that biodiversity and related environmental and social interfaces are considered alongside production goals.

Rehabilitation of the mining site

Ecological restoration is aimed at enhancing, repairing or reconstructing degraded ecosystems for optimizing biodiversity returns. In essence, the restoration of mined land is based around ecosystem reconstruction. It is usually a question of re-establishing the ability of the land to capture and retain fundamental resources – energy, water, nutrients and species.

Ecological restoration with biodiversity benefits in mind must involve an orderly set of considerations that promote successful procedures and practices. These procedures, although based on common premise and practices for most mining projects, will have to be made more focussed and innovative and relevant to unique circumstances in each area and ecosystem. Restoration objectives must be formulated based on a good understanding of the ecosystem characteristics determined during the pre-mining environment. While the very concept of restoration generally implies reinstating the pre-mining ecosystem, the practicality of the approach would require attaining the speed of relevant biological and ecological restoration processes to achieve biodiversity targets, achieve economic balance and ensure long-term stability with ongoing management at a reasonable cost.

The restoration options may also present a choice of creating “new” habitats that are different from the ones existing before commencement of quarrying. The potential of different sites to serve as new habitats that can contribute to the biodiversity targets will however depend on a variety of factors such as: their size (given that many targets specify minimum sizes of habitat to be created); technical requirements (e.g. some sites will be more suitable for wetland habitat creation than others) and; practical issues, notably the availability of inert fill material.

Rehabilitation and restoration should be an ongoing effort, which is planned from the outset of a project and is undertaken as the project proceeds.

Existing good practice guidance (ICMM, 2006) on rehabilitation operations recommends the following measures:

- Topsoil is a strategic resource that should be conserved if at all possible. During rehabilitation operations, topsoil must be handled in a manner that will protect the physical and chemical properties and the biological processes to conserve the soil seed bank to maximize plant establishment after re-spreading.
- A weed control program should be implemented, where pre-mining surveys identify the presence of problem weeds, consistent with integrated pest management principles.
- To achieve the desired botanical diversity, successional aspects must be considered when rehabilitating. Native pioneer species at all tiers of vegetation that readily colonize disturbed areas should be included in the seed mix. Species characteristic of later successional stages should also be established early if practicable.
- Good seeding practice is critical to successful rehabilitation for many mines. To establish a diverse vegetative cover, a variety of seeding methods is often preferable – for instance, direct topsoil return, hydro-seeding, and planting of seedlings or natural recolonization.
- Follow-up maintenance of plantings may be necessary and monitoring is essential to gauge the success of the methods employed. Remedial measures may be required if planting survival is low, for example, due to drought or overgrazing.
- The use of planting to establish botanical diversity may provide good opportunities for involving other stakeholders.
- Fauna should be encouraged to return to rehabilitated areas by the provision of suitable habitat.
- Where the rehabilitation efforts would result in a new habitat (for example, creation of a wetland habitat in a mine void), management practices should be adopted for optimum benefits of conservation of characteristic species of such habitats.

Mine closures

Mine closure plans should incorporate opportunities to benefit biodiversity where possible. Duncan *et al.* (1999) advise that many bat species use abandoned mines as daytime roosts and maternity sites. Often large congregations of animals are reported at these sites, and, for many bat species, the historical activities of the minerals industry has permitted their range to be extended. For this reason, habitat surveys for various species should be an

> *'For projects located in areas with high biodiversity conservation and other values, the risk of refusal to proceed with mining projects should be greater, up-front assessments should be longer, more intensive and more costly, investments required for impact mitigation should be higher, and financial bonds should be in place to cover closure and emergency costs'*
>
> -----Dave Richards, Rio Trinto Plc.

integral part of the abandoned mine pre-closure inventory process. Several internal surveys should be useful to determine various species using a mine for different purposes through the seasons of the year.

Bioregional planning approach

Key strategies for biodiversity conservation and management should be based around the concept of bioregional planning, whereby biodiversity considerations are fully integrated with regional biodiversity management policies and programs. Because of extensive experience in landscape planning and coordination, the minerals industry can greatly benefit from opportunities to take a major leadership role in developing bioregional planning and management approaches to biodiversity issues in association with larger land holders such as the state governments and other industries.

The development of integrated conservation plans is already being encouraged in India for mining projects located within close proximity in the same landscape.

Oil and gas

A high degree of coincidence of areas known for their biodiversity and world's known mineral and hydrocarbon reserves can be seen on a global map. This spatial relationship has been well recognized by the conservation community. UNESCO (2004) records that one quarter of World Heritage Sites listed for natural value have mining or oil and gas development in or near their borders. The World Resources Institute (Miranda *et al.,* 2003) reports that one-quarter of active mines and exploration sites overlap with or are within a ten-kilometre radius of protected areas categorized as I-IV under the IUCN system. As global demand for oil and gas is expected to grow over at least the next thirty to fifty years, the world's refineries, energy companies will intensify their prospecting efforts into remoter and unexplored areas, many of which are currently protected as candidates for long term protection.

Careful planning can enable accommodation of both the biodiversity values of an area and the need for economic development from hydrocarbon extraction. Best practice technologies and management techniques for mitigating many of the impacts of oil and gas development are well known and documented (Anon., 2002b; EBI, 2004; IPIECA, 2004). Perhaps the greatest level of innovation, in terms of new technologies has been in the field of drilling technology, where engineers and managers have opted for several technological options to reduce both the economic costs and environmental impacts of drilling in sensitive and remote ecosystems.

Table 17 provides the list of some of the most relevant practice guidelines and their focal aspects for the benefits of practitioners seeking to explore options of mitigating impacts of development in oil and gas sector.

Table 17 Existing guidance on mainstreaming biodiversity in oil and gas projects

EBI (2007). *Integrating biodiversity conservation into oil & gas development.* The Energy and Biodiversity, Washington DC, USA. http://www.iucn.org/en/news/archive/ 2001_2005/press/ebireport.pdf (last accessed on 2007)
The Energy and Biodiversity Initiative (EBI) Initiative seeks to be a positive force for biodiversity conservation by bringing together leading energy companies and conservation organizations to share experiences and build on intellectual capital to create value and influence key audiences. This document prepared by EBI provides guidance on how to achieve the integration of biodiversity considerations into upstream oil and gas development and would be useful for conservation organizations, governments, communities and others with an interest in ensuring the effective integration of biodiversity considerations into oil and gas exploration and development

EBI (2007). *Good practice in the prevention and mitigation of primary and secondary biodiversity impacts.* The Energy and Biodiversity, Washington DC, USA. http://www.theebi.org/pdfs/practice.pdf (last accessed on 2007)
The document represent a mixture of "good," and, in some cases, "best" practice drawn from those that are well known and that have been shown to be effective when used appropriately. The document is primarily aimed at corporate officers, site managers and other relevant personnel responsible for the management, monitoring and conservation of biodiversity throughout the lifecycle of upstream oil and gas operations and therefore represents a "menu" of sound biodiversity conservation practices from which can be chosen the most appropriate measures that fit the operational and geographic setting.

IPIECA (2000). *Biodiversity and the petroleum industry: A Guide to the Biodiversity Negotiations.* http://www.ipieca.org/publications/biodiversity.html
IPIECA has produced this report principally for the use of member companies involved in both upstream and downstream activities. This document outlines the key areas where biodiversity issues overlap with petroleum industry activities and highlights some practices that have been of value in addressing biodiversity through the review a of series of case studies.

EBI (2007). *Biodiversity indicators for monitoring impacts and conservation actions.* The Energy and Biodiversity, Washington DC, USA. http://www.theebi.org/ pdfs/indicators.pdf (last accessed on 2007)
This document is primarily aimed at site managers and other relevant personnel involved in the monitoring and conservation of biodiversity throughout the lifecycle of upstream oil and gas operations. Other organizations interested in biodiversity issues in the oil and gas sector (e.g. conservation organizations) may also be potential end-users. The location-specific nature of many potential impacts on species, ecosystems or ecological processes means that a distinct system of indicators will need to be developed for each individual project as no single all purpose indicator will meet all needs. The guide emphasizes on the method of deriving indicators, rather than the indicators themselves.

IPIECA (2007). *The oil and gas industry: Operating in sensitive environments.*
http://www.ipieca.org/downloads/biodiversity/SensitiveEnvironments ENG.pdf (last accessed on 2007)
Developed by the International Petroleum Industry Environmental Conservation Association (IPIECA), this publication summarizes a series of short case studies which describe some of the oil and gas industry's experience of operating responsibly in sensitive human and physical environments. Cases cover operations near conservation sites of global importance, operations near sites of special value to local people, and activities that address concerns about social and economic impacts of operations on local communities. A key theme that runs throughout the case studies is the need to balance environmental impacts with economic and social benefits—i.e., benefits to the countries and communities in which the industry operates, as well as benefits to the oil and gas companies that provide to the majority of the world the fuels and petroleum products for everyday use to improve quality of life. Full versions of the case studies are available on the IPIECA website.

Rosenfeld, Amy B., Gordon, D.L. and Guerin-McManus, M, (1997). *Reinventing the Well: Approaches to minimizing the environmental and social impact of oil development in the tropics.* CI Policy Papers, Conservation International, Washington, DC. http://www.celb.org/xp/CELB/downloads/ReinventingTheWell.pdf
It is a "hands on" document intended to be used as a practical tool to help the full range of stakeholders make informed decisions about oil development. This report offers recommendations for minimizing the environmental and social impacts of oil exploration and production in tropical ecosystems. It examines the often devastating environmental and social impacts that have resulted from oil development in the tropics and offers a series of "best practices," including technologies, management practices and policies, to address and mitigate these impacts.

Contd...

Dudley, Nigel and Sue, Stolton (2002). ***To dig or not to dig: Criteria for determining the suitability or acceptability of mineral exploration, extraction and transport from ecological and social perspectives.*** **A Discussion Paper for WWF.**
http://www.wwf.org.uk/filelibrary/pdf/to_dig_or_not_to_dig1.pdf
This publication recognizes that oil and gas extraction, and mining, together create most of the energy and resources needed to run our society. They also result in a range of present and future environmental and social costs, both direct and indirect, which need to be balanced against the benefits they bring. The guidance aims to help make decisions about whether or not to proceed with mineral activity rather than providing guidance about how to proceed. The guidelines are based on a decision tree comprising three criteria or "filters" viz., protection status; potential threats to biodiversity and the environment, including downstream impacts and potential threats to human wellbeing. The aims of the guidelines are to ensure maintenance or improvement of biodiversity in the landscape, including downstream; maintenance of environmental services at both site and landscape level and maintenance of human wellbeing, particularly for local communities.

IUCN and ICMM (2004). ***Integrating mining and biodiversity conservation: Case studies from around the world.*** http://www.icmm.com/library_pub_detail.php?rcd=173
This publication shows how good practice, collaboration and innovative thinking can advance biodiversity conservation worldwide while ensuring that the minerals and products that society needs are produced responsibly. The case studies illustrate how management tools, rehabilitation and restoration processes, together with improved scientific knowledge can help conserve biodiversity.

ICMM (2005). ***Good practice guidance for mining and biodiversity*****. International Council for Mining and Metals. London.**http://www.icmm.com/uploads/1295GPG.pdf
This good practice guidance is aimed at providing the mining industry with the steps required to improve biodiversity management throughout the mining cycle. The guide is intended to help develop knowledge and capacity, and it also signals where specialist biodiversity support may be desirable or essential. By implementing this guidance, mining companies should be better placed to identify and evaluate biodiversity and develop mitigation measures for potential impacts on biodiversity and rehabilitation strategies for affected areas.

Based on the experience drawn from various guidance documents described in table 17, the following are some of the specific approaches recommended for upstreaming biodiversity in the development in oil and gas sector:

Generic approaches

- Overlaying oil and gas projects with priority conservation sites is a first step in upstreaming biodiversity into project risk analysis.
- Good mitigation practices should begin with the planning for biodiversity at the earliest stages of the project lifecycle because this would allow the greatest opportunity to influence the design of a project.
- Data-driven, site-level information on biodiversity conservation priorities is the foremost requirement for moving biodiversity risk analyses upstream for reducing the impact of business operations and informing decision-making processes with regard to siting oil and gas operations.
- Despite the considerable advances of the oil and gas sector to address environmental challenges faced in developing projects, sensitive sites specially those that that are not able to withstand the pressure from development activities must be avoided. The sites that need to be avoided should be prioritized based on global and national conservation priorities. Avoidance of impacts can also be ensured by routing oil and gas pipelines to skirt vitally important areas, or by using innovative drilling technology that can avoid damage by accessing an area from a distance.

- Because the project lifecycle of oil, gas, and mineral development projects span many years, or even decades, there is a tremendous opportunity for companies to provide a sustainable flow of funding to sensitive habitats and protected areas over the long term.
- Biodiversity offsets are becoming increasingly recognized as an effective tool that, when implemented with care, can contribute to conservation and can also deliver livelihood benefits for local communities. They can achieve significantly more, better, and more cost-effective conservation outcomes than currently resulting from projects that convert habitat. Biodiversity offsets can also be seen as a means to assist companies that have an impact on biodiversity in better management of their risks, liabilities and costs and foster good relationships with local communities, regulators and shareholders.

Strategies to mitigate impacts of pipeline on vegetation

- Reducing vegetation and rare species loss through routing of oil and gas pipelines along existing road or hydroelectric corridors.
- Developing a weed control plan to prevent species invasion, including measures for cleaning mud and debris from construction vehicles and equipment.
- Reclaiming and reseeding sites immediately following their use, in combination with natural re-vegetation of RoWs.
- Implementing felling plans to reduce commercial timber loss.
- Implementing traffic management plans, salvage, and transplanting techniques, and boring and ramping measures to reduce impacts on rare species and communities.
- Developing and implementing a comprehensive monitoring plan to assess vegetation composition, cover, health, and the presence of weeds at selected sites.

Strategies to mitigate impacts of pipeline on fauna

Potential impacts of pipeline development on wildlife have been extensively studied in the literature (U.S. DOI, 1972; Foothills Pipe Lines (South Yukon) Ltd. 1979; B.C. Gas Utility Ltd. 1998; Salmo Consulting Inc. 1999; Taggart & McCracken, 2002; Canada, National Energy Board (NEB) 1996, 1998, 2003; Encana Ekwan Pipeline Inc., 2003; WCEL, 2003; Aboriginal Pipeline Group *et al.*, 2004). Guidance from some of these different sources has been used to propose the following strategies for mitigating impacts on species:

- Adjusting a pipeline route to avoid significant habitat areas such as spawning areas and reducing vegetation clearance.
- Timing construction activities to avoid calving and feeding seasons or sensitive lifecycle stages.
- Banning fire arms and restricting recreational vehicle travel in construction camps.
- Developing and implementing operating guidelines to address effects on wildlife and to reduce sensory disturbance.
- Controlling access and pipeline-related vehicle use in cooperation with communities and regulatory agencies such as by strategic placement of slash rollback along a ROW for access control.

- Using Horizontal Directional Drilling (HDD) techniques at watercourse crossings to limit habitat clearance in riparian corridors.
- Implementing design and work practices to reduce pipeline effects on wildlife movement.
- Re-establishing wildlife areas after construction through implementing reclamation plans; and Implementing HDD techniques to minimize impacts on fish and fish habitat.
- Implementing erosion and sediment controls to direct construction runoff through silt fences, sediment traps, and vegetative berms to decrease sedimentation in streams.

Table 18 shares examples of measures recommended for mitigating the impacts of oil and gas pipeline projects on different ecosystems and wildlife species in India.

Table 18 Measures suggested for mitigating impacts of pipeline projects on biodiversity: Some examples from India (Source: Rajvanshi, 1999)

Project	Wildlife species *en route* pipeline	Nature of impact	Mitigatory measures
Hazira-Bijaipur-Jagdishpur Pipeline (HBJPL)	Great Indian bustard.	Reduction in available bustard habitat and restriction of bustard movement. Reduction in number of nesting sites and destruction of eggs.	Right of Way (ROW) restricted to 20 meter within the forest Rescheduling of construction phase to avoid nesting and breeding period. Use of existing roads for transportation of equipment to avoid further habitat reduction.
	Gharial, otter	Reduction of basking and nesting sites of gharial.	Avoidance of scrublands for camp sites. New bustard sanctuary proposed in adjacent grasslands
	Gangetic dolphin and turtles	Disruption of gharial, dolphins and otter movements.	Horizontal Direction Drilling (HDD) suggested for river crossing. Rescheduling of constructional phase to avoid coincidence with breeding period of most aquatic species.
Haldia-Barauni Pipeline (HBPL)	Gangetic dolphin, turtles, crocodiles	Obstruction of water flow in river leading to disturbance to breeding biology and local movements of dolphins.	Rescheduling of construction phase to avoid coincidence with breeding period of dolphins. Suggestion of alternative technology to minimize impacts on river characteristics.
	Baer's pochard	Habitat alteration of Baer's pochard.	Incorporate habitat considerations in managing impacts due to physical disturbance to habitats
Salaya-Viramgam Pipeline (SVPL)	Coral, sea turtle, dolphin and dugong	Destruction of coral reefs and mangrove forests. Habitat pollution due to oil spills. Disturbance to movements of aquatic fauna.	Reduction in construction phase to reducing damage to coral reefs. Afforestation of mangroves in coastal areas.
Viramgaon-Chaksu Panipat Pipeline (VCCPL)	Wolf, caracal, desert fox, four horned antelope	Further degradation of terrestrial habitats	Compensatory afforestation suggested.
Bombay-Manmad Pipeline (BMPL)	Leopard, hyena and barking deer	Destruction of prime forest and wildlife habitats. Displacement of avifauna due to fragmentation of forest.	Rescheduling construction phase and minimizing the duration of construction phase. Relocation of camping sites outside forest areas.

Measures recommended for better on- site land management

- Minimize disturbance to natural topography and soil during clearing operations.
- During the construction activity, stacking of construction material and pipes should be restricted within RoU to avoid impacts on other land features in the pipeline corridor.
- Avoid disturbance to natural drainage channels and ensure clearing during dry season to avoid soil loss and pollution of water bodies.
- Deliveries of materials to the project site should be consolidated whenever feasible to minimize the flow of traffic and related disturbance to flora and fauna.
- Ensure protection of top soil and route zone material for ensuring restoration and re-vegetation.
- Re-contouring of disturbed site must be ensured to match the pre-disturbed site landscape and to blend with surroundings.
- After completing the earthwork, soil cover should be restored as soon as possible in the areas outside the pipeline route for initiating replanting of native species to avoid the growth of non-native invasive species.

Measures recommended for laying the pipeline across rivers

- Pipelines should be laid across rivers and streams in pre-monsoon period to prevent blockages and increased silt flow from barren areas along pipeline route and from open trenches constructed for lowering the pipeline.
- After construction, the weakened banks of water bodies should be reinstated and strengthened depending on site conditions.
- To avoid contamination of surface and groundwater sources, liquid effluents from construction camps and spoiled/drained lubricant oil washings from construction machinery if any should not be discharged into the rivers without treatment.
- Further protection of fish should be ensured by careful timing of in-stream work to avoid disturbance to the fish sensitive to siltation.
- While doing construction (lying of pipeline) on major streams, movement of fish and other aquatic animals should be maintained uninterrupted by providing a diversion and restricting activities that pose on site disturbance.
- Wherever possible, use of non potable water should be made for process requirement.
- Pipeline should be laid sufficiently below the scour wherever it crosses a water body.
- Exposure of soil susceptible to wind and water erosion and sediment build up in natural drainage courses should be minimized by adopting erosion control measures such as raising of shrubs and grasses.

Good practice code for ensuring effective mitigation

The development of mitigation plan for biodiversity should highlight the specific activities that portend the impacts and provide a brief on the nature, location and the specific phase or activity of the project that is likely to induce the impacts. This information should form the basis for recommended mitigation measures. The essentials of a good mitigation plan also include specifying costs for implementing various measures and the mechanism for implementing and supervising stipulated controls. Table 19 provides a template to incorporate the desired information in the mitigation planning of projects in all the sectors.

Table 19 **Format for summarizing mitigation outcome for developing EMP**

Project activities	Type of impact	Potential impacts on biodiversity	Where the impact is likely to happen	When the impact is likely to occur	Magnitude of impacts	Mitigation measures	Anticipated costs	Institutional responsibility	
								Implementation	Supervision

For the desired effectiveness of the proposed mitigation plan, **efforts should be made to raise biodiversity awareness among contractors, suppliers and customers**. It would be worth establishing the impact that contractors and suppliers may have on biodiversity and then work on ways to ensure what kind of guidance is needed for project contractors. Writing biodiversity requirements into performance contracts and reporting guidelines and working with relevant sector to develop a code of practice encompassing biodiversity can be other positive approaches for mainstreaming biodiversity in mitigation step of EIA.

5.1.6 Documentation

This stage involves the documentation of the final outcome of the biodiversity inclusive impact assessment in the form of an impact assessment report which is referred by many different names in different parts of the world

- Environmental Impact Assessment report (EIA report).
- Environmental Impact Statement (EIS).
- Environmental Assessment report (EA report).
- Environmental Review.
- Environmental Effects Statement (EES).

Purpose

The purpose of an EIA report is not to reach a decision but to present the consequences of the proposed project for:

- the proponent to plan, design and implement the proposal
- the decision maker to grant or reject project authorization
- the public to understand the proposal and its impact on community

Guidance on reporting

The final EIA report should set out clearly, all the information relevant for environmental decision-making. The report should ideally be guided by the institutional framework, and be structured as per the requirements of the country specific EA systems and sector specific guidelines where these exist.

For example, the structure of the EIA report in India is guided by the stipulations in EIA Notification (1994) as amended on September 14, 2006 and in Pakistan by the guidelines for the preparation and review of environmental reports issued by Govt. of Pakistan in 1997 (GoP, 1997).

According to section 33 of the National Environmental Act 1980, of Sri Lanka, an EIA is a written analysis of the predicted environmental consequences of a proposed project, containing an environmental cost benefit analysis (if such an analysis has been prepared), a description of the avoidable and unavoidable impacts, a description of alternatives to the activity which might be less harmful to the environment together with the reasons why such alternatives were rejected, and a description of any irreversible or irretrievable commitments of resources required by it.

BOX 57 Proposed table of contents for an EIA report

Executive summary

I. Policy, legal and administrative framework.
II. Introduction.
III. Analysis of alternatives.
IV. Project description.
V. Assessment.
VI. Impacts evaluation.
VII. Mitigation.
VIII. Environmental management plan
IX. Environmental monitoring

Annexes

(i) Terms of Reference.
(ii) A glossary of technical terms and units.
(iii) Acronyms.
(iv) List of the team who prepared the EIA.
(v) Records of public meetings and consultations.
(vi) Copies of various permissions (e.g. diversion for forest land, exploratory mining, right of way along existing utilities).
(vii) Tables and maps.
(viii) Technical information too detailed for the main text.

For other countries including Bangladesh and Nepal where guidelines for preparing EIA report are lacking, Box 57 provides generic template for organizing the contents of the report into various sections. Individual sections of the report can be developed based on the outline proposed here:

Executive summary

Experts preparing an EIA must appreciate that the final report will be read by a wide range of people and the subject matter may appear technically complex for some readers. Senior administrators and planners may not understand the importance of technical arguments unless they are presented carefully and clearly. Ensuring the quality of the executive summary is particularly important as some decision-makers may only read this part of the report.

The executive summary should be focused and brief. It must highlight the project objectives and benefits in relation to ecological significance and economic benefits of the biodiversity and ecosystem functions likely to be compromized by the proposed development, the significant impacts of the project (particularly those that are unavoidable and irreversible), key mitigating measures, proposed monitoring and supervision requirements, and the recommendations.

Policy, legal and administrative framework

This section of the report should briefly present the legal framework within which the project is to be evaluated and the regulatory regimes that are guiding the various environmental thresholds and conservation priorities. Practitioners must refer to Appendix VI and X for information on environment related legislations and regulatory regimes applicable to different sectors and in different countries.

Introduction

This section of the report should describe the purpose of the report, including (a) identification of the project and project proponent; (b) a brief description of the nature, size, and location of the project and its importance in the region or national context; and (c) any other pertinent background information. It is always helpful to set out in an EIA report how a project has evolved in response to ecological considerations and development imperatives and present the overall aim and objective of the project. The Terms of Reference (ToR) for the study, work plan, valid time span; start and end date for different components of the study should also be clearly specified here.

Analysis of alternatives

This section of the report should incorporate the information on different alternatives (for route, site, design and technology) that were reviewed. Here, the alternatives should be described; relative impacts of different alternatives on biodiversity with and without mitigation measure should be presented to finalize the most suitable alternative for the project. This should be followed by the description of the project.

Project description

This section should provide a description of the proposed project. It should include the project plan, layout, processes involved, actions planned in different stages of project lifecycle (exploratory activities, site preparation, construction, operation, closure), demands on natural resources (e.g. forest, land and water), description of materials to be utilized and produced (mass balance), design criteria to be adopted, and existing infrastructure including access roads to be used. This information will help in viewing the various factors influencing the ecological sensitivity of the site and socio economic local concerns particularly with respect to poor and subsistence dependents. Project cost should be also stated as these can provide significant clues about the size of operation and its potential to impact.

Once all the major activities have been identified, these should be indicated in the form of a bar chart to appreciate the size, duration and the timing of different actions/operations for assessing the nature; magnitude, seasonality and trends of anticipated changes in ecological characteristics of the project area.

Assessment

This section should be structured to present the ecological baseline with a view to provide an overall picture of present biological conditions and ecological trends if the project were not to go ahead. The information should include explanation of the criteria used to evaluate ecological resources, statement of ecological methods used, time and duration of field surveys, and the analytical techniques adopted for the prediction of impacts. The ecological profile must at least include information on the floral faunal values and their conservation status; ecosystem benefits from the area to be diverted for proposed development and their links with sustenance and livelihoods of local people.

Inclusion of drawings, pictorial illustrations, maps and remotely sensed spatial information, notes on natural history, biological inventories, summaries of public hearings and data supplementing ecological and economic evaluation is highly encouraged as these are helpful aids for better visualization of the ecological and economic importance of biodiversity resources and ecosystem functions of the project area in a 'no project' scenario. For aiding the assessment of the biodiversity status in a post project scenario, this section should provide clear understanding of impact receptors and the sources of impacts on them. All the direct and indirect impacts of the project on ecological units (genes, species and ecosystems) and economic benefits of biodiversity and the project that are anticipated should also be described in this section of the report. Use of checklist, matrix and networks is encouraged to present the results of assessment.

Impact evaluation

This section of the report is most important as it presents the diagnostic information for developing the 'cure' for the problems anticipated in the event of project implementation. The most significant beneficial and adverse environmental and socio economic impacts associated with the project option studied should be clearly stated. The use of various evaluation tools (e.g. weighted scales, ecological models, GIS application, computer aided software etc.,) should be made to build the confidence in the process and results of the evaluation stage. The results of economic analyses must also be integrated in projecting the nature of impacts and their significance. Impacts should be quantified wherever possible. Uncertainties in the results whether due to a lack of knowledge, data or due to indeterminate assumptions should be highlighted. The statement of significance of impacts should take into consideration the national conservation priorities, protected status of species and habitats under existing national and international legislations and the mitigation measures already integrated in the project proposal.

Where mitigation is fully integrated into the scheme and there is high confidence that it will be implemented and will deliver the desired outcomes, the evaluation section should highlight significance of impacts of the mitigated project. Where the evaluation has proceeded in absence of clear understanding of the mitigation measure inherent in project design, the EIA report should provide guidance for developing mitigation strategies to overcome specific impacts on biodiversity and for improving the profitability of the project for society by avoiding impacts.

This guidance document strongly advocates that the evaluation of project impacts should be documented as the output of an integrated EIA that takes into consideration the combined influences of socio-economic, engineering and ecological criteria adopted for project planning (Figure 17). This variance from the traditional evaluation approach that generally presents ecological and economic analysis either as sequential stages or as concurrent stages in impact analysis is specially needed for ensuring that biodiversity/ecology issues become fundamental and not trivial or peripheral in the overall planning of sustainable development.

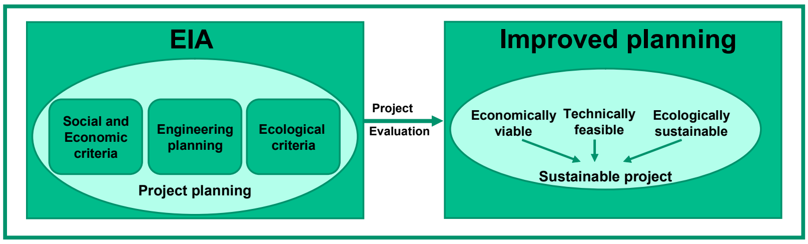


Figure 17 Evaluation of impacts based on integrated EIA

Mitigation

This section should describe various measures to be adopted by the proponent for the mitigation, protection or enhancement of biodiversity values and functions that are likely to be degraded or impaired by the proposed project. The two important components of this section should essentially be the Environmental Mitigation Plan (EMP) and the protocol for compliance monitoring.

The EMP should present the recommended measures for avoiding, reducing, compensating and offsetting impacts on biodiversity values and ecosystem services. For addressing biodiversity related impacts, the EMP should incorporate species specific conservation plans and action plans for habitat management and restoration. Good practices dictate that these mitigation plans must present specific measures to be adopted, benefits to be anticipated, costs to be incurred and institutional arrangements and training requirements if any for implementation of the EMP. Practitioners should refer to Table 19 in subsection on **Mitigation** for generic guidance on presenting the mitigation plan.

The monitoring component of the report should highlight monitoring requirements for validation of the predicted impacts and for determining the success of mitigation measures. The information should specify costs, institutional requirements, time lines and protocols for implementing monitoring programme so that timely feed back can be achieved for taking corrective action.

Characteristics of a good EIA report

The characteristics essential for a good EIA report (Box 58) are essentially to be applied to reporting of biodiversity inclusive EIA.

BOX 58 **Elements of a good EIA report** (Source: Sadler 1996, UNEP 2002)

Transparent – participatory and unbiased

Complete and balanced – informed decision can be made

Reliable – meets established professional and disciplinary standards

Significance – focussed, brief, avoid trifles

Thoroughness – comprehensive to cover all issues in appropriate details

Defensible – risks and impact are qualified and are proportional to uncertainties

Actionable – a document that can be applied by the proponent to achieve environmentally sound planning and design;

Decision-relevant – organises and presents the information necessary for project authorization

User-friendly – communicates the technical issues to all parties in a clear and comprehensible way.

Recommended size of the report

The executive summary of the EIA report should be short and crisp, probably being between 5 and 10 pages. The main report; excluding appendices should preferably flow in about 50-70 pages and should have no more than 100 pages. An exceptionally complex study may be extended to have up to 150 pages including all annexes, drawings and pictures.

In some exceptional cases, depending upon the sensitivity of biodiversity issues linked to a certain project (e.g. proposal for a location of a mine in ecologically fragile area or the routing of a pipeline or a road through biodiversity rich area commanding high level of protection) a stand alone report on biodiversity related impacts of a project may also become a key requirement for environmental decision-making when dealing with controversial projects. The contents of such reports will essentially have to be guided by the specific issues and should be organized in a manner that the contents supplement the full EIA report to facilitate decision. Such reports should be essentially based on focused studies with the aim of overcoming the gaps in a full EIA with respect to biodiversity.

Factors determining the quality of EIA report

Several factors can influence the quality of biodiversity related information in an EIA report (Box 59). The constraints experienced in reporting if any should be conveyed as these may have a bearing on the decision. Outputs of situation assessment surveys conducted in all five countries under CBBIA –

IAIA project indicate that some of the constraints that can be specific to a country are those that are directly linked to the limited availability and quality of existing database on biodiversity, lack of provisions in EA system for ensuring adequate treatment of biodiversity in various stages of EIA and the limited competence and capacity of the practitioners to address impacts on biodiversity. Some countries are improving the EIA practices and reporting skills of the practitioners through targeted capacity building initiatives and by promoting reforms that are aimed at introducing accreditation systems and registration schemes for ensuring checks on competence of individual practitioners and EIA consulting firms in relevant functional areas or discipline.

BOX 59 **Factors determining the quality of biodiversity assessments in EIA**

- Adequacy of information on biodiversity.
- Existence of biodiversity related database.
- Formal scoping requirement for including biodiversity issues.
- Inclusion of biodiversity expert in EIA team.
- Accreditation system for selecting appropriate consultants.
- Capacity building of consultants for adopting good EIA reporting practices.
- Extensive consultation and inter disciplinary thrust.
- Size of project and quality of data.
- Cost of EIA.

Considerable progress in this direction has been made in India where the National Registration Board for Personnel & Training (NRBPT), a constituent of Quality Council of India, has launched the scheme for registration of EIA consultant organizations which has been duly recognized by Ministry of Environment and Forests, Govt. of India (at http://moef.nic.in). On similar lines, efforts are also being made in Pakistan to launch an accreditation scheme for EIA practitioners (Ahmad Saeed pers. comm.).

Until the further reforms are brought about in the legislative provisions in countries in South Asia for more proactive efforts of mainstreaming biodiversity in EIA, greater level of commitment, professional ethics and adoption of good practices is needed on the parts of practitioners to promote biodiversity considerations in EIA reporting. This need can be better appreciated with the growing evidence from around the world that increasing biodiversity information can have positive impacts on planning and design of projects in key sectors such as oil and gas and mining (Figure 18).

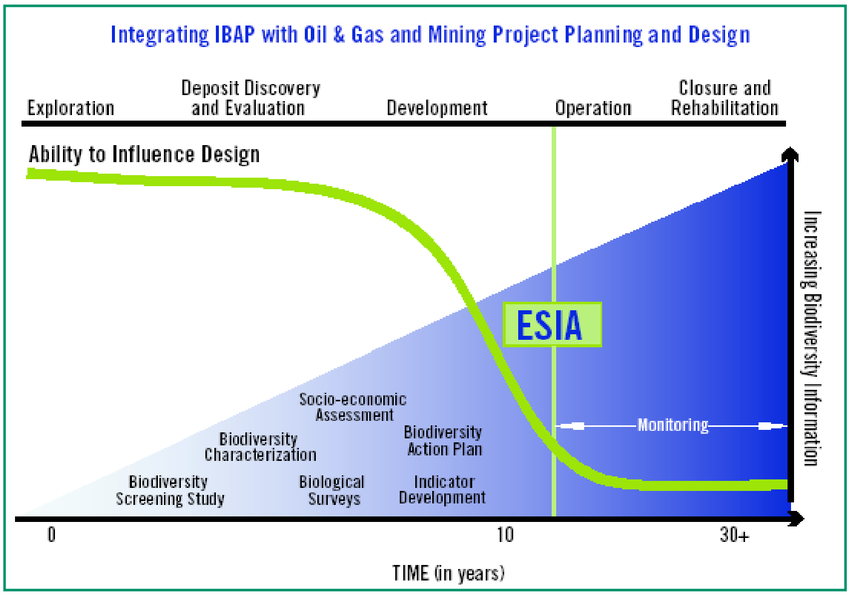


Figure 18 **Benefits of integrating biodiversity information in project planning and design in oil and gas and mining sector**
(Source: CELB, 2007)

SECTION V

6 REVIEWERS' GUIDE

Biodiversity inclusive assessments belong to a relatively new subject of concerns in EIA and have universally been found to be weak (Treweek *et al.*, 1993; Thomson *et al.,* 1997; Warnken & Buckley, 1998; Atkinson *et al.,* 2000; Byron *et al.,* 2000; Gray & Edward-Jones, 2003). The quality of EIAs is particularly weak both in terms of rigour, and coverage given to biodiversity issues in most South Asian countries.

The more obvious reason of neglect of biodiversity in many EIA reports is the priority given to promoting development in key sectors to overcome poverty in South Asia and improve economic well being. Consequently, projects that are considered to be of national, political and strategic importance, often override consideration of potential negative impacts on biodiversity. Further, when locations of such priority project tend to overlap with ecologically important areas, biodiversity issues are consciously underplayed in EIA reports to prevent these issues become barriers to development.

Another ethical factor that invariably influences the quality of biodiversity related information in the EIA documents is the negotiation of costs between EIA consultants and the project proponent. Driven by the motive of making larger profits, some consultants tend to speed up EIA by avoiding field based studies targeted for generating biodiversity specific baselines and rely more on non specific secondary information. Attempts to speed up EIAs also lead to incompatibility of timelines with seasonality of the biodiversity surveys resulting in serious neglect of biodiversity issues.

The current experience of EIA reviews in South Asia identify concentration of assessments only around protected species and habitats, lack of formalized procedures for review, and capacity constraints as other significant factors contributing to the overall poor quality of EIA reports.

The purpose of review of the environmental impact statement is to ensure that the information for decision-makers is focused on the key issues, is scientifically accurate and technically defensible, and comprehensive to include biodiversity viewpoint based on relevant standards and policies where these exist, or based on good practice where official standards do not exist. Reviewers must have adequate skills and competence to review the quality of EIA reports for enforcing checks and balances before decisions are based on such reports.

This section of the document aims to provide generic guidance on mechanisms for harmonizing the process of EIA review in South Asia for better reflection of biodiversity issues in decision-making and to build capacity for improving professional standing of the reviewers for delivering review outputs more responsibly.

6.1 Review of EIA

The review of the quality of an EIA report is a formal step in the EIA process to ensure that the EIA is consistent with accepted standards of good practice for credible decision-making purposes.

6.1.1 Relevance of mainstreaming biodiversity in review process

While the early sections (I to III) of this guidance document reiterated the importance of biodiversity conservation and stressed upon the recognition of linkages between socio-economic development, environmental degradation and biodiversity, Section IV (Practitioners' guide) laid emphasis on the relevance of mainstreaming biodiversity in impact assessment and provided a step by step guidance on how to use EIA as a mainstreaming tool for biodiversity. It is ultimately the effectiveness of a review process that can ensure the efficacy of recommended checks and balances. The outputs of a good review can determine if (i) biodiversity is sufficiently and appropriately integrated in environmental planning and implementation of effective mitigation and (ii) if the results of biodiversity assessment will be able to contribute to balanced decision-making. Case examples from the region (Box 60) demonstrate the reviews have helped in reviewing decisions, reconsideration of issues that were neglected earlier and in identification of the need for additional studies.

BOX 60 **Role of EIA reviews in decision-making**

In the Lionvert oil refinery and power generation project in Sri Lanka, the site selected was in the buffer zone of Muthurajawela marsh, which had been designated for recreational activities under the master plan passed by the cabinet. However the EIA consultant completely overlooked this key issue, resulting in two consecutive EIA reports being prepared for the same project to incorporate the assessment of impacts on marshland ecosystem (Kodituwakku, 2004).

Arun III Hydroelectric project was the biggest project proposed for meeting the domestic power needs of Nepal. It was due for implementation in 1994 with the World Bank as the major financing agency. The project, however, came under criticism by local, and some western, NGOs and individuals as being risky, costly and liable to bring about severe environmental and social impacts. The environmental impact assessment (EIA) carried out for the project failed to provide systematic information on sustainability necessary for making decision on the project. Consequently the project was dropped on institutional, national, economic and financial (Chettry, 2002).

In 1988, as part of the feasibility study for the project, EIA of 4,800 m long four-lane Jamuna Multipurpose Bridge project was done by the Govt. of Bangladesh in collaboration with the World Bank and UNDP. The major issues identified were: land acquisition and involuntary resettlement; pollution of soil, surface water, ground water and air; impacts on natural vegetation, wildlife, fisheries and agriculture; and impact on navigation; socio-economic impacts. The EIA study suggested a number of mitigation measures formulated in 1994. The issue of resettlement though important was still not included under earlier studies and the additional studies. Finally, a Rehabilitation Action Plan (RAP) was formulated by a supplementary study under pressure from the funding agency (Ahammed & Harvey, 2004)

In India, invariably for all projects falling within ecologically sensitive area, stand alone and more focused biodiversity assessment are necessitated. These reports supplement the information in the initial EIA reports which are generally deficient in the treatment of biodiversity related information.

6.1.2 The review process

Most countries have legal frameworks for EIA and guidelines in place for conducting review and although there is some variance in review requirements and process in different countries in the region (Table 20), the key objective of the review in all the countries is essentially to ensure the following:

i. Completeness and conformity with the ToR for the EIA.
ii. Accuracy and veracity as defined by general acceptable scientific criteria (for example, quality assurance and quality control procedures for analysis of sampling data) and use of acceptable methods for the assessment of environmental impacts.
iii. Clarity of description of environmental impacts, recommended mitigation measures, environmental monitoring plan and environmental management plan.

Table 20 Existing institutional arrangement for review of project proposals in different countries

Country	Main oversight agency	Responsibility of preparing EIA	Review responsibility	Mandate and function of the EIA review panel	Review conditions	Responsibility of communicating review results
Bangladesh	Department of Environment	Project proponent	Technical committee constituted by Department of Environment, headed by Director (Technical) and comprising of Deputy Director (Enforcement), Deputy Director (Research), Joint Director (Biodiversity) and Project Coordinator	Preparation of guidelines for conducting EIA and post project monitoring plan. Conduct environmental screening for deciding the requirement of Initial Environmental Examination (IEE) or EIA. Review (IEE) and EIA reports for environmental clearance	The Director General has discretionary power to exempt proponent from obtaining location clearance.	Director General accords approval and issues directive to respective Divisional Office to issue environmental clearance certificate
India	Ministry of Environment and Forests, Govt. of India	Project proponent through engagement of consultants	Expert Appraisal Committee comprising of up to 15 expert members and headed by a chairperson For 'A' category projects the Expert Appraisal Committee is constituted by the Ministry of Environment and Forests, Govt. of India for different sectors.	Determine Terms of Reference for preparation of EIA reports Conduct inspection of sites where necessary Meet at least once in a month Make final decision of proposed project or activity	For category 'A' projects and B1 projects, the Appraisal Expert Committees prepare ToR for EIA within 60 days of the receipt of application and pre-feasibility report and make recommendations within 60 days of the receipt of EIA. For B2 projects, SEIAA conveys its decision to the applicant within 60 days of the receipt of the application.	Central government in the Ministry of Environment and Forests (for category 'A' projects) and State Environment Impact Assessment Authority (for Category 'B' projects) process the communication of review outcome

			For 'B' category projects, State (or Union territory) Environment Impact Assessment Authority (SEIAA) is constituted by central government in consultation with state level administrative authority.		Based on the review, decisions must be communicated to project proponent within 45 days after receiving the recommendations from the review panel	
Nepal	Ministry of Environment, Govt. of Nepal		EIA review and approval committee of the Ministry of Environment which is headed by the Chairman and has representatives from sectoral ministries	provide EIA clearance unconditionally disapprove EIA clearance, provide EIA clearance with condition, return the file with necessary instructions	Right to hearing to the proponent of the project before rejection of EIA clearance, Decision should be given in writing and backed by reasons in the case of rejection. A person involved in EIA study should not participate in the review.	
Pakistan	Pakistan Environmental Protection Agency and Provincial Environmental Protection Agency	Project proponent through consultants	EPA constitutes committee of experts from accredited institutions (Govt. and NGOs)	Advisory role	Conduct review of the IEE within 45 days and of the EIA within 90 days of issue of confirmation of completeness. The review panel may also solicit views of the sectoral Advisory Committee. Director-General may, constitute a committee to inspect the site of the project if necessary and submit its report on such matters as may be specified.	Director General, EPA communicates the result
Sri Lanka	Central Environment Authority, Coast Conservation Department, Northwest Province Environment Authority	Project proponent through consultant	Oversight Agency through Technical Evaluation Committees (TECs) which are project specific	Prima-facie adequacy checking by CEA. Provide independent review of the EIA report for the technical content	Meetings of TEC are convened as needed. Public consultation is a must and one month period is stipulated for inviting public comments	CEA

Source: Ahammed & Harvey (2004); GoP (2000); GoP (1997); MoE&F (2006); CEAA (1995)

6.1.3 Good practice guidance for review of biodiversity inclusive EIAs

The basic framework (Figure 19) for the review procedures for promoting 'biodiversity driven' decision-making is adapted from the more generic framework (Lee & Colley, 1992; European Commission, 1994; VROM, 1994) developed for review of EIAs and incorporates specific process requirement and information needs based on the practical experience of EIA professionals from India and other countries in the region.

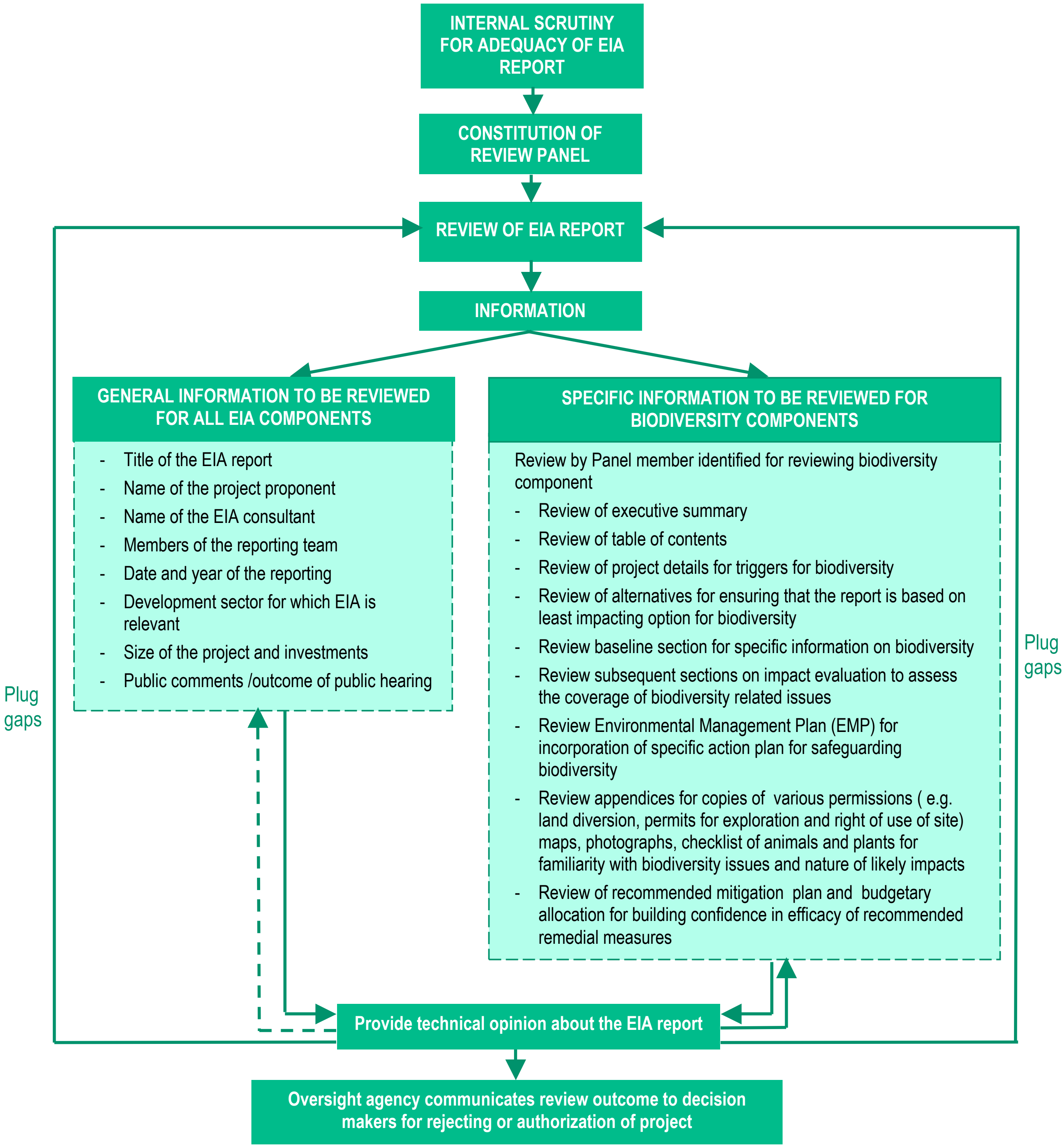


Figure 19 Framework for review of EIA reports for integration of biodiversity issues in decision-making

Guidance on developing review criteria for incorporating biodiversity issues

The guidance is provided here to enable reviewers assess the quality and completeness of the information provided in the EIA report in a quick and easy-to-understand manner. The review format presented in Table 21 is intended to guide the review process through the use of suggested mainstreaming criteria for biodiversity. These criteria are intended to help the reviewers in making a clear distinction between reviewing the quality and adequacy of an EIA report and determining the usefulness of the information in appraisal of the project proposal. The pre-decision review is thus aimed to assist both, practitioners in improving the quality of information and help decision makers note the gaps in the information that may affect reaching informed decisions.

The advantage of the review criteria presented in Table 21 is that it can help initiate the process of review even in absence of regulatory guidelines.

Table 21 **Review format for mainstreaming biodiversity issues in the review stage of EIA**

Biodiversity issues	Review criteria	Quality of information			Adequacy of information		Usefulness of information		
		Good	Average	Poor	Adequate	Not adequate	High	Low	Nil
Coverage of biodiversity issues in introduction and project background	Recognition of biodiversity as a component of IEE/EIA Recognition of triggers for biodiversity change								
Scoping	Incorporation of biodiversity targets in ToR.								
Biodiversity as targets for assessments	Biodiversity components include habitats, species, communities								
Defining biodiversity values	Conservation priorities, protected status, protected area, protected species, unique ecosystems, specialized habitats, economic importance links with livelihoods								
Scale of biodiversity assessments	***Organization level*** Gene, species, ecosystem ***Ecosystem structure and function*** Ecosystem process, good & services ***Geographic scale*** Site, landscape, region ***Temporal*** Immediate, short term, long term								

Assessment of impacts on biodiversity	Description of methodologies Based on field surveys Use of ecological modeling, GIS Software, HSI models distribution maps								
Biodiversity issues included in baseline information	Single or multiples species Absence/presence/ abundance of protected species Population dynamics and other habitat attributes (loss, modification, fragmentation) Movement, dispersal and extinction threats								
Considerations for prediction of impacts on biodiversity	Recognition of the drivers of change in biodiversity Cause effect relationship Relevance of variables Primary, secondary and tertiary impacts								
Time consideration in biodiversity assessment	Distinction in construction and operation phases Short term and long term impacts								
Result of field work survey	Species inventories, historical information of indicator species, resource inventory, resource dependency estimates Recognition of linkages with livelihoods								
Presentation of information for evaluation of impact specifically on biodiversity	Assessment of the confidence level in impact prediction Qualitative measures of impacts Quantitative measures of impacts Identification of significant impacts								
Mitigation measures and efficacy	Identification of specific measures for biodiversity (conservation plan, restoration plan) in EMP Consideration of mitigation hierarchy								

	(avoidance, mitigation, compensation and enhancement) Financial allocation for biodiversity related action plan Allocation of responsibilities for mitigating impacts Whether a follow up monitoring programme included as a part of EMP								
General remarks: **Name of the reviewer:** **Professional background:**									

This guidance should not be seen as a mechanism to promote the use of rigid criteria and stifle the development of open, flexible, intuitive and more context relevant approaches for conducting review. The objective of providing such a guiding tool is not the replacement of the existing guidance for reviews that may exist at the country level but to encourage good practices generally. Not all of the criteria included in the recommended review format may have universal applicability in the South Asia region as the requirements under the regulatory EIA system governing the review process varies with countries. It may not be fair to impose the suggested format for review but it is recommended that reviewers use it to develop evaluation scales and scores to influence the decision to the extent possible. Box 61 provide helpful tips for initiating the review.

BOX 61 **Important note for reviewers**

- Judge your competence for undertaking the review of the EIA report for which you have been assigned the responsibility of review.
- Review procedure and requirements established in the EIA legislation or guidelines before undertaking review.
- Familiarise yourself with review procedures and requirements for the project EIA to be reviewed.
- Read the report quickly from start to end page to review essential information such as the location and type of project, public concerns and Terms of Reference as this may help in ascertaining sensitivity of issues and the level of assessment required.
- Assess the rigour and time required for reviewing the EIA to ensure that the review work can be accomplished within the stipulated time for receiving review comments.
- Read the review criteria provided in Table 21.
- Find answers to specific criteria that are applicable as you review different sections of the report.
- Scale up the evaluation level depending upon the potential of the project to result in significant impacts.
- Scale down the evaluation level if the review requirements are not very stringent for a project category that have several potential benefits and where the review requirements are not specified under the regulatory guidelines.
- Use the assessment rating for each individual question within a particular review section in order to assess the review section as a whole.

Guidance on translating review outcome into appraisal results for decision-making

When all sections of the report have been reviewed and evaluated, the reviewer should assign grades to the report as a whole. It is extremely important to make the final evaluation presented as a 'report card' for making recommendations for facilitating the decision-making.

A grading system in line with several grading systems that are already in place (Lee & Colley 1992; UNEP, 2002) has been recommended in Table 22 for evaluation of EIA reports for adequacy and completeness of information on biodiversity.

Table 22 Evaluation of EIA reports

Quality grade	Quality remark	Explanatory note on quality grade/ remark
A	Excellent	The work has generally been well performed with no important omissions of biodiversity related issues.
B	good	Task performed satisfactorily and is complete with only minor omissions/ inadequacies.
C	Satisfactory	Task is satisfactory despite some omissions or inadequacies.
D	Weak	Indicates that parts are well attempted but, on the whole, are just unsatisfactory because of omissions or inadequacies.
E	Poor	Task is not satisfactory, revealing significant omissions or inadequacies.
F	No opinion	The work is insufficient to base judgment.

Where country procedures and guidelines exist for evaluation of EIA reports for biodiversity, these should be taken into consideration along with good practice principles and criteria described here.

This overall judgment should be supplemented with a brief note indicating specific instructions to the practitioner for providing supplementary or additional data/information, clarifications and explanation to inferences on significance of impacts as the case may be and with clear recommendation for decision makers to approve, reject or keep decision on hold until the gaps in information are plugged.

Identification of experts for review

Experience from the region suggest that lack of sufficient expertise of the reviewers and incentives is the real cause of deficient reviews (Momtaz, 2002; Rajvanshi, 2005; Nadeem & Hameed, 2007).

The expertise required for EIA review is essentially the same as that required for preparing the EIA report. In some countries like India and Pakistan, processes are being initiated that will enable EIA experts to be accredited or registered as capable of carrying out a study or review. Where the accredititation system does not exist, the identification of experts is made based on a criteria reflecting potential reviewer's academic qualifications, professional background and competence, area of expertise, experience of conducting review of EIAs and number of EIAs reviewed. Some countries follow a system of maintaining a roster of qualified experts who are invited to become member on review panels constituted by the relevant competent authority at the national or state level charged with the responsibility of conducting review.

Other possible solution to overcome the capacity constraints of reviewers is the enhancement of skills through well conceived capacity building initiatives. This should be the responsibility of the competent EIA agency. Until such time, till the capacities are appropriately build, use of review packages can be encouraged by developing these for specific sectors and for different countries. Such review packages are already in use in some more advanced countries and should lead to consistent and unbiased outputs that can withstand scrutiny and provide useful inputs for monitoring.

Developing a network of EIA professional in the region to serve as a regional resource pool for enhancing capacity, sharing knowledge and assisting with reviews would be another postive step. This should work well because countries in the region have comparable situations with respect to priorities for development and urgency of conserving the biodiversity wealth. Moreover, many of the linear projects (roads, and canals) have trans boundary context. The evaluation of EIA for such projects by reviewers from regional pool will lead to more credible decision-making.

Transparency of the review process is an ethical issue that must be promoted and respected. Yet, the countries in the region suffer from inherent problems of politisization of decision and lack of trust in the EIA process as a result of which the review is never a transparent process. Although the experts contracted for the review of a particular report should be independent from those involved in preparing the EIA report or undertaking studies, this is not always the case when the organizations are involved. Some countries in the region are therefore debating if peer review process would help overcome some of the deliberate attempts of ‘foul play’ in the review and monitoring of EIAs or if more effecitve mechanism of review by public would be a better option.

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Appendix – IA

Bangladesh: Overview of biodiversity status and threats

Bangladesh, located between 20°34’ to 26°38’ north latitude and 88°01’ to 92°42’ east longitude is one of the youngest country in the region, born only in 1971. It has a border on the west, north, and east with India, on the South east with Myanmar and the Bay of Bengal is to the South. It has a coastline of 3306 km, covers an area of 147,570 km^2 and has a population of 150 million. Physiographically, the country can be divided into hills, uplifted land blocks, and the alluvial plains with very low mean elevation above sea level.

The natural ecosystems of the country range from sandy beaches to mangroves, flood plains, lowland forests, terraces and hills reaching far north into the east. The entire country is biogeographically a transition between the Indo-Gangetic plains and the eastern Himalayas and in turn part of the Indo-Chinese sub-region of the Oriental realm. Nishat *et al.* (2002) divided Bangladesh into 12 broad bio-ecological zones, shown in Figure I.

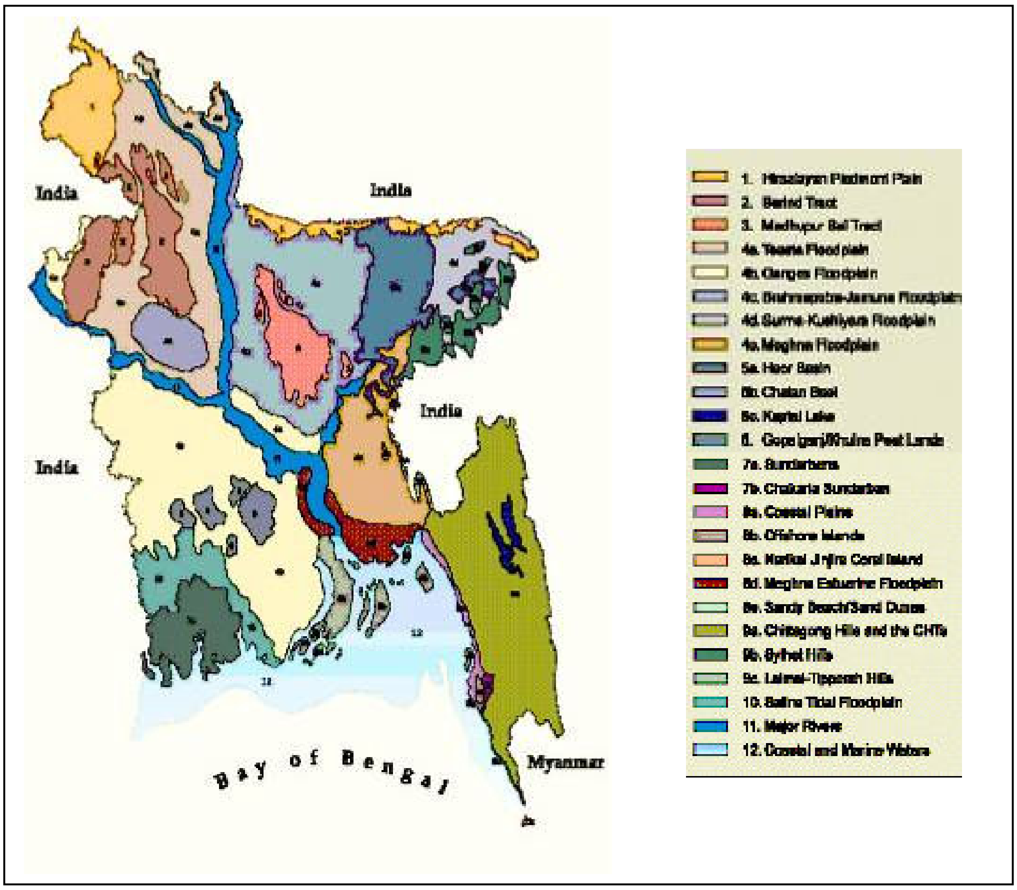

Figure I Bio-ecological zones of Bangladesh (Source: IUCN-Bangladesh, 2000)

The ecosystems of Bangladesh can be placed under 4 broad types *viz.*, coastal and marine ecosystem, inland freshwater ecosystem, terrestrial forest ecosystem and man-made ecosystem.

Among the terrestrial ecosystem, forests including officially classified and unclassified state lands, village forests and tea or rubber gardens that occupy about 2.56 million ha are environmentally and economically important natural resources. The Sundarbans, a World Heritage Site, is a globally recognized mangrove ecosystem.

The terrestrial and aquatic areas of the country together support a large number of diverse floral and faunal assemblages. Around 220 species of vertebrate animals including fish, amphibians, reptiles, birds and mammals have been listed in the Red Data Books of Bangladesh as they are faced with the threat of extinction. Though least known, the invertebrates form a major bulk of the faunal diversity, particularly aquatic invertebrates. The status of the various groups of vertebrates determined based on the numbers of threatened species and modified IUCN categories are shown in Figure II below.

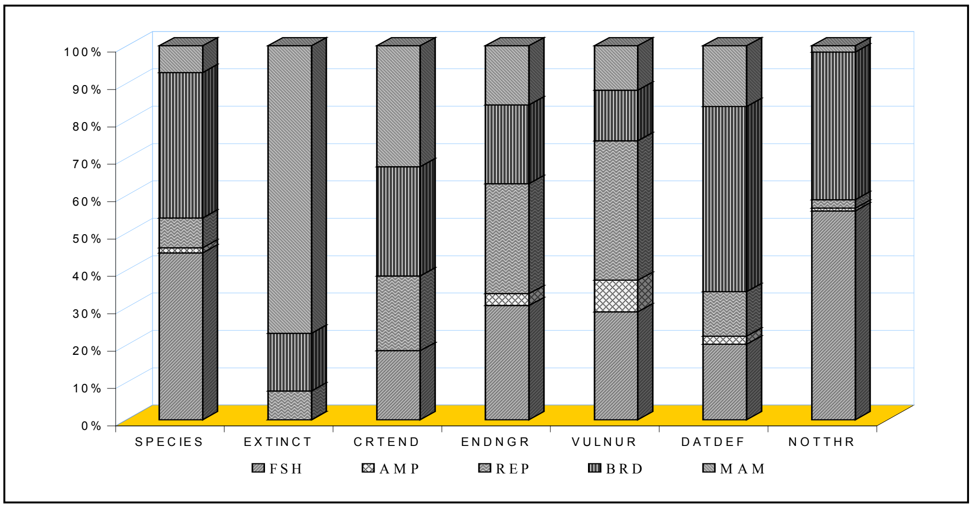

Figure II **Status of threatened species in Bangladesh**
(Source: IUCN-Bangladesh, 2000)

Natural resources of Bangladesh include natural gas, arable land, and timber. The major economic sectors of the country include agriculture, manufacturing industries, and various services such as transport, trade, and housing. Bangladesh which has a comparatively low natural resource base has a high growth rate of population, with almost half of the population below fifteen years of age. Thus, for the survival of Bangladesh's dense population, it is essential to have environmental planning and management that conserves and sustains the ecosystems that support livelihoods.

As an active delta of three of the world's major rivers, suitable conditions prevail for agricultural activities in Bangladesh, four-fifths of the population depends directly or indirectly upon agriculture. The agro-ecosystems are vital to human livelihoods and economy as they contribute 17% of the GDP.

The major causes of threats to biodiversity resources is the deforestation for industrialization, rapid urbanization and high population pressure on existing forest land, both for settlement and shifting cultivation. Other causes of biodiversity loss include water pollution (as a result of excessive use of commercial pesticides), encroachment, grazing, fire, uncontrolled and wasteful commercial logging, illegal felling, fuel wood collection, and official transfer of forestland to other sectors, i.e., for settlement, agriculture, industries and other competing uses such as horticulture. In Bangladesh, invasive floral and faunal species have been intentionally introduced for increasing productivity for commercial gains. Two controversial genera of flora introduced to the country are the *acacia* and *eucalyptus* spp, which exercise adverse effects on soil fertility, water table and humus dependent species and terrestrial wildlife. Bangladesh has high fish diversity due to its extensive wetlands, but indiscriminately introduced invasive species have spread rapidly during severe floods, posing a threat to the indigenous fauna. As a result, 54 indigenous fish species are now threatened with extinction in the country.

Appendix – IB

India: Overview of biodiversity status and threats

India is the seventh largest country in the world and Asia's second largest nation with an area of 3,287,263 km². The Indian mainland stretches from 8°4' to 37°6' N latitude and from 68°7' to 97°25' E longitude. It has a land frontier of some 15,200 km and a coastline of 7,516 km (GoI, 1985) and is a home to over 1 billion people, representing 16% of the world's population. Physically, the massive country is divided into four relatively well defined regions - the Himalayan mountains, the Gangetic river plains, the Southern (Deccan) plateau, and the islands of Lakshadweep, Andaman and Nicobar. Biogeographically, the country is divided into ten zones (Figure III).

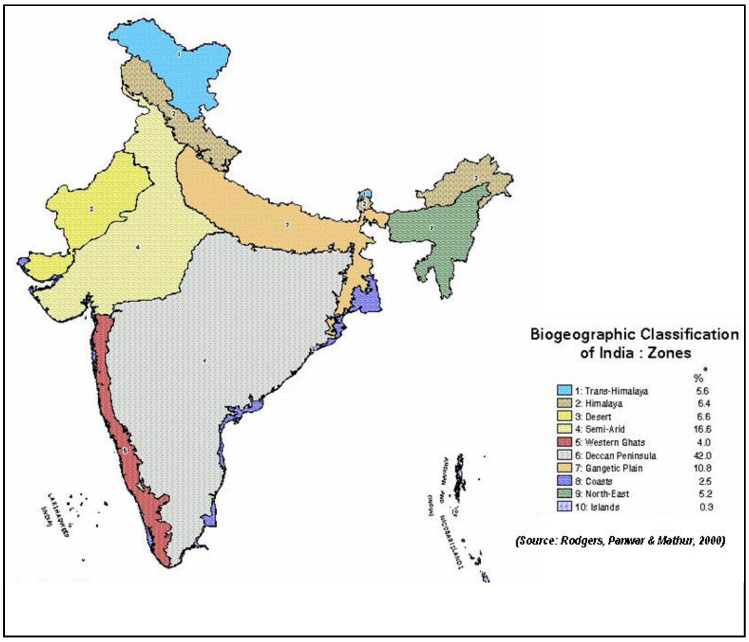

Figure III Biogeographic zones of India

India possesses a distinct identity, not only because of its geographic, historic and cultural attributes but also because of the great diversity of its natural forests, grasslands, deserts, wetlands and marine ecosystems that provide a gamut of diverse habitats for sustaining a sizeable percentage of the world's faunal and floral wealth. India has 47,000 species of flowering and non flowering plants representing about 12% of the recorded world's flora. Its fauna is represented by 422 species of mammals, 5749 species of fishes and 521 species of reptiles which accounts for nearly 10% each of the world's mammalian, insect and fish species, and over 8% of reptiles (www.wii.gov.in). Its avian diversity represented by 1228 species doubles that of Europe. India has many endemic plant and vertebrate species. Among plants, species endemism is estimated at 33% with c. 140 endemic genera. Areas rich in endemism are north-east India, the Western Ghats and the north-western and eastern Himalayas. A small pocket of local endemism also occurs in the Eastern Ghats. Only 44 species of Indian mammal have a range that is confined entirely within Indian territorial limits. In contrast, endemism in the Indian reptilian and amphibian fauna is high. There are around 187 endemic reptiles, and 110 endemic amphibian species. India contains 172 species of animal considered globally threatened by IUCN, or 2.9% of the world's total number of threatened species (Groombridge, 1994).

The main natural resources of India are iron, bauxite, copper and limestone reserves, natural gas, petroleum, arable land and hydro power. India is one of the ten most industrialized nations and is among the ten fastest growing economies in the world. The share of the Industrial sector to GDP is about 30 percent while agricultural sector contributes about 27.6%.

India's globally and nationally important biodiversity is threatened by several factors. The steady growth of human as well as livestock population and current phase of economic and trade liberalization are exerting heavy pressure on limited land resources. The number of urban agglomerations/cities with populations of over one billion has increased from 5 in 1951 to 9 in 1971 and 23 in 1991 (UNEP, 2001). This rapid increase in urban population and country's need for civic infrastructure and industrial expansion has resulted in unplanned urban development that has led to habitat fragmentation, conversion, and associated loss of many biodiversity resources. Some of the root causes of declining biodiversity are poverty and lack of sustainable alternative livelihoods for resource dependent communities; lack of integration of biodiversity and livelihood considerations into development planning in around biodiversity rich areas and lack of financial and social incentives to local communities from conservation efforts and related funding. The greatest challenges for biodiversity conservation are perhaps posed by large scale mining operations in integrated forest landscapes and impoundments of biodiversity rich tracts of natural ecosystems for hydroelectric projects. The environmental problems are linked to the pollution of air and water from increased industrial activities, intensive farming, and the overuse of fertilizers and other chemicals in agricultural production.

Degradation of ecosystem from combined impacts of different census already mentioned is a major threat both to biodiversity and livelihoods (loss of productivity of NWFP, forage, farms and livestock). Industrial projects including hydro-electric-irrigation, mining infrastructure does not compensate the loss of 'commons' (forests, pastures, rivers etc.) diverted by them. Consequently, the overuse of residual commons further compounds the process of degrading the ecological services.

Appendix – IC

Nepal: Overview of biodiversity status and threats

The Kingdom of Nepal, situated between India and China, on the southern slopes of the central Himalayas is located between latitudes 26^o 22' and 30^o 27' N and longitudes 80^o 40' and 88^o 12' E. The country occupies a total area of 147,181 km^2 and has a population of 26.1 million. The average population density is 157.73/km^2, with the highest density (330.78/km^2) in the *terai*, medium density in the hills (167.44/km^2) and lowest in the mountains (32.62/km^2).

Nepal comprises only 0.09% of land area on a global scale, but it possesses a disproportionately rich diversity of flora and fauna at genetic, species and ecosystem levels. Its biodiversity is greatly influenced by its unique geographic position and altitudinal, climatic and ecological variations that range from monsoon tropical, temperate, alpine to artic ecosystems. Because of its location in the transitional zone between the eastern and western Himalayas, it falls within two biogeographical realms – the Palaearctic and the Indo-Malayan biogeographical regions and the major floristic provinces of Asia (the Sino-Japanese, Indian, western and central Asiatic, Southeast Asiatic, and African Indian desert) creating a unique and rich terrestrial biodiversity. According to Hagen (1998), Nepal has seven physiographic divisions from south to north: Terai, Siwalik Hills Zone, Mahabharat Lekh, Midlands, Himalaya, Inner Himalaya, and Tibetan Marginal Mountains.

The angiosperm flora of Nepal comprising of 5,856 species belonging to 203 families (Hara *et al.,* 1978 & 1982; Akiyama *et al.,* 1998) is impressively high on a global scale considering the area of the country. A comprehensive account of Nepal's fauna has been produced. Suwal & Verheugt (1995) listed a total of 181 mammalian species belonging to 12 orders and 39 families. Grimmet *et al*., (2000) reported 852 species belonging to 18 orders; Shrestha (2001) listed 185 species of fishes and Shah (1995) reported 143 species of amphibians and reptiles. Thapa (1995, 1997) reported 144 species of spiders and 5,052 species of insects of which 1,131 were discovered for the first time and described from Nepalese specimens. Altogether, 342 plant species and 160 animal species have been reported as being endemic to Nepal. Of the mammalian species listed from Nepal, 27 mammal species are listed as threatened by IUCN. Additionally, 22 bird species, nine reptile species (one endangered, two vulnerable, one rare, four indeterminate and one insufficiently known), and two insect species are listed under IUCN's Red List (1995).

In terms of natural resources of Nepal, forests make up the second largest resource base after water. The hydroelectric potential of the country is estimated to be about 45,000 MW. The forested area represents 29% of the country's total land area. The economy in terms of foreign exchange to subsistence is heavily reliant on agriculture, forestry and fishing.

Poverty, ecological fragility, and instability of high mountain environments, deforestation, poor management of natural resources, and inappropriate farming practices are the primary threats to mountain biodiversity of Nepal. The cumulative impacts of these threats result in accelerated soil erosion, catchment's degradation, and loss of biodiversity. Diversity in forests is also under increasing pressure from growing human population; unsustainable harvesting of fuel wood, timber, leaf litter, medicinal plants and other forest products, the impacts of excessive grazing by large numbers of livestock, and the construction of roads, dams and settlements, etc. One of the greatest threats faced by Himalayan flora and fauna is over-exploitation and poaching for trade of specific plants and animal parts that fetch high commercial values in local and international markets. Of the many species threatened with extinction, three wildlife species (Himalayan black bear (*Selenarctos thibetanus)*, brown bear (*Ursus arctos)* and the Himalayan musk deer (*Moschus chrysogster*) are poached for their organs that fetch enormous amounts of money through illegal international trade. The increasing pressures of tourism have induced greater demands of natural resources and introduced several alien species.

Appendix – ID

Pakistan: Overview of biodiversity status and threats

Pakistan covers a land area of 88.2 million ha and has a has a coastline of about 1,046 km with 22,820 km^2 of territorial waters and an Exclusive Economic Zone of about 196,600 km^2 in the Arabian Sea (Anon., 1999). It lies between 23°35’ to 37°05’ north latitude and 60°50’ to 77°50’ east longitude touching the Hindukush Mountains in the north and extending from the Pamirs to the Arabian Sea. With its dramatic geological history, broad latitudinal spread and immense altitudinal range, Pakistan spans a remarkable number of the world’s ecological regions. These range from the coastal mangrove forests of the Arabian sea to the spectacular mountain tops where the western Himalaya, Hindukush and Karakoram ranges meet. The region's topography (Figure IV) is constantly changing, as frequent earthquakes help the mountains grow at the remarkable rate of 7 mm (1/4 inch) a year.

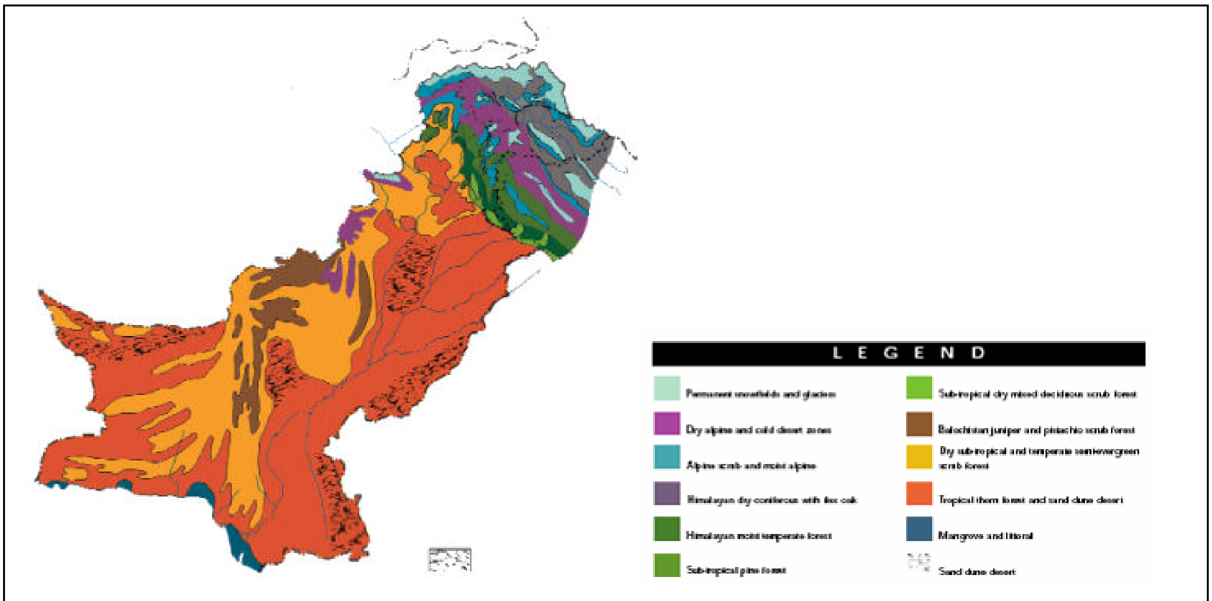

Figure IV Vegetative zones of Pakistan (Source: Roberts, 1991)

The country's flora and fauna are composed of a blend of Palaearctic and Indo-Malayan elements, with some groups also containing forms from the Ethiopian region. About 5,700 species of flowering plants, 174 mammals, 668 species of birds, 177 species of reptiles and 198 freshwater fish species including both native and introduced species have been reported (Anon., 1999). Due to man-made borders and the country not being an isolated entity in bio-geographic terms, the rates of endemism are low (about 7% for flowering plants and reptiles, and 3% for mammals). On the other hand, the proportion of 'restricted range' species is much higher and for many of them, Pakistan contains the bulk of the global population (IUCN, 2004).

The natural resources of the country include land, extensive natural gas reserves, limited petroleum, low grade coal, iron ore, copper, salt and limestone.

A number of serious environmental problems are inherent in the country, which are of great ecological concern for a sustainable economic future. These include – poverty; urban migration and the growing population; shortage of potable water; agricultural runoff and pesticide misuse; pollution of fresh water and marine systems; water logging and salinity; deforestation and soil erosion and desertification. The biggest threat to biodiversity is the progressive loss, fragmentation and degradation of natural habitats leading to the disappearance of countless species from forested area, rangelands and freshwater and marine ecosystems. Based on various reports (e.g. Mallon, 1991) and the opinions of recognized authorities (T.J. Roberts, *pers. comm.*, R. Rafiq, *pers. comm.*), at least 10 ecosystems of particular value for their species richness and/or unique communities of flora and fauna are threatened with habitat loss and degradation. Trees are indiscriminately cut to provide for the ever-increasing demand for timber. The rapidly increasing domestic livestock population is also taking its toll on the genetic diversity of country's rangelands and forests. This loss has been more rapid in the past few decades. Among the other factors of biodiversity decline, is the increase in the number of trawlers and the international demand for shrimp that has resulted in shrimp fishing beyond sustainable yield and have threatened the existence of many species of marine turtles caught in the trawlers.

Appendix – IE

Sri Lanka: Overview of biodiversity status and threats

Sri Lanka, an island in the Indian Ocean is located to the south of the Indian subcontinent. It lies between 5°55' and 9°55' north of the equator and between the eastern longitudes 79°42' and 81° 52'. Being an island country, Sri Lanka is endowed with a coastline of 1585 km and has a land area of 6.5 million ha. Land is the most vital and heavily threatened natural feature. The country's total population is around 19 million and a population density of 280 persons per km^2.

Sri Lanka has rich ecosystem diversity for its small size. Its natural ecosystems include (i) the marine and maritime or coastal ecosystems influenced by the sea, (ii) the natural forest ecosystems, (iii) the natural grassland ecosystems and (iv) the inland wetland ecosystems. Of the 83 wetland sites in Sri Lanka, 41 are included in the Asian Directory of Wetland Sites (UNEP, 2001).

Among the Asian countries, Sri Lanka has the highest biodiversity per unit area of land in terms of flowering plants and all vertebrate groups, excepting birds. The vegetation of Sri Lanka supports over 3,350 species of flowering plants and 314 species of ferns and fern allies. There is also considerable invertebrate faunal diversity. The vertebrate fauna include 51 species of teleost fishes, 39 species of amphibians, over 125 species of reptilia, over 390 species of birds, 96 species of mammals including 38 species of marine mammals. Approximately 28.3% or 927of the flowering plant species are endemic to Sri Lanka. Among the different vertebrate groups, the highest proportion of endemic species is recorded among the amphibians (65%), reptiles (52%), and freshwater fishes (41%). Among the invertebrate groups, the highest proportion of endemics is recorded among the freshwater crabs -100% and land mollusks -76% (UNEP (2001).

Until the 1960s, the Sri Lankan economy depended heavily on the export oriented plantation of crops of tea, rubber and coconut. But the adoption of open economic policies in late 1970s and the trade liberalization programme stated in the late 80s, lead the country more towards industrialization. By 1998, the services sector contributed 53% to the GDP, while agriculture, forestry and fisheries sector provided 21% (The South Asia Environment and Natural Resource Centre (UNEP, 2001).

The trends of biodiversity losses are significant. Over 284 flowering plants and 90 fern species are identified as globally threatened species. Among the animals, over 55% of the endemic species in the each of vertebrate groups, and over 50-100% of species in the invertebrate groups are under threat. Most of the ecosystems and habitats are under threats due to pressures arising from the increasing demand for land for urban expansion, agriculture, large-scale development projects and expansion of tea plantations. The dense forest cover in Sri Lanka decreased by 20%, during the period 1956 to 1992. The rate of deforestation from 1960 to 1990 has been estimated at 42,000 ha per year. Removal of timber and other forest products have affected biodiversity both at species and genetic levels. Slash and burn cultivation and forest fires have affected specially the biodiversity in the dry zone. Mining in natural ecosystem in the wet and intermediate zones especially for precious stones, result in the complete removal of the natural vegetation. Over 200-300 marine fish species and invertebrate are exported for the aquarium. Over exploitation is inevitable and affects the diversity of these reefs. At present, around 20 floral and 10 faunal invasive species have been introduced in various ecosystems. Over visitation to wild life and natural reserves, in vulnerable areas of Sri Lanka have significant impacts on ecosystem in terms of changes in community composition and dynamics. Water and soil pollution due to agrochemicals and industrial wastes and sediment loads and increase in temperature of seawater due to global worming are the factors that threaten the coral reefs in Sri Lanka. About 80% of the industries are concentrated in the districts of Colombo and Gampaha. Some of these industries such as textile dyeing, bleaching, food processing, leather tanning, metal finishing, agro and mineral products are highly polluting and pollute inland water. Marine turtles are still exploited, and turtle egg poaching, slaughtering of turtles for their flesh or carapace and turtle hatcheries that operate illegally, are common occurrences along the coastline.

Appendix – II

Biodiversity conservation: An overview of country specific legislations

Bangladesh

The Forest Act, (GoB, 1927), The Private Forest Order (GoB, 1959), and The Bangladesh Wildlife (Preservation) (Amendment) Act (GoB, 1974) are the key legislations in place for conservation of forests and wildlife in Bangladesh. In 1992, the Government of Bangladesh announced 'The National Environmental Policy of 1992' for ecological protection from natural disaster, sustainable use of natural resources and other related programs. Bangladesh has prepared National Conservation Strategy (NCS) and the National Environment Management Action Plan (NEMAP) for 1995 to 2005 under assistance from UNDP. Both NCS and NEMAP contain national strategy and national program for conservation of sites important from biodiversity consideration.

Bangladesh has signed, ratified, accepted and acceded to CITES, World Heritage Convention, Ramsar Convention, Convention on Biodiversity, Climate Change Convention and Convention to Combat Desertification. Bangladesh has also initiated the preparation of Biodiversity Strategies and Action Plan (BSAP) for conservation of biodiversity in Bangladesh under the sponsorship of the GEF.

India

The adoption of a National Policy for Wildlife Conservation (MoE&F, 1970) and the enactment of the Wildlife (Protection) Act (GoI, 1972) subsequently amended in 1993 and 2002 led to a significant growth in the protected areas network, from 5 national parks to 96 and 452 wildlife sanctuaries to 504 today respectively.

The enactment of Forest (Conservation) Act, 1980 (amended in 1988) helped in regulating the diversion of forests for non forest purpose and afforded legal protection to biodiversity within forested habitats of the country.

The recently enacted National Biodiversity Act (GoI, 2002), provides for conservation of biological diversity, sustainable use of its components and equitable sharing of the benefits arising out of the use of biological resources.

Among the key policy guidance, Wildlife Conservation Strategy (MoE&F, 2002) and National Environment Policy (MoE&F, 2006a) are notable and aim to provide mutually reinforcing strategies for conservation and development.

India is also a party and signatory to most of the multilateral agreements relevant for biodiversity conservation. These include Ramsar Convention (1971), CITES (1973), Vienna Convention (1969), Montreal Protocol (1987), CBD (1992), Convention on Climate Change (1992), World Heritage Convention (1972), Basel Convention (1989) and Bonn Convention (1983).

Nepal

The importance of conserving wild species of fauna and flora was first recognized by His Majesty's Government of Nepal (HMGN) in Nepal's first Five-Year Development Plan (1956-1961).The enactment of the NPWC Act in 1973 provided a regulatory mechanism for the conservation of natural areas and wildlife. It prohibited destruction, exploitation and removal of fauna or flora, and any kind of damage to habitat. The Act was subsequently amended four times, in 1974, 1982, 1989 and 1994, for the protection of endangered species of wildlife and their habitats, and management of different categories of protected areas (national park, strict nature reserve, wildlife reserve, hunting reserve, conservation area and buffer zone), and for the regulation of consumptive and non-consumptive uses of biodiversity so that the welfare of the people is sustained.

In order to fulfill its international obligations towards the conservation of genetic diversity, Nepal has become a party to several international agreements and conventions that include International Union for the Protection of New Varieties of Plants (1961), CITES, (1973), Convention on Biological Diversity (1992), Ramsar Convention (1971), International Technical Conference on Plant Genetic Resources: Global Action Plan on Plant Genetic Resources, Leipzig, (1996) and World Trade Organization (WTO) under the General Agreement on Tariffs and Trade (GATT), 1994. To honour obligations under the Convention on Biological Diversity, the two important policy documents – the National Conservation Strategy (HMGN/IUCN 1988) and the Nepal Environmental Policy and Action Plan (EPC, 1993) have been published by HMGN under support from Global Environment Facility and UNDP. These policy documents have highlighted the necessity of establishing appropriate policies, regulations, and management approaches to ensure sustainable extraction of medicinal plants.

Pakistan

The legislative framework for the conservation of wildlife consists of the various provincial acts and ordinances. The first legislation targeting environmental conservation as a whole was the Pakistan Environmental Protection Ordinance of 1983. This has very recently been replaced by the Pakistan Environmental Protection Act (GoP, 1997). These laws provide for the establishment of provincial wildlife management boards with responsibility for the formulation of policy and the supervision of activities related to the conservation and management of wildlife.

The Government of Pakistan has recognized the importance of preparation of the National Conservation Strategy and in becoming a signatory to, and ratifying, the Convention on Biological Diversity (CBD) in 1994. To meet the planning requirements of the Convention on Biodiversity, the Biodiversity Action Plan has already been prepared for Pakistan in 2000 under an agreement between the Government of Pakistan and the World Bank's Global Environment Facility. Pakistan is a party to two other international conventions dealing with species: the Bonn (1987) and CITES (1973), Pakistan is also a party to two area-based treaties: the Ramsar Convention (1971), and the Convention Concerning the Protection of the World Cultural and Natural Heritage signed at UNESCO, Paris in

1972. In addition to these treaties, Pakistan is a party to the United Nations Convention on the Law of the Sea (1982).

Sri Lanka

Major legislative enactments on the biological resources of Sri Lanka are the National Environmental Act (NEA) (GoSL, 1980), Forest Ordinance (1845), The Flora and Fauna Protection Ordinance (1937), National Heritage Wilderness Areas Act (1988), Botanic Gardens Ordinance (1928), Fisheries and Aquatic Resources Act (1996), the Plant Protection Ordinance (1999), and the Customs Ordinance (1969). The concept of environmental protection is enshrined in the country's constitution A National Environmental Action Programme (NEAP) was prepared by the Ministry of Environment and Parliamentary Affairs and is the first comprehensive document regarding environmental planning in the country. The National Environmental Steering Committee and NGO’s were involved in the formulation of the NEAP.

The preparation of the Biodiversity Action Plan was undertaken in response to Article 6 of the Convention (CITES). While consolidating the ongoing efforts of conservation and sustainable use of biological diversity, the Biodiversity Action Plan aimed at establishing a policy and programme regime, to bring national action to various aspects of the subject, including capacity-building and bio-safety measures, in line with the articles of the Convention. A National Conservation Strategy (NCS) for the country has been prepared by a special task force. The NCS identifies constraints to conservation and lay out a plan of action to remove them. It also provides guidelines for the implementation and monitoring of the Action Plan. The NCS includes directions for the establishment of a comprehensive system of protected areas and in the forestry sector, for the identification of forests for protection by the state.

Appendix – III

Developments in road sector: An overview by country

Bangladesh

The Government of Bangladesh has accorded high priority to the building up of necessary surface transport system, particularly a suitable road transport network. The total length of paved road network in Bangladesh has increased rapidly in recent years. The paved road network has increased from 600 km in 1947, to about 300,000 km at present. Of this 21,571 km of national, regional and district roads are managed by the Roads and Highways Department. The other roads including about 250,000 km of rural roads and 29,000 km of urban roads are managed by City Corporation and local government institutions. Cumulative ADB lending to Bangladesh, for transport and communication as of 31 December 2004 was 1,687.0. The investments on road projects in Bangladesh are being met both from government funds (128.7 Million US Dollar) and the Asian Development Bank loan (320.4 million US Dollar).

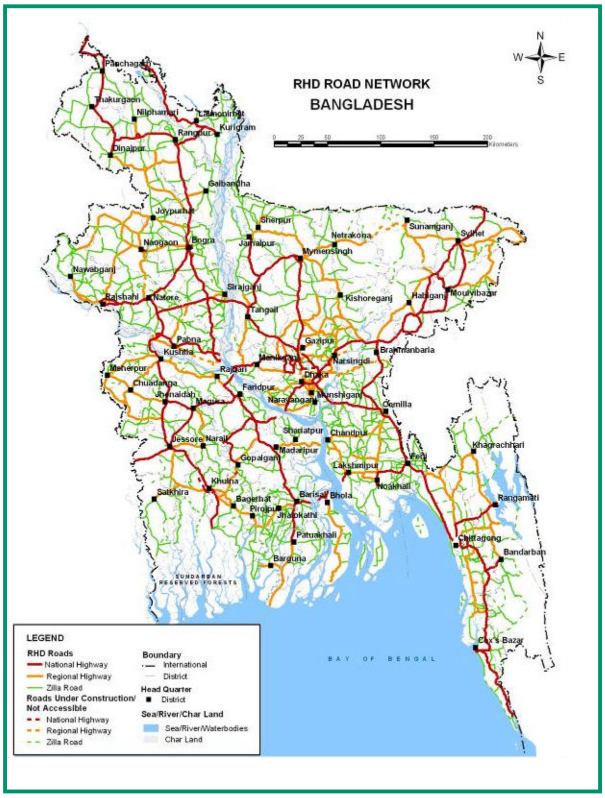

Figure V Road network of Bangladesh (Source: Roads and Highways Department, Bangladesh)

India

India's transport system is one of the largest in the world. It serves a land area of 3.3 million square kilometers (km^2) and consists mainly of roads, railways, and air services. Road transport with the total estimated road length of about 3.4 million km, is now the dominant mode. India's road network mainly consists of three categories of roads: national highways (about 60,000 km) that provide high-density links between states; state highways (about 600,000) km for linking national highways with district headquarters, important towns, and minor ports and major district roads; and rural roads (about 2.7 million km) mainly consisting of linking rural communities with the highway network. Improving the road transport network has been recognized as an important factor in promoting economic development, social integration and poverty alleviation in India. The Government of India has targeted to achieve balanced development of the total road network, which includes adding capacity by widening roadways, improving riding quality, strengthening road safety measures, and improving connectivity among rural communities. These objectives are being achieved through two elaborate and ambitious road building programmes- (i) The National Highway Development project which envisages construction of 6,000 km golden quadrilateral linking Delhi, Mumbai, Chennai, and Kolkata and (ii) the 7,300 km north–south, east–west corridors from Kashmir to Kanyakumari and Silchar to Porbandar. This project requires US Dollar 11 billion. Financing for this project is being met from earmarked excise duty (cess) on petrol and diesel, multilateral funding, budgetary allocations, and market borrowing. The Prime Minister's Rural Roads Program - Pradhan Mantri Gram Sadak Yojana (PMGSY) is under progress to address the problem of lack of rural road connectivity. PMGSY has identified more than 170,000 unconnected habitations requiring new road connectivity. The revised target to achieve connectivity to all habitations with a population of 1,000 (500 in the case of hilly or tribal areas) or more by the year 2010 would require US Dollar 30 billion. About 40 % of this requirement is being funded from the cess on high-speed diesel oil and about 7% from the committed assistance from ADB and the World Bank. Funding sources for the balance of 53% have not yet been identified.

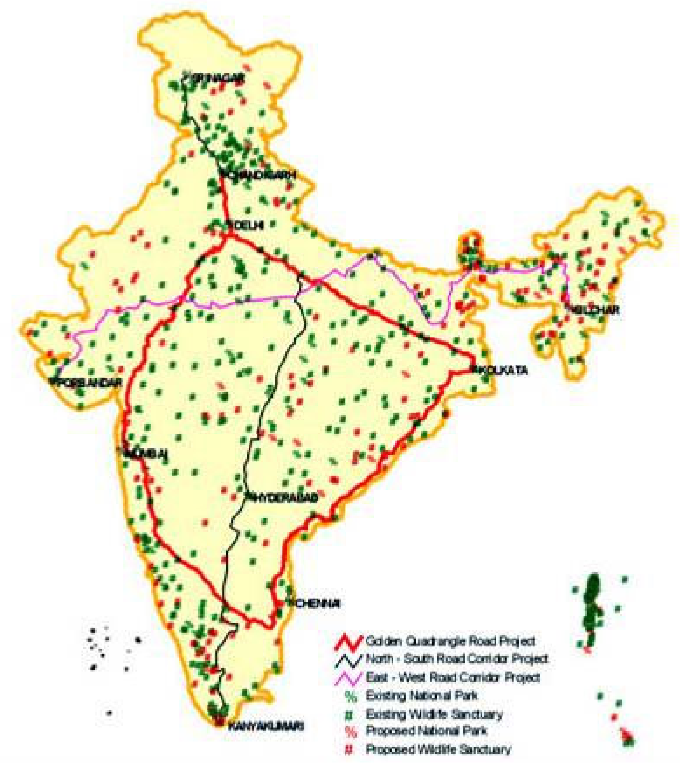

Figure VI Road network of India between major metropolitan towns (Source: GIS center, WII)

Nepal

Nepal is a landlocked country with China to the north and India to the south. Because of its mainly mountainous terrain and difficult weather conditions, roads and aviation are the major modes of transportation in the country. Nepal's total road network and density is the lowest in the region. The current road network extends to 37,000 km including 7535 km of highway and 20,000 km of rural road network**.** Of the rural roads, only 30 percent of the rural population has access to all-weather roads. More than 60 percent of the network is concentrated in the lowland (Terai) areas of the country. The poor condition of the road network has been recognized as a major barrier in the delivery of social services in the remote hill and mountainous districts and in improving the country's economic development. Therefore, improving and modernizing means of transportation and increasing communication networks to integrate rural area has been realized as a target under the Nepal

Millennium Development Goals for enhancing productive capacity to alleviate poverty (GoN & UNEP, 2006). The Government of Nepal has given the highest priority to linking of district headquarters by road network. In respect to this 70 out of 75 district headquarters are to be connected by road by the mid 2007. The road expansion is rapidly progressing with 3317 km (638 km strategic road and 2679 km rural roads) already constructed in 2003-5 and number of additional districts connected with road expected to become 10 by 2007. A 20 year road network plan to construct 28000 km network of road is under preparation. The road expansion and improvement in Nepal is receiving substantial funding support from international donors. ADB signed an agreement with the Government of Nepal recently for a US$55.2 million grant to help expand and rehabilitate the 490 km feeder road system in Nepal (ADB http://www.adb.org/Documents/News/NRM/nrm-200604.asp). The road development projects in Nepal would require careful planning to avoid impacts on the mountain ecosystem as the area already has 4144 km road length aligned through forests and 5274 km aligned through hills and fragile areas.

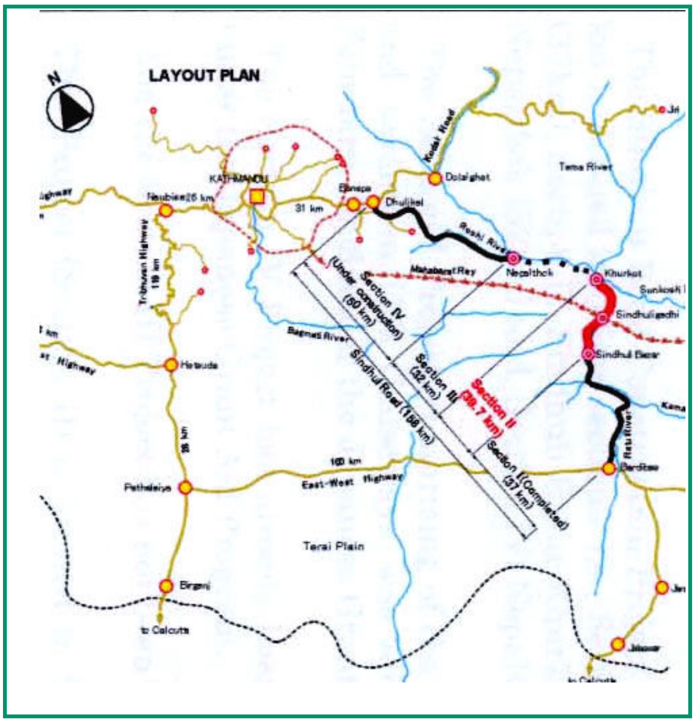

Figure VII Road network of Nepal (Source: Ministry of Physical Planning and Works, Nepal)

Pakistan

Road transport is the backbone of Pakistan's transport system; The 8,800 km long national highway and motorway network which is 3 percent of the total road network and carries 75% of Pakistan's total traffic (World Bank). There is growing recognition within the Government of Pakistan (GoP) that the country's ability to realize its economic potential is closely linked to the efficiency of its

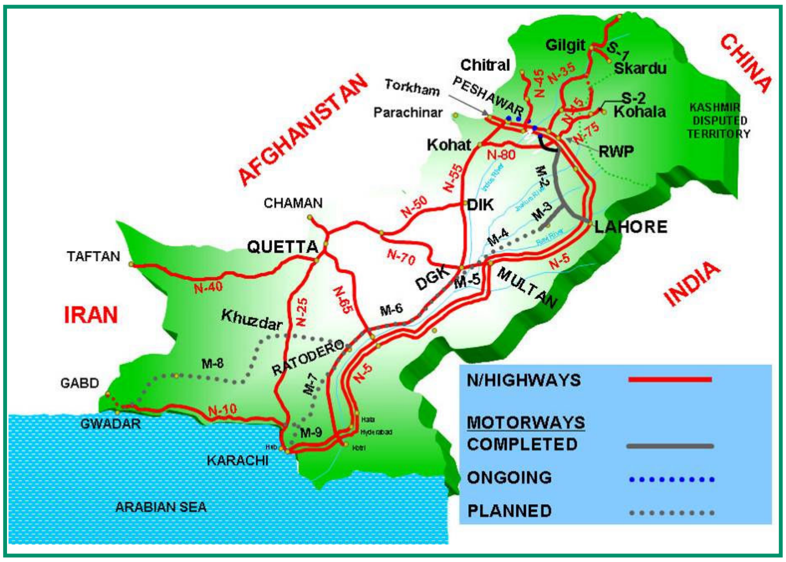

Figure VIII National highway network of Pakistan (Source: National Highway Authority, Pakistan) transport system. Roads are increasingly being viewed as a ‘service’ and a ‘business’ and major investments are being made in improving the network and rehabilitation of existing highways.

Sri Lanka

Sri Lanka has an extensive road network dating back to pre-independence times. The systematic construction of roads in Sri Lanka started in 1821 when the British built a road from Colombo to Kandy. The present total road network of approximately 100,000 km including 11,658 km of national highways, 15,000 km of provincial roads, and other rural roads is vital for the movement of people and goods and play an important role in integrating the country, facilitating economic growth, and ultimately reducing poverty. While the road density in Sri Lanka is higher than that of many developing countries, their capacities have not expanded in line with the growth of the vehicle population, which currently stands at around 2.4 million and carry over 70% of the traffic in Sri Lanka The liberalization of the economy in 1978 caused a rapid increase in the demand for road transport. The rapid transfer of 98% of freight transport from rail to road over the past 50 years has also resulted in an additional demand for road transport. In spite of the substantial increase in traffic demand, there has been very little investment for construction of new highways or for widening and improving existing trunk. The Government of Sri Lanka recognized an urgent need to invest in the

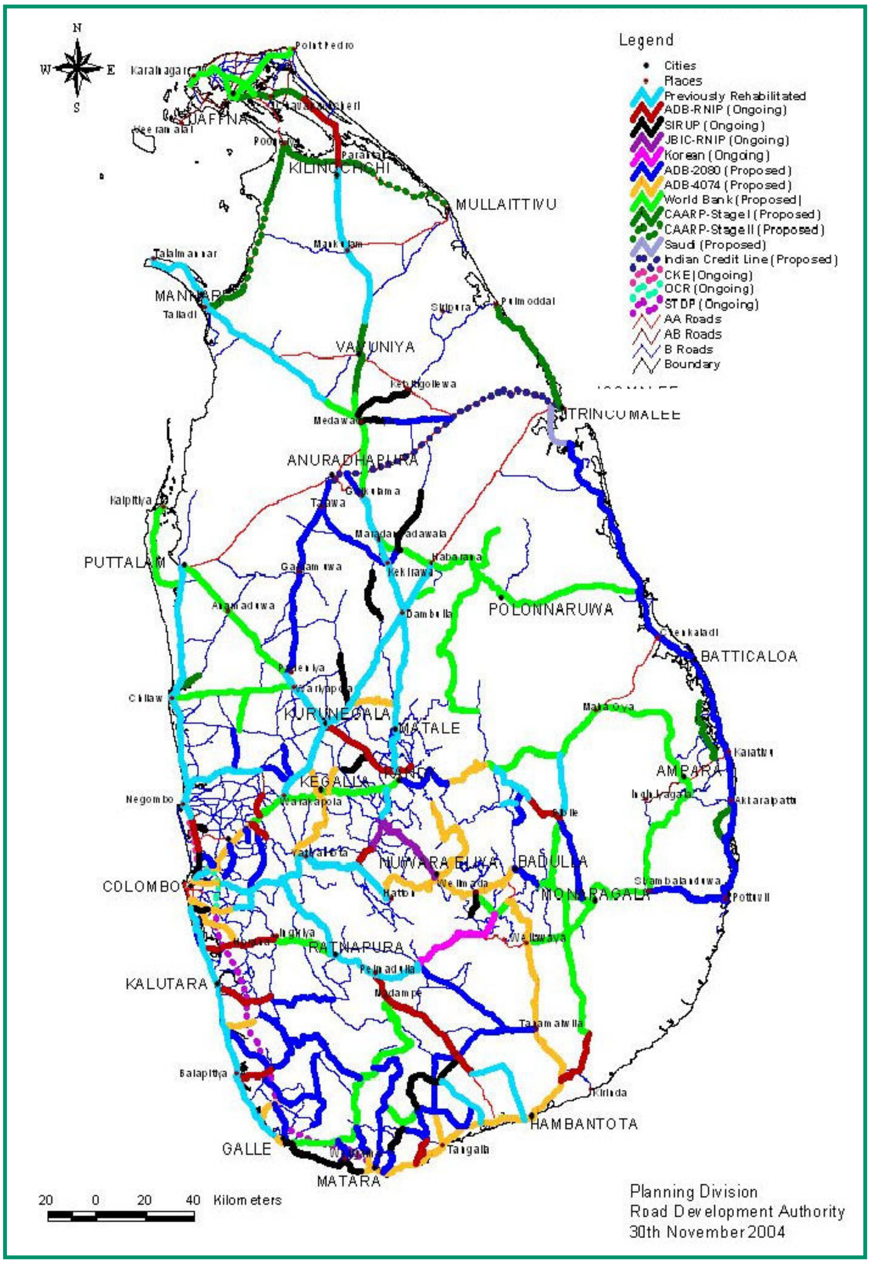

Figure IX National highway development programme of Sri Lanka – 2004 onwards (Source: Planning Division, Road Development Authority, 2004) improvement of its transport infrastructure. Several new highway and expressway projects are now underway with new traffic management system. The Government budget allocation for road sector developments has rapidly increased from SL.Rs.9.65 million (US Dollar 88,654.11) in 2003 to SL. Rs. 37.29 million (US Dollar 342,581.53) in 2005**.** Major projects in the pipeline under government aid include rehabilitation of the cluster of 20 road projects, Outer Circular Highway and Colombo – Kandy Alternate Highway. In addition, the Asian Development Bank and Japan Bank for International Corporation (JBIC) have funded rehabilitation of several sections of roads (totaling 348 km in length) and 47 bridges under its Road Network Improvement Project (RNIP). Other projects involving the rehabilitation and reconstruction of bridges and roads are being funded by Japanese International Corporation Agency (JICA), Kuwaiti Fund for Arab Economic Development.

Appendix – IV

Developments in mining sector: An overview by country

India

The history of mineral development is as old as the civilization in India and the mineral production dates back to the ancient times as the mining activities can be traced to as far back as 6,000 years or so. The country has a well-developed mining sector, which has vast geological potential with over 20,000 known mineral deposits. India produces as many as 84 minerals comprising 4 fuel, 11 metallic, 49 non- metallic industrial and 20 minor minerals. Their aggregate production in 1999- 2000 was about 550 million tonnes, contributed by over 3,100 mines (reporting mines) producing coal, lignite, limestone, iron ore, bauxite, copper, lead, zinc etc. The mining leases numbering 9,244 are spread over 21 States on about 13,000 mineral deposits occupying about 0.7 million hectares which is 0.21% of the total land mass of the country (TERI, 2001). The aggregate value of the mineral production in 1999-2000 was more than Rs. 450 billion (approximately US $10 billion).

The distribution of the value of mineral production shows that fuel minerals account for about 82% (of which solid fuels 44% and liquid /gaseous fuels is 38%), metallic minerals about 8%, non-metallic minerals 4% and the balance 6% is contributed by minor minerals. The National Mineral Policy (1993) opened the gates of Indian mineral industry to domestic and foreign investment, much of which was earlier reserved for the public sector. It aims to boost the country's exploration and mining efforts and render the mineral industry more competitive. In October 1996, the Ministry of Steel and Mines, Government of India, issued guidelines for grant of large areas for aerial prospecting under the provisions of the amended MM(R&D) Act (1995).

Pakistan

Pakistan has a favorable geological environment with a large number of mineral deposits including metallic, non-metallic, precious and semi-precious stones. Currently, Pakistan produces about 58 minerals. Mining all over the country is conducted on a small scale. During the last few decades its contribution to GNP has been about 0.5%. The future of mining in Pakistan is bright. Mega projects like Thar Coal, Duddar Lead-Zinc, and Copper-Gold are in the process of development.

Sri Lanka

Sri Lanka has reasonable endowments of mineral resources in relation to its size. The major mineral commodities are kaolin, ball clay, feldspar, vein quartz, silica sand, calcite, dolomite, mica, graphite, ilmanite, rutile, zircon, rock phosphate, seashells, inland coral, salt, gypsum and gems. Gems have been the most economically valuable resource accounting for more than 90% of all mineral exports from the country (GS&MB, 2002). Over 2200 metal quarries are in operation. Apart from the major minerals, mining of construction materials (limestone, dimension stone & aggregate) constitute a significant portion of mining. Despite the relatively high economic and social benefits, gem mining which is a wide spread activity has caused significant environment damages.

Appendix – V

Developments in oil and gas sector: An overview by country

Bangladesh

Bangladesh has relatively low levels of domestic oil reserves (28 million barrels) and consumption (91,000 bbl/day) as estimated in 2005 (Oil and Gas Journal, http://www.ogj.com/) that makes it a net oil importer. To date, oil exploration has been rather unsuccessful in Bangladesh. Exploration and production activities are primarily carried out by the Bangladesh Petroleum Exploration and Production Company (BAPEX), a subsidiary of the state-owned Bangladesh Oil, Gas & Mineral Corporation (Petrobangla). However, the country has also initiated several Production Sharing Contracts (PSCs) with foreign oil companies and has employed tax incentives to attract foreign company involvement. In 1993, after the formation of a new National Energy policy, the government of Bangladesh divided its territory and offshore sites into 23 blocks and opened them to foreign bidding for oil and gas exploration.

While estimates of the country's reserves vary, natural gas is Bangladesh's only significant source of commercial energy. The government of Bangladesh estimates that natural gas accounts for 80 percent of the country's commercial energy consumption. Natural gas reserve estimates vary widely for Bangladesh. Bangladesh's Ministry of Finance estimated 28.4 trillion cubic feet (tcf) of total gas reserves in 2004 of which 20.5 tcf is recoverable. Oil & Gas Journal (OGJ, http://www.ogj.com/) reported that Bangladesh had 5 tcf of proven natural gas reserves as in January 2006. In mid 2004, Petrobangla put net proven reserves at 15.3 tcf.

India

India has become the fifth largest consumer of oil in the world in 2006. The combination of rising oil consumption and fairly stable production levels leaves India increasingly dependent on imparts to meet consumption needs. According to Oil and Gas Journal (OGJ, http://www.ogj.com/) India has 5 – 6 billion barrels of proven oil reserves in 2007, the second largest amount in Asia – Pacific region. Much of India's crude oil reserves are located off the western coast (Mumbai High) and the north east of the country. Substantial undeveloped reserves are located in the offshore Bay of Bengal and in Rajasthan state. To help meet growing oil demand, India has promoted various exploration and projects over last several years. ONGC is the dominant player in India's upstream sector, accounting for nearly three – fourth of the country's oil output during 2006.

Similarly, India has 38 trillion cubic feet (tcf) of proven gas reserves as in January 2007. The bulk of natural gas production comes from western offshore regions, specially the Mumbai Complex. The onshore fields in Assam, Andhra Pradesh and Gujarat states are also major producers of natural gas. Despite that there have been several large gas finds in India over last five years, natural gas consumption (1089 billion cubic feet) is outstripping the new supply leading to newer developments in this sector to maximize recovery. India's natural gas import is likely to increase in coming years. This would lead to the consideration of number of LNG import terminals and pipeline projects.

Pakistan

Pakistan has not experienced many new oil fields as a result of which the majority of produced oil comes from fields located in Southern Indian Basin. Additional producing fields are located in middle and upper Indus basins. The combination of rising oil consumption (approximately 350,000 bbl/day) and flat production (around 60,000 bbl/day) in Pakistan has led to oil imports from Middle East exporters with Saudi Arabia as the lead importer. As Pakistan's net oil imports are projected to rise, there is all possibility of the increase in refining capacity in five of its existing refineries and proposals of setting up of new refineries. In June 2006, already Kuwait agreed to fund a US$ 1.2 billion oil refinery to be located in Port Qasim, Karachi.

Pakistan had 28 tcf) of proven natural gas reserves in 2006. The bulk of these reserves are located in the southern half of Pakistan. Pakistan's largest natural gas production occurs at the Sui field, which is located in the Southern Indus Basin. Pakistan Petroleum Limited (PPL) operates Sui field, with production averaging 655 mmcf/d. In the past few years, the country discovered seven new natural gas fields. The Pakistani Government expects the development of these new fields to add an additional 1 bcf/d to Pakistan's natural gas production. Pakistan's Government is also working on plans to build a pipeline that spans from Iran's massive natural gas reserves to Indian markets across Pakistani territory.

Appendix – VI

Environmental legislations: An overview by country

1. Bangladesh

The Government of Bangladesh enacted the Environmental Conservation Act (GoB, 1995) with a view to providing a legal framework for conservation and improvement of environmental quality and regulation of environmental pollution. To address these needs, the Environment Conservation Rules (1997) were subsequently promulgated and EIA became a mandatory requirement for authorization of projects in Bangladesh under these rules.

In Bangladesh, the EIA procedure adopts a tiered system to determine the level of details necessary to appraise a project from the environmental angle before significant efforts and funds are committed for implementation of the project. The three tiers are (i) screening (ii) Initial Environmental Examination (IEE) and (iii) detailed Environmental Impact Assessment (EIA) Screening decides whether the EIA process should be applied to a development project, and if it is required, the type of study (IEE or EIA) required. The primary responsibility for conducting EIA study for any project rests with the project proponent who may get the study done through the in-house expertise or an independent environmental consulting agency having requisite qualification to perform the task. The responsibility for carrying out review of the EIA report before awarding clearance rests with the Department of Environment (DoE) which is the focal organization and regulatory body for EIA approval, at the Government level. The process for EIA in Bangladesh is summarized in Figure X.

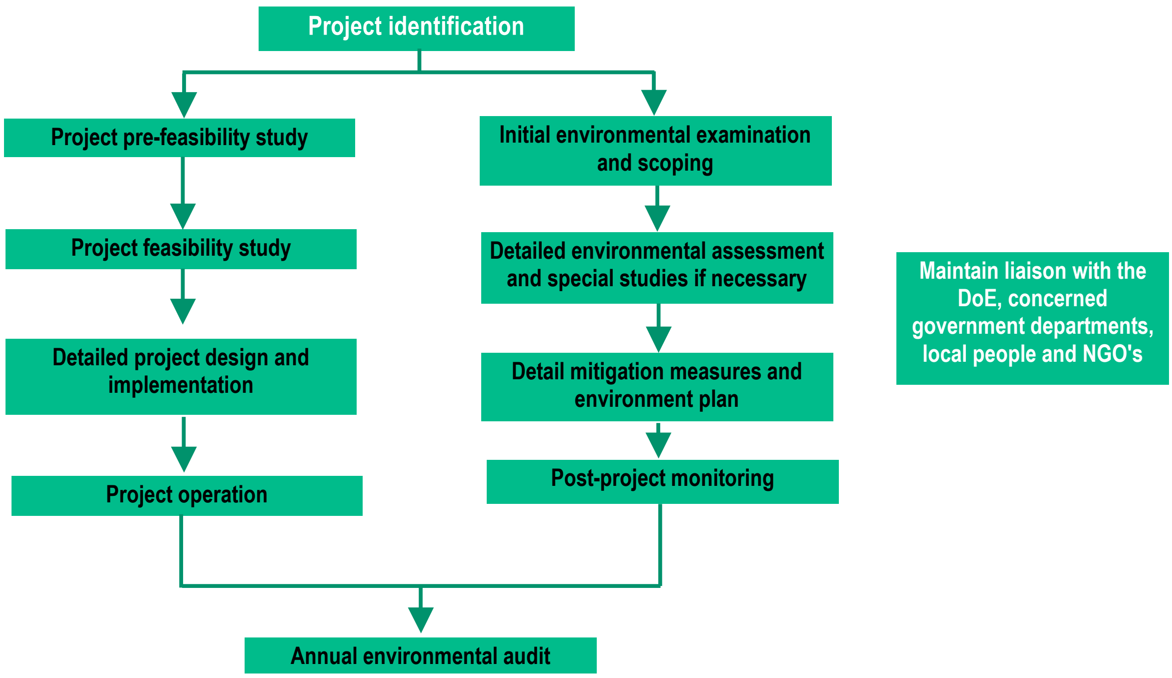

Figure X EIA process in Bangladesh

2. India

The Environmental (Protection) Act, 1986 is the umbrella legislation for the protection of environment in the country. The EIA Notification issued on 4th May 1994 (MoE&F, 1994) and subsequently amended on September 14, 2006 (MoE&F, 2006b) under the rules of the above Act lays down the regulatory process for EIA in India. The EIA Notification stipulates that prior environmental clearance from regulatory authority is mandatory for construction of new projects or activities or the expansion or modernization of existing projects or activities listed in its schedule to be taken in any part of the country. All projects are broadly classified into Category 'A' and 'B' projects based on the spatial extent of potential impacts on human health and natural and man made resources. All projects included in Category 'A' require environmental clearance from the Ministry of Environment and Forests, Government of India on the recommendation of the Expert Appraisal Committee and for all Category 'B' projects, environmental clearance is required from the State Environmental Impact Assessment Authority (SEIAA) duly constituted by the Central Government. As per the provisions of the EIA Notification as amended on 14th September 2006, the environmental clearance process comprise of four stages-screening, scoping, public consultation and appraisal based on final EIA report.

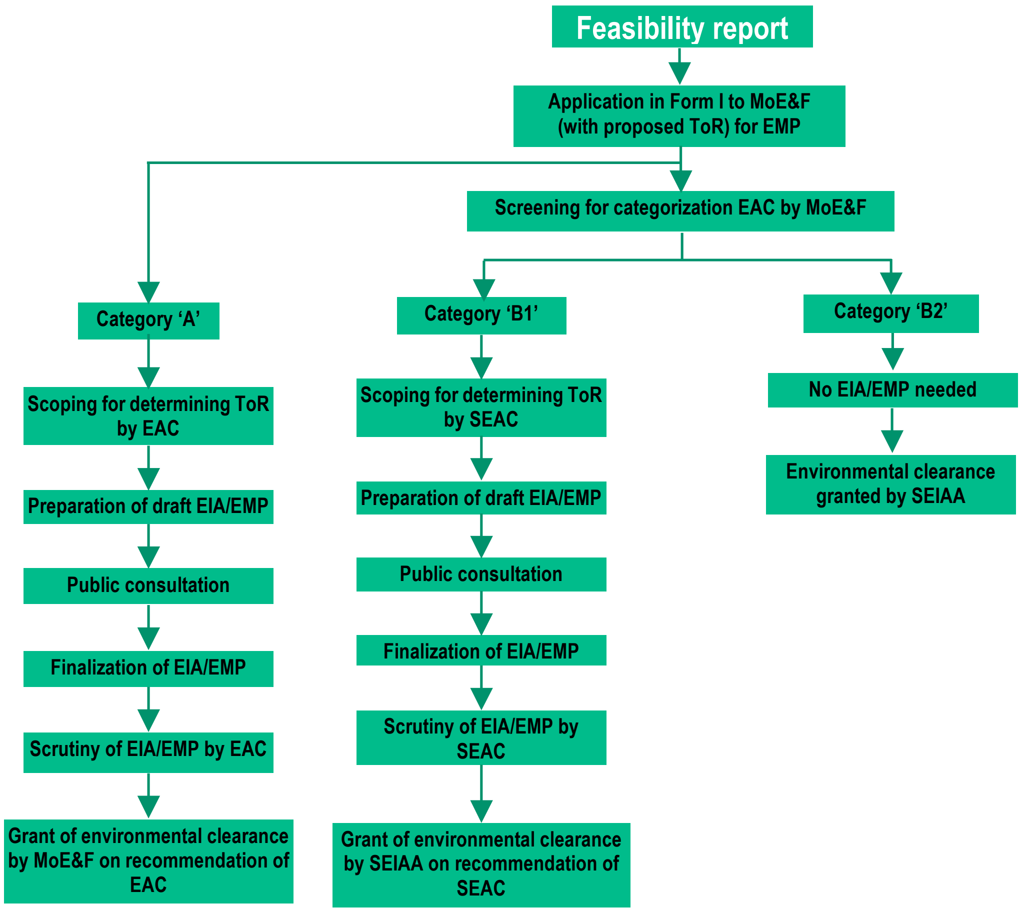

Figure XI EIA process in India

3. Nepal

The Environment Protection Act is an 'umbrella' law for providing a legal basis for the EIA system in Nepal. This newly adopted environmental protection law, together with the Environment Protection Rules makes the integration of IEE and EIA legally binding for the ‘prescribed’ projects. Proposals requiring IEE and EIA study have been included in Schedules 1 and 2 of the EPR, 1997 (amended in 1999). Ministry of Population and Environment (MoP&E) published an additional notice in the Nepal Gazette, on 23 August 1999, stating that the proposals which are not listed in Schedules 1 but the have investment worth ranging between Rs. 10 million (US Dollar 141843.97) to 100 million (US Dollar 1418439.71) may require IEE study, and those which are not listed in Schedule 2 but have investment worth over Rs. 100 million (US Dollar 1418439.71) should undergo an EIA process.

The establishment of the Ministry of Population and Environment (MoP&E) was announced on September 22, 1995. This Ministry was subsequently dissolved in March 2005 and its Environment Division was transferred to the Ministry of Science and Technology renamed as the Ministry of Environment, Science and Technology (MoES&T). The MoES&T as the lead agency for environment has the responsibility of promoting the EIA process by helping the sectoral ministries (nine in number). On receipt of EIA report from the project proponent, the concerned ministry makes observations and then submits the scoping, ToR and EIA reports of the projects to MoES&T for final approval. The MoES&T constitutes a review committee with the representation from concerned ministries, project proponent and EIA expert and has the ultimate responsibility of communicating the decision based on the EIA report after public notice period is over. The process for EIA in Nepal is summarized in Figure XII.

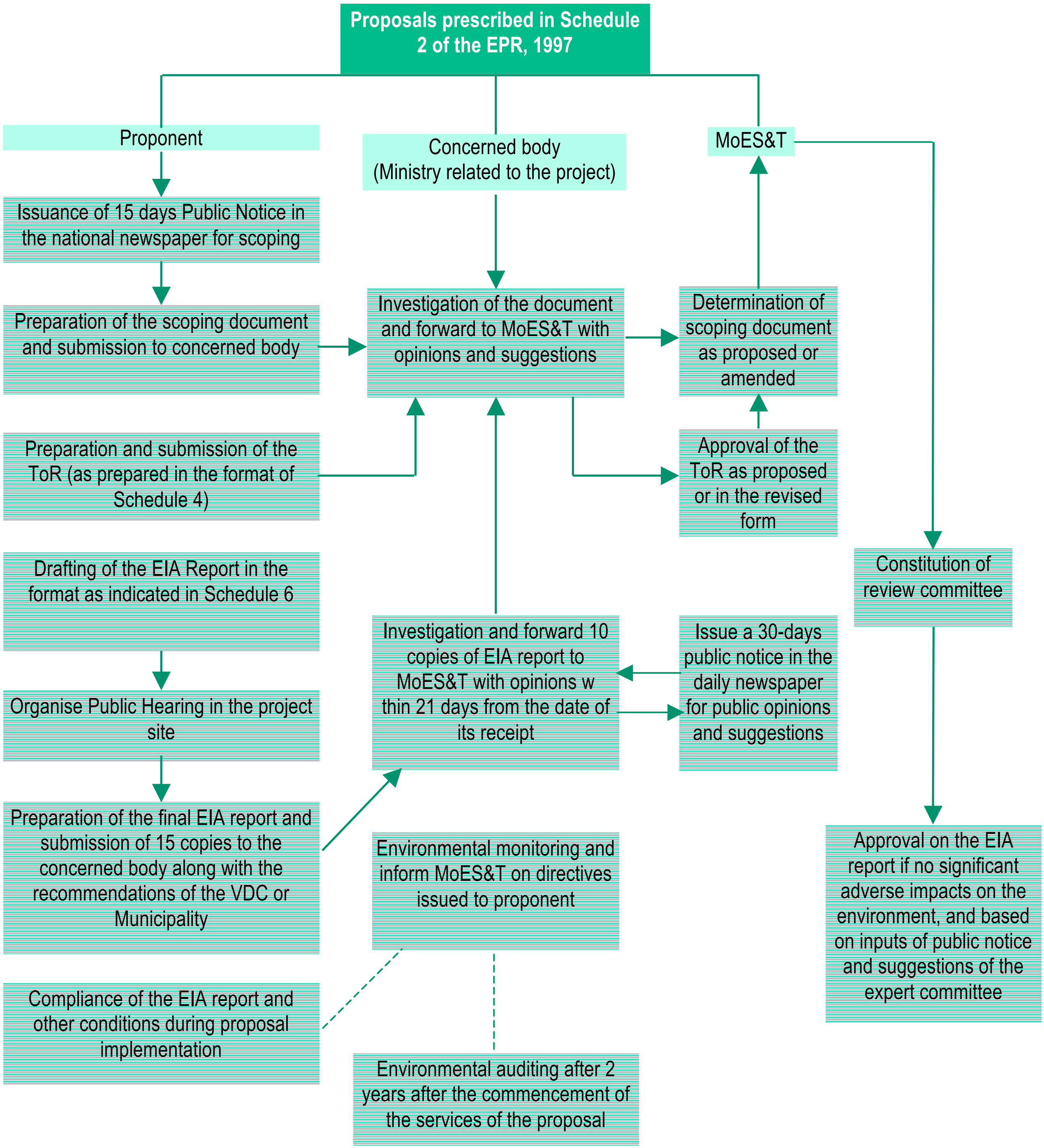

Figure XII EIA process in Nepal

4. Pakistan

The formalized arrangements for implementation of EIA system in Pakistan evolved over a period of fifteen years. It started with the promulgation of Pakistan Environmental Protection Ordinance (PEPO) of 1983 (repealed in 1997). Environmental impact assessment of all development projects whether public or private is a legal requirement under section 12 of Pakistan Environmental Protection Act of (1997), which became operational in year 2000. Requirements regarding the content, style and details of the EA are stated in the Pakistan Environmental Assessment Procedures, 1997 (PEAP). PEAP (1997) also provides the specific guidelines for the preparation of the EA reports. Subsequent Initial Environmental Examination (IEE) and EIA Review Regulations (2001) provide the list of projects categorized in Schedule I and II to make clear distinctions between projects which require IEE (preliminary environmental review) and the projects which require EIA (a detailed environmental study). This categorization is based on the nature and magnitude of projects and the anticipated level of impacts arising from them. In addition, the Federal Environmental Protection Agency (EPA) may also direct the proponent of any project, irrespective of its listing or non listing in the two schedules, to submit an IEE or an EIA if the project is likely to have major impact or is located within environmentally sensitive area. For the preparation of the EIA, it is the responsibility of the proponent to reach out to all stakeholders: communities, NGO's, regulators, and concerned government departments. After submission of the report, the responsibility of reviewing the document for technical soundness and accuracy of content lies entirely with the concerned EPA.

After EPA accepts the EIA, a date for a Public Hearing of the EIA is fixed, and announced in a national newspaper. Based on the EPA's review of the report, an environmental approval is granted in the form of an NOC. The process for EIA in Pakistan is summarized in Figure III.

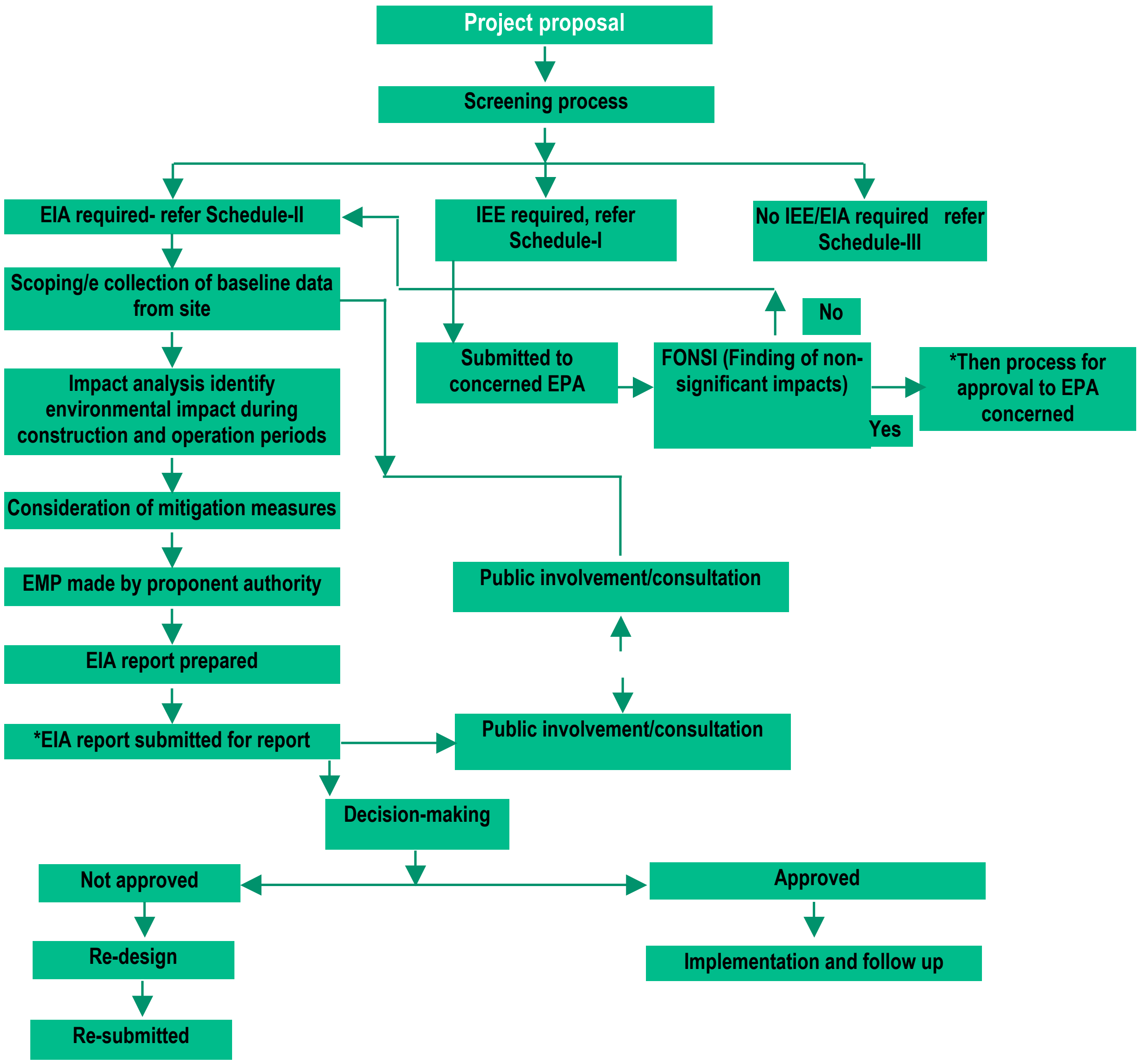

Figure XIII Current EIA/IEE process in Pakistan (Source: EPA, Pakistan, 2005)

5. Sri Lanka

Although several laws exist in Sri Lanka to protect the different aspects of the natural environment such as wildlife, forests, and water bodies, specific legislation taking into account the integrity and quality of the environment in its broadest sense came into being only with the enactment of the National Environmental Act No. 47 of 1980 (Government of Sri Lanka (GoSL, 1980)). This act established the main institution, the Central Environmental Authority (CEA) as the lead government agency for environmental protection in Sri Lanka.

The need for the Environmental Assessment (EA) was first introduced in coastal areas by the Coast Conservation Act No. 57 (GoSL, 1981). EA was introduced as a legal requirement throughout the country by the enactment of an amendment to the National Environmental (amendment) Act No. 56 (GoSL, 1988). This act stipulates that approval of major development projects, whether public or private in origin, requires the preparation of one of the two types of reports an Initial Environmental Examination (IEE) and/or an Environmental Impact Assessment (EA). However, mandatory EAs were only made effective after regulations and orders required to implement the EA process were introduced in June 1993 (GoSL 1993a & 1993b). Other actions of GoSL arising from the 1988 amendments that strengthened the legal framework for environmental management were: the issuance of regulations published in the Gazette no. 772/72, 1993c, which designated specific types of projects as 'prescribed activities' requiring detailed EAs for approval from responsible ministry and agency. The CEA has published general EA guidelines (CEA, 1995a & 1995b) and sectoral guidelines for the agricultural (CEA, 1997a), transport (CEA, 1997b), tourism, irrigation and energy (Hennayake *et al.,* 1997) sectors. Once an EIA report is submitted, as per the provisions of NEA (1998), it is placed for a public inspection and comment during the stipulated period of 30 days. According to the Gazette Extra Ordinary No. 1159/22 dated 22nd November 2000, public commenting period for IEE is not mandatory. A public hearing may be held to provide an opportunity to any member of the public (who has submitted his comments) to be heard if the PAA considers it to be in the public interest to do so. The EIA process is implemented through designated Project Approving Agencies (PAAs) specified under Section 23 Y of the NEA (1998). At present, 17 state agencies have been specified in Gazette Extra Ordinary No. 859/14 dated 23rd February 1995 as PPAs. When the PAA is also the project proponent, the CEA is required to designate an appropriate PAA. In cases where more than one PAA is involved, the CEA must determine the appropriate PAA. In the event of doubt or difficulty in identifying the appropriate PAA, it has been a practice for the CEA to take over the role of PAA. The process for EIA in Sri Lanka is summarized in Figure XIV.

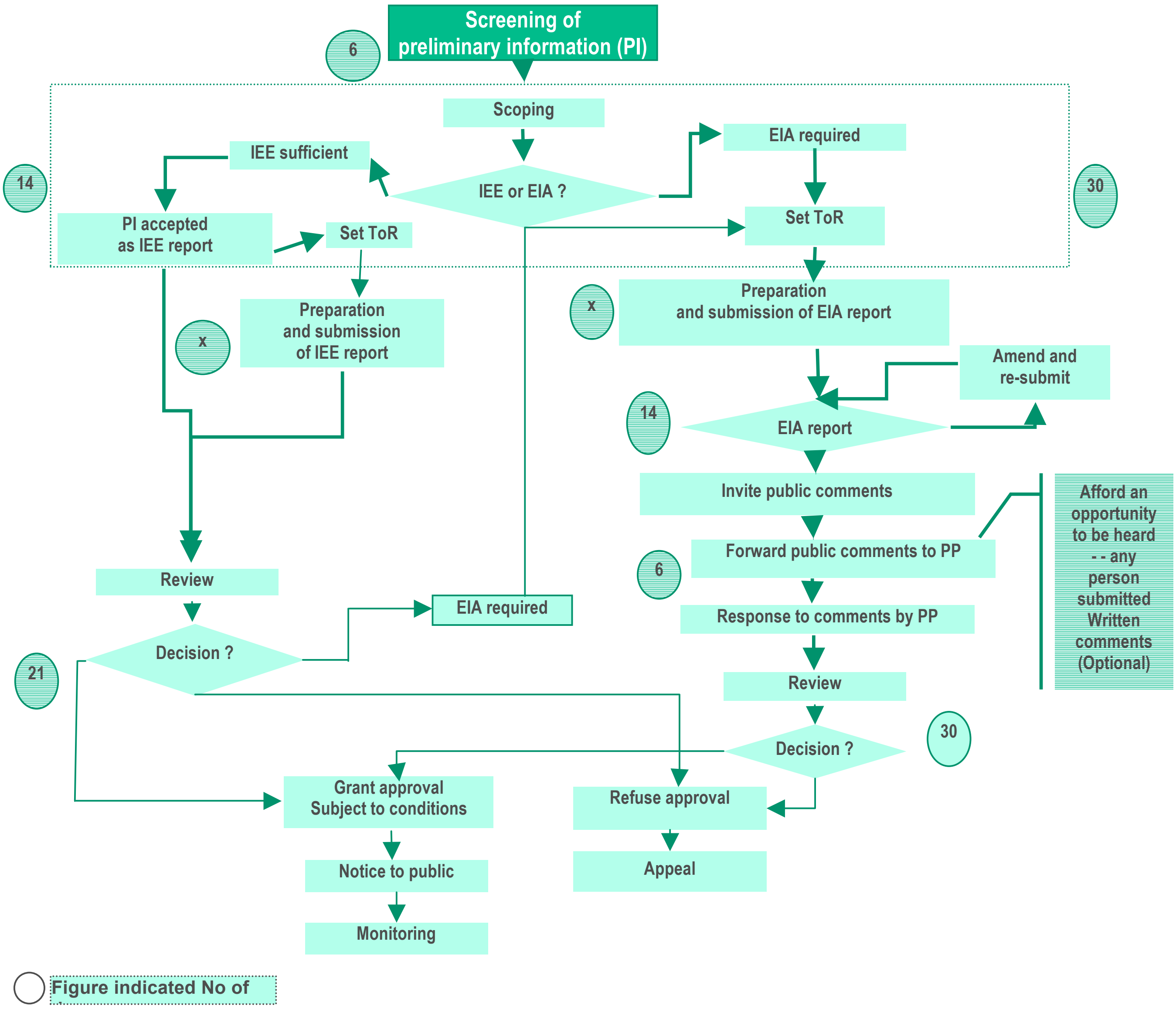

Figure XIV EIA process in accordance with the National Environmental Act (1988) Govt. of of Sri Lanka (Source: CEA, 1998)

Appendix – VII

Legal and policy framework for biodiversity conservation and EIA in different countries in South Asia

Framework / Country	Legislations related to environment & biodiversity conservation and EIA	Vision/policy document	Policy institution/ executing agency	Apex national council
Bangladesh	• The Forest Act, 1927(as amended up to 2000) • Bangladesh Wild Life (Preservation) (Amendment) Act, 1974 • Water Pollution Control (amendment) Act, 1974 • Environment Pollution Control Ordinance, 1977 • Forest (Amendment) Ordinance, 1989 • Water Resource Planning Act, 1992Environmental Preservation Act, 1997 • The Environmental Conservation Rules (ECR), 1997 • National Water Policy, 1999 • Environmental Conservation Act (ECA) 1995, 2002 • Bangladesh Environment Protection Act, 2003	• National Conservation Strategy (NCS) • The National Environment Policy (NEP), 1992. • National Forest Policy, 1994 • The National Water Policy, 1999National Land Use Policy, 2001 • Coastal Zone Policy, 2005	• Ministry of Environment & Forests • Department of Environment, Govt. of Bangladesh	• National Environment Committee
India	• Indian Forest Act, 1927 • Wildlife Protection Act, 1972 (amended 2002) • The Water (Prevention and Control of Pollution) Act, 1977 (amended 1992) • Forest (Conservation) Act, 1980 • The Air (Prevention and Control of Pollution) Act, 1981 (amended 1987) • Environment Protection Act, 1986 (amended 1991) • Coastal Zone Regulation Act, 1991 (amended 2001) • EIA Notification, 1994 (amended 1997, 2006) • Biological Diversity Act, 2002	• National Policy on Pollution Abatement, 1992 • National Conservation Strategy and Policy Statement on Environment and Development, 1992 • National Biodiversity Strategy and Action Plan (NBSAP), 2002 • National Environment Policy, 2006 • Wildlife Action Plan, 2002	• Ministry of Environment & Forests, Govt. of India • State/UT level regulatory agencies	• Ministry of Environment & Forests, Govt. of India
Nepal	• Aquatic Animals Protection Act, 1960 • Plant Protection Act, 1964	• National Environment Policy & Action Plan, 1993	• Ministry of Population & Environment, Govt. of Pakistan	• Environment Protection Council

Framework / Country	Legislations related to environment & biodiversity conservation and EIA	Vision/policy document	Policy institution/ executing agency	Apex national council
	• National Parks and Wildlife Conservation Act, 1973 • Wildlife Sanctuary Rules, 1977 • Soil & Watershed Conservation Act, 1982 • King Mahendra Nature Conservation Trust Act, 1982 • Nepal Petroleum Act, 1983 • Nepal Electricity Authority Act, 1984 • Mines & Mineral Act, 1985 • National Parks & Wild Life Conservation Act, 1987 • Electricity Act, 1992 • The Forest Act, 1992 • Water Resources Act, 1992 • Industrial Enterprises Act, 1992 • Management Act, 1992 • Environment Protection Preservation Act, 1993 • Environment Protection Act, 1996 • Environment Protection Regulations, 1997		of Pakistan	
Pakistan	• The Forests Act, 1972 • The Provincial Wildlife (Protection, Preservation, Conservation and Management) Acts, Ordinances and Rules (Sindh 1972, Punjab 1974, and NWFP 1975) • Pakistan Environment Protection Ordinance, 1983 • Environmental Protection Act 1997 • Pakistan Environmental Protection Act, 1997 • Government of Punjab, Forestry, Wildlife, Fisheries and Tourism Department (Notification No. FOFT (EXT) VIII. 17/96, 1998 • Environmental Tribunal rules, 1999 • Pakistan Environmental Protection Agency (review of IEE/EIA) Regulations, 2000 • Project Implementation and Resettlement of Affected Persons Ordinance, 2001 • Pakistan Biosafety Rules, 2005 • National Drinking Water Policy, 2005	• National Conservation Strategy, 1992 • Forest Sector Master Plan, 1992 • Biodiversity Action Plan, 2000 • National Resettlement Policy March, 2002 • National Environment Policy, 2005 • Clean Development Mechanism (CDM), National Operational Strategy, 2006	• Ministry of Environment, local and rural development • Environmental Protection Council together with Federal/ Provincial Environmental Protection Agencies	• Environment Protection Council

Framework / Country	Legislations related to environment & biodiversity conservation and EIA	Vision/policy document	Policy institution/ executing agency	Apex national council
Sri Lanka	• Fauna and Flora Protection Ordinance No.2, 1937 (amendment Acts No. 44, 1964) • Forest Ordinance, 1945 (amended in 1966 and 1988) • Soil Conservation Act, 1951 (amended in 1953, 1981 and 1996)Felling of Tres (Control) Act No 9, 1951 • National Water Supply and Drainage board act No 2, 1974 • Maritime Zone Law, 1976 • Marine Pollution Prevention Act No 39, 1981 • National Resources, Energy and Science Authority Act No 78, 1981 • National Aquatic Resources Research and Development Agency Act No. 54, 1981 (amendment Act No.32, 1996) • National Environment Act, No. 47 1980 (amended in 1988 and 2000) • Coast Conservation Act, 1981 (amended in 1988 and 1997) • National Heritage and Wilderness Areas Act No. 3, 1988 • Mines and Minerals act No 33, 1992 • Fauna and Flora Act No. 49, 1993 • Fisheries and Aquatic Resources Act, 1996 • Plant Protection Act, 1999 • Forest Ordinance (Cap 453) • Land settlement Ordinance (Cap 463)	• National Forest Policy, 1996 • National Environment Action Plan, 1998-2001 • Biodiversity Action Plan	• Ministry of Environment and Natural Resources • Central Environment Authority	

Source:

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Sri Lanka
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Appendix – VIII

Information sources for conducting ecological assessments

Topics	Key references
Vegetation ecology	Mueller-Dombois, D. and H. Ellenverg (1974). *Aims and methods of vegetation ecology*. John Wiley, Chichester. Anon., (2000). *Riverine chars in **Bangladesh** : Environmental dynamics and management. Environment and GIS Support Project for Water Sector Planning*. University Press, Dhaka. ISBN: 9840515802 Puri, Gopal Singh (1960). *Indian forest ecology; a comprehensive survey of vegetation and its environment in the **Indian** subcontinent*. Oxford Book and Stationery Co., New Delhi. Negi, Sharad Singh (1989). *Forest types of **India**, **Nepal**, and Bhutan*. Periodical Expert Book Agency, Delhi India. Sen, David N. (1990). *Ecology and vegetation of **Indian** desert*. Agro Botanical Publishers (India), Bikaner. ISBN: 8185031290 Shrestha, T. B. (1982). *Ecology and vegetation of north-west **Nepal** (Karnali Region)*. Royal Nepal Academy, Kathmandu, Nepal. Numata, Makoto (1983). *Structure and dynamics of vegetation in eastern **Nepal***. Laboratory of Ecology, Faculty of Science, Chiba University, Japan. Shrestha, Keshab (1995). *Biodiversity assessment of forest ecosystems of the central mid-hills of **Nepal**. Biodiversity Profiles Project (Nepal)*. Euroconsult, Arnhem. ISBN: 907328709X Snead, R. E, and Mohammad Tasnif (1966). *Vegetation types in the Las Bela region of west **Pakistan***. Coastal Studies Institute, Louisiana State University, Baton Rouge. Akbar, Khalid Farooq (2000). *Urban corridors : The ecology of roadside vegetation in Sahiwal city*. LEAD, Islamabad, **Pakistan**. ISBN: 9698529039 Fernando, S. N. U. (1968). *The natural vegetation of **Ceylon**: The forests, the grasslands, and the soils of Ceylon*. Lake House Bookshop, Colombo.
Vegetation classification	Champion, H. G. and S. K. Seth (1968). *A revised survey of the forest types of **India***. Government of India, New Delhi. Gandhi Tara (1989). ***Rajasthan** vegetation index. Society for Promotion of Wastelands Development*, New Delhi. Vana Vibhaga (2002). *Forest and vegetation types of **Nepal**. by Natural Resource Management Sector Assistance Programme (Nepal).* Nepal Vana Vibhaga. Tree Improvement and Silviculture Component, Kathmandu, Nepal. ISBN: 9993370223 Lilles, Jens-Peter Barnekow (2005). *The map of potential vegetation of **Nepal** : A forestry/agro-ecological/biodiversity classification system*. Forest & Landscape Denmark. ISBN: 8779032109 Dickoré, W. B. and Marcus Nusser (2000). *Flora of Nanga Parbat (NW Himalaya, **Pakistan**): An annotated inventory of vascular plants with remarks on vegetation dynamics*. Botanic Garden and Botanical Museum Berlin- Dahlem, Berlin, Germany. ISBN: 3921800439.
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Conservation status	
Animals	IUCN (1996). *IUCN Red List of threatened animals*. The IUCN Species Survival Commission, IUCN, Gland.
Plants	Nayar, M. P. and A. R. K. Sastry (1987). *Red Data Book for **Indian** Plants*, Vol. I,II,& III. Botanical Survey of India, Calcutta.
Wildlife census techniques	Rodgers, W. A. (1991). *Techniques for wildlife census in **India**. A field manual*. Technical

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Air, water and land pollution	Economopolous, Alexander P. (1993). *Assessment of sources of air, water and land pollution Part I (of two): Rapid inventory techniques in environmental pollution*. No. WHO/PEP/89. WHO, Geneva.
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Overview of EIA methods	World Bank (1997). *Roads and the environment: A handbook*. World Bank Technical Paper No. 376. World Bank, Washington, D.C. IAIA website. www.iaia.org
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Minimum viable populations	Gilpin, M. E., and M. E. Soulé (1986). *Minimum viable populations: processes of species extinction*. In: Soulé ME (ed). Conservation biology: The science of scarcity and diversity. Sunderland MA: Sinauer. Pp 19-34. Goodman, D. (1987). *The demography of chance extinction*. In: Soulé ME (ed). Viable populations for conservation. New York NY: Cambridge University Press. Pp 11-34. Soulé, M. E. (ed). (1987). *Viable populations for conservation*. New York NY: Cambridge University Press.
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Metapopulations	Gilpin M. and I. Hanski (eds). (1991). *Metapopulation dynamics: Empirical and theoretical investigations*. New York NY: Academic Pr. Pp. 336. Hastings A, Harrison S. (1994). *Metapopulation dynamics and genetics*. Annual Review of Ecology Systematic 25:167-88.
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Habitat corridors (connectivity)	Forman, R. T. T. and M. Godron (1986). *Landscape ecology*. New York NY: J Wiley.

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Appendix – IX

Valuation methods at a glance

Valuation Method	Reliability of Results	Ease of Application	Data Collection and Analysis	Applicability, strengths and weaknesses
Market price	High	High	There are three main steps involved in collecting and analysing the data required to use market price techniques to value ecosystem services: (i). Find out the quantity of the product used, produced or exchanged; (ii). Collect data on its market price; (iii). Multiply price by quantity to determine its value.	The greatest advantage of this technique is that it is relatively easy to use, as it relies on observing actual market behaviour. Few assumptions, little detailed modelling, and only simple statistical analysis are required to apply it. Data is generally easy to collect and analyse. Market information, including historical trends, can usually be obtained from a wide variety of sources such as government statistics, income and expenditure surveys, or market research studies. In most cases it will be necessary to supplement these secondary sources with original data, for example through performing market checks or conducting some form of socio-economic survey A major disadvantage is the fact that many ecosystem products and services do not have markets or are subject to markets, which are highly distorted or irregular – the market fails. In such cases, it is inappropriate to use market price techniques: • Ecosystem services such as catchment protection or nutrient retention are rarely available for purchase or sale. Because they have many of the characteristics of public goods[6], it is in fact questionable whether the market can ever accurately allocate or price them. • Many ecosystem products are utilized at the subsistence level. They are not

[6] A public good is characterised by the non-excludability of its benefits – each unit can be consumed by everyone, and does not reduce the amount left for others. Many ecosystem services are pure or partial public goods – for example scenic beauty (a pure public good), or water quality (which has many of the characteristics of a public good). In contrast a private good is one from which others can be excluded, where each unit is consumed by only one individual. Most natural products are private goods.

Valuation Method	Reliability of Results	Ease of Application	Data Collection and Analysis	Applicability, strengths and weaknesses
				traded in formal markets, and are consumed only within the household. • There exist a wide variety of subsidies and market interventions which distort the price of ecosystem products. Examples include subsidies to water and electricity, centrally-set royalties and fees for products such as timber and state controlled prices for basic food and consumer items. • Because markets for most ecosystem products and services are not well-developed, they tend not to be competitive, and prices are a poor indicator of true social and economic values. This may be the case where there is an additional social or environmental premium attached to products and services, where there are only a small number of buyers and sellers, or where there is imperfect market information. • In many cases, even where an ecosystem product has a market and a price, it is impossible to measure the quantities produced or consumed. Especially at the subsistence level, ecosystem product consumption and sale is often highly seasonal or irregular. For example, particular products are only available at particular times of the year, are used under special conditions, or are collected and used on an opportunistic basis. Ecosystem products are also often collected and consumed as part of a bundle of items or have high levels of substitution[7] or complementarily[8] with other goods. For example, they are used only when other products are unavailable or unaffordable, or they form occasional inputs into the production of other goods. • Even where an ecosystem good or service has a market, and quantities bought or

[7] A substitute good or service is one which is used in place of another – for example kerosene instead of firewood, or bottled water instead of tap water.
[8] A complementary good is one which is used in conjunction with another – for example between other products and fishing activities such as the collection of reeds for fishing baskets or firewood for fish smoking.

Valuation Method	Reliability of Results	Ease of Application	Data Collection and Analysis	Applicability, strengths and weaknesses
				sold can be measured, prices do not tell us how important this product or service is to society, nor how much some buyers would actually be willing to pay.
Effect on production techniques	High	High	There are three main steps to collect and analyse the data required for using effect on production techniques to value ecosystem goods and services: • Determine the contribution of ecosystem goods and services to the related source of production, and specify the relationship between changes in the quality or quantity of a particular ecosystem good or service and output; • Relate a specified change in the provision of the ecosystem good or service to a physical change in the output or availability of the related product; • Estimate the market value of the change in production.	Effect on production techniques are commonly used, and have applicability to a wide range of ecosystem goods and services. Their weakness relates to the difficulties that are often involved in collecting sufficient data to be able to accurately predict the biophysical or dose-response relationships upon which the technique is based. Such relationships are often unclear, unproven or hard to demonstrate in quantifiable terms. Simplifying assumptions is often needed to apply the production function approach. An additional concern is the large number of possible influences on product markets and prices. Some of these should be excluded when using effect on production techniques. In some cases, changes in the provision of an ecosystem good or service may lead not just to a change in related production, but also to a change in the price of its outputs. In some cases, product may become scarcer or more costly to produce. In other cases, consumers and producers may switch to other products or technologies in response to ecosystem change or to a scarcity of ecosystem goods and services. Furthermore, general trends and exogenous factors unrelated to ecosystem goods and services may influence the market price of related production and consumption items. They must be isolated and eliminated from analysis.
Replacement cost techniques	High	High	There are three main steps involved in collecting and analysing the data required to use replacement cost techniques to value ecosystem goods and services:	Replacement cost techniques are particularly useful for valuing ecosystem services, and have the great advantage that they are simple to apply and analyse. They are particularly useful where only limited time or financial resources are available for a valuation study, or where it is not possible to carry out detailed surveys and fieldwork.

Valuation Method	Reliability of Results	Ease of Application	Data Collection and Analysis	Applicability, strengths and weaknesses
			• Ascertain the benefits that are associated with a given ecosystem good or service, how it is used and by whom, and the magnitude and extent of these benefits; • Identify the most likely alternative source of product, infrastructure or technology that would provide an equivalent level of benefits to an equivalent population; • Calculate the costs of introducing and distributing, or installing and running, the replacement to the ecosystem good or service.	The main weakness of this technique is that it is often difficult to find perfect replacements or substitutes for ecosystem goods and services that would provide an equivalent level of benefits to the same population. In some cases this results in ecosystem under-valuation, as artificial alternatives generate a lower quantity or quality of goods and services. Yet this technique may also lead to the over-valuation of ecosystem benefits, as in some instances the replacement product, infrastructure or technology may be associated with secondary benefits or additional positive impacts. The reality of the replacement cost technique is also sometimes questionable: we may question whether, in the absence of a well-functioning ecosystem, such expenditures would actually be made or considered worthwhile.
Mitigative or avertive expenditure techniques	High	High	There are four main steps involved in collecting and analysing the data required to use mitigative or avertive expenditure techniques to value ecosystem goods and services: • Identify the negative effects or hazards that would arise from the loss of a particular ecosystem good or service; • Locate the area and population who would be affected by the loss of the ecosystem good and service, and determine a cut-off point beyond which the effect will not be analysed; • Obtain information on people's responses, and	Mitigative or avertive expenditure techniques are particularly useful for valuing ecosystem services. In common with other cost-based valuation methods, a major strength is their ease of implementation and analysis, and their relatively small data requirements. As is the case with the replacement cost technique, the mitigative or avertive measures that are employed in response to the loss of ecosystem goods and services do not always provide an equivalent level of benefits. In some cases it is also questionable whether in fact such expenditures would be made or would be seen as being worth making. An additional important factor to bear in mind when applying this technique is that people's perceptions of what would be the effects of ecosystem loss, and what would be required to mitigate or avert these effects, may not always match those of "expert" opinion.

Valuation Method	Reliability of Results	Ease of Application	Data Collection and Analysis	Applicability, strengths and weaknesses
			measures taken to mitigate or avert the negative effects of the loss of the ecosystem good or service; • Cost the mitigative or avertive expenditures.	
Damage cost avoided techniques	High	High	There are four main steps involved in collecting and analysing the data required to use damage cost avoided techniques to value ecosystem goods and services: • Identify the protective services of the ecosystem, in terms of the degree of protection afforded and the on and off-site damages that would occur as a result of loss of this protection; • For the specific change in ecosystem service provision that is being considered, locate the infrastructure, output or human population that would be affected by this damage, and determine a cut-off point beyond which effects will not be analysed; • Obtain information on the likelihood and frequency of damaging events occurring under different scenarios of ecosystem loss, the spread of their impacts and the magnitude of damage caused;	Damage cost avoided techniques are particularly useful for valuing ecosystem services. There is often confusion between the application of damage costs avoided and production function approaches to valuation. Here it is important to underline that whereas this technique deals with damage avoided such as from pollution and natural hazards (which are typically external effects), change in production techniques usually relate to changes in some input such as water (typically internalised). A potential weakness is that in most cases estimates of damages avoided remain hypothetical. They are based on predicting what might occur under a situation where ecosystem services decline or are lost. Even when valuation is based on real data from situations where such events and damages have occurred, it is often difficult to relate these damages to changes in ecosystem status, or to be sure that identical impacts would occur if particular ecosystem services declined.

Valuation Method	Reliability of Results	Ease of Application	Data Collection and Analysis	Applicability, strengths and weaknesses
			• Cost these damages, and ascribe the contribution of the ecosystem service towards minimising or avoiding them.	
Travel cost	Medium	Medium	There are six main steps involved in collecting and analysing the data required to use travel cost techniques to value ecosystem goods and services: • Ascertain the total area from which recreational visitors come to visit an ecosystem, and dividing this into zones within which travel costs are approximately equal; • Within each zone, sample visitors to collect information about the costs incurred in visiting the ecosystem, motives for the trip, frequency of visits, site attributes and socio-economic variables such as the visitor's place of origin, income, age, education and so on; • Obtain the visitation rates for each zone, and use this information to estimate the total number of visitor days per head of the local population; • Estimate travel costs, including both direct expenses (such as fuel and fares, food, equipment, accommodation) and time spent on the trip;	The travel cost method is mainly limited to calculating recreational values, although it has in some cases been applied to the consumptive use of ecosystem goods. Its main weakness is its dependence on large and detailed data sets, and relatively complex analytical techniques. Travel cost surveys are typically expensive and time consuming to carry out. An additional source of complication is that several factors make it difficult to isolate the value of a particular ecosystem in relation to travel costs, and these must be taken into account in order to avoid over-estimating ecosystem values. Visitors frequently have several motives or destinations on a single trip, some of which are unrelated to the ecosystem being studied. They also usually enjoy multiple aspects and attributes of a single ecosystem. In some cases travel, not the destination *per se*, may be an end in itself.

Valuation Method	Reliability of Results	Ease of Application	Data Collection and Analysis	Applicability, strengths and weaknesses
			• Carry out a statistical regression to test the relationship between visitation rates and other explanatory factors such as travel cost and socio-economic variables; • Construct a demand curve relating number of visits to travel cost, model visitation rates at different prices, and calculate visitor consumer surplus.	
Contingent valuation	High	Low	There are five main steps involved in collecting and analysing the data required to use contingent valuation techniques to value ecosystem goods and services: • Ask respondents their WTP or WTA for a particular ecosystem good or service; • Draw up a frequency distribution relating the size of different WTP/WTA statements to the number of people making them; • Cross-tabulate WTP/WTA responses with respondents' socio-economic characteristics and other relevant factors; • Use multivariate statistical techniques to correlate responses with respondent's socio-economic attributes; • Gross up sample results to obtain the value	A major strength of contingent valuation techniques is that, because they do not rely on actual markets or observed behaviour, they can in theory be applied to any situation, good or service. They remain one of the only methods that can be applied to option and existence values, and are widely used to determine the value of ecosystem services. Contingent valuation techniques are often used in combination with other valuation methods, in order to supplement or cross-check their results. One of the biggest disadvantages of contingent valuation is the large and costly surveys, complex data sets, and sophisticated analysis techniques that it requires. Another constraint arises from the fact that they rely on a hypothetical scenario which may not reflect reality or be convincing to respondents. Contingent valuation techniques require people to state their preferences for ecosystem goods and services. They are therefore susceptible to various sources of bias, which may influence their results. The most common forms of bias are strategic, design, instrument and starting point bias. Strategic bias occurs when respondents believe that they can influence a real course of events by how they answer WTP/WTA questions. Respondents may for instance think that a survey's

Valuation Method	Reliability of Results	Ease of Application	Data Collection and Analysis	Applicability, strengths and weaknesses
			likely to be placed on the ecosystem good or service by the whole population, or the entire group of users.	hypothetical scenario of the imposition of a water charge or ecosystem fee is actually in preparation. Design bias relates to the way in which information is put across in the survey instrument. For example, a survey may provide inadequate information about the hypothetical scenario, or respondents are misled by its description. Instrument bias arises when respondents react strongly against the proposed payment methods. Respondents may for instance resent new taxes or increased bills. Starting point bias occurs when the starting point for eliciting bids skews the possible range of answers, because it is too high, too low, or varies significantly from respondents' WTP/WTA. With careful survey design, most of these sources of bias can however be reduced or eliminated.

Appendix – X

Environmental legislations applicable to different sectors in different countries

Country	Legislations
Bangladesh	• The Highways Act, 1925 (Bengal Act III of 1925) • Bangladesh Wildlife Preservation Act, 1973 (amended 1974) • The Motor Vehicles Ordinance, 1983 • Gas Safety Rules, 1991 • Environment Policy, 1992 • Environmental Conservation Act of (ECA), 1995 • Bangladesh Environmental Conservation Act, 1995 (amendment 2000, 2002) • Environmental Conservation Rules, 1997 • Environment Court Act, 2000 • National Conservation Strategy of (NCS), 1992 • National Environmental Policy, 1992 • National Industrial Policy, 1992 • National Forest Policy, 1994 • National Energy Policy, 1995 • National Environment Management Action Plan of (NEMAP), 1995 • National Water Policy, 1999 • National Land Transport Policy, 2002
India	• Land Acquisition (Mines) Act, 1885 • The Petroleum Act, 1934 (Act No. 30 of 1934) • The Oilfields (Regulation and Development) Act, 1948 (53 of 1948) • Coal Mines Provident Fund and Miscellaneous Provisions Act, 1948 • National Highways Act, 1956 • Mines and Minerals (Development and Regulation) Act, 1957 • The Petroleum and Natural Gas Rules, 1959 • Petroleum and Minerals Pipelines (Acquisition of Right of User in Land) Act, 1962 • The Wildlife (Protection) Act 1972 • Coal Mines (Nationalisation) Act, 1973 • Coal Mines (Taking Over of Management) Act, 1973 • Coal Mines (Conservation and Development) Act, 1974 • Oil Industry (Development) Act, 1974 • Forest (Conservation) Act and Rules,1980 • Environmental Protection Act, 1986 • Coal Mines Labour Welfare Fund (Repeal) Act, 1986 • Goa, Daman and Diu Mining Concessions Act, 1987 • Air Pollution (Prevention) Act, 1981, amended 1987 • Water Pollution (Prevention) Act, 1974, amended 1988 • National Highways Authority of India Act, 1988

Country	Legislations
	• CESS and other Taxes on Minerals(validation) Act, 1992 Oil and Natural Gas Commission (Transfer of Undertaking and Repeal) Act, 1993 • Mines Act, 1995 • Coal India (Regulation of Transfers and Validation) Act, 2000 • Control of National Highways (Land and Traffic) Act, 2002 • Offshore Areas Mineral (Development and Regulation) Act, 2002 • Petroleum and Natural Gas Regulatory Board, Act, 2006 • The National Mineral Policy (1993) • Guidelines for laying petroleum product pipelines, Ministry of Petroleum and Natural Gas Notification, 2002 • EIA Notification, 1994 (amended in 2006)
Nepal	• Aquatic Animals Protection Act (AAPA), 1961 • National Parks and Wildlife Conservation Act (NPWCA), 1973 • Public Road Act, 1974 • Soil and Watershed Conservation Act (SWCA), 1982 • Nepal Petroleum Act, 2040 (1983) • Mines & Mineral Act, 1985 • Petroleum Regulation, 2041 (1985) (amended in 2046 (1989) and in 2051 (1994)) • Petroleum Industry (Income Tax) Regulation, 2041 (1985) (issued under the Income Tax Act, 2031 (1974)) • Water Resources Act (WRA), 1992 • Forest Act, 1993 • Environment Protection Act (EPA), 1996
Pakistan	• Explosives Act, 1884. • Regulation of Mines and Oil Fields and Mineral development Act, 1948 • Motor Vehicle Ordinance, 1965 and Rules, 1969 • Pakistan Environmental Protection Act, 1997 • Highways Safety Ordinance, 2000 • Pakistan Petroleum (Exploration & Production) Rules, 2001. • Pakistan Petroleum Rules for offshore, 2003 • National Mineral Policy, 1995 • Petroleum Exploration and Production Policy, 2001
Sri Lanka	• The Timber Act, 1822 • Forest Act, 1885 • The Fauna and Flora Protection Act No.2, 1937 • The Crown Lands Ordinance, 1947 • Motor Traffic Act, 1951 • Soil Conservation Act, 1951 (amended in 1953, 1981 and 1996) • The Flood Protection Ordinance, • The National Heritage Wilderness Act No. 4, 1988 • Mines and Mineral Act, 1992 • National Policy on Wildlife Conservation, 1990