Asian Regional Environmental Assessment Programme, IUCN Nepal

EIA Training Manual

for Professionals and Managers

This manual was tested in training workshops held in Kathmandu during March 5 to 11 and April 22 to May 1, 1996

IUCN
The World Conservation Union

EIA Training Manual for Professionals and Managers

Ram B. Khadka
EIA Programme Coordinator
IUCN–The World Conservation Union

Ron Bisset
Senior EIA Advisor
Scott Wilson Resource Consultants
Scotland, UK

Peter A. Neame
Senior Environmental Scientist
SRD–Sustainable Resource Development Inc. Canada

Contributors/Reviewers:

Badri Dev Pande (Public Participation)

Govinda Sharma Ghimire (Ecology and Ecosystem)

Bimala Shrestha (Health)

Bishnu Bhandari (Social Aspects)

Narayan Belbase (Legal Aspects)

Bhusan Tuladhar (Pollution)

Tim Webb (Calyx Expert System)

Uttam Sagar Shrestha (Case Studies)

IUCN–The World Conservation Union

Founded in 1948, The World Conservation Union brings together states, government agencies and a diverse range of non-governmental organizations in a unique world partnership: over 880 members in all, spread across some 133 countries.

As a Union, IUCN seeks to influence, encourage and assist societies throughout the world to conserve the integrity and diversity of nature and to ensure that any use of natural resources is equitable and ecologically sustainable. A central secretariat coordinates the IUCN Programme and serves the Union membership, representing their views on the world stage and providing for their goals. Through its six Commissions, IUCN draws together over 6,000 expert volunteers in project teams and action groups, focusing in particular on species and biodiversity conservation and the management of habitats and natural resources. The Union has helped many countries to prepare National Conservation Strategies, and demonstrates the application of its knowledge forward by an expanding network of regional and country offices, located principally in developing countries.

The World Conservation Union builds on the strengths of its members, networks and partners to enhance their capacity and to support global alliances to safeguard natural resources at local, regional and global levels.

IUCN-The World Conservation Union officially launched the Nepal Country Office on 23 February 1995 with His Majesty's Government, Ministry of Finance as the government partner. IUCN Nepal has been developing partnerships with various government line agencies as well as with non-governmental organizations to carry forward its activities to conserve Nepal's natural resources and ecological processes.

As a part of the decentralization policy of IUCN HQ, the South and South Asian Regional Environmental Assessment programme in Nepal was established within the IUCN Country Office, Nepal, with an intention to assist members and partners in the region to build capacity to establish an effective system of Environmental Assessment.

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Foreword

Social and economic development in South Asian Countries stands at a dilemma between meeting basic human needs of ever increasing population at one hand and conserving the declining natural resources on the other. Development endeavours such as the construction of roads, hydro-electric dams, irrigation canals, industrial installations and recreational facilities induce changes into the natural as well as the human system in the environment. Impacts associated with such developments could bring about adverse results if the process is not regulated or controlled through improved project selection and more responsive project planning and design. Environmental Impact Assessment (EIA) has, therefore, emerged as an instrument to charter a new course of development action which ensures environmental protection and human development. EIA process has therefore a strong bearing to the vital point made in the World Conservation Strategy (1980), Caring for the Earth (1991), the Global Biodiversity Strategy (1992) and the Convention on Biological Diversity (1992) that both biodiversity and biological resources should be conserved in order to ensure the Earth's vitality for now and the future.

With regard to the provisions on the environment and development field, the focus on action at national level is emphasized by the article 14 which dwells upon impact assessment and minimising adverse impacts. The article deals with four following areas:

- EIA of a party's proposed projects, programmes and policies;
- Transfrontier cooperation, in particular notification, information, consultation and emergencies;
- Emergency planning including international cooperation; and
- Liability for damage to biological diversity.

Nepal is poised to launch its ninth periodic 5-year plan beginning from the mid-July of 1997. Experiences of over 40 years of planned development in Nepal have indicated that the fragility of Nepalese mountains and the fertility of diverse farmlands are heavily impacted not only by infrastructure developments but also by land-use changes. The National Planning Commission of Nepal has therefore encouraged to develop procedures and processes of EIA through its National Conservation Strategy (NCS) Implementation Project executed jointly with IUCN–The World Conservation Union. Previous but pioneering works in developing EIA guidelines for various sectors and testing them through pilot projects have encouraged IUCN Nepal to come up with a EIA Training Manual for Professionals and Managers. It is hoped that this manual will be useful to a wider audience to build-up a capability for development while keeping up with the vision of poet Devkota to make Nepal beautiful, peaceful and great.

Tirtha Bahadur Shrestha
Coordinator
Heritage and Biodiversity Conservation Program
IUCN Nepal

Acronyms

ACC	Alternative Choice Coefficient
ADB	Asian Development Bank
CBA	Cost Benefit Analysis
CEQ	Central Environmental Quality
CFCs	Chlorofluorocarbons
CIDA	Canadian International Development Agency
dBA	Decibels above reference noise
DDT	Dichlorodiphenyltrichloroethane
DM	Delphi Method
DOR	Department of Roads
EA	Environmental Assessment
ECG	Environmental Core Group
ECM	Environmental Compatibility Matrix
EEC	European Economic Committee
EES	Environmental Evaluation System
EH	Environmental Health
EIA	Environmental Impact Assessment
ERIP	East Rapti Irrigation Project
ERL	Environmental Resource Limited
ESCAP	Economic and Social Commission for Asia and Pacific
ESSD	Environmentally Sound and Sustainable Development
FMUDP	Forest Management and Utilization Project
GIS	Geographic Information System
HMG	His Majesty's Government
IEE	Initial Environmental Examination
ISM	Impact Summary Matrix
IUCN	The World Conservation Union
KAP	Knowledge Attitude and Practice
L	Locally occuring impact
L	Long-term Impact
LM	Leopold matrix
M	Medium-term Impact
M	Magnitude
MGM	Modified Graded Matrix
MOPE	Ministry of Population and Environment
MW	Meghawatt
N	National Impact
NCS	National Conservation Strategy

NESP	Nepal Environmental Impact Assessment Strengthening Project
NGO	Non-governmental organization
NGP	National Group Process Technique
NPC	National Planning Commission
NPC	National Planning Commission
PIU	Parameters Important unit
PPP	Policy Plan or Program
R	Regional Impact
RCNP	Royal Chitwan National Park
S	Short-term impact
SEA	Strategic Environmental Assessment
SIA	Social Impact Assessment
SP	Site Specific or limited to Project Area
SRD	Sustainable Resource Development Inc
TOR	Terms of Reference
UE	Economical Environmental
UN	United Nations
UNCED	United Nations Conference on Environment and Development
UNEP	United Nations Environmental Programme
UNESCO	United Nations Educational Scientific and Cultural Organization
WECD	World Environment Commission on Development
WHO	World Health Organization

NESP	Nepal Environmental Impact Assessment Strengthening Project
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WECD	World Environment Commission on Development
WHO	World Health Organization

Environmental Impact Assessment (EIA)

- Early in the Project Cycle
- Integration of All Aspects Concerned
- Alternatives are the Key Factor in EIA

Introduction

This Environmental Impact Assessment (EIA) Training Manual is designed for providing training in order to impart EIA knowledge and skills to professionals and administrators, in the process of enhancing EIA capability. Recognising the use of EIA as a comprehensive and versatile instrument for achieving sustainable development, the need for enhancing the country's capability in terms of trained human resources in EIA has long been felt nationally and internationally. This training manual is developed in order to fill a gap in the provision of appropriate training materials on EIA. Effort has been made to establish an EIA system by developing EIA guidelines in several sectors. However, to effectively implement these guidance in actual field conditions, trained human resources are required, particularly for conducting and managing EIA in the government ministries/departments, academic institutions and in private sector organisations. Although there have been training materials on EIA, produced by national and international agencies, most of them reflect their own conditions, which are not really appropriate to Nepal, as local relevance is often lacking. This EIA training manual is a much needed document and will contribute to:

- the development of knowledge and skills on EIA to meet immediate needs,
- the development of knowledge and skills on EIA to meet long-term requirements, and
- enhancement of motivation, commitment and long-term involvement of all sectors in the EIA process.

This EIA training manual incorporates organisational structures and technical aspects; key skills and knowledge; simple language; cultural factors; and social, political and industrial parameters, reflecting the realities of this part of the world. This manual will support capacity building for EIA and will provide a basis for developing country-specific EIA training programmes.

Most of the commonly used environmental terms related to EIA in the document have been included in a glossary.

A few working exercises and relevant case studies have been included in Volume II. These exercises were tested for their validity and applicability in the training workshop organised in March and April, 1996, in Kathmandu, and were found to be most appropriate. More case studies and exercises can be added in the future.

The sidebars given in each chapter /pages on the left hand side provide a brief version of the full text. The purpose of the sidebars is to facilitate the trainers in the process of presenting the subject matter in training courses. The sidebars can be copied on to the transparencies and can be utilised as guides for training lectures.

This training manual is designed for both professionals and managers. Professionals include those who actually conduct EIAs, and managers are those who screen the project and determine whether an EIA is required, review EIA reports and monitor project implementation. Managers include officials in government ministries/departments, corporate bodies and proponents. While providing training for managers, Chapters 1 to 5 are necessary as background materials. In addition, Chapters 10 to 14 are also needed to be included in the course. However, a brief introduction on EIA processes is also desirable for managers. The details of the EIA process may not be appropriate for managers. For the professionals, all the chapters given in this manual must be included in the course in order to make them fully capable of understanding the total process.

This manual is a compilation of many works published and unpublished, and to acknowledge all of them in the text is not possible. Some ideas, concepts and sometimes even a chapter have been extracted from a list of references in order to make this manual complete. However, UNEP's *EIA: Issues, Trends and Practice* has been utilised extensively in the process of compiling this manual. To be issued by UNEP shortly, this publication is a comprehensive and excellent document which covers almost all aspects of EIA and is extremely useful for developing and enhancing EIA capability for developing countries. *EIA: Issues, Trends and Practice* is an inspiration and the basis for the development of this training manual. The authors express their gratitude to UNEP for allowing the use of its publications.

This training manual is developed under the project ADB TA No. 2244 Nep; Nepal EIA Strengthening (NES) Project for the National Planning Commission, HMG Nepal; and it is executed by SRD-Sustainable Resource Development, Inc., Canada/ESSA, Canada, and IUCN–The World Conservation Union, Nepal. The authors would like to acknowledge their indebtedness to these institutions for their permission to publish this EIA training manual. The authors would also like to thank Dr. Edy Botroisworo, Environmental Specialist, ADB, Manila; Dr. R. D. Pant, Hon. Member of the National Planning Commission, Nepal; Mr. Surya Man Shakya, Advisor, NPC; and Mr. Bimal Koirala, Joint Secretary of the Ministry of Industry for their encouragement and practical support.

Mr. John McEachern, Country Representative of IUCN Nepal, was a source of inspiration, and his constant support for completion of the project and preparation of this manual is highly appreciated.

Last but not least, the participants who attended the training workshops organised during March 5–11 for EIA managers and April 22-May 1, 1996, for EIA professionals in Kathmandu have contributed greatly to the refinement of this manual and have critically tested the materials given in this manual, and in this respect, the authors would also like to acknowledge their contributions.

Organising Training Sessions

I. Training Manager and Trainers

The training manager should be a person who has an excellent understanding of the EIA process, who can organise the training course, and can also design appropriate field exercises. Trainers should be familiar with the training manual, and they also should be able to develop training materials on appropriate topics for presentation, during the training course. The training materials (e.g., posters, flipcharts, transparencies, etc.) developed should be based on the training manual.

To ensure the maximum effectiveness of any visual aids (such as transparencies) it is recommended that:

- all transparencies are copied and presented to the participants in advance,
- no more than 25 typed words appear on each transparency (block capitals should not be used),
- no more than 10 transparencies should be used in one hour, and
- no transparency should be used if the letters cannot be read by the most distant participant.

In addition, it is suggested that the presentations should cover no longer than 40 minutes time, with at least 15-20 minutes allocated for discussion.

II. Training Manual

This training manual provides basic theoretical concepts, applications, methods and in some cases, illustrations and case studies. The trainers have to study this manual thoroughly and develop their own training materials, including illustrations and field exercises. A few exercises are given in Volume II and can be rearranged if necessary. However, in the course of utilising this manual for organising EIA training, more materials will be developed, more suitable exercises and illustrations will be framed, and more local case studies will be written through the involvement of participants and trainers. Subsequently, this manual will continue to be refined and revised to become more applicable and suitable to local conditions.

III. Training for EIA Managers and Administrators

Background for Participants

Participants will be those people who are currently involved in environmental administration, managers in environmental sections of government ministries and departments, corporate bodies, and those who are familiar with EIA guidelines which are to be implemented. Participation from public and private sector organisations, NGOs and public and private sector project proponents is possible. The basic qualification for attending this training course should be, at least, an undergraduate.

Duration of Training

The duration of training should be, at least, six days. However, one-time training may not be effective. Therefore, training courses should be held several times a year, depending upon requirements. Participants who have attended previous training sessions should be encouraged to attend further specialised training for refreshing and updating their knowledge and skills.

Modus Operandi for Training

1. Once the participants are selected, a pre-training session (maximum half a day) should be organised, wherein the participants are invited and briefed on the modus operandi of the training courses. Reading material and other background information should be provided to them for further reading. This pre-training session should be organised at least one week before the actual training session commences.

2. During training sessions, the training manager introduces the goals and objectives of the training and provides the schedule of the training sessions to be followed. Participants will be provided with a diagnostic quiz and will be asked to complete it within one hour. The quiz is designed to cover salient features of EIA and will help to assess the participants' level of knowledge of EIA; it also provides information on training needs, which will help the training manager to modify the training courses. The results of the quiz conducted before the course commences can be compared with the results of a quiz taken at the end of the course; this comparison can provide an evaluation of the effectiveness of the training course.

3. The first part of the first day of the training course will be devoted to giving lectures on the basic concepts of environment, environmental services, global and local environmental problems and the relevance of EIA for halting further degradation (Chapter 1); EIA principles and process (Chapter 2); EIA and the project cycle and the project management (Chapter 3). For each of these chapters, suitable illustrations with local examples and demonstrations should be presented in order to familiarise participants with basic concepts. For at least two hours on the first day of the course, participants should be taken on a field trip to a nearby area, where the environment and its degradation, due to human activities, can be demonstrated properly. In consultation with trainers assigned on the first day, the training manager will pre-arrange for field demonstrations.

4. Project screening will be presented as one of the initial important EIA activities during the morning session of the second day. This will be followed by a series of exercises designed to acquaint participants with the screening processes. National and sectoral EIA guidelines (gazetted) will be provided to the participants in order to facilitate screening exercises. This process familiarises participants with how to use screening schedules given in the gazetted guidelines.

5. The morning session of the second day will also be devoted to explaining the process of IEE (Chapter 4). Each participant will be provided with a blank preliminary interaction matrix and will be asked to complete it in relation to the impacts identified for a hypothetical proposed project.

6. Part of the second half of the second day will be devoted to explaining the scoping process. A project recommended to undergo a full-scale EIA by the process of screening will be selected for scoping.

7. An EIA Terms of Reference (TOR) will be drafted on the basis of the scoping results. A brief presentation on how TOR are developed will also be made.

8. Brief lectures on impact identification, impact prediction, evaluation and comparison of alternatives and EIA methods (Chapters 7 and 8), with illustrations and examples for each case, will be presented on the third day of training.

9. EIA managers and administrators will require an introduction to some aspects of EIA monitoring and impact auditing. Principles of impact monitoring and auditing will be presented in the morning session of the fourth day. Identifying monitoring indicators and the mechanisms for measuring impact indicators will be discussed.

10. Presentations on the structure and contents of EIA reports will be made in the morning session of the fifth day. Evaluation of structure and contents of some previous EIA reports will be made. The second half of the fifth day will be devoted to presenting review criteria for EIA reports. The participants will be divided into five groups, and each group will be asked to review a previously completed EIA report. This exercise will be continued during the morning session of the sixth day. Each group will present its findings to the plenary, and discussion will be held to clarify the concepts.

The afternoon session of the sixth day will be devoted to presenting the topics of strategic EIA and sustainable development (Chapter 15). The same diagnostic quiz will be administered again to the participants. Evaluation will be made by comparing initial results with the final results of each participant. The outcome of the comparison will be provided to the participants, to reiterate what they have learned.

IV. Training for EIA Professionals

Background for Participants

Participants should be those actually involved in conducting EIA for development proposals. They include people with a background in social science, natural science, and engineering, from private sector consultancies, enterprises, industries, contractors, academic and training institutions, government organisations, NGOs and corporate bodies. Individual specialists who act as consultants may also participate.

Duration of Training

The training should last for 12 days; however, it should be organised on a regular basis, depending upon the need.

Modus Operandi of Training

1. Training for professionals should be exactly like that of the EIA managers and administrators and should include a pre-training session and the diagnostic quiz. It will differ on the depth of coverage of the training material.

2. Similar to the training to the managers, the first and second days of the training of professionals will cover Chapters 1 to 5 of the manual with illustrations and examples.

3. Annex 1 focuses on an integrative approach on EIA and covers key subjects that are often involved in EIA analysis. The third day of the training session will be devoted entirely to presenting this chapter.

4. The topic of baseline data collection (Chapter 6) will be presented in the morning session of the fourth day. The afternoon session of the same day, the fifth and the sixth days will be devoted to impact prediction, evaluation and comparison of alternatives, and EIA methods (Chapters 7 and 8), mitigation measures (Chapter 9), monitoring (Chapter 12), drafting EIA reports (Chapter 10) and public involvement (Chapter 14).

5. The participants will be taken on field visits to the areas, where development activity is likely to take place. They will be provided with necessary information and will be asked to conduct an EIA for the proposed project. This exercise will demonstrate all processes involved in EIA. The training manager will decide for a project and a location for the field exercise. This will occur during the seventh to the tenth day of the training course.

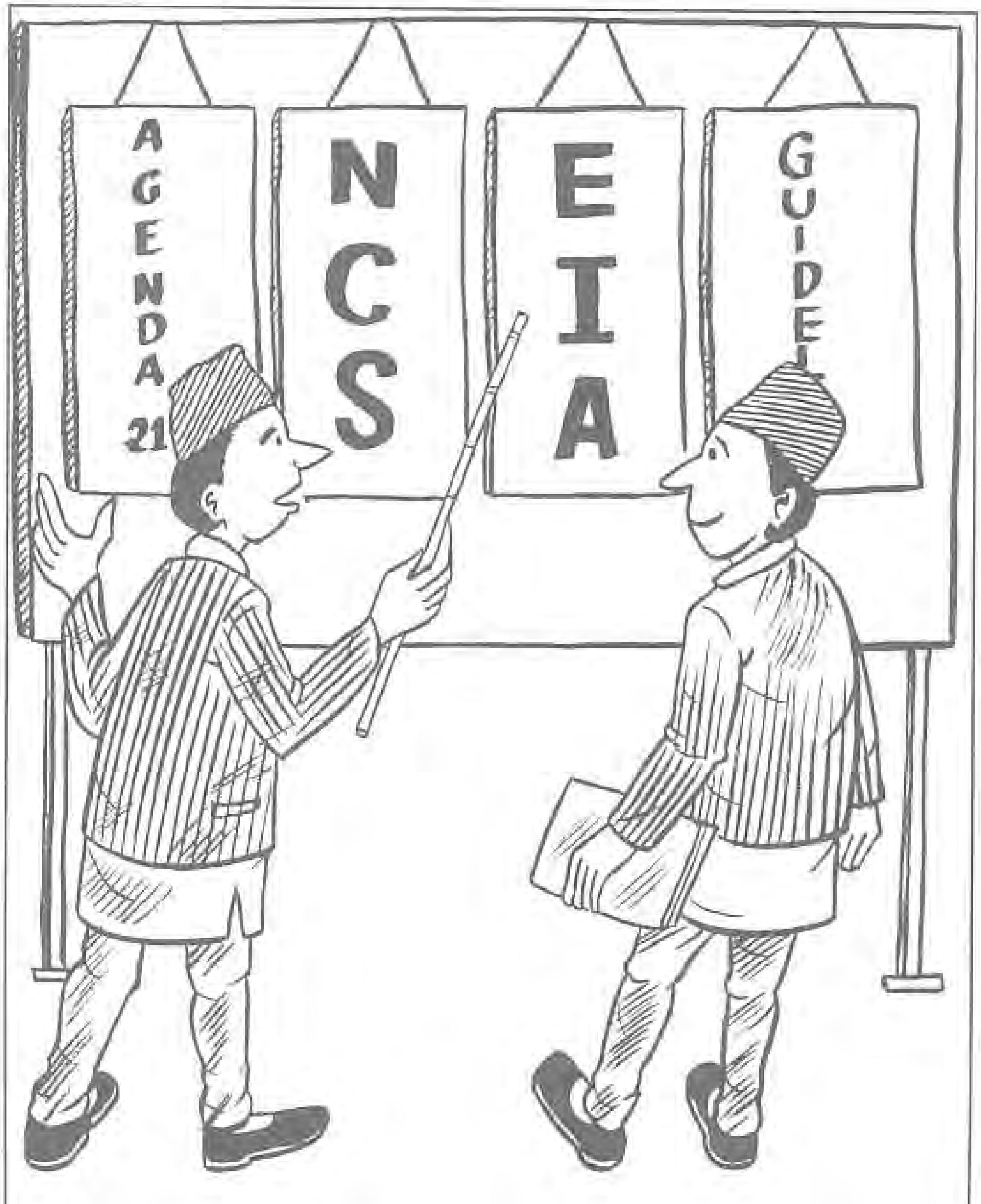
6. The morning session of eleventh day will be devoted to presenting strategic EIA (Chapter 15), and the afternoon session of the eleventh day and the morning session of the twelfth day will be devoted to demonstrating the application of strategic EIA in test cases. The diagnostic quiz will be administered again during the afternoon session of the twelfth day in order to evaluate the effectiveness of the training course.

V. Institutions for Organising Training

The Tribhuvan University; Departments; the Institutes of Engineering, Science and Technology, Forestry, Agriculture, Social Sciences; and research and training institutions can offer trainings as part of their regular class courses. The Nepal Administrative Staff College is an appropriate institution to organise courses for managers and administrators. Any private or public sector institution can also organise EIA training courses utilising this manual as a basis for designing their own training curricula.

1

Introduction to Environmental Impact Assessment (EIA)



Summary

- Key Environmental Concepts
  - Definition of Environment
  - Ecosystem Structure and Function
  - Natural, Human and Man-made Capital
- The Relevance of EIA
- EIA in Nepal

1. Key Environmental Concepts

Biosphere; a life-support system

The biophysical environment includes plants and animals (biotic) that interact with the physical elements (abiotic) through the process of material and energy cycling, involving the lithosphere (soil, rocks), atmosphere (air and other vital gases) and hydrosphere (water), as well as radiation from the sun. This interaction of biotic components with abiotic elements of the natural environment constitutes the complex system of our biosphere: a system which sustains life on earth.

Photosynthesis; produces food for all life

Food chain; a closed cycle

As a primary component of the biophysical environment, plants produce all food materials with the help of sunlight (via photosynthesis) and maintain animal life. Green plants are eaten by one set of animals called *herbivores* (plant eaters), and they, in turn, are eaten by another set of animals called *carnivores* (flesh eaters). The third set of organisms, which decomposes dead and decaying matter, is called *detrivores* (decomposers). The process of eating and being eaten, in a natural system, is called a *food chain* and involves energy cycling.

Ecosystem; a dynamic, self-functioning, self-perpetuating system

The biotic and abiotic components of nature interact, structurally and functionally, giving rise to a system called an *ecosystem*. The biosphere contains many ecosystems such as forest, water, grassland, marine, etc., each of which is able to perpetuate itself.

Environment; a system that includes human beings and their surroundings

The biophysical systems interact with the social and economical aspects of man, and this makes human beings one of the entities of the environment. Therefore, the environment can be broadly defined as "the natural and social conditions that process around all the organisms which include mankind and future generations".

Natural environment; the sink for all wastes and source for all resources

Human beings, as a component of the environment, receive numerous services from ecosystems, which provide all vital life-support elements (such as oxygen for respiration; water and food for consumption), provide material inputs, in the form of natural capital, to the economic system of man—producing man-made capital—and also provide "sink" functions to all the wastes produced through the economic activities, for example, when gases are emitted into the atmosphere.

Natural capital provides man made and human capital

Natural capital is defined as a stock of environmentally provided assets such as soil, atmosphere, forest, water, oil, etc., that flow from ecosystem to the economic system; they are either renewable or non-renewable, marketable or non-marketable. Sustainability means maintaining these resources without any significant depletion. Human capital refers to people and their capacities, education, skills, cultures, technologies, etc., while man-made capital includes houses, roads, factories, etc. Man-made capital is a product of natural capital.

Excessive use of natural capital has affected global ecosystems

Ecosystems are capable of providing specific services to human beings. They provide a limited amount of resources (perhaps turned into man-made capital) and absorb a limited amount of waste, without their functions being impaired and ultimately degraded. However, with increasing human population growth and economic development, there is over-exploitation of certain resources (e.g., global marine fish stocks) which has affected the productive capacity of the environment, especially at the local and regional levels. Similarly, the disposal of increasing amounts of waste, has begun to "overload" the assimilative capacity of ecosystems (the "sink" function), causing additional degradation of the structural and functional integrity of the ecosystems.

EIA is a useful instrument for reducing adverse impact on the environment

These global trends have been apparent for the past 10–15 years and provide a context of increasing urgency in terms of applying quickly the environmental management instruments to the process of developing the geographic scales (local to international). One of these instruments continues to be EIA, although as described below, EIA had its origin in a different context concerned, but different problems and difficulties were important.

2. Relevance of EIA

The degradation of human environmental quality became a major concern in the USA, EIA was introduced to a development-related to a decision-making to help reduce further degradation

The use of an EIA began in 1970 in the USA and spread rapidly throughout the world. EIA was introduced into a development related decision-making because of increasing public concern (transformed into political pressure) for the environment. Until 1970, development projects had been appraised in terms of economic costs and benefits and expected the technical performance. The environmental implications were not investigated systematically. The increase in public concerns for quality of the human environment led to extensive media covering examples where constructing and operating development projects led to serious environmental damage. At the same time, the unexpected adverse consequences of non-project activities, such as spraying of DDT to control insect vectors and protect valued crops, had become known. This set of circumstances led to a growing demand that the possible environmental implications of such actions be taken into consideration before a decision to proceed ahead.

EIA was introduced to make project level information systematic. Efforts were made to establish a first -

The formal use of EIA had been an outcome of both political pressure and realisation occurred amongst the policy makers and the politicians due to which development-related decision-making could be improved by considering environmental issues before decisions were made. To enable such issues to be taken into account in decision-making, it was necessary to introduce a systematic procedure whereby this information would be produced prior to *generation EIA during the 1970s*

making a decision, in a format that is easily understood and usable. 1970 saw the birth of what can be called "first-generation EIA". With a few exceptions, EIAs were focused to provide information on projects which could be used in authorising decisions. The first 15 years of EIA experienced great advances in technical capabilities in terms of predicting impacts and presenting the results in user's friendly reports. Also, the importance of the social dimension was increasingly recognised with an adequate number of individual EIAs considering the social impacts and involvement of an expanding range of stakeholders involved (government ministries, departments and agencies, NGOs and members of the public).

Project based EIAs were not able to reduce the rate of global environmental damage

Towards the end of 1980, public concerns shifted toward the cumulative global impacts of "development", for example, the global warming phenomenon caused by continual and ever-increasing emissions of CO_2, etc., from power stations (those burning fossil fuels), and from motor vehicles. It was clear that the individual project-related EIAs were not influential in reducing the rate of such environmental damage. Their benefits and effectiveness were more local. The same lesson was being learnt in relation to ozone depletion and global biodiversity reduction. At the same time, the concept of sustainable development was moving towards the centre of environmental discussion and debate.

The birth of second generation EIA took place as strategic EIA to tackle the environmental issues arising at higher level of activities

Sustainability has no "boundaries"–it is applicable locally, regionally, nationally and globally. It is applicable to projects, plans and policies in fact all the development activities. Achieving sustainability has become an operating political and administrative principle for many governments (to a greater or lesser extent), and provided both a stimulus and a challenge to EIA. The birth of "second-generation EIA", particularly the emphasis on managing the environment at higher levels of activities, was the initial response to this challenge. It should not be forgotten, however, that the "first and second generation EIA" are two sides of the same coin. It is still appropriate to use the general term "EIA" to describe all its variants, as the basic objectives and operating principles remain the same although the method and scope of application may vary (See Chapter 15 on Strategic EIA).

The use of Stratetic EIA at the PPP level has proven to be an effective tool to achieve sustainable development

The integration of EIA into project planning and project related decision-making has proven to be an effective tool in producing projects which have been able to achieve their social and economic objectives while causing minimal environmental disruption. This result has contributed towards sustainability. In future, it is expected that a more positive and extensive contribution will come through the increased use of strategic EIA, in conjunction with project related EIA.

International policies, agreements and guidelines on EIA

The relevance of EIA has been recognised at the international level for a long time. The Stockholm Conference (1972), the World Conservation Strategy (1980), and the Commission on Environment and Development (WECD, 1987) have recommended the integration of environmental concerns into the developmental process as an effective means to achieve sustainable development. UNEP (1987) adopted three goals and thirteen principles pertaining to the implementation of EIA. The 1992 Rio Declaration states in its Principle 17 the following commitment to EIA:

> *"Environmental Impact Assessment as a national instrument shall be undertaken for proposed development activities that are likely to have significant adverse impacts on the environment and are subject to the decision of a competent national authority" (Agenda 21 UN, 1993).*

The Environmentally Sound and Sustainable Development (ESSD) strategy for the Asia-Pacific region recommended the application of EIA in development planning as a useful tool for promoting ESSD (ESCAP, 1992).

Though many agencies adopt EIA guidelines, most guidelines are very general, and not suited for a particular country

Several agencies of the world—particularly UN organisations, the World Bank and the Asian Development Bank—have their own EIA guidelines, as well as a system of integrating environmental concerns into the development projects they fund. However, most of these guidelines are very general, covering a wide range of applications, and are not tailored to the needs of particular countries. In particular, the environmental problems relating to the tropical parts of the world are generally overlooked.

3. EIA in Nepal

National and sectoral EIA guidelines have been implemented by the Nepalese government

Nepal is relatively new to the concept of EIA. In the past, EIAs were conducted for individual development proposals, usually at the initiative of bilateral and multilateral donors according to their respective policies. The National Conservation Strategy (NCS), 1987 recognises the urgent need of the adoption of EIA, and has made the establishment of a national system of EIA a priority. This system entails the requirement of an EIA before major development projects are approved by the relevant government departments. The Eighth Plan (1992-1997) has also emphasised the need for such a system. Realising the immediate need for a national EIA system, the NPC/IUCN NCS Implementation Project began developing EIA guidelines through a participatory approach by utilising an intersectoral Environmental Core Group (ECG). The government approved and endorsed the national EIA guidelines as an umbrella document in 1992. Likewise, the government has implemented sectoral EIA guidelines of the Industrial and Forestry sectors in 1995, Other sectoral guidelines currently being developed are Water Resources (Irrigation and Hydropower), Road, Mining, Water Supply, Human Settlement and Urban Development and Municipal Sanitary Landfill Site Selection. These guidelines emphasise the application of EIA at an early stage of the project cycle. Accordingly, the national EIA guidelines have been utilised for a number of development projects, the results of which substantiate the validity of these guidelines in Nepal's context.

Most of the development projects in Nepal are now undergoing the EIA process

There are 75 projects that have undergone EIA procedures so far, in Nepal. About two-thirds of those projects have undergone EIA at the construction and post-construction stages. Water resources (hydropower and irrigation) projects account for 29 projects, wherein EIA was carried out at various stages of the project cycle. EIA has also been integrated into 17 road projects, nine housing projects, eight forestry projects, seven industrial projects, two resettlement projects, one mining project and one agricultural project.

The current EIA system is not effective and methodical

Private consulting firms were involved in donor-funded projects for conducting EIAs. In such cases, TOR is often prepared by the donor agencies and the final EIA reports are reviewed by them, often without making national agencies involved, as there is no requirement for national level EIA. However, in the absence of a system of monitoring and evaluation in EIA implementation, the quality of EIA has suffered. Since the EIAs were carried out as a project clearance mechanism, this should be treated as a cosmetic change only.

Prerequisites to establish a workable system of EIA are not in the place

Although a well-founded EIA system contributes towards achieving sustainable benefits from development, it generally depends heavily upon the political and administrative decision-making-processes, decentralisation, public participation, community empowerment, and above all, EIA legislation. To this end, Nepal is making gradual progress; the public hearing with community participation on Arun III Hydro Project, the public hearing and litigation in the case of the Godawari Marble Quarry, and a series of public hearings and public participation programmes on Kaligandaki 'A' Hydro-electric Project are recent examples of decentralisation initiatives. Although these efforts were not fruitful due to illiteracy and lack of awareness of the people involved in the process, nevertheless such practices, if continued, would highly benefit environmental conservation in the future.

(a) EIA Legislation in Nepal

Statutory provision for EIA is incorporated in the Water Resources Act

In Nepal, the Water Resources Act (1992) and Electricity Act (1992) require the preparation of an EIA report. Section 8 of the Water Resources Act requires preparation of an environmental study report by proponent who wants to conduct survey or utilise water resources. Similarly, Section 4 of the Electricity Act requires *and Electricity Act of 1992.*

preparation of an environmental study report by proponent who propose to survey, produce, transmit or distribute more than 1,000 kV of electricity. These two Acts are the main legislation that have introduced the legislative model of EIA in Nepal.

(b) Environmental Protection Bill, 1996

Statutory provisions need to be consolidated

One of the key functions of the Ministry of Population and Environment (MOPE) is to formulate regulations in relation to environment protection. The ministry is empowered to investigate and conduct research on the effectiveness of EIA, and to prepare and publish reports. The Environment Protection Bill obliges the proponents to prepare an Initial Environmental Examination (IEE) report or an EIA report in relation to prescribed plan, programme or projects which may induce changes in existing environmental conditions by physical activity, development activity and change in land use. Prescribed proposals cannot be implemented without the approval of relevant agency or MOPE. A list of proposals which require IEE or EIA is included in the regulations. Relevant agency is empowered to grant approval to the proposal which require an IEE and ask the proponent to prepare an EIA report on the basis of the findings of the IEE. MOPE and relevant agency are empowered to grant approval to any proposal which has passed through EIA by specifying conditions which are to be fulfilled by the proponent. The bill has given broad power to HMG to make regulations to enable it to provide procedural aspects of IEE and EIA.

EIA reports must pass through public scrutiny

Similarly, MOPE is required to make available of the draft report on EIA for public information, comment and review. The ministry empowered to provide suggestions to the ministry in relation to any EIA report submitted to it.

Relevant government agencies must take into account the findings of IEE or EIA reports

MOPE may issue directives to mitigate or remove impacts

In consideration of whether to grant approval to any proposal, the relevant government agency must take into account the findings of any IEE or EIA reports, suggestions or comments received from public and suggestion of the committee set up in accordance with section 6(5) of the bill. Whenever the agency decides to approve a proposal, it may attach conditions for the approval in order to mitigate the environmental impacts of the proposal. Whenever the findings of the IEE or EIA reports show that the proposal is likely to have significant adverse impacts on the environment, the relevant government agency is empowered not to grant approval for implementation of such a proposal. If the MOPE finds, while monitoring the environmental impacts which is likely to have caused after the implementation of the proposal is made the environmental impacts appear to be more significant and harmful than the impacts predicted in the IEE or EIA reports, it is empowered to issue directives to mitigate or remove such impacts and the proponent is obliged to follow such directives.

(c) Avoidance of EIA

There is sometimes a tendency to avoid EIA requirements

Some proponents maintain that an enforced EIA process is socially unjust to investors. However, the financial cost of preparing an EIA report hardly exceeds 0.6 per cent of the final development costs. Evidence linking the problems inherent in the EIA process to actual costs is largely anecdotal and difficult to quantify. Regardless of whether the costs and delays are real or perceived, a situation has arise whereby EIA is viewed as an obstacle to development which is to be avoided or suitably modified whenever possible. Most understandably, this view is generally held by the industry sector.

EIA legislation must provide mechanisms to prevent avoidance of EIA

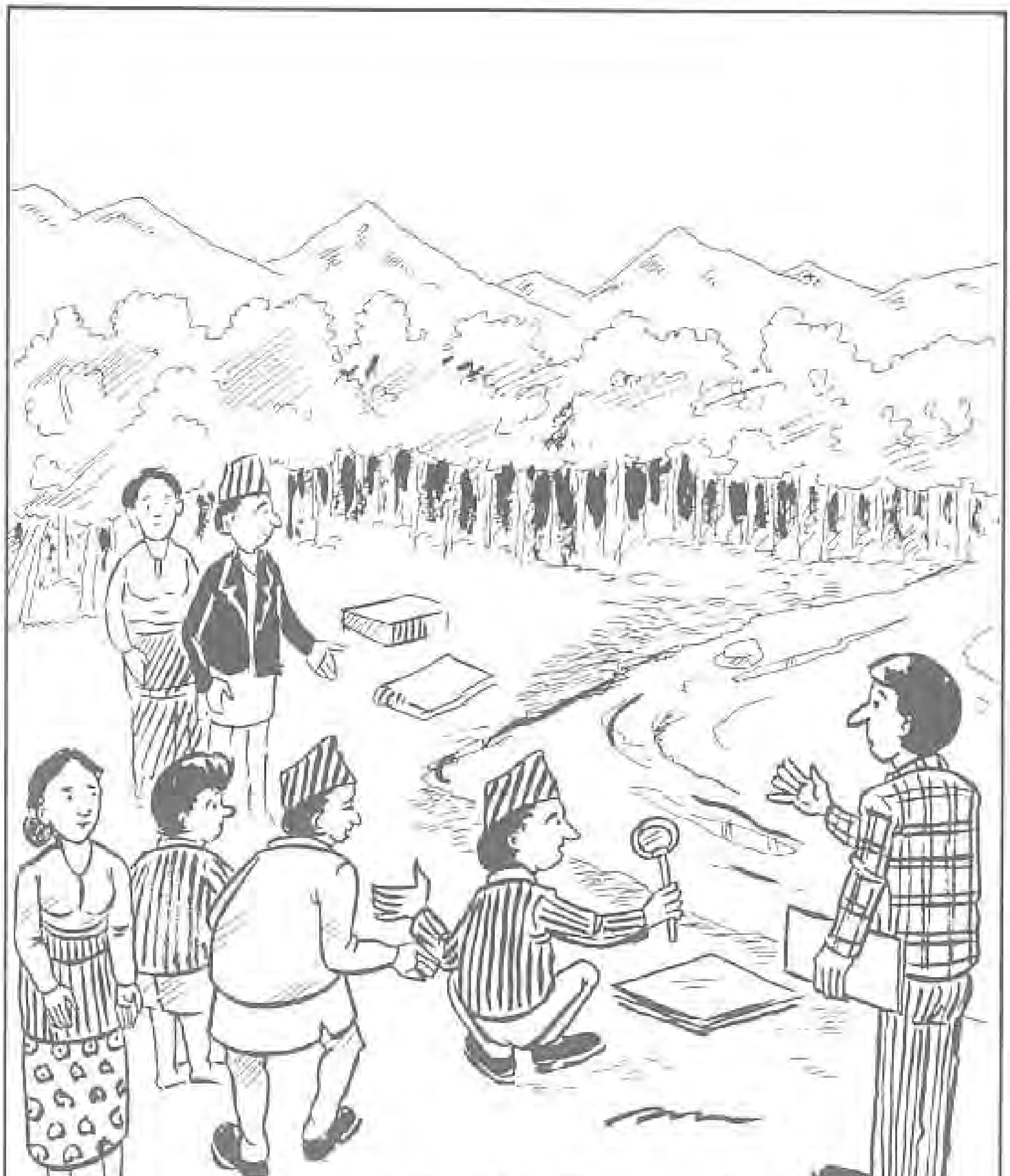
The phrase "significant impact on the environment" is used in the National EIA Guidelines, but it has not been defined. At the same time, there is a strict provision for standing and judicial review. It is likely that EIA could be easily avoided in many cases. The United States agencies have been forced by the courts to provide documentation and evidences to support the decisions whether or not to undertake an EIA. In many jurisdictions, such decisions are subject to judicial review. Thus, Nepalese EIA law should provide liberal standing provision, a judicial review and an effective framework to prevent avoidance of EIA.

(d) Enforcement of EIA Laws

The standing requirement needs to be liberalised to promote enforcement of EIA laws

In many countries, there is provision for private enforcement on EIA legislation. To this end, the standing requirement is liberalised to enable environmentally concerned citizens to file civil suits. The first environmental statute to permit private enforcement is the US Clean Air Act of 1970. Australian legislation has also incorporated such a provision in an environmental legislation, including EIA legislation in some jurisdictions. Also, in Nepal, there are similar statutory provisions. However, in extreme cases, citizens can access the Supreme Court, in accordance with Article 88 of the Constitution of the Kingdom of Nepal, under the extraordinary jurisdiction of the Supreme Court.

2
EIA Principles and Process



Summary

- Definition of EIA
- Usefulness of EIA
- Project Types, Impacts and Effects
- The EIA Process

1. Definition of EIA

The need for establishment of an EIA system

There has been a remarkable increase in an adoption of EIA in the process of implementing development projects, in order to make them more sustainable and environmentally sound. Since 1970, the realisation of its importance has led many countries of the world to adopt this tool. In most of the cases, EIA legislation was enacted; national policies, emphasising the adoption of EIA, were enunciated; and institutional and capacity building for strengthening EIA capacity in the government, NGOs and private sectors have been taking place. However, globally, the EIA process is still in the formative stage, and many developers, nationally and internationally, still consider this tool as a costly, time-consuming and superfluous effort.

The definition of EIA

EIA has been defined in slightly different ways by many authors and institutions, both nationally and internationally. One of the most complete and clear definitions, given by Munn (1979), refers to the need "**to identify and predict the impact on the environment and on man's health and well being of legislative proposals, policies, programmes, projects and operational procedures and to interpret and communicate information about the impact**". Box 1 shows the main issues associated with the meaning of EIA.

2. Usefulness of EIA

The EIA processes

EIA is considered as a project management tool for collecting and analysing information on the environmental effects of projects to aid planning and implementation of decisions. As such, it is used to

- **identify** potential environmental impacts;
- **examine** the significance of environmental implications;
- assess whether impacts can be mitigated;
- **recommend** preventive and corrective mitigating measures;
- **inform** decision makers and concerned parties of environmental implications; and
- **advise** whether development should go ahead.

EIA as both an art and science.

EIA is a combination of both art and science. Management aspects in EIA are an art, whereas the technical analysis in the process is based on scientific principles.

Purpose of EIA

EIA provides a systematic examination of environmental implications of proposed actions and alternatives to assist decision-making. The cost benefit and trade off analyses between the project implementation and associated environmental costs facilitate the decision makers in making decisions which are more likely to result in sustainable projects.

Box 1: The Meaning of Environmental Impact Assessment

ENVIRONMENT

- Bio-physical { Natural / Manipulated }
- Social and Economic
- Cultural

IMPACT

- Adverse/Beneficial
- Cumulative { Spatial / Temporal }
- Direct/Indirect
- Short/Medium/Long-Term
- Environment on Project/Project on Environment
- Reversible/Irreversible

ASSESSMENT

- Quantification
- Prediction
- Evaluation
- Monitoring
- Auditing

EIA as an aid to decision makers

EIA also provides a basis for negotiations among developers, public interest groups and regulators, in order to achieve a balance of interests between development and environment.

Accruing benefits for developers, interested parties and the environment

Although EIA is erroneously considered as a costly and a time consuming process by developers, in reality, EIA generates huge benefits in selection of project location, process design and development actions, and thus providing:

- an opportunity for cost-saving (via waste recovery);
- ways to minimise or reduce environmental consequences during the project implementation, which, otherwise, would incur a large amounts of money for correction;
- an early warning for likely potential conflicts;
- smoother authorisation process; and
- sustainable benefits from the project.

EIA is considered as a tool to achieve sustainability

EIA has been considered as a central management tool for achieving sustainable development. The Brundtland Commission (1987) defined sustainable development as *"development which meets the needs of the present generation without compromising the ability of future generations to meet their own needs"*. This means we should hand over to our future generations not only man made and human capital, but also natural capital such as fresh air and forests. By helping to ensure that projects are designed in environmentally and sensitive ways, EIA can make a positive contribution towards moving the countries along the road to sustainability.

3. Project Types, Impacts and Effects

Any actions that serve human interests constitute development

EIA generally applies to projects, which require construction (e.g., infrastructure, or manufacturing projects). There are two types of projects; **Point** refers to power stations, bridges, etc., and **Band** refers to linear projects such as roads, electrical transmitting lines, etc.

Different types of impacts

Components of the environment are affected by the project implementation at different degrees of intensity and level. The effects can be analysed in terms of magnitude, referring to the severity; spatial, referring to the areas of coverage; reversibility (if the pre-development situation can be re-created) and time scale. For example, if an archaeological site is damaged or destroyed while constructing a road, the impact is irreversible, and the magnitude is severe since it is not possible to recover; from a spatial point of view, it is only local but from a temporal point of view, the loss is forever. Therefore, impacts may be of high or low magnitude reversible or irreversible; from a spatial point of view local, regional or international and in the temporal aspect long-term, short-term and medium-term, depending upon the intensity of impacts. Finally, impacts can be beneficial as well as adverse.

Alterations may bring changes with certain effects, which ultimately lead to impacts

In many cases, the terms "impact" and "effect" are used synonymously. However, the term "impact" is an outcome of two preceding events. Take an example of air pollution deposited on the leaves of crops which slows down the photosynthetic process (change) and reduces crop yield (effect), affecting the farmers economically (adverse impact). If the deposition of air pollution in marsh land reduces the oxygen content in the water (change), which prevents respiratory activity of mosquito larvae (effect), it eventually kills them (beneficial impact).

4. The EIA Process

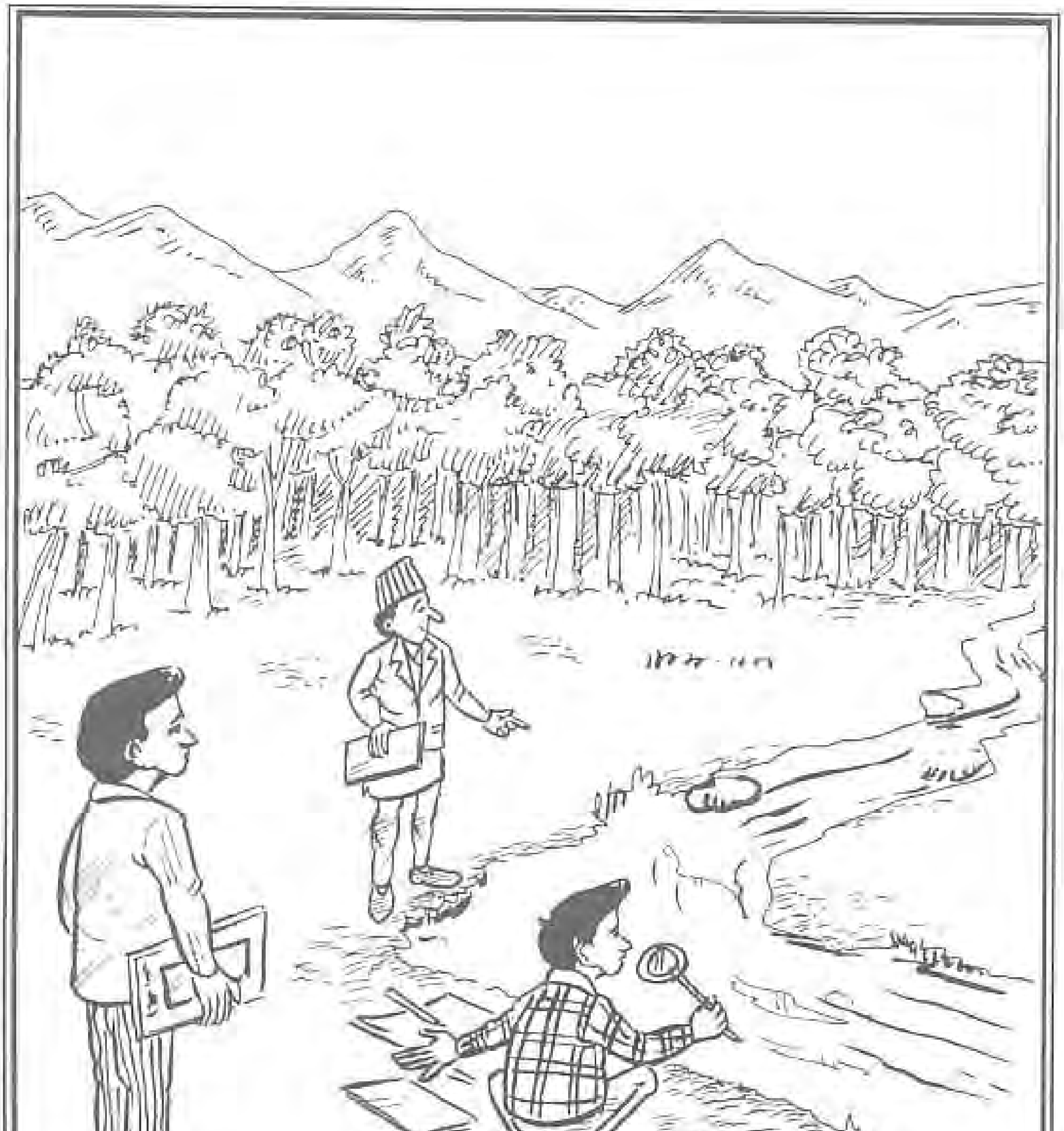
In all national EIA systems there is a basic sequence of activities, which is followed once a project has been identified. Box 2 shows the main activities, in their logical sequence, with brief comments.

Box 2: EIA Process

- *Project Screening:* Determines whether the project in question, needs an EIA.
- *Scoping:* This process identifies all significant impacts. Also, it can be used to identify project alternatives. Forms the basis for the Terms of Reference.
- *Project Description and Consideration of Alternatives:* Seeks to describe all reasonable alternatives, including the preferred and "no action" options (project location, scale, process, layout, and operating conditions).
- *Description of Environmental Baseline:* Establishes the current state of environment and any trends.
- *Prediction of Impacts:* The impacts are predicted (as far as possible, quantitatively) in terms of characteristics such as magnitude, extent and duration.
- *Evaluation of Impacts:* The significance or importance of the predicted impacts is determined.
- *Mitigation Measures:* Measures to avoid, reduce and minimise adverse impacts and to enhance beneficial impacts are designed.
- *Stakeholder Involvement:* Occurs at various stages in the EIA process to ensure quality, comprehensiveness and effectiveness of EIA, and to ensure that stakeholder views are adequately addressed in the decision-making process.
- *Monitoring and Auditing Measures:* Impacts which should be monitored are identified and any auditing requirements are specified.
- *EIA Report:* Contains the information obtained, analysed, interpreted and compiled in a report form. The report should contain a non-technical summary, methods used, results, interpretation and conclusions.
- *Review:* EIA report submitted for review in order to assess whether or not all the possible issues have been adequately addressed and to facilitate the decision-making process.
- *Decision-making:* With the help of information and conclusions given in EIA reports and the outcome of reviews, the decision makers determine whether or not the project should go ahead.

3

EIA, Project Cycle and Project Management



Summary

- Introduction
- Project Concept Identification
- Pre-feasibility Stages
- Feasibility Stage
- Project Appraisal and Decision
- Implementation of the Project
- Management of EIA Studies

1. Introduction

EIA should be proactive rather than reactive

There are two aspects of project management. First, there should be consideration of how EIA is linked to the main stages of the project cycle. Secondly, there are some important issues in the management of EIA studies.

Administrative procedure requires the preparation of an EIA report which is available to the decision makers and to the other interested parties. There has been an unfortunate tendency in EIA work to focus on producing a document for authoritative purposes—an EIA "product". The production of EIA reports is important and they must be of high quality, but the focus of the EIA "product" tends to lead to EIA work which is being performed late in the project cycle, and when developmental options/alternatives are reduced, which acts as a justification for the project. Basically, this situation characterises EIA in the "reactive" mode. To meet its objectives, EIA has to be "proactive" – it should be initiated in the beginning of the project cycle and continue throughout the life of a project. The main "linkages" between EIA and the typical project cycle are given below. For each stage in the project cycle, the relevant EIA activities are described (See Figure 1).

2. Project Concept/Identification

Screening an initial Environmental Examination (IEE) can be applied at this stage

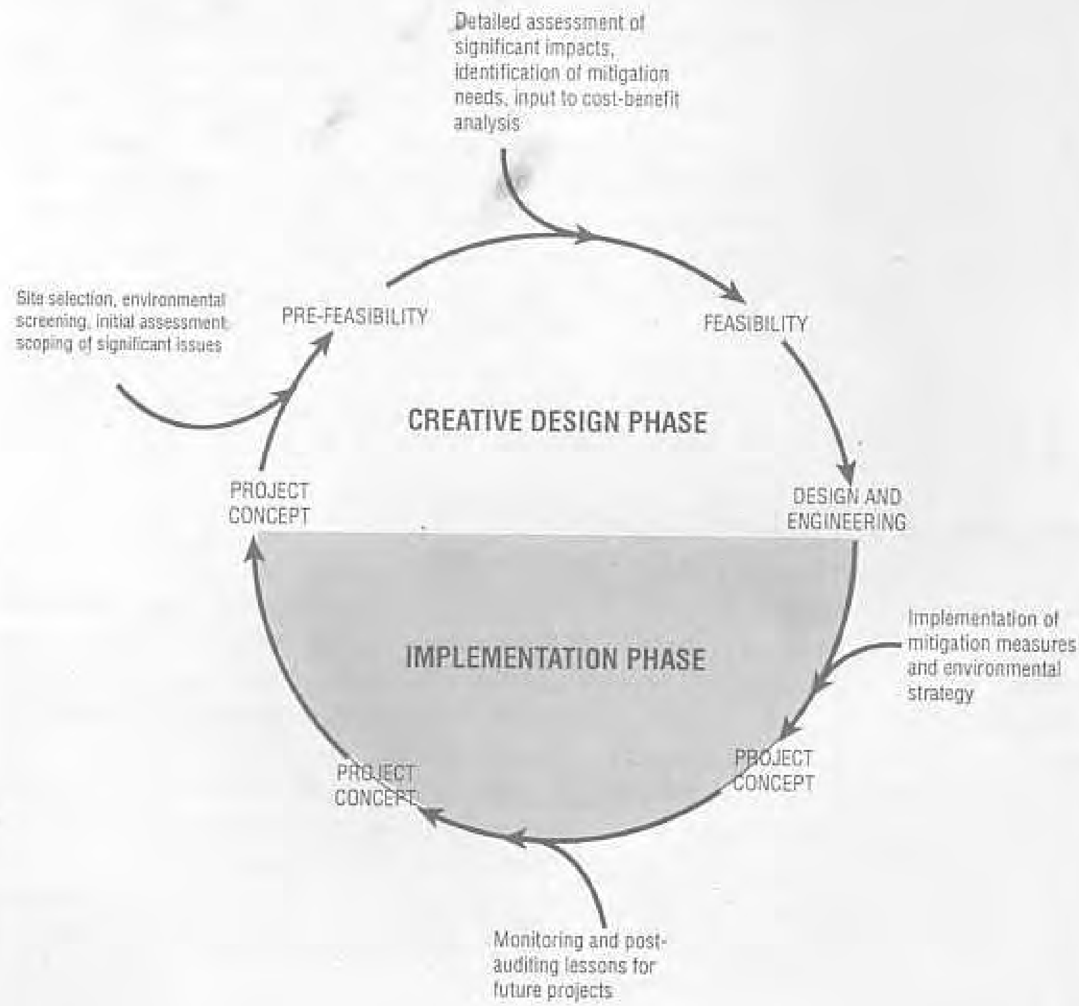
At this stage, in the project planning cycle, detailed designs will not be available, but the basic nature of the project will be known (for example, whether it is to be a coal, oil or nuclear power station; a highway or a dam/reservoir). Some basic facts may be known for such projects, for example, power output and an area of land which is likely to be inundated. A site or sites may also be known. At this stage, the project may be subject to "screening" to decide whether a full, in comprehensive EIA report must be prepared. Most countries have basically project type lists, concerning implementation of the EIAs. In Nepal, if a proposed project happens to be listed on the government gazetted schedules, then an EIA report must be prepared.

Alternatives can be proposed and analysed

EIA work begins with screening. If screening recommends that an EIA report is required, then the initial studies will begin. At this early stage, a quick environmental overview/reconnaissance or preliminary EIA can indicate whether any of the alternatives proposed are environmentally "disastrous". These can be eliminated from further consideration, and new alternatives can be identified. Major benefits of a "quick and dirty" overview are as follows:

- Identification of "viable" alternatives (from an environmental viewpoint).
- Provision of an early indication of likely significant impacts for further EIA work.

Figure 1: Project Cycle



3. Pre-feasibility Stage

Scoping and formulating TOR

The main EIA activities, at this stage, are identification of issues/impacts for investigation and, usually, formulation of the Terms of Reference (TOR) for the EIA. The term used for these activities is "scoping". The details of scoping are given in Chapter 5.

4. Feasibility Stage

The majority of EIA studies carried out include CBA at the feasibility stage

At the feasibility study stage of the project cycle, EIA activities should be carried out in conjunction with economic, technical and design work. If preliminary EIA work starts from the project inception period onwards, it will be more effective for the decision-making at all stages of the evolution of a project. However, if EIA is an "add-on" after the project design is over, the process of EIA becomes cumbersome and time-consuming. It becomes quite expensive to incorporate mitigation measures as recommended by EIA in the later stages, which may mean changing project design or the alternatively, EIA may recommend changing of the whole project concept, and in such circumstances, all the efforts put for making the project design will be wasted. The East Rapti Irrigation Project is an example of a case wherein a post-design EIA cancelled the whole project concept (Box 3). Therefore, EIA should be considered as a means for prevention rather than a cure, and at the feasibility study stage, all EIA work should be carried out.

Possible alternatives to be identified and assessed by both design and EIA

During the EIA, alternatives may be assessed, and there will be a process of evolution and change in the basic project design and, possibly, also in the initial range of alternatives. Some of these evolution and change may result from EIA work with suggested project design/site alterations, or from external factors relating to engineering or economic criteria. EIA work has to be adaptable to deal with these external changes, just as a design work needs to adapt to the EIA results. Thus, there should be a close inter-relationship between the design and EIA work. Often, however, there is a tendency for project design team to consider the project to be an end in itself and not as a means to be an objective. This can make things difficult for the EIA team.

5. Project Appraisal and Decision

Deciding whether or not the project should 'go-ahead'

During the project appraisal, a decision is made by the proponent or the government, and in some cases lending agencies, as to whether the project is viable. At this stage, EIA results will be put into consideration with other feasibility studies. Should appraisal result in a "go-ahead" status then normally an application for authorisation(s)

Box 3: EIA of East Rapti Irrigation Project (ERIP)

1. Background/Project Area

Nepal is a country wherein 90 per cent of the population depends on agriculture. In order to meet the food demand of its growing population, the policy of the government is to increase productivity per unit area by providing facilities of irrigation. The proposed irrigation scheme to be implemented in the Chitwan Valley in mid-western Nepal to irrigate 5,303 ha of land by utilising the perennial source of water from the Rapti River was an outcome of government policy.

Chitwan Valley is a fertile alluvial plain and is inhabited by 66,736 people in 9,781 households in the command area of the proposed irrigation scheme. The western part of the valley has been irrigated by two large irrigation schemes and the southern part by 85 farmers managed irrigation schemes. However, a total of 5,303 ha in the northern part remains unirrigated.

2. Project Description

The proposed project was to provide a diversion weir of 400 m in length across the Rapti River designed to divert a maximum flow of 14.3 m^3/sec. An under sluice, guide banks and 3.7-wide fish ladder were also proposed to be constructed. A self-flushing de-sander, 21.9 km of canal networks and 24.6 km of drainage networks were also designed to be constructed to protect the river banks.

3. The Major Environment

(a)River System and Hydrology: Rapti is the major river flowing on the northern border of the Royal Chitwan National Park (RCNP). The highest average discharge rate of Rapti River at the proposed weir site is estimated to be 180 m3/s in August, whereas the mean annual flow is 62 m^3/s with a flow of 17.4 m^3/s in the dry season.

(b)Royal Chitwan National Park (RCNP): RCNP was established in 1973 by legislation and was also registered as a World Heritage Site by UNESCO in 1984. The park provides an excellent habitat for 13 endangered mammalian species and 489 species of migratory and breeding birds, and it maintains an excellent wetland habitat; oxbow lakes and marshy areas. The East Rapti River plays a critical role in maintaining the RCNP habitat and provides breeding grounds for 44 fish species and crocodiles.

4. Likely Major Environmental Impacts

The assumption made in the feasibility study that the amount of water diverted for irrigation from the Rapti River would be augmented downstream by the flow from tributaries was not verifiable because of the absence of regular records of flow data. Total diversion of water from the river during the dry season would likely to affect

- flora and fauna of RCNP habitat;
- rare and endangered animals of RCNP;
- current income generation from eco-tourism in RCNP;
- irrigation return flow, which is expected to contain residual chemicals due to the application of more fertilisers and pesticides that might affect water bodies;
- air and water due to the establishment of agro-industries in the area;
- the intensity of water- and vector-borne diseases due to seepage and water logging; and
- local economy, with beneficial impacts such as expected increases in crop production from 22,810 MT/yr to 74,979 MT/yr, and in employment opportunities for the people of the area.

5. EIA and its recommendation for ERIP

No consideration for EIA was made in the project feasibility stage for ERIP. After project design was completed, RCNP authorities raised questions about the impact of the project in RCNP. It was decided then to conduct EIA, and it was concluded that the project as envisaged should not be implemented; however, the EIA study also recommended that farmers-managed irrigation schemes should be strengthened and that the recharge of the river due to the opening of tributaries downstream should be monitored for at least two years. This has brought the total project concept again into the project reformulation stage in the project cycle. Thus, the entire expenditure incurred for the feasibility study and project design was wasted.

has to be made by the project proponent to a local/central government agency. This decision is, in a sense, final and it determines whether a project is to be implemented. The EIA report also plays an important role in this decision-making process.

6. Implementation of the Project

EIA as a guide for implementing a project

At this stage, in the project cycle, the EIA report will act as a "reference" guide to the implementation and use of mitigation strategies and monitoring schemes. Thus, the usefulness of an EIA report does not end with the "official" authorisation to proceed. It may form a basis for a management plan to assist project implementation and management practice. For example, EIA report recommendations can form a part of a contract tender document.

Comparison of predicted impacts to actual impacts

Lastly, after the project is completed, an "audit" can be done to determine how close the EIA's predictions were to the actual impacts of the project. This forms a valuable record for others conducting EIAs on similar projects in the future.

7. Management of EIA Studies

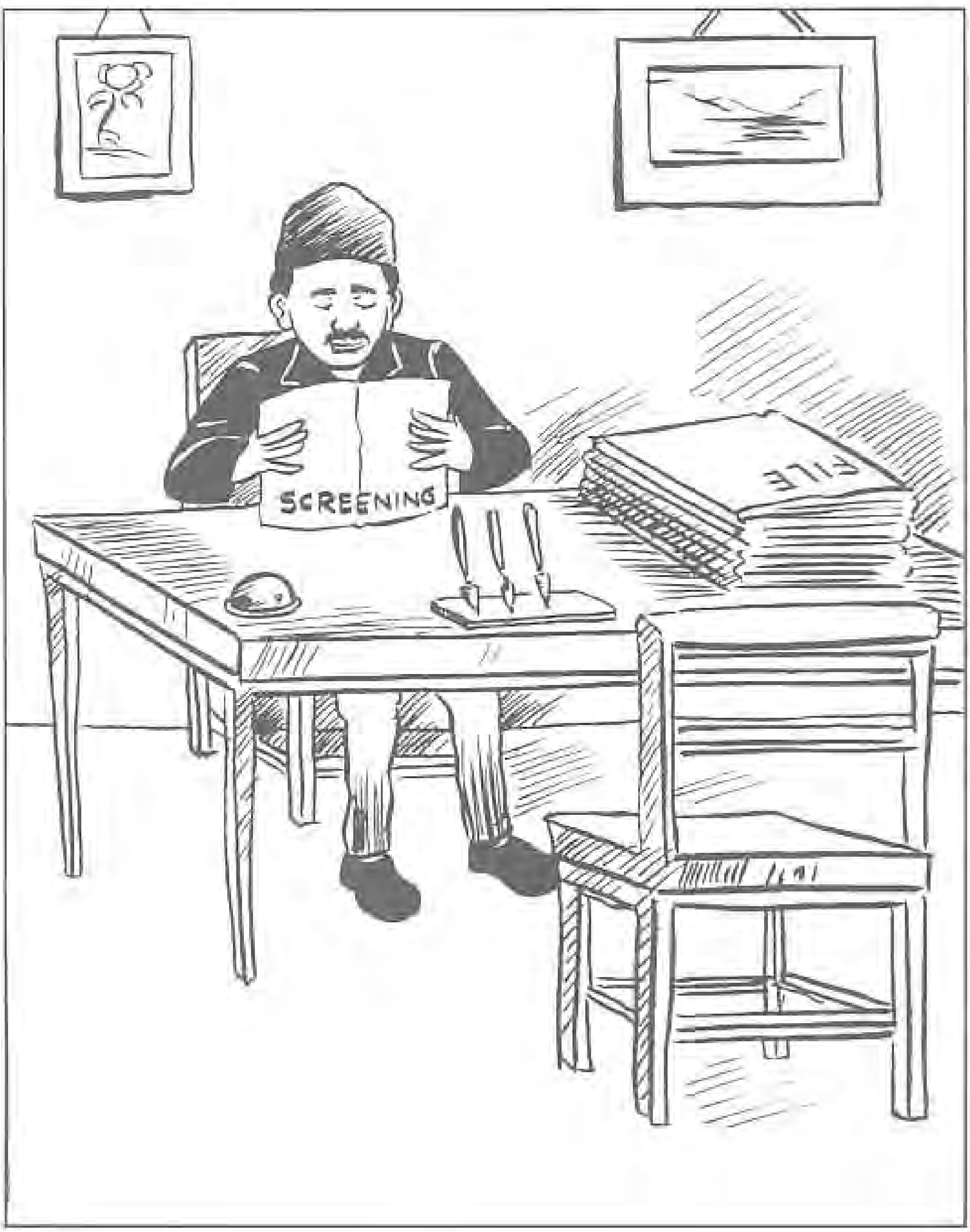
EIA is multi-disciplinary and intersectoral

EIA differs from other types of project related studies in many important aspects—the scope and breadth of the work usually include a diversity of topics ranging from archaeological investigations to noise/vibration assessments. EIA is a multi-disciplinary activity and this factor provides one of its major challenges in terms of project management.

EIA reports should be accessible to all interested parties

Another important challenge results from the role of EIA, and more important is the final EIA report. This document, unlike the written output of other types of project related analyses, has many audiences. The readers/users of engineering and economic financial feasibility studies tend to be the project proponents and the financial backers or supporters. This is a relatively restricted readership, however, it may be extended occasionally to technical experts in project authorising agencies. The situation is quite different with EIA reports. Such reports are read/used by the project proponents, financial backers, experts (and elected representatives) in authorising agencies (and other organisations) who deserve a rights to comment on an EIA report and submit their views on the desirability of a project) and, of course, the members of the public. Thus, there is a challenge of facilitating open communications and understanding of the main issues.

4
Screening and Initial Environmental Examination (IEE)



Summary

- Objectives of Screening and Initial Environmental Examination (IEE)
- Screening Procedure in the Nepal National EIA Guidelines
- Initial Environmental Evaluation (IEE)
- Methods for IEE

1. Objectives of Screening

Screening is a mechanism for identifying projects requiring EIA

Many projects are considered by the government for implementation every year. EIA needs only to be applied for those actions which may significantly affect the environment. It is therefore important to establish mechanisms for identifying projects requiring EIA; this process of selection is referred to as "screening".

The importance of screening

Screening of development proposals during the early stages of project planning accomplishes the following:

- saves money;
- saves time (i.e., avoids unnecessary delays);
- immediately identifies the major environmental impacts that are likely; and
- establishes a conception that an EIA study needs to be conducted.

2. Screening Procedure in the Nepal National EIA Guidelines

The National EIA Guidelines 1993 uses lists of projects, thresholds and sensitive areas as a criteria to assist screening. All projects are divided, eventually, into three categories:

- projects requiring IEE;
- projects requiring EIA; and
- projects for which it is not clear whether an EIA or IEE is needed.

The guidelines contain three schedules which contain separate lists of different project types. When a project is proposed, it is necessary to check whether the project is listed or not . If it is listed in schedule 1, it requires an Initial Environmental Evaluation (IEE).

The projects listed in schedule 1 are those which are likely to have a limited number of significant impacts, which can be easily predicted and evaluated, and for which, mitigation measures may be prescribed easily. The IEE is used to confirm whether this is, indeed, requires the consideration of EIA.

Schedule 2 contains projects, for which, EIA is required. Schedule 3 contains a list of environmentally sensitive areas and any project, which is likely to affect such an area, must be subject to an EIA. All other projects must be examined on a case-by-case basis to decide whether or not an EIA or IEE is required. If there is an uncertainty, then an IEE should be conducted. The results of the IEE will determine whether or not an EIA is required.

3. Initial Environmental Examination (IEE)

IEE is conducted if there is no definite solution in screening

Projects for which requirement of an EIA could not be easily ascertained, is subject to an Initial Environmental Examination (IEE). An IEE is carried out to determine if significant adverse environmental effects are likely to occur which require detailed study before mitigation measures can be determined. Therefore, an IEE requires:

- Adequate in-depth analysis than screening;
- Adequate technical input and advice from environmental specialists and experts; and
- Adequate amount of more resources and time (Box 4).

If IEE provides solutions for potential environmental problems and the application for screening was not able to identify problems properly, then there is no need for conducting a full-scale EIA.

How IEE should be conducted

In order to carry out an IEE, it is necessary to understand the following components of the project activities and the surrounding environment:

- Project activities to be implemented;
- Setting of project, resources' demands and the waste produced;
- Policies, regulations and guidelines to be known of IEE; and
- Resources and environment are likely to be impacted.

This information can easily be made available in the project proposal and some experts may visit the project area as an inventory survey, which may be called a preliminary analysis.

Box 4: EIA Process

1. IEE process identifies:
   - Most likely significant impacts (positive/negative) from proposed actions;
   - Mitigation measures for adverse impacts not expected to be significant;
   - Mechanisms for enhancing beneficial impacts; and
   - Residual uncertainties not possible to be resolved in the IEE stage.
2. A simple matrix/checklist could be used for IEE

4. Methods for IEE

Use of Interaction Matrix/Checklist

A preliminary scoping exercise can be conducted to solicit information from planners, policy-makers, project proponents, concerning authorising agencies, affected populations and NGOs. A list should be prepared for the project activities which, upon implementation, would be, likely, to affect environmental resources, including human beings. A simple matrix can list project activities in the horizontal column, with the anticipated environmental resources to be listed in the vertical column (see Figure 2). The response of each environmental parameter to each project activity is represented by an interaction cell and could be rated 1–3, where "1" represents no impact, "2" moderate impact and "3" severe impact. A completed matrix, in which, no impact was rated higher than "2" might be considered to place the project in the category making an IEE sufficient, as the impacts are not severe and impact mitigation can be prescribed easily. If even only one impact is rated "3", then a significant adverse environmental impact is anticipated and an EIA is recommended.

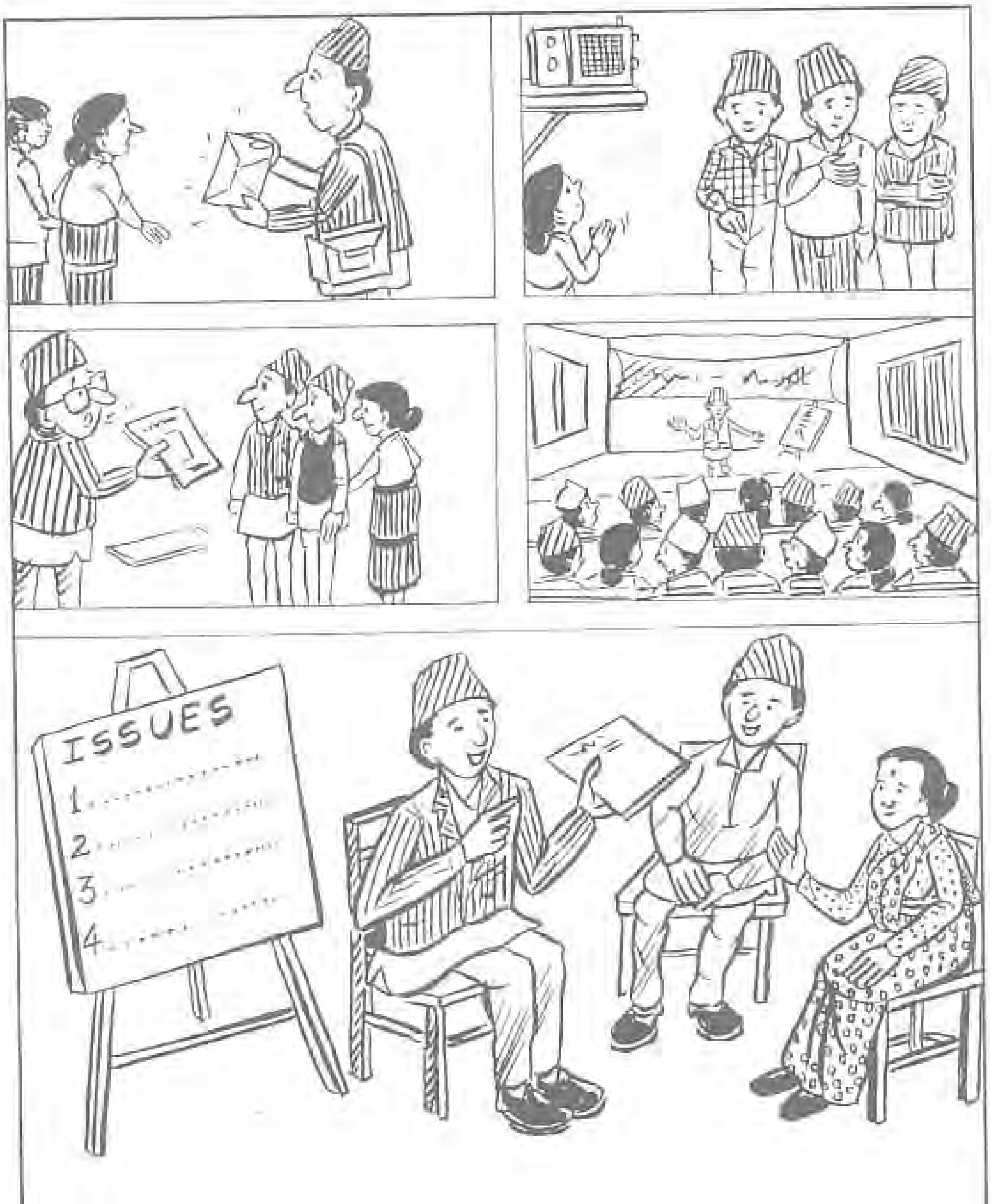
The use of information obtained in IEE

The appropriate time to carry out an IEE is at the pre-feasibility stage. This has tremendous benefit because if the environmental issues are properly addressed, at this stage, there is no need to carry out an EIA during the feasibility stage. However, if there remain some residual problems, even after IEE, there should be a recommendation for carrying out a full-scale EIA, focusing only on particular key issues.

Involvement of resources and time

Project proponents, authorising agencies, EIA experts (at least two), local people, NGOs and other interested groups should participate in the process of IEE execution. Meetings, brainstorming sessions, field examinations, data collections and processing would be enough at this stage of evaluation. Minimum expenditure will be incurred, and the time for the period required is one month maximum.

5
Scoping and Preparation of Terms of Reference (TOR)



Summary

- Objectives of Scoping
- Scoping Approach
- EIA Methods Which Can Assist Scoping
- Terms of Reference (TOR)
- Main TOR Components
- A "Model" TOR

1. Objectives of Scoping

Scoping is the heart of EIA

The next important step, following the screening procedure is to determine the coverage or scope of the EIA study of a project proposal identified as having been potentially significant with environmental impacts. This activity is referred to as "scoping". Scoping helps in developing and selecting alternatives to the proposed action and in identifying the issues to be considered in an EIA. It is also a procedure designed to establish the terms of reference (TOR) for an EIA study (Box 5).

Aims of scoping

Scoping is required in order to help:

- identify concerns and issues for consideration in an EIA;
- enable those responsible for an EIA study to properly brief the study team on the alternatives and on impacts to be considered at different levels of analysis;
- determine the assessment methods to be used;
- identify all affected interests;
- provide an opportunity to the public involved in determining the factors to be assessed;
- facilitate an early agreement on contentious issues;
- save time and money; and
- establish terms of reference (TOR) for EIA study.

Scoping is not an isolated exercise. It may be useful to reconvene some, if not all of the participants (while maintaining representativenes) to deal with issues of assigning impact significance once the impacts have been predicted (See Chapter 7).

2. Scoping Approach

Planning for public involvement

Developing a communication plan is an important internal planning tool for those conducting a scoping exercise. Purposes of scoping at an early stage are: (i) to define all the communities and agencies which are allowed to participate in making decisions relating to the proposal; and (ii) to identify whom to talk to, as well as when and how to undertake the communication exercise. The project proponents, relevant experts, affected local people, as well as groups with special interest should be considered for inclusion in the list of persons to be covered by the communication plan. Box 6 provides a basic list of participants involved in scoping. Ways to make involvement of affected interests and collection of information that include:

- obtaining written submissions from the relevant government agencies and the public;

Box 5: Outline of Scoping Procedure

1. Identify the environmental issues to be considered in an EIA
2. Scoping helps in:
   - Reaching agreement on specific issues;
   - Identifying alternatives;
   - TOR preparation;
   - Public participation;
   - Identifying Methods to be used in the EIA; and
   - Achieving cost effectiveness.
3. Mechanism
   - Open Scoping—public meetings, workshops, seminars, etc.
   - Closed Scoping—letters, interviews, discussions, etc.

Box 6: List of Participants for Scoping

- Proponent (with/without consultants)
- Review agency
- Licensing agencies
- Other relevant agencies
- NGOs
- Public

(Note: Number of participants can be limited and discussions can be held in private)

- holding community meetings and public hearings;
- conducting preliminary field study/observation of sites;
- conducting workshops/seminars; and
- establishing an intersectoral task force.

Collecting existing information

Existing information on the nature of the project should be collected. A preliminary list of potential environmental impacts and practical alternatives supported by maps, drawings and other aids, should be prepared. Such information will form a basis for further discussion.

Information distribution

The information collected so far should be processed and assembled into a package and distributed to appropriate individuals and organisations for comments. Government departments and concerned local and regional officials should be contacted. For major projects, it is always advisable to issue a general public notice inviting public comments and to hold public meetings at the project site, as well as at the central level, in order to facilitate consultation and interaction. This is often the responsibility of the project proponent.

Information dissemination can also be done through the media for a large project, where the number of affected persons is not known.

Issues of public concern

Major concerns raised by affected people are to be:

- compiled into a comprehensive list; and
- categorised.

No concern should be ignored or rejected at this stage.

Analysis of significance

Once the issues have been identified and grouped, their scientific validity needs to be carefully evaluated. If certain questions of a technical nature remain unresolved, a discussion panel or workshop can be organised at an appropriate venue to resolve the problem.

Establishing and addressing priority issues

Issues for which immediate solutions can be provided—such as suggesting feasible alternatives or mitigation measures that can be implemented at an early stage—should be removed from the list. The key issues remaining should be arranged in order of priority.

For those issues which need further information to be resolved, terms of reference (TOR) should be prepared to provide guidelines for the EIA study. The extent of information required for a detailed EIA depends upon the impacts/issues identified in scoping.

Agencies responsible and appropriate timing to conduct scoping and make

Responsibility for scoping may rest with the proponent; however, it is helpful if the authorising agencies were to issue guidelines for this activity to the project proponent. Sectoral agencies of the government as well as relevant donor agencies should be involved in *involvement of concerned agencies and groups*

the EIA scoping exercise. At the community level, key local persons, leaders, and special interest groups such as teachers, women, students and farmers should also be involved in EIA scoping. This involvement will encourage their participation in the EIA process and also implement the proposed project later.

3. Methods That Can Assist Scoping

There are a number of simple methods which may be useful in certain scoping sessions (e.g., a session involving specialists from government ministries and departments). These methods include:

- checklists;
- matrices; and
- networks

These methods may be used as a first step in identifying major issues/impacts in a rigorous and structured manner. Chapter 8 contains a brief discussion of the operating principles for these methods.

4. Terms of Reference (TOR)

Objectives of TOR

If the screening exercise indicates that there is a need for an EIA for a particular project, TOR are prepared following scoping, to provide specific guidelines for the EIA study. TOR assists in:

- Identifying and describing the impacts/issues to be investigated;
- Systematising the working procedure;
- Delineating the specific activities to be implemented;
- Fitting the EIA study into the context of existing policies, rules and administrative procedures; and
- Accomplishing the work within a specified time frame.

5. Main TOR Components

The TOR should specify the following:

a) The project proposal and its reasonable and practical alternatives (including the "no action" option).

b) The environmental components which need detailed or further study should be listed. The indicators of each listed component to be measured or assessed should be specified.

c) The likely significant impacts which should be investigated.

d) The need to identify actions required to be minimised as far as possible.

e) adverse impacts (relocation, increased taxes, compensation, etc.) and enhance benefits.

f) Implementation of an economic evaluation of environmental impacts (to the extent possible).

g) Identification of a monitoring programme for impacts of concern during the project's operation and beyond.

h) The following aspects of the EIA study should be considered;

- **Work tasks:** each specific task to be done should be sufficiently described;
- **Study schedule:** the proposed plan for carrying out the EIA study should be indicated;
- **Review sessions:** periodic review of the work might be needed during study; and
- **Study team:** expertise and specialists needed for the proposed project study team should be described.

i) Provision of a conclusion on whether the project should be implemented or whether it poses an unacceptable risk.

j) The time required for the EIA report and an estimated budget to be completed (e.g., within 3 to 12 months).

k) The completion date.

6. A "Model" TOR

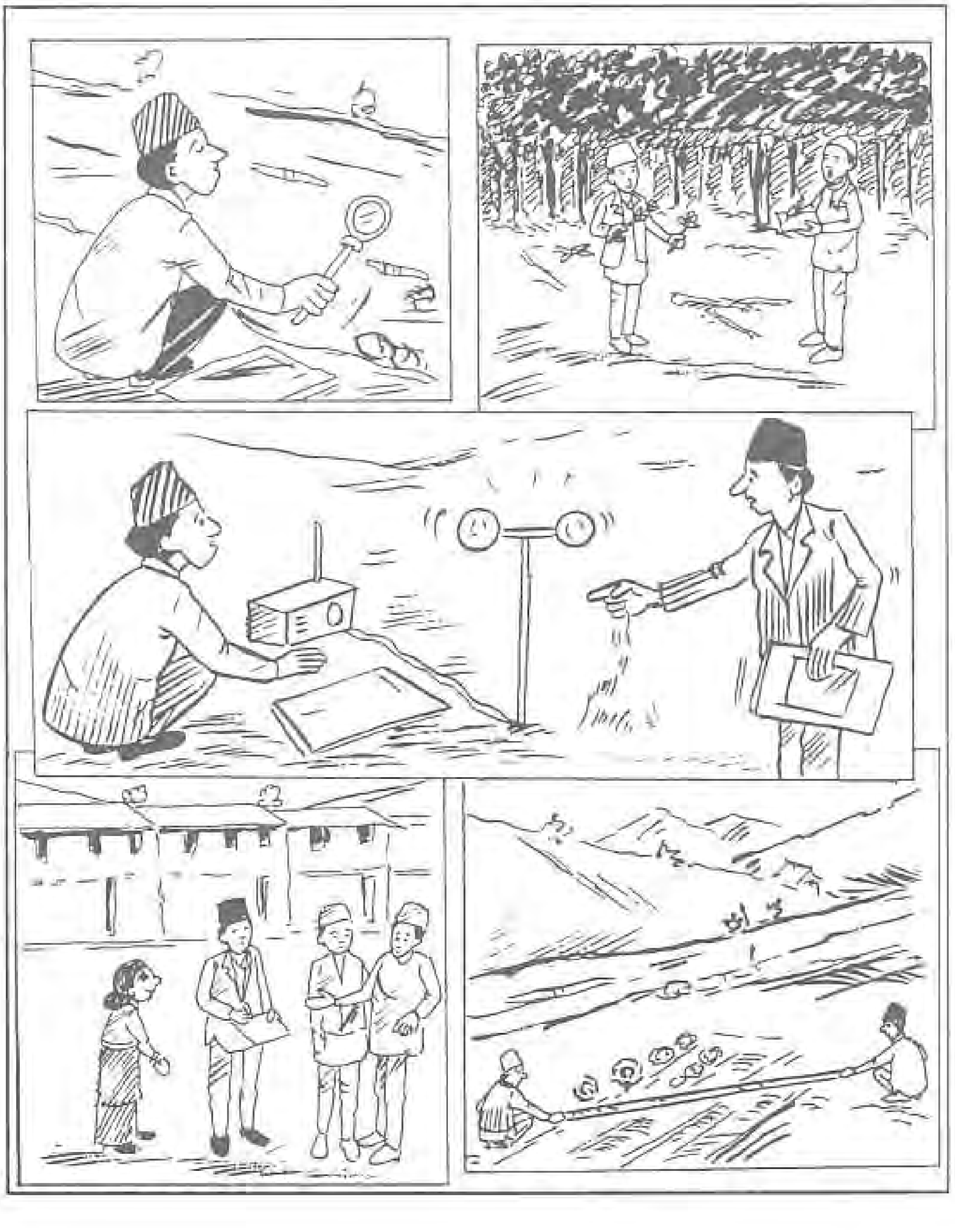
Box 7 shows a general model TOR which can be used as a framework to draft a specific TOR for an individual project.

The TOR provides direction and guidelines for further study; however, they should always be flexible and open to modification as the EIA work progresses.

Box 7: Framework Terms of Reference for Environmental Impact Assessment (OECD/DAC, 1994)

	General headings	Topics to be addressed	Basic requirements
A	Introduction	Background	Introduce the project and the most critical environmental issues involved.
B	Context	The problem	Summarise the basic development issue or problem being addressed by the proposed activity.
		Proposed solution	Summarise how the proposed activity is expected to resolve the problem or issue, with the emphasis on sustainability.
		Objectives of the assessment	Specify the objectives of the assessment and the relationship of the results to project design and implementation.
C	Institutional setting	Legal/policy base	Summarise the legal and policy base for environmental assessment.
D	Alternatives	Alternatives to the project	(a) Assess the potential for achieving the developmental objective by interventions at the policy level.
			(b) Assess the potential for achieving the developmental objective by implementing other projects.
		Alternatives within the project	Evaluate alternatives for key aspects of the project (e.g., scale, sitting, waste management and pollution control options).
E	Institutional and public involvement	Institutional cooperation	Show how agencies participated in the assessment and how the project fits within development priorities of recipient country.
		Public involvement	Show how interested/affected groups participated in the assessment.
F	Required information	Description of project	Describe the project (design, location, size), inputs (raw materials, energy) and outputs (products, by-products emission).
		Description of environment	Identify study boundaries and give baseline data on relevant physical, ecological, social, economic and cultural conditions.
		Information quality	Assess information quality, identify data gaps and summarise limitations on the assessment from such deficiencies.
G	Analysis of impacts	Positive impacts	Predict how lives of affected people will be improved and any enhancement of natural systems resulting from project.
		Negative impacts	(a) Predict any significant reduction in quality of air, water and soil or loss of biodiversity.
			(b) Evaluate the risk of a significant deterioration in the quality of the lives of the affected people.
			(c) Evaluate plans for involuntary relocation and describe measures taken to minimise the number of people relocated.
			(d) Evaluate the cumulative impacts from the project and compare with incremental losses from previous projects.
			(e) Evaluate the potential for transboundary impacts and effects on the global commons.
			(f) Define the meaning of the term "significant" and assess the significance of the expected impacts.
H	Mitigation and monitoring	Environmental management plan	Provide comprehensive and detailed plan covering mitigation of impacts, relocation/compensation schemes and training.
		Environmental monitoring plan	Detail the environmental and social variables to be monitored, location/timing of sampling and use of results.
I	Conclusion and recommendations	Project decisions	Indicate the extent to which the proposed project conforms with the principles of sustainable development.
		Technical matters	Summarise design and operational changes that are critical to improving the environmental acceptability of the project.
		Non-technical summary	Summarise, in non-technical terms, key findings and recommendations of the assessment, including economic benefits.
J	Annexes	Organisation	Provide information on the assessment team, the overall approach, component studies, schedule and budget.
		Report format	Follow a pre-defined format in preparing the environmental assessment report (usually provided by responsible authority).

6
Establishing the Environmental Baseline



Summary

- Introduction
- The Environmental Setting
- Collection of Baseline Data
- Importance of Baseline Data in Critical Decision-making: An Example
- Role of Baseline Data in Monitoring

1. Introduction

Collection of baseline information on bio-physical, social and economic aspects of a project area is undertaken at the early stage of project inception

Baseline studies form the most important reference point for conducting EIA. The term "baseline" refers to the collection of background information on the bio-physical, social and economic setting for a proposed development project area. Normally, information is obtained from secondary sources when there exists a facility of maintaining databases, or the acquisition of new information through field sampling. The task of collecting baseline data starts right from the period of project inception; however, a majority of this task may be undertaken during scoping or after scoping activities.

Baseline indicates measurement of existing conditions, against which changes can be measured and evaluated

Baseline data are collected for two main purposes:

- To provide a description of the status and trends of environmental factors (e.g., air pollutant concentrations) against which predicted changes can be compared and evaluated in terms of importance.
- To provide a means of detecting actual change by monitoring once a project has been initiated.

2. The Environmental Setting

The description of the environmental setting includes the characteristics of the area in which the proposed action would occur. This description should be of the study area, which is defined as the area within which all effects, impacts, features and potential compensation efforts would occur from a proposed action and its alternatives. The level of detail in this description of the study area should be sufficient to convey to readers or reviewers, the precise nature of the natural and human resources potentially affected by the proposed action and alternatives.

The approach commonly adopted in treating this aspect of EIA is the subdivision of the environmental setting into a logical and hierarchical set of categories. The major categories would be likely to, include the following:

Environmental setting

• Geology

Geology. Geological provinces, bedrock formations, history of geological stability or instability.

• Topography

Topography. General topography of region, specific topography of project area.

• Soils

Soils. Soil mapping, soil series properties constraints to development.

• Groundwater resources	**Groundwater resources.** Nature of water bearing formations, recharge rates, sustainable safe yields, locations and depths of existing wells, quality.
• Surface water resources	**Surface water resources.** Drainage basins and sub-basins, named and unnamed water bodies and water courses, regulatory classification of water bodies, flow regimes, water quality data and evaluation, identification of existing permitted discharges to surface waters.
• Terrestrial communities	**Terrestrial communities (botanical and zoological).** Spatial arrangement of vegetative community types, vegetative species-abundance listings, wildlife species-abundance listings, records of threatened and endangered plant and animal species.
• Aquatic communities	**Aquatic communities.** Nature of aquatic habitats, species-abundance listings for aquatic macro-invertebrate and fish communities, ecological indexing of community data.
• Environmentally sensitive area	**Environmentally-sensitive areas.** Identification of wetlands, flood-plains, steep slopes, stands of mature vegetation, aquifer recharge areas, areas of high water table, areas of rock outcrop, prime agricultural lands, mines.
• Land use	**Land use.** Existing patterns of land use in the region, regional planning for future use, zoning.
• Demography	**Demography.** Estimated population, recent trends and projections for future population.
• Sound levels	**Sound levels.** Existing sound levels, sources of sound.
• Socio-economic	**Socio-economic characteristics.** Economic and social structure of communities, tax rates, characteristic types of development.
• Infrastructural services	**Infrastructural services.** Nature and scope of human services such as police and fire protection, hospitals, schools, utilities.
• Transportation	**Transportation.** Layout and function of existing roadways and airports, existing and projected capacities and demands.
• Cultural resources	**Cultural resources.** Location and characterisation of identified cultural resources (archaeological, historical, cultural, landmark), potential for unidentified resources to be present in project area.

This is a generic list. In a specific EIA it is only necessary to collect baseline data on the features likely to be impacted. For example, if the TOR does not require the investigation of aquatic or noise impacts then no data on these issues is needed.

3. Collection of Baseline Data

Baseline studies in EIA may take a long time, hence EIA is blamed for higher costs and delays in project implementation

EIA is often conducted under severe time constraints. In most cases, two to three months are allocated for EIA study. Sometimes it may go up to six months. EIA practitioners often tend to take up the majority of time collecting baseline information; in the end, the volume of baseline data becomes so large that it becomes difficult to handle it properly, and it may be irrelevant in the preparation of EIA.

It is often forgotten why the baseline information is collected, where to incorporate it and what level of understanding is needed. Sometimes, it becomes too superficial, while in other cases it might go deeper, and in the end, much of the investment of time and money is wasted.

Therefore, the studies should be focused on those aspects that are likely to be affected

Collection of baseline data should be designed to satisfy information requirements and should be relevant to the EIA analysis. Only baseline data needed to assist prediction of the impacts contained in the TOR (output of scoping) should be collected. Of course, during scoping the same, baseline data will have been obtained, but intensive, directed and focused efforts to collect these data must be directed by the requirements of the TOR.

4. The Importance of Baseline Data in Critical Decision-making: An Example of Fish Population in a Hydro-electric Project (Arun III Nepal)

Four critical decision points exist in project implementation

There are four critical points in decision-making in the sequence of project implementation. The nature and the extent of baseline information required, at each of these decision points, are quite different. The following example of a hydro-electric development project, in relation to how it is likely to impact on fish population will illustrate the four critical decision points and the requirement of baseline information at each stage.

Example of the Arun III Hydro Power project and its impact on fish population

A series of potential sites for generating hydropower has been identified at different stretches of the Arun River in eastern Nepal. The most promising of these sites is Arun III, where preliminary investigation has suggested a possibility of generating of 402 MW of hydropower. This example is used to demonstrate how important it is to have environmental baseline studies phased in, with major stages, in project decision-making. For reasons of brevity, the focus will be on a rather narrow set of environmental concerns, particularly on fishery resources. However, the principles demonstrated by this example are equally valid for a broad range of environmental concerns.

(i) Decision on Project Approval

Sahar fish (Tor tor Ham) are threatened by the Arun III project

Sahar fish (Tor tor Ham), a delicious long-distance migratory fish, is available in plenty in the entire stretch of the Arun River. The usual migratory cycle of this fish has been reported to be upstream for breeding in summer and downstream for feeding in winter. Most of the fishermen living along both sides of the river use traditional method/technology to catch the fish and sell their catch to the local market for income.

Impacts likely to be created by damming the river:

• Population of fish would decline

• Economy will be affected

• Social reaction to such an impact

One of the major environmental concerns in damming of the river is that it obstructs the upstream and downstream migration of sahar fish, which in turn creates a number of issues.

- Reports from fishermen of the area indicate that the population of sahar fish has declined recently due to excessive fishing through the recently introduced fishing technique of dynamiting. The obstruction created by damming will further reduce the population and may destroy the fish spawning area.
- The sahar fish (*Tor tor* sp.) is considered to be a most delicious hill stream fish and is important to the local people both in terms of economy and preference.
- Fish resources come under the jurisdiction of the Department of Fish and Fishery, HMG, but current legislation does not account for the regulation of river fish resources in Nepal. However, in the absence of such regulatory mechanisms, it would be highly relevant to consult the local fisherman and the local government about their concerns before proceeding with the project, which is likely to produce adverse effects for fish resources of the area.

To substantiate such likely issues, there should be adequate baseline data for decision makers to approve the project

For the justification of each of the above issues, it is necessary to support them with baseline information. First, data on current abundance of fish, their migratory pattern, spawning characteristics, localities, the current rate of exploitation, the economy earned by the fishermen, etc., need to be determined. Secondly, a small-scale feasibility study should be carried out regarding the establishment of a hatchery to replace the possible loss of production due to the project operation. Thirdly, it is also necessary to explore the possibility of creating some potential sahar fish habitats and spawning grounds by removing obstacles in the tributary rivers that open into the main river.

This information will clarify the issues that have been raised, and on the basis of the information, the decision makers/project proponents will have to decide whether or not the project should be approved for implementation.

(ii) Decision on the Location of Project

There may be several locations proposed. However, for this case a location which has minimum implications on fish production should be selected, and this decision should be supported by baseline information

If the first critical decision made is that the project is approved for implementation, then the second critical decision would be to find out an appropriate location for the construction of a dam. Engineering feasibility might have proposed several sites for dam construction, and on the basis of technical and economical feasibility, the best site might have been identified. However, from the point of view of the environment, particularly, in the case of fish resources, a more detailed and focused baseline study would have to be conducted for each of the alternative sites proposed, mainly on:

a) Sites for damming which would be likely to have less effect on fish spawning grounds;
b) Sites which would be likely to create more area for spawning; and
c) Sites which would be likely to impose minimum obstruction for fish migration.

In any of the above issues, the results of baseline studies undertaken, at site selection stage would indicate the benefit–cost ratio of the project implementation. This has to be taken into consideration, while making a critical decision regarding site selection.

(iii) Decision on the Project Design

Project design may not need any additional information. However, in this case, in order to determine the actual amount of water release, additional information on hydrology may be required

At this stage of project planning, the decision and recommendations made at decision points 1 and 2 should be incorporated into the project design. Primarily this case, the following aspects have to be considered:

- The release of maximum and minimum flows necessary to protect migrating adult fish and their offspring. For this case, the hydrological regime of the river should be well understood.
- Introducing a coordinated mechanism in the project design is necessary for maintaining the regular water flow downstream.
- The design has to incorporate all recommended mitigation measures, and also a fish ladder has to be included in the design, if necessary.

All considerations at the design stage should be backed by baseline information, and a critical decision has to be made before construction as to whether or not all measures recommended in previous decisions have been taken into consideration in design.

(iv) Decision on the Operation of Project

Data collection in the operation phase is the continuation of pre-construction baseline studies. Comparison of such data would enable determination of whether the mitigation measures applied are as effective as predicted

Studies at this stage of the project cycle would be directed towards establishing monitoring and operational feedback systems to ensure that the design features built into the project are implemented properly. A number of studies should be made at this stage. For example, the survival rate of juvenile fish below the dam should be compared with that in unaffected parts of the river; assessing whether the newly developed habitat is being used to the extent predicted; and the relationship between fish production in the river and commercial fish catches.

Most would be the continuation of studies, initiated during the previous decision stages. In effect, environmental monitoring in the operational phase of a project is a continuation of pre-construction baseline studies. The overall objective is to ensure that the project is operated in accordance with its design specifications, to determine whether the mitigation measures applied were as effective in protecting the resource base as predicted.

5. The Role of Baseline Data in Monitoring

The following example in this regard illustrates the implications of this operational definition. Siltation in the rivers of Nepal is a problem caused by erosion, landslide and flooding. In order to check/control the siltation process, watershed management projects with intensive afforestation programmes were initiated. The amount of silt carried by the rivers at different times of the year was measured before project implementation. Measurements of the amount of silt after the project implementation were also made at different times of the year through the monitoring programme. The comparison of pre-project data with post-project data was made, and if reduction of silt load in the river has taken place, then the measures adopted through watershed management are considered to be effective (it is being safely assumed that no other factor was causing the decline in silt loads). Thus, this example illustrates the importance of baseline data which can be used as reference points in EIA.

7
Impact Prediction, Evaluation and Comparison of Alternatives

Summary

- Introduction
- Methods of Impact Prediction
- Choice of Prediction Methods
- Uncertainty in Impact Prediction
- Evaluation
- Comparison of Alternatives

1. Introduction

Impact prediction refers to the analysis of the condition of potential impacts in the future. However, it also takes account of a reference point and describes the condition with or without action

Prediction should be based on the available environmental baseline and project data. Such predictions should be described in quantitative or qualitative terms, preferably quantitative.

An environmental impact prediction should, at the minimum, perform the following functions:

- determine the initial reference or baseline condition;
- estimate the future state with the proposed action; and
- estimate the future state without the proposed action.

Impact prediction takes into account the following:

Magnitude of an impact refers to its severity

Magnitude of Impact. This is defined by the severity of each potential impact. It also indicates whether the impact is irreversible or, reversible and the potential rate of recovery. The magnitude of an impact is considered high if a major adverse impact is not mitigated. A major adverse impact would affect the potential subsistence/ recreational/ commercial use of bio-physical resources, with the result that the value of resources would be reduced far below the publicly acceptable level. Moderate to minor unmitigated impact of a similar nature will result in resources still being usable, but at some inconvenience to the public.

In prediction of impact, the magnitude is often expressed as high (H), medium (M) and low (L).

Spatial extent refers to the influence zone of impact

Extent of Impact. The spatial extent or the zone of influence of the impact should always be determined. An impact can be site-specific or limited to the project area (SP); a locally occurring impact within the watershed of the proposed project (L); a regional impact that may extend beyond the watershed (R); and a national impact affecting resources on a national scale (N).

Temporal dimension indicates the time duration of impacts

Duration of Impact. Environmental impacts have a temporal dimension that needs to be considered in an EIA. Impacts arising at different phases of the project cycle may need to be considered. An impact that generally lasts for only three to nine years after project initiation may be classified short-term (S). An impact which continues for 10 to 20 years may be defined as medium-term (M), and impacts that last beyond 20 years are considered long-term (L). Those types of impacts produced during the construction phase of a project are generally short-term.

2. Methods of Impact Prediction

Different types of methods are used for impact prediction; they are mostly extrapolative, and in some cases, normative

There are many potential methods available for predicting impacts on a variety of resources. One study conducted by ERL indicated that 150 impact prediction methods have been utilised in just 140 EIA reports of the Netherlands and North America (VROM, 1980). No prediction methods are perfect, and more and more additional methods are being devised.

Predictive methods can be **extrapolative**, in which the predictions are made on the basis of past and present data, and include trend analysis, scenario analysis (the common sense forecast of the future), analogies (transferring experience from elsewhere), and intuitive forecasting from group consensus. **Normative** methods examine how the fulfilment of a desired target is achieved; for example, in one of the construction project the target set is to employ 50 per cent of the local populace. To meet this target, it may be necessary to change the project and associated employment policy.

In general, the methods are divided into the following six types described below.

2.1 Mathematical Models

Cause-effect relationships are transferred into mathematical function using deterministic or stochastic models

Such models are based on cause-effect relationships usually expressed in the form of mathematical functions. They may be simple input-output models or they may be complex dynamic types. Such models are primarily used for predicting the impact only partially (e.g., model for phosphorus retention in a lake, or model to predict the economic multiplier in a particular area). Models which are comprehensive and provide a holistic approach are often rare, except in some cases of land use planning.

Mathematical models are divided into two types. **Deterministic** models are usually derived through fixed relationships. They are more commonly used in socio-economic impact prediction, such as the economic multiplier in a project where injection of money in the project area takes place and the impact on the economy of the project area is examined, if the economic multiplier is being considered. The **stochastic** model is a probabilistic type, in which the prediction depends upon the degree of probability of occurrence of a number of events in a given area and time.

Input equals to output in mass balance models

A simple model termed a "mass balance model" is usually applied for indicating the input from one compartment resulting in the output for another. If the inputs are water, food and chemicals in one compartment, then the outputs would be water and wastes flowing out into another compartment. Mass balance models are primarily useful for predicting impacts from industries or manufacturing sectors.

2.2 Statistical Models

Use of regression or component analysis

Statistical techniques such as regression or component analysis are sometimes used to indicate the relationship between the data and test hypothesis, for example, when trying to predict flood frequencies.

2.3 Geographic Models

Use of images, maps, etc.

Satellite images, physical maps and aerial photographs used with GIS systems can provide information on existing resources. Prediction of the impacts of the development project can be made by analysing the effect of project activities on the resources present in the location.

2.4 Field and Laboratory Experimental Methods

Field surveys indicate the availability of resources as a reference point for prediction, while laboratory tests provide simulation data

Field inventories before project implementation provide the baseline condition of resources. For example, a fish resource survey in the Arun River in Nepal indicated that a long-distance migratory fish called Sahar (*Tor tor Ham*) is dominant among other fish species. Construction of a dam in the upstream reaches of the river might create an obstruction for their upstream migration for breeding. The prediction of this impact is that the fish population upstream will decline, since there will be no more fish coming upstream beyond the dam. Similarly, laboratory tests also provide some insight on the effects of certain activities on the resources. For example, the application of DDT in fields might inhibit the growth of seedling crops. The laboratory simulation tests would determine what doses of DDT might inhibit the growth and the application of up to what dose range of DDT would be safer.

2.5 Physical Models

Physical models are made to closely resemble the area to be impacted as far as possible

These models are closely linked to field and laboratory experiments. Basically, a model of an area likely to be impacted is constructed but on a smaller scale, for example a stretch of a river or a valley. The natural features, such as topography are included. In the case of rivers, the effect of impoundment on flow can be calculated. In the case of valleys, it is possible to determine the deposition of gases and particulates from an air pollutant-emitting source.

2.6 Expert Judgement

Experiences in one place might provide the likely condition for another

An event occurring due to certain activities in a particular location may be analogous to another similar location with similar activities. The experience of one place could be very well utilised for similar places elsewhere where the environmental impacts are unknown. For example, many irrigation projects in Nepal's Terai produce salinisation effects. Planning to construct another irrigation project in the Terai may mean creating more salinisation problems. Decisions on likely impact based on past experience are the result of conceptual models often referred to as expert judgement by specialists.

3. Choice of Prediction Methods

Predictive method should be chosen on the basis of its reliability and replicability

The assessor is responsible for selecting impact prediction methods for the particular development project in question. However, the assessor has to bear in mind the following common objectives while selecting prediction methods. Such methods should: (a) produce acceptable results; (b) be replicable; (c) be consistent; and (d) be adaptable. A development project might need more than one method for impact prediction. For example, establishment of an industry requires the consideration of water pollution, air pollution, and social and economic aspects. For each of these, different methods have to be adopted for predicting impacts that are likely to result from the establishment of an industry.

Simple predictive methods are often used

In practice, however, there is a tendency to use less formal predictive methods, especially the expert opinion. Even when formal predictive models are used, they tend to be simple. There are two reasons for this: (i) a simple EIA analysis is more understandable by decision makers because all exercises in EIA analysis are usually designed as an aid to decision makers, and (ii) traditionally, the information contained in EIA reports is often released for public review, which also needs to be easy to understand.

However, there are some circumstances where the use of complex methods is necessary

Munn (1979) identifies the conditions in which computer-based complex models for impact prediction should be used. The conditions are as follows:

- if the project requires handling of a large volume of data;
- if there exist complex interrelationships;
- if the proponent wants the study to be completed quickly; and
- if there is an involvement of statistical probability.

Development of a complex model is time-consuming and expensive and has limited use for particular sectors of the environment.

4. Uncertainty in Impact Prediction

There always exists some sort of uncertainty in prediction; what differs is the confidence limit

When the impact of some activity is predicted, the assessor gives the impression that it is going to happen certainly. In most of the cases, there tends to be no room for uncertainty; however, it is universally true that all the predictions have some elements of uncertainty. Uncertainties about social, physical and economical environment; uncertainties about guiding values such as policies, priorities and legislation; and uncertainties about related decisions such as planning, negotiation, coordination, etc., usually affect the accuracy of prediction in the EIA process.

However, in resolving the question of uncertainty, the issue of probability and confidence limit of impact prediction has to be addressed. All predictions should be expressed such that each of the outcomes should be within a certain range of percentage of confidence. For example, a new industrial unit might emit a noise level of 65-70 dBA, and this is concluded at the 95 per cent confidence interval. This means that only five times out of 100 would the noise level be predicted to exceed the expected range.

5. Evaluation

Evaluation of impacts should be based on comparing the values against set standards

Once an impact is predicted, for example, that a fishery is likely to decline by 25 per cent, a decision needs to be made on the significance of the decline. Basically, how important is the decline? There are a number of ways of answering this question:

- Scoping results may be used as a guide;
- Relevant national laws, regulations or policies which may give protection to the species;
- Expect judgement (scientists); and
- Reconvening the scoping sessions.

For other types of impacts, e.g., an increase in noise levels, reference may be made to national (or international) standards or guidelines.

If a consensus is required amongst a group of stakeholders, then there are some techniques which may be used.

6. Comparison of Alternatives

6.1 Approaches

Defining issues to be addressed and setting

Assessment of alternatives in EIA has been considered as the "heart" of environmental impact reports. CEQ regulations in the United States require that for a project, comparison of alternatives should *out a clear basis for selecting a preferred alternatives are very important*

define the issues and a clear basis for choice among alternatives for the decision makers and public in EIA analysis.

In order to achieve systematic decision-making among alternatives, it is desirable to use trade-off analyses, which typically involve the comparison of a set of alternatives relative to a series of decision factors. The following formal and informal approaches can be used to carry out the comparative analysis:

The approaches for alternative analysis constitute a formal and informal methods

a) **Qualitative approach.** In which descriptive information on each alternative is presented.
b) **Quantitative approach.** In which quantitative information on each alternative is presented.
c) **Ranking, rating or scaling approach.** In which the qualitative or quantitative information on each alternative is summarised through the assignment of a rank, rating or scale value usually based on the characteristics of the impacts (severity, reversibility, etc.).
d) **Weighting approach.** In which the importance in weight of each alternative is presented in view of the relative importance of the decisive factors.
e) **Weighting-ranking/rating/scaling approach.** In which the relative importance of either environmental factors or impacts are determined and numerical weights are assigned to each factor or impact. The important weight is multiplied by the ranking/rating of each alternative, then the resulting products for each alternative are summed up to develop an overall composite index or score for each alternative.

Decision-making which involves the comparison of a set of alternatives, relative to a series of decision factors is not an unique to considering environmental impacts. This is a classic decision-making approach and is often referred to as multi-criteria decision analysis.

6.2 Simple Methods for Comparing Alternatives

Several different methods have been used for evaluation of alternatives. Brief examples of some of these methods are given below.

Alternative profile concept: a graphic display technique

- Alternative profile concept: This concept graphically presents the effects of each alternative. Each profile scale is expressed on a percentage basis, ranging from negative to positive with the maximum absolute value of the impact measured. The impact measurement represents the maximum change, either plus or minus, associated with a given alternative being evaluated. If the decision factors are displayed along with the impact scale from +100% to –100%, a dotted line can be used to connect the plotted points for each alternative and thus describe its "profile". This is useful for visually displaying the relative impacts of a series of alternatives.

Reference alternative: a fixed reference is set and measurement of deviation provides beneficial/adverse impacts

- Reference alternative: This technique was originally used for evaluating the cooling system and alternatives for nuclear power plants. To determine scale values, a reference cooling system was used and each alternative system was compared to it. The following scale values were assigned to the alternatives based on the reference alternative: very superior (+8), superior (+4), moderately superior (+2), marginally superior (+1), no difference (0), marginally inferior (–1), moderately inferior (–2), inferior (–4), and very inferior (–8).

Rating utilising letters, such as A+ indicating beneficial and C– indicating negative, is common

- A letter rating system was used by Voorhees and Associates (1975). This methodology incorporates 80 environmental factors oriented to the types of projects conducted by the US Department of Housing and Urban Development. The scaling system consists of the assignment of a letter grade from A+ to C– for the impacts, with A+ representing a major beneficial impact and C– an undesirable, detrimental change.

Setting an evaluation guideline as a reference point

- Dee et al. (1973) described a rating checklist for the Environmental Quality account for water resources projects. Scaling is accomplished following the establishment of an evaluation guideline for each environmental factor. An evaluation guideline is defined as the smallest change in the highest existing quality in the region that would be considered significant. For example, assuming that the highest existing quality for dissolved oxygen in a region is 8 mg/l, if a reduction of 1.5 mg/l is considered as significant, then the evaluation guideline is 1.5 mg/l, irrespective of the existing quality in a given regional stream. Scaling is accomplished by quantifying the impact of each alternative relative to each environmental factor, and if the net change is less than the evaluation guideline, it is insignificant. If the net change is greater and moves the environmental factor towards its highest quality, then it is considered to be a beneficial impact; the reverse is true for those impacts that move the measure of the environmental factor away from its highest existing quality.

6.3 Details of Some of the Important Method for Analysing Alternatives

(i) Nominal Group Process Technique (NGP)

NGP is an interactive group technique

Developed in 1968, this method is one of the oldest interactive group techniques and it is particularly used in socio-psychological studies. At present, this technique has been found to be quite useful in EIA, particularly in evaluating the significance. The following four steps are usually involved in carrying out the NGP:

a) A panel of participants is asked to provide its ideas on a particular issue in writing.
b) The ideas thus generated by the participants are listed in a flip-chart for a series of discussions.
c) Brainstorming sessions are organised for the purpose of clarification and evaluation of the ideas.
d) Independent voting is held for the priority ideas and decisions.

Ideas which have been finalised from the above mentioned steps are rated or ranked for decision for action. Rating or attaching an importance scale can be done by utilising a pre-determined importance scale.

(ii) Delphi Method (DM)

DM is another subjective method that involves the participation of stakeholders. This is a good method for bringing consensus among experts

This method can be used to incorporate views of various stakeholders into the evaluation process. The Delphi method is an established means of collecting expert opinions and achieving consensus among experts on the various issues under consideration. It has the advantage of obtaining expert opinions from individuals with guaranteed anonymity, avoiding potential distortion caused by peer pressure in group situations. Compared with other evaluation methods, it can also be undertaken in a short time period and at a relatively low cost.

Delphi exercises usually have a three-stage approach: (1) general questionnaires asking panel members to identify important impacts (adverse and positive), (2) first-round questionnaires asking panel members to rate the importance of the list of impacts identified in the first stage, and (3) second round questionnaires asking panel members to re-evaluate the importance of each impact in light of the overall panel response to the first round.

Determining the relative importance of impacts is an important aspect of evaluation

There is another aspect to evaluation which becomes very important when a number of alternatives are being compared to a range of impacts. Basically, it is necessary to determine the relative importance of each impact. For example, is the decline in the fishery of equal importance to the noise level increase, or is it more important ? If so, is it two or three times more important ? Certainly no decision maker will consider all impacts to be equally important.

EES is a subjective analysis in which initial weights are distributed among environmental attributes on the

(iii) Environmental Evaluation System (EES)

This is one of the oldest techniques for environmental impact evaluation and predicting and comparing significance. EES was developed at the Bettelle Laboratories. According to this system, environmental impact is measured in 78 environmental components and this value is converted into common units using a scalar called *basis of importance value ranging from 0–1*

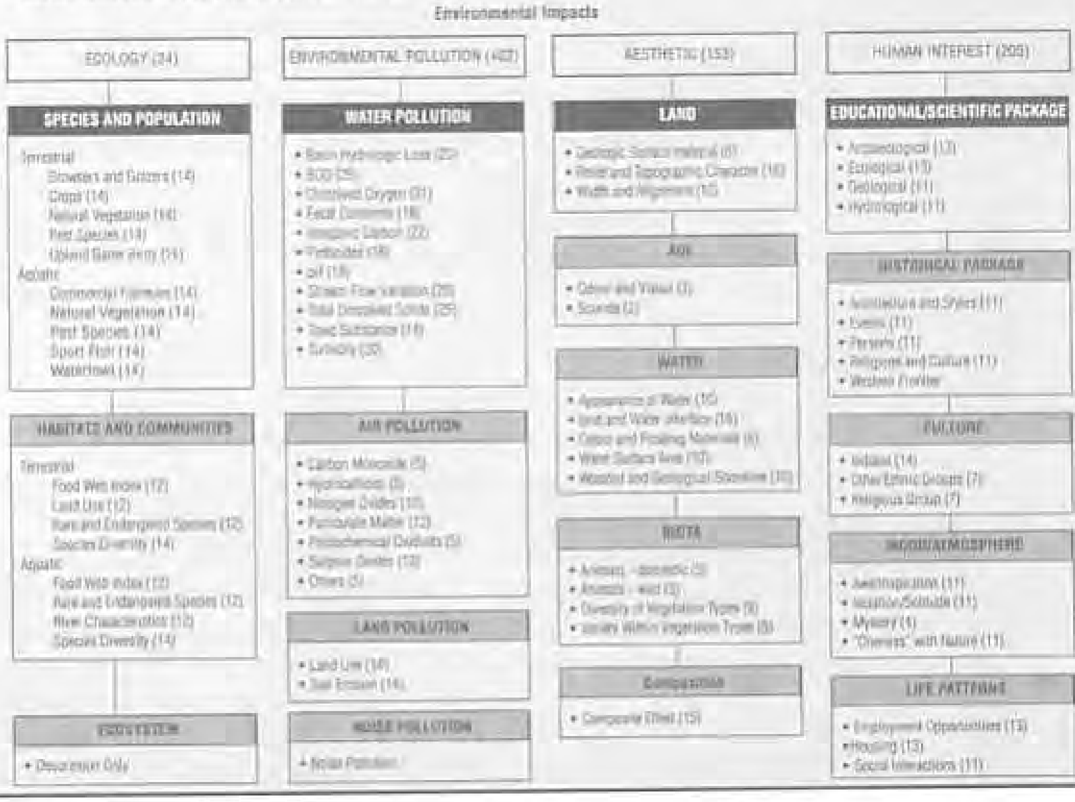
Parameters Important Unit (PIU). Converting environmental effects to common units ranging from 0 to 1 is known as environmental quality scale ranging from the worst to best in the scale. However, the system using scalar is not flawless and cannot be used universally. In EES, Delphi techniques are used to distribute 1,000 initial weighting units among four divisions of the environment, which are further divided into 17 major components consisting of 78 environmental parameters. The distribution of initial weightings is made entirely by subjective judgement, and in such a ranked comparison technique pairs of parameters are compared for relative importance and the total weights are divided among available units. To illustrate this, if 48 out of 1,000 units are to be allocated for education and scientific aspects consisting of archaeological, ecological, geological and hydrological factors, then in this process experts are asked how many units should be given to ecological, geological and hydrological parameters out of a total of 48 PIU. If ecological and archaeological parameters are given the highest value of 1, and geological and hydrological parameters are given a value of only 0.5, then the distribution of PIU among these four parameters will be as follows:

(1) Ecological	= 1.0	(2) The distribution out of the total 48 PIUs will be:	
Archaeological	= 1.0	Ecological $\frac{1}{3.0}$ x 48	= 16
Geological	= 0.5	Archaeological $\frac{1}{3.0}$ x48	= 16
Hydrological	= 0.5	Geological $\frac{0.5}{3.0}$ x 48	= 8
Total	= 3.0	Hydrological $\frac{0.5}{3.0}$ x 48	= 8
		Total	= 48

The foregoing analysis indicates that ecological and archaeological parameters are of full importance, while geological and hydrological parameters are half of the importance of the former. In this way, value for other parameters can also be calculated.

Although EES methods are considered to be quite reliable, they are criticised for being entirely based on the opinions of judges who cannot represent multiple publics. The use of scalar is questionable; environmental categories are counted twice, and this method cannot account for secondary and higher order interactions. Box 8 illustrates the framework of EES.

Box 8: Framework for EES (Source: Dee et al. 1973)



4. Examples of Comparison of Alternatives

(i) Unranked Paired Comparison Technique

One of the most important and useful methods of scaling/rating of choice of alternatives in decision-making is the unranked paired comparison technique. This method has been used in several EIA studies, particularly for comparing alternatives and for making a sound decision on the most suitable alternative. The following example will illustrate the use of this technique.

Comparison of Alternatives (Simple Technique)

Supposing there are four decisive factors in a plan such as F1 referring to achieve overall objectives, F2 achieving economic efficiencies, F3 achieving social soundness and F4 to achieve the environmental soundness of the plan. The best one has to be selected at one time. This can be done by ranking decision factors and selecting the factor which has the highest score. A group of people/individuals are asked to rank these alternatives of decision assigning a value of 0-1 to each decision factor on the basis that they feel importance.

F1— Relating to the degree of achieving overall objective;

F2 — Relating to the economic efficiency;

F3 — Relating to the social concerns;

F4 — Relating to the environmental concerns;

F5 — A dummy factor

The total weight for each case has been summed up as a grand total. Each total is divided by the grand total, thus estimating Factor Important Coefficient (FIC) of all factors equal to 1.

From the value of FIC the decision factors can be compared and in this case F1 constituting 0.4 is the best factor, followed by F4 and F2. The comparison of the factors indicating the degree of achieving of the objective is given the highest priority, followed by environmental concerns and economic efficiencies as second and third priorities respectively (Box 9A).

Box 9A: Paired Comparision Technique and Weight Assignment

DECISION FACTORS	ASSIGNMENT OF WEIGHTS				SUM	FTC
F_1	1	1	1	1	4	**0.4**
F_2	0	1	0	1	2	**0.2**
F_3	0	0	0	1	1	0.1
F_4	0	1	1	1	3	0.3
F_5	0	0	0	0	0	0.00
Total	**1**	**3**	**2**	**4**	**10**	**1.00**

Comparison of Alternatives in Complex Situation

However, if there are several ways to achieve each decision factor, in such case, the analysis of comparing alternatives, becomes more complex. The following example illustrates the analysis in a complex situation.

Suppose there are three alternatives to address the issues, such as A_1, A_2, A_3, A_4, for each of the decision factors (Box 9B).

F_1 has three scenarios:

(a) achieving the objective fully,	A_1
(b) not achieving the objective, and	A_2
(c) moderately achieving the objective.	A_3

F_2 has three scenarios:

(a) achieving medium economic efficiency,	A_1
(b) achieving low economic efficiency, and	A_2
(c) achieving high economic efficiency.	A_3

F_3 has three alternatives:

(a) undesirable social impact expected,	A_1
(b) no social impact expected, and	A_2
(c) beneficial impact expected.	A_3

F_4 has three alternatives:

(a) decrease environmental quality by 20 percent,	A_1
(b) decrease environmental quality by 10 percent, and	A_2
(c) decrease environmental quality by 10 percent.	A_3

The scaling/rating/ranking techniques consist of considering each alternative. The ranking assignment of alternatives relative to others is done by providing the most desirable value of 1 to one pair and the less desirable value 0 to another pair. The use of this paired comparison technique for the comparison of the three basic alternatives of four basic decision factors is shown in boxes from 10 to 13 respectively. It should be noted that the assignment of 0 to a member of a pair does not denote zero desirability; it simply means that in the pair considered it is the less desirable.

Following the assignment of the relative desirability of each alternative relative to each other, the individual choices of assignments are added horizontally to each factor, and all of these sum values are added vertically to obtain a grand total. Each horizontal sum is divided by the grand total, which gives the value of Alternative Choice Coefficient (ACC). The total of the sum column should be equal to (M) x (M–1)/2, where M is equal to the number of alternatives included in the assignments. In this example, four alternatives were included, hence the sum column total should be equal to 6. The total of the ACC column should be equal to 1.00 (Boxes 10–13).

The ACC column indicates that alternative A_1 is the most desirable relative to decision factor F_1, followed by A_3 and A_2. A_3 is most significant, and indicates that A_3 and A_2 are significant, respectively.

The next step in the process is to construct the decision matrix in relation to the given factors. The Factor Important Coefficient (FIC) values (Box 9A) and ACC values are tabulated in relation to the factors considered. The FIC value for each factor is multiplied by the ACC values of each alternative. For example, the FIC value of F_1 (0.40) is multiplied by the ACC values of A_1 (0.50). The products of these multiplications are presented in a decisive matrix. The sum of each alternative also indicates that A_3 is a significantly better choice, followed by A_1 (Boxes 14–15).

Box 9B: Decision Factors and Alternative Proposals

DECISION FACTORS	ALTERNATIVE PROPOSALS		
	A_1	A_2	A_3
F1	Achieve greatest degree of fulfilment of needs and objectives	Achieve least degree of needs and objectives	Achieve medium degree of meeting needs and objectives
F2	Medium economic efficiency	Low economic efficiency	High economic efficiency
F3	Undesirable social impacts expected	No social impacts expected	Beneficial social impacts expected
F4	Decrease overall environmental quality by 20%	Decrease overall environmental quality by 10%	Decrease overall environmental quality by 10%

Box 10: Scaling/Rating/Ranking of Alternatives Relative to F_1

ALTERNATIVE	ASSIGNMENT OF DESIRABILITY						SUM	ACC
A_1	1	1	1				3	0.50
A_2	0			0	1		1	0.17
A_3		0		1		1	2	0.33
A_4 (dummy)			0		0	0	0	0.00
Grand Total							**6**	**1.00**

Box 11: Scaling/Rating/Ranking of Alternatives Relative to F_2

ALTERNATIVE	ASSIGNMENT OF DESIRABILITY						SUM	ACC
A_1	1	0	1				2	0.33
A_2	0			0	1		1	0.17
A_3		1		1		1	3	0.50
A_4 (dummy)			0		0	0	0	0.00
Grand Total							**6**	**1.00**

Box 12: Scaling/Rating/Ranking of Alternatives Relative to F_3

ALTERNATIVE	ASSIGNMENT OF DESIRABILITY						SUM	ACC
A_1	0	0	1				1	0.17
A_2	1			0	1		2	0.33
A_3		1		1		1	3	0.50
A_4 (dummy)			0		0	0	0	0.00
Grand Total							**6**	**1.00**

Box 13: Scaling/Rating/Ranking of Alternatives Relative to F_4

ALTERNATIVE	ASSIGNMENT OF DESIRABILITY						SUM	ACC
A_1	0	0	1				1	0.17
A_2	1			0	1		2	0.33
A_3		1		1		1	3	0.50
A_4 (dummy)			0		0	0	0	0.00
Grand Total							**6**	**1.00**

Box 14: FIC and ACC Values for Decision Problems

DECISION FACTOR	FIC VALUE	ACC VALUES OF ALTERNATIVES		
		A_1	A_2	A_3
A_1	0.40	0.50	0.17	0.33
A_2	0.20	0.33	0.17	0.50
A_3	0.10	0.17	0.33	0.50
A_4	0.30	0.16	0.42	0.42

Box 15: Decision Matrix for Alternative Analysis

DECISION FACTOR	ACC VALUES OF ALTERNATIVES		
	A_1	A_2	A_3
A_1	0.200	0.068	0.132
A_2	0.066	0.034	0.100
A_3	0.017	0.033	0.050
A_4	0.051	0.124	0.124
Grand Total	**0.334**	**0.259**	**0.406**

(ii) Impact Ranking and Alternatives Comparison

The ranking method follows the National EIA guidelines of Nepal

One of the most commonly used methods in Nepal for choosing alternatives is the impact ranking method, which has been utilised in EIA in the past and is considered to be a simple method that decision makers tend to understand quite easily. In this method of alternative analysis, impacts identified are predicted in terms of magnitude, extent and duration. Each of these predictions is then translated into numbers. Nepal's National EIA Guidelines (1993) give the following assessment framework in the form of a numerical scale.

Magnitude		Extent		Duration	
High/major (M)	60	Regional (R)	60	Long-term (LO)	20
Moderate (MO)	20	Local (L)	20	Medium-term (MT)	10
Minor (MI)	10	Site Specific (SP)	10	Short-term (ST)	5

The impact values or scores for each of the alternatives are summed up and multiplied by the probability of occurrence for a particular impact. The final impact scores for all the alternatives can then be compared; the highest value corresponds to the greatest potential for environmental impact. Alternatives with the lowest values are generally selected for consideration.

An example from Melamchi Water Supply Scheme

The following example, illustrating the applicability of this method, is taken from the project entitled "Environmental Impact Assessment for Water Supply to Kathmandu-Lalitpur from Outside the Valley", in which a preliminary EIA was conducted in 1989.

The Kathmandu Valley is facing a shortage of water supply. Since there is no source of water within the valley, an exploration of suitable sources of water for Kathmandu from outside the valley was made, and the following three most feasible sources were identified:

Melamchi/Modified Melamchi Schemes (1 and 2)

Melamchi is a river located 25 km north of Kathmandu. The Melamchi River was identified as a potential source for water supply, and the following structures were proposed for its utilisation:

- River intake capacity of 10 m^3/sec
- Sedimentation tank
- 27 km-long tunnel with a diameter of 2.5 m
- Treatment plant at Sundarijal
- Balancing reservoir of 5 million m^3 for Melamchi Scheme
- Balancing reservoir with capacity of 18 million m^3 for modified Melamchi Scheme
- Diversion canal
- Access road of 60 km in length

Lower Roshi Khola Scheme (3)

Another potential source for water to Kathmandu is the Roshi Khola located 20 km east of Kathmandu. The structures proposed were:

- One 116-m-high dam to provide storage of 58 million m^3
- Pressure tunnel 150 m in length
- Storage reservoir with capacity 3.3 million m^3 within the valley
- Water treatment plant
- Access road of 5.5 km in length
- 3,000-person workforce
- Resettlement of 310–600 households

During the preliminary investigation, baseline data on all three schemes were collected; issues were scoped and evaluated; and the most pertinent issues common to all three schemes were identified, predicted and evaluated. Initially, the common issues were categorised into different degrees of magnitude (Minor, Medium and Major), extent (Local, Regional, Site specific), and the duration (Short-term, Medium-term and Long-term) as specified in the rating framework in the National EIA Guidelines (HMG, 1993) (Box 16). The quantitative characteristics of the impacts were given, and the categories of impacts were then translated into numerical values, again as given in the National EIA Guidelines (Box 17). The relative probabilities of occurrence for each impact were estimated through discussions with experts and analysis of the past records of similar places elsewhere (Box 18). The values presented were then multiplied by the probability of corresponding issues. Results obtained after multiplication were tabulated and indicated that the Melamchi scheme was the most feasible (score 73), followed by the Modified Melamchi (score 91); the Lower Roshi Khola Scheme had the highest score (114) and was found unfeasible on environmental grounds (Box 19). The values calculated using this method are all based on professional judgement; however, the advantages of this method are the considerations of relative probability of occurrence for all the impacts identified, the simplicity of processing and its easy understandability.

Box 16: Impact Categorisation

ISSUE	MAGNITUDE	EXTENT	DURATION
Reduced downstream water supply	Minor	Local	Long-term
Reduced downstream water quality	Minor	Local	Long-term
Increased downstream sediment transport	Minor	Local	Long-term
Increased downstream scouring	Minor	Local	Long-term
Deteriorating reservoir water quality	Major	Site-specific	Long-term
Increased erosion in general due to project	Major	Local	Long-term

Box 17: Ranking Impact Categories

ISSUES	MAGNITUDE	EXTENT	DURATION	TOTAL
Reduced downstream water supply	10	20	20	50
Reduced downstream water quality	10	20	20	50
Increased downstream sediment transport	10	20	20	50
Increased downstream scouring	10	20	20	50
Deteriorating reservoir water	60	10	20	90
Increased erosion in general due to project	60	20	20	100

Box 18: Relative Impact Probabilities

ISSUE	WATER SUPPLY SCHEME		
	MELAMCHI	MODIFIED	LOWER ROSHI KHOLA
Reduced downstream water supply	0.1	0.1	0.2
Reduced downstream water quality	0.1	0.1	0.2
Increased downstream sediment transport	0.1	0.1	0.2
Increased downstream scouring	0	0	0.2
Deteriorating reservoir water quality	0.2	0.4	0.6
Increased erosion in general due to project	0.4	0.4	0.2

Box 19: The Result Comparison of Three Schemes

ISSUES	WATER SUPPLY SCHEME		
	MELAMCHI	MODIFIED MELAMCHI	LOWER ROSHI KHOLA
Reduced downstream water supply	5	5	10
Reduced downstream water quality	5	5	10
Increased downstream sediment transport	5	5	10
Increased downstream scouring	0	0	10
Deteriorating reservoir water quality	18	36	54
Increased erosion in general due to project	40	40	20
Total	**73**	**91**	**114**

8
EIA Methods

Summary

- Introduction
- Checklists
- Interaction Matrix Method
- Network Method
- Calyx Expert System
- Overlay Mapping

1. Introduction

In the history of EIA, an enormous variety of methods have been devised to help undertake EIAs and prepare EIA reports. These EIA methods are structured, formal frameworks which allow impact data to be identified, manipulated and presented. Some methods are suited to one of these tasks, whereas other methods can be used for all of them. In this section, a brief description of the advantages and disadvantages of methods, which are the most frequently used is presented.

These EIA methods are tools used to assist EIA implementation, not rigid formulae to be used exactly as described here. They can (and indeed should) be modified, adapted, extended or simplified to meet the needs of a particular EIA.

The EIA methods presented here are loosely divided into two main categories; those which are useful for:

a) identifying impacts; and

b) presenting the results of the EIA in the EIA report.

First, the following methods suited to identifying impacts will be presented.

2. Methods of Impact Identification

2.1 Checklists

Checklists are usually very simple. The checklist ensures that all relevant impacts are identified and unimportant issue is omitted.

As one of the first EIA methods, checklists are still in general use, though in many different forms. Usually, checklists consist of a list of environmental factors which may be affected by project activities. Checklists can range from simple lists of items to more complex variations which incorporate guidance on the scaling and weighting of impacts. Broadly, there are five different types of checklists used frequently in impact identification, and they are briefly described below.

a) **Simple lists.** These checklists contain only a list of environmental factors and are very simple to use. The simple checklists focus attention only on those factors which have to be considered for EIA analysis. Their use ensures that a particular factor is not omitted from analysis. In essence, these checklists act as an *aide de memoire*. However, they do not give any guidance on how impacts should be assessed, and they do not advise the type of predictive technique to be used and the type of data required (Box 20).

Box 20 Typical Project Checklist by Impact Area

POTENTIAL IMPACT AREA	CONSTRUCTION PHASE			OPERATION PHASE		
	ADVERSE EFFECT	NO EFFECT	BENEFICIAL EFFECT	ADVERSE EFFECT	NO EFFECT	BENEFICIAL EFFECT
A. LAND TRANSFORMATION AND CONSTRUCTION						
a.Compaction and setting						
b.Erosion						
c.Ground cover						
d. Deposition (sedimentation, precipitation)						
e. Stability (slides)						
f. Stress-strain (earthquakes)						
g.Floods						
h.Waste control						
i.Drilling and blasting						
j.Operational failure						
B. LAND USE						
a.Open space						
b.Recreational						
c.Agricultural						
d.Residential						
e.Commercial						
f. Industrial						
C. WATER RESOURCES						
a.Quality						
b.Irrigation						
c.Drainage						
d.Ground water						
D. AIR QUALITY						
a.Oxides (sulphur, carbon, nitrogen)						
b.Particulate matter						
c.Chemicals						
d.Odours						
e.Gases						
E. PUBLIC SERVICE SYSTEMS						
a.Schools						
b.Police						
c.Fire protection						
d.Water and power system						
e.Sewerage system						
f. Refuse disposal						
F. BIOLOGICAL CONDITIONS						
a.Wildlife						
b.Trees, shrubs						
c.Grasses						
G. TRANSPORTATION SYSTEMS						
a.Automobile						
b.Trucking						
c.Safety						
d.Movement						
H. NOISE AND VIBRATION						
a.On-site						
b.Off-site						
I. AESTHETICS						
a.Scenery						
b.Structures						
J. COMMUNITY STRUCTURE						
a.Relocation						
b.Mobility						
c.Services						
d.Recreation						
e.Employment						
f. Housing quality						
K. OTHER (List as appropriate)						

b) **Questionnaire checklist.** This method includes a set of questions to be answered. The questions are listed under generic categories such as "terrestrial ecosystem" and "disease vectors". Those assessing impacts must attempt to answer the questions in all categories. There can be three answers, depending on how much is known about the particular impact under consideration. For example, if it were known that an impact were likely or unlikely, then the appropriate answer (Yes/No) would be marked. However, if insufficient evidence was available for a definite response, the "Unknown" category would be marked. This indicates that further work is needed to ascertain whether an impact is likely. Box 21 shows a small section of a questionnaire checklist.

Comments

Checklists are simple and easy to use as guides, however, they have their own drawbacks

- The checklists described above are quite simple to use and are often used for structuring the initial analysis as a guide to ensure that no vital components of the environment are omitted.
- Checklists tend to be rigid and have a characteristic "tunnel vision" focus on only one side of impact analysis, usually the environment. The various activities involved in project implementation are omitted.

2.2 Interaction Matrix Method

When project activities are plotted against the resources, which are likely to be impacted, the interaction point may be marked as an impact area

Interaction matrices are some of the earliest types of method utilised. The simple matrix refers to a display of project actions or activities, along with one axis, with appropriate environmental factors listed along with the other axis of the matrix. When a given action or activity is anticipated to cause a change in an environmental factor, this is noted at the intersection point in the matrix and can be further described in terms of magnitude and important considerations. Many variations of the interaction matrix have been utilised in EIA are as listed below.

(a) Leopold Matrix (LM)

The Leopold Matrix is similar to other matrices, but the interaction box is divided diagonally into two parts—the upper part for Magnitude (M) and lower part for Importance (I)

This matrix method was developed by Leopold et al. (1971), and it has been used for the identification of impacts. It involves the use of a matrix with 100 specified actions and 88 environmental items. In constructing the matrix, each action and its potentiality for creating an impact on each environmental item must be considered. Where an impact is anticipated, the matrix is marked with a diagonal line in the interaction box. The second step in using the Leopold Matrix is to describe the interaction in terms of its **magnitude** (M) in the upper section and **importance** (I) in the lower section of each box.

Box 21: Part of a Questionnaire Checklist

Disease Vectors

a) Are there known disease problems in the project area transmitted through vector species,such as mosquitoes, flies, snails, etc.?	Yes	No	Unknown
b) Are these vector species associated with:			
• aquatic habitats?	Yes	No	Unknown
• forest habitats?	Yes	No	Unknown
• agricultural habitats?	Yes	No	Unknown
c) Will the project provide opportunities for vector control through improved standards of living?	Yes	No	Unknown

Estimated impact on disease vectors?

highly adverse ←——— insignificant———→ highly beneficial

Magnitude and Importance are represented on a scale of 1 to 10, with 1 representing the lowest and 10 the highest

The magnitude of an interaction or impact is the extensiveness or scale; it is described by the assignment of a numerical value from one to ten, with ten representing the largest magnitude and one the smallest. Values near five on the magnitude scale represent impacts of intermediate magnitude. Assignment of a numerical value for the magnitude of an interaction is related to the extent of any change (for example, if noise levels in a village were expected to increase by 20 dB(A), this is a large increase at night and may score 8 or even 9). The scale of importance also ranges from one to ten, with ten representing a very important impact and one an impact of low importance. Assignment of a numerical value for importance is based on the subjective judgement of the interdisciplinary team working on the EIA. A +\- can be used to show whether an impact is beneficial or adverse.

Factors in the Leopold can be contracted or expanded and used in IEE; visual display is another advantage

One of the attractive features of the Leopold Matrix is that it can be expanded or contracted; that is, the number of actions can be increased or decreased from the total of 100, and the number of environmental factors, can be increased or decreased from 88. The primary advantages of the Leopold Matrix are that it may be useful in IEE (see Chapter 4), and that it can also provide a valuable means for impact communication in terms of a visual display of the impacted items and the major actions, causing impacts.

(b) Modified Graded Matrix (MGM)

The total of relative weight and the important weight multiplied by priority value identifies where attention is needed

Lohani and Thanh (1980) used another grading system in which relative weights are assigned to each development activity. If the relative priority of development activity is determined, then the total value of a particular activity is the sum of the vertical column represented by that activity in the matrix multiplied by the priority value. Finally, the total value of all the interactions is the sum of all horizontal values in the matrix. This method is particularly helpful in identifying major activities and in defining areas where attention is mostly needed in the process of analysis.

(c) Impact Summary Matrix (ISM)

ISM is an easy, complete form of matrix which is helpful for decision makers

An impact summary matrix can clearly identify the potential impact areas, predict the impact severity, specify the corresponding mitigation measures, and help in identification of agencies responsible for implementing mitigation measures. This kind of matrix is simple, covers all the aspects, and provides a complete EIA overview in summary form. Additionally, it provides a easy guide for decision makers (Box 25).

Box 22: Environmental Baseline Guidelines Evaluation

		Scale														
	ENVIRONMENTAL PARAMETERS	IMPORTANCE					PRESENT CONDITION					MANAGEMENT REQUIRED				
		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
ECOLOGICAL	Forest					■		■							■	
	Terrestrial Fauna			■			■							■		
	Rare and Endangered Species				■		■							■		
	Fish and Fisheries	■			■			■					■			
PHYSICAL	River Hydrology					■				■	■					
	Surface Water Quality	■			■				■					■		
	Air Quality	■								■				■		
	Sendimentation															
	Landslide/Erosion					■			■						■	
HUMAN INTEREST	Land Use Pattern					■								■		
	Water Supply					■								■		
	Rural Economy					■		■							■	
	Social Structure					■					■				■	
	Health					■		■							■	

Box 23: Environmental compatibility matrix for Upper Bhotekoshi Hydro Project (IUCN Nepal, 1995)

PROJECT ACTIVITIES	CONSTRUCTION						OPERATION	
ENVIRONMENTAL PARAMETERS	*SITE CLEARING*	*TRANSPORT*	*CONSTRUCTION*	*SOLID WASTE DISCHARGE*	*WORK FORCE*	*WASTE DISCHARGE*	*LAND ACQUISITION*	*OPERATION*
Forest	– 2S	–	–5L		– 5L	–	–	
Fauna	– 1S	–	–5L		–2L	–	–	
Endangered species	– 1S	–	–		–	–	–	
Fish and fisheries	–	–	– 4L		+4L	– 3L	–	
River hydrology	–	–	– 4L		–	–	–	
Air quality	– 2S	+3S	– 5S		–	– 2L	–	
Drinking water	– 1S	–	– 2L	– 3L	–	–	–	
Sedimentation	–	–	– 4L		–	–	–	
Erosion/landslides	– 2S	–	– 5L		–	–	–	
Land use	– 2S	–	– 5L		–	–	–	
Land intake	–	+3S	– 5L		–	–	–5L	
Rural economy	–	+ 3L	+ 5L		+ 5L	+ 5L	+ 5L	
Social structure	– 2L	–	– 4L		± 4L	– 2L	–	
Health	– 2L	–	– 4L		± 4L	– 3L	–	

Box 24: Decision Matrix for Upper Bhotekoshi

ENVIRONMENTAL PARAMETERS	PROJECT ALT.	
	NO PROJECT	WITH THE PROJECT
Forest and flora	2	– 5L
Fauna	1	– 5L
Endangered species	1	– 5L
Fish and fisheries	2	– 4L
River hydrology	5	– 5S
Air quality	5	– 3S
Drinking water	4	– 5L
Erosion/landslide	3	– 5L
Land use	5	– 5L
Rural economy	2	+ 5L
Social structure	5	+ 3L
Health	2	– 3L

Box 25: Environmental Impact Matrix of Arun-III Hydro Project – Part of Impact Summary Matrix

RESOURCE/PROJECT ACTIVITY	IMPACT	IMPACT PREDICTION			MITIGATION	RESPONSIBILITY
		MAGNITUDE	EXTENT	DURATION		
Microclimate						
1. Reservoir operation	Changes in temperature humidity	L	L	L	None required (see text).	
2. Vegetation/forest removal	Changes in temperature humidity	L	L	S	Protection of vegetation on south-facing slope;	HMG
					Avoid or minimise to absolutely necessary extent dump sites in forested area;	JV/Contractor
					Implement reforestation programmes;	HMG
					Replace adit road with shorter roads;	DOR/SWK; JV/Contractor
					Combine adit and powerhouse construction camps;	DOR/SWK
					Evaluate alternatives to dam site's access road;	JV/Contractor
					Implement ground cover/erosion protection/revegetation measures.	
Air Quality						
1. Vehicle emissions	Increase of air pollution; possible health hazard	L	L	S	Reduce travel distances by placing construction camps close to work areas;	JV/Contractor
					Replace adit road with shorter road;	DOR/SWK
					Eliminate spoil dumps and associated travel to the extent possible;	JV/Contractor
					Engines to comply with international standards for exhaust gases;	Contractor
					Maintenance of engines and exhaust gas check;	Contractor
					Dust control with water in dry season.	Contractor
2. Road dust	Increase of airborne dust during dry season	L	L	S	Reduce distances between camps and work areas;	JV/Contractor
					Black top heavily used area;	Contractor
					Breathing protection;	Contractor
3.Indirect Impacts	Influx of 2–3000 job seekers and small entrepreneurs; uncontrolled settlement	M	L	S	Regulation of settlement on public and private land.	HMG
Socio-Economic and Cultural						
1. Project Construction	Loss of arable land	H	L	L	Intensify production on remaining land;	HMG/Project
					Reclaim arable land after construction;	JV/Contractor

Loss of forest resources	L	L	L	Control deforestation;	HMG
				Forestry conservation and development programme.	HMG/Project
Displacement of approx. 144 families; interruption of normal farming activities	H	L	L	Minimise project land requirements;	JV/Contractor
				Compensation and rehabilitation programme.	HMG/Project
				Intensify production on remaining land;	HMG/Project
				Provide skill training for employment on construction.	Contractor
Requirement of additional food for local people, workforce and immigrants	M	L	S	Encourage production of crops and livestock products for sale to workforce and other outlets;	HMG/Project
				Contractor to provide logistics for his workforce.	JV/Contractor
Requirement of additional fuel supplies	M	L	S	Contractor to provide kerosene and electricity to workforce; limit use of local fuelwood;	Contractor
				Prohibit unauthorised felling of trees and use of open fire;	HMG/Project JV/Contractor
				Forestry development programme.	HMG Project
Disruption of traditional social and cultural patterns by large-scale immigration	M	L		Training and strengthening of the capacity of VDCs	HMG/Project
				Limited work contracts for non-indigenous labour.	JV/Contractor

KEY

Magnitude	Extent	Duration	
H = High	L = Local	L = Long-term (Over 20 years)	JV = Joint Venture Arun III
M = Moderate	R = Regional	M = Medium-term (Over 10 years)	DOR = Department of Roads
L = Low	N = National	S = Short-term (Below 10 years)	SWK = Scott Wilson Kirkpatrick (Road Consultant)
	I = International		NEA = Nepal Electricity Authority
			HMG = His Majesty's Government of Nepal

2.3 The Calyx Expert System

The Calyx system aids in determining potential environmental impacts of projects

Calyx is a computerised decision support system that is used to determine the potential environmental impacts of projects. The user of the system enters the information that describes the activities that will take place as part of the project, and the components of the environment present at and around the project site may be affected by the project.

Calyx contains a set of impact rules that describe the conditions, under which environmental impacts will occur, based on general principles—not on specific legislation. These rules were initially developed in Canada and have since been modified extensively with input from various Asian countries, including Thailand, Indonesia, the Philippines, Malaysia and the South Pacific.

Impact rules based on qualitative information make the system usable even with limited data. On-line definitions help interpret qualitative criteria where there is more quantitative data

The rules describing the conditions under which environmental impacts will occur have largely been written to use qualitative rather than quantitative information in order to make the system usable in situations where information is limited. For example, a Calyx impact rule that concerns siltation impacts on a river may require that the user specify whether the river is turbid (muddy), rather than asking for a specific measure of turbidity. In associated on-line definitions, assistance is given in terms of how to interpret qualitative criteria if more quantitative information is available.

Calyx combines project information with impact rules to determine relative magnitude of potential impacts

The Calyx software combines the information provided to it describing the project and its environmental setting with the internal database of impact rules to determine the relative magnitude of potential environmental effects. When information is missing or unavailable, Calyx provides a range of possible magnitudes for impacts (e.g., from low to medium).

User-friendly interface describes project and environment, determines/analyses impacts and produces reports

The Calyx software provides a user-friendly interface that leads users through the process of describing the project and the environment, determining and analysing impacts and producing reports. In addition, Calyx contains databases of mitigation measures and monitoring procedures that are indexed to environmental impacts. These databases provide the user with an important information resource to assist in the determination of mitigation and monitoring options for particular projects.

Salient features of the Calyx system

Some of the features and capabilities that make Calyx particularly relevant to the situations such as those in Nepal include the following:

Ensures broad coverage of impacts, including socio-economic, ecological, physical, etc.

1) Calyx helps to ensure that particular types of impacts are not omitted due to limitations in the knowledge of the users. Even when environmentally trained individuals are available to carry out EIA, they are frequently trained mostly in one field, such as slope stability of hydrology. Calyx can help to ensure that there is broad coverage of all types of impacts, including socio-economic, ecological and physical.

Tracks secondary and downstream impacts

2) Calyx keeps track of potential secondary and downstream impacts that might not otherwise be considered.

Mitigation/monitoring databases provide specific information

3) The mitigation and monitoring databases will help provide specific information that is not easily available from other sources, especially during operation of small scale EIAs and IEEs for which resources may be minimal.

Guided user interface leads users through key steps

4) The user interface provides a level of formalism and structure that leads users through the key steps: describing the project and environment, determining impacts, providing additional information and determining appropriate mitigation activities to reduce impact magnitudes.

Standardises reporting

5) The production of standard report formats will assist in information exchange and communication.

EIA training tool

6) The system can be used to help train and familiarise users with the EIA process both in terms of the steps required and in terms of the types of impacts that they should be considering for the typical projects wherein they work.

Information accumulation and distribution

7) The system can start the process of accumulating and distributing information on environmental assessment. In future, the updated knowledge base and accumulated information on projects will provide an important information resource.

2.4 Network Method

Cause-condition-effects of certain actions may lead to the formation of complex networks where the effect of an activity at one point may become the cause for another. In this way, formation of a chain of events becomes an impact tree

The network method begins with a list of project activities or actions and generates a network of cause-condition-effects (i.e., chains of events). This type of method is basically an attempt to recognise that a series of impacts may be triggered by a single project action (Box 26). Hence, this method provides a "roadmap" type of approach to the identification of second- and third-order effects. The idea is to start with a project activity and then identify the types of impacts which would initially occur. The next step is to select each impact, identify the impacts which may be induced as a result of these; then select each of these impacts and identify which may be further induced as a result. This process is repeated until all possible impacts are identified. Sketching this in a network form is commonly referred to as an "impact tree". One advantage of this type of approach is that it allows the user to identify impacts by selecting and tracing the events as they are expected to occur (Box 26).

Comments

Networks are very good in identifying impacts, cumulative interactions and showing these to the decision makers. They are also useful to use as working tools as the network can be amended easily as the EIA progresses. Networks and checklists do not show properly the spatial distribution of impacts nor are they very useful for band projects.

Interaction matrices identify direct impacts, but it is difficult to use them to identify indirect, secondary, etc., impacts. They can, however, form the basis for constructing a network to identify such impacts.

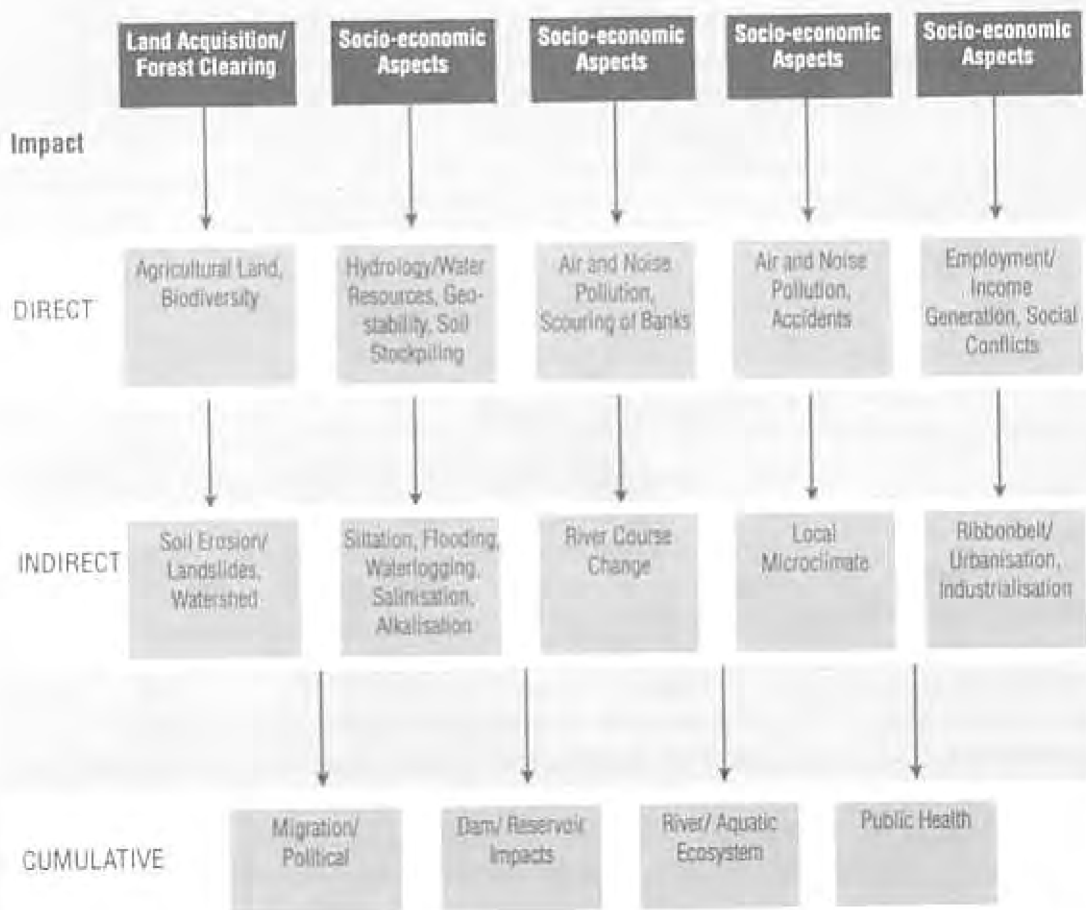
2.5 Overlay Mapping (OM)

Overlay mapping is a simple technique for displaying the impact areas; the resources likely are to be impacted and intensity of impacts can be presented through colour shading

Overlay mapping has a long history in a wide variety of planning activities. When EIA became mandatory in the United States in 1970, the potentiality of overlay maps to show the spatial distribution of impacts was soon recognised. Indeed, McHarg (1968) had described the use of such a method of selecting highway routes by analysing their impacts before the legal introduction of EIA in the United States.

This method was first used manually, now they are often computerised. A transparent overlay sheet is prepared as the base map, which shows the location of the project and consider the boundaries of the area in the impact assessment. A transparent overlay sheet is prepared for each feature that are to be assessed. The degree of the impact on each feature can be shown by the intensity of the shading taken from a specific black/white or colour code. If an impact on a mixed deciduous forest is very serious, then the dark shading would be incorporated on the sheet. The forest may be used occasionally for recreation, and therefore the effect on recreation may be considered minimal. Consequently, the impact would be given a pale shading wherein it overlaps with the forest. Other areas used for recreation may be severely affected and given a dark shading. The extent of an impact can be easily identified in the area covered by the transparency in a particular shading. A representation of the aggregate impact of a project (impacts on all selected environmental features) can be obtained by overlaying each transparency on the base map. The aggregate impact on different areas is shown by the relative intensity of shading.

Box 26: A Network of Impact Analysis of Road Construction in Nepal



Comments

This method is good for showing the spatial distribution of impacts

This simple method of visually representing the individual impacts and combinations of impacts has a number of advantages. The results from an application of the overlay method can be easily understood. Most importantly, it is an excellent method for showing the spatial distribution of impacts. With this information, it is relatively easy to relate the individual impacts with the total aggregate impact of a project on human populations that inhabit the localities affected. This allows the distribution of beneficial and adverse impacts being determined.

It does not account for the impact of characteristics which deal with probability, time and magnitude, but it is useful for a linear projects

However, overlays are less successful in dealing with other impact characteristics such as probability, time and reversibility. Experience concerning the overlay method indicates its most usefulness in assessing the alternative routes for linear development such as pipelines, highways and transmission lines. Composite displays enable the impacts of routes to be assessed and also show routes which will have the least environmental impact. Therefore, overlays are a very useful "search" mechanism for identifying the least-damaging route for linear developments.

9
Mitigation Measures

Summary

- Introduction
- Consideration of Alternatives
- Corrective Measures
- Compensatory Measures
- Preventive Measures
- Implementation of Mitigation Measures
- Mitigation in the EIA Process

1. Introduction

The purpose of mitigation measures is to avoid, reduce or minimise unwanted impacts and enhance beneficial impacts.

Mitigation measures are recommended actions which reduce, avoid or offset the potential adverse environmental consequences of development activities. The objective of mitigation measures is to maximise project benefits and minimise undesirable impacts. Although a wide range of mitigation measures may be proposed, the following are the ones relevant to most of the development projects.

2. Consideration of Alternatives

Selection of alternatives is also a form of mitigation in terms of impact, cost and technology.

The consideration of alternatives to a proposed project is one of the key functions of an EIA, which involves an examination of alternative ways of achieving the objectives of a proposed project. Again, the aim is to arrive at a developmental option which maximises the benefits while minimising unwanted impacts. Important aspects of the developmental proposals, for which alternatives are needed to be considered, which include:

- scale
- technology
- location
- fuel
- raw materials
- design
- time schedule
- economic factors

3. Corrective Measures

Corrective measures for projects usually involve a "technology"

Corrective measures may be adopted to reduce the adverse impacts to the acceptable levels. Such measures are considered during EIA and are built into the project design. This work is closely linked to the consideration of alternatives. The following are the examples of the types of corrective measures, that can be used:

- installation of pollution-control devices; and
- construction of a fish ladder (in dams, weirs)

4. Compensatory Measures

This form of mitigation measure tries to replace any valued feature lost.

Compensatory measures are actions that address adverse impacts which are unavoidable. Possible compensatory measures include:

- restoration of damaged resources elsewhere;
- creation of similar resources or habitats elsewhere to replace a loss; and
- compensation to the affected persons.

5. Preventive Measures

Preventive measures reduce or eliminate potential adverse impacts before occurrence

Some potential adverse impacts may be reduced or eliminated before occurrence by introducing preventive measures. Examples of preventive measures include:

- implementation of a health education programme; and
- initiation of a public awareness programme.

6. Implementation of Mitigation Measures

The cost of mitigation measures should be included in the main budget of project construction and operation phases.

Implementation of mitigation measures requires funding, which should be estimated and included in the EIA report. All the proposed mitigation measures should be integrated in the project design, so that these measures may automatically form a part of the construction and operational phases of the project.

7. Mitigation in the EIA Process

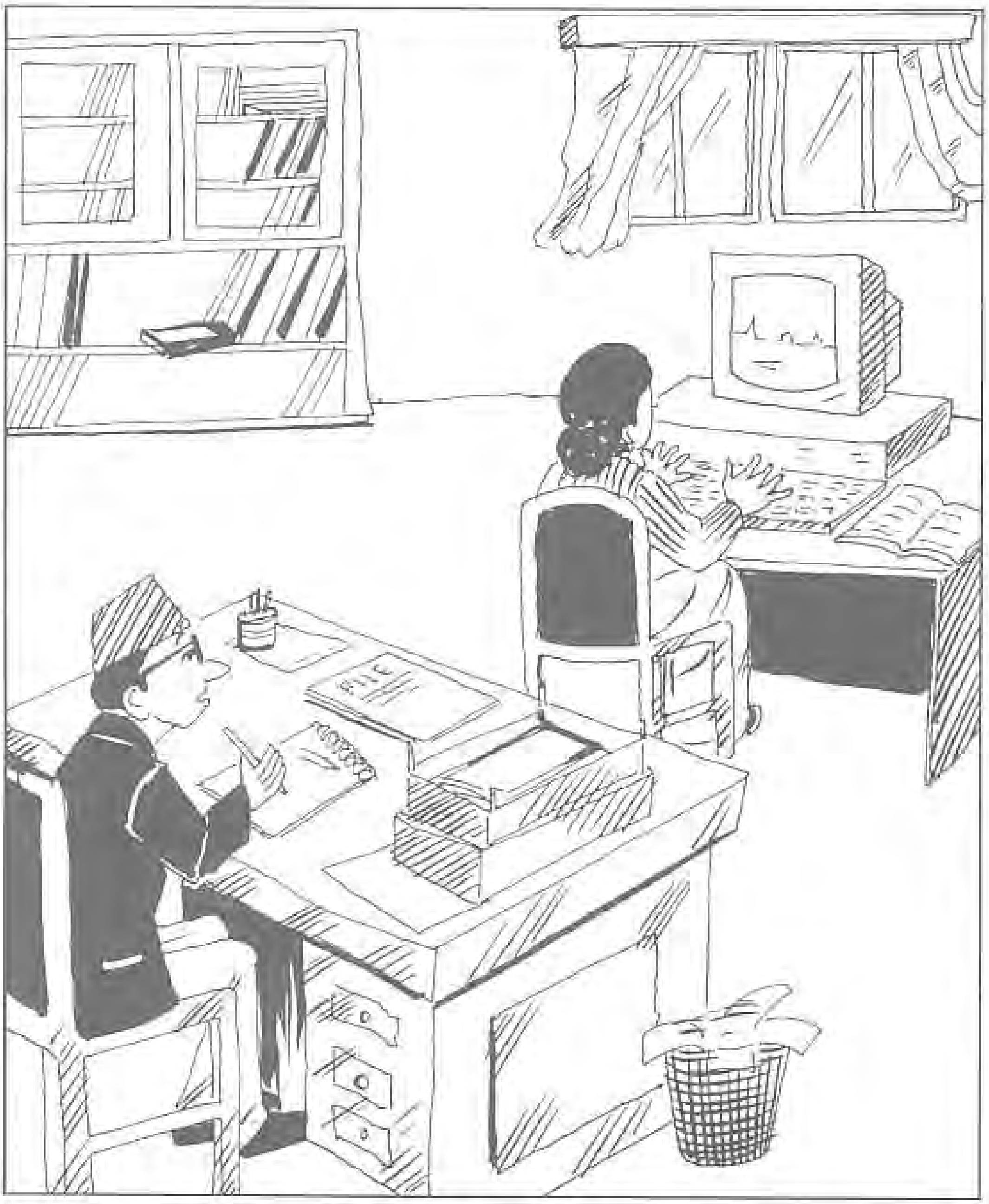
The designing of mitigation measures is not only confined to one stage—the development of mitigation measures may start from the project inception.

Mitigation is not limited to one point in the process of assessment; however, it follows logically from the prediction and assessment of the relative significance of impacts. The original proposal for project design may be changed in light of mitigation changes occurred as per result of consultation with local people or local authorities. The consideration of alternatives, scoping, baseline study and impact identification may suggest further mitigation measures. At any time, during project implementation, new types of impacts can be identified and appropriate mitigation measures taken for addressing them a proposed. Thus, the development of mitigation measures for impacts identified, is not limited to the project design or feasibility stages, but it may start from the very beginning of the project inception period.

Appropriate mitigation measures should be developed for the impacts made on different resources. However, for each of these measures, a specific monitoring system should also be designed.

Usually, mitigation measures are designed and presented for each of the adverse, significant impacts identified. For example, if certain activities in the project may pollute the air quality, particular measures for mitigating such impacts should be designed. If road construction activities result in the disturbance of hill slopes, this might lead to soil erosion and landslides, affecting the road itself. In such situations, appropriate slope stabilisation measures should be identified and implemented. A summary matrix in Chapter 8 describes the details of such mitigation measures designed for each of the impacts identified (Box 25). Mitigation measures are of no value unless they are implemented. Hence, there is a clear link between mitigation and monitoring of the outcomes. Mitigation measures, therefore, should be devised with monitoring in mind; they must be clear enough to allow checking of the effectiveness. The use of particular measures may also be decided on the basis of previous experiences of relative effectiveness of the previous monitoring activities in other relevant and comparable cases.

10
Drafting EIA Reports



Summary

- Introduction
- EIA Report Format (Main Body)
- EIA Report Annexes
- EIA Report References

1. Introduction

EIA reports should be understandable by the project proponent, decision makers and interested groups

The EIA report should be concise and limited to addressing significant environmental issues. The details and the sophistication of analysis should be commensurate with the potential impact. The report should be prepared with the responsibilities of the main target, i.e., the users, such as project proponents, the public, and decision makers, in mind. The preparation of the EIA report is the formal responsibility of the project proponent.

2. EIA Report Format (Main Body)

EIA reports should contain:

The EIA study report should include the following sections:

(a) Executive Summary

A non-technical and precise executive summary

The report should include a precise and non-technical description of the significant results and recommended actions, summarised in 10–15 pages or less.

(b) Project Description (including alternatives)

Activities of the project at different phases of project cycle

This section should outline the activities of the proposed project and reasonable alternatives. The main differences between the alternatives should be highlighted.

(c) Baseline Information

Baseline information on bio-physical, socio-economic and cultural aspects of the project area

Depending upon the nature of the project, the EIA report should also present baseline information pertaining to the current status and existing trends of the geophysical, biological and socio-economic situation of the area under study, including any change anticipated prior to project implementation. Data gaps and limitations should also be mentioned.

(d) Identification of Environmental Impacts

Identification of adverse and beneficial impacts

The EIA report should also describe likely significant impacts, adverse as well as beneficial, envisaged as a consequence of the proposed project activities at different stages of the project cycle. Impacts should be predicted and quantified, as far as possible, in terms of spatial and temporal contexts, reversibility, probability, and whether they are adverse or beneficial.

(e) Alternative Analysis

Selection of least-damaging options

Alternatives should be compared systematically in terms of their environmental impacts; capital and recurring costs; suitability to local conditions; and institutional training and monitoring requirements. To the extent possible, the environmental costs and the benefits should be quantified and economic values attached to each of the alternatives.

(f) Mitigation Measures

Cost effective and feasible mitigation measures

The EIA report should propose pragmatic mitigation measures to all the activities that are likely to have a significant adverse impact on the environment. As mitigation or abatement measures cannot be expected to eliminate adverse impacts totally, it is recommended that compensatory measures be proposed as well. It is essential that the cost effectiveness of mitigation measures be analysed against the viable alternatives.

(g) Review of Policy and Legal Framework

Existing policy, legal framework and guidelines and recommendations for any amendment should be carried out

Based on the nature and magnitude of the project, a review should be undertaken on the policy, legislative and control framework relating to the project, with an examination of weaknesses and strengths. The report should suggest necessary amendments to such policies, legislation and the means to strengthen capacity if these are likely to hinder effective management of the project in terms of its interactions with the environment (compliance and enforcement).

(h) Monitoring

Specific and effective monitoring programme with appropriate monitoring indicators

The EIA report should clearly specify the nature of monitoring required, stipulating who should undertake this activity, how much it would cost and what other inputs are necessary. Time schedules should be specified for monitoring.

(i) Auditing

The EIA report should, if considered appropriate, include an audit design and its justification.

3. EIA Report Annexes

All relevant documents should be appended in the main report

The EIA document should be accompanied by a series of annexes relevant to the project operation and project area in question. All technical information and description of approaches and methods used to provide conclusions in the EIA report should be included in annexes if their inclusion would substantially lengthen the text or make the text difficult to comprehend by non-experts.

The following details should also be provided in the annexes:

- study team personnel and organisations involved in EIA preparation;
- individuals and organisations contacted during the study, including their postal, telephone fax and e-mail address;
- references listing the written materials used in study preparation;
- records of inter-agency interaction/forums/meetings, including lists of invitees and actual participants, with a brief summary of the discussions and observations; and
- a glossary.

4. EIA Report References

All the references cited in the text should be given in an alphabetically arranged reference list

EIA draft reports should list references cited in the text of the main report. Cited works should be arranged alphabetically by surname of author or senior author (in the case of joint authorship), and in chronological order for each author. Publication information should be listed in the following order:

- Author(s);
- Date of publication;
- Title of cited reference;
- Name of publication or journal;
- Volume, numbers of series, issues, if any; and
- Page number(s).

Examples:

- Nepal Electricity Authority, 1990. Socio-Economic and Environmental Impact of Arun III Hydro-project; Joint Venture, a mimeographed report, pp. 1-250.
- Ross, W.A., 1987. Evaluation of Environmental Impact Statements, Journal of Environmental Management, 25:137–147.
- Tomlinson, P. and Bisset, R., 1983. Environmental Impact Assessment, Monitoring and Post Developing Audits: in PADC (eds.), Environmental Impact Assessment, Martinus Nijhoff, The Hague, pp. 4057–4425.

11

Review Criteria for EIA Reports

Summary

- Introduction
- Review Guidance
- Presentation of Contents

1. Introduction

EIA reports may be biased in favour of proponents. In some cases, EIA is implemented as a cosmetic feature or as a means to gain a project approval. This usually happens in countries where the EIA system is still in its formative stage

Environmental agencies, NGOs and the public warn that EIA reports may be biased in favour of the proponents, and there is a concern for the honesty and objectivity of the proponent or those who are involved in preparing an EIA report. The authorising agencies are the only institutions that decide whether or not the project in question should be approved. The EIA report is the only input for such decisions.

It is crucial, to maintain public confidence, that EIA reports are subject to a thorough critical review before they are used in approval decision-making. This review should, at the very least, include the following:

- the public and NGOs (if scoping has been undertaken, a copy of the EIA report should be sent to each participant as well as copies being available in the local area and in Kathmandu);
- an environmental agency; and
- interested and affected national and local government entities

It is useful if a draft EIA report is reviewed. Any required amendments can be incorporated into the final EIA report (which should follow the same review process).

By reading an EIA report critically, the reviewers form an opinion pertaining as to whether or not the report should be accepted or whether it requires one or both of the following:

a) More information; or
b) Further clarification.

Reviewers consist of a panel of experts who review the documents in terms of:

(a) adequacy of addressing all significant environmental issues determined by scoping, and

(b) comparison of the content of EIA report against the points given in TOR

There exist no specific and universally-used criteria, and they vary from country to country. In most cases, a series of questions in the form of checklists are usually answered by the reviewers. The basic starting point for any review is to compare the EIA reports with the TOR produced to guide and direct the EA work. Precise and comprehensive TOR assist the process of review by providing a very useful "baseline" against which to compare the content of an EIA report. This is especially useful when the reviewers may not be very familiar with good EA practice and the characteristics of a useful and relevant EIA report.

2. Review Guidance

(i) Executive Summary

An executive summary of a report should be non-technical and should contain only 10–15 pages covering all important aspects of the EIA study findings

All EIA reports should have a summary of the findings and results of the EIA. In many cases, the summary is the only part of an EIA report that senior decision makers may read. Therefore, it is important that this summary is of high technical and presentational standards and is short (perhaps no more than 10–15 pages).

Such summaries should be checked to ensure that they include, at the minimum, a discussion of:

- **Significant impacts.** Both adverse and beneficial impacts.
- **Mitigation measures.** Measures to prevent, reduce or minimise adverse impacts and enhance beneficial impacts.
- **Residual Impacts.** Impacts which cannot be avoided.
- **Impact distribution.** Identification of human settlements (urban/rural) and sensitive areas which may be significantly affected by the project implementation, particularly those components which may suffer and receive no benefit.
- **Selection of preferred alternatives.** A clear description of why preferred alternatives are better than others.

(ii) Main Body of Report

A well-formatted EIA report should contain the following sections:

- a description of legal and policy context;
- a brief description of baseline environmental conditions;
- a section on impact identification, prediction and evaluation, including a comparison of alternatives;
- a section on mitigation, monitoring and auditing strategies; and
- technical appendices.

(iii) Baseline Description

Baseline description should be covered within approx. one-tenth of the total pages and should contain the existing patterns and trends of resources likely to be impacted

This section should not be a long description of such parameters as habitats, species and pollution levels. It should be short (for example, not more than 10% of the total pages of the main text), and should provide the following:

- a synthesis of baseline data to provide an overview of the quality of the existing environment in the vicinity of the project and major trends;
- assurance that this overview has taken account of the cumulative impacts of projects in process of implementation and/or about to be implemented before being subjected to EIA; and
- a list of sensitive areas or species.

This part of a report should contain:

• identification of impacts;

• prediction of impacts identified; and

• selection of most significant impacts and alternative evaluations

(iv) Impact Assessment/Prediction

This section is the "heart" of an EIA report and needs careful attention. Review should focus on the following factors:

- the extent of the impacts that have been quantified;
- description of time/space of boundaries of the EIA study;
- impact characteristics (adverse/beneficial, reversibility, etc.);
- provision of criteria by which impacts have been described as significant;
- consideration of cumulative impacts on specific locations; and
- probability estimates, (e.g., are the predictions based on the "most probable outcome" or "worst case analysis"?); and
- any data gaps should be identified and assumptions justified.

At this stage, it is essential to review the types of mitigation measures prescribed; whether they are feasible and cost-effective; whether there is a need for a specialist to examine the validity of mitigation measures, schedules for implementation, assessment, institution responsible, and costs.

(v) Mitigation/Monitoring Strategies and Plan

Mitigation strategies need careful attention in EIA review. Depending on the impact to be mitigated and the type of mitigation suggested, it may be necessary for the EIA reviewers in a government agency to "appoint" a specialist either from the outside or from the "in-house" to review suggested mitigation measures. It is important to ensure that mitigation measures are practical and have a good chance of working. For example, revegetation of soil is a specialist subject and any such investigation should be assessed by someone with the specific relevant knowledge. In addition, attention should be paid to the discussion in the EIA report on:

- schedule for implementation;
- assessment of effectiveness;
- institutional framework for implementation; and
- costs.

The chapter on selection of alternatives should focus on salient features of alternatives, methods for comparing them, their differences, and why certain alternatives are preferred.

(vi) Selection of Alternatives

In the process of choosing alternatives or selecting least-damaging options, this section of an EIA report should include:

- a description of major characteristics of each option;
- a precise description of the basis of comparison;
- important differences between the alternatives; and
- the reasons for selecting the preferred alternative.

(vii) Technical Appendices

The appendices should contain information suited to the needs of readers and users of the EIA report

The section on technical appendices should contain all information which is often required as back-up material for reviewers, decision makers and interested public. This information includes:

- results of baseline studies and surveys;
- predictive techniques/models used;
- data sheets used in field surveys;
- results of analysis of quantitative data; and
- maps, photographs and other supporting documents, which are not used in the main text.

3. Presentation of Contents

Three things deserve attention while preparing an EIA report:

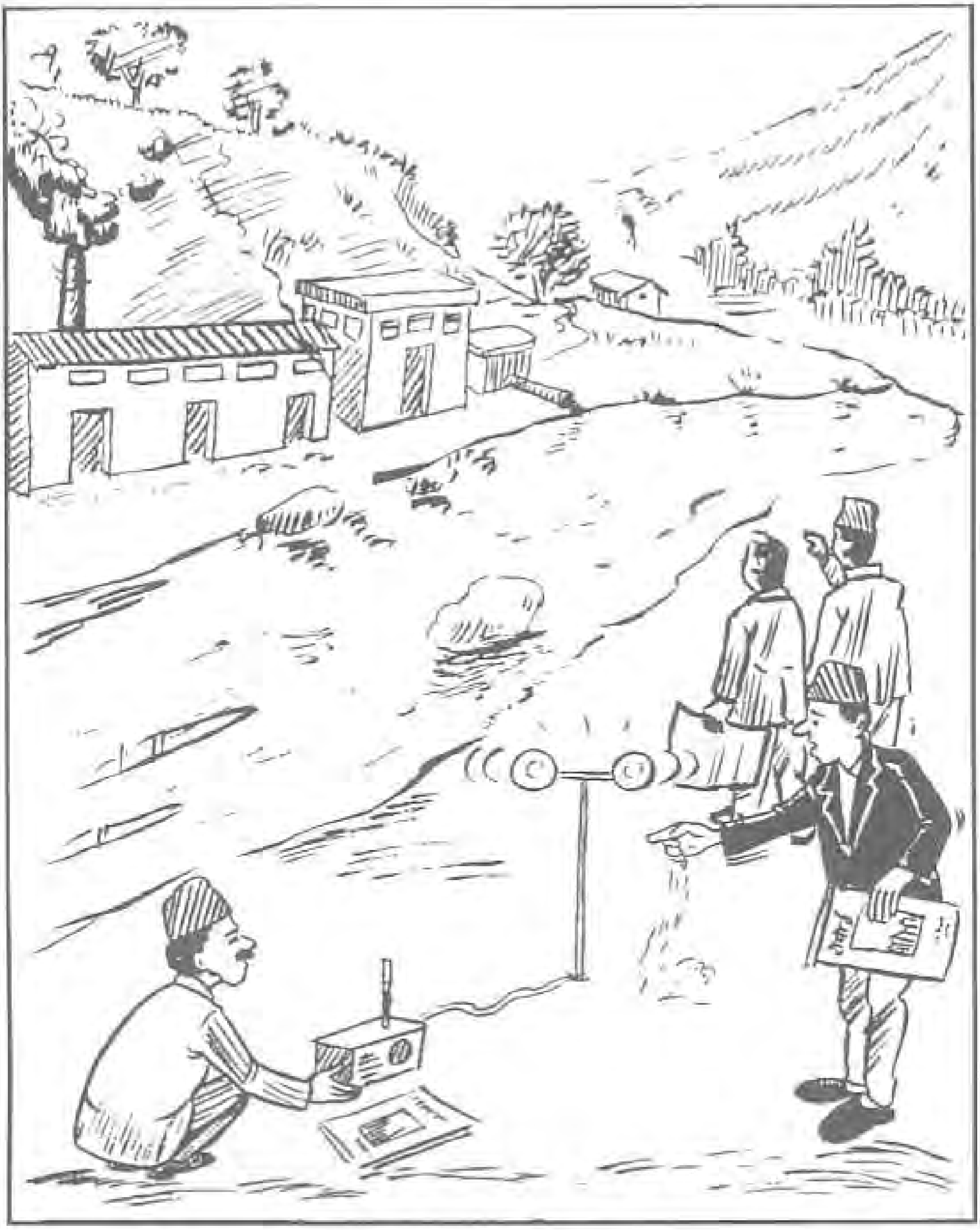
• technical jargon should be avoided;

• use of graphical presentation of data; and

• complete references provided

The way data are presented in an EIA report is almost as important as the nature/type of data being included. Careful use of clear visual aids (photographs, maps, charts, tables, graphs, etc.) can convey a considerable amount of information in an easily understood format. It also saves a lot of words and therefore contributes to shorter, more precise EIA reports. EIA reports should contain a minimum of technical terms and jargon, and if some technical terms must be used, then a glossary must be provided. Similarly, if other published or unpublished documents are used in the EIA and their contents/conclusions are referred to in the EIA report text, then full references should be provided so that the documents can be easily accessed, if necessary.

12
Monitoring



Summary

- Introduction
- Principles of Monitoring
- Types of Monitoring
- Level or Intensity of Monitoring
- Institutional Requirements

1. Introduction

Monitoring is designed primarily to:

• check implementation of mitigation measures;

• act as an early warning system; and

• be a continuous measurement process

A serious shortcoming of the most environmental impact assessments is the absence of baseline data and the impact monitoring during the construction, operation and completion phases of large development projects. Without such data and programmes, it is impossible to test impact predictions and the success of mitigative measures. Furthermore, the lack of appropriate ecological monitoring impedes scientific progress in impact prediction and assessment and makes it difficult to learn from experience.

Environmental monitoring is one of the most important components of an EIA. It is essential for:

- checking the implementation of mitigation measures in the manner described in the EIA report;
- providing early warning of potential environmental damage; and
- input to EIA audits.

2. Principles of Monitoring

What is needed for monitoring:

• indicators;
• information;
• criteria for selecting indicators;
• analysis data;
• setting of objectives;
• decision-making; and
• improved mitigation

Certain principles of EIA impact monitoring should not be overlooked. If the EIA monitoring process is to generate meaningful information to achieve these objectives, it must establish the following:

- indicators to be used in monitoring activities;
- objective judgements on the meaning of the monitoring data based on criteria for indicators; and
- tangible conclusions based on the processing of information and objective judgements.

3. Types of Monitoring

Various types of monitoring activities are currently in practice; each is relevant to an EIA study. The main activities are briefly described below.

Pre-project baseline data allows comparison over time with project data

Baseline Monitoring. A survey should be conducted of basic environmental parameters in the area surrounding the proposed project before construction begins, so that subsequent monitoring can assess changes in those parameters over time against the baseline. If possible, reference sites, which are not likely to be affected by the project, should also be used.

Baseline data and post-project data are completed to examine effectiveness of mitigation measures

Impact Monitoring. Environmental parameters within the project area expected to change, must be measured during the project construction and operational phases, in order to detect impacts, which may have occurred as a result of project implementation. Monitoring should be regularly performed for a period of time determined in advance. The need for continued monitoring should be reviewed periodically. Interruptions in monitoring may result in insufficient data to draw accurate conclusions, concerning project impacts.

A periodic sampling of certain parameters ensures project compliance with environmental protection standards

Compliance Monitoring. This form of monitoring employs a periodic sampling method, or continuous recording of specific environmental quality indicators or pollutants, to ensure project compliance with recommended environmental protection standards.

The main aim of EIA monitoring is to provide the information required to ensure that project implementation has the least possible negative environmental impact on the area's people and environment.

4. Level or Intensity of Monitoring

Not all the impacts identified can be monitored; some critical parameters should be selected for monitoring

Impact monitoring is an important component of the EIA process. It must be given proper emphasis within the project cycle if it is to function as intended.

It is not possible to monitor all the aspects covered by the impact identification process. A selection, or "scoping out", should therefore be made of the most important and critical parameters that could influence the project and its surrounding environment. The level or intensity is to be determined on the basis of the potential severity or degree of uncertainty, associated with the environmental impact being monitored.

5. Institutional Requirements

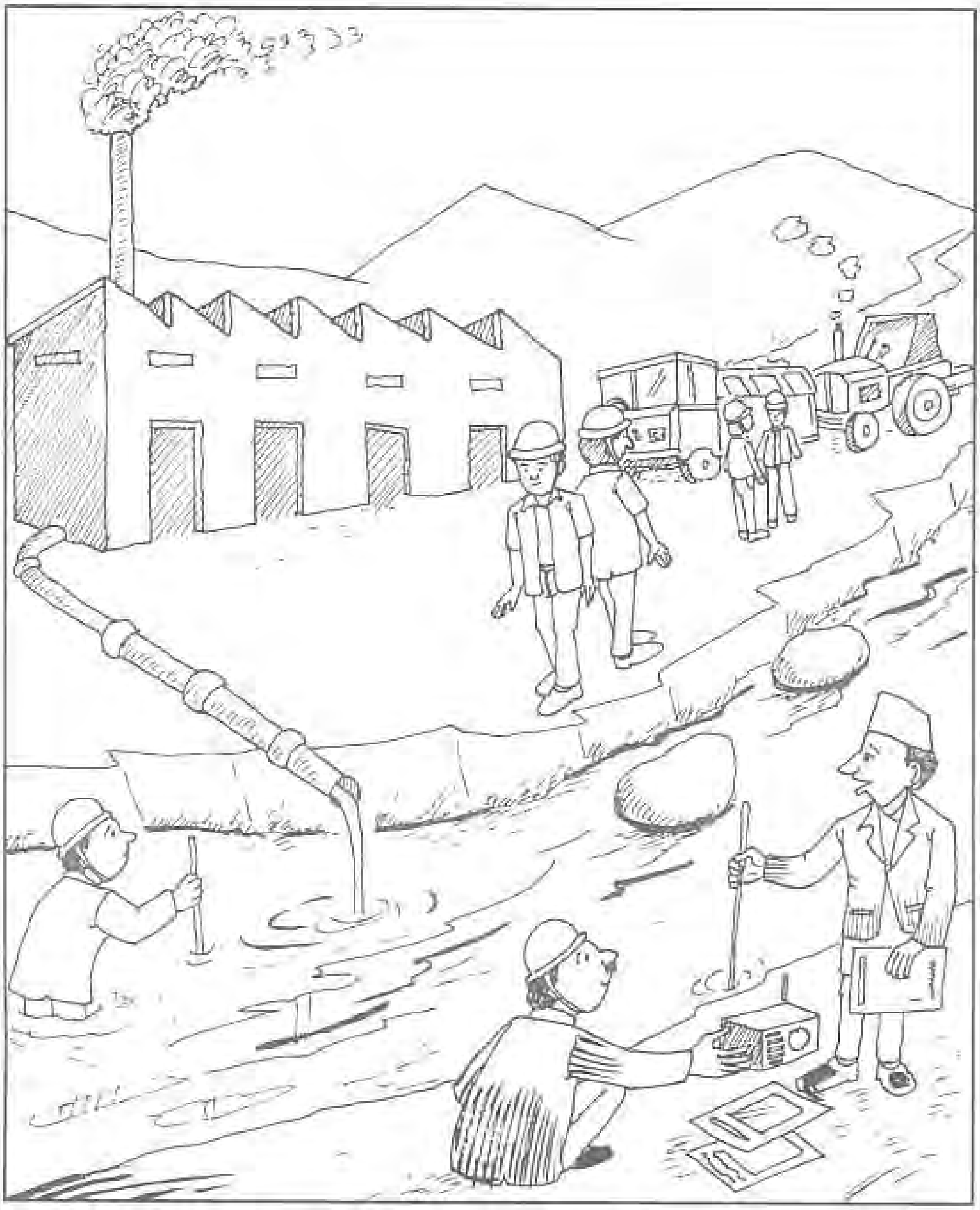
Proper institutions with trained manpower for monitoring must be established within the system

Institutional factors determining the effectiveness of monitoring should not be underestimated. There needs to be a firm institutional commitment to the monitoring process by the agencies responsible, particularly in regard to the following:

- willingness on the part of the institutions and organisational personnel involved to support the monitoring process with the necessary level of resources and authority;
- continuity in the monitoring programme should be maintained;
- technical capabilities of the personnel involved must be developed;

- integrity or honesty of the process must be maintained;
- decisions must be taken based on a thorough review of results;
- monitoring information must be made available to all agencies concerned; and
- effective action should be taken on the basis of decisions to deal with any problems by changing project operational practices or possible installation of mitigation measures.

13
Compliance and Enforcement



Summary

- Introduction
- Post-Authorisation Phase
- Monitoring and EIA Auditing
- Institutional Framework

1. Introduction

An effective EIA is successful that causes minimal environmental damage

The effectiveness of an EIA is dependent not only on its influence on project design and decision-making, but also in terms of its influence of how the project is implemented and the way, in which its interactions with the environment are managed. In many ways, a successful EIA equals a successful project that achieves its objectives with minimal environmental damage and therefore causes little or no public concern and minimal demand on the resources of regulatory authorities.

The importance of a regulatory system

Of course, it is necessary to have a regulatory system within which projects will be implemented. It is not feasible to rely only on the self-regulatory abilities of project proponents and operators. Such a regulatory system requires an institutional structure with a set of formal procedures to enable compliance and enforcement, compliance meaning being in conformity with the law.

Conformity can be achieved in a number of ways, including promotion of new technology, economic incentives, persuasion, consultation, information provision and enforcement. Enforcement includes:

- inspections and monitoring to verify compliance;
- investigation of violations;
- measures to compel compliance without legal action; and
- measures to compel compliance through legal action.

2. Post-Authorisation Phase

Once a project is implemented, compliance and enforcement will focus on any written requirements regarding mitigation measures, discharge limits and monitoring activities to be undertaken. These may be included in any authorisation document (licence, permit, etc.), and also often in contract documents which govern the way the project is constructed.

Once an authorisation has been issued, there is often a "change over" in terms of the key participants or actors in the development process. The EIA consultants may no longer be involved, and contracting and/or consulting engineers are likely to be in charge of supervising construction. In some cases, the proponent and the operator may use different staff during project design and project construction and operation stages. At the government level, the role of the sectoral ministry may become more influential and that of the environmental ministry or department decline. Basically, there may be a break in staff continuity, which needs to be bridged effectively to ensure that the commitment to implementing the EIA results is continued after authorisation.

There are two main "pillars" upon which compliance and enforcement can be based . These are:

- monitoring and EIA audit system; and
- institutional framework (organisations and procedures)

Both are equally important. One of these without the other is of little use.

3. Monitoring and EIA Auditing

Issues related to monitoring and EIA have been discussed in Chapter 12. There is one additional type of monitoring which is needed for compliance and enforcement. This form of monitoring (often described as compliance monitoring) employs either periodic or continuous sampling of emissions or discharges (for example, aqueous effluent from a pulp and paper mill which is being discharged into a river) to ensure that the concentration or amounts agreed on are not being exceeded.

Monitoring of mitigation effectiveness and impact monitoring provide raw data which can be used to undertake an EIA audit. Such audits can be effective tools by providing control authorities with an overall picture of the main impacts of a project and identifying issues of concern, where actual impacts have exceeded expectations.

An audit is a one-time measurement process for assessing:
• environmental impact;
• accuracy of prediction;
• effectiveness of mitigation; and
• functioning of monitoring

The term "audit" is usually associated with finance and accounting, however, auditing refers to the examination and assessment of a certain type of performance. In the case of an EIA, an audit assesses actual environmental impacts, the accuracy of predictions, the effectiveness of environmental impact mitigation and enhancement measures, and the functioning of monitoring mechanisms. The audit should be undertaken after the project has been operational for some time, and it is usually performed only once.

Audits should be carried out only for those parameters which are most significant

Audits are not required in all cases. However, at the project approval stage, both project proponent and authorising agency should consider whether the application of an EIA audit is likely to result in new information or an improvement in management practices. Particular attention should be given to the projected cost effectiveness of any proposed audit and to the technical difficulties likely to be encountered.

Auditing is carried out only one time after project implementation, and authorising

The audit should be carried out by the agency which approves the project, with assistance from other relevant organisations, if required. The auditing could be scheduled immediately after project completion, or after three or four years of operation.

agencies or the proponent are responsible for the audit's implementation

Audit results should be disseminated widely, but be sent especially to the project proponents and relevant agencies. A central location or depository should be established for audit reports, allowing all the workers in the field of EIA to read the results, thus enabling lessons learnt to be transmitted to EIA specialists who will be involved in future EIAs. The audit is a crucial stage of project implementation that may show a need to alter the implementation of a project to prevent or reduce unwanted consequences.

4. Institutional Framework

Project EIAs can be a starting point for building institutional capacity for compliance and enforcement

There is no point in monitoring discharges, effects of mitigation measures, impacts and undertaking EIA audits if there is no institutional framework which can manage these activities, interpret the results, and be able to take effective corrective action through consultation and persuasion or enforcement actions. Projects subject to EIA, which may be externally financed can be used as a vehicle to build and expand institutional capacity for compliance and enforcement. Such EIAs will identify institutional weaknesses and put forward strategies for dealing with them. Often-needed institutional strengthening can be achieved through the financial assistance made available for project implementation.

Involvement of the community is important

Whatever the existing capacity of the institutions, it is helpful to establish a forum, whereby liaison between the local community, the project operator, and the relevant control agencies can occur to discuss issues and problems, and agree on a "solution". The aim is not to "sell" the project, but rather to involve them actively in impact management. Such community liaison arrangements might be needed only for very controversial projects, or if the institutional capacity is very weak or non-existent. The need should be assessed on a case-by-case basis.

14

Public Involvement

Summary

- Introduction
- Need for Stakeholder Involvement
- Approach to Stakeholder Involvement
- Stages of Stakeholder Involvement
- Cost

1. Introduction

Public involvement is the heart of the EIA process

The involvement of the public is a vital component in both the successful EIA systems and specific EIA studies. Different terms have been used to describe this aspect of EIA, for example, consultation and participation.

Who is the public ? Generally, this phrase refers to the following:

- local people (individuals) and communities (for example, villagers) are likely to be affected by a project;
- project beneficiaries (may not be local);
- NGOs active in the local area or with an interest in natural resources/social welfare; and
- the interested "public" in the country of any external financing agency(ies).

In all cases, national and local government agencies, with responsibilities of management for natural resources and the welfare of people, likely to be affected, are also involved in EIAs.

People involved in the EIA process are called stakeholders

These individuals, groups or organisations representing the various interest groups, should be involved in EIA. Often, EIAs provide opportunities to others being involved, for example, the research scientists, who may be the experts on aspects of the concerning locality. In total, they are often referred to as "stakeholders", and this term will be used in this chapter.

Three types of involvement

• Information dissemination

• Consultation

• Participation

There are basically three main types of involvement in EIA. First, there is an information dissemination, wherein the proponent provides information on a proposal to the stakeholders only once , or at regular intervals. The flow of information is 'one-way' and there is no provision to be taken into consideration for responses.

Secondly, there are consultations, with information exchange involved between the proponent and stakeholders in a two-way process. Also, during consultations, there are opportunities for the stakeholders to express their views on issues related to the proposal. The proponent and/or authorising agency is not bound, however, to take account of such views in decision-making, although they may do so if they consider it to be appropriate. Although often not required formally, consultations can include mechanisms for feedback, between a proponent/agency and the stakeholders so that the latter may know the extent, to which their views have been taken into account in decision-making.

Finally, there is a participation. As the term indicates, this requires shared involvements and responsibilities. Basically, it implies an element of joint analyses and control over decisions and their

In participatory decision-making, there is no single source of ultimate control or authority. The participating parties must discuss and reach a decision by means of an agreed process, for example, by mediation and consensus-building.

Consultation is simply involvement whereas participation is the process of gaining power

Globally the role of stakeholders in EIA is expanding. There is a definite move from consultation towards participation. Strictly speaking, consultation can mean that stakeholders have no formal influence on decisions, whereas participation means shared control and, therefore, power. There is a "middle ground" between these two positions, which can be explored in individual EIAs. This middle ground provides a context in which the views of stakeholders can be influential at key points in the EIA process. In this chapter, the term "involvement" will be used to describe all processes whereby stakeholders are linked to EIAs.

2. Need for Stakeholder Involvement

Importance of stakeholders' involvement, has been proved through experience

Why is stakeholders involvement through consultation and participation considered to be an essential part of EIA ? Experience has shown that the following benefits will occur:

- improved understandings among the potential impacts of the proposed projects;
- identification of alternative sites or designs, and mitigation measures;
- clarification of values and trade-offs associated with these different alternatives;
- identification of contentious issues (and a possible forum to resolve them);
- establishment of transparent procedures for implementing proposed projects; and
- creation of accountability and a sense of local ownership during project implementation.

Difficulties in planning appropriate stakeholders involvement

The difficulties and constraints, which characterise involvement are well known:

- identification of all interested and affected parties;
- linguistic and cultural diversities making mutually intelligible and communications problematic;
- illiteracy;
- lack of local knowledge and comprehension regarding the scale and nature of certain types of development projects;
- unequal access to consultation (for example, women);
- time/cost implications in dealing with these difficulties; and
- means of dealing with these problems must be found.

3. Approaches to Stakeholder Involvement

Plan for involving stakeholders is essential

It is very important that a plan for stakeholder involvement is prepared **before** EIA work begins. It is essential to have such a plan because there is a tendency for EIA practitioners to focus their attention on the technical aspects of the EIA work to the detriment of the process and involvement. This will occur even if an anthropologist or rural sociologist has been included in the team, as often such experts are marginalised in large teams of engineers, planners or environmental scientists.

A stakeholder involvement programme should be an integral part of the TOR

It is preferable if the basic features of a stakeholder involvement programme are an integral component of the TOR. In this way, the EIA can benefit from involvement at specific times, and those involved can be kept informed of the EIA progress and the ways in which their concerns and views have been considered and dealt with in the EIA. If it is not possible to integrate a plan for involvement into the TOR then it is best to prepare a separate document based on the TOR, outlining the programme for involvement. Preparation of this document should be the responsibility of the EIA team leader acting with advice and input from a social scientist/s with knowledge of local cultures and techniques of stakeholder involvement. By this means the likelihood of cost-effective involvement is increased substantially.

To prepare a plan will require consideration of the following aspects:

- objectives of the EIA;
- identification of the stakeholders and, if any of them are transhuman or pastoral, mapping of their routes in time/space;
- budgetary/time constraints and opportunities;
- identification of appropriate techniques to involve stakeholders;
- traditional authority structures and decision-making processes;
- identification of approaches to ensure 'feedback' to stakeholders;
- identification of mechanisms to ensure consideration of stakeholders' views/opinions/suggestions by the study team; and
- need to guide involvement to focus on issues.

Different methods of involving the stakeholder

It is very important to formulate a strategy to maintain a continuing interest on the part of stakeholders, particularly with regard to lengthy EIAs. Local people may rapidly lose interest, if they feel that there are few visible benefits for their communities from their involvement in the EIA.

There are numerous techniques which can be used to involve stakeholders, especially the public, in EIA:

- **Public Meetings.** These are "open" with no restriction as to who may attend.
- **Advisory Panels.** A group of individuals chosen to represent stakeholder groups, which meets periodically to assess work done/results obtained and to advise on future works.
- **Open Houses.** A manned facility, in a locally accessible location, which contains an information display on the project and the study. Members of the public can go in to obtain information and make their concerns/views known.
- **Interviews.** A structured series of open-ended interviews with selected community representatives to obtain information/ concerns/ views.
- **Questionnaires.** A written, structured series of questions issued to a sample of local people to identify concerns/views/ opinions. No interviewing may be involved.
- **Participatory Appraisal Techniques.** A systematic approach to appraisal based on group inquiry and analysis and, therefore, multiple and varied inputs. It may be assisted, but not controlled or directed, by external specialists.

Five basic principles for public involvement

There are a number of basic principles to be followed with undertaking stakeholder involvement:

- Sufficient relevant information must be provided in a form which is easily understood by non-experts.
- Sufficient time must be allowed to individuals to read, discuss and consider the information and its implications.
- Sufficient time must be allowed to enable views and opinions to be presented.
- Provision of a response to issues/problems raised or comments made by individuals. This feedback is very important if public confidence in the involvement process and the EIA system is to be maintained.
- Selection and timing of venues or contexts, which encourage maximum attendance and free exchange of views (including those who may feel less confident about expressing their views, such as women and old people).

Group or individuals to be involved

The main challenge is to identify and involve individuals and groups likely to be affected, but whose interests are not necessarily reflected by local/national government organisations or NGOs. It is essential to identify representatives for such affected individuals and groups and to obtain their inputs. Examples of such representatives are as follows:

- **Traditional authorities.** Such as village headmen, tribal elders and religious leaders.

- **Voluntary organisations.** Such as local community development or users' groups, kinship societies, recreational groups, neighbourhood associations labour unions, gender groups, ethnic organisations, and co-operatives.
- **Private sector representatives.** Such as private business interest groups, trade associations or professional societies.

In many situations, it is very important to obtain the views of women because of their various social and economic roles. Special efforts need to be made to identify the best means of obtaining their views.

It is relatively easy to identify those stakeholders that have a formal responsibility for the management of natural resources and human welfare. Of particular relevance will be ministries, departments or agencies concerned with:

- land use planning or management;
- natural resources (water, minerals);
- cultural heritage;
- health;
- social infrastructure (for example, education);
- transport;
- agriculture/forestry; and
- wildlife.

Identification of concerned NGOs

Similarly, it is relatively simple to identify concerned NGOs. Those active in the local community and/or economic development may have a local presence or office. In many cases it may be necessary to contact a national office, likely to be located in the capital city. Sometimes it is necessary to determine who has "standing" *vis a vis* an EIA. For example, an international environmental NGO may have a national presence, but may not be working in the particular study area in question. The question then arises whether or not it should be involved. There is no simple or correct answer, as it will depend on specific local/national circumstances. International NGOs should never be used as a substitute for a local entity. Box 27 summarises the main stakeholders.

There is no single 'correct' approach to stakeholder involvement. The choice of techniques and the 'mix' employed will depend very much on the circumstances of each EIA. It is imperative that the advice of an anthropologist/rural sociologist (with local knowledge if possible) is used and a plan is prepared. Furthermore, it is very helpful if widespread publicity regarding the EIA and the programme for stakeholder involvement can be generated through the media, especially through radio and newspapers.

Stages of involvement

Once the plan for involvement has been prepared, the EIA work can begin. Current EIA practice shows two main stages at which involvement occurs: scoping/preparation of TOR and the release of the draft/final EIA report. However, depending on circumstances and opportunities, it is possible to be more innovative and extend involvement to additional EIA phases. The possibilities and benefits are outlined briefly, below. The context of specific EIAs will determine the scale, timing and nature of involvement, but it is useful to consider the implications of all options before selecting a preferred involvement strategy which suits a particular EIA.

4. Stages of Stakeholder Involvement

Four stages of stakeholder involvement

The stages at which involvement may occur, are during:

- scoping to prepare the TOR for an EIA;
- project appraisal (while conducting the EIA/feasibility studies) either at release of the preliminary/interim EIA report and/or the draft/final EIA report;
- project implementation (application of EIA recommendations); and
- project evaluation (extent to which a project has achieved its objectives).

Involvement at these different stages may have a variety of objectives and require appropriate approaches and strategies. Also, the extent to which the involvement becomes participatory, that is, when stakeholders are able to influence or control decision-making, will vary according to the phase or stage of the involvement process.

The different methods of scoping

Scoping can be undertaken in a number of different ways. It may involve a meeting or series of meetings "behind close doors", involving only the proponent and a number of concerned agencies. Alternatively, it may be 'open' with public meetings (i.e., open to all local interested people and groups), or organised by means of a workshop or seminar to which stakeholders are invited.

Of course, the selection of participants is a crucial factor in determining the representativeness of any scoping activity. Scoping exercises involving a workshop or similar meeting require careful preparatory work and planning, covering:

- background information to be provided to the participants;
- organisation of sessions during the workshop/seminar;
- expected outputs; and
- provision of a workshop/seminar organiser.

Box 27: Players in the EIA Game

Participation of these actors is necessary in the consultation process

• Proponents	The polluting pushers
• Donors	The schizophrenic patrons
• Negatively affected parties	The opponents
• Positively affected parties	The supporters
• Decision-making authorities	The directors
• Environmental administration	The guides
• Lawyers and courts	Formal guardians
• NGOs	Informal guardians
• Consultants	The happiest folks in town
• Politicians	Spoilers of the game

(i) Project Appraisal and EIA Report Preparation

Benefits of preparing an early preliminary or interim report

One option for initiating involvement during project appraisal is to prepare an early preliminary or interim report which describes the results obtained to date, and whether any new issues have been identified. This report can be a focus for involvement and shows stakeholders, who may be unfamiliar with EIA, the type of work done and the nature of the output. This can be beneficial as it allows an additional opportunity for informing stakeholders of the aims of the EIA and to increase their understanding of EIA work. If there is no opportunity for such involvement until much later, at the draft/final EIA report stage, then scope for meaningful involvement may be seriously constrained by lack of time and financial resources.

Two main issues to be discussed after the draft/final EIA report is made available

At the stage when a draft/final EIA report is available, there are two main issues to be discussed. First, whether the EIA has been undertaken in accordance with the TOR, and whether it is technically acceptable.

Secondly, and perhaps more importantly, it should be considered whether one of the alternative development options should be implemented. Usually, stakeholders are invited to present their views on both issues and the authorising agency reserves the right to consider such representation, but not necessarily, to base a decision on them. The World Bank now requires participatory involvement at this stage, if a project will involve involuntary resettlement and/or affects indigenous people (these are defined in World Bank policy statements and the operational directives). In these circumstances, the Bank and the in-country executing agency enable the affected individuals and groups to control decision-making on project approval and implementation. It can be useful at this stage, whether or not, involvement has been participatory, if a plan incorporating participation is devised for project implementation and evaluation activities.

(ii) Project Implementation

During construction and operation of a facility, the EIA recommendations on mitigation and monitoring should be implemented and, if necessary, developed further. Increasingly, consultative and participatory processes are established to 'manage' development - environment interactions, for example, by means of liaison committees. Again, participation is seen as increasingly essential to create favourable social conditions to help ensure the eventual success of a project.

(iii) Project Evaluation

Evaluation of the "success" of a project

A related, but distinct exercise is to evaluate the extent to which a project achieves its objectives (economic, social and environmental). It is useful to incorporate the views of stakeholders in such evaluations; obtaining multiple perspectives on 'success' can identify social/organisational sectors which may feel that a project has either not been a success or is, in fact, harming their interests. Such views may, if not addressed, lead to increasing local disaffection or even alienation from the project, thus helping to ensure that it 'fails'. If participatory involvement is undertaken on a regular basis, such feelings can be identified and remedial actions formulated and implemented.

5. Cost

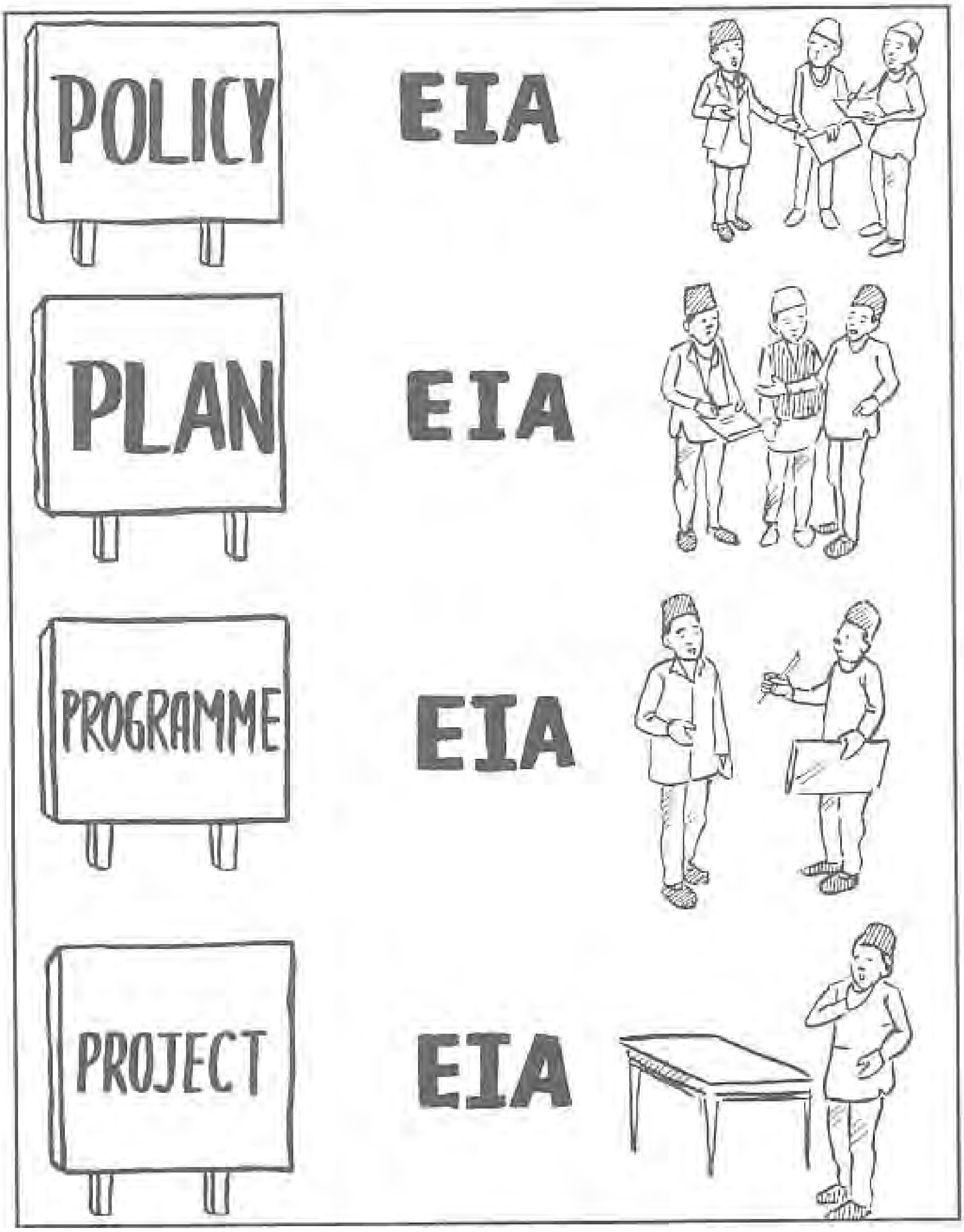
Involvement of time and money

There is no doubt that stakeholder involvement takes time and resources and costs money. For projects in remote localities and multi-cultural contexts, the costs and other difficulties must be tackled and provisions made in EIA planning and budgeting stages. Costs which need to be considered may include the following:

- hiring of social scientists with local knowledge and experience of involvement processes;
- preparation of information sheets and report summaries in local languages;
- media publicity (newspapers, radios);
- travel costs to enable representatives of stakeholders to attend meetings; and
- EIA team time, travel, and accommodation costs to 'service' the involvement process.

However, as indicated at the beginning of this chapter, the short- and longer-term local and national benefits are considered to significantly outweigh the costs.

15
Strategic Environmental Assessment (SEA) and Sustainable Development



Summary

- Introduction
- Use of SEA
  - Sectoral SEA
  - Regional SEA
  - Cumulative EIA
  - Plan SEA
- SEA and Sustainable Development
- Limitations to SEA

1. Introduction

Project-level EIA is reactive and ineffective for many higher level activities

EIA implementation at the project level is constrained by a number of well-documented deficiencies:

i) Project-oriented EIA is self limiting (reactive), not forward-looking (proactive), and is ineffective in tackling the current scale and rates of global ecological deterioration;

ii) There are difficulties in assessing cumulative impacts;

iii) There is a lack of flexibility in considering alternatives and mitigation measures; and

iv) The impact of non-project actions such as fiscal policy, trade and privatisation is not assessed.

SEA is used increasingly in addressing issues, particularly at the higher level of activities where causes of unsustainability are believed to be located

In order to address environmental issues at higher levels of decisions, EIA is being applied under the name of Strategic Environmental Assessment (SEA). This is considered a second-generation EIA process, and it is believed that this process moves beyond the "impact fixation" of project-level EIA. The belief in designing a proactive approach to EIA is rooted in the conviction that the cause of unsustainable development lies in the "upstream" phase of the decision-making cycle. The use of SEA represents a promising means of addressing some of the major environmental issues but it is still a relatively new concept, and its use is restricted mainly to developed countries. However, this approach of EIA is being increasingly used to address the environmental implications resulting from proposed activities which cannot be addressed by project level EIA.

SEA is a tool to evaluate tiered PPPs. The environmental issues considered at higher tiers need not be considered at lower tiers

Therefore, SEA is defined as "the formalised, systematic and comprehensive process of evaluating the environmental impacts of a policy, plan or programme and its alternatives, including the preparation of a written report on the findings of the evaluation, and using the findings in public accountable decision-making." It is, in other words, the EIA of policies, plans and programmes, keeping in mind that the process of evaluating environmental impacts, at a strategic level, is not necessarily exactly the same as that at a project level. Although policies, plans and programmes are generally described as "strategic" in this and other texts, they are not identical, and many of them require different variations of SEA. A policy is generally defined, as an inspiration and guidance for action, a plan as a set of coordinated and timed objectives for the implementation of the policy, and a programme as a set of projects in a particular area. Policies, plans and programmes (PPPs) may be sectoral (e.g., transport, mineral extraction), or spatial (e.g., national, local).

In theory, PPPs are tiered; a policy provides a framework for establishment of plans, plans provide frameworks for programmes, and programmes lead to projects (Box 28). In practice, these tiers are amorphous and fluid, without clear-cut divisions. The EIA for these different PPP tiers can itself be tiered, so that issues considered at the higher tiers need not be reconsidered at the lower tiers.

2. The Use of SEA

Strategic EA is being used to analyse the effects of several issues

Several important activities, including project and non-project development actions which cannot be covered easily by project-specific EIA, are now being subjected to SEA. They include the following.

(i) Sectoral SEA

Sectoral SEA facilitates the selection of project alternatives

Sectoral SEA, perhaps the most common form of SEA, is the process of examining potential environmental and social implications of all or most of the potential projects proposed for the same sector. Sectoral SEA can influence project selection much easier than project-level EIA. Sectoral SEA provides an environmental ranking of all proposed projects in one sector before pre-feasibility and helps decide in project selection (e.g., gas vs. coal vs. hydro vs. nuclear energy in the power sector, or road vs. rail vs. air in the transport sector).

SEA applied at the planning stage helps develop sound strategies for selecting appropriate alternatives, identifies data gaps and makes consideration of EIA at the project level cheaper, quicker and more robust

Sectoral SEA begins with a certain development objective and then evaluates the number of possibilities for achieving the objective. For example, instead of implementing a nuclear power plant designed to generate 2,000 MW at a certain location, if a sectoral SEA is applied, a number of viable options would be examined in order to meet the projected needs, including energy conservation and development of renewable energy. Sectoral SEA would reduce the cost of any needed project-level EIA by narrowing its focus.

A sectoral SEA can:

a) Provide the most environmentally and economically sound strategy to achieve the objectives;
b) Introduce non-traditional options into the planning process at an early stage;
c) Help in ranking potential alternatives in sequence of environmental soundness;
d) Start gathering the existing data and identify the data gaps;
e) Make project-specific EIA cheaper, quicker and more robust;
f) Make everything transparent so that the project selected would be acceptable to taxpayers and affected people; and
g) Help to avoid "pork barrel" selection of projects, making the instalment of a project for political reasons alone, for example, less likely.

Box 28: Tiers of SEA and EIA

Source: Glasson et al., 1995

East Rapti Irrigation Project and Arun III are examples of the consequences of not subjecting projects to SEA at the planning stage

In project-specific EIA, some of the issues regarding human settlements, wildlife, social aspects, etc., tend to get undermined in the hurry to complete engineering and economic analyses. These environmental and social costs then re-emerge after the expenditure on detailed engineering has been completed. The East Rapti Irrigation Project in Nepal is one example of such a case in which, without looking for problems at the project design and planning stage, planners fixed the project location from a technical and economical point of view and completed pre-feasibility and design of the project, but ignored the presence of the Royal Chitwan National Park, for which the Rapti River is the water source. However, an EIA, conducted after the completion of the project design, has recommended abandonment of the project concept and reformulation to strengthen the farmer operated irrigation systems. This project wasted huge amounts of money.

Nepal's 201-MW hydropower project Arun III was criticised because not enough alternative sites were socially, economically and environmentally compared with the single large one proposed. No sectoral SEA was carried out during the period of project planning.

(ii) Regional SEA

Summation of the impacts of all the activities of several projects implemented in a region is called regional EIA; this can be achieved in a better way by applying SEA at the planning stage

Regional SEA is another type of SEA. Regional SEA is the analysis of cumulative impacts resulting from the implementation of environmental, social, economic and multi-sectoral developments within a defined geographical area, in a certain period of time. If an area, such as a watershed is likely to be subjected to intense development pressure for the first time, then there is a need to analyse the effects of the likely impacts and propose mitigation measures to be undertaken. This can be done in two ways. First, the project proponent undertakes the individual project EIA (e.g., for irrigation, hydropower projects, road construction, town development, etc.). In such cases, impacts from all these activities should be summed up through cumulative impact assessment procedures. Alternatively, a single SEA can be applied at the planning stage.

(iii) Cumulative EIA

Cumulative EIA refers to the analysis of consequences when particular areas are subjected to multiple "stresses" resulting from past, existing

Cumulative EIA is the process of assessing impacts of currently proposed projects added to the existing development in the area and to the impact of foreseeable future projects in the same area. Application of SEA at the planning stage also addresses cumulative EIA. The distinction between cumulative EIA and regional EIA is not a sharp one, however, and in many cases both of them overlap. Regional EIA specifically focuses on one geographical region and

and future development projects. Application of SEA would be helpful in effectively mitigating such impacts

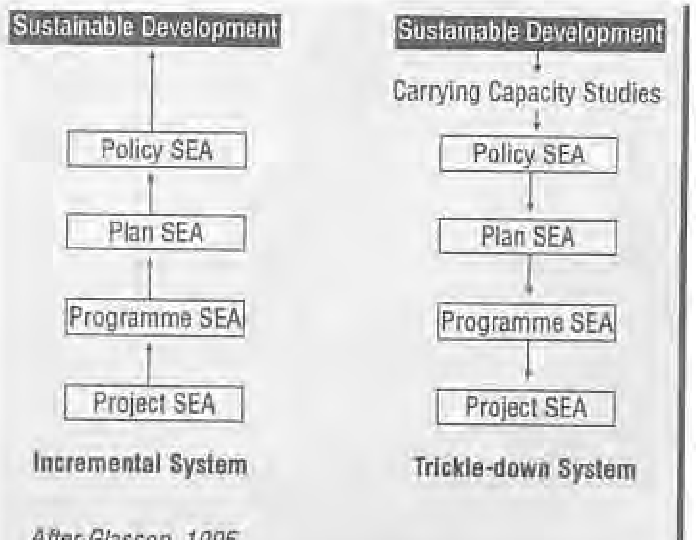
includes the past, present and future installation of projects with resource allocation between competing ones in analysis. Cumulative EIA focuses on the synergistic relationships between impacts from past, present and future installation of projects in a defined area. Both of these impacts are often well addressed in project-specific EIA; however, an application of SEA for both the cases would be more appropriate to address all impacts that are likely to occur.

(iv) Plan SEA

Strategic EIA can be applied to plans as indicated above. A strategic EIA of the proposed Bara Forest Management Plan has been implemented. This plan covers a forest area in the Terai and advocates a variety of individual actions ("sub–projects") to achieve a major shift in the management practices of the forest. The overall impacts of these actions (the plan) were assessed and mitigation measures and alternative, less environmentally damaging options were suggested (Box 29).

3. SEA and Sustainable Development

It is now well recognised that the application of SEA can be a crucial step in the achievement of sustainable economic development. The procedural aspects of applying SEA in development policies, plans and programmes can be divided into two types: (1) expanding the existing project-specific EIA system incrementally to the sustainable objective, and (2) adopting a "trickle-down" procedure towards the objective of sustainable development. The difference between these two types is illustrated below.



After Glasson, 1995

Box 29: EIA of Bara District Forest Management Plan

An Example of Sectoral Strategic Environmental Assessment

1. Background

Forty-two per cent of Nepal's natural forest is protected by the law. However, extracting timber, fuelwood and fodder and deforestation for acquiring agricultural land are still common practices. As a result, the forest area of Nepal is degrading at an alarming rate; if this continues, the remaining forest area will be degraded within the next 20-25 years.

Nepal's Terai region is predominantly occupied by a species of tree called *Shorea robusta* (sal), a species which is in high demand due to its good quality timber. A large part of such forests has been already destroyed by illegal felling and clearing for agricultural land. Although this species of tree has great potential for regeneration, the saplings in the Terai are being constantly destroyed by excessive cattle grazing and forest fires; also the large crown canopy of sal trees prevents light penetration to the ground, which is required by the growing sal saplings on the forest floor.

The Forest Sector Master Plan (1988) realised that the current practices of protection-oriented forest management are not enough to maintain and conserve the forest resources of Nepal; it is also necessary to implement a production-oriented forest management plan for the sustainable use of forest resources. With these objectives in mind, the Department of Forest, in collaboration with the Forest Management and Utilisation Project (FMUDP), developed a strategy for the Production Oriented Forest Management Plan that relies on the natural regenerative potential of sal trees.

2. Project Description

The Operational Forest Management Plan (OFMP) is proposed for implementation on an experimental basis in 26,000 ha of forest area in the Bara District of Nepal, and the harvesting operation is proposed to be carried out initially in 14,000 ha for the first five years. However, the implementation of OFMP in the Bara District forest includes the activities geared towards shifting from protection-oriented to production-oriented forest management, and may encompass an array of adverse and beneficial impacts associated with bio-physical, social and economical aspects.

Such a large project for changing the management regime from one type to another requires the consideration of environmental impact assessment (EIA), as has been specified by the government-endorsed national and forestry sector EIA guidelines. Therefore, an EIA was carried out for OFMP, and two alternatives were analysed: the "do-nothing" alternative which evaluated the impacts if the existing situation continues, and the implementation of the proposed management plan.

3. Impact Analysis

On the basis of analysis of background reports and scoping exercises, 19 environmental impacts were identified. Each impact was evaluated and predicted for its magnitude, extent and duration. The following were major environmental impacts identified and predicted:

- People's participation
- Fuelwood gathering for domestic use
- Loss of habitat and biodiversity
- Economic activities
- Uncontrolled forest fires
- Forest clearing
- Grazing
- Tenure rights
- Awareness and education
- Wood poaching
- Employment
- Health
- Legal and institutional arrangement
- Silvicultural practice
- Wildlife poaching
- Transportation
- Soil erosion
- Timber harvesting methods
- Marketing strategies

4. Conclusion

Finally, the Production Oriented Forest Management Plan which was examined during EIA, did not include most of the issues listed above. It contained only timber management aspects. Therefore, EIA recommended the inclusion of almost all the issues listed above and the design of appropriate mitigation measures to overcome the adverse impacts identified. Ranking of each impact through the participatory approach indicated that most of the adverse impacts identified in the "do-nothing" alternative will be mitigated by implementation of OFMP. Therefore, the EIA study recommended implementing OFMP and incorporating consideration of the impacts identified.

The final version of OFMP incorporated all the impacts identified and was modified according to the conditions given in the EIA recommendations. , The government of Nepal recently approved OFMP and authorised the proponent to implement plan activities as specified in the revised OFMP.

The incremental system is widely used; however the trickle-down system is more effective

The incremental system goes on expanding its policy towards sustainable development, whereas the trickle-down system adopts sustainable development as the central objective of its process.

Incremental systems of SEA are most commonly used at present. For example, in the United States, some legislation and procedures are applied for both SEA and project-specific EIA, and a proposed EEC directive on SEA is the expansion on directives of project-specific EIA. However, the recently implemented Dutch SEA system is based on a trickle-down system. For example, their policy sets a reduction of air pollution by 70–90 per cent. Plans and programmes are designed to achieve the objectives set out in policy. Therefore, the trickle-down SEA system is likely to become a key method for implementing sustainable development objectives. The following steps are usually required for implementing a trickle-down system.

Procedural steps for trickle-down SEA

- first, a commitment to sustainable development;
- all objectives required for achieving sustainable development (e.g., 70% reduction in air pollution) must be determined;
- conduct SEA of alternative policies, plans and programmes which can meet these objectives;
- choose the most suitable alternative;
- set EIA for individual projects; and
- design monitoring and evaluation for all the steps.

4. Limitations of SEA

Limitations are numerous; however, more research and refinement of existing systems would make SEA systems more effective

There are various limitations for effective implementation of SEA. A few of the major limitations which might act as key impediments in the process are listed below:

- political systems focus on short-term objectives, so long-term goals set by SEA may not be accepted;
- it is very difficult to set objectives and standards for sustainable development, so this might hinder SEA implementation;
- availability of data required for SEA is nationally difficult (absence of database system), politically unfeasible or nonexistent on global issues; and
- determination of carrying capacity is a complex task and may take a long time.

Trickle-down systems are considered to be most effective and useful

In spite of these limitations, SEA is still one of the most direct and effective ways to ensure that human activities are carried out at an environmentally sustainable level over time. Many countries have now adopted this method of analysing environmental impacts. In the future, this method, particularly the trickle-down system, is likely to be more popular in achieving sustainable development objectives.

Other uses of SEA

SEA has also been suggested for use in non-project actions such as trade agreements, structural adjustments, privatisation, treaties and national budgets. However, applications of SEA in such cases are limited to a few cases, and examples in these fields are rare. Nonetheless, application of SEA for such actions would certainly be very useful and would help in achieving sustainability, but it would need more rigorous practice and efforts in order to make it more defined and objective.

Despite these difficulties, the use of SEA is expanding rapidly. Box 30 shows the basic steps, in implementing SEAs, and Box 31 describes the likely information requirements.

Box 30: Basic Steps in SEA

1. *List the objectives of the policy, plan or programme, including the formal decisions that need to be taken, and identify the constraints.*

   Give the objectives and priorities; identify any conflicts and trade-offs between them; indicate how binding the constraints are and whether they might be expected to change over time or are negotiable.

2. *Scope and analyse existing environmental issues, problems and protection objectives.*

   Focus on the main issues and problems that could be affected either negatively or positively by the policy, plan or programme; use relevant environmental policies to list relevant environmental protection objectives for these issues/problems.

3. *Specify feasible options for planning decisions and identify their environmental consequences.*

   Identify and evaluate environmental issues and impacts, including cumulative impact and sustainability issues; do not disregard likely effects simply because they are not easily quantifiable.

4. *Undertake consultation.*

   Identify key stakeholders and obtain their views on the SEA results before decisions on implementation are made.

5. *Identify measures to mitigate or compensate significant environmental impacts and suggest a preferred option.*

   Concentrate the analysis on those impacts which are material to the decision; compare them with relevant environmental protection objectives; compare alternative options; include a "with-and-without" proposal; test the sensitivity of the outcome of the analysis to possible changes in conditions or to the use of different assumptions.

6. *Set up any monitoring necessary and decide at which stage to evaluate the implementation of action.*

   Wherever possible, identify further requirements for assessment; specifically list any projects, activities, etc., that may require EIA at the project level.

7. *Give recommendations for decision-making (when appropriate).*

   - Approval/refusal of proposal(s); and
   - Terms and conditions for implementation.

8. *Write a summary of the information provided.*

Box 31: General SEA Information Requirements

A good quality SEA will use and produce information on:

1. The planning process:
    - The policy, plan or programme to be approved, including an overview of relevant past development;
    - Its main objectives;
    - An indication of how it will influence concrete projects;
    - The way environmental policy goals and standards have been taken into account in its development; and
    - Main mitigation measures and alternative options that have been investigated in formulating the policy, plan or programme.
2. Baseline context of the planning process:
    - Existing environmental quality of and problems in the areas affected; and
    - Objectives for environmental protection and related measures.
3. The environmental consequences of policy options:
    - Identification and description of environmental consequences of options; and
    - Comparison of options in light of:
        - Sustainability;
        - Existing environmental quality of the area affected, including environmental problems relevant to the planning process; and
        - Objectives of environmental protection.
4. The arrangements for monitoring and post-approval analysis of the implementation of the policy, plan or programme:
    - Relationship to further decision-making;
    - Feedback of monitoring data to further stages of policy-making, etc.; and
    - Requirements for EIA in later stages.
5. The difficulties and uncertainties:
    - Overview of the difficulties (technical deficiencies or lack of knowledge) encountered in compiling the required information; and
    - Discussion of the resulting uncertainty in the provided information and what this uncertainty means for the planning process.

Annex

Integrative Impact Assessment

Summary

- Introduction
- Biophysical Impacts
- Social Impacts
- Impact on Cultural Resource
- Health Impacts
- Economic Impacts
- Fiscal Impacts
- Risk and Uncertainty
- Cost Benefit Analysis in EIA

1. Introduction

In the past, impacts on the natural environment were the main focus of EIA.

In the early 1970s, most of the EIA studies were used to analyse the impact of human activities on the natural environment. Biophysical components were the major factors that were given the most attention, and investigation of the effects of human activities, particularly the impact of pollution on flora and fauna, was the major focus of the studies.

Human beings as manipulators of the environment, expansion of the concept of environment, and the integration of the human sciences

However, the later part of the 1970s was devoted to devising methodologies and concepts to be adopted for interdisciplinary EIA. At the later stage, when human factors were considered and placed at the central point in the entire biosphere as manipulators, the whole set of human sciences such as socio-cultural, economic and health aspects were also considered as a part of the environment. Therefore, besides the natural sciences, the integration of human sciences was made part of the total process of EIA analysis (Box 32). A brief description of the components of biophysical, social, economic and fiscal, cultural, and health and legal aspects is given below. This description does not cover everything, however, and the intention is to introduce, these subjects and their integrative role in the EIA process. Box 33 provides the evolution of EIA in chronological order.

2. Biophysical Impacts

This component covers all biological elements, including different forms of plant life, structures, functions and their interaction with other components of an ecosystem.

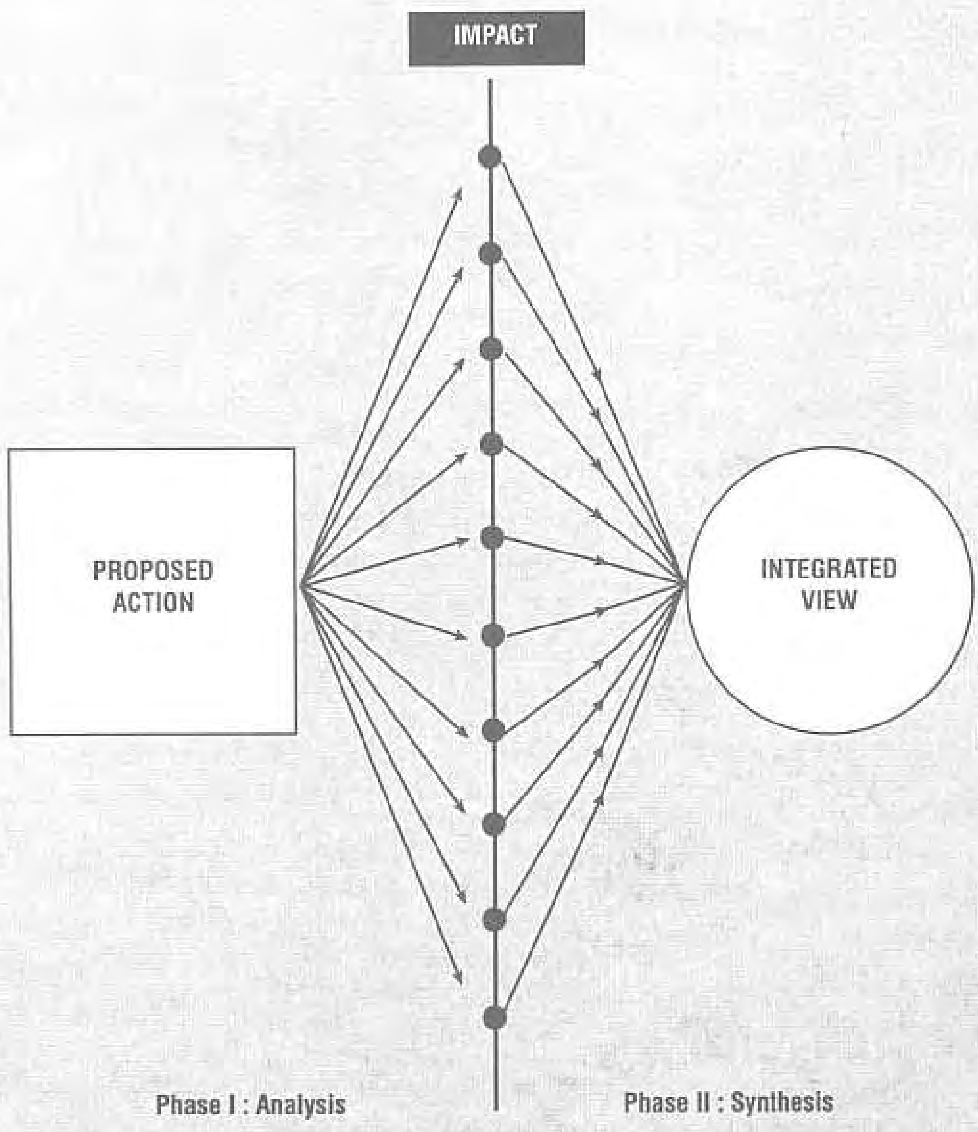
Another component of a biological system is the animal life, which ranges from microscopic protozoans to large animals such as elephants. In ecological terms, they occupy different niches in trophic-dynamic systems.

A balanced mountain ecosystem may contain forests, rivers, terraced land, livestock and people.

The biological systems interact with physical elements such as air, water, soil, rocks and solar radiation, giving rise to a system known as an ecosystem (Chapter 1). The material-cycling, assimilative, and productive roles of an ecosystem bring a balance to nature. However, human activities which are intended primarily for self benefit tend to destroy the natural balance, consequently giving rise to many man made disasters. For example, in the mountains of Nepal, the ecosystem in totality has been maintained in balance for a long period of time. The forests, rivers, terraced agricultural systems, livestock and human beings have lived from generation to generation in total harmony with nature. However, with the increase in human population, the demand for their basic needs has also

Increased human population demands more resources; this leads to

Box 32: Integration of Impacts in the EIA Process



Source: McAllister, 1980

Box 33: The Evolution of Environmental Assessment (After SADLER, 1994)

DATE AND PHASE	TRENDS AND INNOVATIONS
1. Prior to 1970 **Pre-EIA**	Project review based on engineering and economic studies (e.g. cost–benefit analysis); limited consideration of environmental consequences
2.1970–1975 **Methodological development**	EA introduced in some developed countries; initially focused on identifying, predicting and mitigating bio-physical effects; opportunity for public involvement in major reviews
3.1975–1980 **Social dimensions included**	Multi-dimensional EA, incorporating social impact assessment (SIA) and risk analysis; public consultation an integral part of development planning and assessment; increased emphasis on issues of justification and alternatives in project review
4.1980–1985 **Process and procedural redirection**	Efforts to integrate project EA with policy planning and follow-up phases; research and development focusing on effects of monitoring, on EA audit and process evaluation, and on mediation and dispute resolution approaches; adoption of EA by international aid and lending agencies and by some developing countries
5.1985–1990 **Sustainability paradigm**	Scientific and institutional frameworks for EA begin to be rethought in response to sustainability ideas and imperatives; search begins for ways to address regional and global environmental changes and cumulative impacts; growing international cooperation on EA research and training
6.1990–Present	Strategic environmental assessment (SEA) of policies, programmes and plans introduced in some developed countries; international convention on transboundary EA; UNCED placed new demands on EA for expanded concepts, methods and procedures to promote sustainability (e.g., through sustainable development strategies)

deforestation, which causes flooding, erosion, siltation and initiation of desertification in Terai.

increased. This has resulted in extraction of more fodder, timber and fuelwood from the forests, consequently leading to massive deforestation, which in turn contributes to flooding, siltation and erosion of fertile topsoil from agricultural terraces. The loss of fertility of soil results in a reduction in food grain production, thus making the lives of mountain people extremely difficult. The effect of such devastation is not only limited to mountains; the scouring effect of shallow mountain rivers also carries a large amount of sand and silt and deposits it in the fertile land of the Terai, initiating a process of desertification.

This example indicates that the destruction of one vital component of an ecosystem might lead to a chain of disasters, affecting human survival itself.

Food-chains are the basic feature for maintaining the balance of natural systems.

Take an example of a food-chain in an ecosystem. A wheat field contains wheat grains, field rats, snakes and hawks. Wheat grains are eaten by field rats, field rats are consumed by rat-snakes, and rat-snakes are preyed upon by hawks. If, for example, the rat-snake population is removed from the food-chain by human activities, the field rat population will increase enormously and eventually will destroy the total wheat crop.

Hence, in conclusion, during the process of planning of an economic development project, consideration of the following four major measures should be made in order to avoid or minimise the adverse impacts on biophysical components:

Four measures to be undertaken while planning economic development projects

to avoid adverse impacts on biophysical components

i) The project activities which may affect the bio-physical components of the project area have to be carefully analysed, and measures to be adopted to avoid any adverse impacts should be devised and implemented.

ii) The composition, structure and abundance of flora which happen to be the habitat for keystone animals; which may include economically valuable plants, endangered, rare, endemic and threatened species; and also constitute primary components of biodiversity, should be protected from the damage likely to take place with the implementation of project activities.

iii) Keystone animals that are important players in food-chains; may be endangered, rare, threatened and endemic species; and form an important component of biodiversity, should not be affected by the project activities. Measures to protect such animals from any adverse impacts should be included in the development activity packages.

iv) Any activities which affect bio-geochemical cycles within an ecosystem should be carefully planned, and efforts should be made to minimise the impacts through appropriate measures.

3. Social Impacts

To preserve and conserve the interests of indigenous people from development activities, social impacts have been included as a part of EIA.

In the past, concern in the United States, Canada and Australia for the indigenous ethnic groups and for the effects of development activities on their culture and on their way of life has been taken into consideration. This was one reason for the development and use of social impact assessment as a part of EIA.

Social impacts can be subdivided into the following:

- **Demographic impacts** — such as displacement and relocation effects; and changes in population make-up.
- **Socio-economic impacts** — including income and income multiplier effects, employment rates and patterns, prices of local goods and services, and taxation effects.
- **Cultural impacts** — traditional patterns of life and work, family structures and authority, religious and tribal factors, archaeological features, social networks and community cohesion.
- **Institutional impacts** — including demands on the government and social service, NGOs in areas such as housing, schools, criminal justice, health, welfare and recreation.
- **Gender impacts** — the implications of development projects on the roles of women in society, income-generating opportunities, access to resources, employment opportunities and equity.

Traditionally, social considerations were intended to indicate demographic changes.

Traditionally, social considerations in EIA were limited to changes that occurred in demographic and socio-economic characteristics because:

i) the changes can be quite easily quantifiable (such as number of in-migrants and out-migrants, family size, etc.), and
ii) the magnitude of changes can be indicated.

A more comprehensive analysis would require the additional inclusion of the following socio-cultural parameters:

- quality of life;
- social organisation and structures;
- cultural life, including language, rituals and general lifestyle. A cultural life makes a social group immediately, recognisable as being distinct from other groups;
- dispute-resolution institutions and processes;
- relationships between generations; and
- value systems.

Individuals, institutions, communities, social systems and their interactions provide the basic definition of social impacts.

A combination of demographic and socio-cultural changes offers a working definition of "social impacts". Social impacts include changes which affect individuals, institutions, communities and larger social systems and the interactions between them. In basic terms, these are alterations in the ways people live, work, play and relate to each other; organise to meet their needs and change the values, beliefs and norms that characterise their "group"; and guide their individual and collective actions.

Social impacts affecting the bio-physical resources

There are two main reasons for incorporating social impacts in EIA. Firstly, people and their social relations/values are components of the environment and have strong linkages. Hence, assessment of social impacts and their linkages with other environmental parameters is necessary. Social changes might affect biophysical resources. For example, construction taking place in a rural area can result in the in-migration of large numbers of workers, in addition to the already established local people. The addition of more people in the area will exert more pressure on biophysical resources and will produce social problems. Additionally, direct environmental change may produce social change.

Environmental changes may lead to social impacts.

Eradication of malaria from Nepal's Terai region by the application of DDT in the 1960s eliminated the anopheline mosquito—a vector species of malaria. People from different parts of Nepal moved into the area and settled in a number of new villages. These people exploited the newly available natural resources in an unsustainable way by significantly reducing forest and wildlife populations. This illustrates an environmental change giving rise to social problems. A purely "environmental" EIA might have missed this consequence because the social impact of actions associated with malarial eradication would not have been investigated.

Social impacts should be assessed as a component part of an EIA

The close relationship between social and environmental systems makes it imperative that social impacts are identified, predicted and evaluated in conjunction with biophysical impacts. It is best if social scientists with experience in assessing social impacts are employed as team members under the overall direction of a team or study team leader who has an understanding of the links between social and biophysical parameters and who is able to ensure, therefore, that this integration occurs throughout assessment work. Sometimes the social impact assessment is conducted almost in isolation from the other work, and the results of the work are incorporated in the EIA report as a "stand alone" chapter which has very little connection to the rest of the text.

Long-term losses usually outweigh short-term gains. However, the costs and benefits of a project should be distributed on the basis of gender and equity.

Secondly, local people are not often the main beneficiaries of development projects. They may enjoy a few short-term benefits (e.g., increased access to jobs, especially during the construction phase), but they are subject to a variety of cumulative adverse impacts which are long lasting (such as local natural resource depletion and declining air/water quality). Increasingly, equity and gender issues are also appearing as prominent development-oriented objectives in the policies of various governments. Information on the social distribution of the environmental costs and benefits is important in designing mitigation measures and for informing decision makers of the equity effects of particular development options.

EIA encourages public consultation where local people react to the expected changes, eliminating likely adverse impacts and avoiding delays and costly events.

There is a current trend which encourages the integration of social impact assessment into EIA. EIAs increasingly include a programme of public consultation and review. This provides an opportunity for individuals and groups to influence the nature and location of proposed developments. There is an important benefit of this process—people and social groups react to expected changes that affect their interests and can take proactive steps to prevent, avoid or reduce the intensity of expected adverse events. Species and natural communities, however, cannot act similarly. These specific social issues will lead to greater consideration of social impacts on the part of developers and governments, as a way of encouraging the creation of a planning process that encourages local people to adapt in acceptable ways to expected changes. Successful pursuit of this strategy should lead to more successful project implementation through elimination of delays and other costly events.

Social impacts are complex, but there are a variety ways to analyse them.

Social impacts are very difficult to identify and predict any degree of certainty because of the variety and complexity of social structures and systems. However, demographic and cultural resource impacts may be more objective, so it becomes easier to identify and predict them.

The first step in social impact analysis is to identify social groups which make up local communities. Relevant characteristics which may be used to identify such groups include:

- ethnic/tribal;
- occupational;
- socio-economic status; and
- age and gender.

Defining the capacity of local people; the structure, function and linkages of local

The analysis also includes defining the actual capacity of the people to make major decisions regarding the uses of biophysical resources upon which they depend for their livelihood. The distribution of production is also another important aspect to analyse. Identification *institutions is essential.*

and analysis of the existing local institutions and their systems of operation— particularly for biophysical resource utilisation, conflict resolution, authority and leadership structures, representation of social communities and their technical and political capacity—have to be made (Box 34).

Implementation of a project in ecologically sensitive areas

Another aspect of social analysis is the consideration of EIA for a project which is being planned for implementation in an ecologically sensitive area, from which the local people are deriving their livelihood. People utilising resources in such an area can be broadly categorised into three resource user groups:

Social groups can be categorised into:

(1) Permanent residents, who are compatible with the environment;

(2) New settlers, who are less compatible; and

(3) Non-residents, who are potentially dangerous.

1) Those who are residents from generation to generation; stable, low-energy and sustained-yield production systems, operated by local people, based on knowledge transmitted through generations; well adapted and compatible with the environment;
2) New settlers, who have comparatively less knowledge of the resource base of the area and of sustainable resource-use practices, and usually devastate the area through excessive use of biophysical resources; and
3) Non-resident people, who often visit the area for exploitation of biophysical resources and are potentially more dangerous than either of the above types.

The KAP of resource users category (1) has to be enhanced, while others have to be discouraged.

While carrying out EIA, it is important to analyse all three types of resource users. The Knowledge, Attitude and Practices (KAP) of category (1) should be enhanced by involving the people in all levels of project implementation. Categories (2) and (3) of resource users have to be linked with local authority, leadership or any other kinds of regulating agencies in order to protect the biophysical resources.

Indigenous, tribal, low-caste, ethnic and minority people

Particular attention must be paid to the consideration of indigenous, tribal, low- caste, ethnic and minority groups in implementation of projects, in which these groups in the society become most vulnerable to dislocation and changes in socio-economic status. Otherwise this might, in turn, create more environmental problems, as they will be forced to adopt inappropriate production systems.

However, in some countries, indigenous groups of people are provided resource-use or land use rights through constitutions, policies or regulation; but in many cases, such rights are nullified due to socio-economic and political status. In some cases, one tribal group dominates and others are ignored, such as in Africa; the caste system in South Asia is similar, where the lower castes and "untouchables" become most vulnerable. In such circumstances, as described above, the primary concern of EIA is not to encroach upon the lands and other properties of these vulnerable groups of people.

Box 34: Principles for Social Impact Assessment

Involve a diverse public. Identify and involve all potentially affected group and individuals.

Analyse impact equity. Clearly identify who will win and who will lose, and emphasise vulnerability of under-represented groups.

Focus the assessment. Deal with issues and public concerns that really count, not just those, that are easy to measure.

Identify methods assumptions and define significance. Describe how the SIA is conducted, what assumptions are used and how significance is determined.

Provide feedback on social impacts to project planner. Identify problems that could be solved with changes to the proposed action or with alternatives.

Use social scientists. Trained social scientists employing social science methods will provide the best results.

Establish monitoring and mitigation programmes. Manage uncertainty by monitoring and mitigating adverse impacts.

Identify data sources. Use published scientific literature, secondary data and primary data from the affected area.

Plan for gaps in the data. Evaluate the missing information and develop a strategy for proceeding.

After Interorganisational Committee on Guidelines and Principles for Social Impact Assessment, 1994

If encroached upon, adequate compensation should be paid to them and should relate to their preferences and responses to development opportunities (Box 35).

Avoid involuntary resettlement; in case it happens, there must be adequate compensation.

Two important aspects have been recommended while considering social aspects in EIA: (i) it is always advisable to avoid involuntary resettlement, mostly in cases where vulnerable groups of people are involved, and (ii) in cases where projects require land acquisition from indigenous territories, the people affected should be compensated adequately so that their standard of living is improved or, at the least, is at a similar level.

4. Impact on Cultural Resources

Cultural resources have to be carefully investigated in the project site with the help of records maintained by relevant agencies.

Cultural resources refer to archaeological, historical, religious, cultural and aesthetic values. Cultural resources are part of the resource base; it is therefore important that the development options under consideration are screened for potential impact on cultural properties. In the process of conducting EIA, it is essential as a first step of the EIA process to check whether or not the area contains UNESCO World Heritage Sites, which now number over 300 sites recognised as having outstanding universal value. The second step is to check the national inventories of cultural resources which can provide important data. Additionally, agencies like museums, universities, departments of archaeology, and other relevant agencies should be consulted.

If the site contains archaeological artifacts, then the developer has to act according to national archaeological regulations.

A project that involves a large-scale modification or disturbance of land and is located in an area where there are cultural resources requires an intensive survey by qualified archaeologists, and, on the basis of findings, the decision makers have to decide whether or not the project should go ahead or whether to adopt project alternatives or devise mitigation measures to be adopted, along with institutional training and monitoring requirements, etc. In all these processes, involvement of local communities is necessary.

If in the project site, there are some buried materials of archaeological/ historical value, discovered within three meters under the earth's surface, they are called "Archaeological Chance Finds", and the construction contractor should obey the following rules and national archaeological laws:

Box 35: Information Required for Social Impact Analysis for Indigenous People In EIA

Legal and Traditional Rights. Analyse whether or not legal, traditional and constitutional rights exist for the use of bio-physical resources.

Resource Use Pattern. Whether or not the implementation of the project changes the resource use pattern.

Community Participation. The opinions of indigenous people, regarding the environmental soundness and cultural appropriateness of the project and the key concerns that have to be incorporated in project design and implementation.

Demarcation and Registry of Area. Resolution of disputes, establishment of buffer zones, etc.

Flora and Fauna. Survey on flora and fauna and determination of endangered, rare and endemic flora and fauna.

Social Infrastructure. Evaluate impacts on schools, medical facilities, transport, market networks, water supply, drainage and waste disposal system.

Public Health. Evaluate health risk, diseases, pollution, health, sanitation and hygiene, traditional medicine and practices.

Institutional Aspects. Capacity of local organisation, indigenous groups, decision-making, etc.

World Bank EA Source Book, 1991

1) Notify relevant departments of such findings;
2) Request a site inspection;
3) Completely halt work until inspection results are received; and
4) Decide whether or not to proceed with further work.

Relocation of shrines should be locally acceptable and nationally agreeable.

If sacred religious shrines need to be relocated from the project area, the first thing that should be determined is whether the shrines are of national or local significance. This has to be confirmed by consulting a national heritage register. If it is a national treasure, then the concerned departments, NGOs and local people should agree on whether relocation is possible. However, such an intervention should be scientifically sound, locally acceptable and nationally agreeable. If the shrine to be relocated is only of local significance, the local people, community leaders, NGOs and others should reach consensus and local people should be involved in the total process of relocation. Alternatively, if there is a series of shrines of archaeological and historical value that is likely to be affected by development activities, then a strategy for restoration, conservation and management should be developed and implemented.

5. Health Impacts

Depletion of biophysical resources led to the development of social impacts, which gave rise to key human health problems that require special attention in EIA.

Traditionally, health issues have been given little attention in EIAs. Even when social impacts were being investigated, the effects of a proposal on individual mental and physiological well-being (health status and trends) were often omitted or treated in an unsatisfactory manner. The World Health Organisation (WHO) defines health as a state of social and individual well-being and not just an absence of disease. If this view is accepted, then the links between health and social impacts are very apparent. Often, but not always, health impacts depend on initial environmental impacts, such as habitat changes causing increased vector densities (e.g., the black fly which transmits onchocerciasis, commonly known as "river blindness", or the snail involved in transmission of bilharzia), or the increased likelihood of contact between the vectors and humans. This direct relationship between a biophysical change and disease incidence may be one of the reasons, why social impact assessments do not always examine health impacts. However, there are disease pathways which occur solely within a social context. A common example is an increased incidence of sexually transmitted diseases resulting from the influx of a large construction labour force.

The following are reasons why the consideration of health impact assessment has been given priority and has been integrated into the EIA process.

- prevention is better than cure, as with other forms of assessment;
- it is specified in many forms of impact assessment legislation;
- environmental degradation is linked with health impacts;
- environmental, social and health outcomes can be improved;
- the methodology can be incorporated in EIA;
- systematic settlement of health issues improves the legitimacy of the decisions made; and
- human health issues often prompt a public response and/or their involvement.

However, there are some difficulties in undertaking health impact assessment:

- Baseline data — lack of such data on human health in local communities;
- Time scale — while environmental effects can take a long time to show up, health effects can take even longer;
- Synergistic effects — the interaction of different chemicals, etc., can make it difficult to isolate the effects or effects responsible for ill health;
- Variety of human responses to exposures;
- Lack of knowledge of dose–response relationship; and
- Issues of confidentiality.

Project implementation can create human health problems, mostly due to

(i) Exposure to harmful pollutants;

(ii) Change in socio-economic status; and

It has been indicated that there are winners and losers in the development process. Some groups or individuals may be more exposed to harmful pollutants, and their health status will decline. Also, some groups may suffer a decline in their standard of living and become poor. Such a change in socio-economic status can be accompanied by increases in morbidity and mortality due to poor nutrition, unsanitary living conditions and reduced physical and financial access to health care facilities. Health impacts also can occur directly from development, particularly from hazardous installations when an accident occurs, such as the release of a certain amount of a toxic gas or an explosion (the Bhopal disaster is an example).

(iii) Relocation to new areas.

Similarly, relocation of individuals and groups to new areas causing disaster development (e.g., a dam flooding a valley containing several villages) due to increase in death and illness rates amongst those being relocated. The old and the young have been the most vulnerable to illness and death. Such an example can be cited from the Rara Lake area in Nepal, where a national park was established in 1975. The inhabitants were displaced to the Terai region without assessing the social and health impacts of displacement. After several years it was found that 80 per cent of the young and old populations died because they could not adapt to the new conditions.

The involvement of environmental health experts is necessary.

In the case of social impact assessment, the EIA logical framework of step-by-step activities, undertaken to assess and evaluate impacts and to formulate mitigation and monitoring measures, applies to health impact assessments. The scoping activities will determine the specific health impacts being investigated, and an expert in environment or public health should be a part of the overall EIA team. Depending on the type of project and its locality, it may be necessary to use specialists (e.g., toxicologists, epidemiologists and social psychologists) to provide periodic advice/input to the health expert (Box 36).

Health impact assessment requires three levels of analysis and study:

(i) Evaluation of the existing situation of the diseases in the project area;

(ii) Evaluation of the intensity of disease occurrences in relation to the implementation of project activities; and

(iii) Mitigation measures, both preventive and curative.

The first step in the assessment of health impacts is to conduct a survey on the existing diseases and epidemics that the people of the proposed project mostly suffer from. Records may be made available from the hospitals and health centres located near the project site. Prevelant diseases should be categorised into different magnitudes, based on intensity of occurrences. The second stage in the process is to analyse the project activities that are likely to intensify the already existing diseases (for example, irrigation projects may create stagnant water pools, which might enhance the breeding of mosquito vectors, thus intensifying the malarial diseases in the area), bring new diseases (for example, construction workers might introduce communicable diseases like venereal diseases and tuberculosis), and create some new miscellaneous diseases (the project process might release some toxic pollutant into water bodies or release emissions into the atmosphere) which were not known to the area before project implementation (Box 37).

After analysing the possible health impacts that are likely to occur, the intensity, magnitude and significance of such impacts should be evaluated. For each of the likely significant impacts, mitigation measures are formulated generally in the form of preventive measures.

However, for the curative measures also, the capability of existing hospitals and health centres to handle all kinds of possible diseases, including accidents, should be analysed. If necessary, recommendations for expanding the capacity of medical facilities are to be made. This should be made on the basis of the estimation of types of disease and intensity that are likely to happen during and after project implementation.

Box 36: Steps in Health Impact Assessment Process (After Giroult, 1988)

STEPS TO BE TAKEN	TOOLS TO BE USED
Step 1 Assessment of primary impacts on environmental parameters	Regular impact assessment process
Step 2 Assessment of secondary or tertiary impacts on environmental parameters resulting from the primary impacts	Regular impact assessment process
Step 3 Screening of impacted environmental parameters of recognised health significance	Epidemiological knowledge
Step 4 Assessment of the magnitude of exposed population for each group of EH factors	Census, land-use planning
Step 5 Assessment of the magnitude of risk groups included in each group of exposed population	Census
Step 6 Computation of health impacts in terms of morbidity and mortality	Results from risk assessment studies
Step 7 Definition of acceptable risk (or of significant health impacts)	Assessment of trade-off between human and economic requirements
Step 8 Identification of efficient mitigation measures to reduce significant health impacts	Abatement of EH factors' magnitude, reduction of exposure, reduction of exposed populations, protection of risk groups
Step 9 Final decision. Yes, if public health authorities are satisfied with proposed mitigation measures to control significant health impacts. No, if significant health impacts were assessed and if doubt remains on the efficiency of proposed mitigation measures.	

Box 37: Major Environmental Health Factors Associated with Urban (and Partly Rural) Development and Their Associated Health Impacts (Adapted from WHO, 1985)

ENVIRONMENTAL HEALTH FACTORS	ASSOCIATED HEALTH IMPACT
Low-level pollution sources:	
• Air pollution from domestic, industrial and transport sources	Ranges from fatal lung cancers, through bronchitis, emphysema, asthma to general lung function impairment and eye and lung irritation.
• Water pollution from disposal of domestic sewage and liquid wastes, industrial effluents	Increased transmission of water-related diseases or direct pollution effects (poisoning, acute or sub-acute)
• Soil pollution through uncontrolled disposal of solid and liquid wastes	Increased transmission of soil-associated disease agents: acute or sub-acute poisoning, contamination of food chains
• Noise pollution from industrial, domestic or traffic sources	Partial or total hearing loss, disturbance and irritation
• Occupational exposure to toxic substances	"Occupational disease", acute or sub-acute poisoning
Accidents and hazards:	
• Transport accidents through increased traffic level	Fatal and non-fatal injuries
• Workspace accidents from poor layout, unsafe machinery, etc.	Fatal and non-fatal injuries
• Accidents at home from poor layout and design, including fire	Fatal and non-fatal injuries
• Major hazards from natural and man-made causes	Fatal and non-fatal injuries; may be very high numbers of casualties
Disease transmission:	
• Overcrowding	Increased incidence of communicable diseases
• Lifestyle changes	Increased incidence of communicable diseases
Social/psychological:	
• Overcrowding	Increased stress, mental health effects
• Lifestyle changes	Increased stress, mental health effects

6. Economic Impacts

Employment of work-force and the material inputs are the main sources for income in the project area.

The focus in economic impact assessment is the estimation of the change in economic variables caused by:

- Project construction and operation;
- Work force requirement and the income earned by workers;
- Raw materials and other inputs for the project; and
- Capital investment.

Economy generated by employment varies greatly at different stages of the project cycle.

It is essential to estimate the size of the labour force, skilled manpower requirement and the duration of their involvement. the requirement of manpower varies at different stages of project implementation; for example, the need for labour peaks at the mid point of construction and then declines gradually. An estimation of capital expenditure on local materials and services is also required for economic evaluation.

Types of labour force employed, semi-employed and not employed, vis-a-vis the total employment required by the project, have to be analysed.

A thorough analysis of the labour force and the local economy requires information on: (i) the categories of labour available; (ii) the categories of labour that are highly demanded and employed, not employed and partly employed; (iii) estimation of unemployed labour; (iv) proportion of females looking for employment; and (v) the number and type of employment likely to be generated by project implementation. These data can be manipulated for analysing and predicting economic impacts. The money that comes into the area in the form of wages is the Initial Income Injection (III) into the local economy. Some part of such extra money will be spent on buying goods and services, helping to improve the economy of those who sell goods and services. In this way a flow of money in the project area is being maintained with certain changes in the economy at each stage. Thus, the value of the economic multiplier will be high. In some cases, the income earned by labourers will be remitted outside the project area to their families; in such cases, the value of the multiplier would be low. This is the reason why the emphasis on the employment of local people is desirable rather than employing people from outside the project area.

Economic impacts are the causes for social impacts and can be created by immigrant labour forces, which during construction phase impose short-term impacts, and during operation phase produce long-lasting impacts.

Social impacts are the outcomes of economic impacts, and this is particularly true for the project in which in-migration of workers from outside is dominant. This does not always happen; however, it happens when the labour market in the local area is insufficient. In-migrant labour forces can take up any type of employment and create social problems. The impacts created in the operational stage are more far reaching than in the construction period. The reason is that most workers during the construction period tend to be unmarried and stay on-site for short periods of time. However, workers in the operational period tend to remain for longer periods of time and bring their dependants with them; as a result, the impacts on the local service provision, such as schools, hospitals, sewage treatment and leisure facilities, will be more comprehensive and long-lasting.

In developing countries, with development activities going on, large numbers of people are attracted in search of employment. Such a massive aggregation of people can place significant additional strains on the local infrastructure, environment and local government resources.

7. Fiscal Impacts

Most of the taxes and revenue of the project are collected at the central level of government, whereas local government bears all depreciation costs of excessive use of local resources, infrastructure and services. This creates fiscal impacts on local government.

When economic impacts are being investigated, the focus is usually on the effects on the nature and behaviour of the local economy. Commonly, the economic consequences for local and other governmental organisations are omitted. These consequences are termed fiscal impacts because they are concerned with changes in the costs and revenues of these organisations. Major projects can cause large increases in local population and, as a result, cause stress on local services (such as health provision), infrastructure (such as roads and sewerage), and local resources. Key factors determining fiscal impacts include:

- size of investment and labour force requirements;
- capacity of existing service delivery and infrastructure systems;
- local/regional tax or other revenue-raising processes; and
- likely demographic changes arising from project requirements.

Using such information, the fiscal impacts can be predicted and action can be taken to avoid or minimise possible consequences which might strain local government finances. One common problem often arises from the need for expenditure on services and infrastructure which increases more rapidly than revenue from the project, creating a "deficit" and short-term cash flow difficulties. Unless borrowing is permitted, this can cause serious problems with needed infrastructure and services not being provided or being provided only in part, although they were intended to be in place when a project was approved. Lack of provision can cause social and environmental impacts through overloading of infrastructure such as water supply networks or sewerage systems. Again, there is a direct linkage between biophysical damage and social changes.

A problem which can increase such difficulties is the possible mis-match between project fiscal impacts and local administrative boundaries. This is true where the project revenue is received by one local government entity, but most of the costs in terms of services/ infrastructure provision have to be met by another entity, as most people decide to live within the boundaries of that government entity. If this situation is considered in the context of an EIA, then valuable time can be saved by formulating a strategy of dealing with the problem instead of developing a remedial strategy once the damage has begun.

8. Risk and Uncertainty

Risk assessment has been ignored in the past; however, at present there is a tendency to adopt it.

EIA deals with future events and, thus, has to cope with the issue of predicting events whose likelihood of occurrence is not known precisely or accurately. Until recently, this issue was usually handled by ignoring it. EIA reports used words such as "will" and "might" to indicate in a qualitative manner the likelihood or probability of events occurring. It was left to the decision makers and the public to interpret the meaning and significance of such qualitative expressions. As can be imagined, this is not an easy task.

The terms "risk", "uncertainty" and "hazard" have different meanings.

It is useful to distinguish between risks and uncertainties. Risks are involved when probabilities can be assigned to the likelihood of an event occurring. For example, there is a likelihood of 1 in 10,000,000 (10^{-7}) per year that someone will be struck by lightning in a particular country. Uncertainty is concerned with a situation in which very little is known about future events (or impacts) and, therefore, no probabilities can be calculated and assigned to outcomes. There are also events which are unknown and cannot be anticipated in advance. For example, the use of chlorofluorocarbons (CFCs) has led to ozone depletion. This was an unknown outcome when CFCs were introduced into refrigeration and, realistically, could not have been evaluated as an impact when they were introduced.

It is useful to define the term "hazard" at this point because it is used commonly in EIA and project appraisal. A hazard can be defined as the inherent or intrinsic property of a system (which can be an operating factory or a mode of transport) to cause damage. The likelihood of that damage or harm occurring is termed the "risk". Risk assessment is the scientific process of assessing the probability of an adverse effect of defined characteristics caused by a hazardous event occurring (for example, the explosion or release of a toxic gas occurring at a chemical installation). Risk assessment answers two basic questions:

- How likely is an event to occur?
- How harmful can it be in terms of deaths, injuries and property and ecosystem damage?

Box 38 provides questions to be addressed at different stages of analysis of risk assessment in EIA.

Box 38: Questions Addressed by Risk Assessment

What can go wrong?
e.g. what are the possible impacts on human health and welfare?

How severe will any adverse consequences be?
e.g. how many people and which geographical area might be affected, and what financial costs might be incurred?

How likely is the occurrence of adverse consequences?
e.g. what is the historical and empirical evidence to judge the likelihood of failure in process technology. Human error may also be an important consideration.

What measures will need to be taken in the event of procedures going wrong?
Considerations might include emergency planning, clean-up and recovery planning, etc.

What can be done, and at what cost, to reduce unacceptable risk and damage?
One means of integrating risk assessment into existing decision-making processes is to ensure that the risk of failure is carried by the proponent/developer. Some countries make provision for rehabilitation funds to be established to cover worst-case scenarios.

Risk assessment is primarily an engineering requirement.

Risk assessments have been undertaken, traditionally, for proposed hazardous facilities such as nuclear power stations, pipelines transporting flammable materials, and installations, which use or produce hazardous materials. In the past, these have been undertaken separately from EIAs—often because there were no EIA requirements— but even when EIA requirements existed. Basically, risk assessment is based on engineering systems, their potential malfunction and relating the consequences of such an event to human health (mortality and morbidity) and structural damage to buildings.

There are three distinct stages in a probabilistic risk assessment:

- identification of hazards;
- identification of initiating events that might lead, via various pathways or scenarios, to a hazardous event occurring; and
- quantification of the probabilities accompanying the various initiating events and the associated consequences of the final hazardous events.

Expressing the impacts in terms of probabilistic risks rather than using the phrase "likely to happen" is considered more informative.

There has been an increasing dissatisfaction, particularly in the industrialised countries of the north, concerning the vague, qualitative way in which many social, health and environmental impact predictions are expressed. Decision makers and the public have been seeking more and more information on the likelihood of certain impacts occurring. For example, instead of making a statement such as, *"...is likely to reduce fish biomass by 10%,"* it is possible to be more specific, *"...there is a risk of 0.2 of a 30% reduction in fish biomass even though the expected reduction is only 10%"*. The latter statement gives more information to decision makers. This trend has occurred at the same time that risk assessment is being increasingly incorporated in EIAs. It is now realised that EIA reports could be improved if concepts and techniques taken from probabilistic risk assessment could be used to produce probabilities for impacts, particularly those affecting ecological systems (and species) and social systems (local communities).

There is one additional benefit. Quite often in EIAs, worst-case analyses are used to ensure, basically, that potentially serious impacts are not under estimated. There is a general preference in EIA to be conservative and over estimate rather than underestimate impacts and have to initiate "emergency" mitigation measures. Decision makers can find it difficult to deal with such worst case analyses if no probability estimates are given. In fact, there is a potential to remove worst case analyses from EIAs, since probabilistic analysis of a range of impact outcomes could automatically include the worstcase event.

There is, however, little real-life experience in identifying probabilities for EIA predictions, and the costs and resource implications of trying to do so are not clear. At present, it would seem appropriate for EIA teams to be aware of the benefits of assigning probabilities and to do so when and where appropriate, without compromising the overall quality of the EIA work and exceeding budgetary and time constraints. In the case of hazardous installations, the use of probabilistic risk assessment is essential within the overall EIA study.

9. Cost–Benefit Analysis (CBA) in EIA

The sum of monetised beneficial effects of a project over time is aggregated as 'benefit', and the sum of monetised adverse effects aggregated over time is termed 'cost'. The tool that weighs the benefit against the cost is called Cost–Benefit Analysis (CBA).

CBA is a tool for aggregating, across individuals and over time, the economic value of a project's effects, measured in terms of market prices. In CBA, the monetised value of a beneficial effect is called a "benefit" and the monetised value of an adverse impact is called a "cost". If the sum of the benefits (expressed in present value) exceeds the sum of the costs (in present value), it is assumed that the proposed project should be adopted, not otherwise.

An economic analysis (such as CBA) by itself is seldom a sufficient basis for the decision-making process of the project. There are considerable difficulties in incorporating environmental impacts into the monetary calculations of the economic analysis. These impacts may, however, have great influence on the outcome of the project; therefore, it is important to carry out a separate analysis of them.

It is sometimes argued that the environmental impacts should be incorporated in the economic (monetary) calculations when it is feasible and justifiable to do so. The environmental effects should be measured, valued in monetary terms and added to the economic analysis as benefits and costs. The monetisation of the effects is usually done by the CBA method.

There are some problems in the use of CBA, such as in valuing the environmental impacts, the practice of discounting, irreversible impacts, sustainable development and the distribution of impacts.

(I) Valuation of Environmental Resources

In EIA, there is an increasing tendency to incorporate the Cost–Benefit Analysis of environmental effects; however, the valuation of natural resources poses an inherent difficulty.

There are difficulties in making estimation of the relevant environmental effects, which are further compounded by the fact that the relatively gradual changes in resource use can sometimes produce discontinuous and catastrophic effects in multi-species ecosystems. Even when the physical environmental effects can be predicted with some degree of accuracy, the monetary valuation of these effects can still prove impossible or exceedingly difficult, as most environmental resources have no market prices.

There are a variety of methods in CBA that attempt to monetise environmental effects. However, there are limitations in the applicability of these methods, especially in developing countries.

The calculations often require large amounts of statistical data which can be very difficult and quite costly to obtain. Some methods, like the "willingness-to-pay" method, are also unsuitable for development projects.

Agricultural and forest products, waste water treatment and materials that are damaged, can be monetised; whereas quality of human life, plants and animals, ecosystem services, pain and illness cannot be monetised.

Some environmental impacts are monetisable and some are definitely not. The impacts that are monetisable are the ones having direct money implications, including agricultural and forest production, industrial processing, municipal water treatment and material damages. Among the impacts that are definitely not monetisable are changes affecting human life, animal life, plant life, pain and suffering from illness, equity in resource use and conservation for future generations.

The monetised values of environmental impacts can at best be regarded only as minimum estimates of the "true" values. They should be expressed as a range of values, rather than exact numbers, and they should reflect the likely margin of error they contain.

(ii) Discounting

Discounting is one of the essential parameters for CBA, however, its full utilisation in long-term natural resource conservation is not fully understood.

The common practice in CBA for adding the benefits and the costs occurring in different years is to discount the future quantities to their present value.

There is substantial disagreement among economists regarding the current theoretical approach to measuring the social rate of discount. Subjective judgement of the relative importance of the present and the future is the only basis for utilising discount rate. It must be acknowledged that a social discount rate can never be precisely known, even if it is expected to exist, because the preferences and circumstances of the future generations remain unknown.

The use of lower discount rates will, in general, make the long-term capital-intensive public projects more profitable than short-term projects. The major argument in favour of lower rates, is that the present generation should invest more of its resources for the benefit of future generations and for conserving natural resources.

Using a higher rate of social discount will make more money available to deal with more immediate social problems and will also reduce the opportunity for large-scale projects, which destroy the natural environment.

More fundamental than the "correct" rate of discount is the issue of whether discounting is appropriate at all. The distinction between short-term and long-term in CBA typically applies only to a period of roughly fifty years. Impacts beyond fifty years are seldom considered because however large they might be, once they are discounted to the present value, using even a comparatively low discount rate, they do not amount too much.

Since the future is inherently uncertain, discounting of valuable natural resources at today's opportunity cost does not seem to be reasonable for future generations. Therefore, discounting third-generation impacts and beyond seems unacceptable.

(iii) Irreversibility and Future Options

CBA is not able to distinguish between reversible and irreversible impacts; rather it treats irreversible as reversible.

Many of the environmental impacts of development projects are either completely irreversible or reversible only over a very long time-scale. Decisions with irreversible impacts are different from those decisions with impacts that can be undone if necessary; there is an option value in retaining a choice which would be otherwise foreclosed. The decision must include considerations that take into account the uncertainty of what may happen in the future.

CBA techniques usually treat irreversible costs (even if they have been considered and quantified) no differently from more reversible ones. The implicit value judgement inherent in CBA therefore is, that irreversible consequences are no more important or serious than reversible ones.

(iv) Sustainable Development

Sustainable development seeks to meet the needs and aspirations of the present without compromising the ability to meet those of the future.

CBA does not take into consideration the concept of sustainable development.

Sustainable development has implications for economic theory and practice, and the following measures are often ignored in present-day economic theory.

- Renewable natural resources should be used in a manner which does not eliminate or degrade them or otherwise diminish their usefulness for future generations.
- Non-renewable resources should be used in a manner which does not unnecessarily preclude easy access to them by future generations.
- Non-renewable energy resources should be used at a rate slow enough to ensure the high probability of an orderly societal transition to renewable energy sources when non-renewable energy becomes substantially more costly.

- In the context of agricultural and other biologically-based projects, sustainability implies the permanent maintenance of biological productivity of the site.

Applications of CBA often do not promote sustainable development, unless sustainability of the economic activity is explicitly included as an objective.

(v) Distribution of Impacts

CBA is concerned with the maximisation of net monetary social benefit and not with the equal distribution of benefits and costs.

Under the assumption of CBA, a society will be economically efficient in its use of resources when net monetary social benefits such as the difference between total monetary benefits and total monetary costs are maximised. Efficiency is measured without regard to whom the benefits and costs accrue and irrespective of whether society considers the prevailing distribution of income to be desirable.

Glossary of Terms

ABATEMENT	Measures taken to reduce or eliminate pollution and related impacts, and may involve legislative procedures and technological applications.
ACTION	Any policy, programme, plan or project that would affect the environment.
ADVERSE IMPACT	An impact that is considered undesirable.
ALTERNATIVES	Different means of meeting the general purpose and need for a proposed action (project or programme).
ALTERNATIVES ANALYSIS	The process of screening and evaluating alternatives.
AVOIDANCE OF IMPACT	Usually associated with mitigation and involves identification of when and where actions should be taken in order to avoid particular adverse impacts.
ACTIVATED SLUDGE	Active materials consisting largely of protozoans and bacteria used to purify sewage. When mixed with aerated sewage, the sludge organisms break down the organic matter in the sewage using it as food to multiply and produce more activated sludge.
AEROBIC	Living only in the presence of air.
ALKALINITY	Describes the ability of an aqueous solution to resist acidification.
AMBIENT AIR	Surrounding air.
ANAEROBIC	Living only in the absence of oxygen.
ANTHROPOGENIC	Produced as a result of man's activities.
AUDITING	Analysis of environmental monitoring data, in order to establish the record of change associated with the project; and the comparison of actual and predicted impacts in order to determine the accuracy of predictions and the effectiveness of EIA management practices and procedures.
AUTOTROPHIC ORGANISMS	Organisms which produce their own food in the form of organic matter through the process called photosynthesis.
BENEFICIAL IMPACTS	Impacts which are considered to be desirable.

BENEFIT-COST ANALYSIS	A method of comparing alternative actions according to the relative costs (technical, environmental, and economic) incurred and the relative benefits gained. The analysis incorporates discounting calculations to take into account the time value of investments.
BEST MANAGEMENT PRACTICES	Methods or techniques that effectively accomplish a certain purpose with the least environmental impact.
BIODIVERSITY (SOMETIMES BIOLOGICAL DIVERSITY)	Refers to the variety of life on Earth: the types of plants, animals and other organisms that exist on the planet and the variety within species, ecosystems and habitats.
BIOPHYSICAL	Biological species interacting with the physical environment.
BASELINE STUDIES	Work done to collect and interpret information on the state/trends of the environment likely to be affected by a development action. Such studies include desk studies, literature reviews and on-site investigations.
BIOMAGNIFICATION (SOMETIMES BIOACCUMULATIONS)	The concentration of a persistent chemical (organochlorine insecticide) by the organisms in a food chain, so that, at each successive trophic level, the amount of substance is increased.
BIOCIDE	Any agent that kills living organisms. Sometimes used as a synonym for pesticide.
BIODEGRADATION	The breakdown of substances by micro-organisms (aerobic bacteria).
BIOME	A natural community of terrestrial organisms living in a given area which reflects the climatic regime of that latitude.
BIOTA	The flora and fauna of an area.
BOD (BIOLOGICAL OXYGEN DEMAND)	The amount of dissolved oxygen, consumed in a biological process which degrades the organic matter in water.
BUFFER ZONE	An area adjacent to the boundary of a protected area, which plays a role in protecting it. The area is not necessarily exempted from economic use; however, harmful activities are prohibited.
BASELINE MONITORING	Monitoring to identify and characterise features of existing environment (e.g., size of population of animals).
CARNIVORE	Flesh-eating animal/plant: a secondary consumer in a food chain.

CARRYING CAPACITY	The number of organisms that can be supported in a given environment indefinitely at a given level, allowing for seasonal and random changes without any degradation of the environment that would diminish the number in the future.
COD (CHEMICAL OXYGEN DEMAND)	The amount of dissolved oxygen consumed in the chemical processes in water affected by contaminants.
CONSERVATION	The planning and management of resources, so as to maintain and enhance their quality, value and diversity in such a way that their potential is maintained for present and future use by mankind. Nature conservation is the application of this concept to fauna, flora and physiographical features.
CONTAMINATION	The introduction to water or foodstuffs of substances containing toxins or live pathogens, radioactive materials, etc., which constitute a hazard to human health.
COPPICE	Shoots, produced by felling trees or shrubs, near to the ground, causing several shoots to arise from adventitious buds on the stump.
COMPENSATION MEASURES	Monetary payment or replacement in kind for losses incurred in a development project; the recreation of lost or damaged habitat.
CONDITIONS OF APPROVAL	Stipulations (e.g., mitigation requirements, discharge standards) listed in the decision document, such as a Record of Decision, that a project must implement after approval and during project construction and operation.
CUMULATIVE IMPACTS	Environmental impacts that result from the incremental impact of the proposed action on a common resource when added to other impacts from past, present, and reasonably foreseeable future actions. Cumulative environmental impacts may occur from the collective effects of individually minor actions over a period of time.
CEQ	The US Council on Environmental Quality, a body established by NEPA to oversee and review implementation of the Act. Issues guidelines and regulations which govern interpretation and implementation of the Act.
COMPENSATION	A form of mitigation which involves action such as financial payment to people affected by a development action or protection/creation of a habitat or similar feature, which is similar to the one affected adversely.

COMPLIANCE MONITORING	Monitoring of effluents at the point of discharge (i.e., pipeline/chimney) to measure the concentration to enable comparison with standards or other agreed criteria to be made.
COST-BENEFIT ANALYSIS	Technique used to compare the ratio of costs to benefits for a development action. Comparison is made through conversion of costs/benefits to monetary units, e.g., US dollars. It has not yet been used successfully to incorporate all environmental social and health impacts of concern.
DECIDUOUS	Plants which shed all their leaves annually during a particular season.
DEOXYGENATION	Depletion of dissolved oxygen in water by biological or chemical processes.
DESULPHURIZATION	The removal of sulphur or sulphur compounds from substances such as oil, coal, metals, ores, or gases.
DIRECT/INDIRECT	Some impacts are direct or " first-order ", for example, noise from construction has an immediate effect on wildlife and/or nearby human residents. In many cases, an initial direct "first-order" impact is the beginning of a chain of indirect or secondary impacts, for example, an influx of people to a reservoir site can lead to deforestation, which in turn leads to increased erosion and sediment in the reservoir. This sediment can affect light penetration into the water column and thus affect photosynthesis and primary production, and so on. Such "chains" of impacts can merge and diverge and incorporate feedback loops.
DRAFT ENVIRONMENTAL STATEMENT	In the USA, a draft statement is produced and circulated to the relevant government agencies and made publicly available. A period of time is allocated for comments to be made and the **final environmental statement** must contain a section which lists all comments and the responses of those responsible for preparing the document.
ENVIRONMENTAL IMPACT ASSESSMENT (EIA) DOCUMENT	The report that document the EIA process for a particular action or class of actions.
ENVIRONMENTAL REPORT	A generic term for reports concerning EIAs, initial EIAs, and environmental site audit reports.
ENVIRONMENTAL AUDIT	A preliminary evaluation of a site or property to identify and assess the magnitude of any existing environmental hazards and associated risks.
ECOLOGY	Study of plants and animals in relation to their physical environment.

ECOSYSTEM	Functional and structural interrelationship between biotic and physical environment.
ENVIRONMENTAL IMPACT ASSESSMENT (EIA)	An activity designed to identify, predict, interpret and communicate information about the impact of an action on human health and well-being, including the well-being of ecosystems, on which human survival depends. Sometimes known as Environmental Assessment except for in the USA where an environmental assessment is a preliminary EIA undertaken to determine, whether an Environmental Statement should be prepared - See Initial Environmental Assessment/Evaluation.
ENVIRONMENTAL QUALITY	The state of the environment as perceived objectively, in terms of measurement of its components, or subjectively in terms of its attributes such as beauty and worth.
ENDANGERED SPECIES	A term for species of plant or animal, that is in danger of extinction throughout all or in a significant portion of its range.
ENVIRONMENTAL ASSESSMENT (EA) PROCESS	The systematic, reproducible, and interdisciplinary consideration of the potential effects of a proposed action and its reasonable alternatives on the physical, biological, cultural, and socio-economic attributes of a particular geographical area.
EXTINCTION	A human-induced or natural process, whereby a species/subspecies or distinct biological population irreversibly ceases to be extinct for all time.
EXCLUSION	A decision mechanism by which projects with known or insignificant impacts may be exempted from a formal impact assessment.
ENVIRONMENTAL IMPACT ASSESSMENT (EIA)	Work undertaken to identify, predict and evaluate impacts from a proposed development action.
ENVIRONMENTAL IMPACT STATEMENT/REPORT	Document in which the results of an EIA are presented to decision makers and, in some cases, the public.
FOOD CHAIN	The process of eating and being eaten in a natural system whereby energy flow takes place from lower trophic level to a higher one.
HOLISTIC	An approach to planning which considers the environment as a systematic whole, rather than dealing with separate components or parts.

EFFLUENT	A liquid, which flows out of a containing space. Also, sewage, water, or other liquid, partially or completely treated, or in its natural state, flowing out of a reservoir, basin, or treatment plant, or part thereof.
ENVIRONMENTAL IMPACT ASSESSMENT (EIA) PROCESS	A system administering a formal EIA policy, that combines the procedures governing when and how EIA is applied and the method for performing and presenting the appropriate analysis.
ENVIRONMENTAL IMPACT ASSESSMENT (EIA) PROCEDURE	The steps and responsibilities required or suggested by the agency responsible for implementing the EIA, determining when EIA is performed, who scopes, performs and reviews the analysis, and how the results influence decision-making.
EMISSION	The total amount of solid, liquid or gaseous pollutant emitted into the atmosphere from a given source within a given time, as indicated, for e.g., in grams per cubic meter of gas or by a relative measure, upon discharge from the source. Emissions are commonly reported in terms of weight of pollutant per unit of time.
ENDEMISM	Plants and animals that originate in, are confined in the wild to a particular area, country or region.
ENVIRONMENTAL EFFECTS	The measurable changes, in the natural system of productivity and environmental quality, resulting from a development activity.
ENVIRONMENTAL IMPACT	An estimate or judgement of the significance and value of environmental effects for natural, socio-economic and human receptors.
EUTROPHICATION	Enrichment of a water body by plant nutrients, which leads to an increase in the growth of aquatic plants and often to algal blooms. The algal growth can smother higher plants, reduce light intensity, produce toxins which kill fishes, or cause deoxygenation of the water.
ENVIRONMENTAL PANEL/ENVIRONMENTAL ADVISORY PANEL	Such panels are used in Canada and the Netherlands to provide an objective review of the quality of EIA work and the subsequent statement/report. They perform a "quality control" function. These panels will be a feature of the new World Bank procedures, particularly for major contentious projects. Unlike the Canadian/Dutch panels, the Bank panels will stay in operation, during construction and for a period during the operational phase to review the operation of environmental mitigation/monitoring actions and the overall environmental management performance.

EARP — Environment Assessment and Review Process. The name of the EIA system in Canada.

EPA — US Environmental Protection Agency. Often thought, erroneously, to have a major role in the US EIA system. Its role is restricted to commenting on virtually all EIAs prepared and being prepared for its own development actions.

ENVIRONMENT — Increasingly, it means the complex web of interrelationships between abiotic and biotic components which sustains all life on earth, including the social/health aspects of human beings.

ENVIRONMENTAL HEALTH IMPACT ASSESSMENT — The component of EIA which focuses on the health impacts of development actions. Most attention is concentrated on morbidity and mortality, but increasingly the World Health Organisation (WHO) definition on health as being a state of "social, physical and psychological well-being and not just the absence of disease" is being used to guide this type of assessment work. WHO recommends this work to be known as the "Health and Safety Component of EIA".

ENVIRONMENTAL AUDIT — Check(s) made at regular intervals on the environmental performance of a project during both construction and operation. The check(s) can cover such aspects as compliance with environment standards (e.g., effluent quality), implementation and success of mitigation measures, response to "emergency" situations and knowledge amongst employees of any environmental policy/guidelines.

EIA TECHNIQUE/METHOD — Often used interchangeably to mean a systematic structured aid to the identification, prediction, evaluation and comparison of impacts of one or more development alternatives. Usually, a technique refers to a mechanism for predicting future changes in specific environmental parameters (for example, an air pollutant dispersion model or noise attenuation model), whereas a method refers to a structured aid which guides the collection, manipulation and comparison of impact data produced through use of various EIA techniques.

HUMAN-MADE CAPITAL — Refers to materials such as houses, roads, factories, etc.

INITIAL ENVIRONMENTAL ASSESSMENT/EVALUATION — Preliminary analysis undertaken to ascertain whether there are sufficient likely significant adverse impacts to warrant a "full" EIA . In some countries, use of initial assessments forms a meaning of "screening" proposed projects.

IMPACT/EFFECT	Often used interchangeably to mean an environmental change of concern. Sometimes "effect" is used to mean a change in parameter state, for example, a change in noise levels from 40 dB to 55 dB at housing during the day. The predicted consequence of this, in terms of human response, is the " impact ."
IMPACT MONITORING	Monitoring of environmental/social/health variables, which are expected to change after a project has been constructed and is operated, to test whether any observed changes are because of the project alone and not due to any other external influences. Impact monitoring is an important component of auditing.
IMPACT AUDIT	Comparison of predicted impacts, as contained in the Environmental Statement/Report, with actual impacts caused by the construction/operation of the development (detected by monitoring programmes). Such a comparison tests the utility/accuracy of the impact prediction techniques and assists in the improvement of EIA.
LOCAL/STRATEGIC IMPACTS	Generally, local impacts are those of concern, only to local people. Some environmental impacts may be only "local" in terms of location, but strategic if they affect a habitat or species of national or international importance.
"MOVING " BASELINE	Existing state of the environment, projected into the future, assuming no development proceeds. This projected baseline situation, rather than existing at the time of EIA work, is, theoretically, what should be compared to the state of the environment predicted in the event of a development action proceeding.
MITIGATION	An action which may prevent or minimise adverse impacts and enhance beneficial impacts.
MONITORING	Systematic measurement/observation of environmental/ social/ health variables in time and space.
NEPA	US National Environmental Policy Act of 1969. The first law requiring the preparation of environmental impact statements for major development actions. Current implementation is through the NEPA Regulations of 1978 issued by CEQ.
NATURAL CAPITALS	The stock of environmentally provided assets such as air, water, soil, atmosphere, forests, wetlands, etc.

POSITIVE LIST	Screening method in which a list containing the project types is produced all of which require an EIA. If a proposed project is on the list, then an EIA must be undertaken. Such lists often include thresholds (e.g., power stations may have a threshold of 30 MW(e), so that only those proposed power stations of 30 MW(e) and above need an EIA.
POLLUTION	The presence of matter or energy whose nature, location or quantity produces undesirable environmental effects.
PPM (PARTS PER MILLION)	The unit commonly used to represent the degree of pollutant concentration where the concentrations are small. Equal to mg/l divided by the specific gravity. In water analysis, *ppm* is always understood to imply weight/weight ratio.
PRECIPITATION	Change of forms of water into cloud, dew, rain, hail, or snow, etc. due to variation of places as per latitudes.
PREDATOR	An animal that kills other animals for food.
PRESERVATION	An action to maintain features of the environment as they are.
PROTECTION	Action to prevent damage to abiotic and biotic features of the environment.
PROJECT	A coherent collection of actions and activities initiated by humans for the purpose of social and or economic development.
PROPONENT	An organisation, company or institution planning to initiate a project with environmental implications.
PROPOSAL	An adequate description of a project, policy, or programme subject to assessment.
RECOMMENDATIONS	Advice or suggestions for improving decisions concerning the implementation of a proposal.
RESIDUAL IMPACT	Predicted adverse impacts which remain after mitigating measures have been applied.
RISK ANALYSIS	A technique used to determine the likelihood or chance of hazardous events occurring (such as the release of a certain quantity of a toxic gas) and the likely consequences. Developed for use in the nuclear and chemical industry where certain possible events, in low probability, may have occurred with extremely serious results. Attempts are being made to form concepts from probabilistic risk analysis to characterise environmental impacts, whose occurrence and natures are not easy to predict with any degree of accuracy.

REVERSIBLE/IRREVERSIBLE IMPACTS	An impact is irreversible when the pre-development situation cannot be recreated. If, after a period of time, the pre-development situation can be recreated (either through natural processes or with human assistance), then the impact is reversible.
RESILIENCE	The ability of a system (ecological, economic, social) to absorb stresses, created by external disturbances, without modification of the system.
RIPARIAN	Anything connected with or adjacent to the banks of a stream or any other body of water.
SCOPING	An attempt to identify the key or priority issues in a particular assessment, so that the attention, and therefore the resources, can be focused on these issues and not on those considered of less relevance.
SCREENING	Selection of actions requiring environmental impact assessment. Common methods for screening include: project threshold (e.g., size, cost, etc.); sensitive area criteria; positive and negative lists; and preliminary environmental assessment/initial environmental evaluation.
SEDIMENTATION	The separation of an insoluble solid from a liquid in which it is suspended. The particles are settled by gravity.
SEPTIC TANK	A watertight sedimentation tank for sewage in which solids settle and are decomposed anaerobically. The liquid effluent may be passed from this tank into the ground, or into a seepage tank in which it is filtered through sand or gravel before release.
SILT	Sediment made up predominantly of grains between 0.06 mm and 0.004 mm in diameter.
SILTATION	The deposition of fine-grained sediments in the bed of standing or slowly flowing water.
SIGNIFICANCE	The relative importance of an issue, concern or environmental impact, as measured by the prevailing standards, regulatory requirements and societal values.
SOCIAL CAPITAL	Refers to people, their capacity levels, institutions, culture, education, skills, information, knowledge, etc.

SOCIAL IMPACT ASSESSMENT

Component of an EIA concerned with impacts on:

- migration;
- demographic structure;
- local economy;
- local infrastructure (roads, schools, hospitals, sewerage, etc.);
- local government finances;
- social relationships;
- community cohesion;
- "way of life";
- language;
- rituals;
- political/economic processes;
- attitudes/values; and
- can sometimes include health.

SPACE/TIME BOUNDARIES

Specific impacts are characterised by extension in space (area affected) and time (the period of time during which the impact occurs). In any EIA, these aspects of individual impacts should be identified. In some EIAs, the phrases "short-term/long-term" are used to characterise the temporal dimension of specific impacts.

SUSTAINABLE USE

Ecologically sound use of natural resources that meets the need of the present without compromising the ability of future generations to meet their own needs.

TERMS OF REFERENCE

Written requirements governing EIA implementation, consultations to be held, data to be produced and form contents of the statement/report. Often produced as an output from scoping.

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