Government of the People's Republic of Bangladesh

Ministry of Water Resources

National Water Management Plan Project

Guidelines for Environmental Assessment of Water Management (Flood Control, Drainage and Irrigation) Projects

Water Resources Planning Organization

WARPO
পানি সম্পদ পরিকল্পনা সংস্থা

Published on February 2005

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Approved on

October, 2003

Water Resources Planning Organization

Published on February, 2005

Preface

These Guidelines for Environmental Assessment are an update of those issued for assessment of Flood Action Plan (FAP) projects by the Flood Plan Co-ordination Organisation (FPCO) in 1992 under the FAP 16 activities. Since then, considerable experience has been gained in using the Guidelines for environmental assessments of flood control, drainage and irrigation (FCD/I) projects. In addition, several policies, laws, and rules have been promulgated, specific guidelines for project assessment and participatory water management have been published. The original EIA Guidelines are, therefore, in need of updating. Indeed, updating should be a regular procedure to ensure that the lessons learnt from past experience in Bangladesh and elsewhere are used to benefit the environment during preparation and execution of FCD/I projects.

The updated Guidelines are intended to be used in planning of FCD/I projects, and are issued by the Water Resources Planning Organisation (WARPO). This could, in due course, become part of the set of Sector Environmental Guidelines currently being prepared by the Department of Environment (DoE).

The revision process has been carried out by consultants to WARPO with assistance from the Environment and Geographic Information System Support Project for Water Sector Planning (EGIS-II) as part of the National Water Management Plan Project (NWMPP). Supervision has been provided by a co-ordination committee representing WARPO, Department of Environment (DoE), Bangladesh Water Development Board (BWDB), and Local Government Engineering Department (LGED), together with co-opted members from NWMPP and EGIS-II. This version of the Guidelines also takes into account the comments and suggestions received from several organizations, agencies and individuals.

The "Guidelines for Environmental Assessment of Water Management Projects (Flood Control, Drainage and Irrigation)" was prepared on December, 2001 and approved by the Ministry of Environment and Forest vide Memo no. Pa Ba Ma 4/33/92/2003/978 dated 20.10.2003.

The urgent need now is to set up an effective system to ensure the use of the Guidelines by all project agencies and to make sure that the relevant staffs of all agencies active in the water sector are trained accordingly.

The Guidelines will be reviewed and updated in future when necessary, taking into account the future progress to be made in these areas.

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Acknowledgements

These Guidelines have been updated by the Water Resources Planning Organisation (WARPO), Ministry of Water Resources, Government of the People's Republic of Bangladesh with assistance from National Water Management Plan Project (NWMPP). During the process, many organisations, agencies and individuals have extended their support. WARPO gratefully acknowledges their valuable contribution.

WARPO specially acknowledges the following individuals for their splendid contribution.

National Water Management Plan (NWMP) Project: Dr Syed Latif, Local Consultant, Mr Rick Landon, Expatriate Consultant, and Mr Malcolm F. Wallace, Team Leader.

Environmental and Geographic Information System (EGIS-II) Project: Dr Rezaur Rahman, Consultant, and Mr Mujibul Huq, Co-Team Leader.

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WARPO expresses sincere gratitude to Center for Environmental and Geographic Information Services (CEGIS) for extending financial support to publish these Guidelines.

Finally, WARPO gratefully acknowledges the contribution of Department of Environment (DoE) and Ministry of Environment and Forest (MoEF), Government of the People's Republic of Bangladesh.

Table of Contents

List of Figure

List of Abbreviations

BADC	Bangladesh Agricultural Development Corporation
BCAS	Bangladesh Centre for Advanced Studies
BELA	Bangladesh Environmental Lawyers Association
BEMP	Bangladesh Environmental Management Project
BIWTA	Bangladesh Inland Water Transport Authority
BIWTC	Bangladesh Inland Water Transport Corporation
BMDA	Barind Multi-purpose Development Authority
BRDB	Bangladesh Rural Development Board
BWDB	Bangladesh Water Development Board
CARDMA	Coastal Area Resource Development and Management Association
CDSP	Char Development and Settlement Project
CEN	Coalition of Environmental NGOs
CLSHG	Community Level Self-Help Group
DoC	Department of Cooperatives
DoE	Department of Environment
DoF	Department of Fisheries
DAE	Department of Agricultural Extension
DLS	Department of Livestock Services
DPHE	Department of Public Health Engineering
DTW	Deep TubeWell
EA	Environmental Assessment
ECAs	Ecologically Critical Areas
EGIS	Environment and Geographic Information System Support Project for Water Sector Planning
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EMPs	Environmental Management Programmes
FAO	Food and Agricultural Organization
FAP	Flood Action Plan
FC	Flood Control
FCD	Flood Control, Drainage
FCD/I	Flood Control, Drainage and Irrigation
FD	Forest Department
FPCO	Flood Plan Coordination Organisation
FWoP	Future Without Project
GPA	Guidelines for Project Assessment
GPWM	Guidelines for Participatory Water Management
HTW	Hand TubeWell
ICLARM	International Centre for Living Aquatic Resources Management
IEE	Initial Environmental Evaluation
ISPAN	Irrigation Support Project for Asia and the NearEast
IUCN	International Union for Conservation of Nature
LGED	Local Government Engineering Department
LGRD&C	Local Government, Rural Development and Cooperatives
LGI	Local Government Institution
MCA	Multi Criteria Analysis

MoA	Ministry of Agriculture
M&E	Monitoring and Evaluation
MoEF	Ministry of Environment and Forest
MoL	Ministry of Land
MoFL	Ministry of Fisheries and Livestock
MoPS&IWT	Ministry of Ports, Shipping and Inland Water Transport
MoWR	Ministry of Water Resources
MWCA	Ministry of Women and Children Affairs
NCS	National Conservation Strategy
NEMAP	National Environmental Management Action Plan
NFMP	New Fisheries Management Policy
NGO	Non-Government Organisation
NLUPA	National Land Use Planning Authority
NWPo	National Water Policy
NWMPP	National Water Management Plan Project
NWRD	National Water Resources Database
PAP	Project Affected Person
PRRA	Participatory Rapid Rural Appraisal
PSSP	Private Sector Service Providers
SEMP	Sustainable Environment Management Programme
STW	Shallow TubeWell
UNDP	United Nations Development Programme
WARPO	Water Resources Planning Organisation
WASA	Water and Sewerage Authority
WMO	Water Management Organisation

Chapter 1

Introduction

1.1 Objectives and Scope of the Guidelines

These Guidelines cover 'environmental assessment' (EA) - a process that covers two key activities at the planning level:

- *Initial Environmental Examination (IEE)* - a preliminary assessment of the likely project impacts, resulting from a scoping and bounding exercise (Section 3.5). For small projects - nominally those of 1 000 ha or less - and those with no significant impacts, this may be all the assessment required. However, all projects with significant cumulative and/or residual impacts require the further step of EIA (see below);
- *Environmental Impact Assessment (EIA)* - the more detailed follow-up to the IEE, in which the impacts are assessed more precisely. In particular, the impacts are quantified and valued.

For the stages of project development that follow those addressed by these Guidelines, the recommendations contained in the environmental management plans (EMP) are the key output, and they form the concluding section of every EA report.

The aim of this document is to provide the framework for EA of FCD/I projects in Bangladesh. The Guidelines cover activities only at the early planning stages of project development, ie the initial project identification, pre-feasibility and feasibility investigations, although preparation of management recommendations are included for the later stages of detailed design, construction, on-going operations, monitoring and decommissioning of projects. The Guidelines cover both projects and programmes, although for brevity the term 'project' is used to refer to both throughout.

Not least because of the widespread and serious environmental damage done in the past by physical interventions affecting the water sector (largely before formal assessment procedures were developed) there is a great need for wider knowledge of the measures and procedures available to help prevent future damage. EA has a major role to play in this by providing a means to guide and, where necessary, modify projects before any damage is caused. These Guidelines are therefore intended to contribute to the two roles of education and project planning for sustainable development.

The guiding principle behind the Guidelines is to safeguard the physical, biological and socio-economic environments during project preparation and operation. The purpose is not to prevent development, but to ensure that it proceeds with due regard for the environment. EAs therefore cover the interactions between different environmental facets and how they are likely to change as a result of proposed project interventions. The process is not necessarily intended to preserve the environment unchanged, but rather to protect (and - where necessary - conserve) its essential features whilst allowing sustainable development to proceed.

The Guidelines place particular importance on the scoping and bounding exercise to identify the key environmental components and the probable degree of impact on each. Assessment of residual impacts, especially negative ones that cannot be mitigated, is also vital. The results then shape the design and scope of the subsequent EA. The approach is not one of rigid rules and practices, but a flexible set of procedures that can be adapted to suit the severity and extent of the likely impacts arising from each individual set of project proposals, and the project stage at which each EA is done.

1.2 Intended Users

These Guidelines are intended to be a mandatory part of planning FCD/I projects of all sizes. The latter are often subdivided in Bangladesh into large or small projects (>1 000 ha or <1 000 ha, respectively) because implementation of the two categories tends to be carried out by different organisations, notably the BWDB and the LGED. However, it is intended that the detail and scope of the assessments will be different for each category, and will be determined by the stage of the project and the nature of the planned interventions.

All agencies involved in the planning, implementation, operation and maintenance and monitoring of FCD/I projects should use these Guidelines to assist in drawing up terms of reference for environmental studies, in monitoring the studies and in evaluating the resulting environmental assessment reports. The institutional users will therefore include, but not necessarily be limited to: BWDB, LGED, DoE, the Department of Fishery (DoF); NGOs and environmental management institutions. Individual users of the Guidelines will include: environmental and social scientists, engineers, planners and other practitioners concerned with undertaking EA studies, reviewers of EAs and environmental and project development decision-makers. Environmental trainers and students will also find the Guidelines a useful summary of the key procedures. The Guidelines can also serve as a background document for planning public awareness-raising.

1.3 Project Environmental Assessment

The main objective of project EA is to identify the likely environmental impacts of proposed plans, programmes and projects. For FCD/I projects the process is designed:

* To predict - and, when possible, to quantify and value - positive and negative (ie adverse and beneficial) environmental impacts of proposed interventions, balanced against the corresponding situation if no project is implemented;
* To provide guidance on possible measures to mitigate negative impacts and enhance positive impacts, in order to help promote sustainable development;
* To present an environmental management plan to ensure that environmental concerns are built into the construction, operation and monitoring activities of the projects;
* To allow stakeholders (including the relevant institutions, technical specialists and local communities) the opportunity to participate in the formulation of interventions;
* To help decision-makers in making environmentally-sensitive decisions on project developments and resource allocation.

Particularly important is the characterisation of any negative impacts which cannot - or can only partially - be mitigated. These residual impacts need to be balanced in the overall project assessment against the predicted benefits to ensure that, overall, the intervention is beneficial and sustainable.

EA is a vital part of project planning and not just an additional activity aimed merely at ensuring formal compliance with environmental regulations. EA activities should be totally integrated (or "mainstreamed") within the overall planning process of a project, so that environmental concerns are understood and taken fully into account by the other project planners and designers. Whilst still retaining an overview of the physical, biological and socio-economic aspects noted above, the activities of environmentalists undertaking EAs will vary depending on the size and scope of the project and the study team. On larger projects, for example, other specialists - such as economists and social scientists - will undertake some of the detailed investigations, leaving the environmentalists to deal with the natural environment. However, it is still necessary for the environmentalists to take a holistic view of all these activities and ensure that they are all reflected in the EA, even if only as brief summaries with cross-references to the specialist reports.

1.4 Structure of the Guidelines

The Guideline contents are laid out more or less in the order needed for EA activities. Following this introduction, Chapter 2 briefly describes the purposes of EA and how it should be mainstreamed in the process of project planning, appraisal and implementation. Chapter 3 describes the individual steps in the EA process, within the national framework of environmental and social planning. It includes project appreciation, data collection and environmental baseline description, field investigations, people's participation, scoping and bounding, impact assessment, analysis of alternatives and the environmental management plan. Chapter 4 describes the procedures for review of EAs.

The text is supported by lists of the most important references and websites, plus seven appendices which give more details of specific technical aspects. A list of selected EA guidelines appears in Appendix A and Appendix B discuss policy, legal, regulatory and institutional frameworks. Appendix C discusses the potential environmental impacts of FCD/I projects with an initial (but not necessarily exhaustive) checklist. Appendix D provides an introduction to people's participation whilst Appendix E describes the data requirements for EAs, and Appendix F outlines the recommended contents list for EA Reports and, finally, Appendix G presents a glossary of terms.

1.5 FCD/I Projects

1.5.1 The Need for FCD/I projects

The ecosystems and rural human communities in Bangladesh rely on the annual monsoon inundation of the land and, except during unusually severe flooding, are adapted to the process. Flooding is usually only a problem during abnormal events (eg an increase in flood depth, duration or frequency) or where human activities encroach on particularly flood-prone areas or - as with urban settlements and some agricultural cropping patterns - where flood protection is necessary.

By structural and non-structural means, FCD/I projects aim primarily to provide protection from damaging floods, to improve land drainage and - in selected areas - to provide irrigation. Structural flood control measures include embankments, dykes, levees, floodways, drainage works, hydraulic structures and river channel modifications. Non-structural measures include regulation of floodplain uses, restriction of land-use in watershed areas, integrated wetland management, flood preparedness and disaster management. Flood-proofing of houses / settlements (eg by siting them on raised platforms) is also treated as a 'non-structural' measure, because the structures do not specifically control the waters.

1.5.2 Environmental Impacts of FCD/I Components: the Need for Assessments

The major environmental impacts of structural flood control measures arise from modification of the natural patterns of flow, flooding and drainage. This may bring changes in: water levels and flows on both sides of the control structures; siltation; erosion; flood regime; groundwater level; soil moisture; potable and irrigation water availability, and the conditions affecting human and animal health. Damage may be caused to crops, wild fish stocks, fisheries and property as well as to natural flora and fauna.

Among the structural flood control measures, flood protection embankments are probably the most criticised interventions. Most were constructed between 1960 and 1990 to increase agricultural production and/or protect human settlements by reducing the effects of the late monsoon river flooding. However, the associated adverse impacts have been numerous. The most important for the natural environment and capture fisheries has been the destruction of fish migratory pathways between the main river system and the floodplains, both by the structures themselves and by operation of sluices and other control structures in ways detrimental to fish.

Drainage congestion inside many empoldered areas has severely prolonged the natural post-monsoon drainage of the land and prevented timely cropping activities. These effects have led to social conflict between agriculturists and fisherfolk and severely disadvantaged the rural poor, who traditionally rely on the freely-available floodplain fish as their major source of protein. Unequal distribution of FCD/I benefits among local communities has also caused problems.

The severity of these and other impacts underlines the need for EAs of all FCD/I projects, in order to prevent - or at least minimise - environmental damage. It is clearly most important that the lessons learned from these previous interventions are taken fully into account in each EA; Appendix C gives further details of the possible impacts and a long-list of items to consider.

Chapter 2

EA in Planning, Appraisal and Implementation

2.1 The Role of Project EAs

EAs are both reactive and proactive - they are intended to predict the impacts of proposed project interventions and to ensure that environmental requirements are included in project planning. The aim is to identify all the significant negative impacts of a project and to provide recommendations for their avoidance or mitigation, whilst also providing equivalent recommendations on possible enhancement of environmental benefits. The costs of these recommendations, and the other implications for implementation - such as organisational and institutional requirements - also need to be assessed, in forms that can be readily used in the overall project designs and financial and economic analysis. The characterisation of any residual and cumulative impacts is vital (Sections 1.3).

The objective of EA is not to disrupt or impede development, but to improve projects by ensuring that they are planned, constructed and operated in an environmentally sound manner. Unless there are other overriding considerations (eg protection of human life), projects should have no significant negative effects on the functioning of essential environmental processes - including the long-term sustainability of ecological resources and human well-being. An EA should therefore:

- describe the likely environmental conditions if the proposed project were not implemented;
- assess the impacts of the proposed project if no environmental management measures were included;
- specify and cost the environmental measures needed to improve the beneficial impacts and reduce or eliminate the adverse impacts;
- ensure that these are included in an EMP to guide future project development stages.

2.2 Project Assessment Guidelines

2.2.1 National Guidelines

These EA Guidelines for FCD/I projects do not contain details of all the necessary environmental issues and procedures. EA practitioners must follow the relevant instructions in other national regulations and guidelines, as well as those of bilateral or international funding agencies when applicable. All projects are, of course, governed by the national policies, laws and regulations related to the environment and by international treaty obligations, as outlined in Appendix B.

The following national guidelines are particularly relevant to EAs of FCD/I projects; brief summaries appear in Appendix A. Obviously, the latest versions of each must be used and the instructions applied as appropriate to the particular stage(s) of project planning:

- The Guidelines for Project Assessment (FPCO, 1992);
- The Guidelines for Environmental Assessment of Small-scale Projects (LGED, 1994);
- The EIA Guidelines for Industry (DoE, 1997);
- The 2001 Ministry of Water Resources (MoWR) Guidelines for Participatory Water Management (GPWM).

The EIA Manual (ISPAN 1995) for FCD/I projects is a companion document to these Guidelines, the latter indicating *what* should be done and the former *how* it should be done, ie covering the technical aspects in more detail.

2.2.2 International Guidelines

The two widest-used sets of international environmental guidelines are probably the World Bank series of Operational Policy/ Bank Procedures/ Good Practice (World Bank 1999) and the Asian Development Bank's Environmental Guidelines by Sectors (ADB 1990-1991). For irrigation and drainage projects, the FAO's Environmental Impact Assessment is particularly relevant (FAO, 1995). Key volumes and contents of these are listed in Appendix A, with details of the relevant websites following the list of references. Bilateral agencies also have their own guidelines.

2.3 EA in Project Planning

2.3.1 Environmental Perspectives

Many environmental issues are interlinked. Water quality, for instance, affects aquatic organisms and fish in particular, because they lie at the top of the food chain. Fish form the basis of both human nutrition (especially as a freely-available protein for the very poor) and of fisheries as an economic activity (many millions of fisherfolk being involved, either full or part-time) and therefore of human health and well-being.

It is important for environmentalists on a project planning team to be aware of these linkages and to make the other planners aware of them too. The environmentalists need to take the initiative in promoting discussions between team members, so that the environmental consequences of individual planning activities *and their aggregate effects* are appreciated. The other specialists on the team must be fully aware of the environmental requirements and the possible constraints on, and opportunities for, development.

Environmental perspectives are often rather different from, say, engineering and agricultural ones; they include not only the short and medium term concerns, but also the long term and continuing (or 'residual') impacts as the project matures and the environment readjusts. The environmental concerns are also not merely confined to the immediate site of project interventions but to the, often complex, off-site effects - especially the downstream impacts. These can be difficult to identify, still more to assess and quantify. Nevertheless, they are critical to the EA process, to ensure that the environmental issues receive the attention they merit.

2.3.2 Staffing for EAs

Because of the environmental linkages, it is also important that the environmentalist(s) on a planning team retain a broad, all-encompassing (or 'holistic') view of the project activities and their potential impacts on the physical, biological and social environments. However, this is not to say that the detailed assessments should all be done by the environmentalist(s). Indeed, because of the complex nature of many of the issues it is often essential to use specialist inputs for certain aspects. In particular, it is recommended that specialists be used for physical issues such as river morphology and hydrology, for biological issues such as ecological relationships and fisheries and for all social issues.

2.4 EA for Different Project Stages

2.4.1 Project Identification and Prefeasibility Stages: - IEE

The IEE is an essential stage in assessment of all projects as part of the DoE environmental clearance procedure (Appendix B). For FCD/I projects, IEE is the first level of assessment, applied at the

project identification and pre-feasibility planning stage. The IEE addresses outline plans and options, the main objective at this stage being to help define the project in terms of locations, components and designs. The main activities are to:

(a) assess regional resources and the effects of past interventions;

(b) examine the likely project-environment interactions;

(c) establish an effective people's participation programme.

(d) identify the key environmental issues and the range and potential severity of impacts;

(e) compare the environmental consequences of project alternatives;

(f) prepare an EMP (which, for small projects or those with little impact, may be a minimal check only).

The same types of impacts as assessed in IEEs as during the later feasibility stage EIAs (Section 2.4.2), but at more general levels of detail and often at larger scales of resolution. When there are no significant impacts (including cumulative impacts) all that is needed for the IEE report is a simple table accompanied by a few paragraphs of text. Alternatively, a standard proforma can be used (eg the LGED proforma – LGED, 1994, Annex C), provided that all the relevant environmental issues are covered. However, the IEE report should set out clear recommendations for future development, indicating whether or not a full EIA should be carried out at the feasibility stage and what environmental management actions will be needed. (If no specific actions will be needed, this should be stated). The recommendations must be sufficient for the IEE reviewer to take one of four decisions:

- reject the IEE as inadequate for the proposed project (or certain parts of it) and, therefore, to request modification of specific item(s) in the report;
- accept the IEE as an adequate basis to proceed to DoE review (for prefeasibility projects or those with small impacts) or to a full EIA of the project as proposed (with enhancements and mitigations) – implying that project impacts are likely to be acceptable and/or manageable;
- accept the IEE as an adequate basis to proceed to DoE review or a full EIA of the project, but the latter modified to reduce or remove unacceptably adverse impacts; or
- reject the project because the nature and/or magnitude of the adverse impacts are technically, environmentally, socially and/or economically unacceptable.

2.4.2 Project Feasibility Studies: - EIA

EIA is an essential stage in assessment of all Red category projects as part of the DoE environmental clearance procedure (Appendix B). For FCD/I projects, EIA is the second, and main, level of assessment, applied at the project feasibility planning stage. The EIA studies in greater detail the impacts of a specific project design (although there may be some alternatives). The main objective at this stage is to make a quantified assessment of beneficial and adverse impacts a part of the basis for project costs and decisions.

For some Important Environmental Components (Section 3.5.2), the baseline survey requires observations over a whole season or cycle (eg crop production, water quality, migratory birds and fish migration). Where project time constraints prevent this, a note must be added to the report and recommendation made on the extra observations needed.

An EIA report is a significantly longer and more detailed document than an IEE report. It sets out the main features of the environment that are likely to be affected by the project, assessing the impacts (in quantitative terms wherever possible) on the physical, biological and socio-economic environments. The recommendations for future development should set out the requirements for environmental

management and monitoring. The recommendations must be sufficient for the EIA reviewer to take one of four decisions:

- reject the EIA as inadequate for the proposed project (or certain parts of it) and, therefore, to request improved assessment of specific item(s) in the report;
- accept the EIA as an adequate basis to proceed to detailed project design and subsequent implementation of the project as planned, subject to the provisions in the EMP - modified, if necessary;
- accept the EIA as an adequate basis to proceed to detailed project design and subsequent implementation, but with modifications of the design or implementation proposals to avoid or reduce adverse impacts. The modifications to be subject to a revised EIA and EMP;
- reject the project because the nature and/or magnitude of the adverse impacts are technically, environmentally, socially and/or economically unacceptable.

Chapter 3

EA Procedures

3.1 The EA Process

All EAs – whether IEEs or EIAs - should proceed through the steps illustrated in Figure 3.1. The level of detail required will differ depending on the stage of the project and the environmental features and concerns related to the project components and their likely impacts. The following sections outline the activities of the key steps, in the order that they will normally be needed in EAs.

3.2 Review of Project Proposals and Alternatives

The first step in EA for FCD/I projects should be an initial review of the proposed project interventions and possible alternatives during the IEE, as the basis for identifying possible impacts. All the project components should be listed and a preliminary indication of the possible impacts of each made, using relevant items from the checklist given in Appendix C. For EIAs, the review should be refined in the light of the preceding IEE findings to concentrate on the significant impacts related to the IECs. The review should also include scrutiny of previous studies and projects.

3.3 Background Data Collection and Baseline Description

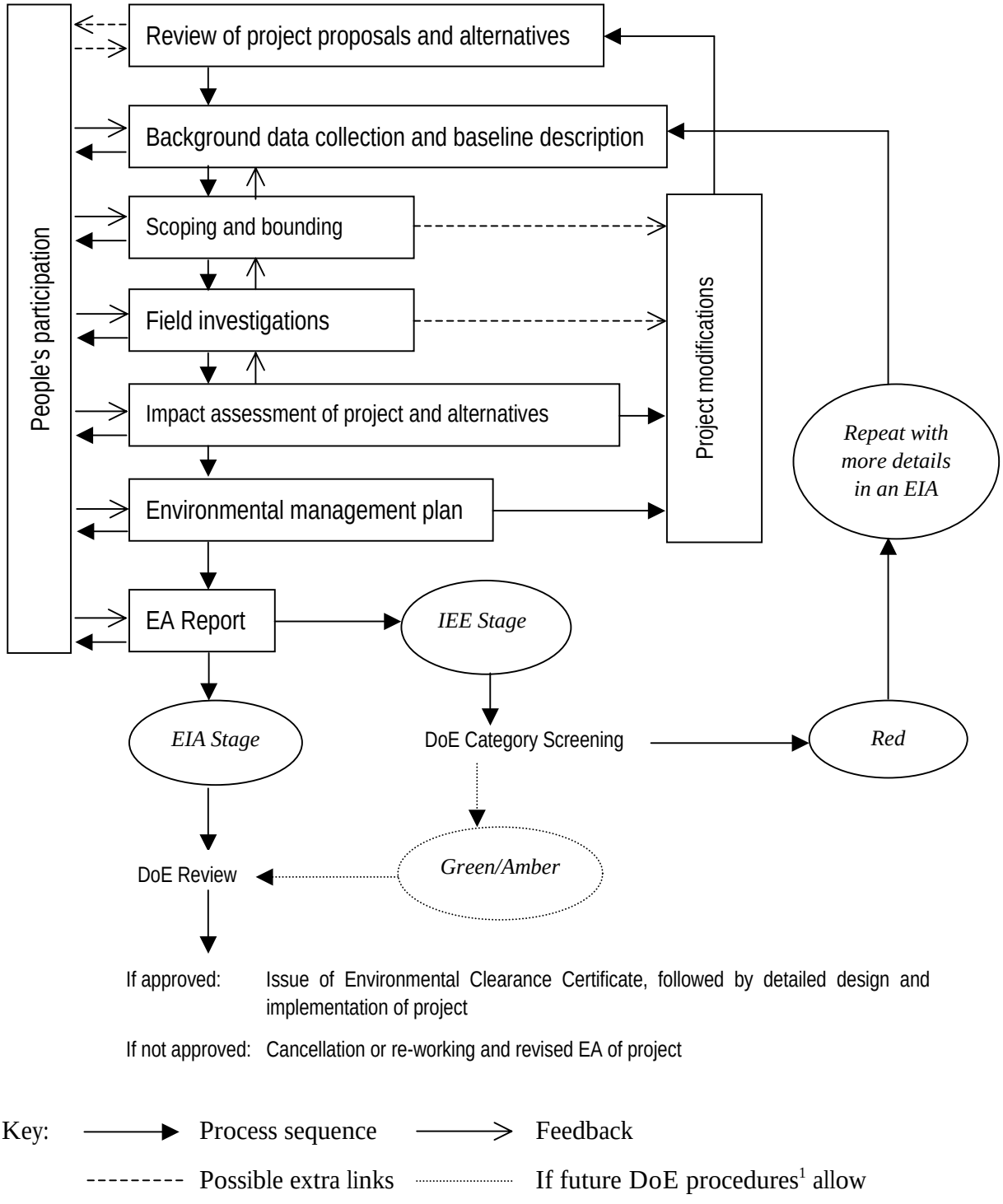
3.3.1 The Baseline Description

The existing data for the project study area should be collected and presented as a baseline description of the relevant IECs and indicators, selected as a result of the above review. For IEEs, the baseline description will normally consist of brief qualitative summaries, based on existing data and discussions with specialist informants, but with only limited field investigations - although these should include people's participation (Sections 3.5 and 3.6). Feedback from the process should be used to refine the selection of IECs, the baseline description itself and the specification of data needs.

For EIAs, the baseline will be more detailed with quantified values wherever possible, since these form the basis for quantification and valuation of the impacts. Depending on the data already available, the proportion of fieldwork will be higher for EIAs than for IEEs and there should be at least two further rounds of people's participation.

Examples of subjects for the baseline description, at whatever stage, include the following, but the topics should include all the relevant issues from the checklist given in Appendix E:

Figure 3.1: Key Steps in the EA Process



Note: 1. DoE procedures (Appendix B here) currently classify all FCD/I projects in the Red Category

2. This diagram is only indicative of the processes involved. The actual activities and sequence may vary slightly, depending on the size, complexity and likely impacts of the proposed components. Similarly, the number of consultations under the people's participation programme, and their place in the planning process, may also vary.

- project location affected area(s);
- climate and weather;
- surface and groundwater distribution pattern, hydrology and quality;
- physiography, landforms and soils;
- agro-ecological zones and land-use patterns;
- ecological zones and system(s);
- archaeological/historical/cultural sites;
- socio-economic aspects.

3.3.2 Environmental Trends

For both IEEs and EIAs, significant trends in environmental baseline conditions and resource availability, demand, quality and quantity should be outlined in terms of:

- Short-term trends due to seasonal or periodic fluctuations in biophysical conditions or resource availability and use.
- Long-terms trends due to changing baseline conditions on a local, regional, national or global scale.

3.4 People's Participation

3.4.1 Policy Requirements and Guidelines for People's Participation

According to the 1999 National Water Policy (NWPo), active participation of stakeholders – not least of local people - is now mandatory in water resources planning and management, and must therefore form an integral part of all EAs. The participation process must comply with the detailed requirements of the GPWM (MoWR 2001). The procedures are briefly outlined here with further information in Appendix D. The GPWM contain the full details.

Quite apart from the Policy requirement, the active participation of local people in project planning and implementation is the key to achieving long-term success and sustainability of FCD/I projects, especially of the operation and maintenance aspects, which are so crucial for the environment (Section 1.5.2).

3.4.2 Objectives of People's Participation

The overall aim of the participation process is to ensure that the groups affected by a proposed project have the opportunity to decide whether or not it should be implemented and – if it is to go ahead - to modify it if necessary. Specific objectives of the GPWM are also (i) to raise environmental awareness among the local stakeholders and the implementing agencies involved with participatory water management and (ii) to achieve sustainable participatory water management.

People's participation should be developed as a 'bottom-up' planning process, in which local people are fully involved in shaping their own future, rather than being objects in a 'top down' planning approach. This can also be expressed as the need for water management to be demand-driven by the participatory process and not exclusively supply-driven by the needs of the project.

As a part of EAs, the primary objectives of people's participation are to:

- enable a dialogue between project planners and local people on all project-relevant topics, such as social conditions, land values, resources usage, informal and customary rights, environmental concerns etc - so that local knowledge and ideas inform the technical design and development of the project. In particular, this is intended (i) to help characterise the environmental baseline conditions; (ii) to identify the Important Environmental Components (Section 3.5.2) and issues, (iii) to provide a basis for accurate appraisal of project impacts and (iv) to allow equitable arrangements for mitigation and compensation to be drawn up;
- ensure early detection of possible social conflicts arising from the proposed interventions, enhancements and mitigations and to explore ways of minimising them - eg through negotiation and education;
- ensure the establishment of organisations and procedures to enable local people to participate in the construction, operation, and maintenance – as well as non-structural elements - of FCD/I projects.

3.4.3 Stakeholders and Stakeholder Organisation

Starting with local stakeholders (Section 3.4.3), the consultation must be genuinely interactive. Members of all communities directly or indirectly affected by a project, both favourably and unfavourably, should participate in the people's participation process. The participation should include local interest-groups, socio-political factions local government institutions (LGIs) and other relevant entities through involvement in local level committees, associations, societies, cultural and other interest groups.

Primary stakeholders in participatory water management include: local fishermen and farmers; water management organisations (WMOs); local government institutions (LGIs); non-government organisations (NGOs); community level self-help groups; private sector service providers; implementing agencies and other public sector agencies

Inhabitants of an area who are directly or indirectly affected by a project are termed 'local stakeholders'. Any individual or group favourably influenced by a water resource project is a beneficiary. Any individual or group adversely affected by a project is a 'project affected person' (PAP). The beneficiaries and PAPs can be male and female farmers, fishermen, small traders, craftsmen, boatmen, landless people, destitute women or any other member of the local community. Participatory water management is also intended to ensure that PAPs will be appropriately compensated for any loss or other adverse impacts (so that as a minimum they will not be worse off as a result of the project) and that the issue will be monitored. LGIs and NGOs are to provide supporting, facilitating and co-ordinating assistance at the local level.

3.4.4 People's Participation during IEEs

People's participation at the IEE stage involves four steps:

- Wide and effective dissemination of information on potential interventions;
- Local-level meetings and discussions, identifying problems and developing a problem-solving process;
- Inventory of problems/ constraints and potentials;
- Assessment and reconnaissance of social, agricultural, fishery, livestock and environmental issues.

3.4.5 People's Participation during EIAs

During EIAs, the participation should be more detailed, involving:

- Identification of all stakeholders - individuals, communities and government and non-government agencies at all levels from the project site to regional and central agencies;
- Application of field methods to ensure full participation, including social assessment by surveys and participatory rapid rural appraisal;
- Assessment of the capacity of local stakeholder to participate effectively and implementation of measures to ensure the latter (eg by involvement of NGOs to help voice local concerns);
- Identification of support of, and opposition to, the proposed project and enhancement/mitigation measures.

3.5 Scoping and Bounding

3.5.1 Scoping

Following the start of the IEE baseline description, the field investigations and the people's participation (Sections 3.3.1, 3.4 and 3.6), a scoping and bounding process should be conducted. This is to refine the type and severity of the possible impacts in terms of the actual local conditions and, therefore, to help identify and select the relevant stakeholders, concerns and the Important Environmental Components (Section 3.5.2) to be studied. The scoping exercise is intended to confirm the impacts that are expected to be significant and the bounding exercise (Section 3.5.3) to determine the time periods and locations/areas over which they must be studied, both making allowance for off-site, cumulative and residual impacts. Specifically, the scoping process must indicate the main environmental features that are likely to be affected.

The process is also intended to indicate justify the level of effort needed for study of each of the different impacts. In particular, it will eliminate the environmental issues and components which will not be impacted or which will suffer negligible impacts as a result of the project. Collection and analysis of data on these aspects will therefore not need further study.

Scoping should use information from as many sources as possible, including at least the following:

- existing written information – the literature survey and review of reports and maps on previous similar projects;
- information from the field investigations;
- opinions from the people's participation, especially:
  - expert opinion from technical specialists, national, regional and government officials, and NGOs;
  - information from local communities, especially those using local land and water resources.

Scoping and bounding by technical specialists is best achieved through interactive technical meetings where information sharing and simple quantitative analyses can identify the Important Environmental Components (Section 3.5.2). The latter should be formulated as far as possible to allow subsequent evaluation in terms of:

- distribution (on- and off- site);
- quantity, quality and seasonality;
- interactions with other resources and IECs (indicating dependencies between them);
- socio-cultural-economic and/or ecological importance and value;
- availability of substitutes or replacements (eg tree plantations to replace lost forest);
- management practices and responsibilities.

3.5.2 Important Environmental Components and Indicators

As part of the scoping exercise, the key environmental features need to be identified. They are referred to as Important Environmental Components, which are defined as follows:

> *Important Environmental Components (IECs)* are features or attributes of the environment that - by virtue of their importance to ecosystem functioning, production of food and/or maintenance of livelihoods and quality of life - are considered essential and worthy of sustaining at existing or enhanced levels under the proposed new project regime.

Environmental indicators (with critical threshold values) are often useful as a basis for characterising IECs. The indicators should – wherever possible – be quantifiable features of the environment that relate to the essential functioning of ecosystems or socio-cultural activities, be representative of other dependent features and be sensitive to positive and negative project-induced changes. As an example, conditions for wild fish (eg water quality, flows, depths, flood areas etc) can be used as quantifiable indicators of the natural aquatic environment. Since they are also linked to land- and water-based livelihoods, fish production statistics can also be used as socio-economic indicators.

3.5.3 Bounding

Spatial and temporal bounds to be used in the EA must be established as part of the IEE and EIA, including an appropriate time frame as well as the appropriate spatial units. For FCD/I projects the following criteria should guide the process:

- physical factors, especially river catchment boundaries;
- ecological boundaries (especially the agro-ecological regions and sub-regions) which encompass the seasonal ranges occupied by the biological populations considered in the EA;
- social and administrative boundaries; including regions, districts and thana boundaries;
- the time frame over which impacts will last, covering the period from short term construction-related impacts to long-term, residual impacts.

Where appropriate, catchment boundaries should include areas where project effects are likely to occur, both up- and down-stream of the immediate project site. Boundaries should also include areas where off-site and cumulative impacts need to be assessed. Temporal bounds should refer to the timings and duration of the proposed project activities during the stages of pre-construction, construction, operation, monitoring and decommissioning. The operational life of an average FCD/I project is taken as 30 years, for which area and community impacts should be considered.

3.6 Field Investigations

Field studies should be carried out to obtain or refine (update, verify and/or detail) essential data not available from existing sources. For IEEs corresponding to regional plans and/or pre-feasibility

studies, normally only rapid field assessments are needed. For feasibility studies, the EIAs demand more detailed investigations, often including seasonal variations. Appendix E provides a checklist of EIA information requirements. The list can also be used as a source of suitable environmental topics to include in people's participation exercises. Sources of data and suggested methods of data acquisition are given in the EA Manual (ISPAN, 1995). People's participation (Section 3.4) is, of course, a vital part of the field investigations.

3.7 Impact Assessment

3.7.1 Impact Assessment Process

All proposed project activities likely to have environmental consequences – both intended and unintended - should be assessed in terms of their potential impacts on the environment and compared with the 'future-without-project' (FWOP) conditions (Section 3.7.7). Assessments should be made for each alternative project or project component with significantly different impacts, although the level of detail will depend on whether or not the alternatives are retained in the project design (see Section 3.7.7). Wherever possible, the impacts should be quantified and valued in physical and financial terms presented by project stage:

- pre-construction
- construction
- operation
- decommissioning.

The assessments should relate to the limits established by the scoping and bounding process (Section 3.5) and to the IECs identified by the initial technical and field appraisals (Sections 3.3, 3.4 and 3.6). At this stage, the impacts without enhancements or mitigation should be assessed – although the possibilities for these should be borne in mind for later description. The impacts should be classified as below, taking into account synergistic effects on the IECs related to non-project actions:

- project-on-environment and environment-on-project
- direct or indirect (often described in terms of 'order' of impact – Appendix C)
- positive or negative
- major, moderate or minor
- long, medium or short term
- reversible or irreversible
- fully or partially mitigable (and, hence, identification of residual impacts)
- cumulative or non-cumulative

At the project identification or prefeasibility planning level (normally the subject of IEE), impacts are often best considered as potential constraints to project type, siting and operation and may be evaluated without potential management measures. At the feasibility level, impact assessments for EIAs should be made against the following, with a greater emphasis on impact quantification and valuation:

(a) Role and Importance of the IECs;

(b) Magnitude of the Impacts;

(c) Areas;

(d) Communities.

3.7.2 Cumulative Impact Assessment

As part of each EA, a separate analysis must be made of the cumulative impacts of the proposed project and past interventions. A small FCD/I project may, by itself, have little impact on the environment but cannot be allowed to proceed without environmental control because the cumulative impacts of many such projects could be very significant. (For example, a series of small FC projects clustered on one river bank could provoke greatly increased frequency and depth of flooding on the opposite bank.) There is a real danger of 'creeping' environmental degradation if small projects are not included in the EA process and if their cumulative impacts are not assessed as part of the EA process.

3.7.3 Risk Assessment and Management

The EA should describe the environmental hazards within the project area and assess how these would be affected by project development and implementation. Where significant risks are considered likely under post-project conditions (eg sudden severe flooding from embankment breaching) an appropriate risk assessment should be used. If after this further analysis, the risk is considered significant, the EMP should outline contingency plans for prevention (or at least reduction) containment and management of the hazards. Such plans should include:

- identification of the agencies and/or community groups responsible for disaster management;
- an outline of the specific steps to be taken in the event of a disaster;
- identification of any necessary early warning systems.

The risk assessment should also examine the assumptions on which the EA is based, and the consequences if the assumptions are not valid. Given the problems in the past, the considerations for proposed FCD/I interventions must include the likely impacts if:

- the operations are not as planned, eg if farmer pressure means that sluice gates are closed during fish migration periods;
- the maintenance is inadequate, eg if water course siltation causes drainage congestion inside a polder.

For any serious consequences, prevention or mitigation measures should be proposed and the necessary critical actions highlighted, eg the need for local agreements on gate operation modes and schedules.

3.7.4 Assessment Presentation - Matrices

Whatever method is used to present the results of an EA, it should provide as a minimum a clear and concise summary of the nature (beneficial or adverse), relative magnitudes and durations of the impacts. All assumptions and terminology should be fully justified and explained.

It is often convenient to display assessments in matrix form, especially where there are many project options and/or impacts. For FCD/I projects the presentation should normally show the project interventions as matrix rows and the IECs as columns. Descriptive or numerical entries in the body of the matrix indicate which project activities and IECs interact to produce an impact. Numerically-based EAs are now less favoured than previously, but can be extremely useful when multi-criteria analysis (MCA) is used to help in making choices between many and/or complex options. (This is a requirement of the GPA – see Section 3.7.6 here). Elements can be scored and weighted in many ways, as described in the EIA Manual but, whatever system is used, it must be transparent to the reader and the scoring system must allow for overriding negative impacts to 'veto' options where necessary.

3.7.5 Screening

After the IEE assessment (Figure 3.1) each project should be screened to determine the DoE project clearance category (Red, Amber or Green – Appendix B) to indicate the next step in the EA process. Under the present regulations, all FCD/I projects will qualify as Red Category projects and should therefore proceed to full EIA. However, if the rules are subsequently relaxed, then smaller projects and those with less significant impacts may be classified as Green or Amber and the IEE report will complete the assessment, subject to the requirements of the GPA (Section 3.7.6) and DoE Clearance.

3.7.6 Requirements of the Guidelines for Project Assessment – Impact Quantification and Costing

Costing of EIAs should be done by an integrated project team (of environmental and social scientists, economists and engineers) in order to ensure consistency of methodologies and adequate identification of all relevant costs and benefits. The quantification and valuation should follow the procedures described in the Guidelines for Project Assessment (GPA) issued by FPCO (1994) supplemented, where necessary, by the EIA Manual (ISPAN, 1995). The main features of the GPA requirements are:

(a) A summary in order of impact priority of: impact type, magnitude, duration and other assessment criteria for specific resources and social issues;

(b) Identification for specific attention of reviewers and decision makers of: impacts and groups of impacts which threaten the long-term sustainability of resource systems or the social fabric of communities, and which cannot effectively be mitigated to acceptably low levels (ie discussion of residual impacts);

(c) Presentation of a multi-criteria analysis (MCA) for the valuation of beneficial and adverse impacts for inclusion into the overall project evaluation, based on:

- economic terms (taka or dollars) where costing is possible and acceptably accurate; or
- quantitative or numeric terms, where costing is not feasible (e.g. using impact scoring); or
- descriptive terms where neither of the above is possible.

(d) Separate cost estimates for:

- residual impacts;
- impact mitigation and environmental management;
- different project components (especially flood protection, drainage and irrigation) and different projects (if more than one are being developed continuously and simultaneously) to ensure adequate attention to mitigation and monitoring;

(e) Estimates of all costs of impact mitigation, compensation and enhancement, including:

- direct project infrastructure costs (eg specific control structures, access roads, embankment strengthening, maintenance, etc);
- associated project costs of environmental management (eg fisheries enhancement, protection and extension; agricultural extension; social, women's and educational programmes, etc);

(f) For impact evaluation, consideration of all likely future changes in resource abundance, availability and accessibility brought about by:

- the effects of the project itself (eg increases in agricultural yields, intensified cropping patterns, deterioration of habitat quality through local human population encroachment, etc);
- effects external to the project (eg changes in development policy, etc);

(g) Estimation of existing values and full replacement costs of resource losses, mitigation and compensation actions needed to effect replacement, as well as the adequacy of such replacement (eg loss of natural fisheries, floodplain habitat which might have to be replaced by managed aquaculture ponds).

3.7.7 Project Alternatives

Depending on the type and level of the project, alternatives may be assessed and discarded before the project plan is finalised or may be retained for later decisions. For alternatives retained in the planning process, EAs at the appropriate level must form part of the project planning documents. For discarded options, only a brief summary and the reasons for rejection (especially any environmental reasons) are all that is needed. In all cases, the FWOP alternative should be described and compared with the baseline. Project impacts will be assessed against the FWOP conditions.

For retained options, the EA should describe the objectives, rationale and planned activities under each alternative and describe and cost the impacts.

3.8 Environmental Management Plan

3.8.1 The Main Contents

An Environmental Management Plan (EMP) should be drawn up as part of the EA at both IEE and EIA stages, to deal with follow-up activities during subsequent stages of project development: detailed design, construction, implementation, maintenance and decommissioning. The level of detail in the EMP will vary according to the stage of project study and development:

For IEEs - identification of broad management requirements and constraints;

For EIAs - identification of specific management activities, staffing (including training needs) and schedules;

The main contents of an EMP are:

- Mitigation and enhancement measures;
- Compensation arrangements;
- Environmental protection and monitoring activities.
- Peoples' participation
- Disaster management (contingency planning)
- Organisational and institutional arrangements
- Responsibility and reporting framework
- Cost estimates for all environmental management activities – including mitigation and enhancement measures.

The EMP should be developed with full people's participation, with the aim of achieving consensus between the EA practitioners, project design and planning engineers, local government agencies, NGOs and local communities.

3.8.2 General Enhancement / Mitigation Considerations

General enhancement/mitigation considerations include:

- alternative project designs and/or operations to make them more environmentally friendly. Obvious examples are measures to improve the aquatic connectivity between the rivers and the floodplains and to help the physical movement of fish. Measures therefore include: provision of fish passes and/or gates; timings of gate openings to correspond with fish migration seasons; operation of gates in undershot modes;
- alteration in project operation (volume, flow, timing, etc.) or management;
- modification of a component to enhance a secondary benefit or reduce an impact;

3.8.3 Beneficial Impact Enhancement

Environmental enhancement should be considered wherever significant gains in production, resource management and environmental protection can be achieved as part of the planned project. Potential enhancement measures to consider include:

- improvements to fish habitats using the machinery available during construction – eg creation or improvements of *duars* (river reaches with deep water used as refuges by fish); adjustments to water levels/flows/flooding characteristics to provide better habitats for fish and other aquatic species;
- replacement or upgrading of affected resources especially flora and fauna needs adjusted to changed hydrology;
- education and/or training to allow more effective management of a diminished resource (eg fisheries training to avoid some existing poor management practices);
- introducing community management systems (eg water user associations).

3.8.4 Adverse Impact Mitigation

Mitigation measures to consider include:

(a) The feasibility of mitigation measures should be evaluated in terms of practicality, manageability and cost. All mitigation proposals should be costed and meet economic efficiency requirements (see the GPA);

(b) Mitigation measures should be planned and implemented in parallel with project features to reduce environmental damage and to provide for more effective program development. Project modifications should preferably be designed into structures or operating procedures. After-the-fact changes tend to be costly and ineffective;

(c) Mitigation and/or enhancement of some impacts may also affect the magnitude and significance of other impacts, and may introduce new impacts which should be considered.

All residual (non-and partially mitigable) adverse impacts should be identified, quantified spatially and temporally and costed for inclusion in the MCA (Section 3.7.6). As the matrix is refined, increasing levels of quantification and analysis are required. Projects with significant residual adverse impacts should only proceed if they are justifiable because of the benefits they bring. Clear statements on the effects of the residual impacts on the sustainability of the environment should be provided in the EA report.

3.8.5 Compensation and Rehabilitation Arrangements

Compensation and rehabilitation measures should also be developed as the EA proceeds, to take full advantage of available information and engineering design possibilities. The measures are likely to be needed in all projects where significant residual impacts remain after implementation of practical mitigation actions and the necessary provisions must be included in the EMP. Examples include:

- resettlement of displaced people - requiring major social and infrastructural programmes;
- development of new wetland habitats;
- development of alternative sources of fish supply for landless people and poor communities deprived of common property fishery resources.

The proposed compensation measures should be formulated to meet requirements of practicality, manageability and cost. All the measures proposed should meet the economic efficiency requirements of the GPA and be included as part of the EMP.

3.8.6 Environmental Monitoring

Environmental monitoring recommendations are an essential part of the EMP; details appear in the EIA Manual (ISPAN, 1995). In the context of FCD/I projects, the monitoring activities should run through the construction, implementation and decommissioning stages of projects. The objectives are to:

- measure the extent and benefit/severity of environmental impacts;
- ensure early detection of unexpected impacts and development of measures to deal with them;
- determine the efficacy of mitigation/enhancement measures to reducing/ improve impacts and to allow periodic review and adjustment of mitigation/ enhancement programmes;
- describe the proposed sampling programmes, including the parameters to be measured; sampling strategies; frequencies, locations and times of sampling; personnel and equipment requirements and estimated costs. Sampling and implementation procedures for monitoring are given in the EIA Manual;
- provide indications on assessment of the monitoring data and how this will be utilised technically and procedurally to improve mitigation and environmental management;
- indicate institutional responsibilities for the monitoring, outlining equipment, facilities, personnel and training needs.

3.8.7 Organisational Arrangements

The EMP should outline the organisational arrangements needed for the mitigation, enhancement, monitoring and other components of environmental management. These arrangements should obviously include the duties of the main agencies, but should also include provisions for local-level participation – eg by NGOs, local committees and individuals. Institutional support should be assured at two levels:

- Local support from the local level institutions;
- Central institutional support developed in close cooperation with WARPO. Supporting institutions include DoE, BWDB, DoF, LGED, FD and other relevant agencies.

3.8.8 Lines of Responsibility

The EMP should indicate the lines of responsibility for environmental management of the project and the reporting requirements of the client and the various agencies and committees responsible for project operation, maintenance and audit. It should describe the required contents of reports, when they should be completed, who is responsible for completing them and to whom the reports must be submitted.

3.9 Reporting and Accountability Framework

Results of environmental assessments are reported at two levels:

(a) The IEE report for pre-feasibility and small studies and

(b) The detailed EIA report for feasibility-level studies.

In order to facilitate EA reviews and to promote efficient implementation of projects, the standard DoE reporting procedures and the outline format given in this Section and Appendix F (or compatible presentations containing the same information) should be used.

EA reports are the main medium of information exchange between EA practitioners, project planners, environmental regulators and decision-makers. The needs of these different organisations will be different and should be carefully borne in mind in the design of the report contents and structure, as listed below. Particular attention must be paid to the EA summary, so that issues are clearly presented for non-technical recipients.

- Project planners – clear descriptions of environmental needs and of the constraints on types and locations of different projects and project components;
- Environmental regulators – (a) impact assessments to fulfil the DoE requirements for environmental clearance of projects, and (b) water resource implications for WARPO to assess in the light of the NWMP programme;
- Decision-makers – a clear, non-technical description of the benefits and disadvantages of projects and project options and the costs of environmental management;
- Local people (beneficiaries, PAPs and the community at large) – a summary of all the key points, with an emphasis on those that affect them directly. This presentation must be in non-technical language and in Bangla;
- Government and international/ bilateral funding agencies – a clear, non-technical description of the benefits and disadvantages and careful presentation of the costs of environmental management activities, including mitigation, enhancement and monitoring measures.

A suggested Table of Contents for IEE and EIA Reports is given in Appendix F. A summary of the EA findings should normally form part of the main report of a project pre-feasibility or feasibility study, accompanied when necessary by a separate environmental annex.

To help wider dissemination of environmental information, each EA report should come with an accompanying recommendation on its distribution. The list should include government agencies with interests related to the proposed developments (eg DoE, LGED, BWDB, WASA, DPHE, DoF and FD) local government offices, relevant NGOs and local community bodies.

3.10 Environmental Values

Many environmental issues are difficult, if not impossible, to value. Conservation of endangered species, preservation of biodiversity and ecologically-critical areas, archaeology and cultural sites, graveyards, and amenity/visual impacts are examples. Nevertheless, these are important – often

crucial – parts of the environment and must be given due prominence in EAs. To ensure this, they should be mentioned in the quantification of impacts and in cost estimates for environmental activities, even when no actual monetary values can be assigned to them.

Chapter 4

Review of EAs

For project planning, the purpose of the EA review is to assess the adequacy of the EA for decision-making on project proposals and to ensure that its conclusions and implications are taken forward into the following stages of project development.

However, before further development can proceed, two institutional checks are required – for which the project report and the environmental annex should be submitted to:

- The Environment Section of WARPO (under its NWPo remit to act as a 'Clearing House'), to review the report and ensure that the interventions in the water resource sector comply with the NWPo and the NWMP programme. The procedure will also allow the addition of relevant information to the National Water Resource Database, not least to assist in characterising residual and cumulative impacts;

- The DoE, as the final environmental review authority for issue of Site and Environmental Clearance Certificates. Specifically, the DoE review is to confirm the screening categorisation, to agree and approve the IEE and EIA conclusions and – if these are satisfactory - to issue the project site and Environmental Clearance Certificate.

Key items from the EA and project feasibility reports should be publicised among the local government and non-government agencies and among the communities in the project impact area(s). Provisions should be made to meet these groups and discuss study findings and proposed plans.

The EA review should address, but not be limited to, four main themes in the EA and EA authors/editors should check that these are all adequately addressed:

(a) ***Quality –*** whether the EA is acceptable in terms of:

- adequacy and reliability of the baseline data – related to the project stage and the severity of impacts expected and to the practicalities of data collection;
- degree of detail in the assessment – related to the project stage and the severity of impacts expected and the constraints on assessment activities;
- adequacy of the people's participation exercise – related to the project stage and practicalities of organising participation;
- clarity of presentation;
- correct choice of temporal and spatial bounds, communities, and IECs;
- use of appropriate environmental impact assessment methods;

(b) ***Content –*** whether the EA satisfactorily address and adequately quantifies the relevant environmental issues, taking into account constraints on the process:

- linkages, interactions, magnitude of impacts, priority and causal sequences;
- risk assessment and disaster management;
- assessment of alternative actions and their relative impacts against the 'do nothing' alternative;

- comparison of benefits, adverse effects and trade-offs, including issues of equity, gender, biodiversity and long-term sustainability;
- assessment of impacts on different ecological components, different communities and different parts of the study area;

(c) ***Environmental Management Plan –*** correct choice of components, which:

- make adequate provision for enhancement, mitigation and compensation;
- include full people's participation;
- fully identify all major cumulative and residual impacts after EMP implementation;
- has sufficient budget and manpower to accomplish the stated environmental management objectives.

(d) ***Conclusions***

- clarity, conciseness and relevance of the summary, conclusions and recommendations;
- adequacy of proposed management measures and monitoring plan and their cost estimates;
- the extent of inclusion of environmental recommendations into the plans for project implementation;
- the environmental significance of residual impacts;

References

ADB (in preparation) Environmental Assessment Guidelines, ADB, Manila

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Websites

Asian Development Bank (ADB)	www.adb.org
Bangladesh Government (GoB)	www.bangladeshgov.org
Environment and GIS Support Project for Water Sector Planning (EGIS)	www.cegisbd.com
Food and Agriculture Organisation (FAO)	www.fao.org
International Union for Conservation of Nature (IUCN)	www.iucn.org
Surface Water Modelling Centre (SWMC)	www.swmc.net
United Nations Development Programme (UNDP)	www.sdnbd.org/partners.htm *(links)*
Sustainable Development Networking Programme, Bangladesh	www.sdnbd.org
United Nations Environmental Programme (UNEP)	www.unep.org
Water and Environment International	www.wso.net/we
Water Resources Planning Organisation (WARPO)	www.warpo.org
World Bank (WB)	www.worldbank.org/es

Appendix – A

Appendix A: Project Assessment Guidelines

A.1 National Guidelines

The following national guidelines are relevant to FCD/I project assessments; EA practitioners should check the latest versions and follow the requirements that apply to EAs.

- The Guidelines for Project Assessment (FPCO, 1994) which aim to ensure that all project components are assessed in a similar manner and to permit multi-criteria assessment (MCA) techniques to be used when comparing proposed project or component alternatives;
- The Guidelines for Environmental Assessment of Small-scale Projects (LGED, 1994) which outline the procedures for conducting EAs of smaller projects, of < 1000ha. The type of environmental impacts likely to arise are also indicated, but insufficient emphasis is put on evaluation of cumulative impacts (ie taking into account the impacts of other projects, even though in themselves they may be small and have little significant impact);
- The EIA Guidelines for Industries (DoE, 1997). This sets out the procedures for environmental clearance of projects by the DoE, as required by the Environmental Conservation Rules (DoE, 1997). Although intended primarily for the industrial sector, the procedures also apply to FCD/I projects (see Chapter 4 here);
- Sectoral Guidelines for Environmental Management, covering 18 sectors which have potentially great impacts on the environment (DoE, under the SEMP Programme, in preparation);
- The Guidelines on Participatory Water Management (BWDB, LGED) February, 2001 which sets out the procedures for people's participation.

The EIA Manual (ISPAN 1995) for FCD/I projects is a companion document to these Guidelines. The Guidelines indicate *what* should be done for EAs and the Manual indicates *how* EAs should be done, covering the technical aspects in more detail.

A.2 International Guidelines

A.2.1 Asian Development Bank Environmental Guidelines by Sector

The ADB has published a series of Sector Guidelines, covering 20 sectors and sub-sectors (ADB 1990-1991), Environmental Papers covering several matters relevant to EA (ADB, various dates) and the two-volume EIA Guidelines for Developing Countries in Asia (ADB 1997). Its Environmental Assessment Guidelines are at present in preparation.

A.2.2 The European Union

The Commission of the European Union (formerly the European Communities) produced a guideline to the procedures for assessing environmental impacts of projects and programmes financed by the European Union (CEC 1992). [This outlines the definition and scope of EIA, including both natural and social environments, and gives a flow chart showing how this is to be incorporated into the project planning process.

A.2.3 World Bank

The World Bank (WB) Environmental Sourcebook in three volumes (1991) gives extensive reference and training material for EIA work; with (to date) 26 updates published between 1998 and 1999. They are available on the Bank's website (www.worldbank.org/es) as is the Guidebook for Preparation and Review of EA (WB 2000). The latter is a guide to the extensive body of environmental material

produced by the Bank for non-specialists charged with commissioning and/or reviewing EA studies and reports. There is also the Pollution Prevention and Abatement Handbook (WB 1999).

The old WB EA Operational Directives are being reformatted to sets of Operational Policy, Bank Procedures and Good Practices (OP, BP and GP respectively), the sets most relevant to EA at present consisting of:

4.01	OP/BP/GP	Environmental assessment
4.02	OP/BP/GP	Environmental action plans
4.03	OP/BP/GP	Agricultural pest management
4.04	OP/BP/GP	Natural habitats
4.07	OP	Water resources management
4.10	OP/BP/GP	Indigenous peoples
4.11	OP/BP/GP	Management of cultural property
4.12	OP/BP/GP	Involuntary resettlement
4.36	OP/GP	Forestry
7.50	OP/BP	Projects on international waterways
10.04	OP/BP/GP	Economic evaluation

Appendix - B

Appendix B: Policy, Legal, Regulatory and Institutional Framework for EA

B.1 The Regulatory Framework

EA exercises must obviously be carried out within the framework of the current environmental policies, laws, rules and regulations. For FCD/I projects, the most important are those relating the environment, water resource and fisheries sectors.

B.2 International Environmental Treaties

B.2.1 Convention on Biodiversity

As a signatory to the Convention on Biodiversity, Bangladesh is committed to the protection of biodiversity, including a commitment to provide resources for its protection and management.

B.2.2 World Heritage and Ramsar Sites

The three seaward forest sanctuaries in the Sundarbans in the SW Region are a World Heritage site, and are a key resource for biodiversity conservation. As Ramsar sites, the Sundarbans and the Tanguar Haor in the NE Region commit GoB to: 'conservation and wise by national action and international co-operation as a means to achieving sustainable development'.

B.3 The Environment Sector Framework

B.3.1 Environment Policy

The 1992 Environment Policy contains provisions for all sectors, not merely the water resources sector. For the latter, the most relevant Policy clauses for FCD/I EAs are:

- ensure environmentally sound utilisation of all water resources.
- ensure that water development activities and irrigation networks do not create adverse environmental impact.
- ensure that all steps taken for flood control be environmentally sound at the local, zonal and national levels.
- ensure mitigatory measures of adverse environmental impact of completed FCD/I projects
- keep the rivers, canals, ponds, lakes, haors, baors and all other water bodies and water resources free from pollution.
- ensure sustainable management of underground and surface water resources.
- conduct EA before undertaking projects for water resources development and management.

The Policy was supported by the 1992 National Conservation Strategy (NCS) and, following widespread and lengthy public consultations, by a recommended implementation strategy as part of the 1995 National Environmental Management Action Plan (Section B .3.3).

B.3.2 The Environmental Conservation Act and Rules

Two pieces of legislation followed the Environment Policy and the NCS: the 1995 Environmental Conservation Act (and Amendment 2000) and the Environmental Conservation Rules of 1997. The former is essentially an enabling Act that establishes the DoE as the agency responsible for enforcing environmental legislation and allows it to set environmental rules and regulations. A key provision in the Act is that:

No industrial unit or project shall be established or undertaken without obtaining Environmental Clearance from the Director General DoE in the manner prescribed by the [Environmental] Rules

The Rules contain the procedures for obtaining Environmental Clearance Certificates from the DoE for different types of proposed interventions, classified into Green, Amber and Red Categories in increasing order of the likely severity of the impacts (Section B.7). The Rules were essentially developed for industrial developments, but under Appendix A of the Guidelines Clause 66 the following fall into the Red Category, for which a full EIA is mandatory:

Construction/reconstruction/expansion of flood control embankments, polders, dikes etc.

Legally, therefore, all FCD/I projects must have an Environmental Clearance Certificate[1], for which IEE and EIA reports must be submitted to - and approved by - the DoE before (re)construction starts. The procedures are outlined in Section B.7.

B.3.3 National Environment Management Action Plan

The National Environment Management Action Plan (NEMAP, 1995), based on a nationwide consultation programme, was intended to develop the Environmental Policy and the National Conservation Strategy into an implementable strategy. It identified the main national environmental issues, including those related to the water sector which EA practitioners should note. The main national concerns included flood damage, riverbank erosion, environmental degradation of water bodies, increased water pollution, shortage of irrigation water and drainage congestion; various specific regional concerns were also identified. A surprising omission, however, was specific mention of fisheries issues, but these may have been perceived as 'fish' rather than a 'water resources' concern. Arsenic contamination of groundwater used for potable water supply did not appear as an issue, as the threat had not then been identified.

B.3.4 Ecologically-critical Areas

Several sites throughout the country where the ecosystem has been degraded to a critical state have been declared Ecologically-critical Areas (ECAs). ECA status confers protection on land and water resources through a series of environmental regulations.

The Forestry Department is responsible for protection of gazetted sensitive areas, which comprise Wildlife Sanctuaries, Game Reserves, Reserved Forests and Natural Reserved Forests.

B.3.5 Urban Open-fields, Garden and Natural Water-bodies Protection Act 2000

The above sites throughout urban areas should preserve their individual characters and should not be leased out or transferred to any other authority. Any encroachment to these areas will be strictly controlled.

B.4 The Water Resource Sector Framework

The 1999 National Water Policy (NWPo) contains over 50 clauses with some environmental content; Table B1 shows the most relevant for EA of FCD/I projects. The water resources sector has not yet progressed beyond the Policy; there is no corresponding Act or Rules, although a draft for the former has been produced under the NWMPP. At present, therefore, EAs for FCD/I projects need only take into account the legal provisions for the environment sector, but EA practitioners should always check the legal provisions in force at the time of each assessment.

1 Valid for one year for Red Category projects, but see Section B. 7.

B.5 The Fisheries Sector Framework

B.5.1 National Fisheries Policy

The 1999 National Fisheries Policy highlights the need to conserve fish breeding grounds and habitats, especially in the development of water management infrastructure such as FCD/I projects. It clearly points to a determination to prevent further drainage of standing water bodies for agricultural development, and to promote fisheries development in all water bodies. Beyond conservation, the policy emphasises the need to expand fisheries areas and integrate rice, fish and shrimp cultivation.

Table B1: Key NWPo Clauses Related to EA of FCD/I Projects

Clause	Requirement
4.5b	Planning and feasibility studies of all projects will follow the Guidelines for Project Assessment, the Guidelines for People's Participation (GPP)[2], the Guidelines for Environmental Impact Assessment, and all other instructions that may be issued from time to time by the Government
4.9b	Measures will be taken to minimise disruption to the natural aquatic environment in streams and water channels
4.9c	Drainage schemes, to the extent possible, will avoid state owned swamps and marshes that have primary value for waterfowl or other wildlife
4.9d	Water bodies like baors, haors, beels, roadside borrow pits, etc. will, as far as possible, be reserved for fish production and development. Perennial links of these water bodies with the rivers will also be properly maintained.
4.9e	Water development plans will not interrupt fish movement and will make adequate provisions in control structures for allowing fish migration and breeding.
4.10a	Water development projects should cause minimal disruption to navigation and, where necessary, adequate mitigation measures should be taken.
4.10b	Minimum stream flows in designated rivers and streams will be maintained for navigation after diversion of water for drinking and municipal purposes.
4.12a	Give full consideration to environmental protection, restoration and enhancement measures consistent with National Environmental Management Action Plan (NEMAP) and the National Water Management Plan (NWMP).
4.12b	Adhere to a formal environmental impact assessment (EIA) process, as set out in EIA guidelines and manuals for water sector projects, in each water resources development project or rehabilitation programme of size and scope specified by the Government from time to time.
4.13a	Natural water bodies such as beels, haors, and baors will be preserved for maintaining the aquatic environment and facilitating drainage.
4.13b	Only those water related projects will be taken up for execution that will not interfere with aquatic characteristics of those water bodies.
5d (v)	WARPO will act as a "clearing house" for all water sector projects identified by different agencies and reporting to the ECNWRC on their conformity to the NWMP.

Source: NWPo, 1999

The policy proposes banning discharges of industrial waste, agro-chemicals and fish-farm chemicals into water bodies. Measures should be introduced to support shrimp culture, with co-ordination

[2] The GPP has now been replaced by the Guidelines for Participatory Water Management (MoWR, 2001)

through national, divisional, district and thana level committees. Shrimp and fish culture should not be expanded into areas which damage coastal mangrove forests.

Implicit in the Policy is the need to conserve fish migration routes which, in turn, implies the need to assess off-site impacts of interventions in the water resources sector.

B.5.2 Fish / Fisheries Sector Laws and Strategies

A national fisheries strategy and a fisheries sector development programme, equivalent to the NWMP for the water sector, are at present lacking – as is a master plan for the sector as a whole, covering inland and marine capture fisheries and finfish and shrimp culture. If / when these are undertaken they will also have implications for the environment related to water resource development.

B.6 Other Policies

Several other policies place obligations on environmental planners in the water resources sector or have implications for water resources development, as summarised in Table B 2 below.

B.7 The DoE Environmental Clearance Procedures

The DoE procedures for issue of the Environmental Clearance Certificate required by FCD/I projects (Section B 3.2) are set out in Figure B 1. At present, EAs for FCD/I projects must follow the procedures for the Red Category, which include submission of:

- An Initial Environmental Examination (IEE)
- An EIA
- An Environmental Management Plan (EMP).

For minor FCD/I interventions and/or those with small environmental impacts, however, the Red Category procedures are too stringent. Unless and until the DoE regulations are formally changed, it is recommended that EA practitioners seek guidance from the DoE on these issues early on in the process.

B.8 The Institutional Framework

B.8.1 Department of Environment

The primary institution for environmental management is the Department of Environment (DoE) under the Ministry of Environment and Forest (MoEF). The DoE is the authority with the mandate to regulate and enforce environmental management, including control of pollution of water resources. The DoE has the task of ensuring that adequate EIAs are undertaken; it is the primary institution for environmental management and setting and enforcement of environmental regulations. Its key duties related to the water sector include:

- pollution control, including: monitoring effluent sources, ensuring mitigation of environmental pollution;
- setting Water Quality Standards (WQS) for particular uses of water and for discharges to water bodies;
- defining Environmental Impact Assessments (EIA) procedures and issuing environmental clearance permits - the latter being legal requirements before proposed projects can proceed to implementation;
- providing advice or taking direct action to prevent degradation of the environment;
- declaring Ecologically Critical Areas (ECAs) where the ecosystem has been degraded to a critical state. ECA status confers protection on land and water resources through a series of environmental regulations.

(The Forestry Department (FD) is responsible for Sensitive Area protection in the following four types of legally protected areas: wildlife sanctuaries, game reserves, reserve forests and natural reserve forests).

B.8.2 WARPO

According to the NWPo, the National Water Resources Council (NWRC) forms the apex co-ordinating body for water resources management. WARPO is mandated as the planning agency for water resources management at the national level and acts as the secretariat of the Executive Committee of NWRC (ECNWRC). WARPO has the responsibility to advise on policy and planning concerning water resources. Its role as a 'clearing-house' for all water sector projects, as mandated in the NWPo, still needs formal clarification.

WARPO is also responsible for the National Water Resource Database (NWRD). EA practitioners should consult the NWRD for the latest data.

B.8.3 Other Organisations

Other government departments with an interest in environmental management of water resources are the DoF and the FD. The DoF is at responsible, with the Ministry of Lands (MoL), for the management of public waterbodies. However, transfer of responsibility for water bodies larger than 20 acres from MoL to MoFL for a ten-year (renewable) period is now under way. The FD is mandated to declare Reserved Forest areas and Protected Areas, the latter often within the Reserved Areas. These declared forests are often sensitive environmental areas, such as natural coastal mangroves or upstream catchment areas with implications for watershed management. The DPHE is responsible for ensuring safe drinking water supplies and improved sanitation conditions in rural and urban areas.

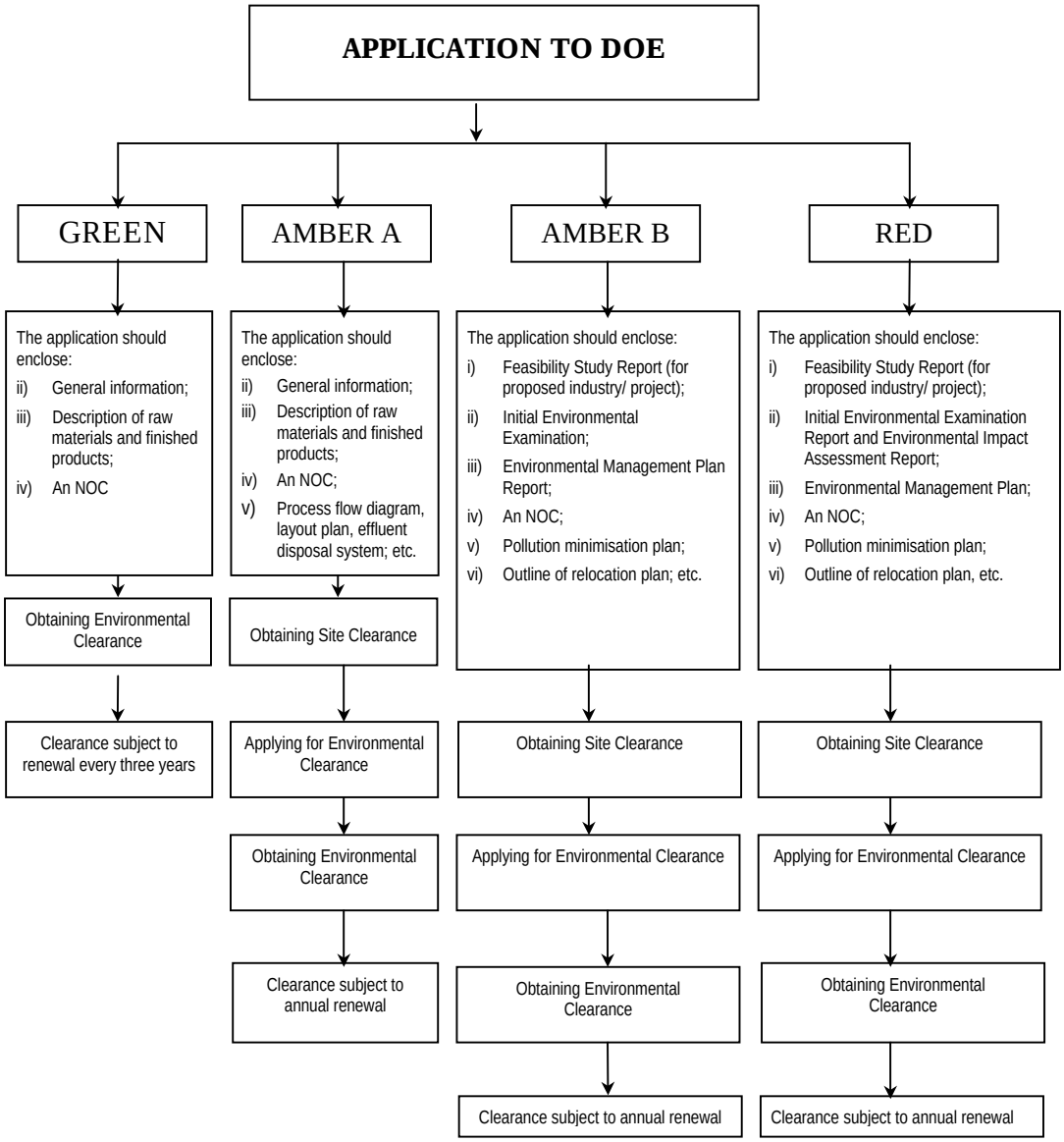
There are also important non-government institutions with environmental interest. These include the International Union for the Conservation of Nature (IUCN), the National EIA Association, the International Centre for Living Aquatic Resources Management (ICLARM), the Bangladesh Centre for Advanced Studies (BCAS) and the Bangladesh Environmental Lawyers Association (BELA). ICLARM has specific wetland management programmes for the country and BCAS provided assistance to the Ministry of Environment and Forest (MoEF) with the National Environment action Plan (NEMAP). Apart from being a significant lobbying body, BELA has provided assistance with drafting environmental legislation and in public-interest litigation. The Coalition of Environmental NGOs (CEN) is the representative lobbying organisation for national NGOs on environmental matters. In addition, several single-issue NGOs have area-based operations and specific interests which impinge on the environmental sector.

Table B 2: Policies Relevant to Water and the Environment

National Policy and Key Water-related Environmental Issues	Implications
Agriculture: Increased food crop production for food security; environmentally friendly, sustainable agriculture; strengthening of agro-forestry; research (eg on fish and rice); introduction of improved high-yielding varieties	Possible land use competition and increased water pollution from chemicals
Education and Awareness: Introduction of environmental education	Agrees with Water Policy awareness-raising
Energy: Expansion of generating capacity	Chemical and heat pollution of water
Forestry: Wildlife protection and biodiversity conservation; re-afforestation; prevention of adverse impacts on mangroves and other ecosystems; integrating of trees and traditional land uses, expansion of forest area	Reduced sedimentation/erosion (hills and coasts) from afforestation activities. Land use competition
Housing and Urbanisation (draft): Urban infrastructure: water supply and sanitation improvements	Land use zoning implications for water quality management and encroachment into environmentally-sensitive areas.
Industry: Raising industrial share of GDP from 10% to 25% in ten years; encouragement of private enterprise; environmentally sustainable development, conforming to Law; ISO 14000 certification encouraged	Increased production/dispersal could increase severity and spread of population problem
Land Use (draft): Agricultural land zoning; provisions for leasing of inland open waters; coastal greenbelt creation; participatory forestry on roads	Supports water resource environmental requirements
Natural Hazards: Flood and cyclone forecasting	Effects of sea-level rise
Safe Drinking Water Supply and Sanitation: Increased and sustainable basic water supply and sanitation; mitigation of arsenic problems; stormwater drainage in urban areas; community participation and social awareness	Implications for surface water quality and groundwater arsenic mitigation
Transport and Communication (draft): Prevent conflicts with water management and co-ordinate land use	Conforms with water resource aims, but water management implications of embankment construction
Land Use: Environmentally-friendly land-use. Zoning for agriculture, residential areas. No change waterbody areas: Includes river dredging. Application of NWPo and Fisheries Policy. Strict regulation of waste disposal; proper waste collection and sanitation in cities. Integrated management in the Coastal Zone. Industry controls to prevent land and environment (but not specifically water) degradation.	Possible agriculture – fish/fisheries clashes. Pollution control benefits form waste, sanitation and zoning measures. NLUPA potentially beneficial for waterbody maintenance. Key areas for co-ordination with WARPO
New Agricultural Extension: Control and prevention of pollution and degradation; EIAs and monitoring; environmentally-sound practices, such as IPM	Control and prevention of pollution and IPM directly relevant to the water resources sector.
Wetland (draft): Wetland conservation, sustainable development and biodiversity conservation; maintenance of wetland functions; people's participation in development decisions; wetlands survey and database:	Conforms with and overlaps Water Policy; careful definition of wetlands required

Source: NWMPP, DDS: Annex G, 2000

Figure B 1: Modified DoE Environmental Clearance Procedures for FCD / I



NOC = No Objection Certificate, usually obtained from local government.

Note: 1. These requirements vary from those of the DoE (1997) in requiring EMPs for proposed, as well as current, projects. Automatic application of Red Category procedures and regular renewal of Certificates are not appropriate for all FCD/I projects, especially small interventions with minimal impacts. Unless/until the procedures are formally revised, the DoE should be consulted for guidance on individual projects.

2. Procedure of obtaining Environmental Clearance:
   a) for Green Category Projects the gestation period for granting Environmental Clearance has been fixed at within 15 days;
   b) for Orange A, Orange B and Red Category Projects at first Location Clearance and thereafter Environmental Clearance will be granted. The gestation period for Location Clearance is within 30days for Orange A, and within 60days for Orange B and Red Category Projects.

Source: Adapted from the Environmental Guidelines for Industry (DoE, 1997)

Table B 3: The Main Institutions Active in the Water Sector

Ministry	Organisation	National/Regional								Regional/Sub-Regional							Local Rural/Semi-Rural								Urban		
		Policy	International river basins	National/regional planning & coordination	Laws, regulations, rules, guidelines etc	Economic instruments	Research/service/education	Flood warning dissemination	Data collection	Programme planning and coordination	Standards monitoring	Major river maintenance & erosion control	Barrages and transfers	Management of medium/large FCD	Regl river maintenance & erosion control	Large scale irrigation projects	Local area development planning	Rural/village water supply and sanitation	Management of small water bodies	Minor irrigation	Maintenance of local drainage	Flood proofing	Management of small FCD	Promotion/education/awareness raising	Urban development planning	Town water supply and sanitation	Flood protection/proofing and drainage
Inter-Ministerial	National Water Resources Council	■			■																						
	Executive Committee of NWRC	■			■																						
	National Economic Council					■				■																	
	Executive Committee of NEC					■				■																	
MoWR	Water Resources Planning Organisation	■		■	■	■																					
	Joint Rivers Commission		■																								
	Flood Forecasting and Warning Centre							■																			
	River Research Institute						■																				
	Surface Water Modelling Centre [1]						■																				
	Environment and GIS Project [2]						■																				
	B'desh Water Development Board								■	■	■	■	■	■	■	■				■	■	■	■				■
MoA	B'desh Agricultural Development Corporation								■											■	■						
	Dept of Agricultural Extension								■											■				■			
	Soil Resources Development Institute						■																				
	B'desh Agricultural Research Council	≈					■																				
	B'desh Agricultural Research Institute						■																				
	B'desh Rice Research Institute						■																				
LGRD&C	Local Government Division																■										
	Local Government Engineering Dept.								■								■				■	■	■				■
	Dept of Public Health and Education								■								■	■						■		■	
	Dhaka Water Supply and Sanitation Authority																								■	■	
	Chittagong WASA																								■	■	
Public Works	Rajdhani Unnayan Katripakha																								■		
Science & Tech	Space Research & Remote Sensing Org						■																				
MoEF	Dept of Environment				■				■		■																
	Forestry Department									≈							≈							≈			
Communications	Dept of Roads and Highways													≈									≈				
MoPS&IWT	B'desh Inland Water Transport Authority								■						■												
MoFL	Dept of Fisheries								■	■							■		■		■						
MoPlan	Planning Commission			■	■	■				■															■		
	B'desh Institute of Development Studies [1]	≈				■			■																		
	B'desh Bureau of Statistics								■																		
MoL	Ministry of lands				■														■								
MoI	Ministry of Industry				■												■								■		
MRDM	Disaster Management Bureau							■													■						
Other organisations																											
	LGI: Paurashava																■								■	■	
	LGI: Parishads																■	■	■		■	■		■			
	Community Based Organisations													■		■		■	■	■	■	■	■				
	Non-Government Organisations	■	■	■	■	■	■	■										■	■	■		■	■	■			
	Co-operatives																	■		■							
	Private Sector [3]							■										■		■				■			

Notes : [1]*Established as a not-for-profit trust* [2]*At present a project, due to become a trust in 2001* [3] *Excluding consultants and contractors* ■ *directly related to water sector activities* ≈ *Indirectly related to water sector activities*

Source: Draft Final Development Strategy Report (NWMPP, 2001)

Appendix C

Appendix C: Potential Environmental Impacts of FCD/I Projects

C.1 The Range of Possible Impacts

All positive and negative impacts of FCD/I projects related to the following should be assessed during the scoping process.

1. Land and land-use
2. Agriculture
3. Fisheries
4. Water quality
5. Water volumes and flows
6. Human health
7. Social issues
8. Wildlife and biodiversity
9. Natural hazards

The impacts may be beneficial or adverse, but environmentalists tend to be more preoccupied by the adverse impacts, as the benefits tend to be included in the project rationale and direct objectives.

C.2 Beneficial Impacts

The main beneficial effects of FCD/I will be those which are targeted in the project design, ie primary benefits of flood reduction/protection, improved drainage, improved irrigation, higher agricultural yields, etc - as well as secondary benefits such as improved nutrition livelihoods, health and well-being.

C.3 Adverse Impacts

Possible negative impacts of FCD/I projects include a wide range of direct and indirect impacts on the biophysical and social resources of the project area and beyond. The changed hydrological conditions produced by FCD/I embankments include:

- Reduced Inundation Period: Lower inflows of water and lower water levels reduce the inundation period in beels and waterbodies;
- Restricted Overbank Spills: Hatchling density is greatest in surface waters, and overbank spills allow large numbers of hatchlings and small fish to enter the floodplain, even though the spills are short-lived compared with flows in waterways. FCD/I embankments effectively prevent this type of fish recruitment;
- Water Fluctuations and Water Flow: The effects of regulators and embankments on water access to the floodplain are very often to reduce water level fluctuations. The latter are very important in mixing nutrients, stimulating breeding of small fish, and mixing species of different beels and rivers, thus increasing fish populations and strengthening biodiversity. Similar effects apply to other aquatic organisms, including aquatic vegetation. Without water level fluctuations and with lower inflows of river water, floodplain waters inside FCD/I schemes become less turbid, which is not good for the aquatic environment - as clear, stagnant water is lower in nutrients and encourages the growth of weed such as water hyacinth;
- Habitat Loss: Smaller floodplain areas mean smaller spawning and nursery grounds, and smaller areas for fish growth - hence lower fish production, not only within the FCD/I projects but also downstream.

In these circumstances the water flow of the internal channels and inundated floodplains which is very crucial driving force for fish/ aquatic organisms and plant breeding, dispersion and returning to over wintering ground stops.

Set against these adverse impacts, however, are the undoubted benefits of increased protection against flooding and the increases in agricultural production that this permits, provided that the embankment systems are properly operated and maintained. However, Operation and Maintenance (O&M) have proved particularly difficult (or impossible) in many places, and there are many instances of local people - even the supposed beneficiaries - cutting through embankments to relieve particular problems.

Flood-control structures often impart a false sense of security and encourage developments on low-lying floodplains inside the protected areas. However, the risk of flooding is not eliminated, only diminished, and unusually high floods or failure of control structures has led to disastrous results.

Other flood protection measures include modifications to natural water channels, such as dredging, clearance of vegetation and other debris, smoothing channel bed and walls and the channel straightening. All of these modifications help increase the capacity of a stream by increasing the volume of the channel and/or increasing the velocity of flow, thus reducing the build-up of floodwaters. Straightening the channel by eliminating meanders also helps reduce the risk that floodwater will breach the riverbanks on the outside of curves, where the current is most rapid and waters rise the highest. However, these measures may lead to increased bank and embankment erosion.

Floodways (high-flow diversions or spillways) are natural or artificial bypass channels that redirect waters around or away from urban centres or areas of high population density. Further downstream the water may be re-diverted back into the same, or a different, river.

These channel changes, and others resulting from interventions in other sectors (eg road and rail embankments and encroachment on river channels by buildings) obstruct flood flows and reduce floodplain storage capacity, with a corresponding increase in rainfall and floodwater run-off, thus increasing flood heights and velocities. These obviously increase the risk of loss or damage to neighbouring and downstream communities.

Increased rainfall run-off usually also results from human activities such as tree-cutting or forest clearance for agriculture and settlement in river catchments. Agriculture on steep hillsides without adequate terracing or contour planting has similar impacts. The blocking of rainfall access to natural drainage through the soil in settled areas, by activities such as building and road construction, also increase the volume and rate of runoff - as does the installation of stormwater drainage systems.

In coastal zones, potential aquatic impacts of FCD/I works include: spills and discharges from construction; location of new facilities too close to the waterline; land-take by (and, in some cases, contaminant releases from) dredging spoil deposits; surface runoff and point-source discharges, habitat destruction, changes in water chemistry and circulation and erosion and sedimentation from changed flow and wave patterns.

C.4 Impact Assessment Process

(a) ***Role and Importance of the IECs*:**

(i) key links (direct and indirect) in the economic base of the nation, region, or locality (eg water resources links with fish production);

(ii) key links to human health or survival (eg fish as a source of animal protein);

(iii) key resources, including local needs and rare or endangered species/or special habitats (e.g. fuel wood supplies; Royal Bengal tiger);

(iv) irreplaceable cultural resources (e.g. archaeological and religious sites);

(v) resources important to future generations (eg specific paddy germplasm);

(vi) variation in abundance or quality over time (availability of hilsha spawning and nursery);

(vii) importance to ecosystem structure and functions, or as a surrogate for a component;

(viii) rare or endangered species/ or special habitats.

(b) ***Magnitude of the Impacts*:**

(i) percentage increase/decrease – eg in water volumes, flows and quality;

(ii) absolute changes (eg frequencies and/or durations of flood peaks and drought periods; size of at-risk populations; economic losses/gains);

(c) ***Areas*:**

Separate assessments, where necessary, for discrete area units (eg geographical units) to reflect non-uniform impact distributions;

(d) ***Communities*:**

Separate assessments, where necessary, for discrete communities, to reflect non-uniform impacts on different communities or sections of the communities. Special attention must be given to disadvantaged groups of society which may not have an effective 'voice' in development, such as the poor, the landless, the minorities, and female-headed households.

C.5 Common FCD/I Project Components with Environmental Implications

C.5.1 Pre-construction Phase (Planning, Exploration and Study)

(i) Land, topographic and benchmark surveys
(ii) Hydrological and climatic surveys
(iii) Land use and natural resource inventories
(iv) Socio-economic surveys
(v) Land acquisition process
(vi) People's participation

C.5.2 Construction Phase

(i) Land acquisition practices

(ii) Population resettlement (social and infrastructure issues)

(iii) Access:

- road construction and maintenance, including temporary roads
- vehicular traffic pattern changes
- pedestrian traffic pattern changes

(iv) Temporary structures and land occupation:

- storage and godowns
- staff and labour camps
- garages and parking sites
- canteens and kitchens
- waste and garbage disposal sites
- water handling and storage facilities, including bathing facilities

(v) Excavation of canals:

- Drainage
- irrigation
- navigation
- fisheries

(vi) Embankment construction

- labour mobilisation
- soil taking and borrow pit construction

(vii) Installation of tubewells and associated electricity and energy supplies

(viii) Construction of hydraulic structures:

- sluice gates
- regulators
- culverts
- fish ladders
- navigation lock gates
- pump houses
- irrigation canals

C.5.3 Operation and Maintenance Phase

(i) Operation and maintenance of:

- sluice gates
- regulators
- fish ladders
- navigation lock gates
- pump houses
- embankments
- drainage channels
- irrigation canals
- cyclone and flood shelters

(ii) Agricultural development:

- institutional development
- agricultural extension
- credit inputs
- seed acquisition and distribution
- fertiliser storage and application
- pesticide storage and application
- irrigation
- establishment and operation of cooperatives and resource user groups

(iii) Development of infrastructure and supply services

(iv) Initiation of project:

- community educational programs
- project support programs

C.5.4 Decommissioning Phase (Post-project)

- Land reclamation
- Monitoring and evaluation

C.6 Sample Sequence of Environmental Impacts of FCD/I Projects

(a) First Order Impacts: Direct Effects of Project Interventions

eg Changes in topography, land-use and water characteristics.

(b) Second Order Impacts: Off-Site and Medium-Term

eg Siltation/erosion; changes in water availability and consequent cropping changes; changes in natural flora and fauna and general ecology.

(c) Third Order Impacts: Long-Term

eg Changes in river course or character; Changes in bed-levels; changes in soil and water quality.

(d) Fourth Order Impacts: Economic/Financial

eg Fish production; livestock and wildlife/endangered species; employment, living standards and incomes.

(e) Fifth Order Impacts: Social

eg Reduction in loss of life; impacts on structures/locations/activities of historical, social or cultural value; impacts on social and cultural strains and patterns of different sections of community inside/outside the protected area.

(f) Required Levels of Quantification

First Order Impacts	-	Complete quantification, if possible 100%.
Second Order Impacts	-	High level quantification, target 60-80%.
Third Order Impacts	-	Quantification as far as possible, target 20-30%.
Fourth Order Impacts	-	As far as possible impacts to be converted to Taka values.
Fifth Order Impacts	-	Size of PAPs and the judgement of the EA Team.

C.7 Final Checklist for EA Assessment

- Does the screening result accurately reflect the project's likely level of impacts?
- Are all the significant impacts identified and, where possible, adequately quantified? In particular, are the cumulative and residual impacts covered?
- Are all the mitigation measures, and local reactions to them, properly presented?
- Are the assumptions behind the EA fully valid? ie does the risk analysis adequately indicate the consequences if the EA has:
  - underestimated the severity of adverse impacts;
  - overestimated the effectiveness of designs and operations (including mitigations and enhancements);
- Have all the reasonable project and/or component alternatives (including the 'do-nothing' alternative) been discussed and the reasons for selection/rejection adequately explained?
- Is there the summary adequate for EA reviewers, decision-makers and project executors? Does it cover all the key points?
- Does the EMP:
  - cover all the management/monitoring issues?
  - present clear and practical implementation recommendations?
  - include complete costs?

Appendix D

Appendix D: People's Participation

D.1 Objectives of People's Participation

The overall aim of the participation process is to ensure that the groups affected by a proposed intervention (ie a project or programme) have the opportunity to decide whether or not it should be implemented and – if it is to go ahead - to modify it if necessary. This Appendix briefly summarises the GPWM contents (MoWR 2001) relevant to EAs.

The overall objectives of people's participation are to:

- Elaborate the provisions incorporated in NWPo, 1999 in respect of stakeholder participation/ involvement.
- Increase/ improve stakeholder participation/ involvement in water management.
- Give the local stakeholders a decisive voice at all stages of water management.
- Raise environmental awareness among the local stakeholders and the implementing agencies involved with participatory water management.
- Achieve sustainable participatory water management.

As a part of EAs, the primary objectives of people's participation are to:

- ensure that local people participate fully and have a recognised role in decision-making during project planning;
- enable a dialogue between project planners and local people on all project-relevant topics, such as social conditions, land values, resources usage, informal and customary rights, environmental concerns etc. - so that local knowledge and ideas inform the technical design and development of the project. In particular, this is intended (i) to help characterise the environmental baseline conditions; (ii) to identify the Important Environmental Components (Section 3.5.2) and issues, (iii) to provide a basis for accurate appraisal of project impacts and (iv) to allow equitable standards for mitigation and compensation to be drawn up;
- ensure early detection of possible social conflicts arising from the proposed interventions, and explore ways to minimise them - eg through negotiation and education;
- ensure the establishment of organisations and procedures to enable local people to participate in the construction, operation, and maintenance – as well as non-structural elements - of FCD/I projects.

People's participation should be developed as a 'bottom-up' planning process, in which local people are fully involved in shaping their own future, rather than being objects in a 'top down' planning approach. This can also be expressed as the need for water management to be demand-driven by the participatory process and not exclusively supply-driven by the needs of the project.

D.2 Stakeholders and Stakeholder Organisation

Stakeholders in participatory water management include

- Local stakeholders
- Water Management Organisation (WMO)

- Local Government Institution (LGI)
- Non-Government Organisations (NGOs) Community Level Self-help groups
- Private Sector Service Providers
- Implementing agencies
- Other Public Sector Agencies

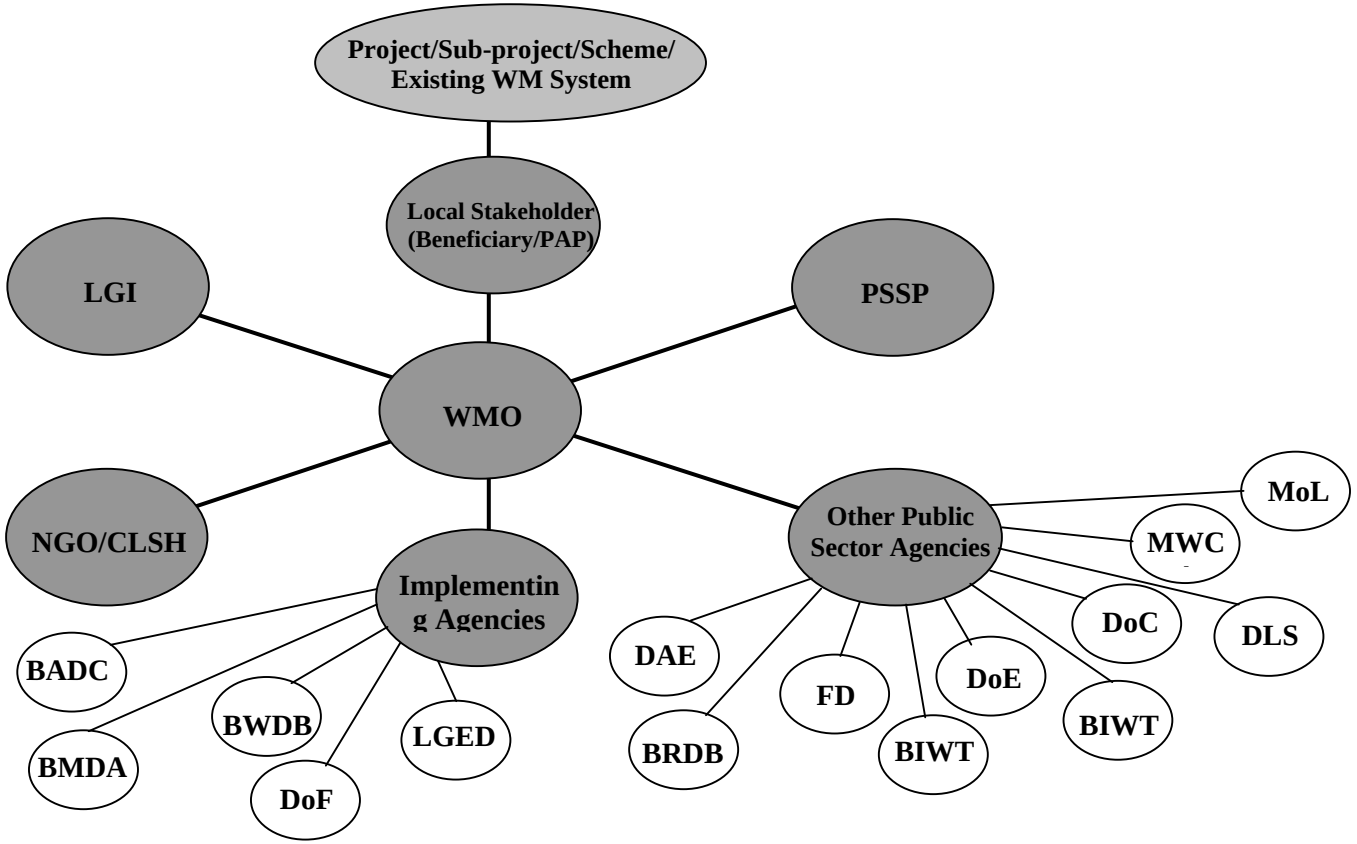
Inhabitants of an area who are directly or indirectly affected by water management are referred to as "local stakeholders". Any individual or group who, in one way or another is favourably influenced by a water resource project is a beneficiary. Any individual or group who is adversely affected by the intervention of a water resource development project is known as a Project Affected Person (PAP).

The beneficiaries and PAPs can be women and men farmers, fishermen, small traders, craftsmen, boatmen, landless people, destitute women or any other member of the local community. Through the process of participatory water management, it will be ensured that the PAPs are appropriately compensated for any loss or negative effect, that the PAPs will not be worse off due to project/ sub-project/ scheme intervention and the issue will be monitored. The Local Government Institutions (LGIs) will provide supporting, facilitating and coordinating assistance to the concerned water Management Organization in respect of participatory water management at the local level (BWDB, LGED, BADC, BMDA, DoF etc.).

D.3 Framework for People's Participation

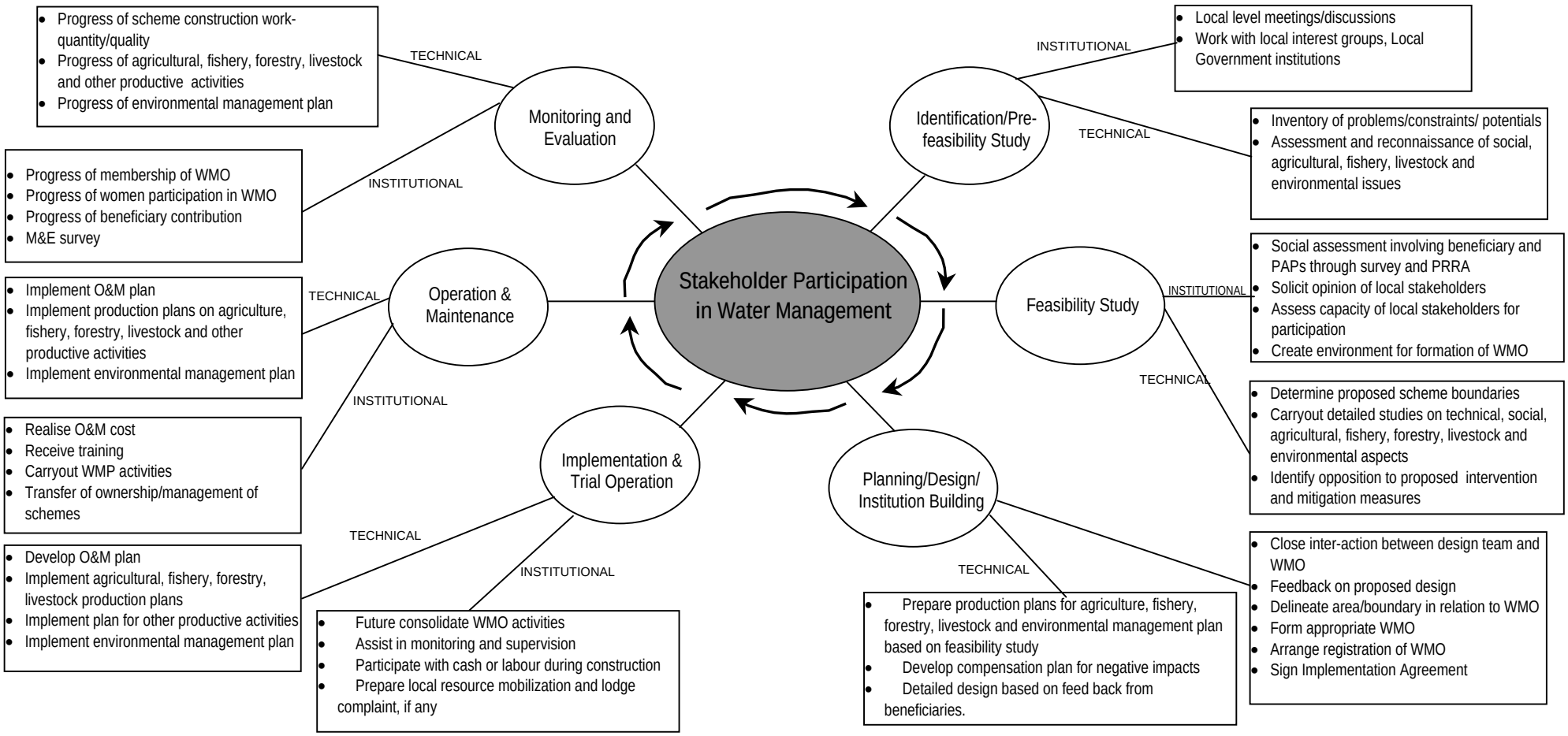
Figure D.1 and Figure D.2 summarise the types of stakeholder envisaged and the main activities at different stages of project planning.

Figure D.1: Stakeholders in Participatory Water Management



Source: GPWM, MoWR 2001

Figure D. 2: Stakeholder Participation in Project Planning and Implementation



Source: GPWM, MoWR 2001

Community concerns should be addressed by the following process given in the GPWM (MoWR 2001):

- Presentation of the project proposals in village-level scoping sessions throughout the study area;
- Provision of an organisational context within which local communities can formally respond to project designs;
- Ensuring that EA and engineering design specialists respond personally to community concerns about the potential impacts of the project;
- Ensuring that community recommendations are built into project designs and implementation;
- Consultation with stakeholders (Figure D.1) on alternative projects or components and/or environmental management, including: mitigation, compensation and enhancement packages.

Starting with local stakeholders, the consultation must be genuinely interactive. Members of all communities directly or indirectly affected by a project, both favourably and unfavourably, should participate in the people's participation process. The participation should include local interest-groups, socio-political factions local government institutions (LGIs) and other relevant entities through involvement in local level committees, associations, societies, cultural and other interest groups.

Appendix – E

Appendix E: Data Requirements for EAs

E.1 Introduction

This Appendix consists mainly of checklists for use in EAs of FCD/I projects. The issues are covered in more detail in the EA Manual. The information requirements are similar for both pre-feasibility and feasibility level investigations, but there are differences in the detail and scales of data and information used. Pre-feasibility investigations normally rely on existing information supplemented by rapid field reconnaissance methods. Feasibility studies require more specific investigations and longer-term data gathering programmes. Only the data relevant to the project under investigation and its likely impacts should be collected and used for the EA. For many multidisciplinary studies only a brief summary of particular items is needed with a cross-reference to more detailed discussions in other sections of the project report.

E.2 Climate

(a) Rainfall pattern for the study area. Maximum, minimum and mean monthly rainfall for the period of record (up to a maximum of about 30 years), including variability in seasonal rainfall and the confidence limits. Cropping seasons related to the rainfall (acceptable range, flooding range, drought range). Location of all recording stations for which data are presented;

(b) General patterns of ambient temperatures and humidity and monthly means, maxima and minima for the period of record (up to a maximum of about 30 years). Indicate the location of all recording stations for which data are presented;

(c) Evaluate agroclimatic conditions in the study area;

(d) For coastal areas, the storm and cyclone patterns and antecedent weather conditions, the seasons of highest occurrence of destructive coastal weather patterns, and the historical record of cyclone and flood damage.

E.3 Water Resources

E.3.1 Surface Water Flow and Volumes

(a) Description and map of the general pattern of surface water distribution and major drainage patterns, including rivers, small waterways, beels, haors and flooded areas.

- Natural and artificial drainage systems that affect the project area (ie include relevant upstream and downstream systems)
- Seasonal changes in water levels and drainage
- Extent, periods of occurrence and causes of waterlogging
- Effects of existing infrastructure (roads, canals, building platforms, etc.) on drainage
- Extent of hydraulic interconnections (“connectivity”) between the main rivers and the floodplains.

(b) Description and map of river erosion hazards(but not duplicating the information under Section E4.3(c).

(c) Analyses of river stages, discharges and low flows for dry months for standard return periods. Major consumptive water users that affect flow conditions in water bodies, especially irrigation. Indicate the availability of water for irrigation.

Mathematical models should be used where detailed predictions of, for example changes in river hydrology, sedimentation or morphology are needed. However, the accuracy of all output should be clearly indicated, as well as the bases on which the model(s) are built (eg number and location of sample site; number of year data; number of calibration points and years used etc.)

(d) Quantitative description of the hydrological cycle within the study area watershed(s) its component systems. Mean, maximum and minimum discharges and water levels for all major lotic (flowing) water bodies, including main river and canal sources and water levels for lentic (standing) water bodies such as haors, baors and beels. Location map of gauging stations for which data are presented.

(e) Quantitative description of historic hydrological problems in the study area, including flooding, flash floods, waterlogging and inadequate drainage. As far as possible locate the types, distribution and extent of such problems on maps and indicate their seasonally and their causes, both natural and man-made.

(f) For coastal areas and shorelines of major rivers, shoreline morphology and stability, and the major circulation patterns adjacent to any proposed structures.

E.3.2 Surface Water Quality

(a) Major physical, chemical and biological properties of the surface waters of the area that determine how they are used for:

- Domestic purposes
- Irrigation
- Livestock
- Fisheries
- Village industries
- Wildlife
- Other uses (specify)

Indicate the hydrological factors which affect water quality, eg seasonal flooding, and high/low water flows.

(b) Water pollution problems and their sources: types of pollutants, severity, and effects on water use. Human activities contributing to water pollution, specifically industrial discharges (deliberate and accidental), urban/ domestic runoff and agricultural drainage (especially pesticides and fertilisers). Evidence that pollutants are reaching groundwater. Potential toxicity of industrial discharges. Actions being taken, individually, communally or institutionally, to diminish or avoid pollution problems.

(b) Description of receiving water bodies in terms of flow rates, water quality characteristics, areas and volumes, and relationships to seasonal flooding patterns. Estimated pollution assimilation capacities of these water bodies related to dispersion capacity; seasonal variations.

Evidence that flow reductions (eg because of irrigation) result in declining water quality by reducing dilution.

(c) Change in water pollution in the last 10 to 20 years. Specifically:

- Relationship to FCD/I activities, including upstream diversions
- Reduction in flows
- Reduced drainage

- Water quality changes related to land or water use (increased industrial discharges, urbanization, population growth in villages, increased use of agricultural chemicals)
- Evidence for links between changes in water quality and changes in public health.

Evaluate whether water quality trends will continue for the foreseeable future, specifically considering increased industrialisation, rate of population growth, agricultural improvements, changes in national, regional, or local pollution control regulations and practices.

E.3.3 Salinity

For project areas located in coastal areas:

(a) Effects of seasonal flooding cycles, amounts of inflowing fresh water, rainfall, tidal action and cyclonic storm surges on water salinity in the area.

(b) Evidence for salinity changes due to human activities, particularly deliberate breaching of embankments or poor operation of control structures. Water uses in the area requiring certain levels of salinity (eg shrimp culture, salt extraction, etc.)

(c) Changes in resource use relate to salinity (eg changes in cropping patterns, replacement of rice cropping with shrimp culture, etc) and the economic effects of such changes.

(d) Trends in soil and/ or water salinity during the past 10 to 20 years. Identifiable causes of such changes and identifiable effects on fisheries, agriculture, wildlife, forests and afforestation, settlement patterns and infrastructure. Expected trends over the next 10 to 20 years.

E.3.4 Groundwater

(a) Quantity and quality of groundwater in local and regional contexts. Specifically note whether the resource is part of a larger aquifer. Evidence for overuse (withdrawals exceeding recharge) or pollution.

(b) Groundwater recharge patterns in the area and their relationship to seasonal rainfall, river discharges and flooding.

(c) Quantify the numbers and types of users of the groundwater resource:

- Numbers of wells by type (HTWs, STWs, DTWs)
- Uses for each type (domestic, industrial, agriculture)
- Volumes or percentages by well type.

Types of user dependency (casual use, required use, etc.) and the relationship of use to the hydrological cycle. Note any alternative water sources available to these users.

(d) Apparent trends in groundwater exploitation and use for the past 10 to 20 years and trends into the future. Specifically indicate changes due to:

- HYV agriculture and increasing use of STW and DTW irrigation
- Previous FCD/I schemes
- Changes in river discharges
- Reductions in dry season surface water flows
- Salt water intrusions

Linkages of these changes to socio-economic factors, such as:

- Drinking water and public health
- Agriculture
- Industrial water use
- Replacement of STWs by DTWs or HTWs running dry
- Effects of on local and/ or regional economics
- Avoidance of contaminated groundwater supplies

E.4 Land Resources

E.4.1 Topography

Description and map of the land types (F0, F1, F2, F3, and F4) within the project area (MPO Flood depth categories, 1985).

E.4.2 Land Use

Description and map of present (and, where relevant and possible, future) land use within the area, geographically and by percentage of area. Categories should include:

- Agriculture- irrigated and rainfed (but not duplicating information under E.4.4
- Natural woodland and scrub
- Plantation forest, including orchards
- Grassland/ pasture, including long-term fallow
- Permanent water bodies
- Temporary or seasonal water bodies
- Coastal areas, including forests, beaches and polders.
- Urban/ village/ settlements/ other surface infrastructure.

Note any conflicts in land use (eg bagda prawn farming and rice production)

Significant trends in land use patterns up to the present, and their likely continuance or anticipated change. Seasonal changes in land use patterns, specifically in relation to:

- Flooding
- Agriculture
- Social factors
- Other factors (identify)

E.4.3 Soils

(a) Description and map of the basic characteristics of soil series and phases that affect land use, particularly:

- Texture (topsoils and subsoils)
- Consistency
- Moisture retention
- Infiltration/ permeability
- Chemical composition (fertility, reaction (pH), etc.). Highlight problems (eg imbalances, deficiencies – such as Zinc and Sulphur)
- Salinity/ sodicity – natural and as a result of irrigation on other land use (eg bagda prawn farming)
- Flooding/waterlogging regime, natural and as a result of irrigation

(b) Crop suitability classification of the major soils of the area (also known as land capability classifications).

(c) Extent and severity of soil erosion in the area, especially on the following (but not duplicating information in E3.1 (b):

- Agricultural land
- Embankments
- Other soil-based structures
- Newly accreted land.

Indicate how erosion is related to human activities (soil take for embankments, house platforms, vehicular traffic, removal of vegetation cover, etc) and natural factors (river bank erosion, etc.)

(d) Description and map of areas where rivers and/ or canals deposit sediments. Effects on topsoil texture and fertility and on land-use.

E.4.4 Agriculture and Livestock

(a) Description and map of the major agricultural cropping patterns in the area (in more details than the outline under E4.2 including food and fodder crops and cash crops.

(b) Description of the types of rice in each of the three growing seasons, specifically:

- The percentage of total rice production from each of the aus, aman and boro crops
- The areas and percentages of cultivated land under these different types of rice.

(c) Details of irrigation: sources, methods, seasons

(d) Homestead vegetation: Species abundance and distribution of: fruit, timber and fuelwood trees and their susceptibility to floods, drought and other natural and/or project related factors.

(e) Quantify land types and seasons in which past crop damage has occurred as a result of:

- Floods
- Drainage congestion
- Drought
- Hail
- Other climatic and hydrological factors
- Project related factors

(f) Trends in cropping area, intensity, production, and types in the above crops over the previous 10 to 20 years, and constraints/causes, eg:

- Flood management
- Surface irrigation
- Groundwater irrigation
- Improved agricultural technology
- Difference between socio-economic groups.
- Comparison of local and national trend
- Expected trends over the next 10 to 20 years with and without project activities

(g) Agricultural inputs for the major crops:

- Seeds, seedlings and saplings
- Organic manure
- Chemical fertilisers
- Biocides (pesticides, herbicides etc.)

(h) Estimates of the numbers of livestock kept by various social groups and their uses for:

- Draught power
- Food sources (meat, milk)
- Other products (leather)

Marketing procedures for livestock and livestock products.

Constraints on livestock maintenance and production, and past/future trends in numbers and production, especially related to:

- Feed and fodder availability
- Disease and treatment facilities
- Flood-related factors

E.4.5 Renewable Energy Resources

(a) Major sources of biomass fuel in different seasons:

Fuelwood, leaves and twigs; agricultural wastes, including residues, bagasse, etc.; manure

Major uses of such fuel for: cooking; crop processing; manufacturing (eg brickfield)

(b) Shortages or constraints on production and/ or use of renewable energy in the area, including factors such as:

- Changes in land use patterns (eg conversion of forest land to cropland)
- Reduction in land area available for fuel production, eg community forests

Programmes to alleviate fuel shortages, eg community forests, agroforestry, homestead

forests, etc.

(c) Describe existing and planned electrical energy use and distribution in the area, and its use for:

- Domestic purposes
- Industrial uses (including cottage and rural industries)
- Irrigation and agricultural uses.

E.4.6 Water Transportation

(a) Describe the navigational use of waterways (rivers, streams, beels, etc.):

- Map of geographic distribution and navigable lengths, with BIWTAa route classifications
- Ports or landings
- Infrastructural facilities
- Changes in relation to the annual flooding cycle
- Key factors that affect navigation:
- Water flowing into the area from outside
- Sedimentation of channels
- Presence of embankments and regulators
- Aquatic vegetation (eg water hyacinth)

(b) Trends in navigational use of waterways in the area related to: erosion, sedimentation, flow reductions, FCD/I developments, etc. Socio-economic responses to these trends, eg increased use of roads, breaching of embankments and economic changes.

E.5 Biological Resources

E.5.1 Open Water Capture Fisheries

(a) Description and map, where possible, of aquatic habitats, eg:

- Baors (old channels "oxbo Lakes" of meandering rivers)
- Beels (permanently or seasonally flooded depressions)
- Haors (large depressions between river levees)
- Canals and drains
- Estuaries (mixing zones between fresh and salt water)
- Floodplain
- Lakes and reservoirs
- Rivers (permanently flowing water bodies)

(b) Description and quantification of habitat types according to their distribution, total area, range of areas of individual bodies, relationship to the seasonal hydrologic cycle, and physical, chemical and biological properties.

- Shoreline characteristics (vegetation, erosion, etc.)
- Water temperature
- Color
- Turbidity
- Total suspended and dissolved solids
- Electrical conductivity
- Salinity (TDS)
- Dissolved oxygen
- Biological oxygen demand
- Acidity and alkalinity
- Total inorganic and organic nitrogen
- Total phosphorous
- Chlorides and sulfates
- Heavy metals
- Phytoplankton
- Zooplankton
- Periphyton
- Macrophytes
- Macro-invertebrates

(c) General fish/aquatic community structure and species diversity in each habitat type (including prawns and shrimp). Changes related to the hydrologic cycle.

(d) Fish/aquatic population structure, expressed in terms of:

- Dominant species
- Rare, threatened and/ or endangered species
- Stages of maturation
- Spawning sites and seasons by species

Aquatic population structural changes related to changes in the hydrologic cycle.

(e) Migratory behavior of aquatic species and dependence on the hydrologic cycle.

(f) Types of fishing gear used by the various categories of fishermen, including:

- Nets (grill, net, lift, cast, push, etc.)
- Traps, crafts
- Harpoons and spears
- Hooks and lines

Indicate how the gear is used relative to habitat types and to the hydrologic cycle, and its impacts on fish and other aquatic species.

(g) Quantified seasonal intensity of fishing in the various habitat types by numbers of capture (gear) units for each category of fishermen and/ or numbers of fishermen per unit of habitat and time. Desirable statistics include catch per unit effort (CPUE) expressed as weight (kg) of fish caught (by species if possible) per category of fishermen per unit of fishing time.

(h) Total production (including shellfish), preferably on a monthly basis, for each habitat type. Distribution by species, category of fishermen, types of gear and hydrologic seasons.

(i) Description of the effects on the aquatic environment of fisheries management in the area, including the following (note that details of the management system appear under Section E 6.2(h):

- Short-term leasing under the MoL *jalmohal* system
- Leasing by the DoF under the arrangement currently (February 2001) under discussion with the MoL. New Fisheries Management Policy (NFMP)
- Enforcement of fishing regulations
- Management practices, including fish stocking programmes

E.5.2 Closed Water Culture Fisheries

(a) Status of fish culture in the area, including average pond size (and limits) for various types of impounded water bodies:

- Aquaculture types
- Cultured (actively stocked and harvested)
- Potentially cultured (suitable for culture but not actively stocked)
- Derelict (not suitable for aquaculture in present condition due to flooding or structural deficiencies)

(b) Type of culture practice:

- Species stocked
- Stocking rates and ratios
- Seed sources (river or hatchery)

- Pond fertilization and/ or fish feeding practised

(c) Production (by various pond types):

- Total production (kg/ha)
- By species (kg/ha)

(d) Extent of fish culture extension services.

E.5.3 Wildlife

(a) Identification and map of all major terrestrial wildlife habitat types in the project area:

- Open fallow land
- Agroforest
- Plantation forest
- Roadside vegetation/ community forest
- Homestead vegetation
- Deciduous forest
- Evergreen forest

Characterise and quantify each habitat type according to plant species composition, canopy cover, amount of edge vegetation, ecotones, ecological requirements of vegetation, and problem vegetation.

(b) Quantification of the habitats according to:

- Areas of habitat within different land types (related to area elevation and flood levels)
- Changes in habitat quality (loss, improved protection, etc.)
- Seasonality of availability and use.

(c) Terrestrial wildlife profile based on:

- Species (by amphibians, reptiles, mammals and birds, dominant, residents and migratory species)
- Distribution, relative abundance and status of populations

Brief comparison of local species numbers and distribution and the local quality of habitats with regional and national characteristics.

(d) Identification and map of all major aquatic wildlife habitat types in the project area:

- Permanent wetlands (rivers, canals, beels, pits, ponds, lakes, mangroves, etc.)
- Seasonal wetlands.

Characterisation and quantification each habitat type according to surface area, water depth, flow, direction, tidal influence, vegetation cover (macro-phytes, algae, etc.), edge vegetation, ecotones, ecological requirements of vegetation, and problem vegetation.

(e) Physical and chemical characteristics of waters in representative wetlands (turbidity, odor, pH, dissolved oxygen, CO_2, chloride, nitrate, iron, alkalinity, total hardness, ammonia, salinity, pollutants and organic matter).

(f) Aquatic wildlife profile for the study area based on species and trophic levels – plankton, benthos, fish, reptiles, amphibians, birds, mammals, dominant, migratory species, and residents. Brief comparison local species numbers and distribution and the local quality of habitats with regional and national levels.

(g) Commercially important wildlife resources by

- Species and population
- Extent of trade (local consumption, export, etc.)
- Hunting and trapping (legal and/ or illegal)
- Recreational value of wildlife (local and foreign visitors)

(h) Rare, threatened and/ or endangered wildlife species by:

- Species
- Critical habitat
- Status and distribution
- Causes of changes in number
- Possibilities for enhancement

(i) Describe wild predator/pests in the study area:

- Species and populations
- Damage extent and seasonality
- Present control measures (effectiveness; and cost)
- Possible biological control
- Identification of pesticides (including insecticides) used and any known effects on the ecosystem
- Identification of pest predators and the possibility enhancement through habitat improvement.

E.6 Human Resources

E.6.1 Socio-Demographic Conditions

(a) Quantification and description of the total population of the project area, growth rates, densities, male-female ratio and the distribution of population by religion and ethnic groups.

(b) Percentage of population affected by flooding, water logging, drainage congestion, erosion and other water related management problems and the extent of each of these conditions. List of the areas (by unions, mouzas and villages) affected and the present responses of communities to floods and various flood related conditions.

(c) Settlement patterns, house types, family types, size of family, numbers of households, location of urban industrial centers, numbers of markets/ central places, historical and cultural sites, transportation and communication facilities.

(d) Map of the following on a base map showing land types, water bodies and major infrastructure:

- Habitation sites (hamlets or paras)
- Village boundaries (mouzas)
- Common access areas
- Social services (eg schools, hospitals/ dispensaries, government offices, banks)
- Cultural sites (eg mosques, temples, churches, shrines, sacred streets, archaeological and historical sites, graveyards, fairgrounds)
- Markets (hats and bazaars)
- Rural industries (e.g. cottage industries, handicraft and boat building centers)
- Transportation routes (rivers, roads and railways, fish landing sites, transhipment locations)

(e) Annual cycles of activity, including:

- Seasonal and hydrological calendar
- Agrarian calendar (including cropping patterns)

- Fishing calendar (including fish breeding cycle)

Note interrelationships and dependencies between the various cycles.

E.6.2 Socio-Economic Conditions

(a) The main economic activities (agriculture, fisheries, business etc.) and the percentage of households in various occupations. Describe the basis of livelihood of the poor, with special emphasis on fishermen, boatman, landless laborers and women (especially female-headed households) that may be affected by project interventions and land acquisition.

(b) Quantification and description of all the socio-economic groups in the project area:

- Landowining farmers (categorise by absentee/ resident landowners and by farm size)
- Landless farmers (categorise by lessors, sharecroppers and seasonal agricultural laborers)
- Professional and subsistence fishermen
- Boat owners/ operators and boat builders
- Village artisan groups
- Petty traders/ shopkeepers and merchants
- Workers in rural industries and support sectors (e.g. transportation)
- Teachers
- Religious leaders
- Government officials
- NGOs
- Women from each of the above groups (including female-headed households), their contribution to family income and food security, and their status within the household and the community.

(c) Socio-economic condition of each group in terms of:

- Land tenure and ownership distribution of land
- Household income and assets
- Level of literacy, attendance and drop-out rates
- Nutritional level and seasonal variations
- Opportunities for employment and income generation, wage rates and seasonal variations
- Demand for and use of government and non-government services (eg education, health and credit facilities)
- Demand for and use of natural resources
- Access to common areas or informal access rights to land and water resources
- Access to tenancy and credit markets
- Access to safe water supply and sanitation
- Access to markets and infrastructures
- Nature and type of internal social organization and or community organization.

(d) Formal and informal social groups and leaders, leadership structure, resource and credit user groups, farmers organization and conflicts (if any) over land and/or water sharing.

(e) Describe the “patron-client” system of “leader-follower” dependency relationship in the area. Assess the effects of such socio-political networks on resource/ benefit distribution and social participation of people in flood management projects. Note actions that would be required to enhance project success, particularly through public participation.

(f) Description of land tenure and ownership in the study area. Categorise land ownership and occupancy in the area in terms of:

- Land types
- Geographical distribution
- Privately owned by residents and absentees
- Publicly owned (government at all levels)

(g) Categorise land occupancy and use by:

- Land type categories
- Owner
- Lessee
- Squatters/ slums
- Common property resources

(h) Description of fishery management in terms of the following (note that effects on the aquatic environment appear under Section E5.1(i)):

- Leasing arrangements (eg leasing of the resource to private individuals and cooperatives)
- Traditional fishing rights and problems
- Licensing of fishermen for fish-catching
- Enforcement of regulations and leasing rules
- Conflicts

Indication of

- How management system affects the fishery and fishing community
- Who controls the open water capture fishery resources in the area
- How the benefits of leased fishery resources are distributed among lessor, lessee and the fishermen
- The socio-economic structure of the culture fishery in the area and how it is managed or controlled.

(i) Fish marketing in the area (capture and culture fishery), specifically identifying marketing channels, intermediaries/ middlemen, buyers, trading spots/ localities and marketing facilities.

(j) Marketing procedures for livestock and livestock products

(k) Socio-economic importance of the navigation system in terms of:

- Numbers of people depending directly on the use of waterways for transport
- Classes of users
    - Boat owners and operators
    - Shippers of goods
    - Passengers extent of dependence of local and regional economies on river transportation
- Movement of goods (tonne-kms, category of goods)
- Movement of people (passenger-kms)
- Income to the sector

(l) Socio-economic and technological changes in the area during the previous 10 to 20 years, especially those related to trends and changes in the natural resource base. Role of population growth in such changes and the role of FCD or FCD/I projects in the area. Trends over the past and likely future trends with and without the project.

E.6.3 Public Health

(a) Sources of domestic water in the area (drinking/ cooking, bathing and laundry) and the seasonal changes.

(b) Description and map of the distribution of tubewells and other protected water sources in the study area. Number and proportion of households:

- having access to tubewells for drinking water
- by season
- affected by arsenic contamination (>0.05ppm) of the groundwater.

(c) Present conditions of disposal of domestic sanitary waste in homesteads, villages and urban areas, and any relationships to the seasonal hydrologic cycle. Quality of receiving waters, especially with regard to faecal coliform bacteria.

(d) Outline of the seasonal distribution of diarrhoeal and other vector-related diseases in the area (include links with hydrological modelling).

(e) Nutritional status of the various social groups in the area, if possible using rapid rural appraisal techniques (link with fisheries needed).

E.6.4 Hazards

(a) Flooding history of the area in recent decades, using land types as a measure of flooding depth. For dry, normal and wet years show:

- Area
- Duration
- Numbers of affected homesteads
- Numbers of affected people

(b) Area and location of land in the area protected by embankments. History of and rationale for, these embankments

- including reference to embankment failures, breaching and erosion.

(c) Non-flood related risks to crops in the area, e.g.

- Pests and crop diseases
- Drought
- Failure of irrigation systems
- Agricultural inputs supply problems (eg fertilizers, pesticides)
- Sand deposition
- Others

(d) Other natural hazards, including earthquakes, cyclones, tornados, hail storms, tidal surges, etc. Known occurrence, severity, and impacts.

(e) Changes in frequency or severity of flooding over the last 10 to 20 years. Damage and loss of life have been related to the magnitude of the event and to other factors, such as increased population density, shifts in population, increased value of infrastructure, etc.

(f) Past and future trends with and without the project. Describe any new hazards being added to the region through development activities not directly related to the flood cycle.

E.6.5 Cumulative Impacts & Constraints

(a) Possible implications of regional and global environmental changes including greenhouse effect changes.

(b) Regional and transboundary patterns of land and water use and other human activities which may affect flow, siltation, erosion, water quality etc.

(c) Cumulative impacts of the proposed project and other project affecting the same IECs.

Appendix - F

Appendix F: Recommended Contents for EA Reports

F.1 General

This Appendix presents separate checklists of contents for IEE and EIA reports, since the level of detail differs between the two. For a specific project only the relevant topics should be included. “Project” is used to mean both project and programme. Sections should be added, deleted and/or amalgamated as necessary.

F.2 Contents of IEE Reports

(For many projects - especially small projects, or those with small impacts - the IEE information may be presented mainly as a table, with minimal supporting text).

List of Contents; List of Tables; List of Figures

Executive Summary

1 Project and Report Setting

Project background; Legislative and planning frameworks (eg DoE regulations, regional plans); IEE aims, methodology, scope and limitations; Relationship with other components of the study; report layout; Acknowledgements.

2 The Proposed Intervention

Project aims, justification and future-without-project description; Project description, including alternatives and previous studies: activities at pre-construction, construction, and operation and maintenance phases.

3 Environmental Assessment Approach and Methodology

Screening in accordance with DoE criteria; Scoping and bounding: IECs; Cumulative impact assessment; Bounding of possible impact areas; Information deficiencies. Cross-reference to Chapter 4, People's Participation.

4 People's Participation

Following the GPWM Guidelines, consultations with, and participative actions of, local people, elected representatives, NGO’s and government officials; Local people’s priorities.

5 Baseline Description of the Existing Environment

Natural physical environment: topography, climate (including climatic change), surface water hydrology, groundwater hydrology, land resources; natural hazards - cyclones, river flooding, rainfall flooding, riverbank erosion;

Natural biological environment: flora and fauna (especially fish); biodiversity issues; ecologically-sensitive areas (ESAs);

Socio-economic environment: administration, demography, settlement patterns, women’s issues, drinking water, sanitation, human health and nutrition, education, landscape aesthetics, cultural and archaeological sites, ESAs, economic development, common resource rights, agriculture, forestry, livestock, fishing, rural energy, employment, industry, access and transport.

6 Environmental Impact Assessment

Assessment methodology; Summary of project impacts assessed against the 'future-without -project' conditions; Impact matrix; Beneficial impacts and adverse impacts, including direct, indirect and cumulative impacts on the IECs - quantified and valued - at the planning, construction and operation

stages; External and cumulative constraints and impacts, upstream and downstream; Uncertainties in the impact assessments.

7 Environmental Management

Beneficial impact enhancements and adverse impact mitigation; Compensation measures; Residual impacts; Environmental protection plan: Environmental risks and contingencies, Implementation arrangements: Stakeholder participation; Quantified and costed environmental monitoring programme, including organisational and institutional arrangements; Implementation schedule; Reporting and accountability.

8 Conclusions

Summary of impact assessment and recommendations for future work, especially for the follow-up EIA study, if required.

List of Acronyms and Abbreviations; Glossary of Technical Terms; References; Appendices.

F.3 Contents of EIA Reports

List of Contents; List of Tables; List of Figures

Executive Summary

Part A - The Project Setting and Study Methodology

1 Introduction

Project background and objectives; EIA aims, scope and limitations; Relationship with other components of the study; Report layout; Acknowledgements.

2 Policy, Legal and Organisational Framework

International treaty obligations; national policies; environmental laws, rules and regulations; environmental and project planning guidelines and directives; institutional framework.

3 Project Description

Project aims, justification and future-without-project description; Project description and previous studies: activities at pre-construction, construction, and operation and maintenance phases; Selection of project alternatives; Overall project schedule and logistics.

4 Environmental Assessment Approach and Methodology

Screening in accordance with DoE criteria; Scoping and bounding: IECs; Cumulative impacts; Bounding of possible impact areas; Information deficiencies. Cross-reference to Chapter 5, People's Participation.

5 People's Participation

Following the GPWM Guidelines, consultations with, and participative actions of, local people, elected representatives, NGO’s and government officials; Local people’s priorities.

Part B - The Environmental Baseline

6 Natural Physical Environment

Atmosphere and climate (including climatic change): rainfall, temperature, humidity, evapotranspiration, winds, storms; Water resources: surface water and groundwater, volumes and quality; Land resources: land and soil types, crop suitability classifications; present land-use; land erosion.

7 Natural Biological Environment

Terrestrial, freshwater and tidal-marine environments: Flora and fauna (especially wild fish) - habitats, migration patterns, seasonal changes; Biodiversity issues; Ecologically-sensitive areas (ESAs).

8 Socio-Economic Environment

Economic development; Agriculture and horticulture; livestock; capture and culture fisheries; Settlement; Industries; Infrastructure; Social development and quality of life: Political and jurisdictional considerations, Demographic and social context; Public health, Aesthetics, Cultural heritage, Historical / cultural / archaeological sites.

Part C - Environmental Impact Assessment

9 Impact Assessment

Summary of project impacts assessed against the 'future-without-project' conditions; Impact matrix; Beneficial impacts and adverse impacts, including direct, indirect and cumulative impacts on the IECs - quantified and valued - at the planning, construction and operation stages; Uncertainties in the impact assessments; External and cumulative constraints and impacts, upstream and downstream.

10 Environmental Management

Beneficial impact enhancements and adverse impact mitigation; Compensation measures; Residual impacts; Environmental protection plan: Environmental risks and contingencies; Implementation arrangements: Stakeholder participation; Quantified and costed environmental monitoring programme, including organisational and institutional arrangements; Implementation schedule; Reporting and accountability.

11 Conclusions

Summary of impact assessment and recommendations for future work, if any.

List of Acronyms and Abbreviations; Glossary of Technical Terms; List of References; Appendices.

Appendix - G

Appendix G: Glossary

accretion	the gradual formation of land areas from deposited river sediment.
algae	water plants that do not have true roots, stems on leaves, but contain chlorophyll. In the future, algae may be used more extensively as a source of food for people.
biodiversity	the variety and variability among living organisms.
biomass	the quantity of organic matter.
biophysical	that part of the natural environment which includes physical, chemical and biological components such as air, soil, water quality, plants and animals.
biota	animal and plant species
bounding	the process to determine spatial and temporal boundaries that an EA will include. Based on physical, chemical, biological, social, economic, jurisdictional, and administrative factors.
brackish	slightly saline
carbon dioxide	a gas (making up about 0.03% of air) taken up by green plants to make food. It is given off into the air when food molecules are broken down by living organisms.
climax vegetation	the plant life present at the end of an ecological succession.
compensation	the provision for enhancement, replacement, restoration, and/or restitution measures for victims of unavoidable negative impacts of project development. Payments may be in cash and/or in kind, although cash payments must be subject to stringent controls. Funds may also be used to recreate lost habitat or other valued resources.
compensation plan	the compensation measures that should be undertaken if a project proceeds. It includes the type of compensation, and how much will be paid to whom, by whom, against what criteria and under what conditions.
conservation	the practice of using natural resources wisely.
cumulative impacts	environmental impacts (usually negative) caused by multiple human activities; and/or natural events which are either repeated or occur in combination. Examples include the combined effects of tubewells lowering the groundwater of a large regional aquifer; water pollution in large rivers and combined impacts of nearly FCD/I on river flows and flooding.
ecological succession	the gradual change in flora and fauna populations that live one after another in a community.

ecosystem a marine, freshwater or terrestrial system, or combination of systems, of living and non-living components with particular inter-relationships that form specific habitat(s). Ecosystem boundaries are often specified for particular projects.

ecotone a transitional zone between two distinct ecosystems.

environment the totality of the natural and human environments (often called the biophysical and socio-economic environments) which forms the subject of FCD/I EA studies. It includes:

(a) all biophysical components of the natural environment of land, water and air, biological resources, and inorganic and organic matter both living and dead:

(b) all socio-economic components of the human environment including, but not limited to, social, economic development, human resources, quality of life, administrative, cultural, historical, archaeological, architectural, structures, sites and things, land and resource usage, and human health, nutrition and safety.

environmental assessment (EA) the evaluation process for informing environmentally-sound decisions during project planning, in order to ensure sustainable development. Three main stages are involved (each of which should include public participation):

(a) early assessment (IEE) to identify and prioritise potential impacts and to allow inclusion early on in the planning process of measures to reduce, mitigate or avoid environmental impacts;

(b) more detailed characterisation, and especially quantification, of environmental impacts (EIA);

(c) plans for implementation management (EMP) to include environmental management measures (physical and non-physical) to deal with all the environmental impacts, with particular attention to any residual impacts.

environmental enhancement an intentional change which amplifies the anticipated positive impact of a proposed project on one or more environmental components.

environmental impact is, in respect to a project,

(a) any change (often referred to as an *effect* or an *impact*) that a project may have on an environmental component;

(b) any change that the environment may have on a project that may then lead to changes in environmental components;

Environmental impact and environmental effect are taken as synonymous in these Guidelines.

environmental impact assessment (EIA) an environmental assessment report prepared at the feasibility level that contains the systematic study, quantified and valued of the impacts of a proposed plan or project plan management recommendations for the subsequent development.

environmental effects monitoring (EEM) measurements over time of environmental components (often at regular intervals) to detect direct and/or indirect changes caused by specific project interventions. Undertaken for many reasons, such as:

(a) to improve environmental understanding of cause-effect relationships,

(b) to provide an early warning of undesirable change in the environment,

(c) to verify earlier EIA predictions,

(d) to evaluate uncertainty, and

(e) to check on the effectiveness of the Environmental Management Plan.

environmental management plan (EMP) a plan for environmental activities during project implementation designed to ensure sound environmental management, mimimising/mitigating adverse environmental impacts and maximising beneficial environmental effects within an overall aim of sustainable development.

environmental protection plan (EPP) a plan that describes specific mitigation actions that will be undertaken during project preconstruction, construction, operation, rehabilitation and decommissioning to lessen the effects of the project on the environment. Usually with specific instructions for personnel involved in project activities. A key component of the EMP that integrates existing legislation, codes of good engineering practice, proponent commitment, and designated mitigation measures.

erosion the carrying away of soil by wind or moving water.

evaluation the assignment of importance, priority, monetary or other values to the estimated impacts. Monetary or economic evaluation is often termed valuation.

evolution the gradual changes in living things over long periods of time.

follow-up activities normally the post-planning (or at least post feasibility planning) set of actions described in the EMP to be carried out during project implementation.

habitat the characteristics of a place in which an organism lives especially the characteristics making it suitable for the organisms.

impact matrix a array of rows (for project activities) and columns (for important environmental components) used for presenting the analysis of positive and negative environmental impacts of a project.

important environmental component (IEC) features of the biophysical or socio-economic environments which are likely to be significantly effected by proposed project developments. Used to highlight particular environmental concerns.

initial environmental evaluation (IEE) the first stage in the EA of a project study for identifying and assessing possible environmental impacts.

insignificant environmental impact is an environmental effect that is not considered significant regardless of level of associate mitigation.

interested party see stakeholder, now the more widely-used term

intervention a specific action (structural or non-structural) in a project.

integrated environment management An integrated engineering, economic-cum-environmental assessment of the alternative structural and non-structural options to attain the project objectives. This integrated approach for the planning, design and management of projects involving in interdisciplinary process is implicit in these Guidelines. To assist the process, the following are recommended:

- A high frequency of interdisciplinary, interaction, informal as well as formal;
- Selection of adequate numbers of specialists in a sufficiently wide range of disciplines.

The process also implies the integration of other technical specialist of and all stakeholders into the process.

land-take the action of taking land, or an area of land taken, for development

larva an young form in the development of many animals.

magnitude of impact the degree of change in an IEC that results from a project intervention.

matrix see impact matrix.

mitigation the elimination, reduction or control of an adverse environmental impact of a project.

mouza the sub-union administrative area.

project for these Guidelines, a 'project' includes:

(a) physical work such as construction, operation, modification, rehabilitation, decommissioning, abandonment or other undertaking relating to a structure or other physical intervention, and

(b) a conceptual plan, study, design or programme (at any level or stage – including local, regional and national; prefeasibility, feasibility, and design) undertaken to ascertain the desirability of proceeding with physical works and associated activities or as part of the implementation process.

project phase or stage the main sequential steps of a project including: preconstruction, construction, operation and decommissioning with the associated planning stages, such as identification, prefeasibility and feasibility.

project proponent the person, body, authority, government or funding agency responsible for proposing or implementing the project.

residual environmental impact any environmental impact that remains (or will remain) after implementation of the measures specified in the EMP.

scoping the initial process by which the important environmental issues and IECs are identified for the various project alternatives

significant environmental impact an environmental impact (normally adverse) which is sufficiently important (ie severe) to need specific attention in an EA.

socio-economic environment all aspects of the human environment. Emphasises the importance of the social and financial/economic aspects, but includes – for example – cultural aspects.

stakeholder a person or organisation likely to be directly or indirectly affected by, or having an interest in, a proposed project. Stakeholders include: residents of the project area (the general public and, especially, beneficiaries and project-affected people); community representatives (elected and traditional); non-government organisations (NGOs); local, regional and national government officials; technical specialists, and national and international funding agencies.

sustainable development development that ensures preservation (and, ideally, enhancement) of key features of environmental quality, and sustainable use of natural resources - thereby providing for economic growth which meets the needs of the present without compromising the needs of future generations. (Adapted from the Brundtland Commission, 1987)