BANGLADESH
ACTION PLAN FOR FLOOD CONTROL

FAP-16

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Guidelines for Environmental Impact Assessment (EIA)

FLOOD PLAN COORDINATION ORGANIZATION
THE PEOPLE'S REPUBLIC OF BANGLADESH
MINISTRY OF IRRIGATION, WATER DEVELOPMENT AND FLOOD CONTROL

October 1992

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PREFACE

These Guidelines for Environmental Impact Assessment were prepared by the Irrigation Support Project for Asia and the Near East (ISPAN) with funding and support from the U.S. Agency for International Development towards the FAP16 Environmental Study component of the Bangladesh Flood Action Plan (FAP).

The Guidelines have been issued for use in ongoing and future FAP and similar flood control, drainage, Irrigation (FCD/I) and water management projects. ISPAN suggests, that the Guidelines document not be viewed as a static entity but should be modified and updated from time to time to incorporate the benefits of experience gained from actual environmental studies, EIAs and project construction and implementation as the FAP proceeds. EIA practitioners and other users of these guidelines are encouraged to communicate their experiences and problems to the Flood Plan Co-ordination Organization (FPCO) and also to the Department of Environment (DOE).

The Guidelines have been prepared by ISPAN in consultation with and with assistance from FPCO and DOE.

BANGLADESH FLOOD ACTION PLAN

GUIDELINES FOR
ENVIRONMENTAL IMPACT ASSESSMENT

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Chapter 1

INTRODUCTION

1.1 Basis for Guideline Development

The following Guidelines for Environmental Impact Assessment (EIA) are intended for use in the study and environmental evaluation of regional plans and projects proposed under the Bangladesh Flood Action Plan (FAP). They were developed initially from similar guidelines used in industrialized and developing countries on a variety of water resource developments and by various government and donor agencies, but have been specifically tailored to:

- address proposed developments under the FAP;
- conform to the Environmental Policy (1992) adopted by the Government of Bangladesh (GOB), along with the subsequent Action Programme.

The Guidelines address types of interventions and projects likely to be included under future FAP programs, and may be used for other relevant water management and FCD/I projects and plans. The Guidelines specifically address EIA at the pre-feasibility (regional) and feasibility (project) levels but not programmes or policies. They are intended to be used in close conjunction with the Guidelines for Project Assessment (GPA) which provide guidance on the economic appraisal of regional and specific projects (Figure 1).

1.2 **Purpose and Scope**

The EIA Guidelines:

- provide a consistent and common basis for the application of EIA to FAP developments to protect environment by ensuring that only environmentally sound projects are designed and implemented;
- assist EIA practitioners in identifying, quantifying and evaluating potential environmental consequences of flood control, drainage and irrigation (FCD/I) and other FAP interventions so that the impacts of a project are highlighted and the project design can be altered or management measures can be developed to enhance positive impacts and lessen or alleviate negative impacts;
- provide a basis for GOB and assistance agency evaluation of the environmental consequences of proposed FAP projects;

- ensure that all FAP projects are developed with full consideration for economic and environmental optimization, and for a long-term sustainability and equitability of environmental resource conservation and use and become economic-cum-environmentally optimal and sound.

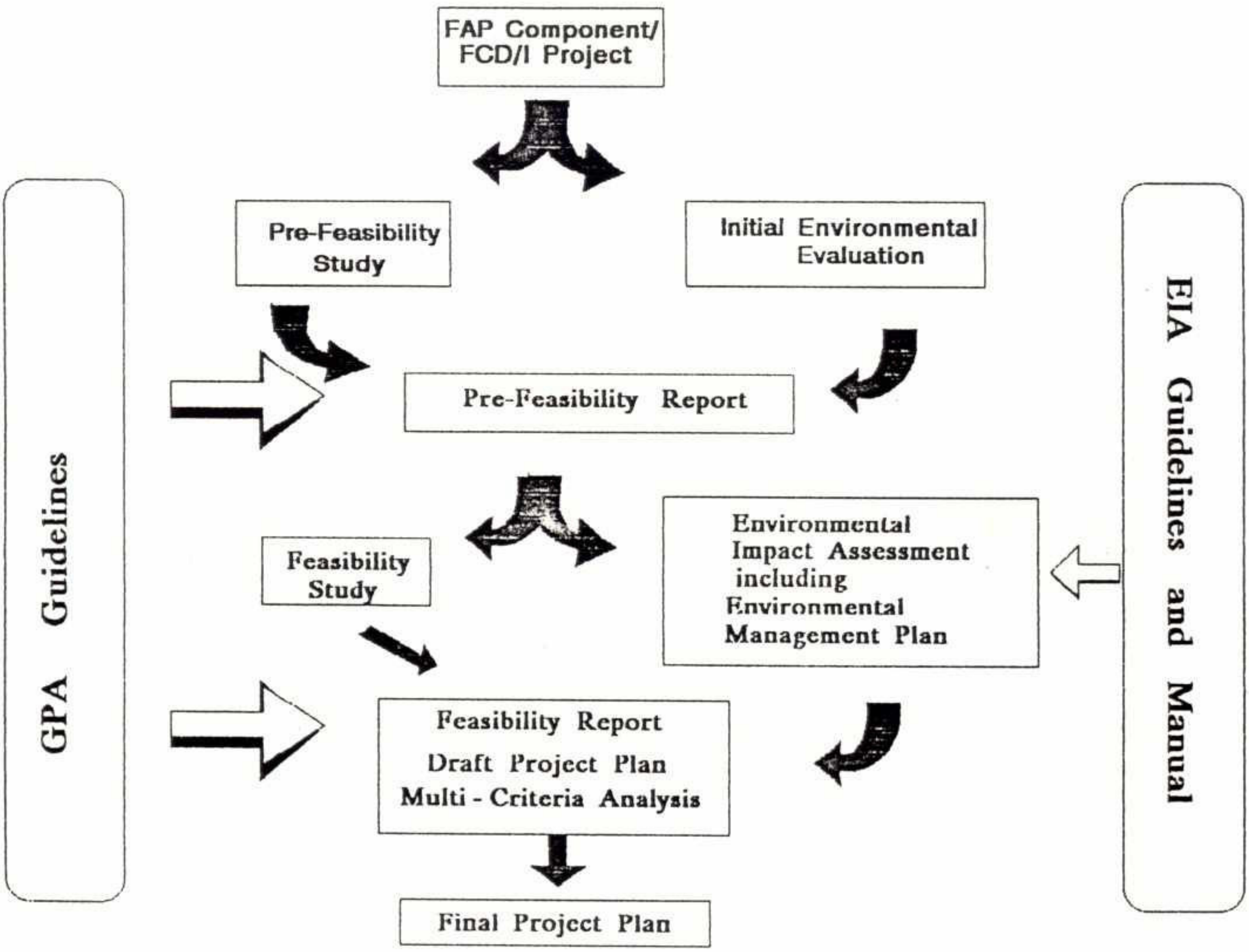

Figure 1 Role and Position of EIA Guidelines and EIA Manual in FAP Project Planning Process.

1.3 Intended Users

Intended users of the Guidelines include but not limited to :

- environmental and social scientists, planners, engineers and other practitioners concerned with the undertaking of EIAs and the preparation of EIA reports for FAP plans and projects, and other relevant water management and FCD/I developments;
- reviewers of EIAs;
- trainees in EIA.

1.4 Organization of the EIA Guidelines

Chapter 2 briefly reviews the main types of environmental impacts to be expected from FAP-related developments. Chapter 3 describes the objectives of EIA as a procedure within the framework of environmental planning, outlines a 10-step approach and one other step - People's Participation to be pursued all throughout and as such not numbered to consistent EIA application, and describes the purpose of the environmental management plan (EPM). Chapter 5 is a broad outline of the principles and purposes of people's participation in the FAP planning and implementation process. Chapter 6 summarizes and main features of the review process to be used once an EIA has been completed. Eight appendices are attached. Annex A lists known potential environmental impacts of FAP-type FCD/I projects; Annex B lists the common components of FCD/I projects which should be examined for potential environmental impacts, and Annex C details the most common information requirements for FCD/I project EIA. Annexes D, E and F though short are very important part of the document dealing with weighted matrix, level of impacts to be considered and their required level of quantification respectively. Annex G presents a suggested outline for an EIA Table of Contents. Annex H gives a glossary of terms used in these guidelines.

1.5 EIA Manual

A two-volume EIA Manual is a companion document to these Guidelines and covers the technical aspects of EIA in more detail. The Manual includes a glossary of all EIA terminology used in these Guidelines.

CHAPTER 2

ENVIRONMENTAL IMPACTS OF THE FLOOD ACTION PLAN

2.1 The greater part of the surface area of Bangladesh is subject to permanent or seasonally occurring inundation. The resulting extensive wetlands result from complex and dynamic hydrologic and geomorphologic interrelationships between major rivers, tributaries and distributaries, channels, water bodies and seasonally flooded plains. Annual flooding represents an essential factor sustaining many biological communities and is the main medium for energy flow and nutrient and material transfer through the ecosystem. Where possible, retention of the essential features of these watlands through seasonal flooding is an objective of water management. Flood control should accordingly be aimed primarily at reduction of the impact of violent specific events associated with excessive water volumes and flow rates causing disruption and destruction of human lives and resources.

2.2 Proposed FAP projects and regional plans will be aimed primarily at the use of structural and no-structural means to provide protection from damaging floods, to improved drainage and in selected areas, provide irrigation. Structural flood control measures will include embankments, dikes, levees, floodways, drainage works, hydraulic structures and river channel modifications. Non-structural measures include regulation of floodplain uses, floodproofing of houses and infrastructure, regulation of land use in watershed areas, integrated wetland management, flood preparedness and disaster management.

2.3 Except for unusually severe flooding, ecosystems and rural human communities in Bangladesh are adapted to, and rely on, periodic inundation of the land. Flooding usually becomes a problem when natural events or human activities increase, flooding intensity or frequency, or man invades flood-prone areas with structures and developments that need to be protected.

2.4 The major potential environmental impacts of structural flood control measures arise from the modification of the natural patterns of flow, flooding and drainage. This may bring changes in water levels and flows on both sides, changes in siltation, erosion, flood protection, altered ground water levels, soil moisture and changes in water availability, socio-economics, fish availability, health status and property damage. Appendix A lists environmental impacts for past flood control, drainage and irrigation projects in Bangladesh.

2.5 Structural flood control measures such as embankments and channel modifications increase the capacity of a stream by increasing the volume of the channel and/or increasing the velocity of flow, but leads to increased bank and embankment erosion. Channel modification includes dredging, clearing it of vegetation and other debris, smoothing the channel bed and walls, or straightening the channel, all of which help increase the rate at which water is passed through the system, thus preventing flooding, straightening the channel by eliminating meanders also helps reduce the risk that water will breach the river bank on the outside of curves where the current is most rapid and water rises highest.

2.6 Floodways (high-flow diversions or spillways) are natural or artificial bypass channels or conduits that redirect waters around or away from urban centers or areas of high population density. Further downstream the water can be re-diverted into the river from which it originated.

2.7 Flood-control structures may impart a false sense of security in that the risk of flooding is not eliminated but only diminished. This may encourage development on the floodplain with disastrous results in the event of an unusually high flood or if control structures fail.

2.8 In addition to the impacts of flood control structures on the environment, the environmentally-related factors affecting flood control should be considered. Infrastructural or other developments on a floodplain expose themselves to risk, depending on their vulnerabilities, and also increase the risk of loss or damage to downstream communities Building can increase flood heights and velocities by obstructing the flood flow, reducing floodplain storage capacity, and increasing run-off.

2.9 Human activities in the watershed, such as cutting of trees or clearing for agriculture and settlements generally will increase run-off, as will hillside agriculture without adequate terracing or planting on the contour. Paving land in the watershed and on the floodplain will also increase run-off, and installing storm drainage systems will increase the quantity and rate at which rain water enters the river system.

2.10 Dredging operations, disposal of materials, shoreline development, increased traffic near the shoreline and other factors related to coastal zone and major bank protection can impact coastal and riverin biota and communities. Potential aquatic impacts include spills and discharges from construction and placement of new facilities near the waterline, contaminant release from sediment resuspension, surface run-off and point source discharges, habitat destruction, changes in water chemistry and circulation, contamination and habital loss from dredge spoil disposal, and erosion and sedimentation from changed flow and wave patterns.

2.11 As with any development, flood protection measures potentially produce a large number of beneficial and negative impacts on social well-being, health and safety (Annex. A). A major concern is usually the unequal distribution of benefits received from flood control measures.

CHAPTER 3

EIA IN PLANNING AND PROJECT APPRAISAL

3.1 Objectives of EIA

The main objectives of EIA are to identify environmental impacts of proposed plans, programs and projects (Figure 1), thereby:

Assisting decision-makers and their constituents in making informed decisions on project developments and resource allocation;

Providing where possible quantitative environmental information so that potential impacts can be avoided in project and program design; providing a basis of development of management measures to avoid or reduce negative impacts; and providing an Environmental Management Plan (EMP) for the project that will help promote sustainable development.

EIA is an integral part of multiple resource development planning and feasibility study of a project. It provides for a quantified assessment of the biophysical, economic and social impacts of proposed projects as well as the likelihood of such impacts occurring. It provides for the participation of local groups in identifying impacts, assessing their significance, and formulating strategies to manage negative impacts and enhance beneficial ones. EIA accomplishes its purpose by providing decision makers with the best quantitative information available regarding intended and unintended consequence of particular investments and alternatives, the means and costs to manage undesirable effects, and the consequences of taking no action.

A professionally carried out EIA has to quantify all major impacts in particular along with the possibility or chances of their occurring and all other impacts (if and where possible).

EIA is not intended to disrupt nor impede development but should enhance development by ensuring that projects are constructed and operated in an environmentally sound manner and do not negatively affect the functioning of essential environmental processes nor the long-term sustainability of resource conservation and human well being. In addition to identifying and describing environmental impacts which a proposed project would likely to cause if no environmental management measures were included, the EIA should:

- specify the necessary environmental protection measures;
- ensure that these are included in the overall project feasibility study; and

- ensure that the project management will include an environmental management plan which will ensure that the prescribed protection measures are actually carried out in the follow up project stages of final design, construction and operation. It needs to be emphasized that Environmental protection measures mean more than mitigation i.e. offsetting unavoidable adverse effects and protection (measures for environmental enhancement when these can be feasibly included in the project.

3.2 Emphasis In EIA

Sound EIA should place emphasis on:

- reliable assessments of environmental disturbances likely to result from the proposed project;
- reliable field data on the background environment and on various environmental phenomena in the field;
- validated relationships between environmental components and resources and the predicted impacts, appropriate under local conditions;

- consideration of impacts on all targets considered sensitive or critical under the prevailing conditions and value systems;
- involving the affected communities at various stages of the assessment; and
- reliance on the judgement of local people and knowledgeable officials/professionals and other interested parties.

3.3 EIA In Project Planning

EIA is a planning tool which is to be used together with the project feasibility study to ensure that the project plan is the optimal Economic-cum-Environmental plan, that is the plan is environmentally as well as economically sound and thus represents the best approach to planning for development projects in order that continuing development will be sustainable. A project plan which is optimal from both environmental and economic perspectives will have a higher benefit/cost ratio than a plan which is not responsive to environmental needs, especially so when long term as well as short term effects are considered.

3.4 Stages of EIA

Within the context of the FAP, EIA will be applied at two main stages of detail pre-feasibility and feasibility.

a) Pre-feasibility level assessment (IEE) addresses regional planning options for water resource development. The main thrust at this stage is to assess regional resources and the effects of past interventions, examine the likely project - environmental linkages and interactions, establish the range and potential magnitude of impacts, identify the key regional environmental issues, compare the environmental consequences of project alternatives and develop an effective people's participation program. The same types of impacts as would be assessed during the feasibility stage are considered but at more general levels of detail and at larger scales of resolution. This assessment may also suggest whether or not a full scale EIA should be carried out at the feasibility level.

Following pre-feasibility studies, the decision-makers may choose to:

- proceed with feasibility studies and a detailed EIA where project impacts are indicated to be likely acceptable and or/ manageable; Once EIA is completed for the selected project;
- proceed with feasibility studies and a detailed EIA on a modified project to reduce unacceptably high levels of impacts; or
- reject the project because the nature and magnitude of the impacts are shown to be technically, environmentally, socially and /or economically unacceptable.

b) Feasibility level EIA provides a basis for:

- detailed impact assessments of selected project options;
- mitigation planning to reduce biophysical and social impacts;
- planning for adequate compensation for unavoidable impacts;
- planning project enhancements;
- establishing a monitoring program; and
- ongoing people's participation in project construction, operation and maintenance.

3.5 Relationship of EIA to Technical and Economic Feasibility: In comparative levels of study detail and decision-making, EIA should parallel the engineering studies and economic evaluations.

- Environmental and engineering evaluation should be closely linked so that effective project modifications and environmental management can be developed. Environmental and economic evaluations should be linked to ensure that both environmental benefits and losses of the project as well as the costs of environmental management are accounted for in the cost-benefit analyses.

3.6 **Environmental Objectives in Regional Development for present and future FAP Projects**

The main land and water management objectives for long term regional development should be identified and quantified in IEEs and EIAs as part of Regional Studies under present/future FAP interventions by Project Proponent. The development options should be identified, the main linkages to existing environmental conditions should be identified, and resource use and management systems appraised. The main environmental constraints to development, especially involving further flood control, drainage and irrigation should be identified. The environmental sustainability of present land and water resource management and further management with the projects in place and considering existing trends in population size growth, agricultural development, habitat destruction, soil degradation,pollution, and other relevant factors should be explicitly appraised.

3.7 Integrated Assessments:

An integrated engineering, economic-cum-environmental assessment of the alternative structural and non-structural options to attain the management objectives should be made and alternative ranked. Preferred options should be identified and justified on the basis of technical and economic soundness and long-term environmental resource sustainability. The assessment should clearly set out the criteria and methods used in the evaluation of alternatives. Preferred options hold be realistically appraised on the basis of past experience and performance of similar developments in the region.

3.8 Level of Efforts in EIA

EIA is an integral part of the planning process and should be undertaken by the planning team. The team should be in its or have access to a specialist on every major resources and environmental component expected to be affected by the proposed action. The team leader should preferably be a senior water resources expert with an overview of Bangladesh environment and skill in management and knowledge and capability in the preparation of comprehensive and accurate environmental impact assessments. The detailed skills that should be available on the team are described in the EIA manual.

Levels of effort required for assessment will vary according to:

- o whether the study is at the pre feasibility (regional planning) or feasibility (project) level
- o the size of the area being studied

- the complexity of the area under study
- the amount of background information available
- the experience of the study team members in undertaking EIAs
- the amount of study support available from other study components, especially the engineering studies.
- Availability of adequate budget and manmonth.
- A fair estimate of more or less 10% of fund allocated for feasibility study or 0.5 to 1% of total project cost (may be less in case of Regional study) which in all likelihood would correspond to man-months available is recommended to be earmarked for IEE/EIA studies.

CHAPTER 4

PROCEDURAL STEPS IN EIA

All EIAs should proceed through ten steps excluding peoples' participation which will continue through out the process as outlined in Figure 2. The levels of detail required will differ for pre-feasibility and feasibility EIA, as explained below:

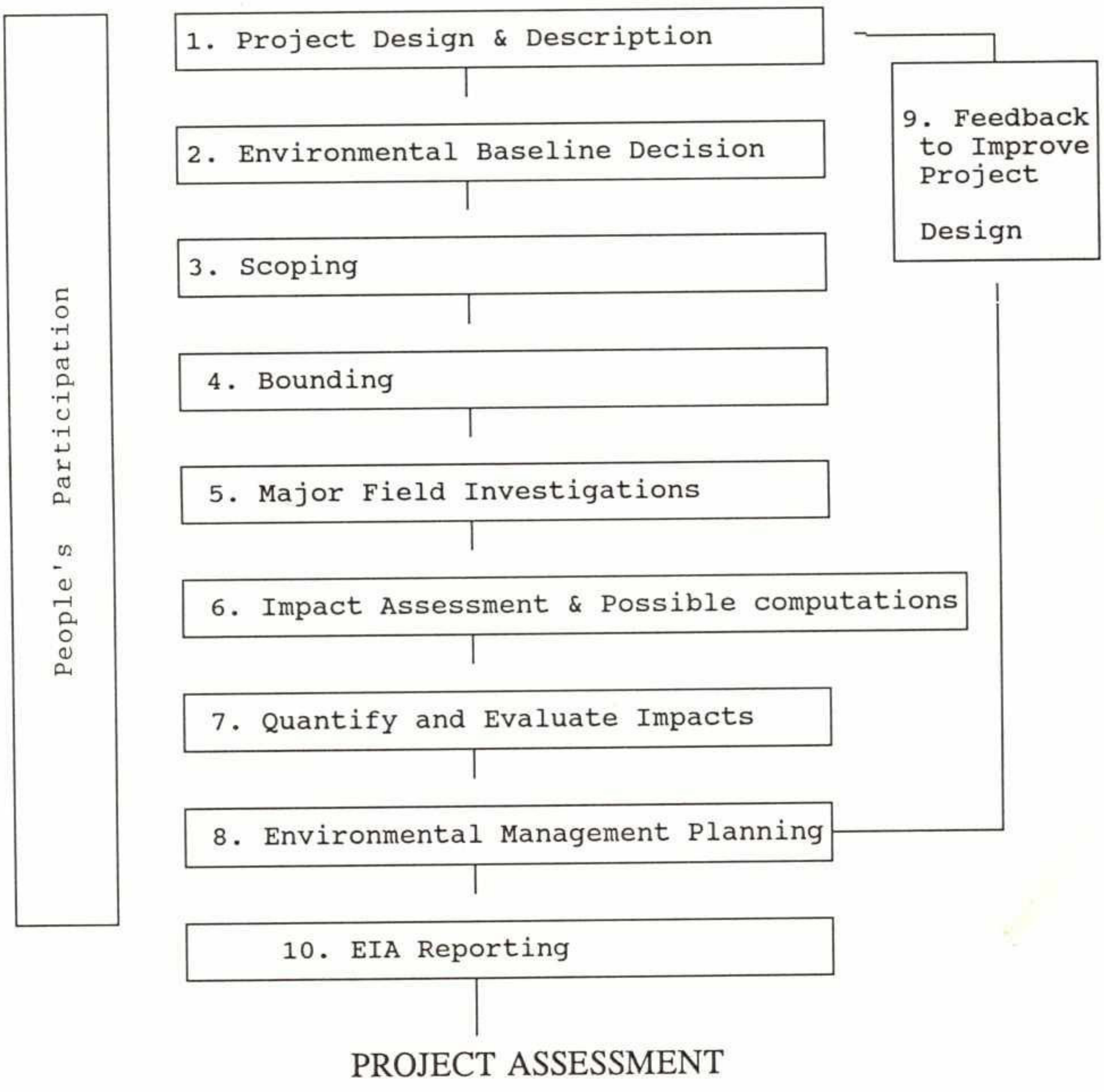

Figure 2. Recommended Steps in EIA.

Although not a numbered step in the EIA, active participation of local people should be sought in project study, appraisal, planning, implementation, operation and maintenance, This is described further in Chapter 5.

4.1 Project Design and Description (Step-1)

Describe the objectives, rationale and planned activities and potential interventions of the project and project alternatives, including the "without project" scenario. All proposed project activities both routine, and accidental events, having potential environmental significance should be ascertained and the principal disturbances likely to be inflicted on to the environment should be identified and quantified. Annex B lists the most common components of FAP projects. Distinction should be made between project components by project phase:

- preconstruction
- construction
- operation
- abandonment (if eventual project cessation or removal is likely)

The location, spatial extent, physical dimensions and temporal extent (for temporary facilities) should be identified, quantified, described and mapped in appropriately scaled maps.

4.2 Environmental Baseline Description (Step-2)

Describe the environment of the area likely to be impacted and identify important environmental components (IECs) and Indicators. The IECs should include components in water, land biological and human resources, including human aspirations.

A description of the project study area (see step 5 Bounding below) should be prepared, based on literature information and data, discussion with knowledgeable informants and a field reconnaissance of the area. The project study area should include all adjacent basins that may be influenced. Examples of components to be included in the description are:

- area and location
- climate and weather
- hydrological cycles
- physiography, landforms and soils
- surface and groundwater distribution
- land use patterns

- terrestrial and aquatic habitats
- terrestrial and aquatic species including rare and endangered ones
- biodiversity/genetic pool
- vegetation
- historical environmental trends
- natural hazards
- major socio-economic features
- urban and rural settlements
- infrastructure
- archaeological/historical/cultural sites
- patterns of cumulative effects over the region

The EIA manual provides additional guidance on scales of data, quantification and levels of detail required.

4.3 Scoping (Step 3)

A scoping process should be used to identify the:

- main environmental issues of importance to all interested parties so that these concerns can be addressed in the assessment; and the
- Important Environmental components (IECs)

Scoping is best accomplished by integrating the knowledge available from as many sources as possible, including at least the following:

- archived information sources including literature survey and review reports on previous similar projects
- expert opinion from technical specialists, national, regional and local government officials, and Non-Governmental Organizations (NGOs); and
- knowledge gained from local communities, especially those using local land and water resources through direct communication with site reconnaissance

Scoping by technical specialists is best achieved through iterative technical meetings and workshop sessions where information sharing and simple quantitive analyses can identify the IECS to be considered further and to tentatively eliminate those components not requiring further attention. Scoping of local community concerns is addressed in Chapter 5. Scoping of issues for feasibility EIA should be more detailed than those for pre-feasibility level investigations.

Following identification IECS, should be evaluated in terms of:

- distribution (within the study area and elsewhere)
- quantity, quality and seasonality
- interaction with other resources and IECs (dependency or effect)

- socio-economic and/or ecological importance
- availability of substitutes
- economic value
- management responsibility and practices
- historical or cultural importance

4.4 Bounding (Step 4)

Spatial and temporal bounds to be used in assessing project impacts should be established. Selection of the appropriate time frame for the assessment of impacts as well as the appropriate spatial units for area-wise and community-wise impact assessment is a very important step in the EIA process. The spatial and temporal limits within which impacts will be assessed should be explicitly defined according to specified criteria. For FAP, FCD/I plans and projects within the FAP the following are recommended:

- physical factors, especially watershed boundaries;
- ecological boundaries, especially agroecological regions and sub-regions, which encompass the spatial and seasonal ranges occupied by biological populations being considered in the assessment; and
- social and administrative boundaries, including regions, districts and thana boundaries.

Watershed boundaries should include areas both up and downstream of the immediate project site within which project effects are likely to occur. Boundaries should also include areas within which off-site and cumulative impacts need be considered. Temporal bounds refer to the timing and duration of the proposed project phases (preconstruction, construction, operation and abandonment). For example, the operational life of an average FCD/I project in Bangladesh is taken as 30 years for which areal impact assessment (area and communitywise should be ensured.

4.5 **Major Field Investigations (Step 5)**

Field studies should be carried out to obtain data not available from existing sources and to update existing information, some of which may require verification and further detail. For regional plans and pre-feasibility level studies, rapid field assessment are recommended. For feasibility level EIA more detailed investigations entailing data collection and consideration of seasonal cycles should be undertaken. Annex C indicates the recommended feasibility-level information requirements for each major resource sector/ important environmental component. Sources of data and suggested methods of data acquisition are given in the EIA Manual.

4.5.1 Selection and validation of methods:

For feasibility level studies, a conceptual model of the environmental resources system is useful as a basis for identifying data needs, for planning and assigning priorities to data collection programs, and to delineate disturbance-background-impact interrelationships.

This should link the main environmental components and their associated processes and use by communities to the key features of the hydrological cycle and to the socio-economic systems within the area. Conceptual models can be in the form of biological calendars, networks or matrices. Both direct and indirect linkages between and among project components and IECs should be identified and evaluated. The EIA manual provides further detail on conceptual models. It is important to validate the concepts where possible by the time and study is over. Details of desired matrices/models have been discussed under 4.6.

4.5.2 Environmental Indicators

Indicators may be found useful as a basis for environmental description and assessment. Indicators are measurable features which relate to the essential functioning of the ecosystem, are sensitive to positive and negative project-induced changes, are looked to land and water-based livelihoods, and or are sensitive to seasonal changes.

4.5.3 Environmental Trends

It is of cardinal importance to distinguish significant trends in environmental baseline conditions and resource availability, demand, quality and or quality.

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

4.6 Impacts Assessment and possible computations (Step 6)

Based on the nature of the project-environmental linkages, the baseline conditions within the receiving environment and the amounts of change expected in each case, the environmental impacts of the proposed project(s) should be identified and quantified as much as possible. Impacts should be evaluated with and without management measures.

At the regional planning level, impacts are best considered as potential constraints to project type, sitting and operation and may be evaluated without potential management measures. At the feasibility level, major impacts should be very seriously strived to be quantified and other important impact should at least be assessed according to each of the following criteria:

a. Role and importance of the IEC in the ecosystem:
   - o key links in the economic base of the nation, region, or locality (e.g. water);
   - o environmental components directly or indirectly oinked to human health or survival (e.g. animal protein);
   - o local key resources (e.g. fuel wood);
   - o irreplaceable cultural resources (e.g. archaeological sites, historic shrines);
   - o internationally recognized resources (e.g. Royal Bengal tiger);
   - o resources of importance to future generations(i.e. specific paddy germplasm);
   - o variable in abundance or quality over time (i.e. periods of critical availability e.g. supply of draught animals);
   - o important to ecosystem structure and function or as a surrogate to such a component;
   - o rare or endangered species/ or special habitats.

b. **Magnitude of the effect.**

   Impacts and the changes in the underlying processes should be assessed as quantitatively as data, information and understanding will permit. Quantification should be appropriately expressed, e.g.:
   - o percentage increase/decrease in volume, flow and composition;
   - o absolute change, e.g. frequencies and/ or durations (e.g. flood peaks, drought), size of at-risk populations (e.g. number of people potentially affected, economic losses/gains).

c. **Duration and type of impacts:**
   - o long or short-term
   - o reversible or irreversible
   - o cumulative or non-cumulative
   - o direct or indirect
   - o synergistic effects on the IECs by non-project related actions
   - o project-on-environment and environment-on-project

d. **Area:** environmental impacts are seldom uniformly distributed over the study area but are usually localized or unequally distributed. Evaluation of the quantified impacts as a single value representing the total aggregate impact over the entire study area would be inadequate for assessing environmental implications. Major impacts should be assessed for separate geographical units in the study area.

e. **Communities:** most socio-economic conflicts arise not from the total aggregate impacts but rather from differential impacts on different sections of the community. Various impacts should be assessed separately for each of the major sections of the community particularly for the poor and landless sections and quantified wherever possible.

Assessments should also be made for each viable project option and for each major component of the option where these are responsible for specific impacts.

The impact assessment should preferably be displayed in matrix fashion for ease of comparison and interpretation. There are many forms of impact matrices, however, standard procedure includes project activities entered as matrix rows and IECs listed as matrix columns. Elements of the matrix indicate which project activities and IECs interact to produce an environmental impact. These elements of the matrix may be scored and weighted in a large number of ways. The EIA manual describes some of these methods and provides references for obtaining additional information. The Government of Bangladesh (GOB) prefers that a weighted matrix be used which is illustrated in Annex-D. Whatever matrix representation is used, it should provide clear and concise results. All assumptions, terminology, and aspects of delineating matrix elements should be fully justified and explained. It is expected that the team will use an established matrix methodology that is documented in the literature.

Besides using a matrix approach for project on environment impacts, a separate analysis should be completed for cumulative impacts. In a heavily populated country, such as Bangladesh, the probability of non-project activities causing interactions with project ones is large. Often a cumulative impact can swamp a project impact (for example, the diversion of a large portion of the Ganges flow by India has considerable interaction potential with the smaller flow alterations associated with FAP projects in the downstream areas. Global climate change and regional riparian activities are also existing cumulative impacts that could be exacerbated by particular project activities).

As there are impacts of various nature and magnitude, those are of various levels. Five levels of impacts (from A to E) and their order of consideration while conducting an EIA have been elaborated in Appendix E.

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4.7 Quantify and Value Impacts (Step 7)

a. The main impacts identified in Step 6 should be quantified and valued using the methodology given in the EIA Manual and the guideline for projects assessment (GPA). Main features of quantification and valuation have been elaborated below for ready reference.

b. The type, magnitude, duration and other assessment criteria for impacts on specific resources and social areas should be summarized and listed in order of priority. 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, should be identified for specific attention of reviewers and decision makers.

c. A system of multi-criteria analysis (MCA) has been adopted within the FAP for the valuation of beneficial and negative impacts for inclusion into overall project evaluations. Under the MCA system, impacts are evaluated in:

- o economic terms (taka or dollars) where costing is possible and acceptably accurate; or
- o Quantitative or numeric terms, where costing is not feasible (e.g. using impact scales as in step 6. or
- o descriptive terms where neither of the above is possible.

d. Environmental impacts will be costed at two levels in overall project accounting:

- o costs incurred by or through residual impacts (i.e. by impacts which cannot practically be mitigated);
- o cost of impact mitigation and environmental management.

e. Valuation of environmental impacts in economic terms is best accomplished by an integrated team of environmental scientists, project economists and design engineers to ensure consistency of methodologies and adequate identification of all relevant costs and benefits.

f. Benefits and costs accruing to different project components (especially flood protection, drainage and irrigation) and to different projects (if more than one are being developed contiguously and simultaneously) should be computed and reported separately to ensure adequate attention to mitigation and monitoring.

g. All costs of impact mitigation, compensation and enhancement should be included in evaluation (see section 4.8.1 for description of mitigation and enhancement). This includes costs of mitigation and management:
   - o directly related to the project (e.g. specific control structures, access roads, embankment strengthening, maintenance, etc.);
   - o externally related to the project through environmental management programs within the project impact area (e.g. agricultural extension, social, women's and educational programs, fisheries enhancement and extension, etc.).

h. Evaluation of impacts should take into consideration all likely future changes in resource abundance, availability and accessibility, brought about by:

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

i. Replacement costs and existing values should be fully costed in terms of resource losses, mitigation and compensation action needed to effect replacement, as well as the adequacy of such replacement (e.g. loss of natural fisheries, floodplain habitat which might have to be replaced by managed aquaculture ponds).

Required levels of quantification (which are to a varying degree) of various levels of impacts (from A to E elaborated in Annex E) have been added as Annex F.

4.7.1 **Grade Impacts:**
Grading of impacts for magnitude and significance should be carried out.

4.7.2 **Mapping and presentation of impact magnitude**

As many maps as possible should be included in the EIA report to make the contents more understandable. Once the Environmental Management Plan (EMP) is detailed out and dedicated steps should be taken to quantify most critical residual impacts. These impacts scaled down to manageable level be repeated in a maps for better understanding of the concerned people related to the project in the following steps (decision maker for the project for example).

Clarification of various impacts into high, medium and low criticality should be done first and then criticality values from 1 to 10 on a graded scale be assigned. The high criticality impacts are allotted weights of 8, 9 or 10; the low ones are allotted 1, 2 or 3 and the medium ones from 4. to 7.

An opinion assessment may be conducted at this stage among members representing the different affected communities.

The above opinion assessment be then used to modify and upgrade the criticality weight allocation for the particular project.

Major impact magnitudes be shown on separate maps of the area (including upper and lower reach effects if possible, and critical in the opinion of the EIA team) with different colours which could be dark green for significant positive, Red for significant negative, light green for moderate positive, orange for moderate negative, yellow for marginal positive and gray for marginal negative or suitable hatches for clear differentiations when presenting maps in black and white.

4.7.3 Evaluation of Trade offs between impacts:

Trade offs between impacts need very careful balancing using basic areal units. In case of socio-economic impacts which calls for more attention may be evaluated based on 3 income groups (for example Lower, Middle and High income groups). To arrive at a just conclusion it is suggested that the impacts on about 75/% lower income population be used to say completely while those on 20% middle income population be scaled down to one third. The 5% high income population based on criteria established during the process of EIA may be ignored.

The areas with positive and negative trade-offs may be shown in drawings using different hatches for clarity of understanding.

4.8 Environmental Management Planning (Step 8)

An environmental Management Plan (EMP) should be developed to deal with all follow-up activities during project construction, implementation, maintenance and (if required) abandonment. The main components of the EMP are:

- Mitigation and enhancement
- Compensation
- Monitoring
- Peoples' participation (described further in

Chapter 5).

- o Disaster management plan (contingency planning)
- o Description of the institutional implementation of the EMP.
- o Description of all residual impacts
- o Reporting and accountability framework
- o Budget estimates for EMP implementation (for the detailed level EMP - see below).

The level of detail in the EMP will vary according to the stage of project study and development:

a. For the pre-feasibility EIA - identification of broad management options and major constraints.

a. For the feasibility EIA prior to review and decision on project development - identification of specific mitigation options, relative costs and expected residual impacts;

b. For the selected option to be developed - description of specific proposed mitigation, cost estimates, implementation schedules,mode of implementation, personnel requirements and training, and institutional arrangements.

For step 3 a detailed EMP report separate from the EIA is recommended to provide a working link to detailed engineering designs and contract documents.

Reviews and recommendations on the environmental management plan should be undertaken through consensus between the EIA practitioners, the project design and planning engineers, the regional government ministries responsible for project operation and maintenance, and local community representatives.

Budgeting for mitigation and or enhancement programs should be included in the project development and O&M budgets to ensure implementation. Effective budgetary support for mitigation programs may involve:

- o one time financial grants to implementing agencies or bodies;
- o continuing financial inputs as part of project management

Recovery of mitigation costs from project beneficiaries should be considered if FAP implementation policy is in accordance.

4.8.1 Mitigation and Enhancement

Mitigation and enhancement measures should be developed as the EIA proceeds to take full advantage of available information and engineering design possibilities.

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a. Mitigation nd enhancement measures should be identified, fully described and evaluated for all severe impacts and for all other grades of impacts where the costs of such mitigation are in appropriate proportion to the effects in reducing impacts.

   o Selection of alternatives (elevation, slopes, dimensions, site, size, sources of materials, placement of access roads, connections with existing systems, construction materials, energy, work force, scheduling of construction and or operation, etc.) that may not be optional on technical or economic grounds but are environmentally more benign;
   o modification of a component to enhance a secondary benefit or reduce an impact;
   o change in construction materials, methods, work force, etc;
   o alternation in project operation (volume, flow, timing, etc.) or management;
   o supplementary programs to counteract adverse effects (e.g. immunization);
   o education or training to reduce risk or to allow more effective management of a diminished resource (e.g. fisheries training to avoid some existing poor management practices;

b. 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 Guidelines for Project Assessment).

c. 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.

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

e. Environmental enhancement should be considered where significant gains in production, resource management and environmental protection can be achieved within the project area, through close collaboration with project development and operation and with financial support from the project. Potential enhancement to be considered includes:

   o replacement or upgrading of affected resources;
   o education and /or training to allow more effective

management of a diminished resource (e.g. fisheries training to avoid some existing poor management practices);

- o introducing community management systems (e.g. water user associations).

f. All residual (non-and partially mitigable and adverse) impacts should be identified and quantified spatially and temporally. Such residual impacts should be classified and costed for inclusion in the Multi-criteria Analysis (see Guideline for Project Assessment). As the assessor passes from the first initial matrix to the final lists of residual impacts, increasing levels of quantification and analysis are required. Residual impacts and their severity are one of the most crucial parts of the EIA. These impacts must be delineated as significant or insignificant. Plans and projects with significant residual impacts should only proceed if they are justifiable in the circumstances. Clear statements on the effects of the residual impacts on the sustainability of the environment in question should be provided in the EIA and project feasibility reports.

4.8.2 Compensation Plan

Compensation measures should be developed as the EIA proceeds to take full advantage of available information and engineering design possibilities.

a. Compensation measures should be developed in all cases where significant residual impacts remain after implementation of practical mitigatory actions;
- o resettlement of displaced people requiring major social and infrastructural programs;
- o development of new wetland habitats;
- o development of alternative sources of fish supply to landless and poor communities deprived of common property fishery resources.

b. The feasibility of proposed compensation measures should be evaluated in terms of practicality, manageability and cost, and all proposed measures should meet economic efficiency requirements (see GPA), and be included as part of the cost of the EMP.

4.8.3 Environmental Monitoring

Environmental monitoring, as an integral part of EIA providing much useful base line data on actual environmental performance of FAP, FCD/I projects, is an essential part of the EMP. The EIA manual contains a great deal of valuable information on this component.

a. Within the context of the FAP, monitoring is directed at the construction and implementation phases of projects already subjected to EIA. The objectives are to:

- o measure and extent of expected or poorly quantified impacts;
- o ensure early detection of unexpected impacts;
- o determine the efficacy of implemented mitigation measures in reducing impacts;
- o provide for periodic review and adjustment of mitigation programs.

The type of monitoring is an integral part of environmental management.

b. Another form of environmental monitoring is directed at existing projects with the objective of:

- o acquiring knowledge of the type and magnitude of ongoing project-environmental interactions;
- o discovering, though analysis of the data and comparison with baseline conditions, any unforeseen secondary benefits or adverse impacts.

c. Establishment of environmental monitoring programs should be undertaken by the operational and maintenance agencies on the basis of expected severity of impacts and doubts as to the efficacy of proposed mitigation measures. Proposals for monitoring should be drawn up for review and approval by the Project Review Committee. Proposals should include:

- o the objective(s) of the monitoring program;
- o proposed sampling programs, including parameters to be measured, sampling strategies, location and times of sampling, personnel and equipment requirements and estimated costs;
- o indications as to how the monitoring data will be utilized technically and procedurally to improve mitigation and environmental management.

Suggested sampling and implementation procedures for monitoring are given in the EIA Manual.

d. Responsibility for the environmental monitoring programs, including equipment, facilities, personnel and training should be assigned to the agencies having permanent responsibility for the resources in question.

4.8.4 Disaster Management Plan

The EIA should contain a full accounting of all hazards within the project area and assess how these would be affected by project development and implementation.

4.8.4.1 **Risk assessment and management**

Where significant risks are considered likely under post project conditions (e.g. sudden severe flooding from embankment breaching), an appropriate risk assessment methodology should be used. If after this further analysis, the risk is considered significant, the EMP should outline a contingency plan for containment and management of the hazard. Such plans should include:

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

4.8.5 **Institutional Support**

The EMP should outline the institutional arrangements made to carry out the mitigation, enhancement, monitoring and other components of ongoing environmental management. At the present time the development of institutional support for FAP-related programs and projects is in an evolutionary phase. Institutional support should be assured at two major levels;

- o Local institutional support should be obtained through the activities of the Environmental Planning and Management Council(see chapter 5).

- o Central institutional support should be developed in close cooperation with the main proponent of the project which in most cases will be the Bangladesh Water Development Board.

4.8.6 **Reporting and Accountability Framework**

This details plans for regular and ongoing reporting of EMP activities to regulatory government agencies responsible for project operation and maintenance and to other concerned parties. It describes the required contents of reports when they should be completed, who is responsible for completing them and to whom the reports must be submitted.

4.9 Feedback to Improve Project Design (Step 9)

The results of the scoping, communication with interested/concerned parties, the impact assessment and the people's participation process should be fully utilized in ongoing fashion to improve and enhance the design of the project. Potential modifications to the project could include:

- o selection of more environmentally benign structural alternatives (e.g. submersible rather than full flood embankments);
- o selection of non-structural alternatives to reduce flood damage;
- o modification of project design (e.g. setback distance, embankment heights);
- o implementation of mitigation measures (e.g. provision of fish passage to permit fish access and/ or implementation of operating procedures to minimize specific impacts).
- o Change in sitting of project.

4.10 EIA Reporting (Step 10)

Results of environmental assessments are reported at two levels:

- o an initial environmental evaluation report for pre-feasibility (regional planning) level studies;
- o a detailed EIA for feasibility-level studies

An Environmental Management Plan (EMP) should be an integral part of EIA when reviews are being carried out and a decision is being made to proceed with project implementation (see Chapter 6).

Standardized approaches to study and reporting procedures on methods and data collection are encouraged to facilitate reviews and to promote efficient implementation of project development and mitigation measures. EIA reports are the main medium of information exchange between EIA practitioners, project planners and engineers and decision makers. They should be detailed and analytical while presenting information, conclusions and recommendations clearly and unambiguously, and should include maps/overlays of impacts based on impact severity and should compare situations with and without project and with - and without recommended mitigation measures (area and community wise). A detailed outline of suggested EIA Table of contents is given in appendix G.

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Chapter 5
PEOPLE'S PARTICIPATION

Active participation of local people in the entire project cycle, i.e. program identification, study, appraisal, planning and implementation, should be employed as the key to achieving long term sustainability and success of FAP water management programs. The overall aim of the participation process is to ensure that those social groups affected by a program have an opportunity to decide whether the program should be implemented. 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.

5.1 Objectives of People's Participation

The primary objectives of people's participation in EIA are:

a. to enhance the sustainability of FAP projects by ensuring that these are relevant to the people of the area;

b. to have local people participate fully in plan or project scoping to identify Important Environmental Components and issues;

c. to give local people a decision-making role in the identification and exploration of environmental concerns of all FAP regional plans and projects;

d. to obtain local knowledge, information and ideas relating to the technical and hydrological development of the projects and plans;

e. to obtain local information about social conditions, land values, resources usage, informal and customary rights, so that an accurate appraisal of project impacts can be made and equitable standards for mitigation and compensation developed;

f. to ensure early detection of possible social conflicts arising from program interventions so that these can be minimized through negotiation and education;

g. to ensure that institutions and procedures are established that enable local people to participate in the construction, operation, and maintenance of FCD infrastructures;

h. to ensure that institutions and procedures are established that enable local people to participate in nonstructural FAP programs.

5.2 **Steps in People's Participation**

People's participation involves the following steps:

a. Identification and selection of programs for study after local needs and perceptions have been ascertained through an extensive dialogue with all social groups likely to be affected.

b. Use of participatory rural appraisal methods to ensure that;

   o all social groups likely to be affected by the program, both inside and outside the program area, are identified and consulted;

   o special attention is given to identifying the needs and interests of the rural poor, ethnic groups, minorities, women, and groups that depend on marginal or fragile resources;

   o all land and water resources used in the area are identified and placed in the local context in terms of their use, availability, role in maintaining family livelihoods, and vulnerability to program effects;

   o all informal rights to land and water resources and all customary usages are identified, understood, and recorded.

3. Development of an organizational context within which local people will be:

   o guaranteed representation (by resource user group);
   o Briefed and updated about information being developed about the social and economic effects of the program;
   o consulted about the engineering and design components of the program;
   o able to negotiate the environmental management plan especially compensation, mitigation, and enhancement packages; and
   o granted the right to decide whether or not a particular program will be implemented.

5.3 **Scope of People's Participation**

Scoping of community concerns can be accomplished by the following:

a. Presentation of the project or planning proposal by the EIA team in village level scoping sessions throughout the study area.

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b. Provision of an organizational context within which local communities can formally respond to project designs.
c. Adherence to a requirement that EIA and engineering design specialists respond directly and in person to community concerns about the potential technical and social effects of the program.
d. Adherence to a requirement that program designers should integrate community recommendations into program components.
e. Consultation/negotiation with the affected communities about alternative programs and/or acceptable environmental management planning including: mitigation, compensation, and enhancement program packages.
f. In addition to local communities, public consultation should encompass the wider community of concerned government ministries, national and international NGOs, donor groups and agencies, and other interested parties.

Chapter 6
EIA REVIEW PROCEDURES

The purpose of the EIA review process is to assess the adequacy of the EIA for decision-making on regional or project proposals and to consider its conclusions and implications for project implementation.

EIA reports should normally be appended to the main project assessment report and should be accompanied by various technical annexes. Project reports should be submitted jointly and should be subjected to three separate reviews by:

- Local government agencies, community groups and NGOs operating in the project area;
- A Project Review Committee comprising representatives from the Ministry of Irrigation, Water Development and Flood Control (MIWDFC), concerned Ministries, knowledgeable NGOs working and selected professionals/academics and
- The Department of Environment (DOE) which is the final authority to review and approve EIAs and for giving environmental clearance to all projects in Bangladesh.

Key items from the EIA and project feasibility reports should be publicized among the communities in the project impact area(s) and provision made to meet these groups and discuss study findings and proposed plans (see chapter 5).

The Project Review Committee's review should address, but not be limited to, four main themes in the EIA:

1. Quality - whether the EIA is acceptable in terms of:
   - level of analysis;
   - data requirements (adequacy and reliability of baseline data);
   - clarity of presentation;
   - correct choice of study area, communities, boundaries and IECs;
   - the choice and development of the appropriate environmental impact model(s);

2. Content - whether the EIA satisfactorily addresses and adequately quantifies the relevant environmental issues:
   - linkages, interactions, magnitude of impacts, priority and casual sequences;
   - risk assessment and disaster management;
   - assessment of alternative actions and their relative effects;
   - comparison of benefits, adverse effects and trade-offs, including issues of equity, gender, biodiversity and sustainability;

- assessment of impacts on different sections of communities on different parts of the study area;
- tables and overlays that present the clearest overall impact picture.

3. Environmental Management Plan
   correct choice of components,

   - makes adequate provision for mitigation and compensation;
   - fully identifies all major residual impacts after EMP implementation;
   - has sufficient budget and manpower to accomplish the stated objectives.

4. Risk Assessment and Disaster Management - adequacy of the predictions and contingency plans.

5. Conclusions

   - clarity and conciseness of conclusions and recommendations;
   - adequacy of proposed management measures and their cost estimates;
   - adequacy of proposed monitoring programs;
   - the extent of acceptance of environmental recommendations into the project implementation phase;
   - the environmental significance of residual impacts;
   - Any other environmental implications of project approval.

6. EIA Report Acceptance or Rejection:
   The EIA review process concludes with one of two basic types of decisions:
   - the assessment is inadequate for decision making and requires additional study; or
   - the assessment is acceptable and adequate for decision-making.

In the case of an inadequate assessment the review report should indicate areas of deficiency and identify ways to obtain the required information or conduct the necessary analysis.

If the assessment is accepted, the review report should provide the rationale for a positive decision and should recommend either to:
- proceed with project assessment; or
- proceed with modifications to project design and/or the environmental management plan and specify which options to adopt; or
- cancel the project.

If a modified project is accepted which differs significantly from that assessed in the EIA and revised EIA should be prepared and submitted for review.

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Chapter 7

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Annex A
POTENTIAL ENVIRONMENTAL IMPACTS OF FLOOD ACTION PLAN DEVELOPMENTS

1. Potentially Beneficial Effects

Beneficial effects of FAP projects include those which are primarily targeted in project design, e.g. flood protection, improved drainage, improved irrigation, higher agricultural yields, etc. as well as secondary benefits such as improved nutrition and effects of increased economic well-being.

1.1 Land/Land Use

- creation of more secure land for agriculture, settlement, industry and infrastructure

1.2 Agriculture

- net reduction of sand deposition on agricultural lands
- reduction in crop losses from floods
- more secure crop production in protected areas
- higher rice yields in both wet and dry seasons
- increased inducement to utilize HYVs
- reduced flood hazard to livestock
- increased tree crops
- increased species diversity
- decreased salinity in coastal agricultural areas protected from storm surges
- extended cropping periods and areas due to improved drainage
- increased fuel, fodder and feed.

1.3 Fisheries

- opportunity for creation of aquaculture ponds in borrow pits
- reduction in losses from pond aquaculture and impounded water bodies

1.4 Water Quality

- increased sanitary/pollution assimilation capacities in wet season
- reducation of saline contamination of shallow coastal aquifers by storm surges

1.5 Water Quantity

- reduced surpluses of water

1.6 Human Health

- nutrition gains from increased agricultural production
- reduced loss of life from flood hazard
- reduced incidence of post-flooding diarrhoeal disease
- improved sanitation

1.7 Social Benefits

- increased agricultural sector employment
- increase in incomes and general economic activities for some social sectors
- improved incentive for investment in capital stocks and efficiency of economy, encouraging development in general
- improved security for housing, industries and infrastructure
- increased employment opportunities for women

1.8 Hazards

- reduced hazards from extreme floods and tidal surges
- reduced vulnerability to flood-induced hazards

2. Potentially Negative Impacts

Negative impacts of the various FAP interventions could include a very wide range of direct impacts on the biophysical and social resources of the project area, e.g. reduction in fish populations used as food source. They could also include secondary, indirect and cumulative impacts, both within the specific project area and over a wider area beyond or downstream of the actual project site. The extent of negative impacts would depend on the scope of the proposed project, the nature and value of the resources affected, and the extent to which mitigative measures could offset any negative effects. Not all the negative impacts listed would necessarily occur in any given project, but they would have to be considered and assessed during the EIA.

2.1 Land and Land Use

- increased pressure on available land resources from population increase as a result of higher agricultural yields and improved nutrition and economic status
- loss of riskier but seasonally productive land area and soils to embankments, roads and brick-making
- waterlogging within polders and compartments
- decreased security in downstream or peripheral areas
- inequalities in the distribution of benefits, disbenefits
- resettlement and dislocation

2.2 Agriculture

- deterioration of soil physical properties in waterlogged areas
- loss of natural flood-induced pest control
- trend to HYV monoculture reducing agricultural diversity
- reductions in agroecosystem resilience
- potentially greater losses of crops under conditions of extreme flooding and embankment failure

2.3 Fisheries

- loss of formerly flooded habitats for major capture fishery species
- reduction in allochthonous nutrient inputs
- loss of natural stock replenishment
- loss of access to fisheries for socially disadvantaged groups
- reduction in natural fishery production and harvests
- replacement of natural fisheries with potentially more expensive aquaculture
- potential long-term aquaculture productivity declines from bio-chemical accumulation in soils and ponds
- increased risk of production loss due to disease and lower bio-diversity
- net reduction in production despite aquaculture increases
- reduction in fishery resource diversity and resilience
- increased short-term turbidity at river dredging or construction sites
- loss of benthic fauna and flora at dredging or under-water excavation sites
- social costs of change from capture to culture fisheries
- increase threats to endangered species
- reduction in spawning and rearing areas

2.4 Water Quality

- decreased sanitary/pollution assimilation capacities in dry season
- increased agrochemical run-off, contamination of surface water
- increased turbidity at a river or coastal dredging and excavation sites
- local ecological toxicity in coastal and river areas from construction discharges and spills

2.5 Water Quantity

- restriction of water-borne transportation by physical structures and siltation
- reduced access to domestic water supplies and potential seasonal drinking water shortages in some regions
- drawdowns in tanks used for bathing and fishing
- water use conflicts, e.g. coastal agriculture, brackish versus freshwater aquaculture
- confinement effects (higher stages and discharges) in downstream areas

2.6 Human Health

- reduced access to drinking water from tubewell sources
- changes in epidemiology due to labor force aggregations

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- increasing chemical toxicity to humans from agrochemicals
- nutritional declines due to reduction in fish protein food sources

2.7 Social Issues

- shift from common resource regimes (e.g. capture fisheries) to private property regimes (e.g. aquaculture)
- impacts to historical and cultural heritage sites

2.8 Wildlife and Biodiversity

- reduction in availability of wetland and terrestrial habitats
- estuarine ecological changes
- increased toxicity and decreased ecological resilience due to agrochemicals pollution
- increased threats to endangered species

2.9 Hazards

- increased depth of flooding, higher flood velocities, and erosion of char and other unprotected active floodplain lands
- build-up of river channels due to sedimentation, increasing risk of sudden embankment failure and overtopping
- water level and velocity increases in river channels
- increased depth of flooding when embankments breached
- increased embankment misuse and abuse
- risk of interactions between FAP interventions and natural disasters such as earthquakes.

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Annex B
COMMON COMPONENTS OF FAP PROJECTS HAVING
POTENTIAL ENVIRONMENTAL EFFECTS

1. **Preconstruction (Planning, Exploration and Study) Phase**

   1. Land, topographic and benchmark surveys
   2. Hydrological and climatic surveys and instrumentation
   3. Land use and natural resource inventories
   4. Socio-economic surveys
   5. Land acquisition
   6. Temporary access roads
   7. People's participation activities

2. **Construction Phase**

   1. Land acquisition
   2. Village and infrastructural resettlement and relocation
   3. Access:
      - road construction and maintenance
      - vehicular traffic pattern changes
      - pedestrian traffic pattern changes
   4. Temporary structures and land occupation:
      - storage and godowns
      - staff and labor camps
      - garages and parking sites
      - canteens and kitchens
      - waste and garbage disposal sides
      - water handling and storage facilities, including bathing facilities
   5. Excavation of canals:
      - drainage
      - irrigation
      - navigation
      - fisheries
   6. Embankment construction
      - labor mobilization
      - soil taking and borrow pit construction
   7. Installation of tube wells and associated electricity and energy supplies
   8. Construction of hydraulic structures:
      - sluice gates
      - regulators
      - culverts
      - fish ladders
      - navigation lock gates
      - pump houses
      - irrigation canals

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9. Operation and Maintenance Phase
    1. Operation and maintenance of:
        - sluice gates
        - regulators
        - fish ladders
        - navigation lock gates
        - pump houses
        - embankments
        - drainage channels
        - irrigation canals
        - cyclone and flood shelters

    2. Agricultural development:
        - institutional development
        - agricultural extension
        - credit inputs
        - seed acquisition and distribution
        - fertilizer storage and application
        - pesticide storage and application
        - irrigation
        - establishment and operation of cooperatives and resource user groups

    3. Development of infrastructure and supply services
    4. Initiation of project:
        - community educational programs
        - project support programs

4. **Abandonment (Post-Project) Phase**
    1. Land reclamation
    2. Monitoring and evaluation

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Annex C
INFORMATION REQUIREMENTS

The information requirements are the same for both pre-feasibility and feasibility level investigations, however there are differences in the detail and scales of data and information used. Pre-feasibility investigations rely on existing information supplemented by rapid field reconnaissance methods. Feasibility studies require more specific investigations and longer-term data gathering programs. Much of the hydrology information and significant portions of the agricultural, sociological and possibly the fisheries data required for EIA will normally be available from the engineering and technical feasibility studies. Further details on methods and scales of study are given in the EIA Manual.

1. Climate

1.1 Describe the rainfall pattern for the study area. Indicate the maximum, minimum and mean monthly rainfall for the period of record, including variability in seasonal rainfall and the confidence limits. Relate the cropping seasons to the portability of rainfall (acceptable range, flooding range, drought range). Indicate the location of all recording stations for which data are presented.

1.2 Describe the general patterns of ambient temperatures and humidity and provide monthly means, maxima and minima for the period of record. Indicate the location of all recording stations for which data are presented.

1.3 Evaluate agroclimatic conditions in the study area, using a standard index of evapotranspiration.

1.4 For coastal areas describe the storm and cyclone patterns and antecedent weather conditions, the seasons of highest occurrence of destructive coastal weather patterns, and the historically recorded extent of cyclonic and flooding damage.

2. Land Resources

2.1 Topography

Describe and map the distribution of land types (F_0, F_1, F_2, F_3, and F_4) within the project area.

2.2 Land Use

1. Conduct semi-detailed land use surveys to map the distribution and uses of land within the area, geographically and by percentage of area. The suggested categories are:
   - agriculture
   - 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.

2. Map and describe urban/village/settlements/other surface infrastructure.

3. Note all trends in land use patterns over the long term, up to the present, and their likely continuance or anticipated change. Map future land-use where feasible. Consider how land use patterns change seasonally, specifically in relation to:
   - flooding
   - agriculture
   - social factors
   - other factors (identify)

2.3 Soils

1. Describe and map the basic characteristics of the soil series and phases that affect land use, particularly:
   - chemical composition (fertility, acidity, etc.)
   - texture (topsails and subsoils)
   - permeability
   - drainage
   - soil moisture
   - soil salinity
   - soil consistency

2. Describe crop suitability of the major soils of the area based on land capability classifications.

3. Classify the uses of soil in the area, including:
   - agriculture
   - structures (embankments, roads, house, platforms, etc.)
   - bricks
   - industry (e.g. pottery)

   Consider how soil demands are met and the extent of conflicts.

4. Describe the extent of major soils that are subjected to irrigation. Note the effects of irrigation on water logging and seepage losses. Identify any nutrient deficiency problems (e.g. sulphur, zinc, etc.)

5. Describe the extent of soil erosion in the area, especially on:
   - agricultural land
   - embankments
   - other soil-based structures

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

6. Describe and map areas where rivers and/or canals deposit sediments. Note if this has any effect on topsoil texture, land use and/or fertility.

2.4 Agriculture

1. Describe and map the major agricultural cropping patterns for each land type in the area

2. Describe the types of rice produced in the area in each of the three growing seasons. Specifically quantify:
   - the percentage of total rice production derived from the aus, aman and boro crops
   - the areas and percentages of cultivated land under different types of rice.

   Note the extent to which supplementary irrigation of aman is commonly practiced.

3. Describe the homestead vegetation in the project area. Characterize the species abundance and distribution of fruit, timber and fuel trees and their susceptibility to floods, drought and other factors.

4. Describe other crops are grown in the area:
   - food crops
   - cash crops
   - fodder crops

5. Note whether the study area is a net importer or exporter of food grains.

6. Quantify land types and seasons in which past crop damage has occurred due to:
   - floods
   - drainage congestion
   - drought
   - hail
   - other climatic and hydrological factors

7. Describe trends in cropping area, intensity, production, and strains in the above crops over the previous 10-20 years. Indicate any known causes for such changes, e.g.
   - flood management activities
   - surface irrigation

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- groundwater irrigation
- improved agricultural technology

Note the extent to which:

- such changes have been distributed among different socio-economic groups
- local trends compared with national ones
- observed trends expected to continue over the next 10-20 years in the absence of major flood management activities.

8. Describe the use of the following agricultural inputs for major crops grown in the area:
   - seeds, seedlings and saplings
   - chemical fertilizers
   - organic manure
   - irrigation
   - pesticides

9. Provide estimates of the numbers of livestock kept by various social groups within the study area and their uses for:
   - draught power
   - food sources

   Quantify the extent of pasture land available in the area. Describe the marketing procedures for livestock and livestock products.

   Indicate any constraints on livestock maintenance and production, or trends in numbers and production, especially related to:
   - feed and fodder availability
   - disease and treatment facilities
   - flood related factors

2.5 Renewable Energy Resources

1. Describe the major sources of biomass fuel in the study area in different seasons:
   - fuelwood, leaves and twigs
   - agricultural wastes, including residues, bagasse, etc.
   - manure

   and indicate the major uses of such fuel for:
   - cooking
   - crop processing
   - manufacturing (e.g. brickfields)

2. Identify any shortages or constraints on production and/or use of renewable energy in the area, including factors such as:
   - changes in land use patterns (e.g. conversion of forested land to croplands)

- reduction in land area available for fuel production, e.g. community forests

and any trends over time in such constraints related to factors such as population growth, etc.

Describe any programs to alleviate fuel shortages, e.g. community forests, agroforestry, homestead forests, etc.

3. 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

3. Water Resources
   3.1 Surface Water

1. Describe and map the general pattern of surface water distribution and major drainage patterns, including rivers (Adjacent and within the area), small waterways, beels, haors and flooded areas. Indicate the:
   - natural and artificial drainage systems and their distribution
   - seasonal changes in water levels
   - seasonal changes in drainage
   - extent, periods of occurrence and causes of waterlogging
   - effects of existing infrastructure (roads, canals, building, platforms, etc.) on drainage
   - extent of interconnections

2. Describe and map river erosion hazards.

3. Provide analyses of river stages and discharges for standard return periods. Provide analyses of low flows for dry months for standard return periods. Indicate the availability of water for irrigation.

4. Provide a quantitative description of the hydrological cycle within the overall watershed encompassing the study area and within its component systems. Give 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. Indicate the location of any gauging stations for which data are presented.

5. Quantitatively describe 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.

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

3.2 Water Transportation

1. Describe the extent of navigational use of waterways (rivers, streams, beels, etc.):
   - geographic distribution and navigable lengths
   - ports or landings
   - infrastructural facilities
   - changes in relation to the annual flooding cycle
   - key linkages that affect navigation:
     - water flowing into the area from outside
     - sedimentation of channels
     - presence of embankments and regulators
     - aquatic vegetation (e.g. water hyacinth)

2. Describe any apparent trends in navigational use of waterways in the area from factors including erosion, sedimentation, flow reductions, FCD/I developments, etc. Evaluate the socio-economic responses to these trends, including factors such as increased use of road transportation, breaching of embankments and economic impacts.

3.3 Surface Water Quality

1. Characterize the 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

   Indicate the linkages within and to the outside which affect the water quality characteristics, e.g. seasonal flooding.

2. Describe any water pollution problems of the area and their sources, expressed in terms of types of pollutant, severity, and effect on water use. Indicate what is known about these water bodies in terms of flow rates, water quality characteristics, areas and volumes, and relationships to seasonal flooding patterns.

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3. Describe the pollution assimilation capacities of these water bodies as determined through analysis of dispersion and seasonal variations.

4. List all human activities contributing to water pollution, specifically industrial discharges (including deliberate and accidental), urban/domestic runoff and agricultural drainage (especially pesticides, fertilizers). Note any evidence that these pollutants are reaching the groundwater. Consider potential toxicity of all industrial discharges. Describe actions being taken, individually, communally or institutionally, to diminish or avoid pollution problems.

5. Describe all major consumptive water users in the area that affect flow conditions in water bodies. Note ;any evidence that such flow reductions result in declining water quality by reducing dilution.

6. Evaluate any evidence that the water pollution situation has changed in the last 10-20 years. Specifically consider:
   - relationship to FCD/I activities, including upstream diversions
   - reduction in flow
   - reduced drainage
   - water quality changes casually related to land or water use (increased industrial discharges, urbanization, population growth in villages, increased use of agricultural chemicals)
   - any evidence for links between changes in water quality and changes in the public health situation.

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

3.4 Salinity

For project areas located in coastal areas, consider the following:

1. Describe the effects of seasonal flooding cycles, amounts of inflowing fresh water, rainfall and cyclonic storm surges on water salinity in the area.
2. Note any evidence for salinity changes due to human activities, particularly deliberate breaching of embankments or poor operation of control structures. Describe ;all water uses in the area requiring certain levels of salinity (shrimp culture, salt extraction, etc.)
3. Consider the extent to which local resource ;uses have been adapted to salinity increases (e.g. changes in cropping

patterns, replacement of rice cropping with shrimp culture, etc.) and the economic effects of such changes.

4. Determine whether soil and/or water salinity has changed during the past 10-20 years. Any identifiable causes of such changes should be recorded as well as identifiable effects on fisheries, agriculture, wildlife, forests and afforestation, settlement patterns and infrastructure. Evaluate whether observed trends in salinity can be expected to continue over the next 10-20 years in the absence of FAP and FCD/I actions.

3.5 Ground Water

1. Describe the quantity and quality of the groundwater resource in a local and regional context. Specifically note whether the resource is part of a larger aquifer. Note any evidence for overuse (withdrawals exceeding recharge) or pollution.

2. Describe ground water recharge patterns in the area and their relationship to seasonal rainfall, river discharges and flooding.

3. Quantify the numbers and types of users of the groundwater resource:
   - numbers of wells by type (STWs, DTWs, HTWs)
   - uses for each type (domestic, industrial, agriculture)
   - volumes or percentages by well type

   Specifically indicate 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.

4. Analyze apparent trends in groundwater exploitation and use for the past 10-20 years and assumed 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

   Examine the linkages to these changes particularly in respect of socio-economic factors:
   - 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 ground water supplies

4. Biological Resources

4.1 Open-Water Capture Fisheries

1. Describe and map, where possible, the various types of aquatic habitat, e.g.
   - beels (permanent or seasonal flood-plain depressions)
   - haors (bowl-shaped depressions between river levees)
   - baors (closed water bodies formed by oxbows of dead rivers)
   - floodplain
   - rivers (permanently flowing water bodies)
   - canals and drains
   - estuaries (mixing zones between fresh and salt water)
   - lakes and reservoirs

2. Describe and quantify 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.
   - shore-line characteristics (vegetation, erosion, etc.)
   - water temperature
   - color
   - turbidity
   - total suspended and dissolved solids
   - conductivity
   - salinity
   - 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

3. Describe general fish community structure and species diversity in each habitat type (including prawns and shrimp). Indicate how this changes in relation to the hydrologic cycle.

4. Define fish population structure, expressed in terms of:
   - dominant species
   - rare, threatened and/or endangered species
   - life stages (larvae, fry, juveniles, sub-adults, adults)
   - stages of maturation
   - spawning sites and seasons by species

Relate population structural changes to changes in the hydrologic cycle.

5. Describe the migratory behavior of the species present and its dependence on the hydrologic cycle.

6. Describe and classify types of gear used by the various categories of fishermen, including:
   - nets (gill, net, lift, cast, push, etc.)
   - traps, crafts
   - harpoons and spears
   - hooks and lines

   Indicate how gear is used relative to habitat types and to the hydrologic cycle.

7. Quantify the 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.

8. Compute the total production (including shellfish) in the area, preferably on a monthly basis, for each habitat type. Indicate the distribution by species, category of fishermen, types of gear and hydrologic seasons.

9. Describe fisheries management in the area, including:
   - practice of old short-term leasing system
   - practice of New Fisheries Management Policy (NFMP)
   - enforcement of fishing regulations
   - management practices, including fish stocking programs

10. Describe fish landing and marketing practices in the area, specifically identifying buyers (middlemen), landing sites, trading localities, fish processing plants and distribution routes.

4.2 Closed Water Culture Fisheries

1. Describe the 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)

2. Describe the type of culture practiced:
   - species stocked
   - stocking rates and ratios
   - seed sources (river or hatchery)
   - pond fertilization and/or fish feeding practiced

3. Describe the production (by various pond types):
   - total production (kg/ha)
   - by species (kg/ha)

4. Describe the extent of fish culture extension services.

4.3 Wildlife

1. identify and map all major terrestrial wildlife habitat types in the project area:
   - open fallow land
   - agroforst
   - plantation forest
   - roadside vegetation/community forest
   - homestead vegetation
   - deciduous forest
   - evergreen forest

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

2. Quantify the habitats in the project area according to:
   - areas of habitat within different land types (relating to area elevation curve and flood levels)
   - changes in habitat quality (loss, improved protection, etc.)
   - seasonality of availability and use

3. Prepare a terrestrial wildlife profile for the study area based on:
   - species (by mammals, reptiles, amphibians and birds, dominant, residents and migratory species)
   - distribution, relative abundance and status of populations

   Compare local species numbers and distribution and the local quality of habitats with regional and national levels.

4. Identify and map all major aquatic wildlife habitat types in the project area:
   - permanent wetlands (rivers, canals, beels, pits, ponds, lakes, mangroves, etc.)
   - seasonal wetlands

Characterize and quantify 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.

5. Characterize the 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.

6. Prepare an 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. Compare local species numbers and distribution and the local quality of habitats with regional and national levels.

7. Identify and quantify all critical wildlife habitants, according to:
   - habitat type
   - location and area
   - land type
   - vegetation
   - causes of habitat conversion (changes in previous 10-20 years, deforestation, afforestation)

8. Describe any 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)

9. Describe any rare, threatened and/or endangered wildlife species by:
   - species
   - critical habitat
   - status and distribution
   - causes of decline
   - possibilities of enhancement

10. Describe wildlife 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

5. Human Resources

5.1 Socio-Demographic Conditions

1. Quantify and describe the total population of the project area, growth rates, densities, male-female ratio and the distribution of population by religion and ethnic groups.

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

3. Describe 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.

4. Map the following on a base map showing land types, water bodies and major infrastructure:
   - habitation sites (paras)
   - village boundaries (mouzas)
   - common access areas
   - social services (schools, hospitals/dispensaries, government offices, banks)
   - cultural sites (mosques, temples, churches, shrines, sacred streets, archeological and historical sites, fairgrounds)
   - markets (hats and bazaars)
   - rural industries (e.g. cottage industries, handicraft and boat building centers)
   - transportation routes (rivers, roads and railways)

5. Describe the annual cycles of activity. These should include the:
   - seasonal and hydrological calendar
   - agrarian calendar (including cropping patterns)
   - fishing calendar (including fish breeding cycle)

   Note interrelationships and dependencies between the various cycles.

5.2 Socio-Economic Conditions

1. Describe the main economic activities (agriculture, fisheries, business etc.) and calculate 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 that may be affected by project interventions and land acquisition.

2. Quantify and describe all the socio-economic groups in the project area:
   - landowning farmers (separate by absentee/resident land-owners and by farm size
   - landless farmers (separate 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.

3. Indicate the 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 (e.g. 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.

4. Identify formal and informal social groups and leaders, leadership structure, resource and credit user groups, farmers organization and conflicts (if any) over water sharing.

5. 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 that actions would be required enhance project success, particularly through public participation.

6. Describe land tenure and ownership in the study area. Categorize land ownership and occupancy in the area:
   - in terms of land types
   - in terms of geographical distribution
   - privately owned by residents and absentees
   - publicly owned (government at all levels)

7. Categorize land occupancy and use by:
   - land type categories
   - owner
   - lessee
   - squatters
   - common property resources

8. Describe fishery management in the area in terms of:
   - leasing arrangements (e.g. 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

   Indicate:
   - 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.

9. Describe the fish marketing in the area (both capture and culture fishery), specifically identifying marketing channels, intermediaries/middlemen, buyers, trading spots/localities and marketing facilities.

10. Describe the marketing procedures for livestock and livestock products.

11. Evaluate the 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

12. Identify any socio-economic and technological changes in the area during the previous 10-20 years, especially those related to trends and changes in the natural resource base. Comment on the role of population growth in such change and the role of FCD or FCD/I projects in the area. Identify any trends observed up to the present which could continue or even worsen during the next few decades in the absence of appropriate flood management actions.

5.3 Public Health

1. Indicate the sources of domestic water in the area (drinking/cooking, bathing and laundry) and the seasonal changes in such sources.

2. Describe and map the distribution of tubewells and other protected water sources in the study area. Compute the number and proportion of households having access to tubewells for drinking water and the seasonal variability in such numbers and proportions.

3. Describe present conditions of disposal of domestic sanitary waste in isolated homesteads, villages and urban areas, and any relationships to the seasonal hydrologic cycle. Present and evaluate any data on the quality of receiving waters, especially with regard to faecal coliform bacteria.

4. Outline the seasonal distribution of diarrhoeal and other vector borne diseases in the area.

5. Describe the nutritional status of members of the various social groups in the area if possible using rapid rural appraisal sort of technique.

5.4 Hazards

1. Describe the flooding history of the area in recent decades. Use land types a measure of flooding depth. For dry, normal and wet years show:
   - area
   - duration
   - numbers of affected homesteads
   - numbers of affected people

2. Quantify the amount of land in the area protected by embankments. Describe the origins of these embankments.

3. Give a brief history of flood-related problems in the area, including reference to embankment failures, breaching and erosion.

4. Identify non-flood related risks to crops in the area, e.g.
   - pests and crop diseases
   - drought
   - failure of irrigation systems
   - failure to obtain necessary inputs (e.g. fertilizers, pesticides)
   - sand deposition
   - others

5. Note the extent to which the area is subject to other natural hazards, including earthquakes, cyclones, tornados, hail storms, tidal surges, etc. Describe their known occurrence, severity, and impact.

6. Determine whether the frequency or severity of flooding has increased over the last 10-20 years. If sao, note whether damage and loss of life have been related to the magnitude of the event or to other factors, such as increased population density, shifts in population, increased value of infrastructure, etc.

7. Given continuance of present climatic and hydrologic conditions, decide if the trends seen to date can be expected to continue in the absence of FCD/I activities. Describe any new hazards being added to the region through development activities not directly related to the flood cycle.

5.5 Cumulative Impacts

1. Possible implications of regional and global environmental changes including greenhouse effect changes.

2. Consider regional and transboundary patterns of land use and other human activities which may affect flow, siltation, erosion, water quality etc.

Annex - D
Weighted Matrix

In the weighted matrices, when preparing the impact matrix, one indicates the relative magnitudes by numbers e.g. on a scale of 1 to 10, rather than by symbols or letters. Also one assigns a weigh or relative importance to such impact, again by numbers on a numerical scale of 1 to 10 and mentions these two indicative measures in each of the relevant boxes as M/I. Of course both the magnitude and importance of the likely impact are dependent entirely on the judgement of the assessing team. Simple calculations have been suggested to asses the total environmental impact of a particular project component or activity (and hence to help planning mitigation measures) or even the overall weighted relative impact of a total project (to help compare alternative projects).

Thus the total impact of ith component/Activity:

$$Pi = \sum_{j=1}^{j=m} (Iij.\ Mij)$$

Where Mij and Iij are respectively the relative magnitude and relative importance (on scales of 1 to 10) for the likely impact of ith component/activity on jth environmental attribute and m is the total number of environmental attributes relevant.

Also the overall relative impact of the project:

$$I = \sum_{i=1}^{i=n} Pi$$

Where n is the total number of Project Components/Activities.

Annex - E

Order of Consideration of Environmental Impacts
of FAP, FCD/I Projects while conducting an EIA

A. First Level Impacts

1. Changes in topography directly brought about by construction activity (including borrow pits and waste dumps). Show by detailed controur maps/engineering drawings.

2. Changes in landuse and vegetal cover (to give specific and locationwise trees and other vegetation lost) directly brought about by project activity (land acquisition, township, storage of materials, roads, land clearing, post-project plantations etc.)

3. Changes in water levels and flows at different points in the river caused by the project.

4. Changes in water levels and flows at different points in the protected area.

5. Changes in water levels and flows at different points in the non-protected area, e.g. opposite bank.

B. Second Level Impacts

1. Siltation/erosion at different points in (a) river, (b) protected area, (c) outside protected areas like opposite bank, upstream/downstream areas etc.

2. Changes in ground water recharge, ground water flows and ground water levels at various points inside and outside the protection area.

3. Changes in water availability and consequent changes in cropping patterns and yields at various points ;inside and outside protected areas.

4. Changes in natural flora and fauna and general ecology at different points inside and outside protected area.

5. Changes in nutrient/food material availability, spawning and stocking areas and patterns and of fish-availability.

C. Third Level Impacts

1. Longterm changes in river course or character (even as small a change as a ten percent reduction in width may trigger significant changes in character or course or both.

2. Long term changes in bed-levels and hence in flood levels and their consequence e.g. need to raise or retire embankments.

3. Long term changes in flooding patterns.

4. Long term changes in surface and ground water availability and water levels.

5. Longterm changes in soil and water quality.

6. Long term changes in landuse patterns, agriculture and fisheries.

7. Long term changes in habitational patterns.

D. <u>Fourth Level Impacts</u>

1. Reduction in loss of life
2. Impact on overall agriculture crop production, horticulture, etc. evaluated in Taka.
3. Impact on fish production evaluated in Taka.
4. Protection of property and assets evaluated in Taka.
5. Impacts on livestock and wildlife/endangered species evaluated in Taka.
6. Impacts on human health and health care evaluated in Taka.
7. Impacts on transport, communication, severance, resettlement evaluated in Taka.
8. Impacts on other economic activities including tourism, evaluated in Taka.
9. Impacts on employment, living standards and incomes of different sections of communities inside and outside the protected areas evaluated in Taka.

E. <u>Fifth Level Impacts</u>

1. Impacts on structures/locations/activities of historical, social or cultural value.
2. Impacts on social and cultural strains and patterns of different sections of community inside/outside the protected area.
3. Psychological impacts and reaction of people.
4. Impacts on regional/global environmental issues.

Annex - F

Required Levels of Quantification

A. Level Impacts - Complete quantification if possible 100%.

B. Level Impacts - High level quantifiaction may be between 60-80%.

C. Level Impacts - Quantification to the level possible may be between 20-30%

D. Level Impacts - As far as possible impacts to be converted to Taka values.

E. Level Impacts - All impacts stated reflected as size of communities worried/concerned about alongwith judgement of the EIA Team.

Annex - G

SUGGESTED TABLE OF CONTENTS FOR EIA REPORT

ENVIRONMENTAL ASSESSMENT REPORT
(IEE or EIA REPORT)

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- 7.2 Potential Non-Project Impacts Combined with Project Impacts
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10. GLOSSARY AND ABBREVIATIONS
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Annex H
GLOSSARY

Biophysical is that part of the natural environment which includes physical, chemical and biological components such as air, soil, water quality, plants and animals.

Bounding is the process to determine spatial and temporal boundaries that an environmental impact assessment will include based upon physical, chemical, biological, social, economic, jurisdictional, and administrative factors.

Compensation is the provision for enhancement, replacement, restoration, and restitution to recipients of unavoidable negative residual impacts. Often there is payment in funds or replacement in-kind for losses attributed to a development. Funds may also be used to recreate lost habitat or other valued resources.

Compensation plan is the portion of the Environmental Management Plan that describes the compensation measures that will be undertaken and committed to if a project proceeds. It includes how much compensation will be paid to whom, by whom, and under what conditions.

Cumulative impacts are those environmental impacts that are recognizable in regional patterns of environmental change (usually deterioration) caused by:

(a) multiple human activities ;and or
(b) natural events:

which are either repeated or occur in combination. Examples include lowering of the groundwater in a large regional aquifer or water pollution in the large river such as the Ganges. Global climate change is a type of cumulative effect involving the total planet.

Ecosystem is a marine, freshwater or terrestrial system or combination of systems that include some or all of the living and non-living components. Boundaries of an ecosystem are often specified for a particular application.

Environment is the totality of the natural and human environments on which the project will exhibit influence, and includes:

(a) all biophysical components of the natural environment of land, water and air including all layers of the atmosphere, biological resources, and all 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, archeological, architectural, structures, sites and things, land and resource usage, and human health, nutrition and safety.

Environmental assessment is the process for making environmentally-sound decisions in regard to ensuring the concept of sustainable development is achieved in respect to projects and the plans leading to projects. It has four components:

(a) early planning to avoid environmental impacts,
(b) identification of environmental impacts,
(c) Environmental Management Plan to determine residual environmental impacts and their management, and
(d) public participation.

Environmental Enhancement is an intentional change which amplifies the anticipated positive impact of the project on one or more environmental components.

Environmental impact is, in respect to a project,

(a) any change that the project may cause to an environmental component;
(b) any change to the project that may be caused by the environment which then leads to changes in environmental components;
(c) any cumulative effect caused or exacerbated by the project.

[Note: environmental impact and environmental effect are considered as synonymous].

Environmental Impact Assessment (EIA) Report is the environmental assessment report prepared at the feasibility level which is the systematic study, quantified assessment and reporting of the impacts of a proposed plan or project.

Environmental Management Plan (EMP) is a plan to undertake an array of follow-up activities which provide for the sound environmental management of a project so that adverse environmental impacts are minimized and mitigated; beneficial environmental effects are maximized and sustainable development is ensured.

Environmental Effects Monitoring (EEM) is the taking of repetitive measurements over time of environmental components to detect changes caused by external influences directly or indirectly attributable to a specific anthropogenic activity or development. It is 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 Protection Plan (EPP) is a plan that describes specific mitigation actions that will be undertaken during project preconstruction, construction, operation, rehabilitation and abandonment to lessen the effects of the project on the environment usually with specific instructions for personnel involved in project activities. It is a key component of the Environmental Management Plan that integrates existing legislation, codes of good engineering practice, proponent commitment, and designated mitigation measures.

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

Follow-up activities constitute the set of specific actions described in the Environmental Management Plan for project implementation.

Impact matrix is a square or rectangular array of rows (project activities) and columns (important environmental components) used for organizing the analysis of positive and negative environmental impacts of a project.

Important Environmental Component (IEC) are environmental components of biophysical or socio-economic importance to one or more interested parties. The use of important environmental components helps to focus the environmental assessment.

Initial Environmental Evaluation (IEE) is the initial environmental assessment report prepared for a regional or prefeasibility level study for identifying and assessing possible environmental impacts.

Insignificant environmental impact is a residual environmental effect that is not considered significant regardless of level of associated mitigation.

Interested Party include: residents of the plan or project area, elected bangladesh representatives, Government of Bangladesh officials in various departments, Bangladesh professionals, non governmental organizations (NGOs), the general public in Bangladesh, and donor organizations and international agencies. Intervention is the specific action caused by a project which creates an environmental impact.

Justified in the circumstances occurs when circumstances occur, which when balanced against the public interest, public health and safety, and the protection of natural resources, constitute the best alternative for ensuring sustainable development.

Magnitude is the degree of change in a important environmental component that results from a project activity.

Mitigation is the elimination, reduction or control of the adverse environmental impacts of a project. Mitigation measures are specified in the Environmental Protection Plan portion of the Environmental Management Plan.

Project includes:

(a) a physical work such as proposed construction, operation, modification, decommissioning, rehabilitation, abandonment or other undertaking in relation to that physical work, and

(b) a regional, prefeasibility, feasibility, design or conceptual plan or study undertaken to ascertain the desirability of proceeding with physical works and associated activities such as flood proofing, sector development, etc. for eliminating the negative impacts of floods and such activities that are under the purview of the Flood Action Plan.

Project Phase refers to the main categories of project activities expressed sequentially including: preconstruction, construction, operation and abandonment.

Project Stage refers to the main stage of project planning including: prefeasibility (regional study) and feasibility.

Proponent in respect to a project, means the person, body, authority, government or donor that proposes the project, or who is responsible for the environmental assessment or implementation of the project.

Residual environmental impact is any environmental impact that remain after a reasonable and practical environmental management plan is or would be implemented.

Scoping is the process by which the important environmental issues, project alternatives and important environmental components are identified by the interested parties.

Significant environmental impact is an adverse residual environmental impact that is not justified in the circumstances.

Socio-economic refers to the human environment which includes social and economic components that are not termed biophysical.

Sustainable development is development that ensures preservation and enhancement of environmental quality, and sound and sustainable use of natural resources thereby providing for economic growth which meets the needs of the present without compromising the ability of future generations to meet their own needs (adapted from the Brundtland Commission, 1987).

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