The European Union's Food Security Programme for Yemen

Technical Assistance to the Tihama Development Authority

GUIDELINES FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

December 2008

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List of Abbreviations

"The Project"	Technical Assistance to the Tihama Development Authority at Yemen EuropeAid/122248/C/SV/YE
GOY	Government of (the Arab Republic of) Yemen
I&D	Irrigation and drainage
O&M	Operation and maintenance
TA	Technical Assistance (currently contracted to Euroconsult Mott MacDonald)
TDA	Tihama Development Authority
WU	Water user (in the general context, an irrigation-dependent farmer)
WUA	Water Users' Association
YR	Yemeni Rial (currently approx. 1 Euro = 200 YR)
EA	Environmental Assessment
EIA	Environmental Impact Assessment
IEE	Initial Environmental Examination

Introduction

These Guidelines for Environmental Impact Assessment have been prepared by the Project TA team to assist TDA staff to:

1. Participate in discussions on environmental issues with donor agencies, which are most likely to be involved in any large and/or new construction projects, and which will have their own required approach to EIA.

2. Formulate a practical approach to protection of the environment in the context of routine TDA irrigation and drainage O&M and development activities.

Accordingly, **Chapter 1** presents an outline of the approach to EIA as generally practised in the international context, and **Chapter 2** presents recommendations for application of EIA procedures in day-to-day TDA operations.

1. The EIA Process in the General Context

1.1 Origins of EIA

Starting in the middle of the last century, the involvement of international donor agencies in infrastructure development projects promoted the idea that such projects often have negative effects of the environment, and that the full cost of a project could only be estimated when all environmental impacts are estimated.

The term “environmental impacts” came to include all environmental, social, cultural, and ecological impacts of a project.

More recently, the growing body of scientific evidence that the increase in world population and economic activity is having a large and measurable global negative impact has brought environmental awareness into the mainstream.

Today, the only safe assumption is that all human activity, from the activities of an individual to those of nations, can have negative environmental consequences. Hence all activities, no matter what their scale, need to be examined for environmental impacts before they are undertaken, so that potential negative impacts can be neutralized or mitigated before they cause significant environmental damage.

1.2 Summary of the EIA Process

Because of the influence of donor agencies, the EIA process has become standardized to a large extent.

In order not to waste time and resources, an EIA is generally carried out in two steps, with the need for the second step being reviewed at the conclusion of the first step.

Step 1: The first step is the **Initial Environmental Examination** (IEE). The objective of the IEE is to examine all environmental concerns and to identify practical mitigation measures for negative impacts.

In order to decide the nature of the IEE, “scoping” is undertaken, whereby the key issues to be examined during the IEE are identified. In other words, the objective of scoping is to prepare the terms of reference for the IEE.

The results of the IEE are conventionally documented in the form of a report. Typical contents of an IEE Report for an irrigation and drainage development project are given in **Annex 1**.

If the conclusions of the IEE are that potential negative impacts may be easily mitigated, and the needed mitigation measures are described, then the IEE is generally the end of the process.

Step 2: However, if the outcome of the IEE is that there are serious environmental concerns which required more detailed assessment, the the EIA process proceeds to the second step, which is the **Environmental Impact Assessment** (EIA). The terms of reference for the EIA will be contained in the IEE Report.

The EIA may be considered as a more thorough IEE. The structure and contents of an EIA report will be similar to the IEE, with detailed attention paid to the concerns identified in the IEE report.

The EIA will specify mitigation measures to deal with these concerns. If the cost of these measures renders the project uneconomic, or if the EIA concludes that there are serious environmental concerns which cannot be reasonably mitigated, then the project is abandoned.

In the case of large, complex projects, the EA generally proceeds straight to the second step, the EIA.

1.3 The IEE in Detail

The IEE is an important component of the project formulation and design process, and should be carried out as early as possible in the project planning stage.

The minimum objectives of an IEE should be:

1. To provide information about the general environmental settings of the project area as baseline data.

2. To provide information on potential impacts of the project and the characteristic of the impacts, magnitude, distribution, who will be the affected group, and their duration.

3. To provide information on potential mitigation measures to minimize the impact including mitigation costs.

4. To assess the best alternative project at most benefits and least costs in terms of financial, social, and environment. It is not always necessary to change location of the project, but it can be changed in project design or project management.

5. To provide basic information for formulating management and monitoring plan.

Preparation for the IEE

An early step is to determine the scope of the IEE study. This activity is known as “scoping” as a procedure designed to establish the terms of reference (TOR) for the IEE. The scoping procedure should at least:

1. Identify the likely environmental impacts or other environmental concerns and consideration that need to be further investigated in IEE study.

2. Identify environmental component which need detailed or further study.

3. Determine the general approach and methodology required to carry out the IEE study.

4. Identify in general all affected interest to be consulted in carrying out IEE study.

5. Identify the need to fit the outputs of IEE into the project context, especially on environmental management and monitoring plan.

The next step is undertaking the IEE study, and the following are key important activities:

Describing the Environmental Condition of the Project Area

Collection of baseline information on biophysical, social and economic aspects of the project area is the most important reference for conducting IEE study. The description of environmental settings includes the characteristic of area in which the activity of proposed project would occur and it should cover area affected by all impacts including potential compensation area, and potential area affected by its alternatives.

Normally, information is obtained from secondary sources when there is a facility of maintaining databases, or other existing documentation, and through field sampling. Collection of baseline data should be designed to satisfy information requirements and should focus on relevant aspects that are likely to be affected by the proposed project. Therefore, the level of detail in this description of study area should be sufficient to convey to readers nature of environmental and social resources condition of the affected areas.

Assessing Potential Impact

The "technical heart" of the environmental assessment process involves the prediction of changes over time in various environmental aspects as a result of a proposed project. The prediction of the nature, extent, and magnitude of environmental changes likely to result from a proposed project is aided by various tools and techniques, the choice of which depends upon the impacts of concern, data availability or lack thereof, and the appropriate specificity of quantitative models.

However, the choice of the appropriate method for conducting an environmental assessment can only be guided by certain criteria, but no single method will meet all the necessary criteria. In addition, the prediction has to be based on established scientific knowledge that is often still very limited in ecosystems in many countries. For this reason, the prediction of ecological changes and their impacts often does not generate concrete conclusions on the magnitude of the impacts.

Formulating Mitigation Measures

Once the impacts have been analyzed, their significance will be determined, i.e., whether they are acceptable, require mitigation, or are unacceptable. Subsequently, measures will be devised to mitigate anticipated environmental changes and consequential impacts during project implementation and operation, or further reduce the residual environmental changes inherent in the selected project design.

They normally include technical, social, and institutional measures to be implemented as integral elements of the project. Examples are sound operating rules of a reservoir to ensure minimum impacts on downstream water users, and an adequate drainage system in an irrigation project.

1.4 Environmental Management Plans

Environmental management involves the implementation of environmental protection and mitigation measures and monitoring for significant environmental impacts. Environmental protection measures are taken to: (i) mitigate environmental impacts, (ii) provide in-kind compensation for lost environmental resources, or (iii) enhance environmental resources. These measures are usually set out in a plan, which covers all phases of the project from preconstruction through decommissioning, and outlines mitigation and other measures that will be undertaken to ensure compliance with environmental regulations and reduce or eliminate adverse impacts.

The basic implementation arrangements should be presented in the Plan, taking account of the local conditions. Responsibilities for mitigation and monitoring shall be defined along with arrangements for information flow, and for coordination between agencies responsible for mitigation. A plan should specifies who/which agency is responsible for undertaking the mitigating and monitoring measures, e.g., for enforcement of remedial actions, monitoring, training, and financing. A third party may be contracted in case the local authorities' capacity is limited. Institutional strengthening activities may be proposed, including establishment of appropriate organization arrangements; appointment of key staff and consultants; and arrangements for counterpart funding.

The features of an effective environmental management plan are indicated in **Table 1** overleaf.

1.5 Environmental Monitoring

Environmental monitoring involves: (i) planning a survey and sampling program for systematic collection of data/information relevant to environmental assessment and project environmental management; (ii) conduct of the survey and sampling program; (iii) analysis of samples and data/information collected, and interpretation of data and information; and (iv) preparation of reports to support environmental management. Environmental monitoring is normally carried out before and during planning to establish baseline data needed for environmental assessment and evaluating environmental impacts during project implementation. It continues through project operation to detect changes in the key environmental quality parameters, which can be attributed to the project.

Table 1: Features of an Effective Environmental Management Plan

1. Realistic sampling program (temporal and spatial).
2. Sampling methods relevant to source.
3. Collection of quality data.
4. Comparable new data with other relevant data used in environmental assessment.
5. Cost-effective data collection.
6. Quality control in measurement and analysis.
7. Innovations (e.g., in tracing contaminants and automated stations).
8. Appropriate databases.
9. Multidisciplinary data interpretation to provide useful information.
10. Reporting for internal management and external checks.
11. Allowance for, and response to, input from third parties.
12. Presentation in the public arena (external assessment).

The results of the monitoring program are used to evaluate the following: (i) extent and severity of the environmental impacts against the predicted impacts; (ii) performance of the environmental protection measures or compliance with pertinent rules and regulations; (iii) trends in impacts; and (iv) overall effectiveness of the project environmental protection measures.

Environmental monitoring should have clear objectives, and the survey and sampling program custom-designed to focus on data/information actually required to meet the objectives. In addition, the design of the monitoring program has to take into account its practicability considering the technical, financial, and management capability of the institutions that will carry out the program and period of monitoring that will be needed to achieve the objectives (see Table 3). The monitoring program should include action or emergency plans so that appropriate action can be taken in the event of adverse monitoring results or trends. It should also be constantly reviewed to make sure that it is effective, and determine when it can be stopped.

1.6 The ICID Checklist for Irrigation & Drainage Projects

In 1986 the International Commission on Irrigation and Drainage (ICID) recognized the need to address environmental questions more directly and established an international Working Group on Environmental Impacts of Irrigation, Drainage and Flood Control Projects.

ICID developed a Checklist to provide a foundation for a comprehensive system to evaluate environmental impacts from irrigation and drainage systems. The checklist provides a complete and practical guide to the possible impacts of irrigation, drainage and flood control projects on the environment. By using the checklist irrigation/drainage engineers and planners can become more involved in assessing environmental change and planning the mitigation of adverse impacts.

The main purpose of the Checklist system is to provide a tool which will enable specialists and non-specialists concerned with irrigation and drainage development to improve their knowledge and understanding of the environmental changes which such projects may bring so that adverse effects can be identified and, if possible, avoided or controlled and positive effects enhanced.

A summary of the items in the ICID Checklist is given in **Table 2** overleaf. The full checklist is given in **Annex 4**.

Table 2: Summary of the ICID Environmental Assessment Checklist

Topic	Sub-topics	Findings/Remarks
Hydrology	1-1 Low flow regime	
	1-2 Flood regime	
	1-3 Operation of dams	
	1-4 Fall of water table	
	1-5 Rise of water table	
Pollution	2-1 Solute dispersion	
	2-2 Toxic substances	
	2-3 Organic pollution	
	2-4 Anaerobic effects	
	2-5 Gas emissions	
Soils	3-1 Soil salinity	
	3-2 Soil properties	
	3-3 Saline groundwater	
	3-4 Saline drainage	
	3-5 Saline intrusion	
Sediments	4-1 Local erosion	
	4-2 Hinterland effect	
	4-3 River morphology	
	4-4 Channel structures	
	4-5 Sedimentation	
Ecology	5-1 Project lands	
	5-2 Water bodies	
	5-3 Surrounding area	
	5-4 Valleys & shores	
	5-5 Wetlands & plains	
	5-6 Rare species	
	5-7 Animal migration	
	5-8 Natural industry	
Socio-economic	6-1 Population change	
	6-2 Income & amenity	
	6-3 Human migration	
	6-4 Resettlement	
	6-5 Women's role	
	6-6 Minority groups	
	6-7 Sites of value	
	6-8 Regional effects	
	6-9 User involvement	
	6-10 Recreation	
Human health	7-1 Water & sanitation	
	7-2 Habitation	
	7-3 Health services	
	7-4 Nutrition	
	7-5 Relocation effect	
	7-6 Disease ecology	
	7-7 Disease hosts	
	7-8 Disease control	
	7-9 Other hazards	
Ecological imbalances	8-1 Pests & weeds	
	8-2 Animal diseases	
	8-3 Aquatic weeds	
	8-4 Structural damage	
	8-5 Animal imbalances	

2. The EIA Process in the TDA Context

2.1 Assumptions: Scale of Works & Projects

It is most likely that medium and large projects, for both new construction and O&M, will have donor involvement. All donors have their own procedures for ensuring protection of the environment, and thus TDA will not be expected to formulate separate procedures for such projects.

Routine TDA works will center on O&M activities or small projects. By their size and nature, such projects will normally have minimal environmental impact, and it would be inappropriate (unless significant negative environmental impacts are evident) to implement the a IEE process.

Hence an approach to environmental issues that is proportional to the size of works is required.

2.2 Environmental Concerns & Mitigation Measures

A list of realistic environmental concerns is at each of project design, construction, and O&M stages, together with an outline of possible mitigation measures, is given in **Annex 2**.

2.3 Environmental Screening Checklist

Although in day-to-day activities, environmental issues may not be large, it is necessary for TDA to be seen to adopt a high standard of environmental awareness. As a minimum, all but the smallest works should be vetted for possible environmental impact before they are implemented.

It is therefore recommended that, as a matter of routine, TDA completes an environmental screening checklist for small works. The checklist should be generally sufficient to:

1. Ensure that all potential sensitive environmental concerns have been considered.
2. Identify environmental constraints which require a more detailed assessment (an IEE).
3. Provide a ready-made environmental management and monitoring plan.

A suitable checklist which fulfils these criteria is given in **Annex 3**.

2.4 Recommended Approach

The recommended approach for small medium and large projects is shown in flowchart form in **Figure 1** at the end of this Chapter, and is summarized in **Table 3** overleaf.

Table 3: Screening for Project EA Procedures

Size of Project	EIA Procedures
Small: cost less than $50,000	Screening Checklist (Annex 4) to be completed. If potentially significant environmental problems identified, IEE Report to be prepared. If IEE cannot identify satisfactory mitigation measures, EIA to be prepared. If EIA cannot identify satisfactory mitigation measures, abandon project.
Medium: cost $50,000 to $300,000	IEE Report to be prepared. If IEE cannot identify satisfactory mitigation measures, EIA to be prepared. If EIA cannot identify satisfactory mitigation measures, abandon project.
Large: cost more than $300,000	IEE and EIA Reports to be prepared. If EIA cannot identify satisfactory mitigation measures, abandon project.

Note: this table is illustrative. The costs shown are those adopted for World Bank / FAO-funded projects in Afghanistan from 2003

2.5 Use of Consultants for IEEs & EIAs

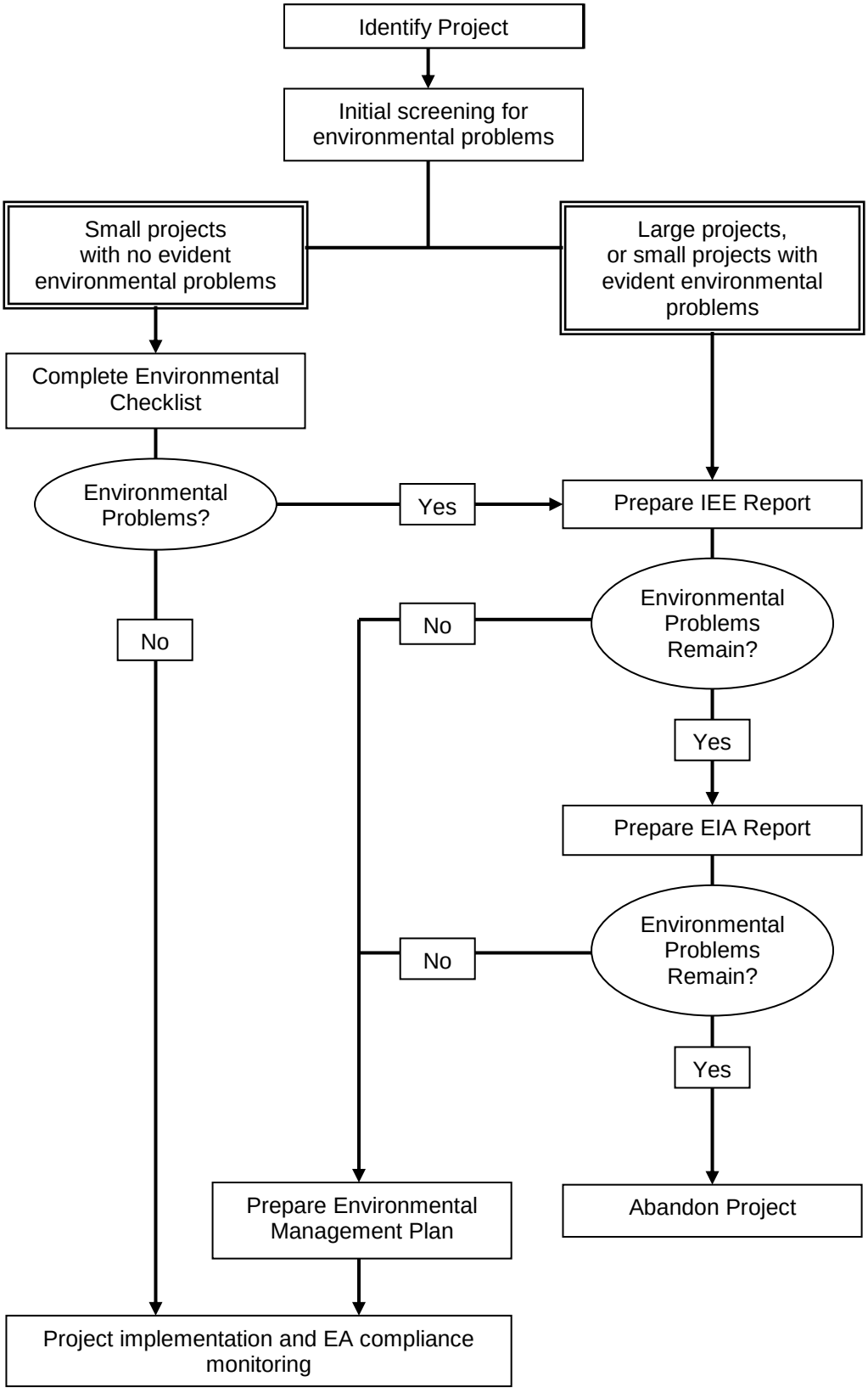
Although TDA staff are suitably diligent and competent to complete the Checklist (Annex 3), there are two advantages to employing independent consultants for environmental assessment on medium to large projects:

1. Environmental mitigation measures incur costs over and above direct construction costs, and TDA might be perceived as avoiding these additional costs by reducing the scope of any environmental study, or viewing potential negative impacts too optimistically.

2. An independent, professional, and experienced environmentalist will be able to more quickly identify problem areas and suitable mitigation measures.

For donor-funded works, engagement of consultants will normally be mandatory.

Figure 1: Summary Flowchart of the EIA Process



Annex 1

OUTLINE CONTENTS OF AN IEE/EIA REPORT

ANNEX 1: OUTLINE CONTENTS OF AN IEE/EIA REPORT

The content and format of the IEE report is given below. If the approved IEE concludes that the project will not have any significant adverse environmental impacts, then the environmental assessment is deemed complete. If there are unresolved issues, the recommendation should be either that further studies be undertaken to resolve the issues, or that a full EIA is required.

A. Introduction: This section usually includes the following:

a. purpose of the report, including (a) identification of the project and project proponent; (b) brief description of the nature, size, and location of the project and of its importance to the country; and (c) any other pertinent background information; and
b. Extent of the IEE study: scope of study, magnitude of effort, person or agency performing the study, and acknowledgement.

B. Description of the Project: Furnish sufficient details to give a brief but clear picture of the following (include only applicable items):

(i) type of project;
(ii) category of Project;
(iii) need for project;
(iii) location (use maps showing general location, specific location, and project site);
(iv) size or magnitude of operation;
(v) proposed schedule for implementation; and
(vi) descriptions of the project, including drawings showing project layout, and project components. This information should be of the same type and extent as is included in feasibility reports for proposed projects to give a clear picture of the project and its operations.

C. Description of the Environment: Furnish sufficient information to give a brief but clear picture of the existing environmental resources in the area affected by the project, including the following (to the extent applicable):

(i) Physical Resources: (e.g.)
- atmosphere (e.g. air quality and climate)
- topography and soils,
- surface water
- groundwater
- geology/seismology.

(ii) Ecological Resources: (e.g.)
- fisheries
- aquatic biology
- wildlife
- forests
- rare or endangered species
- protected areas
- coastal resources

(iii) Economic Development: (e.g.)
- industries
- infrastructure facilities (e.g. water supply, sewerage, flood control)
- transportation (roads, harbors, airports, and navigation)
- land use (e.g. dedicated area uses)
- power sources and transmission
- agricultural development, mineral development, and tourism facilities

(iv) Social and Cultural Resources: (e.g.)

- population and communities (e.g. numbers, locations, composition, employment)
- health facilities
- education facilities
- socio-economic conditions (e.g. community structure, family structure, social well being)
- physical or cultural heritage
- current use of lands and resources for traditional purposes by Indigenous Peoples
- structures or sites that are of historical, archaeological, paleontological, or architectural significance.

D. Screening of Potential Environmental Impacts and Mitigation Measures: Using the checklist of environmental parameters for different sector projects, this section will screen out "no significant impacts" from those with significant adverse impact by reviewing each relevant parameter according to the following factors or operational stages. Mitigation measures, where appropriate, will also be recommended environmental problems due to project location, and related to project design, construction, and operations. Potential environmental enhancement measures and additional considerations will also be covered.

E. Institutional Requirements and Environmental Monitoring Plan: This section should state the impacts to be mitigated, and activities to implement the mitigation measures, including how, when, and where they will be implemented. Institutional arrangements for implementation should be described. The environmental monitoring plan will describe the impacts to be monitored, and when and where monitoring activities will be carried out, and who will carry them out. The environmental management and monitoring costs should also be described.

F. Public Consultation and Information Disclosure: This section will describe the process undertaken to involve the public in project design and recommended measures for continuing public participation; summarize major comments received from beneficiaries, local officials, community leaders, NGOs, and others, and describe how these comments were addressed; list milestones in public involvement such as dates, attendance, and topics of public meetings; list recipients of this document and other project related documents; describe compliance with relevant regulatory requirements for public participation; and summarize other related materials or activities, such as press releases and notifications. This section will provide of summary of information disclosed to date and procedures for future disclosure.

G. Findings and Recommendations: This section will include an evaluation of the screening process and recommendation will be provided whether significant environmental impacts exist needing further detailed study or EIA. If there is no need for further study, the IEE itself, which at times may need to be supplemented by a special study in view of limited but significant impacts, becomes the completed environmental assessment for the project and no follow-up EIA will be needed. If an EIA is needed, then this section will include a brief terms of reference (TOR) for the needed follow-up EIA, including approximate descriptions of work tasks, professional skills required, time required, and estimated costs.

H. Conclusions: This section will discuss the result of the IEE and justification, if any, of the need for additional study or EIA. If an IEE, or an IEE supplemented by a special study, is sufficient for the project, then the IEE with the recommended institutional and monitoring program becomes the completed EIA.

Annex 2

COMMON ENVIRONMENTAL CONCERNS & MITIGATION MEASURES

ANNEX 2: COMMON ENVIRONMENTAL CONCERNS & MITIGATION MEASURES

Environmental Concerns	Potential Impacts	Mitigation Measures
Design Stage		
Hydrology	Downstream water availability	Maintain flow requires for downstream uses
	Flooding regime	Design to ensure no increased damage
	Waterlogging	Improve drainage, line canals
Soils	Increased salinity	Design for adequate drainage
		Design to ensure no increase in groundwater abstractions
Sediment	Local erosion, dust	Specify appropriate construction procedures
	Wadi morphology	Design to minimise changes in wadi flow regime
	Sedimentation	Design sediment exclusion works
Health	Incidence of diseases	Ensure proper drainage
Construction Stage		
Hydrology	Downstream water availability	Utilise temporary works to maintain required flow
Pollution	Discharges from campsites	Provide proper sanitation arrangements
	Vehicle emissions	Ensure appropriate maintenance
Sediment	Local erosion, dust	Ensure sufficient channel sections during construction
		Spray water on exposed surfaces
		Cover material during transportation
	Wadi morphology	Ensure construction procedures do not affect wadi flow regime
Ecology	Drainage of water bodies	Minimise drainage of habitats
	Disruption of habitats	Schedule construction to minimise disturbance
Health	Incidence of diseases	Ensure proper drainage
		Prevent groundwater pollution
Local communities	Socio-economic disturbance	Provide all amenities in construction campsites
		Route construction traffic to avoid communities
		Maintain clear access for communities
Operation Stage		
Hydrology	Downstream water availability	Appropriate operation of water control structures
	Flood regime	Appropriate operation of water control structures
	Waterlogging	Appropriate operation of water control structures (ensure demand matches supply)

Soils	Increased salinity	Assist communities to apply appropriate irrigation, drainage, and tillage techniques
		Restrict groundwater abstractions
Sediment	Blockage of canal and drains	Appropriate operation of silt exclusion structures
	Wadi morphology	Ensure sediment returned to wadis does not precipitate changes in wadi flow regime
Ecology	Drainage of water bodies	Minimise drainage of habitats
	Disruption of habitats	Appropriate operation of water control structures
		Schedule O&M activities to minimise disturbances
Local communities	Socio-economic disturbance	Schedule O&M activities to minimise disturbances
Health	Use of canals and drains as waste disposal sites	Work with other local authorities to provide alternative disposal facilities

Annex 3

ENVIRONMENTAL SCREENING CHECKLIST FOR ROUTINE TDA WORKS

ANNEX 3: ENVIRONMENTAL SCREENING CHECKLIST FOR ROUTINE TDA WORKS

INSTRUCTIONS

This checklist focuses on environmental issues and concerns to ensure that these are adequately considered in sub-project verification. It takes into account sub-project location, environmental risks, and possibilities for mitigation measures. The purpose of the checklist is to identify the potential environmental impacts of the project.

Use the "remarks" section to provide details of any other issues. Use the conclusions/ recommendations section to discuss any suggested mitigation measures.

Project name:

Location:

Type of construction:

Screening Questions		Yes	No	Mitigation Measures/Remarks
A	Project location: is the location near or within any of the following environmentally sensitive areas:			
1	Protected area			
2	Wetland			
3	Buffer zone of protected area			
4	Special biodiversity zone			
B	Potential environmental impacts: will the project cause:			
1	Loss of precious ecological values as a result of encroachment into forest / swamplands or historical / cultural buildings / areas			
2	Flooding hazards			
3	Drainage hazards			
4	Impediments to movement of people and animals			
5	Potential ecological problems due to increased soil erosion and siltation, leading to decreased stream capacity			
6	Insufficient drainage leading to salinity intrusion			
7	Overpumping of groundwater, leading to reduction in groundwater level and / or salinity intrusion and / or ground subsidence			
8	Impairment of downstream water quality and / or downstream beneficial uses			

9	Dislocation or involuntary resettlement of people			
10	Soil erosion before compaction and lining of canals			
11	Noise from construction equipment			
12	Dust			
13	Waterlogging and soil salinization due to inadequate drainage and farm management			
14	Leaching of soil nutrients and changes in soil characteristics due to excessive irrigation			
15	Reduction of downstream supply during spates			
16	Soil pollution, polluted farm runoff and groundwater, public health risks from fertilizers and pesticides			
17	Scouring of canals			
18	Soil erosion due to furrow and surface flow			
19	Canal sedimentation			
20	Blockage of canals by vegetation			
21	Increase in incidence of water-related diseases			

Other Remarks (use additional sheets if required)

Conclusions and Recommendations

Prepared by: Approved by:

Name:	Name:
Position:	Position:
Date:	Date:

Annex 4

THE I.C.I.D. ENVIRONMENTAL CHECKLIST FOR IRRIGATION & DRAINAGE WORKS

ANNEX 4:
THE ICID ENVIRONMENTAL CHECKLIST FOR IRRIGATION & DRAINAGE WORKS

1. Hydrological changes

1.1 Low flow regime: Is the low flow regime of the river substantially changed by the Project and its dams (by more than ±20% in low flow periods)? If so, does this change benefit or impair aquatic ecosystems, existing or potential downstream abstractions, hydropower, navigation or recreational uses?

1.2 Flood regime: Is the flood regime of the river (peak discharge and stage, speed of flood waves, flood super-position with joining rivers, duration or extent of floodplain inundations downstream) substantially changed by the Project as a result of changes in abstractions, retention storage, reservoir releases, flood protection works, new road/rail routes, river training or surface drainage works? If so, does this change benefit or impair aquatic and flood-affected ecosystems, lead to an increase or decrease in flood damage or change land use restrictions outside the Project?

1.3 Operation of dams: Can modifications to the operation of any storage or flood retention reservoir(s) compensate for any adverse impacts associated with changes in flow regime, whilst minimising the losses to the Project and other users? Possible modifications affecting water quality downstream, saline intrusion, the sediment regime of channels, the ecology of affected areas, amenity values, disease transmission or aquatic weed growth should be considered. (A separate environmental assessment of large reservoir(s) may be required).

1.4 Fall of water table: Does the Project cause a fall of the water table (from groundwater abstractions, reduced infiltration due to river training, drainage or flood protection works)? If so, does this fall lead to increased potential for groundwater recharge (from seasonal rainfall) and improved conditions for land use; or lead to depletion of the groundwater system, affecting wells, springs, river flows and wetlands?

1.5 Rise of water table: Does the Project cause a rise of the water table (from increased infiltration or seepage from irrigation, seepage from reservoirs and canals, or increased floodplain inundation)? If so, does this rise lead to improved yield of wells and springs and improved capillary rise into the root zone; or lead to waterlogging of agricultural or other land in the Project area or vicinity?

2. Organic and inorganic pollution

2.1 Solute dispersion: Are the Project and its dams leading to changes in the concentrations of organic or inorganic solutes in the surface water due to changes to the pattern of water abstraction and reuse in the basin or flow regulation? If so, do the changes benefit or impair biological communities or domestic, agricultural or industrial water users in the basin?

2.2 Toxic substances: Are significant levels of toxic substances accumulating or being introduced, mobilised and transmitted due to the construction and operation of the Project and its dams, or are levels being reduced? Substances such as pesticides, herbicides, hydrogen sulphide, oil derivatives, boron, selenium and heavy metals in irrigation supplies or surface, drainage and ground waters should be considered.

2.3 Organic pollution: Are nutrients, organic compounds and pathogens being reduced or introduced and concentrated, due to the Project, its dams and its associated domestic settlements? If so, does the change result in a reduction or increase in environmental and water use problems in the Project area or downstream (in rivers, canals, reservoirs, end lakes, evaporation wet lands, depressions, deltas, estuary regions) or in the groundwater?

2.4 Anaerobic effects: Is the Project reducing or creating anaerobic conditions or eutrophication in any impoundments, natural lakes, pools or wetlands due to changed input or accumulation of fertilisers, other nutrients and organic matter or due to changed water quality resulting from dams, river abstractions and drainage flows?

2.5 Gas Emissions: Is the Project, either directly or through associated industrial processing, causing decreased or increased gas emissions which contribute to air pollution (03, SO3, H2S, NOR, NH4, etc) or the greenhouse effect (CO2, CH4, NON, etc)?

3. Soil properties and salinity effects

3.1 Soil salinity: Is the Project leading to progressive accumulation of salts in the soils of the project area or the vicinity because of prevailing high salt content in, the soil, the groundwater, or the surface water; or can a progressive leaching effect be expected?

3.2 Soil properties: Is the Project leading to changes in soil characteristics within the Project area or the vicinity due to such activities as irrigation, the application of fertilisers or other chemicals, cultivation practices or dewatering through drainage? Changes which can improve or impair soil structure, workability, permeability, fertility associated with nutrient changes, humus content, pH, acid sulphate or hard pan formation or available water capacity should be considered.

3.3 Saline groundwater: Are changes to the rates of seepage, percolation or leaching from the Project and its dams increasing or decreasing the concentrations of chlorides, nitrates or other salts in the groundwater?

3.4 Saline drainage: Are changes to the concentrations of chlorides, nitrates or other salts in the runoff or drainage water from the Project area in danger of affecting biological communities or existing or potential downstream users (particularly during low flow conditions)?

4. Erosion and sedimentation

4.1 Local erosion: Is increased or decreased soil loss or gully erosion being caused within or close to the Project area by changes in land gradient and vegetative cover, by irrigation and cultivation practice, from banks of canals, roads and dams, from areas of cut and fill or due to storm drainage provision?

4.2 Hinterland effect: Are the Project and its dams leading to changes in natural vegetation, land productivity and erosion through changes in population density, animal husbandry, dryland farming practices, forest cover, soil conservation measures, infrastructure development and economic activities in the upper catchment and in the region surrounding the Project?

4.3 River morpholoqy: Is the regime of the river(s) changed by the Project and its dams through changes in the quantity or seasonal distribution of flows and flood peaks in the river(s), the abstraction of clear water, changes in sediment yield (caused by and 4.2), the trapping of sediment in reservoirs or the flushing of sediment control structures? If so, do these changes benefit or impair aquatic ecosystems or existing or potential users downstream?

4.4 Channel structures: Is scouring, aggradation or bank erosion in the river(s), endangering the Project's river headworks, offtake structures, weirs or pump inlets, its canal network, drainage or flood protection works, the free flow of its drainage system or structures and developments downstream? Consider effects associated with changes noted in as well as those caused by other existing and planned upstream developments.

4.5 Sedimentation: Are the changes noted in 4.1 - causing increased or decreased sediment deposition in irrigation or drainage canals, hydraulic structures, storage reservoirs or on cultivated land, either via the irrigation system or the river(s)? If so, do these changes benefit or impair soil fertility, Project operation, land cultivation or the capacity and operation of reservoirs?

5. Biological and ecological changes

Is the Project, its dams or its associated infrastructure causing substantial and permanent changes (positive or negative) within the habitats listed in 5.1 - 5.5?

- in the natural ecology (habitat, vegetation, terrestrial animals, birds, fish and other aquatic animals and plants),
- in areas of special scientific interest, or
- in biological diversity

Include the likely ecological benefit of any new or modified habitats created and of any protective or mitigatory measures adopted (such as nature reserves and compensatory forests).

5.1 Project lands: The lands within the project area.

5.2 Water bodies: Newly created, altered or natural channels, reservoirs, lakes and rivers.

5.3 Surrounding area: All terrestrial areas influenced by the Project works and its associated domestic settlements and hinterland effects.

5.4 Valleys and shores: River and canal banks, lake, reservoir and sea shores and the offshore marine environment.

5.5 Wetlands and plains: Floodplains or permanent wetlands including deltas and coastal swamps.

5.6 Rare species: Is the existence of any rare, endangered or protected species in the region enhanced or threatened by the changes noted in 5.1 - 5.5?

5.7 Animal migration: Does the Project, its dams or new road/rail routes affect the migration patterns of wild animals, birds or fish? Make allowance for the compensatory effect of any additional provision within the Project (canal crossings, fish passes, spawning locations, resting or watering places, shade, considerate operation).

5.8 Natural industry: Are commercial or subsistence activities depending on the natural terrestrial and aquatic environment benefited or adversely affected by the Project through ecological changes or changes in human access? Changes affecting such activities as fisheries, harvesting from natural vegetation, timber, game hunting or viewing and honey production should be considered.

6. Socio-economic impacts

6.1 Population change: Is the Project causing significant demographic changes in the Project area or vicinity which may affect social harmony? Changes to population size/density and demographic/ethnic composition should be considered.

6.2 Income and amenity: Is the Project introducing significant economic/political changes which can increase or decrease social harmony and individual well-being? Changes in the general levels of employment and income, in the provision of local infrastructure and amenities, in the relative distribution of income, property values and Project benefits (including access to irrigation water) and in the demand for labour and skills (particularly in relation to family/political hierarchy and different sexes and social groups) should be considered.

6.3 Human migration: Has adequate provision been made for any temporary or migratory population influx to avoid social deprivation, hardship or conflicts within these groups or between the permanent and temporary groups? Human migration arising both from the demand for skills/labour during construction and from the requirements for seasonal agricultural labour should be considered.

6.4 Resettlement: Has adequate provision been made for the resettlement, livelihood and integration of any people displaced by the Project and its dams or losing land, grazing or other means of income due to the Project? Also, has adequate provision been made for the subsistence farming needs of people settled on or associated with the Project?

6.5 Women's role: Does the Project change the status and role of women (positively or negatively) in relation to social standing, work load, access to income and heritage and marital rights?

6.6 Minority qroups: Are the Project and its dams causing changes to the lifestyle, livelihoods or habitation of any social groups (particularly minority groups) leading to major conflicts with, or changes to their traditional behaviour, social organisation or cultural and religious practices?

6.7 Sites of value: Is access improved or hampered to places of aesthetic and scenic beauty, sites of historical and religious significance or mineral and palaeontological resources? Also, are any such sites being destroyed by the Project?

6.8 Regional effects: Are the economic, infrastructural, social and demographic changes associated with the Project likely to enhance, restrict or lead to unbalanced regional development? Also, has adequate provision been made for new transport, marketing and processing needs associated with the Project?

6.9 User involvement: Has there been adequate user and public participation in project planning, implementation and operation to ensure Project success and reduce future conflicts? The potential for incorporating within the Project existing systems of land tenure, traditional irrigation, and existing organizational and sociological structures and for the provision of new or extended facilities for credit, marketing, agricultural extension and training should be considered.

6.10 Recreation: Are the Project and its dams creating new recreational possibilities (fishing, hunting, sailing, canoeing, swimming, scenic walks, etc) and are existing facilities impaired, preserved or improved?

7. Human health

Consider each of the items 7.1 - 7.9 in relation to the local population, the labour force during construction and their camp followers, the resettled and newly settled populations and migratory labour groups.

7.1 Water and Sanitation: Are the provisions for domestic water, sanitation and refuse disposal such that oral, faecal, water washed and other diseases and the pollution of domestic water can be controlled?

7.2 Habitation: Are the provisions for housing and forecast population densities such that diseases related to habitation or location of dwellings can be controlled?

7.3 Health services: Are general health provisions adequate (treatment, vaccination, health education, family planning and other health facilities)?

7.4 Nutrition: Is the Project leading to an increase or decrease in the general nutritional status of the population or to changes in other lifestyle or income related diseases? If so, are any specific groups particularly exposed to such health risks?

7.5 Relocation effect: Are population movements introducing new infectious or water-related diseases to the Project area or causing stress-related health problems or bringing people with a low resistance to particular diseases into areas of high transmission?

7.6 Disease ecology: Are the extent and seasonal character of reservoirs, canals, drains, fast flowing waters, paddy fields, flooded areas or swamps and the closeness or contact of the population with such water bodies leading to significant changes in the transmission of water related diseases?

7.7 Disease hosts: Are the populations of intermediate and other primary hosts of parasitic and water-related diseases (rodents, birds, monkeys, fish, domestic animals) and the interaction of the human population with these hosts, decreased or increased by the Project?

7.8 Disease control: Can the transmission of the diseases identified in 7.1, 7.2, 7.5, 7.6 and 7.7 be reduced by introducing into the Project environmental modifications or manipulations or by any other sustainable control methods? Possible environmental measures include both removal of breeding, resting and hiding places of vectors and reducing contamination by and contact with humans.

7.9 Other hazards: Is the risk to the population decreased or increased with respect to:

- Pathogens or toxic chemicals present in irrigation water (particularly through wastewater reuse) or in the soils, which can accumulate in food crops or directly threaten the health of the population;
- Dwellings adequately located and designed to withstand any storm, earthquake or flood hazards;
- Sudden surges in river flow caused by the operation of spillways or power turbines; and
- Structures and water bodies designed to minimize accident and allow escape?

8. Ecological imbalances

8.1 Pests and weeds: Are crop pests or weeds likely to increase or decrease (particularly those favoured by irrigation/drainage/flood control) affecting yields, cultivation and requirements for pesticides or herbicides?

8.2 Animal diseases: Are domestic animals in the Project or vicinity more or less exposed to hazards, diseases and parasites as a result of the Project and its dams?

8.3 Aquatic weeds: Are reservoirs, rivers or irrigation and drainage canals likely to support aquatic vegetation or algae? If so, can these plants be harvested or controlled, or will they reduce the storage/conveyance capacity, interfere with the operation of hydraulic structures or lead to oxygen-oversaturated or anaerobic water bodies?

8.4 Structural damage: Is there a danger of significant damage being caused to dams, embankments, canal banks or other components of the irrigation/drainage/flood control works through the action of plants and animals (including rodents and termites) favoured by the Project?

8.5 Animal imbalances: Does the Project cause zoological imbalances (insects, rodents, birds and other wild animals) through habitat modification, additional food supply and shelter, extermination of predators, reduced competition or increased diseases?