5 SCOPING

Scoping is a process to *define the terms of reference of an EIA study* regarding content, methodology, time, financial resources, responsibilities, and organisation (Figure 10). *Informal* scoping is done jointly by project planners and environmental specialists, preferably with the EIA study team. *Formal* scoping would require also the involvement of other interested groups (governmental agencies, NGOs, affected persons or their representatives) during an official meeting according to legal procedures. Scoping aims to:

- Enable the executive agency to brief the EIA study team on the **issues** and **methodology** used for analysis, prognosis and assessment of likely impacts;
- Provide an opportunity for other **interested groups** to have their interests taken into account. This, however, is rarely done in development cooperation, due to time constraints, lack of opportunities for joint meetings, lack of possibilities to inform the public in developing countries and to hold meetings. Nevertheless, it is essential for a good EIA study that the interests of different groups are considered adequately in environmental appraisals (see also Section 2, stakeholder involvement);
- Focus the EIA study on **relevant issues** and to be sure that resulting EIA is useful to the decision-makers.

Alternative EIA studies

There are three options for conducting an EIA study:

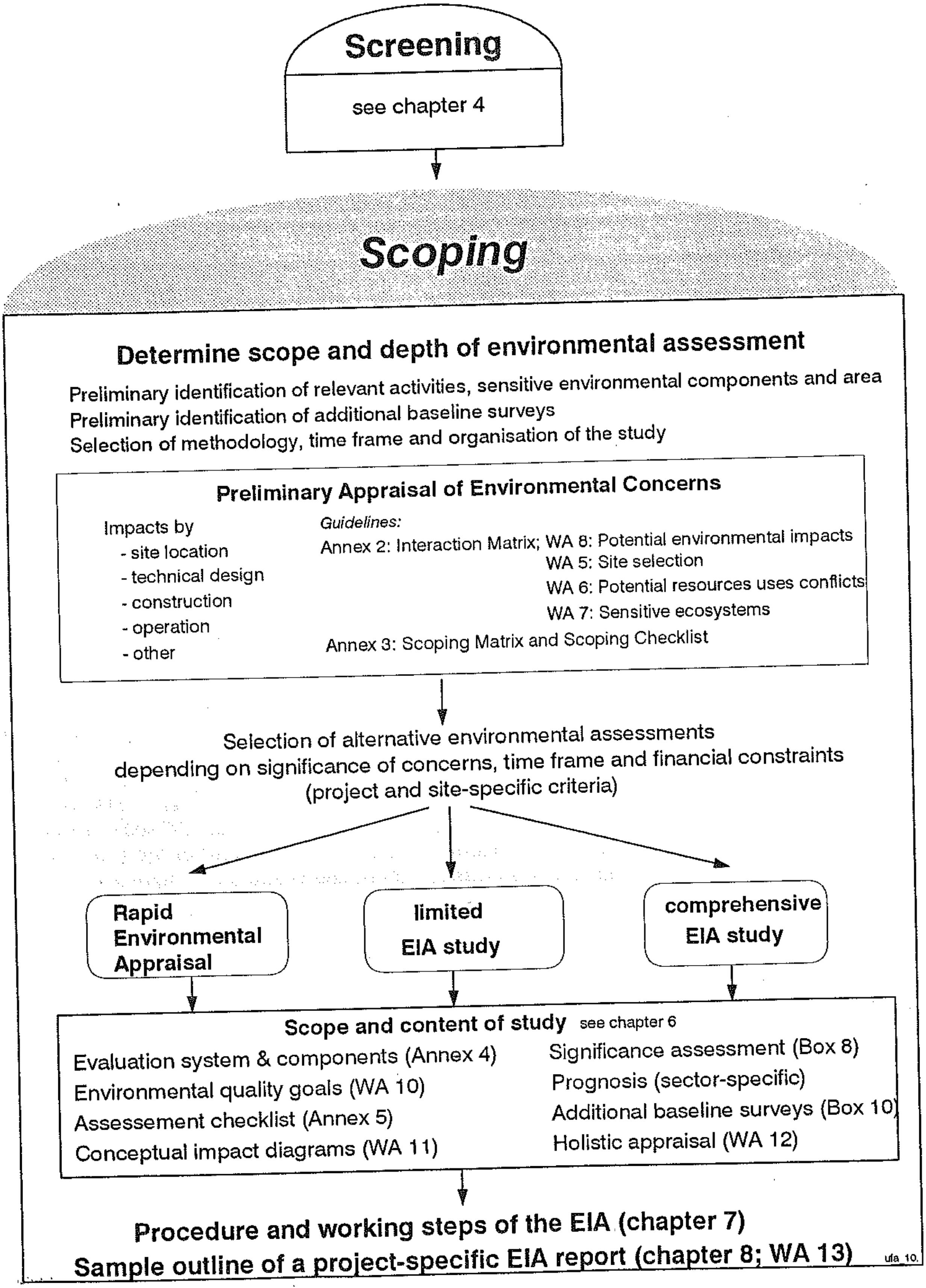
1. Rapid environmental appraisal (REA), based on existing data and information, focusing on important environmental components, using rule-of-thumb estimations or heuristic experience for analysis and prognosis, concentrating on recommendations for environmental management;
2. Semi-detailed EIA study, which analyses in depth a limited number of important environmental components likely to be significantly affected. This analysis may include baseline surveys or in-depth consultations of sector specialists. An Environmental Management Plan should amend the EIA study;
3. Detailed EIA study according to international standards if the environmental changes are likely to be very significant, if sensitive ecosystems or human habitats are seriously concerned. In large irrigation or multi-purpose dam projects, the detailed EIA study can be part of the Feasibility Study. Such detailed EIA requires usually detailed baseline surveys on natural resources, social and socio-economic issues. Complex methods (e.g. modelling) are often employed for the prediction of environmental changes, the overall assessment and valuation of impacts.

Focus of Scoping

The following topics are relevant in scoping:

- Definition of environmental components which must be considered in EIA, based on the identification of project activities and the preliminary decision about which factors may cause effects and which effects are of importance;
- Deciding the depth of appraisal i.e., the degree of precision for analysis/ prognosis;
- Description of additional baseline surveys, e.g. land use, hydrological or hydrogeological surveys, soil surveys, faunal and floral inventories, archaeological surveys, health and epidemiological surveys, pollution surveys (air, soils, water);
- bounding by which spatial and temporal contexts are selected:
  - delineation of survey and assessment areas (Figure 11), taking into consideration localised or more widespread impacts. The following are likely considerations: physical (e.g. watershed boundaries) or ecological boundaries (e.g. habitat ranges, migration routes), and administrative, social or economic boundaries;

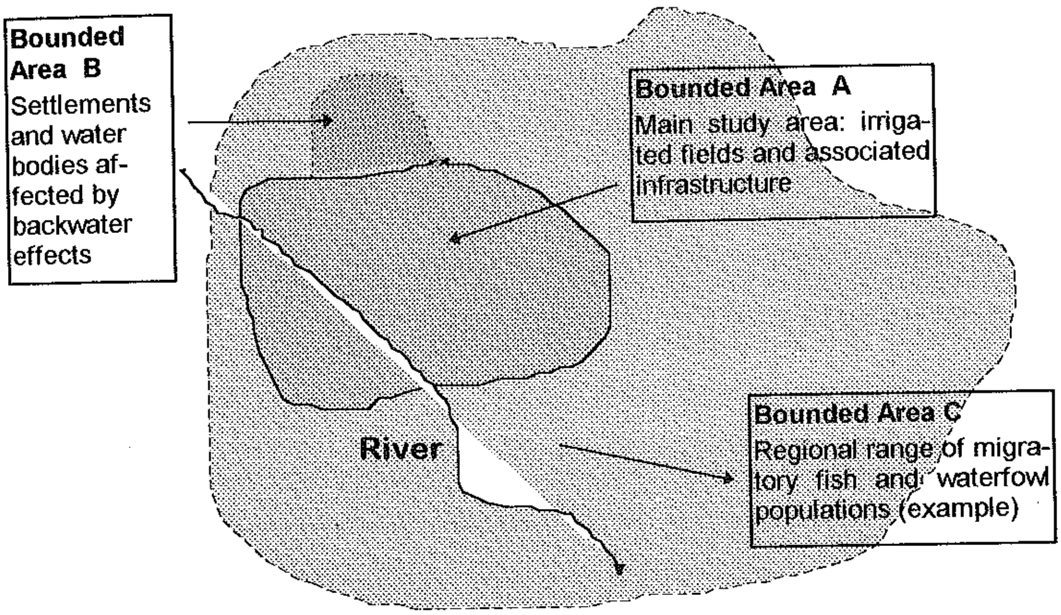
Figure 10 Procedure for Scoping



- definition of time scales applicable to the prediction of potential impacts and different phases of project activities, including recommendations for environmental management during project operation and abandonment;
- outlining methods to be employed for analysis, prognosis and evaluation of specific impacts, and the method of final overall assessment.

These criteria should be defined as precisely as possible on the basis of available data, time, financial resources and the likely significance of impacts. It is impossible to establish general rules of appropriateness except, for example, the more likely significant changes in stream flow occur (high water abstraction), the more detailed analyses, predictions and assessments are required e.g. by hydrological modelling.

Figure 11: Example of project bounding



Organisation

The following issues must be considered and agreed upon:

- Handing over of planning documents;
- Assessment of possibilities of using locally available data;
- Details of the further steps in the EIA procedure;
- Integration of results in the project documentation and presentation of results. Usually, there is an EIA report and technical annexes. Depending on the state of planning and the internal administrative procedures, the results can be included into the appraisal mission's report, or be a separate report of the feasibility study;

Co-ordination

Each executing agency for development cooperation has detailed regulations for administering environmental appraisal, and the environmental and country section units of the agency should be consulted. Further co-ordination is required with responsible national environmental agencies to ensure that relevant national environmental regulations are followed: Typically, contacts are required with environmental agencies, regional and local planning authorities and departments which are responsible for water resources/ irrigation, agriculture, nature conservation and public health.

Box 10

Guiding steps for scoping

The decisions on the topics to be considered in EIA depend on type and features of the project, characteristics of the area and framework conditions. Checklists and Working Aids support decision-making.

1. Rapid determination of environmental components (definition in Chapter 6) which are relevant for further examination in the site- and project-specific context. These depend on the planned activities and potentials for direct or indirect environmental changes resulting from these activities

   Annex 2: Interaction matrix

2. If sufficient information is available, scoping can be conducted with a Checklist and Matrix for Environmental Scoping. The following issues are considered:
   - potential impacts due to site location
   - potential impacts related to technical design / project planning
   - potential impacts associated with construction activities
   - potential impacts related to project operation

   Annex 3: Checklist and matrix for environmental scoping

3. Important potential environmental impacts are: hydrological changes, pollution of soil, air, or water, contamination of fauna or flora, soil degradation, biological imbalances, land and water user conflicts, public health risks, impairments of landscape and cultural heritage, resettlements.

   Working Aid 8: Potential environmental impacts of irrigated agriculture

4. Negative impacts can be due to poor selection of land for agricultural and irrigated land development. A questionnaire considers issues related to land use planing

   Working Aid 5: Questionnaire for site selection

5. Conflicts over increasingly scarce land and water resources are a potential for negative impacts. There should be a distinction of conflicts between agricultural or irrigation developments and other resource users and vice-versa. Resource users may be other development sectors (e.g. urban and rural settlements, forest, rangeland) and nature conservation.

   Working Aid 6: Potential user conflicts over land / water resources

6. Impacts on Ecologically Sensitive Areas need special attention in EIA. These are (1) nature reserves or protected landscapes; (2) wetlands and other ecologically sensitive areas; (3) scarce water resources; (4) habitats or settlement areas of ethnic minorities/ traditional groups

   Working Aid 7: Checklist of ecologically sensitive areas

6 FOCUS AND CONTENT OF AN EIA STUDY

Objectives

The EIA assesses, based on existing technical knowledge and experience whether a project plan:

- complies with laws and regulations regarding environmental protection and whether designs are made according to the state-of-technology (e.g. pollution control; efficient use of non-renewable resources)
- follows land use planning practices and integrates into existing land use plans and water master plans
- observes guiding principles of environmentally sound irrigated agriculture
- contains steering instruments for the implementation and operational phases, such as environmental monitoring and evaluation.

Recommendations for environmental management contain:

- anticipatory planning, implementation and operation in the fields of water supply systems, water management, land husbandry practices, crop production systems
- measures to reduce negative impacts or to compensate for or mitigate residual impacts, e.g. waste re-use, health controls or landscape planning for wetland conservation issues.

Project alternatives or technical options (site selection, choice of agronomic and irrigation technology, modes of operation) can be subject to an EIA study. The influence of an EIA at an early planning stage can be more efficient in developing alternatives than at a later planning stage, or during implementation and operation.

Key issues

The following issues are subject to EIA:

- ecological situation of the project area (state of the environment)
- existing ecological imbalances and degradation of water, land and air in the region and at the project site
- development trends for the project area and the region without the project activities
- description of impacts (changes) directly or indirectly caused by project activities
- interlinkages between impacts on natural resources and socio-economic effects
- recommendations for environmentally sound measures, including the evaluation of site selection and proposed mitigation and compensation measures for environmental protection
- holistic appraisal of the overall effects of the project, both negative or positive.

Environmental quality goals (Visions)

The evaluation of impacts is the key to EIA. Meaningful evaluation requires the development of a valuation system: in particular environmental quality goals, that specify the vision of sustainable irrigated agriculture. Any significant deviation from this "vision of sustainability" creates environmental problems.

Unfortunately, there are only few universally applicable or accepted "hard" standards or regulations of environmental quality goals in agricultural or irrigation land development, such as water pollution control or health standards for wastewater re-use. Most goals and standards are "soft", i.e., they are site-specific and time-dependant due to changing visions, related to socio-economic conditions or cultural perceptions, increased understanding in ecosystem analysis and the adoption of new technologies in irrigation technology, water management, land husbandry, etc.

Guiding principles: environmentally sound agriculture

Environmentally sound agriculture (and irrigation) avoids risks of land degradation and uses resources efficiently while the production is sustainable at a reasonably high level. The guiding principles for environmentally sound agricultural and irrigated land development (see Box 3) need to be adopted in a site-specific context:

- Guidelines for environmental management in agricultural and irrigated land development are shown in Box 11 and Working Aid 1;
- Sector guidelines for setting project-specific environmental quality goals are outlined in Working Aid 10-1, Examples 1 to 3;
- Guiding principles for agronomic "Best-Management-Practices" and "Water Pollution Control" are outlined in Working Aid 10-2 and 10-3 (see also MAFF 1993).

Environmental quality goals aim to:

⇒ water resources (quantity or quality of ground- and surface water), soil, air quality, biodiversity and biological balances, land use systems and landscapes; and comply with other development plans and public health safety standards.

Box 11

Guidelines for Environmental Management

Environmental management should be aimed at:

1. Observation of laws, regulations and technical or safety standards for environmental protection and pollution control;
2. Observation of agricultural policy goals and programmes and compliance with regional development plans and integrated land use plans;
3. Efficient and environmentally sound use of renewable resources;
4. Minimising the use of non-renewable resources;
5. Re-use or safe disposal of farm wastes;
6. Minimising conflicts over natural resource uses;
7. Minimising pollution/ emissions (water, soil, air);
8. Minimising health risks (related to use of agro-chemicals, irrigation);
9. Producing food of good quality.

Details in Working Aids 1 and 10

Checklist of environmental components

The environment consists of both, natural resources and the human environment. EIA should focus on human use of natural resources which are the basis for development, wealth and human health. Thereby, the natural environment contributes to the *quality of life* in human societies. Those environmental components which are regarded as essential elements of the *environmental quality account system* are shown in Box 12: renewable or non-renewable natural resources, the use of these resources and conflicts over competing uses, public health and cultural assets which derive from the use of these resources. Other development goals usually aim at *social welfare* and *economic development*. They are often subject to social and economic impact assessments (see also Figure 4).

The hierarchical system of an environmental quality account is shown in Annex 4. This system is based on 120 identified or predictable problems that currently exist somewhere from a global perspective though not all are present at any location. Present or potential problems are site-specific and must be identified locally where EIA is applied.

For practical reasons, the environmental account system is converted into a checklist (Annex 5). For each item on the list the following information is given: activities in agricultural and irrigated land development with direct and indirect effects/impacts; natural risks (if applicable); directly affected resources; higher order impacts; indicators; key questions for environmental problems.

Box 12

Taxonomic System for Evaluating Environmental Qualities

The hierarchical system describes environmental assets (goods or services) which are subdivided into three aggregated environmental qualities:

- bio-physical resources: water, soil, climate and air, and eco-biological resources consisting of terrestrial and wetland/aquatic habitats and species
- conflicts over resource utilisation: land use competition, use of renewable resources, conflicts with other human development activities
- assets which derive from natural resource uses and which contribute to quality of life values: public health, natural beauty, cultural heritage, social welfare and economic development, and integrity of living space.

Details in Annex 4

Impact (cause-effect) networks

Impact networks visualise the environmental consequences of a project, i.e. they are conceptual tools, tracing and describing relations between and within three elements of environmental appraisals: (1) Classification of project activities which cause environmental changes; (2) Identification of possible negative or positive effects of these activities (cause-effect interaction patterns); (3) Selection of Important Environmental Components (IECs) in order to simplify impact assessment. Otherwise agricultural ecosystems would be too complex with more components that all effects and linkages could be realistically assessed in an EIA.

The network will reduce one large question into a subset of smaller, more easily studied questions, in the hope that putting all of the small answers together will help answering the big question. For example, in the case of flood control and its impact on commercial fish species, useful IECs are flood pattern and regime, water quality, aquatic habitats, capture fish, and human nutrition.

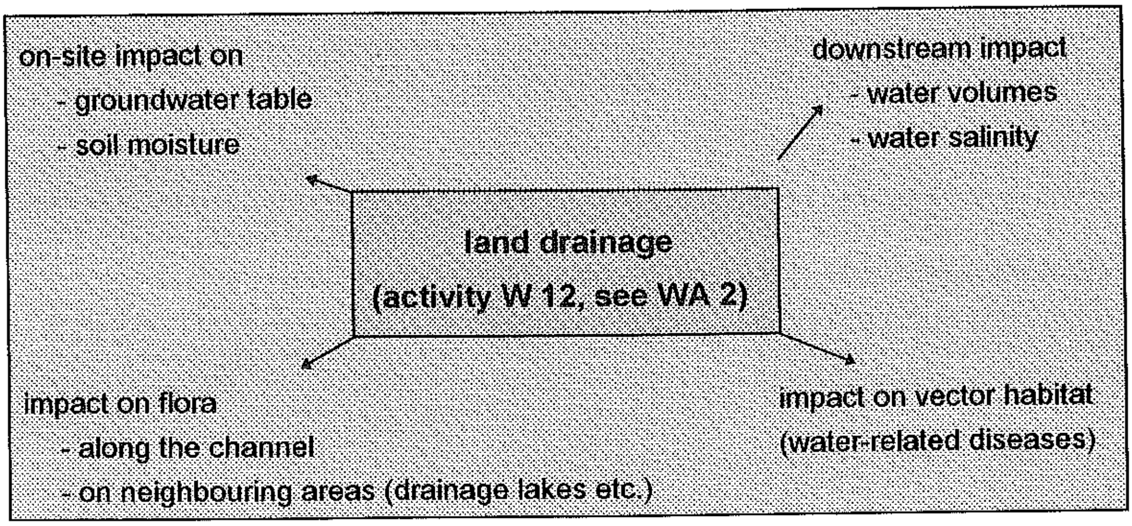
The cause-effect analysis starts with a list of project activities which cause direct effects and, simultaneously or at a later stage, indirect effects (or higher order impacts). Impact networks are shown in Working Aid 11 for different project situations: salinization, flood control, land husbandry, impoundment, plant protection measures, water abstraction, land consolidation impacts on wildlife/ vegetation and water resources.

Impact networks are useful to an integrated team in conceptualising, systematically considering and documenting each major project activity and environmental component and the sequence of likely impacts under pre-existing and future with-project conditions. They also facilitate a better communication between the EIA experts and decision-makers, people concerned and the public because the criteria for analysis are transparent and reproducible.

Impact analysis and assessment: methodological considerations

Once the relevant activities and their potential important impacts are broadly defined, the *divergent model* is used for impact evaluation (Figure 12; see also Rivas et al. 1994): the impact of each activity whose location is assigned to a project area is assessed for a specific set of relevant environmental components in affected areas inside or outside the project boundary (*bounding*, Figure 11)

Figure 12: **The divergent model for impact assessment**



The working steps are:

1. Identify project activities;
2. Elaborate an impact network; example for flood control is in Working Aid 11-2;
3. Determine important environmental components (IECs), example: Figure 13;
4. Analyse and assess the project-induced changes; example flood control in Working Aids 12-1 to 3, with an introduction to the site specific approach.

Such changes have the following dimensions or *impact characteristic*:

- Spatial: location, areal extent of impact e.g., local versus off-site effects
- Desirability and direction of changes, corresponding to the broad descriptors "beneficial" or "adverse" impacts. Note: the evaluation can be biased due to different interests or perceptions of different groups of interested parties!
- Type of changes:
  - Changes in quantity (e.g. river flow volume) or quality (e.g. micro-biological composition of soil fauna) of environmental components
  - Magnitude (size) and intensity of changes
  - Number of adversely or beneficially people affected, or number of environmental components affected (cumulative, synergistic effects)
  - Time scale of changes e.g., duration (sustainability) of impacts, long term versus short term changes; intermittent or cumulative nature of impacts or changes
  - Reversible versus irreversible changes.

Key issues for impact characterisation are shown in Box 13. The analysis of changes (see below) and their characteristics are based on concepts of relevant disciplines (agriculture, water engineering, fisheries, landscape ecology, biology, etc.) and is adjusted to local conditions. A critical issue in impact evaluation is the determination of the significance of impacts because this is frequently open to scientific debate or to different valuation systems of the interested parties. Criteria of significance analysis are the degree of social and economic *importance* to other users and the degree of *sensitivity* of the affected component. The following are the main characteristics:

- Importance of the environmental component, depending on the potential or suitability for other users, the sensitivity to impacts (e.g. ecological resilience), the degree of actual impairments, the significance to local people or decision-makers, or other sensitivities, e.g. a waterbody across an international frontier or proximity to an international frontier;

- Potential to mitigate or compensate for changes;
- Likelihood of changes or risk potential, related to natural risks, risks of new technologies and management-induced risks;
- Conflict potential, e.g. conflicts over scarce water resources, nature conservation goals; acceptability to local communities, the general public and other interested parties; consistency with government policy and development plans; aggravation of environmental issues;
- Potential for technical solutions to reduce or mitigate impacts.

The process of evaluating the significance of impacts is shown in Figure 14, starting from the analysis of project activities, with due consideration of the technical and operational options, and the affected environmental qualities. After identification of the type of impact, important criteria of significance are evaluated. A local valuation and scoring system must be developed for the criteria mentioned in the upper axis in Figure 14. This can be done by numeric, descriptive or economic valuation methods. An example is shown for a flood control project in Working Aid 12-1 to 3. Often, a semi-quantitative and multi-criteria-analysis is appropriate (see Working Aid 12-10):

1. Use economic terms where valuation is possible and acceptably accurate: for example, effects on production, replacement costs, preventive expenditures, human capital, travel cost method, contingent valuation
   example: replacement costs of buildings; loss of fish production in monetary terms;
2. Use numeric terms where costing is not feasible: quantifiable changes in terms of numbers, densities, percentage changes
   example: increase in salinity (dS/cm), soil fertility changes (e.g. organic matter %), water abstraction (flow volume % or m^3s^{-1}, loss/gains in wetland habitats (ha, %)
3. descriptive terms where neither of the above is possible.
   example: loss of cultural sites, loss of recreational value or landscape beauty; overall ecological valuation of a waterway (water quality indices and biological indices plus structural assessments)

For simplification rate the impacts for each environmental component by using a numeric 7-point impact scoring scale:

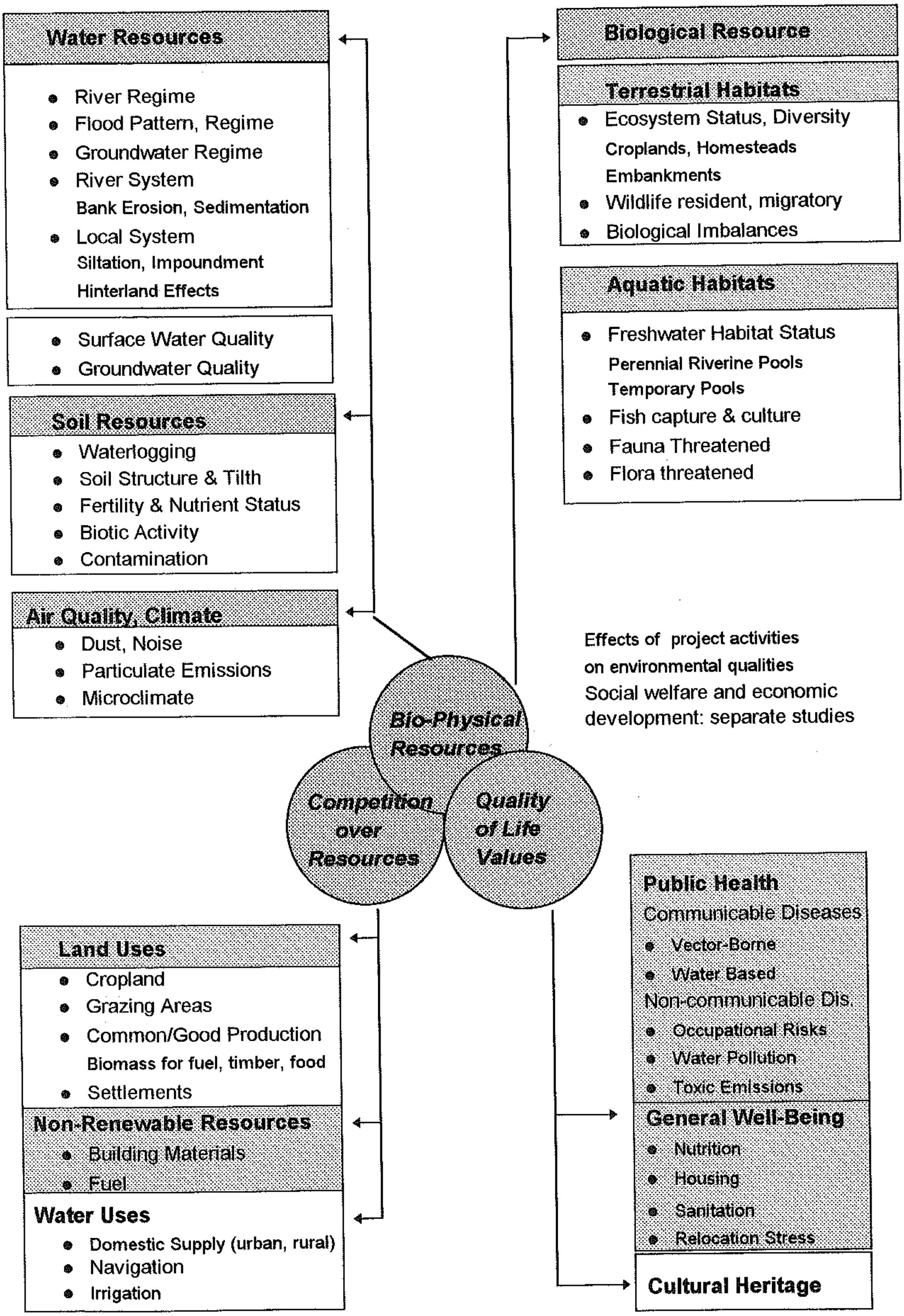
+1,+2 or +3 for beneficial impacts, 0 for no/marginal impacts, -1, -2 or -3 for negative or harmful impacts, the numerals corresponding to "high", "moderate" and "low" respectively. The ratings are based on a combination of ordinal and numeric scaling.

A 10-point scoring system (-5 to +5) is explained in Working Aid 12; see also WA 12-2.

Ratings can be consistently applied to reflect the characteristics of impact evaluation. A possible set of values for beneficial and negative impacts is outlined in Working Aid 12, Introduction and WA 12-2. Rating requires sound judgement and experience and may be best accomplishment by an integrated EIA team working in close cooperation with project planners/engineers and sector specialists from decision-making authorities. Also, the values and perceptions of local people and land users are important and should be included in this in valuation.

Figure 13 Selection of Important Environmental Components

IECs based on impact network analysis for a flood control project (FAP 20,1993)



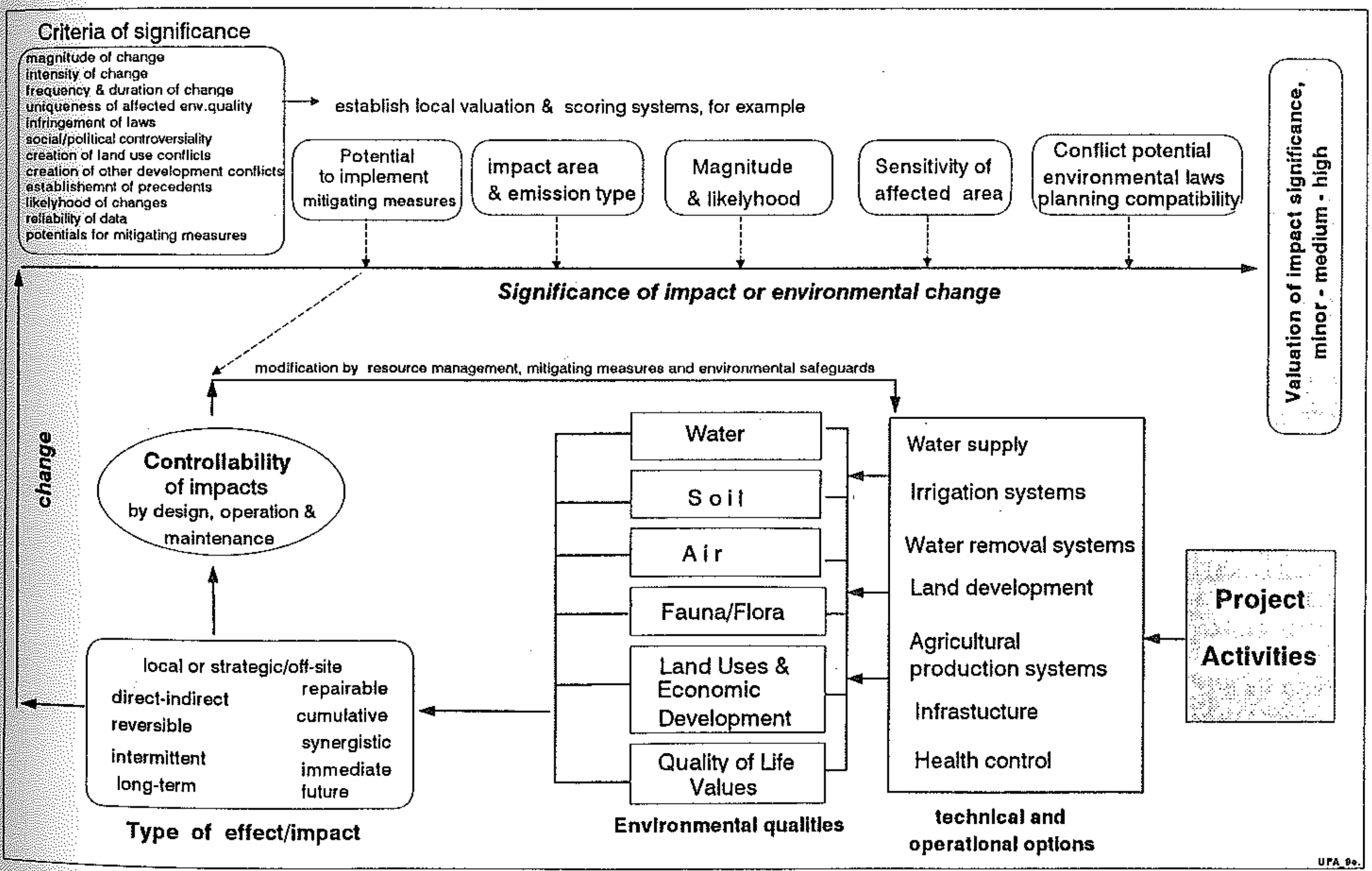
Box 13

Characteristics of environmental effects

Characteristics are related to the type and degree of changes: Who changes and who is affected by changes?, Where does the change happen?, What changes?, How big is the change?, When does the change happen?, How long does the change persist?

- ⇒ local versus strategic effects or on-farm versus off-farm effects
- ⇒ direct versus indirect or first order versus higher order effects
- ⇒ reversible versus irreversible effects
- ⇒ long-lasting versus short-term impacts, or cumulative, synergistic and antagonistic effects.

Figure 14: Significance Assessment of Environmental Effects



Prediction of Impacts

Four approaches in predicting environmental changes are commonly employed:

- modelling
- correlation with specific key indicator variables
- trend analysis (thresholds and limits)
- comparison and projection.

Although modelling is a very valuable tool to estimate future scenarios, at present it is appropriate only for predicting a few environmental changes e.g., hydrological changes. Semi-quantitative models can be of use in the prediction of changes in soil properties, e.g. risk analysis related to salinization or heavy metal contamination (e.g. Blume 1992). Modelling is time-consuming, requires a sound data base and the involvement of researchers. Therefore, modelling is only applicable in detailed EIA, e.g. large scale multi-purpose reservoirs, flood protection or irrigation developments. A selection of ecological models for EIA is shown in Petermann 1993.1, ISPAN 1995; Biswas et al.1990, Biswas and Agrarwal 1992, ERL 1984, Patrono1994.

If an important environmental component can be linked to a variable ("indicator specie"), the future of which can be predicted, then simple correlation can provide a basis for estimating future changes. For example, if the abundance and production from fish and wildlife populations can be related to the abundance and quality of available habitats, then changes in the latter can be numerically related to the population changes; also risks of public health diseases (water-related, vector-borne hazards) can be directly related to vector habitat distribution. However, a frequent problem with quantification by the use of correlated variables in ecosystems is the difficulty in isolating the effects of one cause from that of many others.

Trend analysis is applicable to dynamic shifts of environmental components in terms of hydrological, climatic, biological and corresponding social shifts. However, analysis of trends requires quantitative historical data for the component in question, and also the factors which determine the abundance and distribution of the component.

It may be possible to obtain some estimate of future conditions for a specific area under a specific set of activities by making comparison with areas which have already been subjected to similar activities and where the results have been observed and documented. Many questions can be answered through literature research, small-scale measurement, natural science and social observations and experiments. These methods are probably the most common in use, although there are some drawbacks: impacts are usually the result of complex and site-specific activities, and post-project conditions, such as management changes in land use pattern and socio-demographic shifts, may obscure the primary impacts. Fortunately, post-project monitoring and quantified details of impact analysis are steadily increasing.

Each discipline has its own analytical tools which can be applied to predict impacts. It is, however, an interdisciplinary task to assemble the information so that it can be extrapolated for environmental appraisals. This may, again, involve a great deal of subjectivity and co-ordination amongst the EIA-study team. Finally, all prediction techniques and models are limited in as much as they can portray only parts of the complex agro-ecosystem. Summarizingly,

1. Most **changes** in irrigated agriculture can be predicted only roughly. This is caused by the special conditions of irrigated agriculture (see Box 3) and general limitations in accurate planning and predictions of ecological and economic systems. Such ecosystems are too complex, too innovative and evolutionary for their future development to be predicted precisely. The **availability** and **quality** of data for agriculture and irrigation projects in developing countries are rarely sufficient to meet the criteria for conventional, detailed EIA.

2. Therefore, criteria for analysis and prognosis should be adjusted to the availability of data, time and financial resources for a specific EIA. Often it may be sufficient to use **semi-quantitative methods, experts judgements, rapid examination**, or short **expert's workshops** or **consultations** for environmental issues of special importance.
3. Modelling or other elaborate scientific methods are applicable only in detailed EIA for large and multi-purpose development projects (see ISPAN 1995; ERL 1984), or in EIA-research (e.g. Patrono1995, Biswas et al. 1990).

Other factors of impact appraisal

The following characteristics should be considered in impact appraisals:

- Cumulative and long-term effects on the regional land use and watershed system which are resulting from numerous individual small-scale projects;
- Pilot projects which influence (stimulate) the development of similar activities in the region;
- Framework conditions (see Box 14).

Hence, the evaluation of the significance of environmental impacts can be done only against the background of the site and project specific conditions.

Box 14

Existing impairments and framework conditions

- Existing impairments of natural resources in the region, such as scarce water, water pollution, land use competition, degradation of watersheds.
- Natural risks which hamper the sustainable use of resources: upstream water quality, land suitability, flood hazards, agro-climatic hazards.
- Local management factors which may hamper the adoption of best management practices such as, knowledge of farmers, cultural attitudes, institutional capacity, economic interests of farmers
- Legal & policy framework conditions; agricultural and water policy; rural development programmes; agricultural input subsidies; environmental policy and regulations (e.g. pollution control, re-use of sewage, agro-chemicals for plant protection/ fertilizer use, etc.); land tenure, water rights, water pricing, emission and effluent charges.

Details in Working Aids WA 3 & 4

Holistic environmental appraisal

Generally, both negative and positive impacts on individual or aggregated environmental components should be considered. The impacts on the most important environmental components are assessed by using, for example a 7-point scoring system (see characteristics of impacts). Following the environmental quality account system in Annex 4, the components can be grouped into water-, soil-, and bio-resources, competition over resource uses, public health, and other quality-of-life values. The results can be presented in a table or diagram, supplemented by a brief description of the characteristics and relative importance of impacts. The tables should also reflect the potentials for impact reduction or mitigation, and the respective costs involved. Visualised holistic appraisals can assist planners and decision-makers to decide, whether or not a project is environmentally compatible.

The most crucial part in EIA is the overall assessment of environmental changes. Although various sophisticated methods have been developed, applications are usually restricted to research or large-scale development projects (with disputed results). Therefore, a **descriptive approach** is proposed, as shown in the Working Aids Examples 12-1 to 12-4. Further presentations of environmental appraisals in Working Aid 12 show the variety of presentation methods:

- Example 12-1. Holistic environmental appraisal: simplified, visualised assessment
- Example 12-2: Detailed summary of EIA case study: quantitative assessment with a 10-point scoring system (+5 to -5)
- Example 12-3: Assessment of environmental impacts for alternative developments of a flood control project, with and without mitigation measures (10-point rating system)
- Example 12-4: Summary of environmental impacts of an unmitigated flood control project (20-point impact rating system)
- Example 12.5: Rapid appraisal of technical options using a 10-point scoring system
- Example 12-6: Initial environmental appraisal of a rural road project. Semi-quantitative system with weighting factors
- Example 12-7: Summarising qualitative description of impacts of an integrated water resources development project
- Example 12-8: Holistic qualitative view of environmental impacts of a sewerage recycling project with various project components
- Example 12-9: Environmental appraisal of two German farms, based on the KUL-method (critical environmental impacts): semi-quantitative assessment of extensive and intensive farming systems and their impacts on environmental components
- Example 12-10: Multi-criteria analysis (MCA) of a flood control project This example is semi-quantitative and do not aggregate individual components. The final evaluation is open to the (political) decision-makers

  An introduction to MCA in research projects is given in Working Aid 12-10, showing the system of standardisation, weighting and aggregation of impacts.

An **aggregated grand-index** is used in the overall impact assessment for an infrastructure project presented in Working Aid 12-6. However, its general use is not recommended because environmental qualities are not any longer compatible at the "component level": for example, impacts on soils are not comparable with impacts on public health or the loss of heritage sites. Although numeric impact indices can be weighted to reflect the relative importance of individual environmental components in EIA, they are biased and susceptible to arithmetical manipulation. Weighting of impacts is judgmental because the relative importance of an impact and its change, due to project activities, depends on the site-specific context and also on background, discipline, status, and viewpoint of the individual doing the assessment. It is not repeatable from one individual or EIA team to the next (ISPAN 1995).

There are various methods for holistic evaluation of impacts, for example:

Ecological Risk Analysis. This method compares ecological impacts on alternative locations and identifies the site with the least severe impacts. The following components are considered: fauna and flora habitats, agricultural production, water resources, and recreation. The degree and risk of impacts on the individual components are assessed, based on the analysis of development potentials (e.g. for irrigation, crop production or grazing), sensitivity of ecosystems to changes and existing impairments of natural resource uses. Ecological risk analysis requires consensus about the potentials of environmental components for different users and a sound data base (see Hübler und Zimmermann 1991). One form of holistic ecological assessment is the valuation method for wetlands, applied for environmental planning of a National Park in Africa (Annex 7).

- Financial and economic valuations: To date, economic methods have made only a limited progress treating environmental impacts of projects. Serious problems stand in the way of economic valuation of all important impacts. The following methods of estimating economic worth of environmental impacts are commonly employed: effect on production, preventive expenditures or replacement costs, human capital, hedonic methods if markets are absent (by pricing surrogates such as labour or property), travel-cost methods, contingent valuation methods (e.g. willingness to pay or to accept compensation).

- Multi-Criteria Analysis (MCA) of important environmental components combines impacts that can be quantified in monetary or numeric terms with impacts that defy valuation and which need to be described in terms of significance of impacts, e.g. extent and duration of impact, recipients of impact, irreversibility (see Working Aid 12-10 and discussion in ISPAN 1995).

  Complex methods of MCA standardise weight and aggregate all impacts to yield a numeric ranking of alternatives. They are frequently used in EIA research for projects if technical options or the impact on different sites are assessed by ranking of alternatives (see Introduction to MCA, Working Aid 12-10). An example of a flood control project is in Buck and Pflügner 1991; computerised evaluation approaches for decision support systems are in Patrono 1994 and 1995; examples for soil and water conservation projects in Africa (de Graaf and Watsien 1995). However, most of these approaches are too complex to be applied in common EIA for agricultural and irrigated land development in developing countries.
- examples of descriptive overall evaluation of reservoir projects are given in Rudolf 1988 (Germany) and SMEC 1987 (Botswana, see Working Aid 12-7).

Feedback to improve project design

The EIA should anticipate potential environmental problems and help to develop a project design to avoid those problems. This involves decisions made during project planning stages with regard to site selection, engineering and agronomic design options, technologies and operation. Feedback is an iterative and integral step which should be incorporated into the environmental appraisal process. It should be used before the Environmental Management Plan (EMP) is finalised; otherwise, the EMP should emphasise measures to improve design and operational rules to ensure environmentally sound development.

Feedback can be efficient if the environmental appraisal team is co-operating with engineers and planners in project design closely from its earliest stages. For example, if screening and scoping result in the prediction of significant cumulative impacts at a proposed site, then alternative locations would be examined and, perhaps, another site would be selected which would result in fewer impacts. This feedback loop in planning is especially important in the pre-feasibility phase of irrigated agriculture projects.

The Environmental Management Plan (EMP)

The EMP is an instrument to manage impacts once the project plan is defined. The EMP describes measures to avoid or reduce impacts, resolve conflicts associated with the project, and defines follow-up activities such as monitoring and evaluation. Four elements of EMP are important:

1. Environmental **protection plan** which includes recommendations for impact management through anticipatory planning and operation, mitigation, contingency, and compensation, and (optional) an action plan to enhance the use of bio-resources, companion activities, restoration and re-use.
2. Plan for impact and compliance **monitoring**. Impact monitoring should detect the magnitude of significant impacts by regular data collection and evaluation. Compliance monitoring checks compliance with EMP, existing laws, regulations and standard codes of good engineering practices, agronomic best management practices and site-specific environmental quality goals.
3. Continuous **public participation** and **information** programme related to environmental concerns of people or institutions affected.

4. **Framework for implementation**, including details of cost estimates, schedules, accountability and reporting, proposals for institutional strengthening, education, training, information systems, and technical assistance.

Figure 15 shows the set-up of an EMP and a sample table of content is in Working Aid 13.4 (details in chapter 7, Step 5).

Environmental monitoring is the process of measuring change in the ecological character in any affected site over a period of time. Activities often focus on water resources (changes in volume and quality), soil fertility and protection, public health and nature conservation issues. Environmental monitoring does not automatically require sophisticated technology or high investment. Due to budget, personnel, technical and other constraints, implementation of environmental monitoring may also require a stepwise approach with the following priorities:

1 Significant impacts which may hamper project success in the short term; for example "hot-spot monitoring" to observe sensitive water supply, water quality, critical groundwater levels, yield-reducing levels of soil salinity, incidence of water-related diseases.

2 Significant impacts which can reduce crop production in the long term or which create conflicts with other resource users.

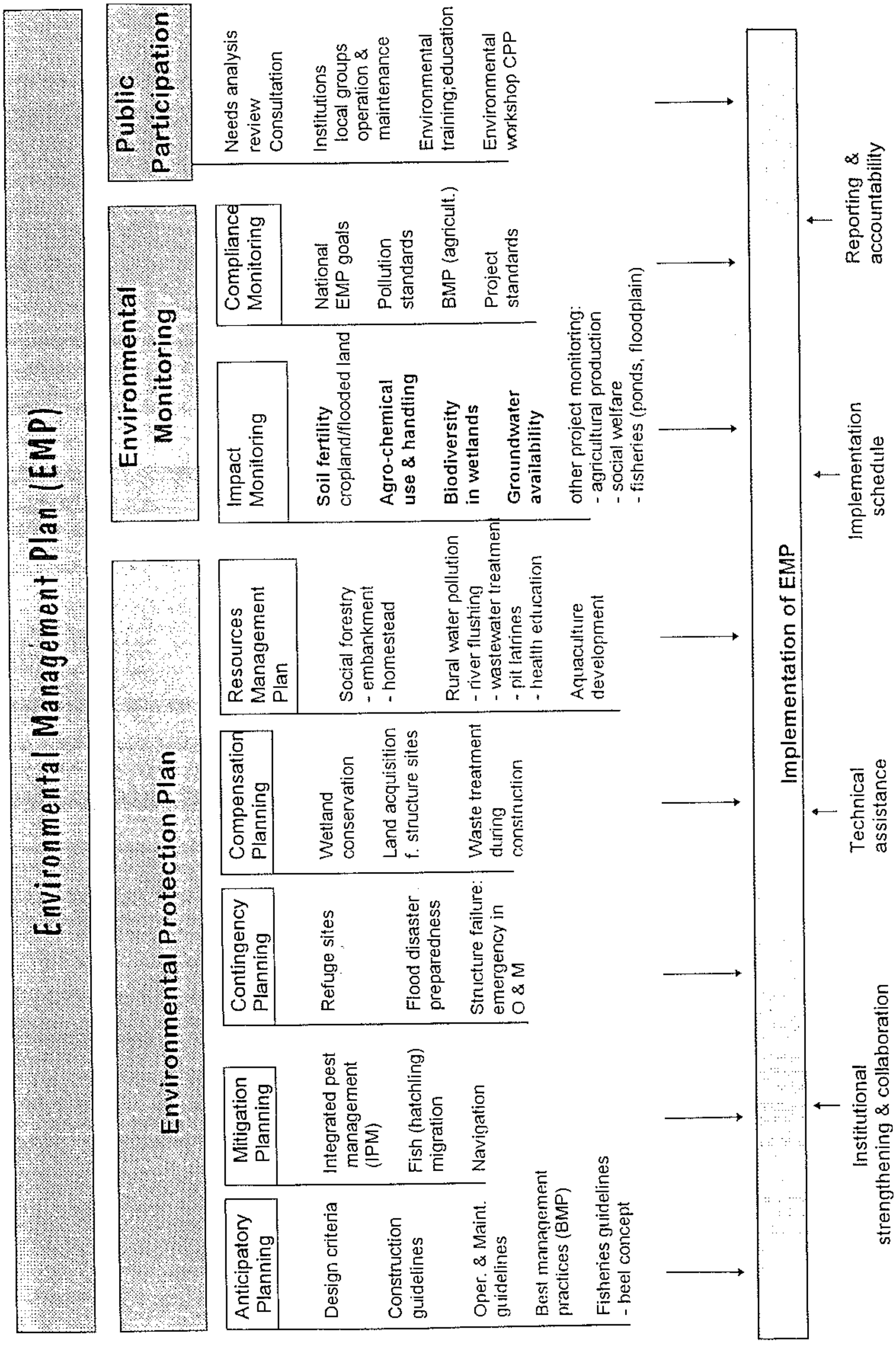
3 Other impacts identified during the EIA but they are less significant.

4 Impacts which can be harmful to biodiversity of the location, or other aspects related to nature conservation.

Working Aid 10-1 shows examples of project-specific monitoring in irrigation and flood control projects (Examples 3 and 4 from Botswana).

Environmental monitoring is a management tool which gives early warning of significant impacts and which deserves immediate action to secure the sustainability of the project. Furthermore, it checks impact predictions of the EIA, examines the effectiveness of mitigative measures proposed to avoid, reduce or mitigate negative impacts, and checks whether the assumptions of engineering or agronomic standard codes are correct and applied by land and water users. Site-specific monitoring activities are outlined in Working Aid 10-3 and 4.

Figure 15: The Environmental Management Plan at project level



7 WORKING STEPS OF AN EIA STUDY

Three types of EIA studies are proposed

- rapid environmental appraisal (REA)
- semi-detailed EIA study (EIA-s)
- detailed EIA study (EIA-d).

They vary greatly in scope, level of detail, rigour, and effort required. However, the focus and frame of the EIA study remain similar. Therefore, the following working steps apply (Figure 16):

1. Gathering information and consultations
2. Environment description
3. Analysis and prognosis of environmental changes
4. Overall environmental appraisal
5. Recommendations for environmental management.

Terms of Reference (TOR) for detailed EIA studies as proposed by the World Bank are outlined in Working Aid 14; sample TOR are for EIA in general and with amendments for irrigation and drainage, dams and reservoirs, and flood protection.

Step 1: Gathering information and consultations

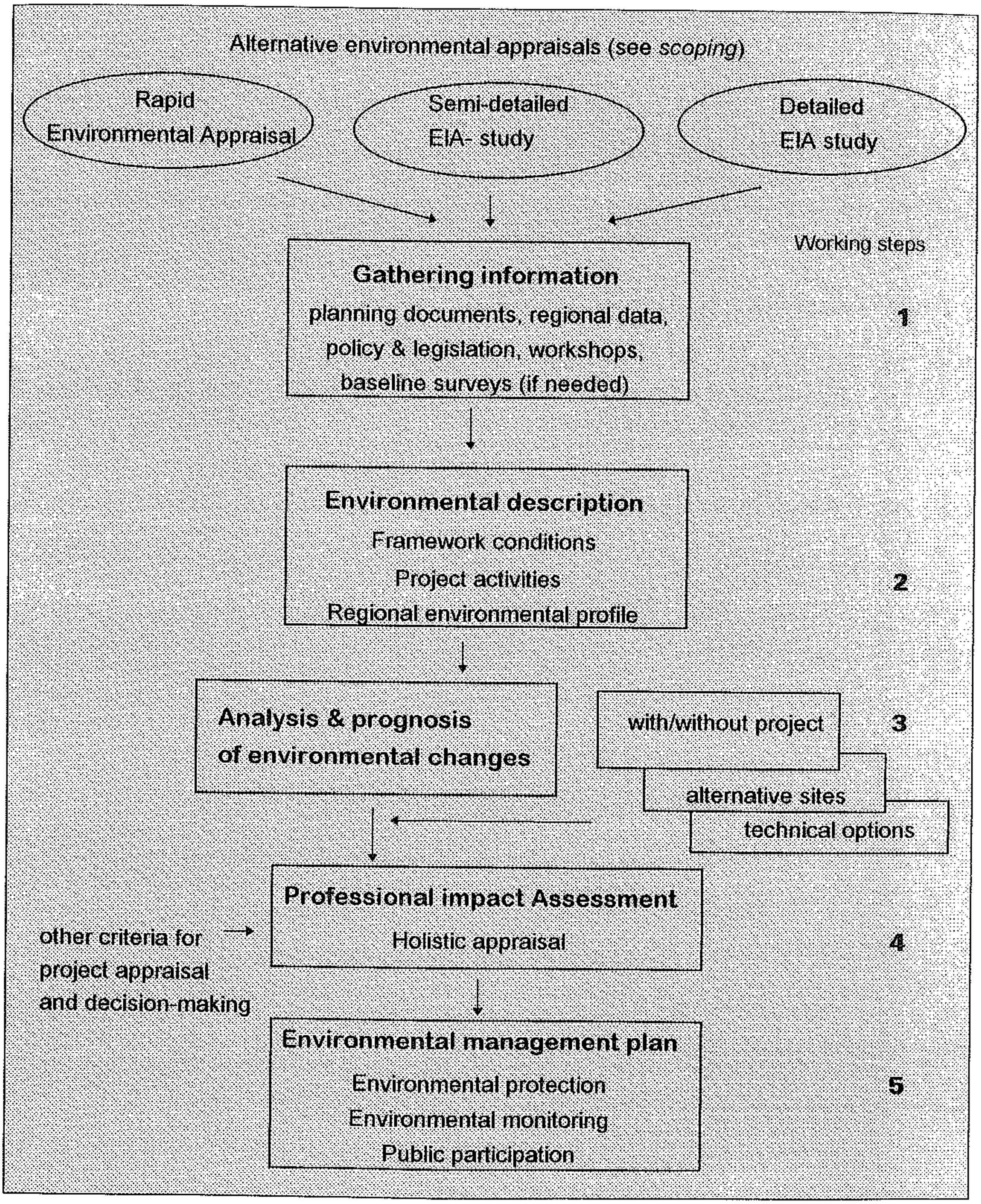
Planning documents: The documents should define the project objectives and activities, including engineering designs, agronomic measures, alternatives of site selection and technical options, and operational guidelines e.g. for water management and land husbandry practices.

Regional data on natural resources, land use and socio-economic development are to be gathered and reviewed:

- **Status of water resources**: streamflow, static water resources, water levels, floods and flood hazards, sediment load and deposits, groundwater levels, aquifer tests, well logs and boring data, groundwater recharge, water quality;
- **Climate**: rainfall characteristics, temperature, relative humidity, evapotranspiration;
- **Soil data:** soil mapping units, physical and chemical characteristics, distribution of soil, suitability of soils for different uses, soil degradation status and risks, soil contamination;
- **Biological resources**: description and delineation of habitats, status of fauna (species diversity, threatened and endemic species, fish, wildlife and wildlife migration), status of flora (plant communities, threatened and endemic species, plant diversity and natural productivity), forest and homestead vegetation, description of biological trends, biological imbalances, agricultural pest and diseases;
- **Land use types**: cropping patterns, farming systems; settlements, homesteads, natural woodland and planted forests, pastures, orchards, water bodies, etc.
- **Farming systems characteristics**: description and delineation of farming systems, area under different cropping patterns and crops, agricultural inputs and mechanisation, labour and animal draught power, gender issues, crop damage by drought, floods or diseases, crop production and yield levels, crop budgets, marketing, off-farm activities, etc.
- **Competition for use** of natural resources including non-agricultural uses, use of non-renewable resources (e.g. fossil water, building material, minerals, fuel); water uses, sources of water pollution, scarcity of water supply, navigation, flood hazards, use of wildlife, capture and culture fisheries, gathering of plants;

- **General socio-economic data;** description of the population, people and lifestyle and the "driving forces"; welfare data such as regional disparity, income, employment, gender issues, poverty;
- **Public health**: communicable and non-communicable disease hazards; nutrition, sanitation and housing;
- **Cultural heritage**: archaeological sites, cultural places or monuments.

Figure 16 **Working Steps of EIA study**



Policy and legislation related to environmentally sound and sustainable development: (i) environmental policy and legislation; (ii) analysis of the state-of-the environment; (iii) environmental planning; (iv) sectoral programmes for sustainable resource use.

Consultations with institutions, people affected and the interested public should identify the views and interests of different groups affected or involved.

Baseline Surveys. In many cases, detailed data are not available or not at hand and data quality may be insufficient. In rapid environmental assessments, time constraints and limited financial resources do not allow additional field investigation; rapid survey methods, such as Rapid Rural Appraisals or informal consultation of sector specialists are appropriate. In detailed EIA studies, baseline surveys must generate the data which are required for detailed analysis and impact predictions. The need for and appropriateness of baseline surveys are defined during scoping (chapter 5). The time and personnel requirements for such surveys are outlined in Box 10.

Costs involved in EIA-studies can be in the range of 3 to 5% of planning costs and up to 10% of appraisal mission costs. Costs of detailed EIA studies for multi-purpose water resources development projects in Southeast Asia are typically between 0.2 and 1% of the total development costs (including construction) if baseline surveys need to be conducted (ESCAP 1985; WB 1992).

Step 2: Environment description

The framework conditions, the natural resource base, the existing uses of the resources and other environmental issues of concern are described:

- Framework conditions are those which directly or indirectly contribute to environmentally sound and sustainable development in irrigated agriculture:
  - people and lifestyles in the area: demography; regional disparities, economic activities, communication, infrastructure and energy, living standard, education and skills;
  - the driving forces: social and economic pressures, availability of and access to natural resources, conflicts over resources;
  - public participation in the planning processes, implementation and operation;
  - legal and institutional framework: description of national environmental policy, agricultural and water resources strategies: laws, regulations and economic incentives, nature conservation policy, regional development programmes and sectoral programmes;
- Description of activities of the project: type and characteristics, options for site location, technical options regarding land husbandry, water use, water management;
- Description of the environmental profile of the area potentially affected by the project: Existing status, degradation and potentials of water, land and biological resources, then continues with resource uses and competition for development, and concludes with public health and other issues of quality of life values;
- Resources having direct economic value, such as fish, wildlife, crops, timber, appear in the description of their land use systems from an ecological point of view and in the description of the economic sector of the environment: competition over resources for human economic development. Environmentally sensitive areas need to be identified (see Working Aid 7 and Annex 7.II).

Step 3 Analysis and prognosis of environmental changes

- Public consultation: identification of the perceptions and consensus of people concerned and other interested parties (NGOs), donors and government officials, regarding existing and future environmental problems and conflicts over resource uses, and their views of the potentials of sustainable use;
- Identification environmental components likely to be affected:

* description of important project activities and alternatives that can cause environmental impacts;
* conceptual analysis of cause-effect relations by using impact networks which establish linkages between project activities and environmental impacts;

- Selection of important environmental components (IECs): From the overall description of framework conditions, public consultation and expert analysis, a subset of environmental components are chosen. The relative importance of a potential impact may help to suggest the level of effort that should be expended on the prediction in EIA. IECs can be ecologically sensitive resources, land use features or aspects of quality-of-life values which require further attention. Often, they are identified in the scoping as having economic, cultural, or scientific value. IECs can also be selected to be representative of the totality of environmental components and represent those components deemed important by the people. For example, a particular habitat or species can serve as an indicator of deterioration.
- Prognosis of impact: description of characteristics and significance of changes of important environmental components by using the system of environmental components shown in Annex 4. The checklist for environmental appraisal in Annex 5 provides a framework for analysing and organising information;
- In a rapid EIA, the expertise on which interpretation and prognosis is based, can be obtained from consultation of specialists. In a detailed EIA study, a team of specialists is engaged to predict impacts in more detail;
- Risk assessment. The major risks involved in the project should be described in terms of natural, technical, and managerial risks, their causes and likelihood;
- Description of alternative site locations and technical options to minimise negative impacts. Check whether technical planning and operational plans are consistent with the state-of-technology, guidelines for best management practices and other practical recommendations for sustainable agriculture and water resource uses.

Step 4 Professional impact assessment

- Identification of project-specific environmental quality goals (Working Aid 10) and evaluation whether or not the project will substantially assist or hamper the achievement of these goals;
- Quantification or description of changes of important environmental components. The results can be presented in a Project Impact Matrix (Working Aid 12-2);
- Determination of the significance of changes (Figure 14); the significance can be expressed in a scoring system (e.g. Working Aid 12);
- Holistic environmental appraisal of affected environmental components. The combined use of a diagram (Working Aid 12-1) and a description (12-7) is recommended;
- Evaluation of the reduction of natural risks (e.g. flood hazards, drought);
- Assessment of the residual risks of the project after safety measures or other technical and managerial measures will be introduced (see Working Aid 12-3).

Step 5 Recommendations for environmental management

- Proposals to adopt site-specific environmental quality goals; definitions of standards and indicators (Working Aid 10);
- Proposals for an environmental management plan (EMP, Figure 15):
  * Recommendations for impact management through anticipatory planning: targets for structural interventions (water supply and distribution systems, flood control, drainage, farmroads, etc.), agronomy and land husbandry;
  * Mitigation plan to reduce adverse impacts e.g. on other land users, water supply, habitat restoration/amelioration; in some projects, limits of acceptable change (LACs) have been defined for specific environmental components, with

agreement on subsequent mitigative action if they are exceeded, e.g. LACs for percentage of vegetation cover or specific land uses;

* Compensation plan for residual impacts, for example land compensation, habitat replacement;
* Contingency plan to prevent accidents or to minimise natural hazards;
* Action plans to enhance resource uses other than current project activities, e.g. social forestry programmes.

- Impact monitoring should detect the magnitude of significant impacts by regular data collection and evaluation. This gives early warning of significant impacts that demand immediate action to secure the sustainability of the project. Also, it serves to check the predictions of the EIA study to allow a final appraisal of environmental changes during the operation of a project. Environmental impact monitoring must focus on important components and their indicators because it is costly and requires skilled personnel for data management and evaluation. The EMP should provide information on objectives, investigation sites, scope of works, schedule, staffing, cooperation/participation, cost estimations, responsibility and reporting.
- An environmental information system improves skills and attitudes towards sustainable management. The action plan defines the type of information and the means of dissemination amongst interested parties;
- An environmental control system is designed to check at regular intervals whether the project is consistent with the environmental goals and other aspects of the EMP. At regular intervals, the EMP must be adapted to changing framework conditions and adjusted operation plans or new technologies and practices.

8 SAMPLE OUTLINE OF THE EIA STUDY

Scoping sets the terms of reference for EIA studies in terms of contents, focus and methods for analysis, prognosis and overall assessment. Depending on time constraints, budget and the likelihood of significant impacts, three types of EIA studies are conducted:

- rapid environmental appraisal (REA)
- semi-detailed environmental impact assessment (EIA-s)
- detailed environmental impact assessment (EIA-d) following international standards (e.g. WB 1991; ADB 1987; BMZ 1993).

Organisation and presentation are similar for all three kinds of EIA studies, although the level of scope and the detail of analysis and evaluation vary greatly. Based on the sample table of contents in Working Aid 13, the following description shows the principle issues which must be considered:

1. **Introduction**. Definition of scope, objectives and methods employed: background to the project and EIA; terms of reference; scope and assessment objectives, format of the report; approach and methods; data sources and special surveys.

2. **Project plan**. This section explains the status of planning, rationale for the project, project goals and activities on the basis of material and information provided by the proponent authority, planners or engineers: description of project location and alternatives; rationale for the project; definition of the project type; details of the project proposals and alternatives regarding structural and non-structural interventions or activities such as water and land development, water management, agronomic measures and land husbandry, infrastructure and health controls measures. Project phases can be subdivided into planning (including baseline surveys), construc-

tion and operation. Also, project organisation, schedule and logistics, and the participation of local people and interested parties are described.

3. **Framework conditions.** Population, people and occupations, legal and administrative framework (administrative setting, national and regional development plans, environmental policy and programmes). A summary of the major driving forces that are likely to affect the environment over the next decades can highlight environmental concerns such as land pressure, resources scarcity, pollution, or the overuse of fragile ecosystems.

4. **Environmental profile of the area.** Description of the existing situation and systematically covering all relevant environmental components: the natural resource base, natural risks, the uses of such resources, existing degradation, sensitivity to impacts, and the importance to local people other users in the context of national and regional settings and development trends. The level of detail and scope are set in the scoping process.

5. **Identification of major issues of concern.** Important environmental components (IEC) which need attention are identified by impact networks (cause-effect relations). Further important factors are the perceptions of local people and relevant governmental agencies, the sensitivity of natural resources affected, existing impairments or scarcity of resources, and environmental risks.

6. **Prediction of important environmental changes.** The effects of the project on environmental components are predicted, and, if possible, quantified. The checklist of environmental appraisal (Annex 5) serves as a framework to separate between bio-physical resources, impacts on land use, conflicts over resource use, and impacts on the quality-of-life. The limitations of impact prediction and shortcomings in impact quantification should be made clear. Management options to reduce predicted impacts and human-made or natural risks due to the project activities, need to be considered as well. In complex irrigation projects the analysis should be done individually for each of the compound project activities, e.g. impacts caused by agronomic measures (such as land husbandry, cropping pattern, pest control, fertilizer use) should be treated separately from impacts of water supply systems, flood control, health control, road infrastructure.

7. **Holistic environmental impact appraisal.** Description how impacts are classified as *significant* according to a number of criteria (Figure 14). An holistic appraisal uses objective descriptors as well as numeric and comparative ratings based on economic, numeric or descriptive evaluations. The results can be presented for important environmental components individually and in tabulated form as the *Environmental Impact Matrix* or diagrammatically as an *Holistic Environmental Appraisal*. The overall assessment of positive and negative changes should also be done descriptively, referring to the site-specific environmental quality goals, professional judgement, and the perceptions of the people and institutions concerned.

8. **Recommendations for environmental management.** This section starts with the concept of environmentally sound development, the setting of site-specific environmental quality goals and the definition of standards and indicators. Then the environmental management plan (EMP) defines an array of follow-up activities, including sound management practices and compliance with environmental regulations, that minimise adverse impacts and that maximise beneficial effects. A sample EMP Table of Contents is shown in Working Aid 13-4.

9. **Executive summary.** This is part of the main EIA study but may be printed also as a separate document for distribution: the interested public, people or institutions concerned. The language is purposely non-technical, and therefore accessible to lay readers.

9 PERSONNEL & TIME REQUIREMENTS

The resources required to conduct an EIA vary greatly, depending on the type and characteristics of the project and the extent of activities, site-specific conditions and the likelihood of significant impacts, environmental framework condition, data availability and quality of information, and the scope and level of detail required for additional baseline surveys. Three alternative EIA studies are proposed in Chapter 5 and their requirements in terms of personnel and time requirements are the following:

Rapid environmental appraisal (REA)

A rapid environmental appraisal needs 2 to 6 weeks preparation. Details and sample a Table of Contents are shown in Working Aid 13.1. Existing data are reviewed and the local people, relevant institutions and the interested public are consulted. Analysis, prediction of significant impacts, appraisal and reporting are done by an environmental experienced specialist. Assistance in all steps of analysis, impact prediction and appraisal is required from relevant national or local experts in those areas with which the REA-specialist is unfamiliar or has insufficient experience. Additional field checks and laboratory analysis may be required but restricted to few issues of major environmental concern. Recommendations for further investigations or monitoring may be made to verify predictions and appraisals at a later project stage. Socio-economic aspects are usually derived from other studies such as social impact assessments and economic studies.

Examples: GTZ (Petermann) 1990: Self-Help Irrigation Schemes around the Lake Chilwa (Malawi). GTZ (Petermann) 1992.2: Al Bireh Sewerage Recycling Project (Palestine).

Semi-detailed environmental appraisal (EIA-s)

A semi-detailed environmental appraisal needs about three months for preparation. Further details and sample Table of Contents are given in Working Aid 13.2. Such a study requires that relevant data are available, although a limited number of field checks are included for more complete assessment. The EIAs can be conducted by an environmental specialist with assistance from sector specialists who contribute to important environmental components of major concern (to be identified during scoping), e.g. hydrology, ecology or soils. The specialist can be in charge of additional surveys which would allow more precise impact predictions, e.g. through hydrological modelling. In addition, expert working groups are employed to consult local specialists.

Example: GTZ (Petermann) 1992.1. Environmental Appraisal of Molapo Farming Systems. Botswana; Bolton et al. 1991 Case study: Nigeria

Detailed environmental impact assessment (EIA-d)

A detailed environmental impact appraisal requires multidisciplinary analysis by a consultant EIA team with specialists in the relevant disciplines. Specialised field studies or modelling activities are performed to analyse, predict and assess impacts of important environmental components. Specialists assist in all parts of the EIA study, write the sections related to their discipline. There must be a great deal of interaction among team specialists and the EIA team leader who has final responsibility for the substance and format of the EIA study (ISPAN 1995).

Detailed *terms of reference* for EIA studies are given by, e.g. World Bank 1991 (Working Aid 14). Standard procedures for EIA studies exist for infrastructure and industrial projects, e.g. ISPAN 1995, ADB 1987, ESCAP 1985, UNEP 1980-1988. The preparation time is in the range of 3-6 months, but may last 12-18 months if baseline surveys are involved.

Usually, multi-purpose dam or large flood protection projects are subject to detailed EIA studies, e.g. FAP 2, FAP 16/19, FAP 16, FAP 20, SMEC 1987, 1990, ESCAP 1985.

Irrigated agriculture projects are rarely subject to specific detailed EIA-studies. Agricultural development case studies include ARUP/ATKINS 1990.

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Abbreviations

ADB	Asian Development Bank (or AsDB)
BMZ	Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung
	German Federal Ministry of economic co-operation and development
DSE	Deutsche Stiftung für international Entwicklung
	German Foundation for International Development
DVWK	Deutscher Verband für Wasserwirtschaft und Kulturbau
	German Association for Water Resources and Land Improvement
EIA	Environmental Impact Assessment, syn. environmental appraisal
EIS	Environmental Impact Studie, syn. EIS Report
EMP	Environmental Management Plan
ESCAP	Economic and Social Commission for Asia and the Pacific of the UN
EZ	Entwicklungszusammenarbeit (English: development co-operation)
EU	European Union
FAO	Food and Agricultural Organisation
GTZ	Deutsche Gesellschaft für technische Zusammenarbeit
	German Agency for technical cooperation
ICID	International Commission on Irrigation and Drainage
ICOLD	International Commission on Large Dams
IECs	Important Environmental Components (in EIA-analysis)
IIED	International Institute for Environment and Development
ITC	International Institute for Aerospace Survey and Earth Sciences
IUCN	The World Conservation Union
ISPAN	Irrigation Support Project for Asia and the Near East (USAID sponsored)
KfW	Kreditanstalt für Wiederaufbau
LAWA	Landesämter für Wasser und Abfall (State Agencies for Water/Waste Management)
MCA	Multicriteria analysis
NGO	Non-governmental organisations
OECD	Organisation for Economic Co-operation and Development
PRA	Participatory Rural Appraisal; RRA Rapid Rural Appraisal

REA	Rapid environmental appraisal
TOR	Terms of Reference
UN	United Nations
UNEP	United Nations Environment Programme
UNDP	United Nations Development Programme
USAID	US Agency for International Development
US-SCS	US Soil Conservation Service
UVP	Umweltverträglichkeitsprüfung (English: EIA)
WA	Working Aids
WB	The World Bank

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