Nile Basin Initiative

Eastern Nile Subsidiary Action Program

(ENSAP)

Eastern Nile Irrigation and Drainage Studies

Cooperative Regional Assessment

Guidelines for Identification and Assessment of Irrigation & Drainage Projects

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Guidelines for Identification and Assessment of Irrigation & Drainage Projects

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Introduction

The present guidelines for analysis and assessment of irrigation projects been prepared within the framework of the Eastern Nile Irrigation and Drainage Study (ENIDS), component 2: Cooperative Regional Assessment. ENIDS is implemented by a joint venture of consultants that is made up of the following three firms:

- One international firm: BRLi (France) who fills up most of the key staff positions. BRLi as the lead consultant is responsible for the overall management of the team and the contact with the client.
- Two regional firms: Shoura Consult (Sudan) and Metaferia Consulting Engineers (Ethiopia), responsible for field work in their respective country under the supervision of key international staff.

The objective of these guidelines is to assist practitioners to plan irrigation investment projects that will realise and sustain their full potential. The guidelines cover the analysis of irrigation projects with a view of selecting the preferred projects and feasibility study (or assessment) of the selected projects. They were developed from the overall experience of the consultant, lessons learnt from the Engineering Component (Analysis Phase) of ENIDS study and review of a number reports on costs and benefits of irrigation projects in Sub-Saharan Africa, the Middle East and North Africa and Asia. The intended users are ENTRO staff and the National Irrigation Planning and Coordination Teams of the Eastern Nile countries. The guidelines may also be useful to consultants and for training of irrigation staff.

Part 1 proposes options for implementation of safe transboundary irrigation projects that would enhance regional cooperation and reduce the risk of conflicts over irrigation water and provides guidelines / principles for optimizing irrigation investments. Parts 2&3 follow the implementation phases of ENIDS Engineering component (analysis and feasibility study). Part 2 describes the process for analysis and selection of irrigation projects whether transboundary or national projects. Part 3 describes the feasibility study process. The appendix is intended to be used as a checklist, to be consulted as necessary by planning teams in the course of documenting the proposal and to give direction and purpose to the overall planning process described in Parts 1, 2 and 3. Annex A gives a typical layout of a feasibility report an irrigation project. It seeks to cover the items to be described for appraisal of the great majority of irrigation new and rehabilitation projects.

In Ethiopia and Sudan where major irrigation development is being implemented or planned, irrigation schemes may grow faster than the institutions needed to manage them and ensure productivity and sustainability. Moreover, for the sake of rapid results on the ground, planners may be tempted to adopt a top down approach. Therefore, in addition to the more obvious and crucial factors of good engineering design, sound construction, financial and economic viability, and environmental sustainability, the guidelines focus on the institutional set-up or accompanying measures of irrigation development and the commitment and participation to the projects of farmers and other stakeholders.

1. Part 1: Harmonizing irrigation development through transboundary investment projects.

INTRODUCTION.

All Eastern Nile countries share the same agricultural goals, primarily food security, and challenges: increasing water scarcity. The objective of section 1 is to propose options for safe transboundary irrigation projects that would enhance regional cooperation and would contribute to avoid conflict over irrigation water.

1.1 OPTIONS FOR TRANSBOUNDARY IRRIGATION INVESTMENTS IN THE EASTERN NILE BASIN

Among th**e** findings of the ENIDS CRA Phase 2 has been the identification of several potential transboundary irrigation development zones (IDZs). Two of them spanning the Ethiopian/Sudanese border have a strong potential for joint investment projects. There are IDZ 3: Lower Blue Nile and its Rahad and Dinder tributaries; and IDZ 4: Tekeze and Atbara sub-basins.

IDZ 3 comprises the Gezira State and part of the Gedaref state in Sudan, the identified projects in Ethiopia are very close to the border with Sudan. The Blue Nile region in Sudan is the most developed in the country (after Khartoum) in terms of socio- economic infrastructure, i.e. roads, railways, agro-processing plants, telephone lines, agricultural research centres, health and education services. The Region is well connected to Khartoum and Port Sudan. In this zone, existing irrigation schemes cover a total area of about 1.3 million hectares or 70% of irrigated area of the country. The irrigated areas have attracted migrant workers and have a high density of population. The flat clay plain of the Blue Nile region has a potential of 3.3 million ha of suitable land for irrigation development (source Nile Water Study, 1978). Both the socio-economic and physical characteristics of this zone make it the most obvious region for irrigation development not only in Sudan but also for the entire Eastern Nile basin. In the 1960's and 70's, Sudan was considered as the future "bread basket" of the Arab world. Joint investments irrigation projects can make IDZ 3 the bread basket of the Eastern Nile basin. The limiting factors of future irrigation development are sedimentation in dams and irrigation canals, and water availability for the winter crops; the planned construction of large multipurpose dams across the Blue Nile in Ethiopia will eliminate them. In a shorter term, the nearly completed heightening of the Roseires dam by ten metres will increase water availability. The planned irrigation projects are presented in table 1 below and shown on map 1.

Table 1:Identified new irrigation projects in IDZ 3.

Name of projects	Net Area (ha)	Unit water requirement (m^3 /ha/year)	Annual water requirement (MCM)
Ethiopia			
Upper Dinder	10,000	9,000	90.0
Lower Dinder	49,550	11,000	545.1
Rahad	45,130	11,000	496.4
Galegu	9,900	11,000	108.9
Subtotal Ethiopia	**114,580**		**1,240.4**
Rahad 2	210,000	9,500	1,995.0
Great Kenana	420,000	9,500	3,990.0
* Roseires	195,600	9,500	1,858.2
Dinder South	67,000	9,500	636.5
Dinder North	168,900	9,500	1,604.6
Sub-Total Sudan	**1,061,500**		**10,084.3**
Grand Total	**1,176,080**	**Average 9,500**	**11,324.6**

Source: Abbay Master plan / Phase 2 / Volume V: Irrigation and Nile Water Study / Irrigation report.
*Projects not shown on map 04.

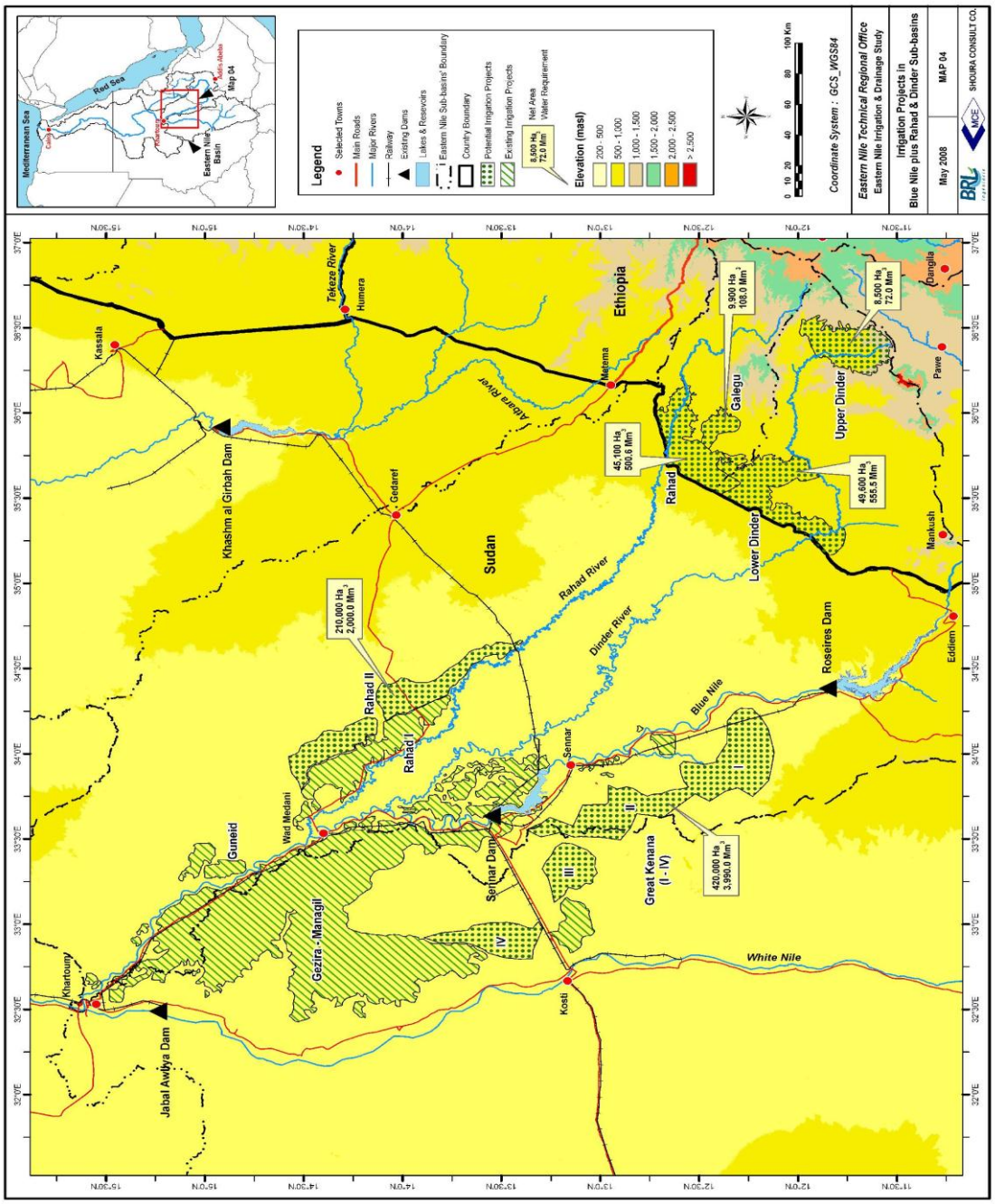
IDZ 4 is included in the Gedaref and Kassala states in Sudan and the lowlands of Amhara and Tigray close to the Sudanese border in Ethiopia. IDZ 4 is served by The Gondar- Metema- Gedaref road, The Khartoum - Gedaref – Kassala- Port Sudan road and railway and the Humera - Andaselassie road. The sole significant irrigation development in IDZ 4 is the New Halfa irrigation scheme (180,000 ha) in Sudan. The zone is sparsely populated by subsistence farmers and pastoralists. As in IDZ 3 the main constraints of irrigation development are sedimentation and water availability for winter crops; the Khashm El Girba dam which provides water to the New Halfa irrigation project is now almost silted-up. The recently completed Tekeze dam in Ethiopia regulates the flow of the Tekeze-Setit river and the construction of the Setit and Rumela dams might no longer be necessary for the irrigation projects in Sudan.

Table CC: Identified new irrigation projects in IDZ 4.

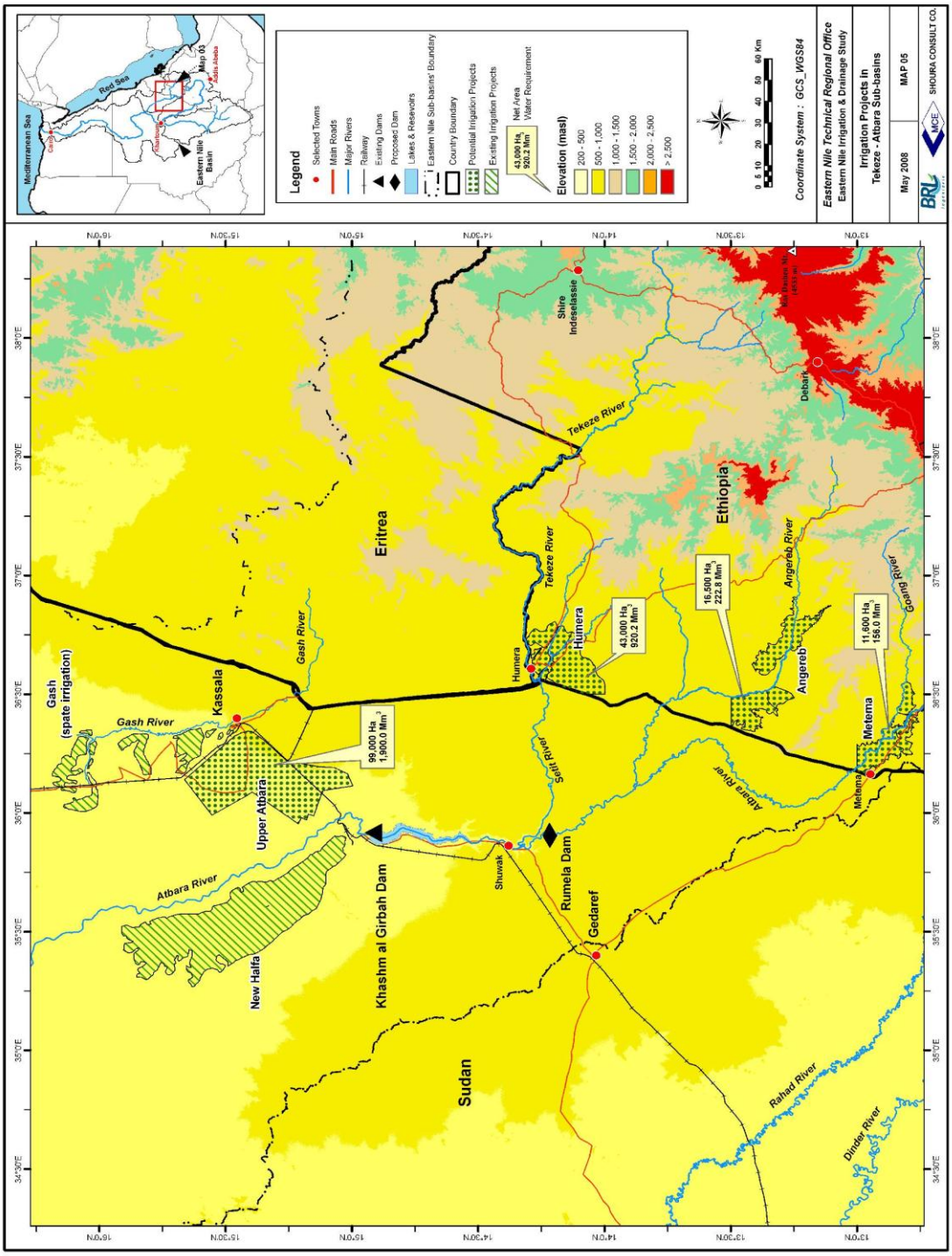
Name of projects	**Net Area (ha)**	**Unit water requirement (m^3 /ha/year)**	**Annual water requirement (MCM)**
Ethiopia			
Humera (see note)	60 000	21 400	1 284.0
Angereb	16 540	13 500	223.3
Metema	11 560	13 500	156.1
* Wolkayite	27 040	13 500	365.0
* Small scale irrigation projects	186 860	13 500	2 522.6
Sub-total Ethiopia	*302 000*		*4 551.0*
Sudan			
Upper Atbara	99 000	19 000	1 881.0
Grand total	**401 000**	**Average 16,000**	**6 432.0**

Source: Tekeze River Basin Integrated Master plan and Upper Atbara project Feasibility Study (figures for areas were rounded to the nearest hundred of hectare). *Projects not shown on map 04.

Map 04: IDZ 3: Blue Nile plus Rahad, Dinder sub basins



Map 05: IDZ 4: Tekeze – Atbara sub basins



1.2 WATER AVAILABILITY AND SCOPE FOR TRANSBOUNDARY PROJECTS

1.2.1 Short term

In the short term it can be assumed realistically that:

- Short term joint investment projects cannot rely on the completion of multipurpose dams across the Blue Nile in Ethiopia;
- Egypt will not accept to give other riparian countries a part of its share of water according to the 1959 Nile Water Sharing Agreement; and
- There is no significant improvement of water use efficiency in existing schemes in Sudan.

In this context available water in the short term is approx 3 BCM annually corresponding to currently unutilized share of Sudan according to the 1959 Agreement. This total amount of water will have to be shared between irrigation and other uses. Reasonably allocating, say 75%, of this water to joint investment projects available water would be then is 2.25 BCM. This amount permits the development of approx 236,000 ha in IDZ 3 or 140,000 ha in IDZ 4 of safe irrigation projects based on the average unit water requirements in each zone. This potential for irrigation development should be shared between Ethiopia and Sudan. With respect to Egypt, the quantity of water available depends upon how much water the country would allocate for irrigation projects in Sudan or Ethiopia knowing that water flowing to the Lake Nasser will be consequently reduced.

The above is a very rough estimate and naturally projects will have to be identified, assessed and selected following the process described in section 2 of this document.

1.2.2 Long term

In the long term, water availability for safe irrigation projects can be significantly increased through:

- The construction of dams in the Ethiopian part of the Blue Nile that will decrease for storage downstream and save water through reduction of evaporation losses from the Sudanese dams and the High Aswan dam;
- Improvements of water use efficiency in existing irrigation schemes in Sudan and /or reuse of drainage water: rehabilitation or modernization project, institutional reforms for better water management.
- Computerized water information system based on remote sensing and /or cell phone for control, measurement and monitoring of water use in large irrigation systems. Egypt has started establishing district data base system, the technology can be transfer to the other countries through regional cooperation.
- Improving and coordinate dams operation and drawdown of the reservoir of Jebel Awlia dam.

Water savings should be assessed and measured before planning further irrigation expansion. The procedures for sharing the increased water supply should be designed and agreed by all riparian countries.

1.3 PRINCIPLE FOR DISTRIBUTION OF COSTS AND BENEFITS

1.3.1 Short term

Some irrigation projects in IDZ 3 & 4 require shared infrastructure for instance, construction of new dams and in the Blue Nile region in Sudan, the construction of feeder canals from the Roseires dam to the projects site (e.g. Rahad 2 and Great Kenana). Capital costs of these new infrastructures should shared between the riparian countries. Two options are possible:

Option 1
The capital cost can be shared according to the Net Present Value (NPV) as estimated for appraisal purposes. Net present values however, are based in part on expected direct benefits and these can be somewhat of a moveable feast. First, the benefits assumed during feasibility and appraisal studies may not be achieved. Does this change the cost allocation? Secondly, a scheme proposal that is predicated on a low value crop could be used to grow a high value one. Usually of course, this is to be encouraged, but should the country be penalized for making better use of shared infrastructure by being allocated a greater share of the capital costs? Also, the calculation of Net Present Values requires an estimate of recurring costs. There is therefore a risk that one country may consider that the recurring costs of the other are over-estimated, or based on in-efficient service delivery, either way reducing the particular net present value and hence share of capital costs.

Option 2
The capital costs can be shared according to the respective area corresponding to the investments made by Egypt, Ethiopia and Sudan that depend upon the shared infrastructure. This option is preferable since it is more simple than option 1 and will avoid possible future re-negotiation on cost sharing if ex post NPVs are significantly different than ex ante NPVs.

For option 2 if:

- Cost of the shared infrastructure is C
- Area of the Egyptian scheme is A1
- Area of the Ethiopian schemes is A2
- Area of the Sudanese schemes is A3

and P1, P2 and P3 is the percentage of the schemes areas that depends on the shared infrastructure for Egypt, Ethiopia and Sudan respectively.

Then the capital costs are distributed as follows:

- **Egypt pays**

$$\frac{C \times P1 \times A1}{P1xA1 + P2xA2 + P3 \times A3}$$

- **Ethiopia pays**

$$\frac{C \times P2 \times A2}{P1xA1 + P2xA2 + P3 \times A3}$$

- **Sudan pays**

$$\frac{C \times P3 \times A3}{P1xA1 + P2xA2 + P3 \times A3}$$

Operation and maintenance costs of the shared infrastructure should not be confused with those of the schemes which they supply. The only transaction that matters here is the service cost of making bulk water available for the use in irrigation projects constructed through investments

made by Egypt, Ethiopia or Sudan investments. In other words, rather than predicate sharing of direct operating costs on an area percentage basis as with capital costs, it is far easier to extract a volumetric service charge.

In addition, invocation of the "user-pays" principle would mean that the direct operating costs of the shared infrastructures is passed onto the farmers themselves, as part of a more general irrigation service charge.

There is no reason to distribute the direct benefits of irrigated production at "scheme gate" because the transboundary costs necessary to achieve them has already been distributed under the capital cost sharing arrangements and the service charge for bulk water delivery. In other words, so long as the capital costs have been distributed and paid and the direct operating costs also paid, then neither country is an investor in the other's operation.

But what about benefits accruing after the "scheme gate"?

It would be particularly difficult, if not impossible, to distribute the sunk costs of existing communication, transportation and marketing infrastructures and the best option is not to try. How can sunk costs be distributed? The issue of added value may become somewhat fractious, but this could be solved by making joint investments (public or private) in market chain added value, in which case, such benefits would be distributed according to each investor's equity position.

Increased costs and benefits of commercial organizations involved in inputs supply and marketing will arise both from the new or expanded commercial opportunities that increased irrigation represents to the commercial services they provide. However, there are no distributive issues with respect to the joint investment projects. Another similar indirect costs and benefits concern public or private enterprises that provide services such as maintenance work or mechanized cultivation and harvesting. Again, there are no distributive issues, even if the maintenance work serves the shared infrastructure because this has been taken care of in the operation and maintenance costs referred above.

1.3.2 Long term

Various assessments have already suggested that water supply in the E.N basin can be significantly increased by a combination of lower storage elevations in Lake Nasser (thereby reducing the colossal evaporation losses) and large scale storage on the Blue Nile in Ethiopia, where higher altitudes and more favourable storage area relationships would mean far lower evaporation losses from the same stored volume[1]. Once carefully assessed and measured the supplementary water for irrigation projects could be allocated for irrigation development following the same principle for distribution of costs and benefits but taking into account the multipurpose nature of these dams: hydropower generation, flood control and regulation of flows, domestic and industrial water supply and so on.

There should be an incentive for each country to use less by increasing water use efficiency in the irrigation schemes. The saved water, being retained in the storage facilities, is then theoretically available to another user who should pay for it. This is consistent with the objective of economically efficient allocation of water at the basin level. But there is a problem!

How should the benefits of any resulting water trade be distributed between the three countries? This is problematic because, although it would be possible to distribute the benefits in proportion to each country's share of the amount saved, unless the same level of physical efficiency gains are achieved by all countries, it raises the potential question of should the country that uses its water less efficiently than the other share in the benefits of the amalgamated increase in efficiency just

[1] There would be collateral benefits accruing to this solution in terms of improved navigation and year round irrigation from the Blue Nile as it passes through the Sudan.

because it has shared the costs of water storage. If it is decided that it should, then it must be asked "to what extent?".

1.4 IRRIGATION AND DRAINAGE TECHNOLOGY FOR JOINT INVESTMENT PROJECTS

Irrigation technology for new irrigation development or modernization of existing schemes should respond to the need to increase water productivity by lowering risk and uncertainty, but also more generally, to the necessity to increase and facilitate control and monitoring of irrigation water by users. The technologies for doing so already exist, particularly the hardware for greater flow control and measurement in irrigation canals. Considerable opportunities can be expected from software technology as electronics, communication systems (including mobile phones), computers, and instrumentation become cheaper and more available. Automation for monitoring and control (including supervisory control and data acquisition in canal systems) and measurement (canal discharges, and even on-farm and water deliveries) is a potential for greater water control in large scale irrigation schemes.

Other technologies that can help saving water and improve productivity include:

- Pressurized systems, not just through drip systems but also through centre pivots with sweeps programmed to serve typical farm blocks. Such technologies improve water use efficiency and can bring irrigation to undulating areas previously thought capable only of purely rain-fed production making it particularly adapted to Ethiopia's part of the basin.
- Wetting front indicator, a technology recognised for its outstanding potential for improving on-farm water management but not yet widely appreciated.
- Drain controllers for their capability to improve control of soil moisture and stimulate sub-irrigation.
- Computerized water information system based on remote sensing and /or cell phone for control, measurement and monitoring of water use in large irrigation systems. Egypt has started establishing district data base system, the technology can be transfer to the other countries through regional cooperation.
- Drainage and drainage reuse for improving land and water productivity, flood control and salinity control which is so much needed in Sudan irrigation schemes. Drainage can also help with health (prevention of water borne diseases). Egypt has a tremendous experience in drainage and drainage reuse that can benefit to the other countries.

1.5 ACCOMPANYING MEASURES FOR TRANSBOUNDARY IRRIGATION DEVELOPMENT

Transboundary irrigation development projects can help defining the most appropriate type and scale of accompanying measures for irrigation development. This could include regional cooperative activities for:

- Harmonization of agricultural, water resources and irrigation policies within and across countries,
- Reducing the institutional divide between water resources development and agriculture
- Harmonization of legal framework in particular with respect to environment protection

- Decentralization of integrated water management activities towards regional and local public bodies which would help to recover costs through user charges and collection instruments, and thus help sustain the investments by water users,
- Regional guidelines / procedures for utilization of the analytical tools developed by ENTRO and the NBI;
- Increase regional trade for maximizing comparative advantages and planning of cropping patterns at basin level;
- Encourage private sector investments and/or joint investments in the irrigation and agricultural sectors;
- Strengthening agencies responsible of environmental legislation enforcement
- Establishing guidelines and indicators for monitoring agricultural water use and use efficiency and impacts of agricultural water-related investments on water availability at basin and sub-basins level;
- Capacity building for project planning, design and implementation,
- Capacity building for irrigation management transfer and cost recovery.

1.6 INSTITUTIONAL IMPLICATIONS OF THE PROPOSED PROJECTS

The study of institutional issues and opportunities associated with the proposed projects (Appendix 5 refers) suggests that the following levels and processes will be necessary for their successful implementation and operation:

LEVEL OF COOPERATION	PROCESS
Information sharing	NBI facilitates information sharing between EN signatories
Joint activities on issues of regional interest	Expansion of the NBI Joint Multi-Purpose Programme
Dialogue	NBI facilitates dialogue between EN signatories
Creation of regional institutions for regulation and monitoring	A convention committing signatories to regulation and monitoring of a/o water quality and quantity issues
Harmonisation of the policy and regulatory framework	Harmonisation of the policy and regulatory framework throughout the entire Nile Basin
Creation of regional institutions for operation and maintenance	Institutions established for specific infrastructural facilities
Joint investment projects	Regional cooperation on a project by project basis
	Bespoke arrangements for specific investments

2. Part 2: Identification of irrigation projects

2.1 OBJECTIVES

The main objective of the project identification phase is the preliminary examination of several irrigation investment projects that conform to country or basin level irrigation development priorities. In the Eastern Nile countries, projects have already been suggested as part of basin plans or national strategy formulation. The intention is to assist the governments in selecting its preferred options for irrigation projects, to plan next steps, and to promote rapid progression to the final stage of the planning process. Experience has shown that this is the most crucial and sensitive stage of planning because it leads to the critical decisions on project choice, concept and content on which all subsequent planning work is based, and which are difficult to change at a later stage.

In the Eastern Nile basin, investment options may include one or several of the following:

- Development of new large public schemes co-managed by farmers and a public or private irrigation agency, mainly in Ethiopia and Sudan;
- Rehabilitation or modernization of large public schemes, mainly in Egypt and Sudan;
- Development of a number of new small scale schemes managed by farmers, mainly in Ethiopia but also possible to be envisaged in Sudan;
- Rehabilitation or modernization of small scale modern or traditional schemes in Ethiopia
- Development of new large commercial schemes in the three Eastern Nile countries.

2.2 GENERAL APPROACH TO THE WORK AND STAFFING REQUIRED

The aim should be to arrive in the shortest possible time at conclusions that will guide decision, carrying out the minimum amount of work necessary to underpin the recommendations but yet to ensure that they are soundly based. Analysis will be aimed at balancing and assessing technical, economic, institutional, social and environmental considerations. The extent of surveys, engineering and other technical investigations that may be needed at this stage will vary widely according to the type of investment that is being considered: for some project-specific investments, pre-feasibility investigations may need to be performed, in others experienced engineering judgement may be all that is required.

The work may be carried out entirely by the Irrigation Coordination & Planning Teams of the ministry in charge of irrigation including local consultants or local consulting companies. Alternatively there may be a need for external support from international consultants depending on the complexity of the investment options and the local capacities to undertake the work within the required timeframe.

Experience from the analysis phase of ENIDS engineering study and experiences of other projects suggest that teams assigned to support the process of investment projects comparison are best kept small and will probably consist of a hydrologist, civil/hydraulic engineer, agronomist and economist. However, given the seriousness with which institutional, social and environmental concerns are regarded by governments and financial institutions, team members will need to have sufficient breadth of experience to consider these aspects and to identify potential hazards and constraints.

It is usually appropriate to initiate the analysis process by holding a round-table meeting with senior representatives of the ministry or department(s) responsible for water resources and irrigation development to discuss their priorities, expectations and hear their recommendations. The participation of the potential financing agency's in country representative, especially towards the end of team's in-country work, is usually a great advantage since it encourages stakeholders' commitment and should avoid any "false starts".

Although the process should involve close contact and continuous exchanges of ideas between the stakeholders and the team members, it is desirable to conclude the process by holding a wider workshop to achieve, or at least advance towards, consensus on the preferred project(s). It is essential that in advance of this workshop the participants are provided with a brief which

summarises the projects, confirms that they are in line with the irrigation sector strategy, and gives reasoned arguments for the selection of the preferred projects. If it is impractical for the team to prepare this before completion of its in-country work, then the workshop may have to be held later, once the team's draft report has been submitted to government and the financing institution.

2.3 ACTIVITIES

2.3.1 Review of Available Data and information

The level of information required for the comparison of projects will vary widely according to the scale and nature of the development. Sound professional judgement is required to decide on the needs and to avoid unnecessary detail or extra survey.

For new development projects, this may include some (but is unlikely to include all, unless in exceptional circumstances) of the following:

- Reconnaissance or pre-feasibility reports already prepared by local or international consulting firms, including outline or preliminary designs and preliminary cost estimates;
- Local climate data;
- Relevant time-series surface water resources data;
- Groundwater and wells inventories and monitoring data;
- Aerial photography and topographic mapping at an appropriate scale for reconnaissance purposes;
- Soils and irrigation suitability mapping (preferably according to internationally recognised legends and classification systems);
- Details of existing land use, farm size, land tenure and water rights;
- Demographic data;
- Local agricultural and livestock production systems data, including crop yields (for rain-fed and irrigated crops) and technologies used;
- Assessments of market and price prospects for the main commodities to be produced.

For the analysis phase of ENIDS engineering study although they were some gaps in the above (and outdated information on population data of the project site in Ethiopia) the team was able to achieve the objective of guiding a decision on the options. If too much information is missing, arrangements should be made to fill the gaps by organizing specific surveys and studies. The specialists will then return later to assess how the new information affects choices. What is important is that the process should be kept moving forward, to avoid unnecessary delay in eventual implementation.

In the case of **existing projects for rehabilitation or modernization**, copies of the original designs and layouts for the existing infrastructure would be required in addition to the above, together with details of:

- The construction history of the scheme, present O&M arrangements, current state of the infrastructure and an indication of rehabilitation needs;
- The environmental performance of the scheme, with regard to sedimentation, water logging, salinization, water pollution and human health;
- The social history of the scheme, with regard to resettlement, compensation of negatively affected persons and conflict resolution;
- Current and past cropping patterns, yields and trends;
- Land tenure system within the scheme;
- Water allocation to, and use within, the scheme, with an assessment of efficiency;
- Farm income and off-farm employment data;
- Information on production support services and their performance;
- Role, responsibilities and organization of the institutions in charge of management and O&M;

- Level of cost recovery and O&M history.

2.3.2 Reconnaissance Field Visits

If an external support team is assigned responsibility for comparing the projects, it is likely to need a minimum amount of time for reconnaissance field visits to the project site(s) to gain first-hand impressions of physical features, problems and issues as perceived by farmers, the coverage and effectiveness of supporting services, and so on. If many projects are to be analyzed, the team should decide on a sample of project sites to be based on the information from review of the secondary data. It is worth noting that he information gained at this stage will be no more than impressions and its value will depend heavily on the experience, intuition and common sense of the team members. It will have then to be backed up subsequently by firm data.

During the field visits the team should always involve government representatives and possibly members of the government Irrigation Coordination & Planning Team. Provided the external team meets in the evenings for an exchange of information and ideas, it is usually more practical for the various members to work independently of the others during the day's field work, to make the best use of the time available. The engineer for example may be too busy with investigations to spend time listening to the agronomist carrying out interviews.

2.3.3 Preliminary assessments of topography, Soils, Land Capability and drainage requirements

Suitable topography mappings (scale 1/50,000) were available for the projects considered by ENIDS study. If suitable topographic mapping is not available, it will need to be prepared so that preliminary engineering designs can be drafted in advance of project preparation. All but the smallest developments can usually be mapped satisfactorily from aerial photography. Field survey may also be necessary for the sites of the main structures and main canals alignments. If this is not already available the team should prepare specifications for the work to be carried out, either by government or by private contractors.

As in the general case for project identification, there was little that the ENIDS team was able to achieve in the way of verification of previous soils land capability and drainage requirement assessments other than to judge that the work carried out to date was adequate, in terms of scale and detail, for the purpose of comparing projects. If such information is not available, terms of reference for upgrading information on soils should be prepared.

For rehabilitation projects this information should be available in initial project documents.

2.3.4 Preliminary Estimates of Irrigation Water Requirements for Possible Cropping patterns

For the proposed **new irrigation development projects**, ENIDS team has assessed the climate database and available estimates from previous studies of irrigation requirements for the range of possible cropping patterns being considered. Available estimates were adopted because they were considered to be of reasonable validity. If their validity is questionable, estimates can be verified using the FAO computer programme CROPWAT in conjunction with the climate database CLIMWAT. However although CROPWAT is quick and easy to use, and this work should take no more than a one hour or so per project (provided data are readily available or assumptions can be made on local planting and harvesting dates), judgement should be exercised to avoid duplication of efforts. The point to bear in mind is that the requirement at this stage is a comparison of options rather than absolute figures.

For the purpose of these preliminary estimates, system capacity and overall peak project water requirements can probably be based on using the 80 percent probability of exceeding effective rainfall for the nearest representative rainfall station to the project area, as derived from CLIMWAT.

Conversion from net water requirements to gross should be made on the basis of empirical local data for efficiency of the types of irrigation systems under consideration, for instance between 50% and 65% for surface irrigation depending on on-farm application technology and farmers' skills, approx 75% for sprinkler irrigation and 90% for drip irrigation. Data needs for future refinement of the estimates should be identified, and will depend on the anticipated method of irrigation envisaged.

A similar approach should be adopted for **rehabilitation projects**, to arrive at estimates of theoretical system demand/capacity for comparison with reality, and to identify system constraints.

2.3.5 Preliminary Assessment of Available Water Resources

After confirming, at a preliminary level, the gross irrigation water requirements per hectare, the volume of water available on an annual or seasonal basis should be determined from the available data.

In general larger projects tend to have been under consideration for a longer period of time so that hydro-meteorological and hydro-geological level of information is usually higher than for smaller projects. The required depth of analysis of time-series data will also vary according to the scale of the project(s), and the existence of other irrigation or competing interests within the basin, within or across international borders.

For large scale projects, government or its Irrigation Coordination and Planning Team and consulting companies will probably have already analysed the data to establish the availability of water for the projects at a given risk of failure in supply (usually 20 percent). This was the case for the proposed projects under ENIDS study. Otherwise, for small projects estimates of mean annual watershed run-off may have to be used with empirical methods.

The hydrologist should judge whether the database is adequate and whether the methodology adopted is soundly based and applied, and appropriate for the particular circumstances of each project. If not, the hydrologist should define the additional work required to determine the feasibility of the proposed projects.

Projects on international waterways require special consideration because they may prejudice other riparian states. ENIDS projects were agreed by the riparian states before the beginning of the study. More generally international agreements with the other riparian states for the efficient and equitable use of the entire basin system should be secured prior to taking the further steps of projects appraisal.

For rehabilitation projects the team should make a comparison between current water availability and as assessed at the time of the design to estimate impacts of other irrigation development and increased water demand for domestic or industrial use after the completion of the project.

2.3.6 Preliminary Assessment of "Without-Project" Situation

From short field visits, the team should make a preliminary assessment of the present "without project" situation for some or all of the projects for analysis. Field visits should particularly examine how farmers would be affected by the projects, or perceive, the potential investment. Although these reconnaissance visits may not be an effective substitute for a subsequent agro-socio-economic study, by widening the range of initial contacts to include not just local government staff and farmers but also possibly persons working with NGOs or for development projects in the projects areas, the value of such reconnaissance is greatly enhanced. The visits, together with the

review of the available data, should enable the team to precise further agro-socio-economic studies in terms of scope and focus for the preferred projects.

For rehabilitation projects the team should also observe the condition of the irrigation and drainage facilities (sedimentation and weeds in canals and drains, types and shape of water division structures and possibly change or destruction made by farmers), the irrigated crops (signs of water stress, pests and diseases), on-farm irrigation methods, conjunctive use of water (from shallow wells or reuse of drainage water) and estimate the size of fallow lands and area with water logging or salinization problem within the command area. For doing so the best way is probably to make a transect walk within the command area (for large scheme a part of the command area or with vehicles) with a small group of farmers to gain information on causes and consequences of the observed problems according to farmers. Comparisons between actual yields and benchmarks extracted from literature or expected yields at the design stage or yields in research stations will also be useful to precise the scope of further agro-economic studies.

2.3.7 Initial Environmental and social Assessment

Comparison of irrigation projects requires screening of the possible environmental impacts of the **new projects** under consideration. The approach to the screening process varies somewhat between governments and financing institutions. Good examples of screening process are given by the World Bank and the African Development Bank categorisation of projects according to the need for Environmental and Social impact Assessment (see Boxes 1 & 1).

The team should use field visits and review available databases to screen the projects, preferably using an Environmental Checklist developed by an International Organization[2] or the government. The screening should determine whether or not any of the projects would result in quantifiable negative impacts, or that land acquisition and resettlement would be required. If, as a result of the screening process, an Environmental Impact Assessment, Social Impact Assessment or a Land Acquisition Assessment, are required, these should be performed as components of the subsequent feasibility studies for the chosen projects.

It is emphasised that the purpose of the initial environmental and social assessment, like the preliminary evaluation of institutional capacity and the preliminary cost-benefit analysis (see below) is not to rule projects out. These assessments are information for facilitating the assessment of projects and ultimately arrive at the best feasibility studies for selected projects.

Box 1

World Bank's categorisation of projects according to the need for Environmental and Social Impact Assessment.

Category A Projects. They are likely to have significant adverse impacts that may be sensitive, irreversible, and diverse. The impacts are likely to be comprehensive, broad, sector wide, or precedent-setting. Impacts generally result from a major component of the project and affect the area as a whole or an entire sector. A full environmental impact assessment (ESIA) is required.

Category B Projects. There may be adverse environmental and social impacts but these are less significant than category A impacts. Few if any impacts are irreversible. They are not as sensitive, numerous, major, or diverse as category A impacts; remedial measures can be more easily planned. Preparation of a mitigation plan suffices for many category B projects. Few category B projects would have a separate environmental report; most may be discussed in a separate chapter of the project document or feasibility study.

Category C Projects. Professional judgement finds the project to have negligible, insignificant, or minimal negative environmental and social impacts. An ESIA or environmental analysis is normally not required.

[2] The International Commission of Irrigation and Drainage has developed a specific check list for irrigation and drainage projects.

Box 2

African Development Bank's categorisation of projects according to the need for Environmental and Social impact assessment.

Category 1: Projects that are likely to have the most severe environmental and social impacts and require a full ESIA.

Category 2: Projects are likely to have detrimental and site-specific environmental and social impacts that can be minimised by the application of mitigation measures included in an Environmental and social Mitigation Plan..

Category 3: Projects that shall not induce any adverse environmental and social impacts and do not need further ESIA action.

Category 4: Projects that involve investment of ADB's funds through Financial Intermediaries (FIs) in subprojects that may result in adverse environmental or social impacts. Specific requirements for this type of project include an assessment of FI capacities to handle environmental and social considerations.

For rehabilitation projects review of available data and field visits should allow the team to identify, if any, the major negative environmental or social impacts of the project such as:

- Water logging and salinization
- High occurrence of water borne diseases
- Water pollution caused by uncontrolled release of drainage and sewage effluents to the water resource
- Conflicts between farmers and pastoralists or upstream and downstream water use
- Conflict between farmers within the scheme due for instance to tail-end effects or poor management.

2.3.8 Preliminary Evaluation of Institutional Capacity

A preliminary evaluation should be made of the capacity of existing institutions to undertake and sustain the irrigation projects being considered, and of any set of accompanying measures or institutional set-up to match the scale of investment to institutional capacities for implementation.

Institutions to be assessed include government agencies responsible for irrigation development, agricultural support services and environmental protection; farmers-controlled organizations such as cooperatives and WUAs and apex organizations if they exist, private sector groups such as contractors and traders involved in agricultural inputs supply and marketing. The best indication of capacity is precedent, i.e. what are the achievements and difficulties encountered of the various institutions involved in other irrigation projects similar to the projects under consideration.

At farmers level, attitude to change, such as willingness to contribute to capital costs in cash and/ or labour and willingness to pay for O&M, should be assessed.

For rehabilitation or modernization projects, precedent may be also the most useful indicator. The commitment and performance of existing organizations in charge of management, operation and maintenance, the levels of cost recovery, equitability and reliability of irrigation water distribution and on-farm productivity should therefore form the basis of an assessment of the opportunities and constraints for strengthening the entities in charge of management, operation and maintenance and/or for establishing new contract agreement between water users, WUAs and the public or private agency in charge of O&M of the main hydraulic infrastructure.

2.3.9 Comparisons of the Likely Costs and Benefits

The main aim at this stage is to compare the likely economic performance of the available options, to confirm that these are likely to be attractive to, and adoptable by, farmers, and to support the selection of the preferred options.

Estimates of Project Benefits
Assessments should be made of the key parameters of realistic yield expectations, cropping intensities, and prices for inputs and outputs, on the basis of budgets for key crops and perhaps simple farm models taking into consideration the time needed for farmers to adopt improved agricultural technology packages. Proposed cropping patterns should be based on agro-ecological conditions and potential market access and size. Assumptions that a high proportion of the land will be planted to high value (i.e. mainly horticultural) crops should be regarded with caution and even some scepticism, because of the likely need for specialised farming skills and potentially restricted market size or difficult access.

Preliminary Cost Estimates
Previous estimates of capital cost should be reviewed to the extent possible with the level of detail available. The level of engineering design detail upon which these estimates will be based will vary, but in most cases estimates will be based on outline designs only, and it will be necessary to make an allowance for physical contingencies of at least 15-20 percent to allow for unforeseen costs that may be added as more detailed engineering designs are prepared.

Operation and maintenance costs should be based on a fixed percentage of the capital cost; usually 2 to 3% of the hardware cost.

Preliminary Cost-Benefit Analysis
A simple cost-benefit analysis, in financial and economic terms, can then be carried out on each of the options. This can take all or some of the following forms:

- Unit capital cost of projects / options
- Net present value (NPV); or
- Economic internal rate of return (EIRR).
- Equilibrium price of meter cube of water (EPW)

It should be emphasised that a high degree of accuracy in cost-benefit analysis at this stage is unnecessary, as all that is intended is a rapid comparative analysis of the options, so that government can better decide on a preferred course of action.

2.4 MULTI CRITERIA ANALYSIS AND RANKING OF PROJECTS

Three categories of criteria can be used in the analysis of irrigation projects: Economic criteria, Social and environmental criteria and other criteria corresponding to costs reducing and/or performance enhancing of irrigation projects identified by researchers. Weighting and use of the proposed criteria for ranking the analyzed irrigation projects should be discussed between the study team and the government Irrigation Planning & Coordination Team.

2.4.1 Economic criteria

In the present era of capitalistic economy and cost recovery, financial criteria such as the financial internal rate of return are given the highest importance by international development agencies and country ministries of finance. The analysis phase of ENIDS engineering components used the following economic criteria

The Economic Internal rate of Return
For irrigation projects, the EIRR equals the parameter 'r' in the following equation:

$$(1+r)^m K = \Sigma_{j=1}^{n} (R - C) / (1 + r)^j$$

where K = cost/ha of project, R = return/ha due to irrigation, C = O&M costs/ha, n = lifetime of project often assumed to be 30 years and m = gestation period of investment. A rate of 10% to 12% is the threshold value widely adopted among international donor agencies when evaluating the outcome of an investment project, below which the investment is generally considered not worth implementing.

The unit costs (K) of irrigation projects include:

- The hardware cost: the cost of physical irrigation infrastructure such as dams, diversion weirs, canals, drains, water division structures, etc; plus
- The software cost which includes engineering management, technical assistance, agriculture extension services, institution building, training of irrigation agency staff and beneficiaries, formation and capacity building of WUAs and so on. As in the case of ENIDS, it is likely that estimates of the software costs will not be available. Thus at the analysis phase the economic criteria would generally be computed based on the hardware capital costs only.

The operation and maintenance cost (C) is self explanatory and generally does not include a monetary estimate of the farmers labour contribution to maintenance work.

The Equilibrium price of metre cube of water (EPW)
The equilibrium price of water is the total cost of water applied for irrigation during the lifetime of the project, assumed here to be 30 years. It is given by the following equation.

$$EPW = \Sigma_{j=1} \ (I + C)_j / (m^3 \text{ water used for irrigation})_j$$

where "I" = infrastructure investment costs and "C"= operation and maintenance costs.

This criterion gives a monetary value of water used for irrigation. Projects having a low EPW are preferable because investments costs of these projects are better valued by water.

The Gross margin per Ha in "cruising years"
The gross margin per ha (GM) is the value of production at farm gate/ha minus direct production costs /Ha. Direct production costs are the costs of agricultural inputs (seeds, fertilizers and pesticides). By "cruising years" we mean the period beyond the time needed by farmers to fully adopt improved technology packages. While the EIRR represents the perspective of bankers or money lenders; the GM is the perspective of farmers, assuming farmers would select irrigation projects that generate more money for their labour. The GM can also be taken as a criterion of impact of irrigation development on poverty reduction as well as impact on macro economy, i.e. contribution of the project to GDP.

2.4.2 Socio-economic and environmental criteria

Level of existing economic and social infrastructures (LEI)
It is now widely recognized that irrigation projects perform better and are more effective in addressing poverty if complementary economic and social investments such as roads, storage facilities and agro-industries, schools, domestic water supply, health centres and so on are planned or already exist. This is an incentive for both the financial institutions and government officers charged with irrigation projects to work more closely with those doing rural development and Sector-Wide Projects (SWPs). Typically SWPs may include rural infrastructure investment, agro-industrial development, integrated water / land/ livestock development and natural resource management such as watershed management, and land and water conservation.

Type and purpose of projects
Irrigation projects with smallholder farmers have usually more impact on poverty reduction because of expanded benefits in the local economy flowing from irrigation development, the so-called "multiplier effect". They also contribute to the empowerment of individuals and communities and improve the nutritional status through increased consumption of fruits and vegetables. On the other hand irrigation projects with large scale commercial farmers may have a greater impact on agricultural production but most of the benefits are reinvested outside the project area or even outside the country. Their impacts on local economy are often limited to employment creation for unskilled and poorly paid labour.

Potential negative environmental impacts
Most often, direct potential negative impacts of irrigation projects are (i) increase of the occurrence of water borne diseases, (ii) pollution of water by agro-chemicals and (iii) farm workers exposure to toxic agro-chemicals (pesticides). Usual indirect impacts are (i) conflicts between farmers and pastoralists and between upstream-downstream communities and (ii) loss of ecosystem functions and natural resources.

Other negative environmental impacts are usually associated with irrigation development such as soil salinity, water logging, soil erosion. It should be considered that they can be avoided by good engineering (design of irrigation and drainage system) and proper management operation and maintenance after project completion.

2.4.3 Other criteria

ENSAP is an important mechanism for implementation of large regional irrigation projects calling on the collaboration between human resources, governments and institutions of the Eastern Nile countries.

Regional projects
It is well known that land and water availability, technical and financial capacities are unevenly distributed among the eastern Nile countries. Large land and water resources are available in Ethiopia but the country has limited technical and financial capacities. Egypt has the strongest technical and financial capacities but scarce land and water resources. Sudan is the intermediate country in terms of available natural resources and financial and technical capacities. In this context, a future regional strategy for regional development should seek to favour co-investment of Egypt and Sudan or Egypt and Ethiopia. The potential benefits for Egypt are increased food security, and in Ethiopia and Sudan: improved design and increased performance of irrigation projects resulting from Egypt's technical assistance and reduction of the financial burden of irrigation development. Such co-investments also have a potential for saving water in the Eastern Nile basin provided they substitute to development of reclaimed desert lands in Egypt.

Size of project
A study by IWMI (2007) and earlier studies by the World Bank (1995) show that project size, as measured by the total irrigated area benefited by a project, is the most important factor influencing unit costs. The larger the project size, the lower the unit costs of irrigation project. The cost reducing effect of project size applies both to hardware costs and software costs. Project size must not be confused with the size of individual irrigation schemes; a large project may include several relatively small irrigation systems.

Significant cost reducing effect of the project size is attributed primarily to engineering economies of scale in formulating and implementing irrigation projects. Secondly, larger projects are supposed to attract better professionals and implementing agencies may have more incentive to be cost-efficient given the higher profile and greater public attention.

In general, an economy of scale arises in production processes when there are indivisible scarce (costly) inputs. Big excavation machinery and dump vehicles for constructing dams and other physical infrastructures are indivisible inputs. More importantly, capable human resources such as planners, government officials, design engineers, construction engineers, project managers,

consultants, contractors, foremen and farmers' organizations are all indivisible scarce resources that are indispensable to irrigation projects. The strong economy of scale of large irrigation projects suggests the very high importance of these scarce inputs.

Size of irrigation schemes within projects

Unit costs of small irrigation systems are generally higher than those of large schemes. Implementing a small irrigation scheme on a project basis leads to diseconomy of scale. However, the benefits of small irrigation schemes are in general higher than those of large schemes. This suggests that at scheme level, the scale factor is less important than the management factor: with fewer farmers to coordinate, smaller irrigation schemes are easier to manage and obtain better economic returns as compared to larger ones. Irrigation projects should be carefully designed so as to combine the management factor making small schemes more effective and the economy of scale of large irrigation projects. Large irrigation projects are better but large irrigation projects with many small irrigation schemes may be the best.

Conjunctive use of surface and ground and drainage water

In the Eastern Nile countries, irrigation is generally associated with canals, dams and reservoirs and there is no example of an irrigation scheme that was designed for conjunctive use of ground & drainage water (although drainage water of upstream irrigated areas is reused downstream in Egypt). A typical case of conjunctive use of ground & drainage water is found in irrigation schemes where farmers subsequently invest in shallow wells and pumps to supplement surface water. Including, where possible, conjunctive use of water in the design of an irrigation project would have no significant impact on project costs and can significantly increase the benefits through improved availability, reliability and flexibility of water for irrigation.

2.5 PREPARATION OF THE ANALYSIS REPORT

On completion of preparation phase the team, in liaison with the government Irrigation & Coordination & Planning Team, will prepare an analysis report. This will be presented in draft form to the government and the financing institution and will be the basis for discussion at a consensus-seeking workshop (see below).

The analysis report should contain the team's conclusions and recommendations with regard to the comparison and ranking of projects, supported by reasoned arguments and highlighting any outstanding issues. Because the intention is that the planning process should be streamlined, the main text should be very concise and should as far as possible **refer** to previous work, rather than quote work and reports. It should however contain, in appendices, draft terms of reference and cost estimates for the various studies and other activities that need to be carried by the feasibility study. It should also suggest the proposed allocation of responsibility between government, consultants and contractors, and provide a tentative programme, in the form of a bar chart, for achieving these **tasks**. It will usually be unnecessary to prepare technical annexes for the identification report, since technical work so far will have been limited and will be superseded by more detailed investigations.

2.6 ACHIEVING CONSENSUS ON INVESTMENT CONCEPTS AND OPTIONS

It is desirable to conclude the analysis phase by holding a workshop, which should be attended by as many as possible of the stakeholders or their representatives, including those of the financing institution, government Irrigation Coordination & Planning Team, and, if possible, representatives of the farmers. In some cases it may also be worth inviting interested NGOs and/or representatives of private sector interests. Although it might seem preferable to hold this towards the end of the team's in-country work, this is usually impractical for operational reasons and because in many cases the team will not yet have completely formulated its ideas. Thus the workshop is more often held sometime after completion of the in-country work, and the draft analysis report can be used as the basis of discussion. Depending on the available budget, various members of the identification study team may attend, or they may be represented by the team leader only.

The workshop should usually commence with a verbal presentation by the team to all participants, preferably supported by visual aids. The workshop may then be broken down into smaller discussion groups. The objective should be to:

- Seek opinions from the stakeholders, to arrive at or advance towards a consensus on the preferred project option(s);
- Discuss the work involved in further planning, the responsibilities for undertaking this, and to agree on a timeframe for the work.

On completion of the workshop, an account of the proceedings should be prepared, probably in the form of a brief aide mémoire agreed with the senior representatives of the government attending the workshop. The aide mémoire should highlight any remaining issues that need to be resolved, and actions required, before proceeding with further planning. The draft analysis report may then, if necessary, be finalised taking account of the deliberations of the workshop, although this may not be strictly necessary if an aide mémoire has been produced: the purpose should be to move to the next stage of planning as quickly as possible, rather than redrafting earlier work.

3. Part 3: Feasibility Study

3.1 OBJECTIVE AND APPROACH

Once the project(s) has been selected and agreed between the government and financing institution, the feasibility study should commence. The purpose of this part of the process is to make the proposed project(s) ready for appraisal by the financing institution and the government. The outcome should be a **feasibility study report**: ideally it should define the project in all respects, so that the task of appraisal is one of merely passing judgement on it, without the need for any repetition of earlier work.

The feasibility report should therefore demonstrate that the project is:

- In conformity with the country's irrigation sector objectives and priorities;
- Consistent with the felt needs of the intended users;
- Technically sound and viable and the best of the available alternatives under existing technical and economic constraints;
- Institutionally workable;
- Unlikely to result in any adverse social impacts without adequate compensation;
- Environmentally sustainable;
- Economically and financially viable; and
- Ready for implementation.

As discussed in Part I, the "project" may comprise a conventional investment in a specific major item of new irrigation infrastructure or "hardware". Increasingly however it is likely to comprise also investments in "software" such as formation and capacity building of institutions in charge of O&M, technical assistance, farmers participation and so on. This has a significant influence on the extent to which planning must be completed prior to appraisal. In the conventional **project** approach it is usually necessary to complete all planning and much of the engineering design **before** appraisal. For projects with a significant software component, the related "sub-projects" are selected and planned in detail **after** appraisal and loan approval, on the basis of criteria agreed at appraisal.

The conventional project approach is usually adopted for investments in major infrastructure development. In this case the level of accuracy desirable in cost estimates at appraisal is important, to avoid cost overruns in project execution which may arise as a result of insufficient design or inadequate site exploration. The conventional project approach is rarely compatible with institutional capacity building, because planning and design are generally carried out against tight deadlines. Nevertheless, there are many cases when there is no alternative to this approach.

Projects with a strong software component may preferable to the conventional project because experience shows that:

- The risks of cost and time overruns during implementation are reduced;
- They offer greater prospects for sustainability and irrigation productivity when under operation.

Planning may be a single integrated operation, or it may be broken down into several parts, such as the Environmental and Social Impact Assessment (ESIA), Agro-Socio-Economic Study (ASES), Engineering Studies, Financial and Economic Analysis (FEA) and so on. Some or all of the work may be carried out by local planning agencies, including government irrigation agencies, local consulting companies and contractors and NGOs; or it may be done by external support teams, including consulting companies.

If the work is broken down into a number of separate studies, The government Irrigation Planning & Coordination Team would review the various reports and compile the feasibility study report. Such a review may involve fieldwork to visit sites of particular importance – for instance those for major infrastructures – and also to inspect particular problems such as areas with poor drainage or operational difficulties (i.e. land acquisition and resettlement) that have been revealed by the work to date.

3.2 ACTIVITIES

3.2.1 Engineering Studies

Engineering studies will be necessary, whether for new development or rehabilitation, to define the physical infrastructure to be developed or type of improvements intended. The degree of detail required will depend on the scale of the works; repetitive works can be based on sample type designs. The object of the engineering studies is to provide the necessary technical information to permit the preparation of preliminary designs upon which estimates of quantities, accurate to plus or minus 15 percent, and project cost estimates, can be based. Such studies should include some or all of the following:

- Interpretation of satellite imagery and aerial photography.
- Site topography survey at appropriate intervals and preparation of topographic maps at appropriate scale and as required by the government Irrigation planning and Coordination Team.
- Surface water resources studies including a correlation of rainfall with run-off. Where practicable, water availability should be simulated to provide an indication of likely availability to meet demand over the period of analysis of the project (generally 30 years). This should permit the prediction of the likely year-by-year cropping intensity, rather than assuming one based on the area that it would be possible to irrigate if the 80 percent probability (say) flows occurred each year. For small un-gauged catchments a synthesis of rainfall, catchment area and assumed run-off coefficients may be acceptable.
- Groundwater studies to investigate water table depth, the nature of recharge and sustainable yield of aquifers.
- Water quality analyses and limitation for irrigation.
- Studies of present utilisation and future demand for surface and underground water and the prospects for other developments within the same catchment that could affect water availability.
- Assessment of the emergence of competing demands for water for urban and industrial uses that could influence availability for irrigation. Conversely, consideration may be given to the use of agricultural drainage water and municipal waste water for irrigation.
- Estimates of water demand for the existing and proposed cropping patterns, based on the use of the FAO CROPWAT software and its computer database CLIMWAT or an alternative locally developed method of estimating crop water requirements if this is appropriate. These studies may include a consideration of the possibility of designing for conjunctive use of surface and groundwater for irrigation, buffer reservoirs and on-farm ponds to increase predictability and security of water supply in dry years and dry periods. Consideration should also be given to the possible crop rotation that farmers might adopt, and cropping patterns that avoid unreasonable peaks in water demand.
- Estimates of surface and subsurface drainage requirements, based on a design storm of selected return period and locally obtained data on subsoil drainage and water table depth.
- Geological and/or geotechnical investigations for foundation design, seepage predictions (which are of particular importance in decisions on whether or not to line canals), slope stability analysis and creep ratios.

Outputs

- Preliminary engineering designs for the scheme layout, main structures and water supply/drainage system including the technology for water control and monitoring by users.
- Preliminary engineering designs for roads and other infrastructure.
- Detailed cost estimates for the civil works and their operation and maintenance.

For schemes being considered for rehabilitation and modernization, a detailed diagnostic operational study to identify the present condition of the infrastructure, constraints, sources of inefficiency and the scope for efficiency gains. Supplementary topographic survey may also be required to verify original construction drawings and to provide additional technical information. It is desirable to enlist the support of farmers, to obtain details of the past performance of the

scheme and what brought about the need for rehabilitation, other than simply "old age". It is also desirable to encourage demand-led investment by establishing what farmers would like to see improved and the extent to which they are willing or able to contribute to the cost of improvements. The modalities for achieving this will vary from case to case, but the best channel of communication with farmers is usually through an elected committee of a water users' association or similar body. Contracting an experienced and competent NGO to assist in the process may offer considerable advantage.

3.2.2 Soils and Land Suitability Studies

If the available soils and land capability mapping are found to be inadequate, arrangements should be made to upgrade this to an acceptable scale and standard, with special attention paid to drainage aspects, bearing in mind that (over) irrigation often bears the risk of water logging and salinization. Soil type, as it affects infiltration and permeability and water holding capacity, is of special importance for the estimation of irrigation scheduling and irrigation water requirements. This time consuming activity should be carried out by the government soil survey agency or private contractors, depending on which is likely to deliver the quickest result.

Outputs
The soils and land suitability should be assessed on the methodology outlined in the FAO soils bulletin N° 55: "Land evaluation framework". Alternatively other methods recommended by the government can be applied.

3.2.3 Agro-socio-economic study

Depending on the nature and complexity of the proposed project and the availability of detailed information regarding the without-project situation, it may be necessary to organise a agro-socio-economic (ASES). This is usually carried out by local consultants. Specialised briefing and support for field work may be given by the staff of the international consultant involved in the projects.

The investigations should be designed to provide information on:

- Population, population density and increase rate, ethnic diversity;
- Distribution men/women and age categories
- Number and size of households ;
- Ratio population active in agriculture/total population ;
- Level of education.
- Health status
- Present land use, farm size, farming systems and practices (including for traditional irrigation if any), crop varieties and yields, use of inputs, and availability of draught power; or for rehabilitation projects, past and present irrigated cropping patterns, yields and trends, on-farm irrigation practices compared with expectations at initial project planning; an explanation for any differences, and the reasons for any decline in areas planted or yields obtained under irrigation;
- For farmers in development schemes similar to those proposed, an indication of yields and production;
- The existence of any group or cooperative activities within the area (eg for marketing and input supply, irrigation O&M) that might have a bearing on the potential for management transfer to irrigators;
- People's development priorities and the extent of their interest in the project and implications for their participation to project implementation;
- Intra-household dynamics; gender division of labour, access to and control over land, labour and capital; control of crops and income from their sale, and the responsibilities of husband and wife as family providers;
- The household economy, and alternative sources of income from off farm activities.
- Time available for crops and livestock production and other activities and any conflicting or competing demands for labour;

- The likely impact of the project on household economy and labour
- The existence and adequacy of roads and transport and storage services for farm products;
- The respective roles of the public and private sectors in input supply and marketing;
- The scope for cost recovery, including contributions towards capital
- Costs and recovery of O&M costs.

If the viability of the project relies on the inclusion of high value crops for the domestic or export market, it will be necessary to carry out marketing studies. **The Eastern Nile countries are not self sufficient in cereals and other non-perishable staple food, therefore there is no need to dwell on market issues for such crops except than verifying the availability and adequacy of transport and storage back-up services and roads.**

Outputs

- A description of the current situation of the agricultural sector: cropping patterns and corresponding profitability for farmers or for rehabilitation projects, a diagnosis of irrigated agricultural production.
- An evidences backed estimation of the likely evolution of the agricultural sector "without the project" in terms of productivity decline, stability or increase supported by sound arguments
- The selection of cropping patterns and crop rotations under irrigation based on: agro-ecological conditions, farmers' preferred crops, priorities of the government and market size and prices (for high value crops).
- Corresponding crops water requirements;
- Corresponding labour and inputs requirements;
- Estimations of land productivity (gross margin/Ha); labour productivity (Gross margin/farm worker) and of beneficiary household income from irrigated farming
- Estimation of farmers' capacity to pay for O&M based on the above
- Proposed O&M charging modalities (see box 2) and level estimate of cost recovery of O&M.
- Level estimate of beneficiaries' participation to project implementation in cash and labour.

Box 2: Types of O&M charges modalities

The following options are possible:

- *Uniform user charge*: users are assumed to have equal access to water and charged evenly. Even if the level of use varies, differences cannot be or are too costly to be assessed.

- *Area based charge*: users are charged according to the irrigated area based on land rights or area actually cropped (declared by the farmer or assessed by the management entity).

- *Area + crop based charge*: the charge is based on area and the type of crop. Differentials may be justified by policy priorities (e.g. cereals for food security) or water consumed by crop or its value. This is the modality used in Sudan public irrigation scheme.

- *Volumetric charge*: water is charged based on actual diversions to a user or a group of user. Metering is necessary but volumes may be represented by time and numbers of irrigation turns, provided discharges are more or less stable and predictable.

- *Quotas at fixed charge*: Water quotas may be uniform (based on area) or vary according to the type of crops. Water charges can be proportional to the nominal volume or vary by crops. This option seems well adapted to Egypt where water allocation will be allocated on a fix amount per feddan basis (=quota).

Each method has its advantages and disadvantages notably with respect to the ease with which charges can be calculated, justified and implemented. Transaction costs associated with charges collection should be carefully assessed when selecting a modality.

3.2.4 Environmental and Social Impact Assessment

If, at the identification stage, a full and separate Environmental and Social Impact Assessment (ESIA) was found necessary, the ESIA should at least consider the following issues

- Potential erosion and sedimentation hazards;
- Water logging and salinization,
- Depletion of groundwater supplies,
- Pollution of surface and groundwater by agro-chemicals
- Risks related to ecosystem functions and natural resources
- Displacement of human settlements and the impacts on ousted people (loss of land and assets)
- Risks of conflicts between farmers and pastoralists and between upstream and downstream water users
- Health aspects.

The ESIA may be carried out by government agency staff or a consulting company.

Outputs
It should be an environmental action plan (EAP) and if necessary a land acquisition plan (LAP) which will include measures such as compensation for ousted people, proposed legal provisions and regulatory mechanisms for minimising adverse impacts, and provision for systematic monitoring and evaluation. All identifiable costs should be itemised for inclusion in the total cost stream of the proposed projects.

In the case of projects for which a full ESIA was not found necessary, it will normally be necessary to prepare a mitigation plan for reversible impacts, which may include a monitoring and evaluation system and compensations measures for negatively affected persons (resettlements).

3.2.5 Land Tenure and Water Rights Investigations

The existing formal or customary arrangements for land tenure and, for rehabilitation projects, water rights should be examined in detail. This should establish whether there might be any obstacles to successful implementation, such as a lack of secure tenure or water rights, which could inhibit farmers participation and contribution to the project.

Outputs
Depending on the circumstances of the project and its location, it may be necessary to arrange for a cadastral survey to establish the existing land tenure pattern and its implications for project planning. This should provide data on the size and distribution of properties and farms, degrees of fragmentation, the proportion of owner and tenant-operated farms, and type of tenure. Data should be interpreted in terms of recommendations for land rights redistribution or consolidation and compensation for lost of land and assets that would result from the project. Land tenure issues should be approached with caution, and the views of the present users taken fully into account.

3.2.6 Assessment of institutional set up for management, operation and maintenance of irrigation projects.

A key condition for sustainable irrigation development is that the **implementation requirements** of the projects should be **matched to a local institutional set up or a coordinated set of accompanying measures** to ensure long terms sustainability and productivity of irrigation projects when under operation. The assessment of the institutional set-up or accompanying measures may be carried out by government as a form of self-analysis but it is likely to benefit from an independent external review. It should address all or some of the following:

- Institutional roles and responsibilities of public or private irrigation agency in charge of management operation and maintenance of major hydraulic infrastructures such as dams, pumping stations, main canals and drains of large schemes.
- Institutional roles and responsibilities of Water Users Organizations for management and O&M of the secondary or tertiary irrigation and drainage work in large schemes or for the whole system of small scale irrigation schemes;
- Institutional roles and responsibilities of large scale commercial farmers in management, operation and maintenance of irrigation projects;
- Financial sustainability of irrigation development: mode of assessment and collect of the O&M fee and control of its utilization by water users.
- Contract agreements between the individual water users and Water Users Associations (by-laws) and between WUAs and the irrigation agency in large irrigation schemes.
- Government technical and financial support to irrigation agencies and WUAs.
- Government supervisory role and control over management, operation and maintenance of irrigation projects in particular regarding maintenance standards, utilization of the collected O&M fee and prevention of corruption or abuses, water pollution and welfare of farm workers for projects with large commercial farmers.
- Support for marketing, storage and processing of irrigated farming products.
- Research and extension service to ensure high productivity of irrigated farming.
- Investment credit: Irrigation development leads to increased needs of investment credit for farming machinery, planting of fruit trees, storage and transportation of the production flow.
- Input access and seasonal credit: High productivity of irrigated farming will also come from increased use of agricultural inputs which will generate an increase of seasonal credit needs.

3.2.7 Economic Analysis: Economic Internal Rate of return (EIRR)

International development agencies assess the merits of an investment by measuring the Economic Internal Rate of Return (EIRR). For irrigation projects, the EIRR equals the parameter 'r' in the following equation:

$$(1+r)^m K = \sum_{j=1}^{n} (R - C) / (1 + r)^j$$

where K = cost/ha of project, R = return/ha due to irrigation, C = O&M costs/ha, n = lifetime of project often assumed to be 30 years and m = gestation period of investment. A rate of 10% to 12% is the threshold value widely adopted among international donor agencies when evaluating the outcome of an investment project, below which the investment is generally considered not worth implementing.

The capital costs (K) of the projects include:

- The hardware cost: the cost of physical irrigation infrastructure development such as dams, diversion weirs, canals, drains, water division structures, etc and land acquisition, resettlement and compensation costs; plus
- The software costs which includes engineering costs and technical assistance during implementation for monitoring and supervision of the project, training of agriculture

extension services, institution building, training of irrigation agency staff and beneficiaries, formation and capacity building of WUAs, additional and so on.

The operation and maintenance cost (C) generally does not include a monetary estimate of the farmers labour contribution to maintenance work.

Maintenance costs should be calculated in detail wherever possible, but estimates of the annual cost based on a percentage of the capital costs may be appropriate for both economic analysis of the projects and the assessment of the water charges. Typical values are given in box 3.

Box 3
Annual maintenance cost as percentage of initial capital costs per type of work

Diversion structure/weir	1.5 %
Main canal (unlined)	2.0 %
Main canal (lined)	1.0 %
Pipelines (AC and PVC, underground)	0.5 %
Buildings	1.5 %
Electric powered pumps	3.0 %
Diesel powered pumps	5.0 %
Night storage and buffer reservoir	2.0 %
Piped distribution systems	1.0 %
Portable pipes and sprinklers	6.0 %
Field canals and structures	2.0 %
Drains (sub-surface)	1.5 %
Drains (open)	2.0 %

Operating Costs. For projects that lead to substantial increases in recurrent costs to be borne by government, a table projecting operating and replacement costs after the close of the disbursement period should be prepared. The table should show by categories the continued cost of running, maintaining and replacing the assets created by the project, and the cost of operating services at the levels necessary to achieve project objectives. Annual cost estimates, both for the economic analysis of the project and also for setting water charges, should include the following:

- Salaries and allowances of O&M staff.
- Maintenance of buildings, offices, stores and housing.
- Running costs of O&M vehicles and plant.
- Where applicable, running costs of pumping plant.

The return due to irrigation will normally consist of the value of the incremental output of the project. To establish this value it is necessary to compare what would happen without the project with what would occur with the project. In some cases it is possible to assume that, without the project, the present (i.e. pre-project) situation would persist. In other cases however there may be facts and evidences to suggest that, even in the absence of any intervention, production would continue either to rise (as a result of improved rain-fed farming practices or spontaneous small scale irrigation development) or to fall (perhaps because of land degradation or progressive increases in soil salinity in the absence of drainage). The agro-socio-economic study should provide information for comparing the situation with and without the project.

All costs should be estimated at market price and the return including products for home consumption should be expressed at farm gate market prices. Taxes and subsidizes should be eliminated from the calculation.

3.2.8 Risk and Sensitivity Analysis

An assessment should be made of the extent to which the proposed investment implies risks for the country and for the project. Risks should be explicitly identified and their possible impact on the economic viability of the investment and on its sustainability examined. Possible sources of risk include competing water demand between irrigation projects and other water users such as municipal and industrial use and tourisms and /or recreational activities. There is alos danger of cost over-runs stemming from inaccurate estimation of quantities in civil works construction, or from delays in implementation due perhaps to poor project management and inadequate staffing, land acquisition or procurement problems. Such delays, in turn, may result in a slower build up of production attributable to irrigation and hence to reduced benefits.

Reductions in benefits could also result from lower than expected yields, slowness of mastering methods of irrigated farming, or the effects of a succession of years with lower than expected water availability. Risks may also be derived from exogenous factors such as unexpectedly large rises in input prices or falls in commodity prices.

There are also risks that do not lend themselves to quantitative analysis. The case of government commitment is one. Availability of domestic financial resources to cover the government share of project costs is another example. Securing beneficiaries' participation is a third one, and several other examples could be quoted. The discussion of the risk factors should not be limited to quantitative analysis, but expand to cover the other major areas of concern, drawing attention to the possible need to take corrective measures before or during project implementation. Risks of an environmental nature should be addressed as part of the assessment of the project's environmental impact.

3.2.9 Planning for Implementation

One of the most common reasons for delays and defects in implementation is difficulty by the implementers in taking all the steps needed for loan effectiveness and disbursement from development partner agencies or the ministry of finance, and to initiate project activities. To encourage smooth and rapid progression from appraisal to project start-up and loan disbursements, it is essential to prepare a detailed implementation plan for the period leading to start-up and extending through at least Project Year 1 (PY1). This should contain step-by-step guidance, as appropriate to the level of experience and capacity of the implementing institution, on all activities to be undertaken. It should also clearly identify who is responsible for and who supervises each activity.

All activities should be scheduled and given their estimated duration and earliest and latest dates for achieving both project start-up and the targets for PY1. Scheduling should preferably be based on critical path analysis, for which a project management software may be used. If the practitioner is not familiar with this, it is better to use a pencil and squared paper rather than not preparing a schedule at all: the act of committing thoughts to paper or a computer screen often surprises even the most experienced practitioners when it is discovered how many activities are involved, and how much time is required to achieve them.

Outputs
With the participation of the institutions concerned under the government Irrigation Planning and Coordination Team, the preparation of an implementation plan should enable them to team up for commencing implementation as soon as funding has been approved. Many of the actions required as a condition for loan effectiveness will require administrative steps involving no significant expenditure; others may require some budget expenditures. They may include:

- Preparing an annual work plan and budget for the first year of the project, and entering this into government's budget for the fiscal year;
- Opening a special bank account to receive project funds for local disbursement;

- Arranging staffing for project implementation, including recruiting or redeploying staff with the required skills and experience, and training staff for new functions that they will have to perform;
- Initiating necessary institutional reforms;
- Drafting and initiating the enactment of legal provisions (for irrigation agency, WUAs, creation of autonomous authorities for bulk irrigation water supply);
- Preparing operational and accounting manuals, setting out procedures to be followed in project implementation, and allocating responsibilities to the different categories of implementer (eg the ministry of finance, irrigation agency, and farmers);
- Preparing procurement packages for equipment, satellite imagery, aerial photography and mapping;
- Drafting requests for proposals/bids for external technical assistance;
- Organizing farmers for their participation to the project.

3.3 THE FEASIBILITY STUDY REPORT

The purpose of the feasibility report is to **facilitate appraisal**. The requirements will vary between government or financing institutions: for IFAD-funded projects, for example, which are aimed deliberately at reducing poverty, targeting usually receives special importance and a separate chapter on the **target group** justifying their selection will be necessary. Thus the proposed content and layout should be discussed with the project controller of the financing institution concerned before drafting commences.

The feasibility report should usually contain a description of the project rationale and planning considerations, which is likely to repeat the arguments developed first in the preparation report, but modified and deepened to reflect the findings of later investigations. In particular, in view of the emphasis now placed on the requirements for implementation, the document should clearly demonstrate the compatibility of the proposed project with existing capacity to implement, operate and maintain it.

The feasibility study report should describe:

- The irrigation and drainage works and other hardware which are proposed for financing.
- The expected phasing of this development.
- Institutional responsibilities and staffing requirements for project implementation;
- The implementation plan;
- Mechanisms adopted for users' participation in implementation;
- Details of expected supervision of implementation by the financing or cooperating institution.
- The organisational structure decided upon for O&M, which may include allocating or transferring responsibility to the users, or to a financially autonomous irrigation authority dependent on the users for financing, and/or participatory joint management.
- The suggested legislative and regulatory framework for WUAs and other management organisations proposed;
- The proposals for water charges and cost recovery mechanisms, reflecting the country irrigation sector strategy;
- Technical assistance and training requirements;
- The estimated changes in cropping patterns and yields expected as a result of the development, and the rate at which these are expected to occur.
- Marketing possibilities and forecast of prices.
- The financial returns to farmers and economic benefits to the country, taking account of all social and environmental costs, with sensitivity and risk analysis.

The feasibility study report should normally incorporate or be supported by the working papers that have been generated at various stages of the planning process. These should either be presented separately or attached to the project document as annexes, depending on the form that best facilitates subsequent appraisal.

3.4 ACHIEVING CONSENSUS ON THE PROJECT PROPOSAL

The feasibility study report should preferably be presented in draft form to government and the financing institution, for discussion at a concluding workshop. This should, like all other workshops held as part of the planning process, be attended by concerned stakeholders or their representatives, including senior representatives of the ministry or department(s) responsible for water resources and irrigation. Senior representatives of the ministry of finance, and if appropriate planning, institutions should be present to inform them of the final shape and cost of the proposed investment. The event should also be attended by the task manager or project controller from the financing institution, the Irrigation & Planning and coordination Team, and any NGOs who might be involved in implementation (eg for training WUAs). It is essential that the views of the users and any losers under the proposed project should be sought and expressed at the workshop, preferably by their designated or elected representatives. The objective of the workshop should be to reach consensus on all aspects of the project proposal.

On completion of the workshop, an aide mémoire should be prepared which should summarise the proceedings and note any matters that still need to be clarified or corrected in the feasibility study report. It should also highlight any outstanding issues that need to be resolved before appraisal and define the actions required to do so. The final version of the feasibility study report should then be prepared on the basis of the consensus or conclusions reached.

Appendix: Activities to be completed and level of details at the successive stage of the planning process

Subject / phase	1. Identification	2. Feasibility study	3. loan effectiveness
1. Hydrology related to Major works	Identify main water sources, collect available data on basin rainfall and flows. Review data and if necessary visit stations to assess data quality. Recommend any necessary improvements to network or processing of data. Analyse flows and frequency of floods. Sample and test quality for use for irrigation purposes. Estimate sediment yields. Prepare preliminary estimate of basin water balance and round-figure estimates of area each source will irrigate. Prepare indicative basin plan for optimum water use	Reworking data if necessary. Revise basin water balance or hydrological model. If necessary generate sequences of daily, monthly and annual flows, with probability analysis. Simulate annual water availability over life of project taking into account increased water use for domestic and industrial purposes and any upstream or downstream other likely irrigation development. Confirm design flood(s) Refine estimates of sediment yield. Install additional measuring devices if this will usefully add to hydrological knowledge.	Further refinement of 2 if necessary to resolve pending issues On-going data collection for future updating of water availability and sediment yield.

Subject / phase	1. Identification	2. Feasibility study	3. Loan effectiveness
2. Hydrology related to Major groundwater development	Collect and study available data on groundwater occurrence and use. From desk study identify areas worthy of further exploration. Review well logs and existing yields. Sample and test water quality. Map preliminary assessment of groundwater potential.	Geophysical surveys drilling test wells, Pump tests, and preparation of simple model of aquifer recharge, storage and yield. Design of wells, specify pumps and drilling methods. Define monitoring system.	Further refinement of 2 if necessary to resolve any pending issues Establish groundwater monitoring programme.

Subject / phase	1. Identification	2. Feasibility study	3. Loan effectiveness
3. Topography of Sites of Major Structures and Scheme Area	Obtain satellite imagery at 1:100,000 for catchment area and at 1:50,000 of command area for reconnaissance. Mapping of catchment and command areas at 1:50,000 with 10 m contour interval, or better. Air-photo mosaics of sites of major structures and main canal alignments, at a scale of 1:10,000. Better still, orthophoto or line mapping at this scale with 2 m contour interval. Rehabilitation projects: initial topo maps.	Mapping scale 1:10,000 with 1 m contour interval, or better for command area. 1:2,500 scale mapping<with 1 m contour interval or better for main canals and major structures and for designing in-field layout and land levelling requirements Maps of larger scale for selected structure sites (weirs, pumping station, etc)	Further surveys for detailed design and construction.

Subject / phase	1. Identification	2. Feasibility study	3. Loan effectiveness
4. Land Capability for Irrigation	**New projects, review of :** LANDSAT/SPOT imagery at 1:100,000 or larger; air photography at 1:50,000 or larger; geological and soil maps at 1:250,000 or better; and land use maps at 1:50,000 or better. Reports and maps of soil survey from research institutions, universities, consultants, Interpretation of available air photographs at 1:25,000 or better. Reconnaissance soil survey at observation density of 1 sample per 100-200 ha plus sampling and testing for physical and chemical properties; 10% of observations consisting of deep pitting to check drainage. **Rehabilitation projects:** Review documents on initial land capability assessment. Define TOR for complementary surveys if necessary.	**New projects** Soil survey with observation in representative areas of 1 observation per 10 ha average, to delimit soil type boundaries and investigate any drainage problem. Define crop-specific land utilization types. Consider erosion hazard, fertility, toxicity and drainage. **For rehabilitation projects** Assess soil constraints for the past and current irrigated cropping patterns Carry-out complementary surveys if necessary.	Establish monitoring system for potential water logging and salinity build-up.

Subject / phase	1. Identification	2. Feasibility study	3. Loan effectiveness
5. Geotechnical aspects for major structures	**New projects** From a review of available air photography and geological and topo maps, assess areas suitable for dams, canals, structures. Carry out field visits to selected sites. Field classification of geological formations and soil types. Decide on requirements for geotechnical investigations for dams, other structures and canals, and prepare programme for 2. **Rehabilitation projects** Same as above for any new major structures to be constructed. Identification of possible needs for lining canals if excessive seepage is observed by the team or reported by farmers or irrigation staff during field visits.	**New projects** Drilling, pitting for dams, other structures and main canals. Confirm availability of borrow material, concrete aggregates etc. **Rehabilitation projects** Same as above for any new major structures to be constructed. Confirm needs for lining canals or particular section of canals.	Further investigations if required during detailed engineering design.

Subject / phase	1. Identification	2. Feasibility study	3. Loan effectiveness
6. Civil and Irrigation Engineering	**New projects** Outline main water sources and irrigable land. Define areas of swamp or seasonal inundation (with support from available topo maps). Prepare preliminary estimates of irrigation water requirements for possible typical cropping patterns. Link present or potential irrigation demands with possible water sources. Hence identify possible schemes for irrigation, drainage, or flood control. Prepare outline designs. **Rehabilitation projects:** Compare current water availability and as per design and estimate impacts of water development which occurred since the construction of the project. Preliminary diagnosis of the condition of existing irrigation and drainage facilities and efficiency of water use. Outlines of improvement to be made to the existing irrigation and drainage facilities	**New projects** Refine estimates of project water requirements for the preferred option and likely cropping pattern. Carry out operational/simulation studies to optimise dam/reservoir/ scheme area. Prepare feasibility level design of the system and construction drawings to the level of detail that ensures that no significant changes will be necessary later. **Rehabilitation projects:** In-depth diagnosis of the condition of existing irrigation and drainage facilities and water use efficiency. Prepare feasibility level design of improvement to the system with a view to facilitate operation and maintenance by users.	Detailed designs and construction drawings, Bills of quantities, Specifications and tender documents, Operational plans for framers participation to construction. Arrange for tendering of works if funding has been approved.

Subject / phase	1. Identification	2. Feasibility study	3. Loan effectiveness
7. Infrastructure costs	Preliminary cost estimates (including O&M) for engineering works, on-farm development and land acquisition.	Refine quantities and cost estimates, accurate to say 15%. Tabulate foreign/local costs and programme of expenditure for engineering works, land development, land acquisition, compensation for loss of land and assets. Identify scope for and nature of farmers' contribution to infrastructure costs.	Refine quantities and costs in the light of further investigations and designs, with schedule of disbursements. Arrange for farmers' contribution to be made.

Subject / phase	1. Identification	2. Feasibility study	3. Loan effectiveness
8. Agricultural Development and Marketing	Review of general policies for irrigated crops and rain-fed crops, food versus industrial crops and horticultural crops Make general assumptions on crop yields, cropping intensity. List local crops. Note development constraints (lack of water, seeds, O&M, extension, research, finance, markets etc.). Preliminary recommendations on strategy for irrigated agricultural development: cropping patterns, cropping intensity, needs for extension and other services. Design Agro-Socio-Economic Study. **Rehabilitation projects** Preliminary diagnosis of the productivity for the existing cropping patterns Define TOR for in-depth diagnosis of the agricultural production system	Carry out Agro-Socio-economic study and prepare recommendations on cropping patterns, estimates of yields with and without project. Jointly with engineering/hydrology study, refine estimates of crop water requirements. Make recommendations on marketing, storage, credit and technical support and cost estimates Rehabilitation projects In-depth diagnosis of the agricultural production system: • Past and present cropping patterns and yields and current trends; • The reasons for any decline in areas planted or yields obtained; • Any conflicts or competing demands for labour; • Problems and constraints from the farmers' perspective. Make recommendations based on the diagnosis	Refine recommendations in 2. Refine quantities and costs for agricultural development in the light of final planning of component, with schedule of disbursements. Prepare tender documents for plant and equipment (including marketing plant and equipment) storage facilities etc. Arrange for tendering for supply of plant and equipment, storage facilities etc. if funding has been approved.

Subject / phase	1. Identification	2. Feasibility study	3. Loan effectiveness
9. Incremental Agricultural Production Benefits	Preliminary estimates of incremental benefits from new irrigation development or from rehabilitation /modernization, on the basis of representative models for the typical crops and cropping patterns.	From Agro-socio-economic Study, refine crop selection, cropping patterns, crop and farm models. Estimate incremental benefits per household / farm and at project level. Assess constraints (credit, labour, extension service, etc) to intensified crop production.	Further refinement if necessary or if additional data become available. Develop proposals for treatment of related constraints.

Subject / phase	1. Identification	2. Feasibility study	3. Loan effectiveness
10. Transfer of Agricultural Production Technology	Identify institutions currently involved in research or extension related to irrigated agriculture (public, private sector, farmers' organisations, NGOs,). Assess the relevance of their present organisation, programmes and field deployment to supporting the irrigation project alternatives under consideration. Make preliminary classification of strengths and weaknesses. Review options for improving relevance or impact of their work.	Define institutional responsibilities for agricultural research and extension. Plan means to link their activities, and to ensure adequate participation of irrigators to ensure client-oriented approach. Define field approach of services, extra resources needed for them to operate as defined, and estimate costs. Define monitoring and evaluation system.	Fine-tune cost estimates. Prepare tender documents for key items. Initiate recruitment of extra staff and/or pre-implementation training for new roles. Organise pre-project seminars for existing field-level extension and research staff. Complete recruitment and first round of training. Initiate monitoring and evaluation. Maintain training.

Subject / phase	1. Identification	2. Feasibility study	3. Loan effectiveness
11. Participation and Water Users Associations	**New projects** Involvement of stakeholders in the identification process and comparison of projects and options through interviews or workshops. **Rehabilitation projects** Preliminary assessment of the achievements and challenge ahead of the existing WUAS through interviews of their committee members with a particular focus on O&M.	**New projects** Consultations with farmers during Agro-Socio-economic study. Establish demand for project preferably by example (eg traditional irrigation, past contribution to community school or clinic construction). Assess need for/feasibility/prospects for success of WUA. Consultation with farmers with regard to scope and layout of scheme. **Rehabilitation projects** Consultation with farmers during the diagnosis of agricultural production system Diagnosis of the performance of existing WUAs in terms of: Objectives and functions Internal structure (organization chart) Capacities Rules (by-laws) and conflict resolution Resource mobilization for O&M (level of cost recovery) Relations and contract agreements with external stakeholders (irrigation agency, contractors, government support services, etc.)	Finalisation of project planning with all stakeholders, from farmers' representatives to financing institution at concluding workshop. If necessary, assist farmers with electoral formalities for WUA committee and drafting constitution. Prepare farmers for making contribution to capital costs in cash or labour. Obtain written commitment to provide construction labour and to accept O&M responsibility.

Subject / phase	1. Identification	2. Feasibility study	3. Loan effectiveness
12. Environmental Impact	**New projects** Initial environmental and social evaluation (IESE) using appropriate available checklist to assess the need for environmental impact assessment (EISA). **Rehabilitation projects** Identify existing major negative environmental or social impacts	**New projects** If recommended by the IESE, carry out EISA, including if required Land Acquisition Assessment, and prepare any necessary Environmental Action Plans and Resettlement Action Plans. Otherwise prepare mitigation plan. Modify project planning necessary to accommodate recommendations. **Rehabilitation projects** In-depth analysis of causes and consequences of major negative environmental and social impacts Prepare any action plans to mitigate or remedy negative impacts.	Refine actions plans in the light of further information collected or received. Specify indicators, organisation and responsibilities for environmental monitoring. Enact any necessary legislation for plan implementation Establish environment monitoring system.

Subject / phase	1. Identification	2. Feasibility study	3. Loan effectiveness
13. Institutions, Management, Cost Recovery, Operation and Maintenance.	Initial institutional evaluation (IIE). Describe institutional framework for irrigation management. Preliminary assessment of institutional strengths and weaknesses (ability, capacity and funding). Decide on needs for institutional capacity assessment (ICA).	Carry assessment of concerned departments/private sector organisations, their staffing and capacity, morale, internal culture and performance. Match project design to capacity to implement, allowing for proposed strengthening or adjustments. Prepare proposals for institutional development/strengthening and training needs, and Public-Private Partnerships. Make recommendations for irrigation management, including formation of WUAs if appropriate. Specify arrangements for assessment and collection of water charges. Specify arrangements for O&M. **Additional for Rehabilitation projects** Prepare action plan for increasing effectiveness of the existing WUAs based on the diagnosis (see 11)	Finalise arrangements or any organisation initiatives and institutional reforms. Enact any necessary legislation to enable changes to be implemented, including legal establishment of WUAs. Plan any pre-implementation Training or seminars. Implement any organisational changes necessary; Establish project entity if necessary. Appoint key project staff. Set up accounts and procurement arrangements. Arrange bidding and contracts With consultants if required. Implement training and start-up workshops.

Subject / phase	1. Identification	2. Feasibility study	3. Loan effectiveness
14. Economic Analysis	Ranking of projects according to agreed multi-criteria analysis using data from rapid assessments.	Estimation of economic and financial returns. Risk and sensitivity analysis. Effect on balance of payments and government budget. Impact on income distribution and poverty alleviation. Cost recovery implications (estimates of water charges)	Finalise financial requirements, loan details and disbursement schedule.

Bibliography

1 Ethiopian Water Resources Management Policy (Ministry of Water Resources, 2001)

2 Ethiopian Water Sector Strategy (Ministry of Water Resources, 2001)

3 Sudan Country Policy on Integrated Water Resources Management (Ministry of Irrigation and Water Resources, 2007)

4 Sudan Country Strategy on Integrated Water Resources Management (Ministry of Irrigation and Water Resources, 2007)

5 Ethiopia Plan for Accelerated Sustainable Development and Eradication of Poverty (Ministry of Finance and Economic Development – MoFED)

6 English summary of the National Water Resources Plan for Egypt – 2017 (The Arab Republic of Egypt, Ministry of Water Resources and Irrigation 2006)

7 Demand for products of irrigated agriculture in Sub-Saharan Africa (FAO Water report N° 31, 2006)

8 Costs and performance of irrigation projects: A comparison between Sub-Saharan Africa and other developing regions (IWMI research report N° 109, 2007)

9 Reengaging in Agricultural Water Management: Challenges and Options (The World Bank, 2006)

10 Eastern Nile Irrigation and Drainage Study / Component 1 / Analysis report. (ENTRO, 2009)

11 The World Bank and Irrigation. (the World Bank, 1995).

Annex A: Outlines of a typical feasibility Report.

SUMMARY AND CONCLUSIONS

The main report should be preceded by a summary which briefly describes:

- The proposed project, its location, size and main components;
- The reasons for its selection, and its relation to government policies
- and plans;
- Estimated costs and disbursement period;
- The proposed organisation for implementation and subsequent O&M,
- and the implications for existing institutions;
- The people who will benefit from the project and the expected impact on their
- incomes;
- The arrangements for fiscal sustainability;
- Any adverse social and environmental impacts;
- The expected economic results;
- The main issues to be resolved before appraisal;
- The implementation plan.

The summary should normally cover topics in the order in which they are treated in the main text of the document, with one paragraph for each chapter of the main text. The summary can usually only be written after the main report has been completed. It should not exceed four pages.

INTRODUCTION

This chapter is administrative and should state the purpose of the report and to whom it is addressed. It should indicate how, when and by whom (i.e. government Irrigation Planning and coordination Team, consulting firms, Ministry of finance, Funding agency) the project has been prepared. It should also state the origin of the project, i.e. whether in a national development plan, from sector strategy formulation, basin development plan or from previous examinations.

Chapter 1: BACKGROUND

The background should refer to other published reports (such as : General Policy for economic Development and Poverty alleviation; National Irrigation Policy and Strategy). A well thought out and presented background chapter is essential to establish the framework for the project rationale and the planning considerations described in later chapters. It usually includes the following:

A. THE ECONOMY

This should describe the contribution of agriculture and irrigated agriculture to GDP and employment, national dependence on particular imports (or food aid) and exports, balance of payment considerations, inflation, public investment programme, adequacy of revenue to meet recurrent funding requirements, and other features of economic development that have a bearing on the project. Recent changes and trends should be highlighted.

B. THE AGRICULTURAL SECTOR

The main characteristics of the sector should be summarised, including brief references to main forms of land use, farm size and land tenure, dominant farming systems, production, input availability and utilization, and constraints to overall development (for instance rainfall volatility, climate change). Present and future estimates of supply and demand for specific commodities should also be briefly mentioned. Specific treatment of market prospects is desirable where these might have an important bearing on project planning, for example on the scale of irrigation development.

C. THE IRRIGATION SECTOR

This should briefly describe the location, extent and nature of existing irrigation and drainage, its historical development, organisation and management, past and present performance in terms of command area developed, area utilised, cropping intensities and patterns, and average yields achieved.

From water resources investigations and water resources management strategies already defined, water use for irrigation should be placed in the context of the country's overall water availability and use, as well as that for the basin in which it will be situated. The scope for further irrigation development should then be described, taking account of competing demands. If the project is a part of an overall river basin plan, that plan should be explained. Other on-going irrigation developments, or those in the pipeline, should also be noted.

The social and environmental impacts of previous irrigation projects, including resettlement, health, erosion and sedimentation, water logging, salinization, pollution or depletion of surface or groundwater supplies, and measures taken to mitigate them should also be briefly referred to. The lessons learned should be highlighted. Similarly, any other problems which have a direct bearing on the project should also be highlighted, such as cost recovery and O&M or water rights agreements for international rivers.

D. INCOME DISTRIBUTION AND POVERTY

These topics should be given special mention when the project is intended to benefit a particular target group of the rural poor, and should discuss related indicators (eg access to land, water or services, nutrition, health etc.), and the factors contributing to differentiation that might have affected the decision to select the particular project or region.

E. GOVERNMENT POLICIES AND PLANS IN THE IRRIGATION SECTOR

Based on the irrigation sector review and strategy paper, government priorities and plans should be reviewed in terms of what government sees as the main national aims and benefits of irrigation - whether these be food self-sufficiency, export earnings, employment creation, income distribution, poverty alleviation or some other. The sector objectives for food crops, industrial crops (cotton, sugar cane, oil crops, other) export crops, social equity, targets for rural income, nutritional goals and so on may be mentioned.

In particular, government policy regarding water pricing and cost recovery, in what form (i.e. direct water charges, land taxes, agricultural product taxes, others) and how effectively this is implemented, should be reviewed, as should the appropriateness of the environment conservation policy.

F. EXPERIENCE OF PREVIOUS SIMILAR PROJECTS

This should summarise the experience of previous similar projects and the lessons learned. It should give details of the number and cost of projects, their completion dates and achievements in terms of new or rehabilitated hectares irrigated and numbers of users. It should also describe any problems or difficulties encountered, such as local funding constraints, lengthy procurement procedures, poor performance of contractors, poor planning, poor O&M and so on. The lessons of experience that need to be taken account of in planning future investments should be listed.

Chapter 2.A: Presentation of The (Name) Irrigation Project

This chapter will only be required for project investment in new irrigation or drainage. A suggested alternative Chapter 2.B for project-specific investment in rehabilitation is given (see Chapter 2.B below).

Together with its supporting annexes and maps, chapter 3 should describe the features of the project area that have implications for the planning of the proposed investment. It should evaluate the development opportunities and potential as well as the limitations, focusing throughout on the investment which is being proposed. It is likely to contain the sections described below.

A. Location and Natural Resources

This section should summarise the location of the project area and its land and water resources, highlighting any physical constraints that would have to be overcome (eg soil erosion and reservoir/canal sedimentation, poor drainage). The reliability of data (i.e. scale of soil surveys, length of rainfall and river flow records) should be assessed and the need for any further data collection (for additional surveys, tests or hydrological observations) before construction should be mentioned. Detailed technical data should be consigned to annexes. Topics to be covered should include the following

Location

The location of the project in relation to important features (the capital, provincial/ regional state capital, administrative boundaries, major rivers, and transport connections to main markets). The project area might be a province/state, watershed, the command area of a dam, or a combination of these. The relevant features should be shown on maps.

Geology, Soils and Land Capability for Irrigation.

Land in the project area should be described with reference to topographic, geological, soil or land classification surveys and maps. Limiting factors should be highlighted. The degree of detail required in land evaluation surveys will vary between projects depending on the characteristics (soil variability, salinity problems, etc.) of the project lands. Guidelines are available in the FAO bulletin N°55: "*Land Evaluation for Irrigated Agriculture*". The use of remote sensing methods and geographic information systems to evaluate the resource base, monitor trends (for example in the irrigated/cropped area over a number of years) and to produce maps can also be considered.

Climate.

The purpose here is not to describe the climate in detail but to demonstrate its influence on and importance to the project concept. It should deal with the main climatic features affecting irrigation requirements and system design: ie rainfall (monthly, annual and its probability) temperature as well as reference evapotranspiration. Data should be summarised in tables, with detailed analysis consigned to an annex. This section should summarise the agronomic justification for irrigated, as opposed to rain-fed, cropping. Any serious climatic hazards (flood and drought) should be noted.

Water resources.

Surface and underground water resources should be described, with reference to hydrological data, geophysical studies and simulation models. Reliable long term hydrological records normally will be required if the project involves surface water diversion or storage, and these should annexed. Where hydrological records are inadequate, it may be possible to carry out a correlation of rainfall with run-off to extend or in-fill the record, by employing proprietary hydrological models. In justifying minor works a synthesis of rainfall, catchment area and assumed run-off coefficients may be acceptable.

Evidence on the nature, recharge and sustainable yield of aquifers will be necessary if groundwater development is envisaged.

Water quality should be examined and any aspects that could limit its use for irrigation should be highlighted. Water resources should be dealt with on a region or basin-wide basis, to demonstrate the context of the existing scheme. The present utilisation and future demand for surface and underground water, and the prospects for other developments within the same catchment that could affect water availability for the project, should also be discussed.

B. THE ECONOMY AND PEOPLE

The Local Economy.

What can be achieved by a project is strongly influenced by the immediate local environment in which it is set. A brief overview of the economy of the project area should be presented, focusing on the importance of agriculture relative to other activities. The emphasis should be on those aspects that would influence the planning of the project: for example urban population and income growth expectations, their impact on demand for basic foods or horticultural crops, the effects of growth in the industrial sector on the demand for labour and the extent to which this affects labour availability and wage rates in rural areas, or the emergence of competing demands for water for urban and industrial uses that could reduce availability for irrigation.

The People.

The people of the project area should be described and their expected reaction to the project should be assessed. The description of the socio-economic situation should give special attention to those aspects that could affect the rate at which the target population for the project will accept changes.

The report should provide information on the number of people in the project area, their types of settlement, ethnic origin and their occupations. An explanation should be given of the way in which resources are at present managed in the project area, distinguishing between the roles of the household, different ethnic groups and the community as a whole.
Intra-household dynamics should be discussed in detail, particularly gender relations as they influence labour division, access and control over land, labour and capital, control of crops and income from their sale, and the responsibilities of husband and wife as family providers.

The household economy – alternative sources of income from off-farm activities, on-farm production, time available for crop and livestock production and other activities - should be described. Any conflicting or competing demands for labour should also be identified.

The relative power of different groups and the extent of influence on individual behaviour and resource management exercised by traditional leaders should be examined. Special mention should be made of any cultural or political factors which could impede the acceptability of the project proposals.

Particular attention should be given to identifying any people whose way of life could be disturbed by the proposed project, particularly those who could be displaced, for example families in areas to be flooded by the construction of a dam.

For projects aiming deliberately at reducing poverty, targeting usually receives special importance and a separate chapter on the **target group** justifying their selection will be necessary. Special emphasis should be given to analysing income and wealth distribution and to explaining the causes of differentiation.

Factors that might affect the community's response to the project or the strategy to be adopted should also be reviewed. These might include nutritional standards and food security, land tenure and the availability of labour during the various seasons of the year. In particular, any experience of cooperative activities within the area (eg for marketing and input supply, traditional irrigation system O&M), that might have a bearing on the potential for future cooperation in scheme organisation and management and O&M, should be rigorously analysed.

The agro-socio-economic studies that may have been conducted in the project area, their findings on people's development priorities, especially the extent of farmers' interest in the project, should be summarised, and conclusions drawn on their implications for project planning. The full findings of the studies may be presented in an annex.

C. Existing Agriculture, Land Use and Land Tenure

Land Use and Farming Systems.

This section should describe present land use, farm size, farming systems and practices, crop varieties, yields and use of inputs, as well as the extent, methods, performance and state of maintenance of any existing irrigation schemes. The existence of irrigated research stations and demonstration centres in the area should be mentioned, and their programmes and results summarised.

The performance of farmers in development schemes similar to those proposed should be described, as an indication of potential yields and production under the project. Any spontaneous development of irrigation or other local initiatives that indicate the potential for farmers' commitment to a possible new irrigation development should be assessed. Much of the above information could come from a Agro-Socio-Economic Study, if this has been carried out as part of the planning process.

Sustainability of Land Use.

This should focus on the sustainability of land use in the project area. It should point to any particular areas of environmental concern, such as water logging and salinity problems in irrigated areas, land fertility losses in rain-fed areas, erosion and sedimentation, groundwater depletion, and so on. Areas affected should if possible be quantified, the economic and social cost assessed (if this is feasible) and trends identified.

Of particular importance is the identification of the underlying causes of any degradation, such as population growth, climate change, current farming practices, excessive ground or surface water abstraction, pollution, land tenure arrangements, or inadequate extension services. Competition for natural resources, for instance between irrigators and pastoralists, or between irrigators and urban users, should be noted and the effectiveness of any existing regulatory measures discussed.

Land Tenure.

The formal rules and local customs for land tenure should be described. The size and distribution of properties and farms, degrees of fragmentation, proportion of owner and tenant-operated farms, type of tenure, etc. should be summarised. The basis for, and reliability of the figures should be given with reference to cadastral surveys and maps. Dynamic factors in the situation (trends in tenure arrangements, increasing fragmentation, consolidation, etc.) should be described. The situation should be evaluated in terms of development opportunities and obstacles (i.e. would land rights redistribution or consolidation be necessary and feasible?).

D. Rural Institutions, Support Services and Infrastructure

Input Supply, Marketing and Processing.

Attention should be given to the arrangements and their effectiveness, as perceived by farmers, for Inputs supply and marketing farm produces. Any particular impact of government agricultural policies (price supports, subsidies on inputs, taxes on products, etc.) in the project area should also be described and evaluated. Note should be made of the adequacy of distribution and storage facilities, as well as of the presence, capacity and current utilisation of agro-industries. The respective roles of the public and private sectors in input supply and marketing should be examined.

Infrastructure.

The extent and state of communications infrastructure (roads, railways, airports), and their impact on the accessibility of the project area should be examined, particularly from the viewpoint of their relevance to the supply of farm inputs and the marketing of output. Availability of electricity (especially for powering pumps) should be noted.

Administration, Support Services and Farmers' Organisations.

This should briefly describe and evaluate the local activities of extension, research and credit services, the system of local government administration, and special institutions (such as NGOs) operating in the project area, to the extent that these are relevant to the project. Special attention should be given to evaluating farmers' organisations, including WUAs, savings and credit organizations, marketing and supply cooperatives and/or local systems of village administration, customary or otherwise, that could form the basis of future WUAs. Any other initiatives towards communities' management of their own affairs and resources should also be mentioned. Successes and failures, and the lessons learned, should be highlighted.

Alternative Chapter 2.B for rehabilitation project The (Name) Irrigation Scheme: PRESENT STATUS

The following describes the typical contents of an alternative to Chapter 3 A above, to cater for an investment in the rehabilitation or modernization of an existing scheme. The chapter should be a diagnosis. It should for example explain the reasons for water shortages or poor O&M, rather than simply stating that these problems exist, and thereby point the reader towards possible solutions to be taken up in the planning of the investment.

A. Location and Natural Resources

This section should be similar in content to that in Chapter 2.A above, except that if the existing scheme has resulted in any significant adverse environmental impacts, these should be described under a separate heading later in this chapter. Water resources should be dealt with on a region or basin-wide basis, to demonstrate the context of the existing scheme.

B. Description of Existing Facilities

This should summarise the development history of the existing system (when and by whom planned, constructed, operated and maintained), and compare its original objectives with reality in terms of:

- Command area as per design and actual;
- Settlement patterns and numbers of beneficiaries as per design and actual;
- Cropping patterns and market outlets as per design and actual
- Land tenure arrangements as per design (of formal legislation) and actual

A brief technical description of the existing water supply, conveyance and distribution facilities should be given, supported by maps and figures, together with a description of the on-farm irrigation technology.

C. The Economy and People

This should be similar to the corresponding section in Chapter 3 above, except that the description of the people should, if appropriate, distinguish between those people of the project area who are involved in irrigation on the areas to be rehabilitated and those who are not.

The analysis will in some cases be based on a diagnosis of the existing situation carried out as part of an Agro-Socio-Economic Study. This may have included an examination of the impact of the project on the local economy, on household incomes, intra-household dynamics (gender relations, gender labour division, access and control over land, labour and capital, control of crops and income from their sale), health and nutrition, farmers' aspirations and felt needs, especially the extent of farmer interest in the project and implications for project planning. Group activities for O&M should be dealt with in a later subchapter, but any experience that is relevant to farmers' participation in the scheme, now or for the proposed rehabilitation, should be highlighted.

D. Rural Services, Infrastructure and Farmers' Organisations

This should contain much of the information listed in the corresponding section in Chapter 3 above.

E. Present Irrigated Agricultural Production

This will be one of the most important parts of a project document for a rehabilitation or modernization proposal, since it should review the present agricultural performance of the scheme. It should preferably be based on detailed diagnosis from an Agro-Socio Economic study, if resources have allowed the latter to be performed. It should cover:
On-farm irrigation practices, compared with the original project concept, and an explanation for any differences;

- Past and present cropping patterns and yields and current trends;
- The reasons for any decline in areas planted or yields obtained;
- Any conflicts or competing demands for labour;
- Problems and constraints from the farmers' perspective.

F. Present Condition of Irrigation Facilities

This section will also be important. Depending on the scale of the project and the extent of operational data available, it should summarise the results of detailed surveys and diagnostic operational studies that have been carried out on the existing system. It should examine water availability and demand for the originally intended cropping pattern and the present use of the irrigation water. The efficiency of water use and the condition and design of the existing facilities should be described with a view to demonstrating the scope and opportunities for improvements through rehabilitation and modernization. These should, in particular, focus on measures that facilitate O&M by farmers and achieve more efficient and equitable water distribution and use.

G. Present Arrangements for O&M and Cost Recovery

The present arrangements for O&M and cost recovery should be described and their effectiveness assessed. Causes of decline in the operational condition of the scheme should be analyzed; and practical recommendations given for making O&M self financing.

H. Environmental Impact of the Existing Scheme

Significant adverse impacts as a result of the scheme should be summarised, as derived from the environmental impact assessment of the scheme.

Chapter 3: Existing Institutions and Project Implementation Capacity

This chapter should highlight any institutional gaps or shortcomings that may form a constraint to implementation. It should lead the reader to conclusions on what must be taken into consideration in the project planning. Relevant institutions are likely to include:

- Central government institutions;
- Local government institutions;
- Private sector organisations and NGOs;
- Farmers organisations

And for rehabilitation projects

- Water users Associations
- Irrigation management entities in charge of major infrastructures on large schemes

An institutional capacity analysis, carried out earlier in the planning process and detailed in an attached annex or working paper, should have established:

- The goals and objectives of the institutions concerned, whether they are still valid or whether there is a need for redefinition (i.e. new legislation) or reorientation, taking account of the requirements of the project.
- The internal structure (organization chart)
- The capacities of the concerned institutions, in terms of staff, physical facilities and budget, and whether there are areas of weakness, imbalances and inconsistencies.
- The financial sustainability
- Rules and regulations (or by-laws) governing the operation of the concerned institutions
- The nature of relationships or contract agreements between a particular institution and other institutions involved in the irrigation
- The performance of the institutions in fulfilling their objectives in a timely and efficient manner, and whether there are any significant operational problems, for example delays in decision-making, late release of funds, problems over procurement of goods, and so on.

The analysis should in particular have resulted in an assessment of the capacity of the institutions concerned to implement the proposed project. As a result it should have led to recommendations to achieve sustainable improvements in existing capacity that will enable the institutions concerned to successfully implement, operate and maintain the project. The analysis may also have resulted in conclusions that affected the choice of project concept or scale, and planning the proposed investment. This should therefore lead into the project rationale and design considerations covered in the next Chapter, and the proposals for project organisation and management, cost recovery, O&M and institutional capacity building which follow in Chapter 5.

Chapter 4: Project Rationale and Panning Considerations

This chapter leads to the point at which the overall needs, justification and feasibility of the project proposals that are to be made can be appreciated. It is the part of the project document which is most likely to repeat arguments developed first when the project was being identified, but modified and deepened to reflect the findings of further thinking or studies. It may briefly refer to options that were discarded or adjusted at earlier stages, but should then explain the reasons why the particular project concept which is now being brought forward for financing was chosen. Based on the information already given in the background sections of the report, its purpose is to complete the explanation of why an irrigation or drainage investment is needed, define its overall objectives, and indicate what kind and scale of project would be best suited to the existing circumstances. However it is not the purpose of this chapter to present the actual project proposals: that function is left to Chapter 6, and anticipation at this point should be avoided.

A. Project Rationale

This section should discuss the objectives of government's strategy for the irrigation sector, the criteria which have led to the selection of the type (i.e. Sector wide Project, new irrigation, rehabilitation, drainage), the location of the project, and the constraints imposed by existing institutional capacity and cost recovery arrangements. It may also explain how the proposed project meets the financing criteria of the particular financing institution or the government.

B. Planning Considerations

Once the conceptual case for a project has been made under the section on project rationale, attention needs to be directed to defining the specific form and to explaining this to the reader. As indicated in the guidelines, the process of irrigation project planning usually involves the establishment of broad objectives (irrigation policy), an identification and comparison of the options for achieving these objectives and an assessment of the preferred options. This leads to decisions on the strategy which, as a consequence, should be built into the project. This section on design considerations is the place to present the results of that process, focusing on the considerations which have led the concept outlined in the rationale to evolve into the project and its main components in their final proposed form. In particular, it should address questions such as:

Selection of the target population for the project and any special targeting measures required to ensure that the project really does benefit these people (the complex issue of how to prevent project resources bringing undue benefits to persons outside the target group, but without whose influence the project might nevertheless not succeed, needs special treatment);

- The **demand** for the project, expressed in terms of demonstrable willingness of the potential users to commit themselves to contributing towards the capital cost and acceptance of responsibility for O&M, and in terms of markets for irrigated crops of sufficient value to justify the investment costs incurred by government and farmers;

- The **commitment** and **capacity** of government to implement the project;

- **The justification for a Sector Wide Approach**, where the aim is building demand for project components investments and to encourage participation in planning, design, construction and O&M; the appropriate scale for the project: this should give special importance to an analysis of the scale and success of any precedents, to assessments of institutional capabilities and to matching the project scale with these; it should also examine the implications on project size of market possibilities, economic and financial viability, environmental concerns and risk exposure;

- The scope for achieving efficiency gains at low incremental cost by rehabilitating and upgrading existing irrigation systems, including traditional irrigation systems;

- **The choice of technology to match O&M capacity** (i.e. upstream versus downstream control, automation etc.) and/or traditional water rights and methods of distribution (i.e. division structures that maintain traditional rights and farmers' operational preferences);

- **The selection of organisational arrangements** for the project: for example whether to reinforce the existing entity to run the project, to create a new organisation or to privatise it; the strategy for eliciting and sustaining the commitment of the intended beneficiaries to the project, particularly the means of securing their effective participation in project management and costs through WUAs and/or apex organisations; whether WUAs should be built on existing structures, traditional or other;

- **The appropriate time frame** for the project and phasing within this; and

- **The need for any ancillary adjustments in laws**, regulatory mechanisms, policies and institutions.

- This is also the place to mention to **the need to build flexibility into the project**, to accommodate capacity-building measures, and to say how this could be done in ways which are consistent with the funding practices of the financing agency. There is often little scope for flexibility in "hardware" projects which focus on the construction of major civil works; but there are many advantages in planning "software" projects - for demand driven development - so that these can readily respond to new information or opportunities that arise in the course of implementation. Where flexibility is being sought, a very important element of the section on planning considerations should be a discussion of the possible mechanisms to be used to provide it and of the safeguards to prevent its abuse. If flexibility is to be attained, as is often the case, by the creation of a Development Fund, the technical and economic criteria to be used in approving releases for subprojects, and the managerial and supervision arrangements, should be foreshadowed under planning considerations, though dealt with in detail in subsequent sections of the report.

Chapter 5: Project Description

The previous chapters will have set the framework of constraints and opportunities for investment, and so derived a project rationale and objectives, with considerations for planning. This chapter, and its supporting annexes (maps and figures), define the project works and activities, their phasing, costs and how they will be financed. In describing the project it is convenient to distinguish between project objectives and their related components on the one hand, and expenditure categories on the other (see Box A.1).

Box A.1
Project Objectives, Components and Expenditure Categories

A project normally has specific **objectives** that can be expressed in relatively simple terms, such as:

- To develop 80,000 ha of rain-fed farming land for irrigation
- To set up a public irrigation agency for the management of the major irrigation and drainage infrastructures
- To form WUAs in charge of O&M at the tertiary level of the irrigation and drainage system and to train farmers in operation and maintenance of irrigation systems and irrigated crop production;
- To develop irrigated crop production technologies adapted to smallholders

Components, for example could include

- Development of 80,000 Ha of land for irrigation distributed in four irrigation schemes;
- Farm development, including equipment for surface irrigation, small scale farm machinery and seasonal inputs;
- Capacity building of irrigation sector institutions
- Research and extension
- Project management and implementation

Expenditure Categories are used to classify the items against which disbursements will be made under the project. Thus, for each objective or component of a project there are likely to be several categories of expenditure, such as:

- Civil Works (with users' contributions separately shown)
- Equipment
- Technical Assistance
- Training

Each of the above may in turn be broken down into a series of items and ultimately into a set of detailed specifications for goods and services.

A. General Description

This section, which generally should be no longer than one page, presents the reader with a brief overview of the proposed project or programme. It can often be quoted more or less intact in the Summary and Conclusions at the beginning of the Report. The usual content is:

- A brief description of the project or programme's overall and immediate objectives;
- Its location and size (if a project-specific investment);
- A brief summary of each main component;

- Costs and phasing;
- Organisational arrangements for implementation and subsequent O&M.

B. DETAILED FEATURES

The aim of this section is to describe the project in more detail so that the reader acquires a fuller understanding of each of its components and the inter-relationships between them. The nature and scope of project actions should be described in sufficient detail for the general reader to appreciate their relevance and technical soundness, but lengthy descriptions, specifications, engineering design details and cost estimates should remain in annexes or working papers.

The section usually contains a separate résumé for each of the project components, quantifying the main physical items that are proposed for financing, grouped under expenditure categories if appropriate. Although the cost estimates are only presented in detail in Section F of this chapter, it often helps to note in brackets at the start of the component description its total cost and the percentage of project base cost which this represents.

Increasingly, also, financing agencies prefer each component résumé to end with brief reference to the field level implementation arrangements, leaving the description of the broader (not component-specific) institutional arrangements for section C of this chapter.

Component résumés might cover the following:

- Main civil works (dams, major structures, pumping stations, canals, drains, feeder roads, tube-wells, power distribution lines).
- On-farm works (land clearing, levelling, on-farm canals, farm drains, wells and pumps).
- Ancillary works and buildings (offices, workshops, experimental farms, houses for project staff, stores, warehouses, market facilities, packing and processing plants, etc.).
- Provision of equipment for operation and maintenance, (workshop equipment, agricultural machinery for hire, vehicles for extension staff, etc.).
- Farm equipment (the provision of farm facilities, agricultural implements and machinery; livestock and the establishment of perennial crops).
- Measures related to agrarian reform (changes in land tenure or ownership, land settlement and land consolidation).
- Land acquisition, resettlement and rehabilitation.
- Institutional development, for the main implementing institutions as well as for supporting services, such as research, extension and training.
- The credit programme required to enable the private components of the project to be financed.
- The provision of training and external technical assistance (eg consulting firms).

Level of details required

While only a summary description is required of each component in the main text of the report, this must normally be derived from more detailed specifications and estimates given in annexes, working papers or separate studies, to which reference should be made.

Project specific investments may be considered in three broad groups:

Major works, such as dams, main canals, specialised processing plants or main roads. Detailed site investigations are normally required, and at least preliminary designs and specifications should be completed to a sufficient degree of detail to demonstrate that they should not need appreciable alterations at a later design stage, and to permit the significant engineering work quantities to be estimated to an accuracy of some 15% as a basis for cost estimates of the same order of accuracy. All multilateral financing agencies have strict procedures to be followed in engineering studies and designs for major dams and for major resettlement of people displaced by reservoirs or other major works which should always be consulted.

Relatively homogenous repetitive works, such as tertiary and quaternary irrigation channels and drains. For these it is necessary to complete surveys and prepare detailed designs and quantity estimates for representative sample areas, and, in all cases, for the area to be covered in the first year of the project. Total quantities and costs for the whole component can then be derived by extrapolation. On-farm works are usually adequately designed on a "model" farm basis, although in areas of irregular topography it may be necessary to design on the basis on large-scale sample surveys. Typical designs should be prepared for the main farm or land types. Where a significant amount of land levelling is required, detailed sample topographical surveys are needed to calculate quantities. A properly designed land classification can do much to help estimate costs of land clearance, levelling and farm drains.

Minor works, such as small structures, farm access roads, etc., estimates can be derived from standard type designs. In the absence of specific instructions from the government or the financing agency, engineering designs should not proceed beyond the point of completing the work and studies necessary to provide an adequate basis for appraisal. Nevertheless, where the degree of accuracy of the preliminary estimates is difficult to determine because of lack of adequate engineering or survey data, it normally would be necessary to commission detailed engineering studies. This is often the case, for example, for the main canals or storage structures of an irrigation project.

Requirements for credit to farmers for on-farm development, pumps, planting of perennial crops and so on, as well as for subsequent operations should be estimated. These should be in the form of a lending programme with estimates year by year of the numbers of loans to be made to farmers, the size of loan, and the type of loan and purpose. A distinction should be made between long and medium terms credit for investment and seasonal short term credit for inputs.

Seasonal credit requirements per farm should be estimated on the basis of data presented in crop budgets and farm models. Longer term credit needs should be assessed from investment models. In any case provision for credit should take account of the repayment capacity of the farmers and previous response to credit facilities.

C. Project Organisation, Management and Coordination

The entity or entities which will be responsible for the various aspects of project execution should be identified. How they would carry out their responsibilities should be explained. The aim should be to show that they are the most appropriate bodies to assume the particular assignments; that they have the powers, structure, staffing, equipment, finance and motivation to undertake their respective functions; that they are capable of carrying them out effectively; and that there are satisfactory arrangements for coordination between (or within) entities responsible for each of the various project activities. Where deficiencies have been noted during the feasibility study process, the changes and improvements that the project would introduce to overcome them should be stated clearly and prominently. In some cases it may be necessary to consider reductions in project scope to conform to the institutional capacities.

Should any new institution have to be created for the management of the project, it is necessary to give in an annex, details of its proposed legal status, functions and responsibilities, internal organisation, operating procedures, staffing and budget. If the entity is not a government department, particulars should be given of its legal charter (basic law) and direction (Board of Directors; how appointed; extent to which subject to political directives, etc.) and any special provisions concerning its funding.

If there is more than one entity involved in project management (such as a project authority, a government department and a credit institution), arrangements for coordination in such areas as joint representation boards, commissions and committees, and in field activities should be described.

A distinction should be made between policy advisory or coordinating bodies, and those with executive powers. Bodies in the former categories may decide or make recommendations on overall policy, distribute assignments between different participating entities, approve plans, budgets, accounts or reports, authorise major expenditures or contracts, or hire senior staff. Executive bodies, on the other hand, supply the former entities with the basis - usually information - on which to exercise these responsibilities; they then implement the decisions and report back on results. There may be policy advisory and executive bodies at different levels: national, regional and in the field.

D. COST RECOVERY AND O&M

This important section should identify overall institutional responsibility for O&M in the short, medium and longer term. As it is likely that the project will involve devolution of at least some responsibilities for O&M to the users, the extent to which this is expected and over what period of time should be clearly explained with the corresponding well defined targets. Proposals should be made for the formation and capacity building of all institutions involved in O&M: autonomous or semi-autonomous irrigation agencies and WUAs or combinations in joint management. The responsibilities, staffing and annual operating budgets required for each should be defined.

According to intended purpose of the project (large scale commercial farmers or smallholders and cropping patterns), estimates should be presented for water charges for a range of cost recovery scenarios, from full cost recovery of all capital and O&M costs, to O&M plus to the considerations of water pricing for bulk water supply.

Recommendations should then be made for setting an appropriate water charge that is affordable, yet covers the cost of supply to the extent required by policy. Practical procedures for collection of water charges should be described, perhaps involving a pilot scheme initially to test the proposed system. Box A1 gives possible modalities for O&M charges.

Box A1: Types of O&M charges modalities

The following options are possible:

- *Uniform user charge*: users are assumed to have equal access to water and charged evenly. Even if the level of use varies, differences cannot be or are too costly to be assessed.
- *Area based charge*: users are charged according to the irrigated area based on land rights or area actually cropped (declared by the farmer or assessed by the management entity).
- *Area + crop based charge*: the charge is based on area and the type of crop. Differentials may be justified by policy priorities (e.g. cereals for food security) or water consumed by crop or its value. This is the modality used in Sudan public irrigation scheme.
- *Volumetric charge*: water is charged based on actual diversions to a user or a group of user. Metering is necessary but volumes may be represented by time and numbers of irrigation turns, provided discharges are more or less stable and predictable.
- *Quotas at fixed charge*: Water quotas may be uniform (based on area) or vary according to the type of crops. Water charges can be proportional to the nominal volume or vary by crops. This option seems well adapted to Egypt where water allocation will be allocated on a fix amount per feddan basis (=quota).

Each method has its advantages and disadvantages notably with respect to the ease with which charges can be calculated, justified and implemented. Transaction costs associated with charges collection should be carefully assessed when selecting a modality.

E. INSTITUTIONAL CAPACITY BUILDING

This section should present proposals for building capacity to implement the project, in terms of staff recruitment, technical assistance, training, and supply of office and equipment.

As an aid to subsequent supervision and evaluation missions, as well as for good project management, it is essential that the intended use and place of use of equipment be clearly identified. Mechanisms by which government can replace all equipment once its useful life has expired and the project has been completed should be spelled out. The initiation of such mechanisms should if possible be incorporated into the project.

Similarly the intended location of all project staff and the expected duration of their assignments should be clearly indicated. If technical assistance is proposed, draft terms of reference should be given and functions, objectives, measurable performance indicators and reporting arrangements specified. The minimum qualifications for candidates should be defined as precisely as possible. If the technical assistance is not for the completion of a finite task, such as the completion of engineering designs, it should be explained how it would be phased out and how the functions would be subsequently assumed by regular staff.

Training arrangements should be described in detail, giving numbers of trainees, their expected place of training and the duration of training. Clear targets and performance indicators should be set, such as, for instance, numbers of staff to be trained at certificate level in water management, numbers expected to be involved in practising their new skills and their location.

F. PROJECT COSTS

The importance of sound cost estimates cannot be over-emphasised: they provide the basis of determining the project's economic and financial viability and also its funding. Estimates should include all investment costs (hardware and software) and incremental operating costs incurred by government during the disbursement period and for the subsequent operation of the project.

Investment costs

In principle the construction costs estimates should include all incremental goods and services required to complete the planned works. Cost estimates for the main civil engineering works should be based on bills of quantities, derived from preliminary designs and justified unit rates. Costs of major equipment items are normally based on recent quotations from potential suppliers. Costs of on-farm development may be drawn from an aggregation of representative farm models but it should be clearly indicated whether or not these include cash or non-cash contributions (eg in the form of family labour or locally available materials) by farmers.

In addition to the construction costs, project costs generally include:

- **Incremental operating costs:** Recurrent costs over and above the "normal" running costs of the concerned agencies - incurred during the disbursement period specifically for the implementation, management and monitoring of the project.
- **Technical assistance**: Foreign or National, aimed at increasing the capacity of concerned institutions to implement the project. Note that such technical assistance is often treated as a category of software investment related to specific project components such as "project management", rather than as a project component in its own right. This may not be the case however if capacity building becomes one of the major objectives.
- **Training**: aimed at improving staff capabilities; most frequently training is related to meeting the staffing requirements for implementing the project, but usually training aimed at more general institutional strengthening also qualifies for project financing.
- **Engineering costs and fees** that would be incurred during the disbursement period.
- **Working capital**, to cover the projected incremental operating costs required to bring the project to the point at which it reaches steady-state operation. For instance subsidizes to

O&M during the period of time needed for farmers fully adopting improved technology package allowing them to pay for O&M.

- **Land acquisition, resettlement and compensation costs**: where substantial numbers of people are displaced.

Items conventionally excluded from project costs are:

- **Sunk costs**: costs which have been incurred prior to the commencement of a project (eg in constructing a dam prior to an irrigation project) are excluded from project cost estimates, but the amounts already invested should be noted if these are known.
- **Taxes and duties**: duties on imported goods, VAT and other taxes are usually excluded from project cost estimates.
- **Land**: the value of the farm land required for the project is normally excluded from project costs, except in cases where a significant area has to be acquired by government for project implementation purposes (as an example: for construction of main canals in an irrigation system).

The text of the main report conventionally refers to the total costs implied by the project proposal. Up to five summary project cost estimate tables can be included in the main report.

- A project cost summary by project component, expressed in local and/or foreign currency.
- A project cost summary by project component and year of disbursement.
- A project cost summary by expenditure category, expressed in local and / or foreign currency, showing the proportion of total costs attributable to each category.
- A project cost summary by expenditure category classified by year of disbursement.
- A summary breakdown of project costs, classified by component and expenditure category.

An indication should be given as to the accuracy of the cost estimates and how these have been derived. Baseline costs are expressed in market prices in constant terms; if the costs of any payable taxes and duties are included, the value should be clearly identifiable. Estimates should all relate to the same date, which should be specified and is usually around the time of the compilation of the final feasibility study report. Special problems arise when preparing cost estimates for projects in countries which suffer from rapid inflation and regularly devalue their currency. Here it is advisable to "freeze" all unit values in local currency at an indicated date and exchange rate, and from then on quote all values in foreign hard currency equivalents.

Contingencies should be added to the base-line costs at rates specific to each category of expenditure to determine total project costs, as follows:
Physical contingencies are included in the project costs to allow for uncertainties and to compensate for possible inaccuracies in the estimates of work quantities. They should not, however, be treated as a miscellaneous category of costs to cover items either overlooked by the planners. Nor should they be added to give a project greater flexibility. In the latter case, the amounts allocated should be identifiable (i.e. an "unallocated" component). The rate of physical contingencies to apply varies according to the degree of confidence placed in the estimates but, for civil works, commonly lies between 10 and 15 percent by the time the feasibility study report is completed. Under exceptional circumstances it may be greater if local conditions preclude accurate estimates. Assumptions should be explained.

Price contingencies may also be estimated to demonstrate the probable escalating effect of inflation on project costs and hence the magnitude of financing required. Assumptions on price contingency rates should be noted, together with those on the assumed period between the date of the base-line cost estimates and project effectiveness. The staffs of financing agencies or ministry of finance are usually in a position to provide project analysts with forecasts of inflation.

Operation Costs.

For projects that lead to substantial increases in recurrent costs to be borne by government, a table projecting operation costs after the close of the disbursement period should be prepared. The table should show by categories the continued cost of running, maintaining and replacing the assets created by the project, and the cost of operating services at the levels necessary to achieve

project objectives. It may be desirable to comment on the government's capacity to continue to meet the implied financial commitments, and on any steps that would be taken to improve fiscal sustainability, such as increased cost recovery from beneficiaries or privatisation of services.

Annual cost estimates, both for the economic analysis of the project and also for setting water charges, should include *inter alia* the following:

- Salaries of O&M staff.
- Maintenance of buildings, offices, stores and housing.
- Running costs of O&M vehicles and machinery.
- Anticipated costs of special repairs of the above
- Where applicable, running costs and anticipated costs of repairs of pumping plant.

Other annual operation costs may include the incremental annual costs of other public services, for instance extension services.

Maintenance costs should be calculated in detail wherever possible, but estimates of the annual cost based on a percentage of the capital costs are sometimes appropriate. Typical values are given below.

Box A. 3
Annual maintenance cost as percentage of initial capital costs per type of work

Diversion structure/weir	1.5 %
Main canal (unlined)	2.0 %
Main canal (lined)	1.0 %
Pipelines (AC and PVC, underground)	0.5 %
Buildings	1.5 %
Electric powered pumps	3.0 %
Diesel powered pumps	5.0 %
Night storage and buffer reservoir	2.0 %
Piped distribution systems	1.0 %
Portable pipes and sprinklers	6.0 %
Field canals and structures	2.0 %
Drains (sub-surface)	1.5 %
Drains (open)	2.0 %

Chapter 6: Agricultural Production and Results

The purpose of this chapter is to describe the proposed agricultural development under the project, and the expected results. Each of the proposed crop production systems should be briefly described, with particular attention being given to the technological changes which would be introduced by the project, and their impact on input requirements and yields. The proposals should be supported by reference to research data and the actual performance of farmers.

A. Agricultural Production

The chapter usually starts with a review of the cropping patterns it is assumed will be introduced, followed by an assessment, drawing on crop budgets and farm models, of the impact on the output and income of typical farms. It should explain the assumptions made on the rates at which yields and cropping intensities will rise and, derived from these and the models, arrive at estimates of the overall impact of the project on farm development and output.

B. Market Prospects and Prices

The financial attractiveness to farmers of the proposed developments normally depends on the gross margin (the difference between farm gate prices and direct production costs) of the commodities which they intend to produce. This section should review the market prospects for the products on which the viability of the project is most dependent and justify the price assumptions used in financial and economic analyses of the project.

Markets and Marketing.

The report should demonstrate that markets exist or can be opened up (at the financial prices assumed) for the incremental output expected to result from the project. In many cases, as is usually the situation for non-perishable staple foods in food deficit countries, no market problems exist. In such situations there is no need to dwell in the report on market issues. However, where the viability of a project depends on access to export markets or on sales of perishable commodities or of items of particularly high unit value, a careful review of market prospects and of possible means of improving these (for instance by carefully planning planting and harvest dates), is an essential element in project planning. The adequacy of transportation services and roads also needs to be examined. A main purpose of this review is to demonstrate that, in the absence of the project, there would be a shortfall in production vis-à-vis demand at the assumed prices in the target market are competitive in serving the market vis-à-vis other potential suppliers. Growth in domestic demand can be estimated on the basis of projections of population and income, and of assessments of income elasticity of demand. Occasionally, for highly specialised products, some specific market research may have to be carried out as part of the planning process.

Prices.

It is conventional practice to use prevailing, normal input and output prices in the financial evaluation of crop budgets, farm models or agribusiness enterprises. Farm-gate prices for farm-level analysis are usually derived from interviews with farmers and from wholesale and retail market price reports, adjusted for transport costs and traders' margins. The analyst, however, should explain the nature of any key factors affecting price formation, assess the extent to which

the assumed prices are likely to be sustainable and, if there are doubts on this, test the sensitivity of the models to price changes.
It is usual to make projections of prices in constant money terms, eliminating the effects of inflation which are implicitly assumed to affect input and output prices equally. Consequently it is important that all prices and costs refer to the same point in time, which must be clearly stated.
Financial price assumptions for the main inputs and outputs should be summarised in a text table.

C. IMPACT ON INDIVIDUAL FARMERS

This section should show through reference to farm models what would be the expected impact of the project on the income of farmers. Models should be developed for each major type of farm model.

Earlier sections should have indicated the nature of the constraints and needs faced by each type of farm model, the opportunities for increased production, and the technology by which it is intended to open these opportunities to them. The results summarised at this point should focus on the same strategy and opportunities but express the expected results in financial terms, using estimated prices justified in Chapter 9 or an attached table or annex.

Farm models also provide the basis for estimating the likely long and short term credit needs of project participants, and for forecasting their debt service obligations. Particular care needs to be taken by the analyst in estimating seasonal credit requirements and the means by which these can be financed. The cost and return implications derived from the financial analysis of the crop or farm budgets can usefully be summarised in a short text table which may also compare financial return per unit of land, labour, cubic metre of water etc., without and with the project. Financial models should assume constant financial unit costs and prices over the period of analysis, unless there is any special reason to depart from such assumptions - for instance, if the expected output from the project would be big enough to depress product prices.

The basic models that are analysed in annexes and summarised in the main text should aim to represent average situations. In practice however, results are likely to vary significantly from one year to another, often because of variations in rainfall and water availability. It is for this reason that, where available data permit, fluctuations in water supply should be simulated for the period of intended economic analysis, rather than simply assuming that the 80 percent probability of exceeding flows would be available in all years. For such reasons, a series of variants on the basic financial models may need to be run to demonstrate the extent of their sensitivity to risk or changes. The purpose of these variants is to show whether or not the project's technical strategy is robust enough to sustain project beneficiaries through misfortunes such as a series of consecutive years of unfavourable weather.

The results of any financial model must be interpreted with considerable care. The mere calculation of an attractive financial rate of return on investment should not be taken to imply that the proposed technical changes would necessarily capture the interest of all farmers.

For a small-scale farmer the most attractive opportunity may be to earn more per day of family labour, or perhaps to generate more of the family's needs for subsistence food with less risk, so that resources can be freed for more profitable (perhaps off-farm) use. For small farmers, concerns over the risks implied by innovation are particularly likely to affect the response to project opportunities. For the specialist vegetable grower who is restricted to a small irrigated area, yield per hectare may be the most important criterion to examine. On the other hand for large-scale commercial farming, net production cost per ton, a balanced cash flow or the financial return on capital investment may be the critical parameters. The analysis should always be made in those terms which are thought - or ideally have been shown through diagnostic studies - to be those most relevant to the people whom the project is intended to benefit.

D Tests for Sensitivity.

Some simple tests can be made on the financial results of farm models summarised earlier. The overall aim of such tests should be to confirm the plausibility of the planning team's assumptions on technological change, from the farmers' point of view. Tests should therefore be made only on the parameters previously identified as being crucial to the decision-making of the farmers.D. Impact at Project Level
The remainder of this chapter should briefly summarise the aggregate impact of the project over time in generating extra output, increasing demand for items such as seeds, machinery, equipment etc., creating new employment, and raising the demand for credit.

For a new irrigation scheme, where a predictable number of farmers is assumed to move into a formerly virgin project area each year, output and input demand streams should start at zero and can be readily calculated by aggregation of one or more standard models. It is important to avoid over-optimism on the pace of entry. A similar aggregation approach is possible if farmers are already present on the land to be developed but, for example, are expected to change progressively from rain-fed to irrigated production, or if the existing irrigation practices are to be upgraded as rehabilitation works benefit their farms. Clearly the entry pattern must match assumptions elsewhere on the rate at which works would be built and become operational.

The text of this final section of the chapter should indicate briefly the approach to aggregation which has been used. Short text tables should then summarise estimates of total and incremental physical quantities for inputs and outputs, plus their financial values where appropriate.

Chapter 7 : Social and Environmental Implications

As a reflection of the seriousness with which environmental issues are regarded, the environmental impact of the project should be described in a separate chapter, regardless of whether the project is rated as Category A, B or C according to the World Bank or similar classification (see Box 1 in Part 1). Irrigation and drainage projects usually have a substantial effect on the ecology of the area in which they are located, and a forecast should be given in the report of the principal changes expected to take place. This chapter should therefore describe all anticipated adverse environmental impacts for new projects or already existing for rehabilitation projects. Particular care should be taken to identify any effects on downstream users, on ecosystem functions, and on the prevalence of water-borne disease. For groundwater irrigation schemes, the probable effects on the depth and quality of the aquifer should be noted. The above information can be presented using the ICID checklist. All negative impacts identified should be highlighted in the text.

Action plans for mitigation should be briefly described. The costs of such action plans should be presented.

Under social implications, the numbers of beneficiaries and any losers should be indicated, and details given of their "with" and "without" project incomes. Changes in access to productive resources that could have an impact - positive or negative - on the poor should be described. Reference should also be made to expected effects of the project on other factors affecting living standards, especially nutrition, education and the role of women.

Chapter 8: Economic Justification

This chapter is intended to provide decision-makers in the government and potential financing agency with an appreciation of the advantages, disadvantages and risks of embarking on the proposed project, from an economic point of view. Convention requires that considerable weight be given to demonstrating the economic viability of the proposed actions. However economic acceptability alone, as measured by the rate of return on capital employed, is seldom a sufficient justification for going ahead with a project.

This chapter should seek to show that, apart from being economically viable, the proposed irrigation or drainage investments are also justifiable in the broader context of national resource availability, are consistent with the economic priorities of the government concerned and compatible with the funding policies of the intended financing agency. Thus, for example, it is not enough simply to demonstrate that an irrigation project would generate satisfactory economic rate of return if there are, within the same country, opportunities for producing the same level of output at a lower cost from rain-fed farming.

The point must also be emphasised that economic analysis should not be used simply to provide a proof of project viability. Rather it should be used as a tool in the planning process to arrive at the option that is likely to produce the best results from all the choices considered. It should also illuminate the strengths - and reveal any weaknesses - of the project. The use of sensitivity analysis techniques is important in showing the nature and extent of risk to which the project is exposed and to point to possible means for improving robustness.

In writing this chapter it is important to bear in mind that the people who have to take decisions on whether or not to fund the project may not be trained economists or technicians. Care should therefore be taken to avoid jargon and the use of excessively complex analytical techniques which may confuse rather than illuminate the basis for decision making. What is required is a clear and objective appraisal of all the factors that should be taken into account in arriving at well-informed decisions on the future of the project.

A. Economic Costs and Benefits

The project's economic benefits consist of the net incremental value of production attributable to the investments being financed by the project..

The table constructed to calculate the economic rate of return should be given in an annex and should show the forecast streams of incremental costs and benefits, and the resulting incremental net balances, as they accrue each year during the life of the project. Cost streams should include the investment costs of the project (hardware and software) plus the management, operation, and maintenance costs of the project. This should include the costs incurred by the farmers as for example their participation in labour to construction costs. The economic benefits stream should include the value of the incremental output of the project.

B. Risk and Sensitivity Analysis

The report should systematically examine each major potential source of risk to which the project is exposed and explore its possible impact. Risks of an environmental nature however should be described in Chapter 8.

C. Effect on Balance of Payments

To the extent that irrigation development has import substitution or export goals, the chapter should include a review of its impact on the national balance of payments. It is usually sufficient simply to indicate the annual level of net receipts once the project has reached full production, but it should be made clear that the net foreign exchange gains are not an additional benefit over and above those taken into account in the calculation of EIRR or NPV.

D. Impact on Income Distribution and Poverty Alleviation

For projects aimed explicitly at alleviating poverty, the chapter should provide the reader with estimates of the without and with-project income distribution situation and any other indicators of the project's expected impact on rural poverty. These might include changes in access to drinking water, health, nutrition and education. The costs per beneficiary and the expected earnings of the farmers vis-à-vis wages in other sectors would also be relevant measures. If the project is intended to bring special benefits to women, these benefits should also be highlighted, and if possible, quantified. Beyond these specific analyses any more general impacts that the project may have on the poorer members of the rural population should be mentioned.

The above should of course be consistent with statements on the project's overall objectives made earlier under **Project Rationale and Planning Considerations** in Chapter 5.

E. Cost Recovery

This section should explain assumptions on cost recovery rates and mechanisms (contribution of free labour for construction or irrigation water charges) and the extent to which they would at least cover the management, operation and maintenance costs of the project.

Chapter 9: Suggested Conditionality

Increasingly, projects are associated with the introduction of changes in government policies. It is therefore important to explain any changes in policy which the Government is committed to introduce, either before the launching of the project or during its implementation. Policy changes may be aimed at addressing specific problems (identified in the Background and Rationale chapters of the report) which would otherwise prevent the successful operation of the proposed project. In this case the interdependence of the project and the policy adjustments should be made explicit.

Policy changes of direct relevance to irrigation and drainage investments typically concern such issues as:

- Land tenure legislation;
- Cost recovery levels and mechanisms;
- Management and scheme ownership transfer;
- The respective roles of the public and private sector in development or the provision of services;
- Enabling legislation for the formation of water users' associations;
- Setting tariff for provision of water in bulk

For each main policy change of this sort, it is useful to explain:

- The nature of the intended reform and its objectives; the measures through which the policy change would be adopted : in some cases these might simply involve changes in procedures (for example, in approaches to consulting farmers on irrigation system design) while in others changes in legislation may be required; draft legislation, if available, should be annexed to the report;
- The level of present commitment to the proposed change, the intended timetable, and the organisational responsibility for bringing it about;
- Possible side-effects of policy changes (eg. redundancy in state enterprises, the functions of which have been privatised) and measures adopted to mitigate these.

Chapter 10: Implementation

Planning must now be increasingly focused on matching proposals for investment in irrigation and drainage with capacity for implementation. This final chapter should provide a clear statement on how the project can be effectively implemented. It is a crucial part of the investment proposal, and careful thought is required in its drafting.

A. Overall Implementation Schedule

For most irrigation projects there is considerable interdependence between activities and components. The use of formal scheduling tools such as critical path analysis, now facilitated by project management computer software, is recommended for the preparation and monitoring of an overall implementation schedule. This should list all steps that have to be taken to execute the main components of the project, place them in operational sequence, identify the critical activities, list demands on management staff or skills in potentially short supply and note other potential constraints or risks.

B. Activities to Achieve Loan Effectiveness

This section should provide crucial information for the gearing-up process for the project implementers. With the aid of the overall implementation schedule it should:

- Identify the tasks to be completed in order to satisfy the suggested conditionality;
- Define the time required to achieve these, and earliest and latest start/completion dates;
- Hence define the earliest date for project start-up;
- Identify the individuals required to perform the necessary tasks, annexing brief responsibility and job descriptions;
- Explain the need for and approach to preparation of annual work plan and budget.

C. Activities for Completion in Project Year One

This section should identify and bring to the government's attention all the essential tasks to be undertaken during the first year of the project. These activities usually form the subject of the first annual work plan and budget, and their listing in the project document can be of great assistance to avoid time overrun. Whenever possible they should have been defined and agreed at a workshop with the intended implementers during final planning, before this chapter comes to be written. If not, they should be discussed at a subsequent review of the draft feasibility study report, or at a project launching workshop as soon as funding has been negotiated .

tasks that often fall within the first project year are:

- Preparation of terms of reference for technical assistance services from consulting companies (for engineering design work), training and research institutions (assistance with training and extension programmes).
- Invitations to bid and bidding, bid evaluation, contract negotiation, award of contracts and mobilization of staff.

- Preparation of procurement packages for project vehicles, construction plant and equipment, and possibly temporary site accommodation. Invitations to bid and bidding, bid evaluation and award of contracts.
- Initiation of information campaigns and animation procedures for demand-driven development.
- Negotiation of agreements with communities on their labour or other contributions to project implementation and subsequent O&M.
- Participatory planning with farmers for irrigation water delivery/distribution systems and in-field works.
- Cadastral surveys.
- Additional site investigations and topographic surveys.
- Detailed engineering designs and cost estimates for subsequent year's construction work.
- Initiation of farmer training and extension programmes.
- Initiation of irrigation staff training programme.
- Six-monthly interdepartmental review/planning workshops.

D. PROCUREMENT

Most multilateral and bilateral financing institutions have their own requirements for procurement that are set out in guidelines issued for borrowers. These should be referred to and their applicability to the items to be procured under the project should be explained. The major financing institutions usually require that borrowers obtain goods above a certain value and contract major civil works through international competitive bidding (ICB) open to suppliers and contractors in all of their member countries. Under prescribed conditions preference may however be permitted for local and regional manufacturers and, where appropriate, local contractors. Programmatic work consisting of many small scattered subprojects is not generally attractive to international companies and does not usually require ICB. However, the principle of competitive bidding will still apply for local purchases or the use of local contractors.

Whatever the expected procurement procedures they should be summarised here, with, if appropriate, an assessment of local capacity to supply different categories of goods or services. An estimate should also be given of the likely time requirements to undertake the various procurement procedures for the main project items. This should be reflected in the overall implementation schedule and phasing of the project costs.

MAPS, FIGURES, TABLES AND ANNEXES

Appended to the report should be the maps, figures, tables and annexes needed to give the detailed background to the main text and to assist the appraisal team and project implementing agencies. Annexes should, to the extent possible, be organised along similar lines to the main text to facilitate extraction of information; frequent cross-referencing should be made to the annexes in the main text. A typical set of annexes for a project document covering a new irrigation investment project might be:

1. Sociological Analysis and Definition of the Target Group
2. Soils and Land Capability
3. Climate and Water Resources
4. Water Rights and Land Tenure
5. Irrigated agriculture (including crop water requirements)
6. Irrigation and Drainage Engineering
7. Marketing and Input Supply
8. Rural Finance Services
9. Roads and Other Infrastructure Development
10. Institutional Capacity Assessment
11. Organisation, Management and Institutional Development Plan
12. Social and Environmental Impact Assessments (for Category A projects; Mitigation Plan for Category B)
13. Financial and Economic Analysis
14. Detailed Project Cost Tables
15. Implementation Plan (containing GANTT/critical path analysis charts)

The list of annexes required for a rehabilitation project would be similar to those above, but the scope and content of some of them will be different. For example, Annexes 1 to 9 should describe the existing situation, but 4 to 9 should also describe proposals for improvements.

Annex 6 should contain a detailed diagnosis of the existing system, and analysis and design for upgrading, including details of expected improvements to operational hydrology.

Annex B: Factors underlying recent agricultural commodity price shock.

Very high agricultural commodity prices in the first six months of 2008 raised concerns worldwide about increased poverty and malnutrition and have led to a bread crisis in Egypt. However, since June 2008, prices have retreated, due to strong production gains in developed countries (FAO 2008a). In spite of recent food price drops, many of the underlying factors behind high and volatile prices appear to be here to stay. Structural factors, such as population and income growth and allocation of good fertile lands to bio-fuel production may prevent food prices from lowering back to the historic lows of the early 2000's. Sustained high prices and increased volatility create a danger first for Egypt but also for Sudan because they are dependent on international commodity markets for food. Ethiopia has been received food aid chronically for many years; traditionally food aid supplies come from production surplus thus food aid amounts are likely to decrease with the continuous raising of demand and supply shortfalls. In short: *Egypt first but also Ethiopia and Sudan are highly exposed to international food commodity price shocks. International agricultural commodities may be entering a period of sustained price volatility due to thinness of markets and limited stocks. Investments to raise agricultural productivity both in the irrigated and rain-fed sector and especially in Ethiopia and Sudan, are critical to long-term food security at the basin level.*

Egypt is particularly vulnerable to fluctuations in international commodity markets because the country is heavily dependent on imported food. Egypt is the second largest importer of wheat in the world. Heavy dependence on food imports raises concerns about food security. Reliance on international commodity markets raises both price and supply concerns. In terms of price, high food prices put enormous pressure on Egyptian households and the national budget (i.e. for bread subsidizes). In terms of supply, five exporters (Argentina, Australia, Canada, France and the United States) supply 73 percent of the world's traded cereals (FAO, 2008b) making access to imported cereal heavily dependent on events in these countries. Population growth, urbanization, and income growth are relatively strong in the Eastern Nile countries and will increase the demand for food. However, supply-side constraints are more binding in Egypt than the upstream countries due to more limitation in the amounts of arable land and water, and less opportunities for increasing the already high y

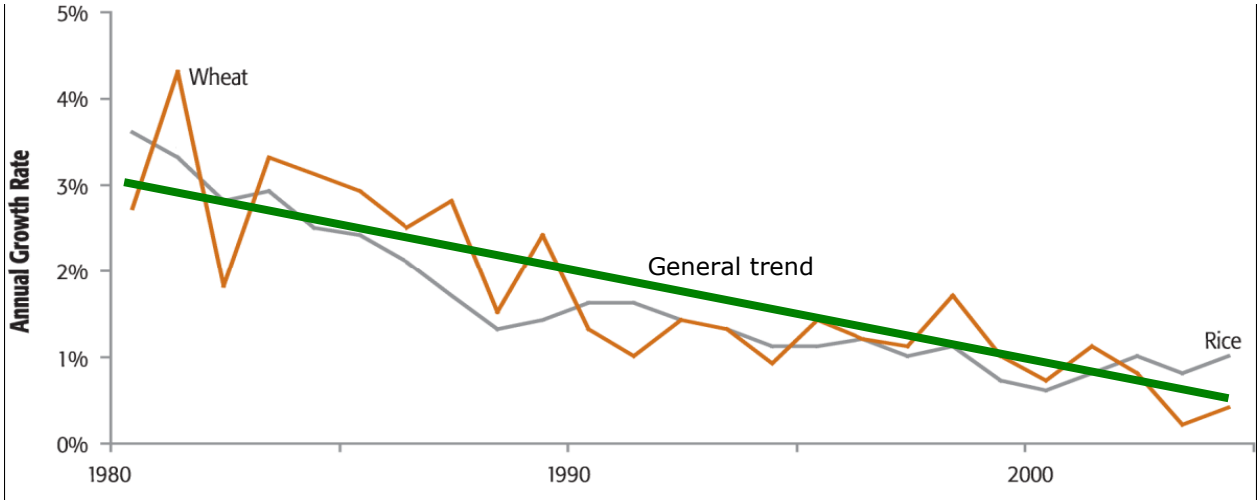
Factors underlying the recent food crisis

The recent food-price shock is widely acknowledged to be a result of the convergence of multiple structural and cyclical factors. Recent commodity market projections by the OECD, FAO, and the World Bank (OECD and FAO, 2008) (World Bank, 2008) suggest a structural shift may prevent prices from returning to pre-crisis levels. While this may or may not be true, of greater concern for the Eastern Nile countries is that the world grain market has become very sensitive to supply shortfalls and ever-increasing demand, making future price shocks very probable. The unpredictable speed at which food prices can increase is especially problematic because of the inelasticity of both supply and demand. Households, especially poor ones, cannot reduce their food consumption in response to high prices. Instead, they must make sacrifices in other areas of their budgets. Farmers, even the world most productive ones, cannot quickly increase production in response to high prices due to the seasonal nature of agricultural production and the limitation imposed by the slow progress of agricultural technologies.

Global production growth rates for major cereals are slowing (Figure 1) Reasons for this are numerous and complex and far beyond the purpose of this report. Unless this trend is reversed, cereals market will remain thin and the likelihood of food-price shocks will increase. Thin international cereal markets imply that relatively small shifts in supply or demand will lead to large shifts in prices. The Eastern Nile basin has a huge potential for agricultural production growth, especially in Ethiopia and Sudan both in the rain-fed and irrigated sectors and through productivity gains and expansion of harvested areas.

Only 18 percent of world wheat production and 6 percent of world rice production is exported; the rest is consumed domestically (FAO, 2008d). At the height of the recent shock some major wheat and rice exporting countries banned exports (for instance Thailand rice exports) for fear of not being able to feed their people. These bans contributed to the rapid escalation of global market prices. The thinner the market, the sharper the fluctuation in international prices and the higher the likelihood of future price shocks.

Figure 1: World growth rates of wheat and rice (percent change 1980 – 2005)



Source: FAO 2008b; note: growth rates are computed on 7 years moving averages.

Climate change will likely contribute to market instability by increasing cereal yields volatility and possibly decreasing global cereal production. Global climate change models project an increasing probability of droughts and floods worldwide. Research on the impact of climate change on cereal production is not conclusive, but there are indications that average world production may decrease.

Policies that promote bio-fuel shift land away from production of food. There is evidence that this is occurring in the United States, a country that accounts for 28 percent of world cereal exports. Similar bio-fuel policies in the European Union, Canada, and elsewhere could exacerbate anticipated structural changes in the production of wheat, other cereals, sugar and oil seeds.

Petroleum is the primary ingredient of fuel and fertilizers, which are two key components of agricultural inputs. A recent study indicates that when oil prices are above 50 U.S dollars a barrel, oil and food commodity prices move together, but when the price of oil falls below 50 U.S dollars a barrel, oil and food prices decouple (World Bank, 2009). Rising petroleum prices can also impact commodity prices by increasing the demand for bio-fuel which diverts cereal and sugar from food to fuel. (FAO, 2008c).

Financial speculation have also contributed to the recent shock. In periods of uncertainty and/or recession, speculators shift to real assets including agricultural commodities. This leads to large increases in investments in commodity markets as speculators bet on continued price increases.