ISN 74341
PDABZ-J

U.S.A.I.D./ O.M.V.S.
INTEGRATED DEVELOPMENT PROJECT
No. 625-0621

VOLUME III,
SECTION 3.8

PROJECT PLANNING AND FEASIBILITY STUDIES ANALYSIS

USAID/RBDO
October 1982
DAKAR - SENEGAL

TABLE OF CONTENTS

		Page
3.8.1.	Introduction	
	3.8.1.1. Cohesion of Donor Interventions	1
	3.8.1.2. Making the Risks Acceptable	2
	3.8.1.3. The IDP Approach	2
3.8.2.	The Long Range Development Plan for the Upper Valley	3
	3.8.2.1. Plan Components	5
	3.8.2.2. Organization of Studies	9
	3.8.2.3. Alternative Scenarios	12
	3.8.2.4. Completion and Implementation Plan	13
	3.8.2.5. Resources Needed to Complete Scenarios	14
3.8.3.	Irrigation Feasibility Studies for the Middle and Upper Valley	15
	3.8.3.1. Introduction	15
	3.8.3.2. Scope of Studies.	17
	3.8.3.3. Project Duration and Timing within the IDP	17
	3.8.3.4. Organization of Studies	18
	3.8.3.5. Terms of Reference for Proposed Studies	19
	3.8.3.6. Preparation of Tender Documents	27
	3.8.3.7. Terms of Reference	28
	3.8.3.8. Reports Required	28
	3.2.3.9. Personnel Requirements	29
	3.2.3.10. Scope of Work for Contract Technical Assistance Team	29

A

3.8.4. Studies on Land Tenure Policy, Women, and Pastoralists 32

3.8.4.1. Land Tenure Policy 32

3.8.4.2. Studies on Women and Pastoralists 35

3.8.5. Fishing Estuary Study 38

3.8.5.1. Introduction 38

3.8.5.2. Background 39

3.8.5.3. The Problem 40

3.8.5.4. Proposed Solution 40

3.8.5.5. Objective of Study 41

3.8.5.6. Study Implementation Plan 41

3.8.5.7. Resources Needed for the Fishing Estuary Study 44

3.8.6. Telecommunications Policy Study 44

3.8.6.1. Introduction 44

3.8.6.2. The Problem 45

3.8.6.3. Proposed Approach 47

3.8.6.4. Expected Outcome 49

APPENDIX - TABLES AND FIGURES

Fig. 1 - Schedule for Implementation of Policy and Feasibility Studies

Fig. 2 - Salt Water Intrusion in the Senegal River Delta

Fig. 3 - Proposed Schedule for the Fishing Estuary Study

B

3.8. POLICY AND FEASIBILITY STUDIES

3.8.1. Introduction

In the last year, the U.S. Government has proposed to the Governments of Senegal, Mauritania and Mali, through the Organisation pour la Mise en Valeur du Fleuve Senegal, a series of interventions aimed at accelerating the agricultural development of the Senegal River Basin. These proposals, which include the Agriculture Research and Groundwater Monitoring Projects in addition to the IDP, are aimed at strengthening interstate and interdonor cooperation to lead to a coordinated development of the SRB in line with both national and regional objectives.

The physical transformation of the basin and the construction and management of the infrastructure that will control its principal water resource have required important policy and structural adjustments from the Governments of Senegal, Mauritania, and Mali. The socioeconomic evolution occurring as a result of the physical changes will engender national policy changes of equal if not greater significance.

The OMVS is the designated instrument of the three riparian states to affect the physical transformation of the basin. It must also monitor regional socioeconomic changes, as the national planning and development structures of the OMVS member governments are by their very nature confined to act within national borders.

3.8.1.1. Cohesion of Donor Interventions

Fourteen national and multilateral donor organizations have coordinated their efforts to finance the basin's infrastructure, funded at $753 million. The first phase of the infrastructure development began in 1981 with the start of construction of the Diama Dam, followed in 1982 by work on the Manantali Dam.

The agricultural development of the basin, an area with a potential for double and triple cropping on 300,000 hectares of irrigated land, will require an investment of over $1 billion. It is not clear whether these sums can be mobilized in piecemeal fashion; whether they can be managed on a project by project basis; whether they will be granted or loaned on a strictly bilateral basis; and whether the results will be consistent with and responsive to the integrated development objectives established by the three riparion governments.

Up until recently, the assumption was that while the basin's infrastructure development should be approached on a system-wide basis, downstream agricultural development could proceed on a strictly national basis. Both donor and national representatives to the OMVS Consultative Committee, most of whom are also involved in the implementation of agricultural projects in the basin, began to discuss in 1979 the need for regional agricultural development planning. In 1980, they requested and

obtained the first basin-wide master plan for irrigated agriculture. The committee subsequently commissioned further work on the socioeconomics of the basin and on the environmental consequences of development.

Only the preliminary analytical steps have been taken thus far to measure the impact of national agricultural policies on the future development of the basin, particulary as they relate to agricultural inputs, marketing, cereals price policies, commercialization of outputs, land tenure, migration, and the role of governments in the supply and service sector. Traditionally, donors and host governments have debated these policy issues within a national development context.

As USAID analyses have pointed out, however, the future socioeconomic viability of the basin is to a very large extent dependent upon the pursuit of compatible agricultural and trade policies among the three OMVS member states. Thus, promoting, encouraging, and harmonizing these policies in and among the three countries is an essential component of SRB development.

3.8.1.2. Making the Risks Acceptable

Seeking the policy reforms needed to implant an efficient and self-sustaining agricultural sector in the Senegal River Basin will be no less significant than sustaining those already carried out to build the infrastructure. Adopting policy reforms and implementing the resultant structural changes will present formidable risks to African governments. Yet donors generally grant financial resources to these governments with requirements for reform. The more profound the reform sought, however, the greater the risk it poses to the receiving governments and the lesser the ability of either partner to support it.

The agricultural policy reforms required for this development effort will affect all three governments and several major institutions within each government. Up to now, the practice of making grants and loans for agricultural development conditional upon reform has been done only on a project specific basis, with no coordinated policy among donors. This lack of coordination has engaged both donors and recipients in protracted and costly negotiations, resulting in an uneven, inconsistent flow of resources to the three riparian states. Moreover, these resources have funded projects that in general have not achieved the desired policy and structural reforms.

3.8.1.3. The IDP Approach

By placing in the OMVS responsibility for planning and coordinating policy matters related to the basin, the three riparian states maintain control over the development process. The OMVS High Commission, working under the policy direction of the Conference of Heads of State and through the management control of the Council of Ministers, can fully discharge its mandate as the principal resource manager for SRB development.

To strengthen the OMVS policy coordination functions, it may be necessary to expand the membership of the OMVS Council of Ministers to include the Ministers of Rural Development. Precedent exists for such an expansion. Most

USAID/OMVS projects have been evaluated by ministries other than those represented on the OMVS Council. Formal approval for the IDP will in fact be provided by the OMVS Council expanded to include Rural Development Ministers.

The most effective coordinating mechanism for donors in the riparian states is the OMVS Consultative Committee. Members of this committee control important resources and can collectively share the investments and risks already discussed. Under the leadership of the OMVS Council of Ministers, a long-term partnership has been created and institutionalized. The Consultative Committee appears to be the best vehicle for evaluating the nature, cost, and benefits of reform; establishing procedures for negotiating the conditionality of development assistance; planning the optimum rhythm of development to pursue; and programming an efficient and fair flow of resources to the three OMVS member states.

The studies financed by the IDP and hereafter described are intended to prepare the analytical framework within which the SRB development partners can debate and agree on courses of action. Study findings will provide to the OMVS Council of Ministers and to the Consultative Committee rigorous analyses of issues and rational options to consider. Participation of national planning and development institutions throughout the study phase will assure that the results reflect national concerns.

Preparation of these studies will follow the sequence outlined below:

1. None of the studies will be launched until IDP management staff (host-country and USAID) is fully established in the field. Their expertise and familiarity with local conditions will be essential to guide the analyses envisaged, and their participation is factored into the staff structure for the conduct of the studies.

2. The upper basin development plan will begin during year <u>two</u> of project implementation, after IDP management staff have been well established. The basin plan is in fact a synthesis of subregional plans for Gouraye (Mauritania), Kayes (Mali), and Bakel (Senegal), which will be completed first.

3. Feasibility studies for 15,000 hectares of new irrigated perimeters will follow completion of the development plans.

4. The start of the other studies will depend upon the level and quality of baseline data produced by the MIS and interpreted by the field staff. These preliminary measures will permit a more precise basis for defining the scopes of the studies on women, pastorolists, fishermen, and land tenure issues.

3.8.2. <u>Long Range Development for the Upper Valley Plan</u>

Despite its historic role in linking the Atlantic coast with the Sudanic economies of the middle Niger River, the upper valley of the Senegal River Basin has been neglected for many years. Roads are poor or nonexistent; there has been little agricultural research, and governments' development

efforts in the area have produced mixed results. Nevertheless, the people of the region have shown great resourcefulness in introducing pump irrigation, adopting animal traction, and investing revenues earned outside the region.

The 1980's and 1990's will be decades of dramatic change in the upper valley. Construction of the Manantali Dam is already bringing new sources of income and employment into the Region. Once the reservoir is filled and used for seasonal water storage, the pace of agricultural change will accelerate and the importance of river transport will grow. With the installation of hydroelectric generators in the mid-1990's, possibilities for rural electrification of the region will multiply. Finally, the linking of the upper valley with Dakar and Saint Louis by a paved road this year will have an important influence on opening up the region.

As a result of these changes, the potential for agricultural production and marketing in the region is increasing quite markedly. This, in turn, will generate higher incomes, greater employment and new opportunities for investment in processing and other industries as well as in various service activities.

Increased incomes will mean changing patterns of consumption and marketing opportunities. Improvements in transportation will permit increased trade flows between the upper valley and other areas of the OMVS countries, the rest of West Africa, and even beyond.

It is inevitable in such a period of transition that a number of critical constraints to development will arise. These may be technical, economic, social, institutional or policy-related in nature. Surveys need to be conducted within the region for example, to identify potential sites for irrigated perimeters; marketing of vegetable crops is already a constraint in some areas; land tenure problems abound. Differences in agricultural price policies between countries lead to serious distortions in the allocation of resources.

A series of studies is required to identify these constraints and the projects or policy changes necessary to overcome them. These studies should be regional because of the numerous linkages between countries.

They will be used as inputs into the preparation of a long range development plan for the upper valley, which will include national development plans for the Bakel, Gouraye, and Kayes Regions. The overall plan will consist of the following components:

a. a definition of the area studied;

b. an inventory of physical and human resources;

c. a description of the existing technological, economic, social, institutional and policy situation;

d. an analysis and assessment of possibilities for developing the region;

e. a series of scenarios outlining alternative ways in which that development might proceed;

f. the identification of major constraints to development;

g. a plan of action with recommendations for ways in which projects or policy changes intended to overcome these constraints can be implemented, including terms of reference of appropriate feasibility studies.

The plan will be prepared by a contract team working under the joint supervision of OMVS and RBDO. The development plans for the Gouraye, Bakel, and Kayes regions will be prepared first, in close consultation with the appropriate technical services of the OMVS member states. Management and programmatic supervision of the OMVS is required in order to assure that the regional development plans are constructed in a complementary and consistent manner. This is especially important in view of the fact that the long-term macroeconomic viability of a region in one country may very well depend upon development actions taken in the neighboring country.

Development of the component plans will begin in year two of the project and utilize staff specifically contracted for the purpose, as well as other national and expatriate personnel attached to the IDP. The regional and subregional plans are expected to provide to OMVS and its member states both baseline data and recommendations for program initiatives. The plan will serve donor and recipient organizations in structuring development interventions in a rational manner, avoiding duplication of effort, and assigning appropriate weight to policy reform considerations in the design of projects.

3.8.2.1. Plan Components

This section describes each of the plan components and the studies necessary for their elaboration.

A. Definition of Area Studied

The delineation of the region to be considered will be in fact one of the first outputs of the study. In general terms, it is intended to cover the upper valley of the Senegal River, roughly the 260 kilometers of river from Diamou (above Kayes) to Waoundé (between Bakel and Matam) and a width averaging 30 km or so, on either bank, a total on the order of 16,000 Km2.

Within this area, zones that are relatively homogenous ecologically and economically (but not politically) should be blocked out; these zones may not be the same for the various components of the study, and should keep in mind the basic river orientation of OMVS.

B. Inventory of Physical and Human Resources

The inventory of physical and human resources will start with an

examination of existing documentation, maps, photographs, and other relevant materials. Data needs that have not already been identified will be evaluated at this time to see if they can be filled within the scope of work for the preparation of the plan. On the basis of the information currently available, a number of studies have already been identified.

Mapping exists at 1:200.000, and 1:50.000 in Senegal and Mauritania. Soils mapping has been done only in the very downstream portion of the region, at 1:50.000 scale. Recent (1980) aerial photography exists of the entire region in both black-and-white and infra-red false color at 1:50.000.

Considerable data exist on Senegal River flow probabilities (both high and low flow) for conditions before and after the construction of the Manantali Dam.

Rainfall and stream flow data collection and projections will be available from a separate OMVS contract.

Some preliminary studies have been made for the development of a few cuvettes in Mali.

C. Description of the existing technological, economic, social, institutional and policy situation

This component will describe the baseline situation in the upper valley. It will include the following studies:

(1) Identification of agricultural projection techniques and farm systems

This study will be undertaken during the first year of plan preparation. It will rely on existing data, especially for irrigated cultivation, and on the farm surveys being conducted in Bakel and the villages with perimeters scheduled for rehabilitation in Kayes. The study will:

a. identify specific techniques of production;

b. estimate yields, labor times, and inputs requirements for each technique, for each time period in the agricultural calendar;

c. combine the various techniques into a series of farm system models that reflect the actual practices and constraints of farmers;

d. identify specific constraints and agronomic problems inhibiting the attainment of farmer objectives;

e. estimate on-farm consumption and marketings for each farm system.

(2) Public and private market structures, flows and prices

This study will be undertaken by a marketing economist. It will include both cereals and vegetables and will consist of several elements:

- assembling data from public marketing agencies on the structure of official marketing and on official flows, storage facilities, cereal stocks, margins and costs, prices and credit;

- gathering information by informal questioning of private traders, transporters, farmers, and consumers concerning private marketing structures, directions and quantities of flows, margins and costs, prices, and credit arrangements;

- conducting formal surveys in approximately 15 urban, semi-urban and rural markets, both within and outside the upper valley, to obtain weekly data on prices, numbers of sellers, weights of traditional selling measures, origin and destination of products in the market, and other relevant information;

- collecting other marketing, transport and credit information from various sources, such as the monthly price surveys of the Dakar and Bamako markets;

- estimating and projecting the demand within and outside the upper valley for cereals, vegetables, and other potential agricultural products produced in the Valley;

- gathering information on world market demand condition, prices, and projections for the agricultural products of the upper valley;

- estimating existing flows of agricultural products within, into, and out of the upper valley by public marketing agencies and private traders.

(3) Livestock and Fishing Sectors

An animal production specialist and a fishing specialist will be employed for six and three months respectively to review the existing documentation and make field visits as necessary to establish an inventory of resources and activities in these sectors. They will work with the agricultural economist, agronomist, and anthropologist to examine interrelations between crop cultivation, livestock and fishing.

(4) Industrial and Service Sectors

This study will be undertaken by a specialist in small-scale enterprises. It will consist of:

a. An inventory of existing industrial enterprises and public private service establishments in the upper valley;

b. a technical, cost, and financial analysis of a sample of processing and other enterprises to assess their efficiency and identify possibilities for improvement.

(5) Comparative Costs and Incentives

Following consultations with appropriate national government ministries, the agricultural economist and the macroeconomist will undertake a study of the comparative costs and incentives of various agricultural, marketing, and industrial activities in each of the three countries in the upper valley. This study will be based on the results of the agriculture, marketing, livestock, fishing, industrial, and service sector studies conducted in the earlier phase of plan preparation. It will systematically organize this information so as to establish a baseline for the determination of each country's long range comparative advantage and the policy constraints and bottlenecks inhibiting the exploitation of that advantage.

(6) Social Studies

These will be directed by the senior anthropologist to be financed by IDP and include the studies of the livestock and fishing sectors described above, as well as studies concerning land distribution and land tenure, and the integration of women and socially disadvantaged groups into agricultural development projects. These studies are described in detail in the "Social Analysis", Volume III, Section 2.0.

(7) Institutional Studies

This section will provide a review of the governmental and nongovernmental institutions in the three regions of the upper valley, a summary of their responsibilities and activities, and a plan for their involvement in the preparation and execution of the recommendations developed by the plan.

(8) Comparative Policies

This study will be undertaken by the economist working in close collaboration with officials of the three national governments, specifically designated to assist in this aspect of the study during the first year of plan preparation. It will consist of a description and comparative analysis of policies in each member country related to official consumer and producer prices, taxes or subsidies on farm inputs, water fees, money and credit, foreign exchange, and other ways in which governments influence the economy of the region. Specific issues to be examined include possibilities for:

a. harmonization of official producer prices and credit and input subsidies;

b. integration of other food and agricultural policies such as trade restrictions, tariff rates, and officially established retail prices;

c. integration of policies related to the processing, transport and marketing of crops, livestock and fish produced in the region;

d. integration of policies related to migration and land resettlement;

(9) Synthesis

A synthesis of the various studies describing the existing technological, economic, social, institutional, and policy situation in the region, will be prepared as a benchmark against which to construct a series of scenarios for regional development. This synthesis will be prepared following formal consultations with the Ministries of Plan in each of the three OMVS Member States. These scenarios will be based on a sector by sector assessment of the possibilities that exist for improvement.

3.8.2.2. Organization of the Studies

During the second year of plan preparation, each of the resource and sector specialists will assess the possibilities that exist for improvement.

(1) Resource Studies

A series of studies will be made to identify and quantify the available resources. These studies will draw as much as possible on existing data and will be directed by the Group Leader for maximum efficacy within the goals of the study.

(a) Land use

The purpose of this study, conducted by the land-use planner under the direction of the team leader, will be to eliminate areas possessing little or no agricultural potential from the project. The area finally selected for potential development will be indicated on the base maps. The land-use planner will be assisted by technical staff seconded by each of the RDA's.

A higher level reconnaissance will then be carried out in the selected areas, delimiting on 1:50,000 aerial photos, units of homogenous development potential. A description of soils aptitude and potential problems, and possible reclamation needs will be prepared. This description should adhere as closely as possible to terminology used in the OMVS countries, and will be keyed to the marked-up photos.

(b) Identification of irrigation potential

This study will identify sites within the study zone suitable for agriculture. Water resources are the river, either controlled flooding in basins near the river channel or pumped, and storage of run-off in tributaries; ground-water use is not foreseen in this study. Development

options will include 20 hectare village perimeters as well as flooded basins and large (up to several hundred hectares if appropriate) perimeters, keeping in mind the possibility of evolving from one to the other. Irrigation probably will be by gravity, but sprinklers should be investigated in areas of high infiltration rates or irregular topography. Flood protection may be required.

Preliminary identification will be made on the basis of aerial photos interpretation, and consultation with the RDA's and local authorities. Priorities for investigation will be proposed by group leaders and cleared by the RDA's in each country on the basis of preliminary estimates of soils suitability, economic viability, accessibility, and social considerations.

On the basis of field inspection, with possible verification of key elevations by topographic surveys, preliminary designs will be prepared, based on agronomic and design data available both from the Project Paper and on-going field work. Appropriate alternative irrigation drainage and flood protection systems will be laid out and costed on a life-of-project basis at a pre-feasibility level. Data on areas and costs will be supplied to the other disciplines in the team to permit an evaluation of development potential at this level of studies.

Sites for feasibility level plans will be proposed by the Group Leader, cleared by OMVS, and approved by the RDA's. These plans will be prepared on the basis of the best existing aerial photography, supplemented by field topographic work to determine principal dimensions and key elevations. Plans will be prepared in sufficient detail to demonstrate technical feasibility and estimate construction and operating costs. Relevant soils data will be shown to permit design of cropping patterns, estimates of yield, and farm operating budgets.

Priority will be given to the Kayes area of Mali, where at least 1,000 hectares of land should be identified in the first year. Study and design on this land will be advanced during the secon year to prepare construction plans for at least 750 hectares of perimeters which will be built during the Immediate Production Phase.

Topographic surveys at 1:2000 scale will be made as necessary to lay out irrigation, drainage, and flood protection works. (Some hundreds of hectares of plans have been made. Some of these may require extension to the coverage to ensure that data is complete).

Plans will be drawn up in sufficient detail to permit accurate quantity take offs and cost estimates, the ordering of equipment, and contracting. The contractor will be responsible for any design of reinforcing, mounting of equipment, etc.

(2) Sector Studies

(a) Agriculture

The study team agriculturalist, working in collaboration with the three IDP staff agronomists, during the second year of plan

preparation will examine the results of agricultural research and field trials in the Senegal River Basin and in similar ecological zones elsewhere (ISRA, ICRISAT, SAFGRAD, IRAT, WARDA). He will determine what new technology would respond to farmers' needs. Field trials will be initiated by project agronomists under the RDA's to adapt these innovations to local conditions. In the meantime, the agricultural economist will introduce the new varieties and techniques into the comparative costs and incentives and into farm system models to determine whether they are consistent with existing farm systems and respond to farmer needs. On the basis of this exercise, and assuming that field trials show no serious agronomic problems, the best of the new techniques will be tentatively accepted for the plan. As part of the plan, the IDP agronomists will also define priorities for agricultural research, incorporate existing research programs into the plan, and identify further research needs.

(b) Marketing and credit

The marketing economist will, during the second year of plan preparation, identify key bottlenecks in transport and marketing as well as the projects or policy changes necessary to overcome them. He or she will also asist the agricultural economist in estimating comparative costs for improved agricultural techniques and farm systems. The marketing economist, with the assistance of the agricultural economist, will also prepare the demand and supply projections for the plan. These will include not only markets within the region but also those located elsewhere in West Africa. Demand and supply projections will be presented to appropriate ministries of the OMVS member states, whose technical staffs will be requested to comment formally. Finally, the marketing economist, in cooperation with the loan officers of local banks and others involved in the formal provision of credit, will draw up an overall regional credit plan that will specify the amount of credit required and likely sources of financing, including savings deposits in local banks and nonformal credit markets.

(c) Livestock and fishing

The livestock and fishing specialists, in addition to establishing an inventory of existing resources and activities, will also assess the development possibilities of these sectors and draw up plans for their development. They will rely primarily on data available from national ministries and USAID and other donor missions and will work in close cooperation with specialized national agencies. Both specialists will work with the agriculturalist and agricultural economist to examine ways in which livestock and fishing can be more fully integrated with crop cultivation in improved farm systems.

(d) Industry and Services

The small-scale enterprise specialist will examine alternative types of processing and other enterprises, such as rice hullers, mills, tanneries, drying facilities, canneries, blacksmith shops, slaughterhouses, and cold storage facilities, to see what improvements might be made with existing units and new types of activities that might profitable

be introduced. He or she will work closely with the marketing economist to ensure that adequate markets are available for the products envisioned and that transport and marketing costs are not prohibitive. Specific projects will be identified and prepared by this specialist and a plan for developing small- and medium-scale industry and services in the region will be elaborated.

(e) Comparative Costs and Incentives

Based on the preceding assessments of possibilities for improvement, the Study of Comparative Costs and Incentives will be expanded during the last phase of plan preparation to include improved agricultural, marketing, industrial, and service activities. This analysis, which will be undertaken principally by the agricultural economist and the macroeconomist, will establish the long range structure of comparative advantage of the different countries in the region. It will also help, along with the Study of Comparative Policies, to identify the critical policy constraints to regional development.

3.8.2.3. Alternative Scenarios

This analysis will be conducted by the macroeconomist working in close collaboration with pertinent host country institutions (the RDA's and the Ministries of Plan, notably), during the second year of plan preparation. It will present at least three alternative scenarios, with detail by zone (Bakel, Gouraye, Kayes), at the standard of reconnaissance/feasibility level study. The analysis of alternatives will include estimates of inputs (capital costs, current costs, labor inputs, land use, financial flows, technical skills, extension services, management, etc.) and outputs (agricultural and fish production, processing activity, market flows, income, consumption, etc). The scenarios will clearly present the linkages between sectors and the complementary capital (roads, irrigation works, etc.); operating (fertilizer, extension, etc.) and institutional (training, credit, role of private sector, etc.) development that will be required. The economic and social feasibility of each scenario must be assessed as must its impact on the environment and its policy implications. The scenarios will be presented to and examined by national policy coordinating committees to be created, at the request of AID, by the OMVS member states at the start of IDP implementation.

A. Identification of Constraints

A major reason for the preparation of scenarios that explicitly show the linkages between components of the environmental, technological, economic, social, institutional, and policy system is that this helps to identify constraints on the development of that system. Some of these constraints might include:

- the need for feasibility studies of irrigated perimeters;
- the need for agricultural research directed towards easing particular labor constraints;
- the need for specific secondary roads;

- the problem of flooding local markets with vegetables at certain times of the year;

- the need to introduce rice hullers into the region;

- inadequate medium-term credit for the purchase of animal traction equipment;

- lack of pump repair services;

- lack of training of extension personnel in rainfed cultivation;

- official barriers to trade between countries;

- fertilizer subsidies that are costly to the government and inhibit the development of private sources of supply.

Each of the scenarios must also be accompanied by recommendations as to how the barriers to its achievement should be overcome. This will require:

- definition of necessary additional studies with appropriate terms of reference;

- identification of the legal and institutional mechanisms required to achieve smooth, coordinated execution;

- detailed analysis of staffing needs;

- budget analysis that includes costing of recommended studies and the operating costs of public institutions to be involved in plan execution;

- recommendations concerning the implementation of required policy changes.

3.8.2.4. Completion and Implementation of Plan

On the basis of the analysis and presentation of scenarios, a specifically designated ministry in each of the OMVS member states will select one of the scenarios to be carried forward to a comprehensive development plan identifying investment projects, defining national and regional priorities, projecting manpower and financial needs, and outlining required policy changes. Completion of the plan will be the responsibility of the macroeconomist. At the same time, feasibility studies will be executed, according to the scenario chosen, for the construction of small and medium-sized perimeters and the construction or repair of 500 kilometers of rural roads. Terms of reference for further feasibility and other studies, as required, will be prepared in conjunction with the completion of the plan or by the member countries as appropriate.

It is expected that the completed plan will serve as an important document for the purpose of mobilizing the support of other donors for the

long range development of the upper valley. OMVS and AID/RBDO will play a vital role as catalysts in this process. Progress in this respect will be part of the Second Special Evaluation of the project.

3.8.2.5. Resources needed to Complete Scenarios

(1) Profession Personnel

The following professional personnel will be required:

		person/months
a.	Macroeconomist-Group Leader	24
b.	Agricultural Economists(2)-(will also provide assistance to farm surveys)	24
c.	Agronomists (supplied by OMVS and RDAs)	30
d.	Irrigation Engineers (supplied by national and regional components of IDP)	32
e.	Land Use Planner	6
f.	Marketing Economist	18
g.	Small-scale Enterprise Specialist (suppled by OMVS Management Unit)	12
h.	Human Geographer/Cartographer (supplied by OMVS Planning Unit)	10
i.	Livestock Specialist	6
j.	Fishing Specialist	3
k.	Anthropologist (supplied by OMVS Management Unit)	12
l.	Statistician/Computer Programmer (supplied by OMVS Management Unit)	8
m.	Short-term Consultants	6
n.	Secretarial and Administrative Assistance (local hire)	24

(2) Support Personnel

In addition to professional personnel, the long range development plan will require the following:

Local Personnel Requirements by Project Year
(person/months)

	1984	1985	1986	1987	1988	1989
Draftsman/calculator	—	12	12	—	—	—
Field Assistants	--	24	24	--	--	--

(3) Provision of Topographical Survey Services

A topographical survey team will be organized with personnel from the Agricultural Developments Division of OMVS and from RDA staff. It will consist of a topographer (COP), an instrument man, and a recorder, with appropriate equipment and a vehicle.

(4) Commodities

The following commodities will be required for the plan:

- microcomputers and related software (provided under the survey and monitoring activities)
- farm/household survey equipment and supplies (provided under the farm survey activity)
- 2 power earth augers ($ 300 each)
- miscellaneous soil survey equipment ($ 500) full camping equipment for soil survey (2 pedologists, 1 cook, 6 laborers).
- soil photographs ($ 25,000).

3.8.3. Irrigation Feasibility Studies for the Middle and Upper Valley

3.8.3.1. Introduction

One of the objectives of the IDP is to accelerate the rhythm of agricultural development in the Senegal River Basin (SRB). The OMVS "1980 Hydroagricultural Indicative Program" proposes a development target of 3,000 hectares of irrigated perimeters per year. USAID's analysis of past trends and current constraints indicates that a rate of 2,000 hectares per year is more realistic. Even this rate will be difficult to achieve without substantial improvement in the process by which projects are identified, designed, and implemented.

Of the fourteen major donor organizations to invest significant resources in SRB development, only six (the U.S., France, the World Bank, the United Nations, Germany, and Canada) have an in-house technical capability to plan and execute feasibility-level project design studies. Other organizations, most notably those with substantial resources at their disposal such as the

Arab funds and the African and Islamic Development Banks, identify and design projects through a lengthy process of international bidding for short-term consultants. Very few of these institutions located in OMVS member states have the institutional capability to prepare even project identification documents up to international standards. Developing such a capability is costly and not always cost effective.

The IDP will finance the development of feasibility level studies for up to 15,000 hectares of irrigable land in the three OMVS member states. These studies will be conducted in year four of the project to fully exploit staff and data resources available at that point in time. The experts needed to conduct the studies will be recruited through a U.S. competitive bidding process following issuance of appropriate RFP's. The studies are expected to be completed over a 12-month period, roughly between January and December of 1987.

Overall responsibility for supervising the studies will rest jointly with the OMVS Development and Coordination Directorate and the USAID River Basin Development Office. This responsibility is consistent with the OMVS mandate as planner of SRB development, and specifically pertinent to the jurisdiction of the OMVS tri-state Permanent Water Commission. OMVS will strengthen its planning role by directing these studies, and its substantial technical staff will participate to the greatest possible extent in the preparation of the studies to keep costs as low as possible.

OMVS will work in close and formal collaboration with the national development agencies of Mauritania, Senegal, and Mali as well as with the USAID missions in those countries in conducting the feasibility studies, which will reflect national hydroagricultural development priorities and complement existing master plans for both the left and right banks of the Senegal River.

The coordinating role of OMVS, and the size of the land area to be studied, should lend to the feasibility studies an element of cohesion not characteristic of irrigated perimeter development in the SRB up to now. Coherent planning is crucial to the development of the SRB if maximum benefits are to be derived from the heavy investments being made in the infrastructure which will govern the river's regime. Only regional coordination of optimum water usage and water quality, harmonious agricultural policies, and interdependent input and marketing systems will lead to a rational exploitation of resources in the three countries.

While OMVS and its member state institutions will collaborate in program coordination, donor coordination will be assured through the process of presenting the completed feasibility studies to the OMVS Consultative Committee (CC).

The CC is an organ of the OMVS and comprises representatives of all but one of the major donors financing development actions in the SRB. (The exception is the World Bank, which acts bilaterally but in close cooperation with other donors.) Members of the CC will be the primary audience for the feasibility studies, as they are the most likely source of financing for the agricultural projects proposed. No other formal donor coordination mechanism exists in the three river basin nations.

3.8.3.2. Scope of Studies

Output of the studies will be feasibility-level irrigation development plans for 15,000 hectares of land located in the middle and upper valley of the SRB, between Podor and Kayes. Member states will decide on distribution of the 15,000 hectares among the three OMVS States, acting through the OMVS Council of Ministers and using division of benefits formulae obtainable from the Fiscal Allocation and Responsibility Project (625-0620). Final configuration of the studies will be in the form of project papers to be separately and individually considered and implemented.

While some sites selected for development will lend themselves to small perimeter development, others will be suitable for medium-and large-scale farming units. Technical and socioeconomic factors will carry equal weight in the selection of final perimeter size.

During the course of project design, multiple perimeter development options will be explored and proposed. This will enable the OMVS and its member states -- whose technical staffs will be associated with the design team throughout the course of the studies -- to determine and adapt the options most consistent with national and regional agricultural development policies.

Once optimum schemes have been selected, the design team will prepare final feasibility documentation for submission to host country and financing sources.

The 12-month effort of feasibility studies will be comprised of three distinct but not mutually exclusive phases:

Phase I: Establishment of working relations with host-country institutions; assignment of national technical staff to the consulting/design team; collection of existing data and generation of primary data and field work; analysis of data; presentation and selection of sites.

Phase II: Preparation, presentation, and evaluation of technically sound and feasible project alternatives, sufficiently detailed to allow for selection of optimal project design.

Phase III: Preparation and presentation of detailed feasibility studies based on project design chosen in Phase II.

Feasibility studies will be prepared for typical perimeters in the middle and upper valley, representing the various physical parameters of the area, such as soils, crops, topography, perimeter area and shape, drainage, and water source. The objective is to formulate concrete project descriptions, including socioeconomic feasibility studies and cost estimates, to submit to donors who will fund detailed design and construction.

3.8.3.3. Project Duration and Timing within the IDP

The studies will begin after completion of the upper valley development plan, or at the beginning of year four of the IDP, as feasibility studies for

the development of irrigated perimeters in the upper valley must follow the development scenario chosen for that region.

Since the extensive data and information already collected for the preparation of the upper valley development plan will be relevant to the design of the irrigation perimeters project, the need for primary data collection should be minimal. By year four of the IDP, the IDP Project Monitoring and Evaluation System (See Volume III, Section 3.9.) will have yielded particularly valuable information for the present project design, especially in the area of organization and management of medium- and large-scale perimeters.

The studies should be completed within 12 months, roughly between January and December 1987.

3.8.3.4. Organization of Studies

A team of consultants will be contracted specifically to conduct these studies. USAID/RBDO will be responsible for contracting procedures in consultations with the OMVS Development and Coordination Directorate. USAID and OMVS will give the consulting team a joint orientation program in Dakar. The team will be under the administrative direction of USAID and under the joint technical direction of USAID and OMVS during the early part of Phase I.

For the latter (field-level) section of Phase I and for most of Phase II, the consulting team will work principally under the direction of the RDA's and the bilateral USAID missions in Senegal, Mali, and Mauritania. The RDA's will be requested to name a division-level member of their staff to oversee the development of the feasibility studies. They will also be requested to assign technical staff to work with the consulting team on an ad hoc basis, to make their facilities (especially soil and topographical laboratories) available to the team, and to provide data and documentation as necessary.

The consulting team will meet with designated host country and USAID personnel at minimum every 90 days to report progress, critically review completed work, and seek direction for subsequent phases of the work. Progress will be judged against pre-set targets and detailed work plans drawn up at the outset by the consulting team and USAID/OMVS.

Site identification for perimeter development will be conducted on the basis of existing left and right bank indicative plans, and in agreement with development priorities established by each country.

Options for perimeter development in all three countries will be presented at a specially arranged meeting of the OMVS Interstate Committee for Agricultural Research and Development (CIERDA). The three member states will be asked to send to this meeting representatives having sufficient decision-making authority to commit their governments to the final aspects of projects design. The meeting is expected to take place at month eight of the study schedule.

Phase III of the studies will be conducted under the supervision of RBDO/OMVS with ad hoc consultations with RDA's. OMVS and its member state

representatives will present the completed dossiers to the Consultative Committee.

3.8.3.5. Terms of Reference for Proposed Studies

A. Topography

The land-use planner will interpret existing aerial photographs and available topographic maps of the project area, and prepare a 1/10,000 scale mosaic of existing aerial photographs of the project area and a map at 1/10,000 scale of the project area. This map should show the sites of villages, tracks, the hydrographic network, and the relief. It should also show land use at the time of the study and serve as the basis for sociological, pedological, environmental, and agronomic surveys, and economic investigation.

The land-use planner will prepare planimetric and altimetric charts (1/1000 scale) of the project areas showing contour lines every 0.2 meters in altitude, locating benchmarks and spot highlights. These charts will serve as a basis for studying irrigation development and determining unit cost.

B. Climatology - Hydrology

Working in collaboration with the RBDO irrigation engineer, the Senegal irrigation engineer and a specialist in hydrology, the contract irrigation engineer will review and evaluate all available hydrologic and meteorologic data and collect additional data as necessary. He will study appropriate probabilities and frequencies of important factors such as precipitation and flood height for irrigation system design. These estimates help determine the dimensions of the irrigation and drainage network and of protective structures against floods and run-off. They will also serve as the basis for estimating probable yields from rainfed cultivation and probable irrigation water requirements throughout the year.

The hydrologic study and analysis will also investigate the quality and movement of solids in irrigation water and the quantity of runoff. It should also assess the movements of the water table during the year.

C. Pedology

The soil scientist will conduct detailed soil classification and interpretation studies in the project area as required to establish soil suitability ratings. These ratings will be related to potential tillage and irrigation methods and other aspects of crop production systems. Physical, chemical, or other soil analysis will be conducted as necessary to verify suitable ratings. Soils classification maps and the suitability of soils will be established at a 1/20,000 scale. The maps will be accompanied by tabulated characteristics regarding land use limitations, drainage problems, and fertilization, and will reflect the work of the agronomist. A soil survey report will accompany the maps. The soil scientist can draw on OMVS laboratories and experts for support.

D. Sociology

The RDA's social scientist, under the direction of the OMVS senior anthropologist, will conduct a socioeconomic analysis to determine the social soundness of the project. The analysis will assess the potential for population movement, the impact of the project on social structures, and the availability of labor. It will evaluate the population's capacity to undertake new tasks and to participate in project work, and examine their attitude toward the introduction of new techniques, crops, activities, and cooperative practices. It will also consider the role of women and children in the farming system. The study will present a profile of the project area with respect to demography, employment, training, regional economy, infrastructure, agriculture, and fishing. This analysis will serve as a reference for viewing the present situation against future goals, highlighting present constraints in agricultural development. The study will also evaluate the present socioeconomic system and discuss its potential for improvement. The socioeconomic analysis will devote attention to the following points:

- demography, active population, migration;

  training;

- health: assessment of available resources and study of major diseases that may be affected by the proposed developments;

- communications;

- land tenure and possibilities of land redistribution, present land holding system;

- agricultural calendars: determine periods of labor availability and constraints and evaluate the possibilities of using villagers for manual labor to carry out development projects proposed;

- relationship between agriculture and livestock: influence of livestock on the rice farming calendar and use of animal by-products;

- transport of fertilizers and crops;

- collective forms of agricultural organization: cooperatives, procurement, marketing, storage, processing, and credit;

- fishing: using available data, describe present economic and social importance, manpower needs, tonnages, equipment and infrastructure, and kinds of fish.

E. Agronomy

On the basis of the conclusions of the pedologic, hydrologic-climatologic, and other studies, the agronomists shall determine optimum crop varieties and agricultural techniques. The study will define the most appropriate cropping

schedules and patterns in line with soil and climatic conditions and available manpower.

The study will describe the introduction of new agricultural techniques such as:

- animal traction
- power tillers
- mechanization
- combined crop and animal husbandry
- multiple cropping

The agronomists will define methods of land preparation, water control, tillage, and fertilization, as well as required inputs, infrastructure, and labor.

F. Study of alternatives

For this study, the agricultural economist/development planner will identify several possible development schemes for the project area, incorporating the work of the various study elements. The planner will discuss these schemes with appropriate national entities before adopting the best solution.

Each alternative will be laid out on a map at 1/10,000 scale, showing the location of:

- crop areas
- administration and service building areas
- important works
- primary and secondary irrigation networks
- primary and secondary drainage canals
- secondary roads, bridges

A summary description of each alternative will be prepared. The economist will prepare cost estimates of sufficient detail to justify selection of a project design for the various alternatives considered.

A preliminary financial and economic analysis of the alternative schemes will be prepared, including market analysis and calculation of costs and benefits. This economic analysis will permit comparison of the various schemes on a differential basis.

G. Civil and Irrigation Engineer

1. Scope of work

The irrigation engineer, working with the RBDO and RDA irrigation engineers, will be responsible for designing detailed feasibility studies.

After the most appropriate development scheme is adopted, design of the networks of the scheme will be supplemented by longitudinal and cross sections for the principal and secondary irrigation and drainage canals and for access roads and tracks and protective structures. Standard plans will be supplied for the various types of structures along the networks. The blueprints will reflect both elevations and cross sections necessary to provide a clear picture of the structures. The scale of these plans should permit easy reading. All proposals should be justifiable on technical grounds, and dimensions should be supported with explicit calculations.

The study will include a geotechnical survey of proposed sites for major engineering works. Quarries will be located to furnish the materials needed for the project (earth fill, aggregate and sand). Mechanical soil trials should be conducted as necessary to test quality. The development work for the entire project area will be detailed at a scale of 1/1000.

Quantitites of work and costs will be appraised within a margin of no more than 15 percent. Cost estimates will detail total expenditure as well as the proportions of foreign exchange and local currency.

The engineers will establish physical and financial time schedules elaborating the most suitable work sequence, use of the area, and corresponding costs. The construction schedule will appear in the form of a bar chart, with a separate bar representing each major activity. The engineers will prepare a table showing the chronological sequence of events from the date of submission of final plans and specifications through bidding, contract award, and completion of construction.

2. Technical considerations

The studies will emphasize perimeter synthesis and analysis as a complete system, presenting an overview of pertinent links between the water source and drainage outlet and showing the interrelationship of these components. An analysis should be made relating the efficiency and cost effectiveness of separate components such as pumps, engines, channels, water management, and distribution techniques, to the system's effectiveness as a whole.

System components to be addressed in the studies include hardware, such as pumps, canals, water control, and works and embankments. The studies will also cover drainage/water management principles and techniques including water requirements, distribution and scheduling techniques, efficient pump engine operation and maintenance, and organization and management of the water user group. They will examine system components in terms of cost effectiveness, technical soundness, and social acceptability. The studies will consider the advantages and disadvantages of various options of each component and present a list of final recommendations.

Feasibility studies and final design for the phased development of any given perimeter should consider the complete system, including canal alignment, grade, conveyance capacity, water management system, and pumping facility, in light of water requirements in the perimeter extremities. If these factors are not taken into account, initial construction plans may become obsolete as the system is expanded.

System Components:

The following is a list of system components that should be addressed in detail in the feasibility studies. Study topics need not be confined to these issues, however.

a. Pumps:

Pumps presently being used in the area for small perimeters are of the diesel driven, horizontal shaft centrifugal type and appear to be well suited for existing conditions. Particular attention will be devoted to matching or optimizing pump efficiency in the seasonal range of total dynamic head encountered, including static lift, total friction loss, and velocity head. In cases where pumps are significantly elevated above source water levels, suction head and friction loss in the suction pipe and foot valve should be monitored. Pump durability, maintenance, availability of spares and parts, as well as initial cost should be considered.

Pumps for larger perimeters may be electrically driven vertical shaft turbines or other appropriate units identified in the studies. Efficiency in the encountered head ranges should be checked.

b. Engines:

For the small perimeters, pumps will be driven by diesel units or small electric motors if the area has access to electricity. Care should be taken in matching engine power, efficiency, and speed to pump requirements. Engines should be durable, efficient, and relatively easy to maintain with spares and parts readily available.

Electrically driven pumps for larger perimeters may be fed from a national grid, if feasible, or from a permanent diesel/generator-set specifically installed for that perimeter or several perimeters in the area. The dependability of electricity, and of diesel engine use should be compared; while electric units are cheaper and easier to maintain, unreliable power supplies in rural areas may make diesel engines more practical. The pumping systems installed on perimeters developed by the office of Niger and at the Selingué Dam should be judged for their relative efficiency. The power supply potentially available from the Manantali Dam should be factored into system design.

c. Pump/engine mounting:

Several methods for small perimeters pumping systems have been attempted or proposed, including a floating raft with flexible hose coupling, movable

mounts on the river bank, and a fixed rail and trolley system. The basic problem is horizontal and vertical movement of the engine/pump to accomodate changing river levels. The studies will evaluate and recommend cost effective, operationally and technically sound systems for use with varying physical conditions.

For larger stationary pumping plants, it will be necessary to design appropriate housing, pumps, and inlets protected from floods, erosion, and sedimentation.

d. Pipelines:

Studies will evaluate and recommend appropriate pipelines and necessary fittings for the suction and discharge sides of the pumps for the small perimeters. The pipeline must be partially portable so it can be lengthened and shortened with river fluctuations. The pipeline should be cost effective, durable and easy to maintain and operate. Pipe size, joints, and foot valves should be fitted to prevent friction loss and thus reduce cost.

e. Storage Reservoirs:

Typically, the demand for irrigation varies with season and crop growth stages. For paddy rice, the peak requirement is usually during land preparation and initial flooding. To accomodate increased demand during this period, various measures can be taken, including:

1. speeding up the pump, which results in increased wear, decreased efficiency, and excess motor power;

2. running the system for a longer period during the day (or night);

3. providing some storage capacity in the system.

One possible solution might be to construct a small elevated earth reservoir at the pump outlet. The pump could be then operated at night or around the clock during peak demand. Water pumped at night could be stored in the reservoir for use the next day.

For example, if a distribution system is designed to operate 8 hours per day, the capacity during peak demand can be trippled by pumping 24 hours per day into a pond with a useable storage capacity equal to 16 hours of pumping. Such a pond would have a surface area of about 0.5 ha. on the small perimeters, with one meter of useable storage depth. A second advantage of storage reservoirs for small perimeters is that they increase stream size and balance flow. A minimum stream size is necessary to assure even distribution in plots and minimum run time in irrigation channels.

f. Conveyance Systems:

Appropriate conveyance techniques should be considered and recommended. Factors to be considered include compacted earth channels, surface channels

with appropriate lining, low pressure buried pipe with riser outlets, or any combination of the above. Conveyance systems should be chosen on the basis of cost effectiveness, maintenance, operational characteristics, and labor intensiveness of construction and maintenance. Recommendations on systems other than compacted earth channels should be based on clear evidence of cost effectiveness resulting from saved water, reliable maintenance, or durability. Water saved through an improved conveyance mechanism can just as easily be lost through inefficient field distribution or scheduling; thus, cost effectiveness should be judged in relation to effectiveness of the total system as opposed to the benefits of individual components. The use of locally available materials to the greatest practical extent is recommended. Specifications for materials and construction techniques are described later.

Design criteria for conveyance systems should include inner and outer side slopes, berm width, freeboard, permissible slopes, and velocities for earth channels. Lined canal design for small perimeters should be based on the hydraulic rectangular, trapezoidal, or circular sections most suited to local conditions and should include specifications for freeboard, masonry work, and foundation.

Canal grades will be determined by the required water surface elevation at field outlets or required slope for conveyance, whichever is limiting.

If buried pipe is recommended, design criteria and specifications should be developed for types of pipe joints, permissible velocities and head loss, risers and valves, trenching and backfill, standpipes, air vents, and anchors.

g. Water control and measurement structures:

The design water management plan should include location, type, and design of necessary structures for controlling and measuring water. Structures include measuring flumes, wiers or meters, appropriate gates or structures for regulating quantity or direction of flow, check structures for regulating water surface elevation, drop structures, and field outlets. These structures should be designed to accomplish several control functions where possible.

Structure design should be based on cost effectiveness, durability, availability of materials and artisans, and simplicity and effectiveness of operation. Complete design criteria and specifications should be recommended.

h. Distribution system layout and design:

Criteria for distribution system layout should be designed so as to minimize canal length and water control structures required. Where possible, canals should be aligned to feed field plots on each side. If buried pipes are used, branch lines should be looped when necessary to minimize friction loss and pressure variations. Layout design should consider interruption of drainage and traffic and minimize necessary underdrains and road crossings.

i. Drainage:

Effective surface and sub-surface drainage systems should be designed, including complete criteria and specifications and drawing on locally available materials and techniques to the maximum extent possible.

j. Land preparation:

Plans and designs for necessary land preparation should include laying out of plots, leveling, and bunding for flooded rice, furrows or borders. Recommendations should be made concerning type and degree of land preparation necessary in light of soils, crops, topography, and tillage methods.

k. Irrigation scheduling and rotation:

Detailed schedule and rotation programs will be developed for each perimeter with general design criteria based on crops, soils, plot sizes, season, and water requirements. The design schedules will include depth, frequency, and stream size. Design stream size should be large enough to assure rapid and efficient field distribution yet small enough to be easily managed by farmers and to discourage significant erosion.

l. User group organization:

The social scientists and extension training specialist will be primarily responsible for this component of the detailed feasibility study, and will present a detailed plan for organization and management of the water user groups for perimeters of various sizes. This plan should cover all aspects of financial and water management, including procurement of inputs such as fuel and oil, system maintenance, storage and transport of fuel, charges and bills to members, operation of the pump and engine, water measurement and scheduling, and settling of disputes. It should also elaborate a system for appointing or electing group officials.

m. Training:

The training studies will detail the type and number of people who should be trained to carry out the work of the user group organization. User in-group organization and training should be initiated as early as possible in the scheduling of perimeter development to allow the user group to participate as fully as possible in planning, design, and construction. Developing a feeling of ownership and responsibility for the system among the user group will be critical to successful perimeter operation and maintenance.

Because the above components are interdependent, careful attention should be paid to their interrelationship and effect on prevailing socioeconomic conditions. The feasibility studies must present viable, complete plans for the individual perimeters as well as general criteria for system design and project site selection in the region.

H. Environmental analysis

The contract team will make an initial environmental examination of the development scheme to determine potential project impacts on the environment, including effects on physical and hydrological resources and public health. They will then recommend measures to mitigate negative impacts.

I. Economic analysis

The economist/development planner will prepare an analysis in sufficient detail to permit an evaluation by financing sources. The analysis will include:

1. Marketing structures: The economist will study the accessibility of products to markets, taking into consideration existing marketing channels and their potential to complement increased and new production.

2. Production: The economist will establish the expected evolution of the cropped area, yields, and production under the project and assess problems related to plant protection, involving use of chemicals, bird pest control, etc.

For each product cultivated, the economist will evaluate the market surplus resulting from project production and additional home consumption. Special attention shall be paid to processing capacities.

3. Farmer's benefits: Using benefit/cost techniques, the economist will calculate the cash flow effects of project activities on farmer budgets.

4. Operating results: The economist will conduct a financial analysis illustrating in detail the project's cash flow over a period of at least 20 years and distinguishing between expenditures in local and foreign currencies. The cost of services provided to the farmer should be calculated on a per hectare basis.

5. Economic returns: The economist will calculate the benefit/cost ratios and internal rates of return for each alternative by projecting the cost and benefit streams and discounting both to present worth by using at least three discount rates. An analysis of the real economic change due to the project's intervention should also be conducted.

The economist will calculate the economic rate of return for the project, including sensitivity analyses of major input and output variables. He/she will also evaluate the project's importance to the region and to the three countries with respect to reducing unemployment, generating income and taxes, foreign exchange savings, and costs.

3.8.3.6. Preparation of Tender Documents

The contract firm shall prepare the Tender documents in a format appropriate for international bidding. These documents should include: information for tenderers, form of tender, form of contract, technical specifications, bid of quantities, and contract drawings.

3.8.3.7. Terms of Reference

The engineers will prepare draft scopes of work (terms of reference) for the supervision of construction for project development.

3.8.3.8. Reports Required

Under the direction of the irrigation engineer, the team will submit the following reports concerning the work performed by the consultant, as specified in the scope of work. All reports should be written and submitted in French and in English and include all relevant data, maps, diagrams, plans, specifications and other documents as appropriate. The following reports should be submitted:

A. Inception Report - Phase I

This report will outline, in narrative and diagrammatic form, the team's detailed organization and work plan for accomplishing the scope of work and appropriate observations.

B. Regular Progress Reports

These reports, to be submitted by the team every two months, should contain a summary of findings, provisional conclusions, and recommendations along with the team's program for the following four months.

C. Interim Report - Phase II

This report will outline the team's orientation towards the project, present a discussion of alternatives and preliminary conclusions, and include additional detail as necessary. The OMVS and USAID's will provide the team with comments on the interim report, which will help guide them in finalizing the project.

D. Draft and Final Report - Phase III

This report will contain all the information required in the feasibility study according to the above terms of reference and the tender documents. The OMVS and USAID's will provide the team with comments on this report for guidance in preparing the final report.

3.8.3.9. Personnel Requirements

	Person/Months
A. IDP long-term technical assistance devoted to studies:	
From-OMVS	
Applied Antropologist	3
From-REDO	
Irrigation Engineer	3
From-Mauritania-RDA	
Agronomist	3
Irrigation Engineer	3
Social Scientist	3
From-Senegal-RDA	
Agronomist	3
Irrigation Engineer	3
B. Contracting Team devoted exclusively to studies:	
Irrigation Engineer Team Leader	12
Irrigation Engineer	6
Agricultural Economist (last 6 months)	6
Soil Scientist	6
Land Use Planner (first 6 months)	3

3.8.3.10. Scope of Work for Contract Technical Assistance Team

A. Irrigation Engineer and Team Leader

The irrigation engineer and team leader will be responsible for the following:

1. Establishing close working relationships with the OMVS Development and Coordination Directorate, the USAID River Basin Development Office, the RDA's and the USAID missions of Mali, Mauritania, and Senegal.

2. Designing a work plan in collaboration with the RBDO irrigation engineer for completing the feasibility studies needed for irrigation development plans. This work plan will be part of the inception report and should include a detailed scope of work for RDA irrigation engineers in the field.

3. Preparing a work plan for all other supporting studies for the design of the irrigation development plans in collaboration with the other members of the team.

4. Supervising and coordinating the work of the RDA irrigation engineers as well as of the other members of the contracting team.

5. Preparing or coordinating the preparation of all reports, including progress reports to be submitted every 90 days.

The irrigation engineer will have the following job qualifications:

Education: A minimum of B.S. (or equivalent) in irrigation engineering with a minor in hydrology.

Experience:

- minimum of five years of experience in design, construction, and operation of small and medium-sized irrigation systems, preferable in developing tropical countries.

- experience in river basin development planning and designing and executing irrigation feasibility studies.

- familiarity with the operation of diesel and electric pumping systems for irrigated agriculture. Fluency in spoken and written French at the FSI-3 level is required.

B. Agricultural Economist

The agricultural economist will be responsible for all economic analyses required to prepare a "ready to implement" development plan that will provide for the following:

1. study of marketing structures;

2. projection of the evolution of cropped areas, yields, and production levels (home-consumed and marketed) under the project;

3. benefit/cost analysis for the farmers;

4. financial analysis for the project;

5. economic returns for the project (either benefit/cost analysis or internal rate of return) with a sensitivity analysis and an evaluation of the project's importance for the region.

The agricultural economist will also participate in preparing all reports and documents.

The candidate should have the following qualifications:

Education: M.S. (or equivalent) in agricultural economics.

Experience: A minimum of five years of professional experience with tropical farming systems, including work with irrigated agriculture, preferable in Africa. The candidate should be experienced in the financial and economic analysis of project design. Fluency in spoken and written French at the FSI-3 level is required.

C. Soil Scientist

The soil scientist will be responsible for:

1. conducting detailed soil classification to establish soil suitability ratings;

2. preparing soil classification maps at a 1/20,000 scale with characteristics regarding land use limitations, drainage problems, and fertilization.

The soil scientist will have the following qualifications:

Education: M.S. (or equivalent) in Soil Science.

Experience: At least five years of professional experience, preferably with irrigation projects. Fluency in spoken and written French at the FSI-2 level is required.

D. Land-Use Planner

The land-use planner will be responsible for interpreting existing aerial photographs and available maps and preparing a 1/10,000 scale map of the project area. He/she will also prepare planimetric and altimetric charts (1/1,000 scale) to serve as a basis for studying plot development and determining unit cost.

The land-use planner will have the following qualifications:

Education: M.S. (or equivalent) in geography, environmental studies, agriculture, or related field with a specialty in remote sensing and mapping.

Experience: in natural resource inventory, mapping, and evaluation from aerial photography. The candidate should have experience in land classification and soil survey interpretation for farm land uses. Fluency level in spoken and written French FSI-2 level is required.

3.8.4. Studies on Land Tenure Policy, Women, and Postoralists

3.8.4.1. Land Tenure Policy

A. Introduction

The process of introducing irrigation in the Senegal River Basin will inevitably involve the acquisition and redistribution of land to a user group or groups. These land transactions should be carried out with care to ensure the continuation of a system of local land administration that secures farmers interests in the land while permitting transfers as the need arises. The current land law and administration systems of each of the OMVS countries are inadequate in this respect.(For further discussion, see the report on "Land Tenure and Irrigated Agriculture in the SRB", Section 2.9 of the Social Analysis.)

A reformed and more complete legal framework would substantially improve the economic viability of projects by :

1. reducing construction costs (currently elevated by delays and/or more costly site choices dictated by land rights patterns),

2. freeing a significant amount of the best land for development (roughly estimated at 20 percent of the "walo" land in the valley) now excluded because nonnational villages own it, and,

3. providing farmers incentives over the long-term for soil conservation and canal maintenance by assuring them a vested and legally secure interest in the land. The issue of long-term social equity should also be considered. For example, no legal recourse exists for transferring lands between villages, and many villages lack irrigable land. Residents of these villages are excluded from new irrigation opportunities and may end up participating in perimeters merely as laborers with no vested interest or hope of gain.

All three countries of the Senegal River Basin have legal frameworks permitting the state to expropriate "unused" land for development. Mauritania and Mali have adopted a rather strict interpretation of this concept. In almost every case where authorities have sought to expropriate land under the law, the local residents have contested, claiming it was owned and indeed used. There is no indication that these cases have been resolved.

Senegal's 1964 National Land Law has been interpreted and applied in different ways in the river basin. Using the law, the GOS decreed the whole Senegalese portion of the river basin a "frontier zone", and authorized SAED to expropriate land for development. Later on, however, a system of local land administration through elected rural councils was instituted. The lines of authority between the SAED and these councils and the means by which the latter will administer irrigated lands are not yet clear. Moreover, a 1977 National Commission reviewing the results of applying the 1964 National Land Law in the Peanut Basin found the rural council to be too large a unit for most matters of land administration, and thus recommended that most of the

council's authority be delegated to village councils. This recommendation may have important implications for small perimeters, which are generally organized and administered by village groups. The elements of a model local land administration system need to be studied and introduced.

B. Implementation plan for land tenure policy studies

In order to implement the IDP land tenure policy studies, the Ministry of Rural Development or of Plan in each country will be asked to establish a Commission on Land Law and Administration. This commission will be charged with elaborating a legal framework and local administration system for the river basin to address land tenure issues. The establishment of this commission will be required as a condition for the start of the land tenure policy study in each country.

The first responsibility of each commission will be to name the institutions to be involved in the study, and to develop a workplan. The IDP will provide a land tenure specialist or other technical expert as requested by each country to help the commissions define the study and develop implementation workplans. The IDP will also provide up to $50,000 to each commission in operating costs to execute the studies. Since each commission is expected to develop its own method for studying and making land tenure policy recommendations, the project has not established a detailed study budget. Each commission will submit its workplan and budget to the OMVS and USAID for approval. Following approval, project funds will be allotted and disbursed locally for each study.

In years one through three of the project, the commission will formulate policy and legal options, with the advice of its own and contractual technical assistants (legal, economic, agronomic, and sociological). The necessary legislative and executive actions for policy implementation should take place by year four. Funding will also be provided for training and orientation sessions for local administrative personnel (of the Ministry of the Interior, the Ministry of Rural Development, the RDA's, and AID project personnel) on methods of implementing definitive or experimental models.

The studies will reexamine the legal and socioeconomic consequences, on the local level, of the current practices of expropriation of land without compensation to owners. The walo lands of the river basin, unlike djeri lands throughout the countries concerned, have traditionally had monetary value and been subject to transactions. Previous government policies of disregarding or denying the economic value of land as a factor of production in development projects may not be viable in the river basin. Both the acquisition process and long-term tenure of irrigated land will be greatly improved by study outputs, including:

1. recommended procedures for determining ownership of land intended for development;

2. recommended formulae for calculating the value of lands to be expropriated, including loss of use during construction;

3. recommended formulae for calculating the value of investments in infrastructure to develop the land;

4. recommended procedures and options for compensation to owner villages and families (in land exchanges, cash, lump sum or extended payments, food, etc.);

5. scope of work for personnel responsible for negotiating acquisitions and exchanges;

6. training materials and sample documents for land tenure issues to be established by villages, and overseen by rural councils and/or local administration;

7. rules for distributing plots in irrigated developments;

8. rules governing tenure, inheritance, and transfer of plots, recognizing the value of the farmer's investment in the land. These rules should take into account the following:

a. that in order to maintain the fertility of irrigated lands, farmers must put considerable labor and inputs into leveling, canal maintenance, and soil conservation measures. Ownership is the best means of providing them the vested interest and incentive to make this effort and investment. If they merely plant and harvest, as is often the case, both the fertility and the infrastructure decline rapidly, and within a few years, the initial capital investment will have totally depreciated.

b. that transfers must not be allowed to lead to either fragmentation of plots, overly large holdings, or absentee landlordship. Minimum and maximum holding sizes should be established, as has been done in a number of North African countries.

One model of ownership rights that should be considered is a form of homesteading, essentially a modification of the current system for rural holdings, but requiring an eight or ten-year period of use and development to secure title. This period would allow authorities to determine whether the farmer has in fact maintained canals and used soil conservation measures.

Upon completion of the studies and formulation of draft laws, Senegal and Mali (in project year five or six) will hold national colloquia on land tenure in irrigated agriculture, at which the reports of the studies will be thoroughly discussed. Mauritania has already scheduled national colloquium on land tenure, with separate financing. Participants in the seminars will include personnel of all ministries concerned with rural development (including Ministries of the Interior, Water and Forests, Livestock, and Rural Development) as well as RDA's, AID project personnel, and OMVS representatives.

In the final year of the project, OMVS will sponsor a colloquium for the three countries, in which the above participants can compare ideas and experiences.

C. Resources needed for studies

Personnel	Source	Level of Effort
OMVS Study Director	OMVS	6 months
Anthropologist	OMVS/IDP	6 months
Land Tenure Specialist	Contract	6 months
Regional Consultants	Contract	9 months
Member State Professionals	Member States	12 months
National Consultants	Contract	9 months

The contract anthropologist provided by IDP to the OMVS will act as regional co-director of the study along with someone named by the OMVS from the Directorate of Development and Coordination. These two will oversee the entire study, assist the national commissions as required, develop terms of reference, and direct contracting for regional and national consultants needed for the studies. They will be assisted by a land tenure specialist who will conduct special short-term studies, organize the colloquia, or undertake other specialized tasks.

Operating Costs

The project will provide a modest amount of operating support to the three National Commissions on Land Law and Administration according to the workplans and budgets approved by CIERDA. Up to $50,000 per country is budgeted for this support.

3.8.4.2. Studies on Women and Pastoralists

A. Introduction

These studies will systematically examine the actual and potential impact of SRB development activities on women and pastoralists. The research will be concerned with two principal issues:

1. immediate and long-range effects, and

2. strategies to mitigate negative consequences and maximize benefits to these groups.

The senior applied anthropologist posted at OMVS will work with women-in-development specialists, social scientists, and consultants in each national program in formulating the detailed plans for these studies. Full-time project, staff will execute much of the field work, while field research assistants will work on specific problems. All these research activities will be coordinated through the OMVS Project Management Unit. To make best use of professional staff and fulltime field personnel, these studies

will be fully coordinated with the monitoring/evaluation system and baseline surveys. The studies, conducted during the first few years of the project, will include specific recommendations for mitigating negative effects and increasing opportunities for these groups. As recommendations are incorporated into project activities, the OMVS Management Unit will monitor and evaluate their results.

Below is a preliminary list of studies, which could be modified as the project is implemented. The OMVS and IDP regional contractor will prepare more detailed terms of reference and a workplan for the implementation of each study for USAID/RBDO approval prior to the disbursement of funds for the study.

B. Women

This study will examine the impact of development, particularly irrigated agriculture, on the organization of women's activities, their health status, and their access to development resources and benefits. Key questions to consider are the extent to which irrigated agriculture increases the demand on women to provide agricultural labor and how this demand affects their other roles and responsibilities. This is an especially important issue in the upper valley, where much of the male adult labor force is absent from villages for extended periods. Increasing family pressure on women to allocate greater amounts of their time to agriculture may become a source of conflict, possibly leading to family dislocation and migration. It may also pressure women to enter the workforce at an earlier age, thus disrupting traditional patterns and expectations. As women increase their participation in agricultural production on irrigated perimeters, they will be increasingly exposed to water-borne diseases. Studies on women in rice growing regions in the Gambia indicate that they have a higher prevalence of disease and shorter life expectancy than men. A cooperative research effort between social scientists and health personnel will be needed to determine the prevalence of these diseases and to design health education and other measures to minimize the negative impacts. Another health-related issue is the potential impact of increased agricultural responsibilities on attitudes and behavior regarding family size. Since irrigated agriculture is labor intensive, women may consider it profitable to have more children. The study will examine the extent to which this hypothesis is valid and consider the potential impact of increased natality on women's health status.

A third concern is women's access to development resources. Current development activities are planned and implemented by male RDA technicians with little attention to their impact on women or towards the special needs of this group. While preliminary data indicate that women do share in the development activities and in the benefits, their degree of equity and participation in decision-making must be investigated. This study should result in a long-range plan taking into account women's concerns and integrating them into a more balanced strategy of development participation and resource allocation. The study will recommend specific organizational changes in the RDA's and in village associations as well as technological innovations to increase women's access to resources and the rate of return for their labor.

The OMVS, IDP, and RDA staffs will plan and implement this study, integrating the section concerning Bakel, Gouraye, and Kayes into the long range development plan for the upper valley.

C. Pastoralists

A major long-term study on the pastoral systems in three major ecological zones of the basin will be designed and implemented under IDP. This study will describe the adaptive strategy of pastoralism within each of the zones, the impact of the drought on their societies, and their post-drought patterns. The study will also examine the establishment of permanent settlements, the introduction of agriculture as an additional productive activity, and the nature of pastoralists' relationships to agricultural villages. With regard to the IDP, the study will examine pastoralists' participation and interest in irrigated perimeters and the immediate and long-range impact of these perimeters on their traditional herding strategies.

The study will guage herders' knowledge and attitudes towards these changes and their opinions on how to mitigate the negative effects and profit from new opportunities. This information can be used to develop intervention strategies for adapting traditional herding practices to the new emerging ecological context of the Senegal River Basin.

Specific issues to be investigated include:

- alternative systems of forage production (dryland or farming, controlled flooding);
- cultivation of food crops adapted to seasonal movements;
- improved animal health and range management practices;
- establishment of permanent and/or semi-permanent settlements and the introduction of mixed-farming systems (in dryland and/or irrigated zones);
- how pastoralists can influence decision-making at the village and regional levels to ensure that their needs for access to water and land are taken into account as irrigated perimeters expand.

The study will consist of the following phases:

Year 1. Literature review, field reconnaissance surveys, establishment of working relationships with host country institutions, design of data collection instruments, and recruitment and training of local personnel in Senegal. The first year's fieldwork will focus on Senegal and will be primarily concerned with refining the methodology and testing of survey and observation instruments.

Year 2. Recruit and train staff for Mauritania and Mali; conduct research.

Year 3. Complete field research and write final report.

D. Resources Needed for the Studies

Personnel	Source	Duration
Anthropologist	OMVS/IDP	12 months
Social Scientists (5)	National/IDP	2 months (each zone)
Research Support Staff	Contract	12 months
field supervisors enumerators interviewers translators drivers		($50,000 total)

E. Operating Support

Operating support will be required for vehicles, travel and per diem, survey materials, office supplies, secretarial, and data processing support. This is budgeted as part of the operating costs for the Project Management Unit with the OMVS.

3.8.5. Fishing Estuary Study

3.8.5.1. Introduction

The Environmental Study for the SRB (AID Project No. 625-0617) identified adverse impacts of the ecosystem of the Delta through the destruction of the habitat of certain species of aquatic life resulting from the construction and operation of the Diama Dam.

While the construction of the Diama Dam is a keystone of the OMVS program for the economic development of the Delta, its operation will disrupt the salinity gradient and most likely lead to the elimination of certain aquatic species and a decrease in food supplies for fish-eating birds in the Senegal River. A considerable number of fishermen depend on the Delta fish for their livelihood and their catches provide an important source of protein for the populations along the river.

In light of these factors, it was recommended that high priorities be assigned to the following:

- protecting representative samples of the ecosystem currently existing in the Delta,
- providing opportunities for local fishermen to continue their livelihood, and
- providing a continued source of protein for the populations of the Delta.

To mitigate the adverse ecological impacts of dam construction, the fisheries section of the SRB environmental assessment suggests the establishment of an artificial estuary in the Diaouling-Tianbrank area of the Delta through the construction of a canal from the Senegal River at Debi to Tianbrank. The SRB environmental assessment establishes a positive benefit-cost ratio through a prefeasibility analysis.

It is extremely important to understand that one or two years after the Diama Dam is closed, the threatened species will have disappeared from the river. Construction on the dam began in November, 1981, and its completion is scheduled for 1986. Preliminary engineering and feasibility studies on the proposed canal at Debi should thus be completed in time to attract the funding to ensure that the canal is constructed and operating prior to closure of the Diama Dam.

The following pages outline in detail the Gannett Fleming's proposal to the OMVS for preliminary engineering and feasibility level studies designed to provide the information required to attract international lending institutions to finance construction of this canal.

3.8.5.2. Background

Every year during the dry season, salt water from the Atlantic Ocean intrudes into the Senegal River Delta (see Figure 2). Salt water intrusion usually begins in November/December as the floodwaters of the Senegal River recede and tidal processes push ocean water upriver. The salt water intrusion process creates a salinity gradient that gradually moves upstream. Salinities vary from 35 milligrams per liter on the ocean side of the gradient to less than one milligram per liter at the upstream freshwater interface. At the end of the dry season in June/July, salinity concentrations can be detected in Podor, located about 200 kilometers up stream of the mouth of the Senegal River at Saint Louis.

Many fish and invertebrates depend on the saltwater gradient to travel between waters of high and low salinity. Some important commercial fish species, such as Ethmalosa frimbriata (African Shad), Mugil curema and Liza grandisquamis (mullets), Elops senegalensis and Elops lacerta (ten-pounders), as well as two invertebrates, the Penaeid Shrimp (Penaeus duo arum) and the Blueclaw Crab (Callinectes spp.), depend on these conditions to spawn.

In addition, the Senegal River Delta is an important feeding and nursery area for many other estuarine and fresh water fishes, such as Sardinella eba, and Pellonula afzeliusi, a less conspicuous but important fish in the food chains of the estuary.

Many bird species derive their food from the fish mentioned. Most important bird species found in the Senegal River Delta include:

Ciconiiformes (in particular Numenius nycticorax, Ardeola ralloides, Bubulcus ibis, Egretta alba, Egretta intermedia, Platalea alba, Threskiornis aethiopicus, Phalocrocorax carbo, Pelecanus onocrotalus, Phoenicopterus ruber, Phoeniconaias minor, Platalea leucorodia and Recurvirostra avosetta).

The Delta is a principal wintering area for paleartic ducks and a breeding ground for Ethiopian ducks. It is also an important resting place at migration periods and serves as a wintering ground for herons, waders, gull, and terns.

3.8.5.3. The Problem

The development plan for the Senegal River Basin includes the construction of the Diama Dam located approximately 40 kilometers upstream of Saint Louis (see Figure 2). The primary functions of the Diama Dam are to act as a barrier against saltwater intrusion into the area upstream of the dam and to provide freshwater storage for irrigation purposes.

Dam construction will destroy estuarine conditions in the Delta above the dam. The water upstream of the dam will be fresh year round, while that downstream of the dam will be ocean water during the dry season and fresh water, due to spillages from the Diama reservoir, during the peak of the flood season. Most importantly, the formation of the salinity wedge moving upstream during the dry season will disappear. According to findings mentioned earlier, the disappearance of the salinity gradient from the Senegal River Delta during the dry season will have a profound impact on the fisheries and ecology of the Delta. Many of the fish species and invertebrates that depend on the existence of the salinity gradient during the dry season to complete some phase of the life cycle, including the commercial species listed previously, will thus disappear from the Senegal River estuary. Local fishermen's catches will decrease drastically, depriving them of their traditional occupation and resulting in a decline in the protein supply in the area. Other animals, especially birds, which feed on these fish will experience a decrease in food supply. It should be emphasized here that the construction of a fish ladder or bypass in Diama Dam would not ameliorate the situation, since fish could not adjust physiologically to the sudden change from salt to fresh water and from fresh to salt water.

3.8.5.4. Proposed Solution

To offset the loss of estuarine conditions in the Senegal River Delta, the environmental study suggests the creation of estuarine conditions in the Tianbrank-Diaouling complex (see Figure 2). This body of water consists of the two depressions of Tianbrank and Diaouling connected to the Senegal River via the Tiallakt Bell. The Tiallakt Bell enters the Senegal River a few kilometers downstream from the proposed Diama Dam. The surface area of the Thianbrank-Diaouling depressions is about 1,500 hectares. The depressions are recharged by natural rainfall and from spills from the Senegal River during flooding.

If enough fresh water from the Diama reservoir were to be transferred to this complex via a three to four kilometer long canal constructed in the Deli area, it would be possible to create estuarine conditions in the Tianbrank and the Tiallakt Bell during the dry season. This scheme would allow a portion of the estuarine fishes and shellfishes to use this area as a bypass to the main Senegal River channel for their migrations.

The benefits of the proposed scheme would be the continued presence in the Senegal River Delta of many fish and shellfish species that otherwise would disappear. Harvesting of fish by local fishermen would provide the continuation of traditional employment and sustain a supply of protein to the local population. In addition, the local and migrant bird populations can be expected to use the Tianbrank-Diaouling area as a new food source after the construction of the Diama Dam.

3.8.5.5. Objective of the Study

The objective of this proposed preliminary engineering and feasibility study is to provide OMVS with a system for taking measures to minimize the destructive effects of the construction of the Diama Dam on natural habitat and thus ensure the survival of aquatic species in the Delta. To meet this objective, we propose to investigate:

- the biological feasibility of creating an artificial estuary in the Tianbrank-Diaouling complex, taking into consideration the requirement of major fish and shellfish species as well as the preservation of a representative sample of the ecosystem currently existing in the Delta;

- the technical feasibility of creating the artificial estuary with regard to hydraulic and civil works and to prepare preliminary engineering designs for all proposed bydraulic structures; and,

- the economic feasibility of creating this estuary, through an analysis of the benefits to be derived from fish harvests, employment, and food considerations against the costs associated with tranfering water from the Diama Reservoir to the Tianbrank-Diaouling Estuary.

3.8.5.6. Study Implementation Plan

Figure 3 systematically diagrams the work necessary to achieve these objectives. Work is divided into three main phases:

- field surveys

- biological and technical analyses

- economic analyses

Task Descriptions

Task 1: Mobilization
Team assembly, material collection, and field trip preparation.

Task 2: Biological field survey

The Garnett Fleming team completed extensive aquatic and terrestrial field surveys in the entire river basin during the environmental assessment project. Data collected for these surveys will be useful for this

study. Additional detailed field work will be necessary to answer specific questions relating to the proposed study area during the dry season and during the turnover period at the beginning of the annual flood.

The following field work is proposed:

- Seining should be done throughout the Tiallakt Bell-Tianbrank-Diaouling complex to determine its suitability as a nursery area. Sampling should be conducted during the dry season, when saline conditions prevail, and during the salinity shift at the onset of the annual flood. To begin to understand the total ecosystem, it will be necessary to observe aquatic plans, birds, and invertebrates.

- Salinity measurements and dissolved oxygen determinations should be made as fish are collected.

- Seining in the estuary and the Senegal River channel will be necessary to augment information already gathered during the environmental assessment. This field program will improve our understanding of the relationships between physical water characteristics, such as salinity, flow turbidity, and use of the area as a spawning ground and nursery for juvenile fishes. This information will serve as the basis for determining the flow and salinity conditions under which the threatened estuarine species can reproduce and thrive.

- Some library research in the U.S. will be necessary to collect information on items such as swimming velocities, salinities, and migration lengths required for spawning and specific gravity of eggs.

Task 3: Topographic and Bathymetric Surveys

Because little is known about the topography and water depths in the Tiallakt Bell-Tianbrank-Diaouling complex, it will be necessary to develop accurate topographical and bathymetric information. The surveying effort will include taking cross-sections at 1 kilometer intervals between the point of confluence of the Senegal River and the Tiallakt Bell and the northern most point of the Tianbrank depression. To determine the optimal routing of the canal between the Senegal River and the Tianbrank, a general topographical survey will be conducted to establish alternative canal routes. The most favorable routes will be further surveyed in detail. Upon final selection of a route, several soil samples will be taken along its axis.

Task 4: Determination of Future Salinity Gradient

After the biological and physical surveys are completed, data will be analyzed to delineate salinity and flow conditions that should be created in the Tiallakt Bell-Tianbrank-Diaouling complex to allow for the reproduction, growth and migration of estuarine species.

Task 5: Preparation of Data for Salinity Model

The flow necessary to create conditions determined in Task 4 will be ascertained by using the mathematical salinity model applied in the Gannett Fleming environmental assessment project to simulate existing and future salinity conditions in the Senegal River for several flow ranges. In Task 5, the cross-sectional and topographical information obtained during Task 3 will be converted into input data for the salinity model.

Task 6: Iterative Modeling to Determine Flow from Diama Reservoir

The model prepared in Task 5 will be used to calculate salinity gradients throughout the Tiallakt Bell-Tianbrank-Diaouling watercourse for a spectrum of different freshwater releases from the Diama Reservoir until the flow release pattern that matches the salinity conditions specified in Task 4 is identified.

Task 7: Determination of Future Fish Harvests

Based on the results of Tasks 2 and 4 and on information already developed in the environmental assessment, future commercial fish harvest will be projected.

Task 8: Determination of Benefits Derived from Future Fish Harvests

Future fish harvests are expressed in terms of their economic value. The benefit analysis will include a quantification of benefits for employment, food production, and wildlife preservation.

Task 9: Preliminary Engineering Design of Canal

Based on the topographical information gathered during Task 3, a canal will be designed to supply the flows specified by Task 6. The canal design will include hydraulic structures required for flow regulation.

Task 10: Cost Determination for the Canal at Debi

Constructions costs will be determined for the canal designed in Task 9.

Task 11: Benefit-cost Analysis

This analysis will compare costs developed in Task 10 and benefits determined in Task 8 in order to establish the economic feasibility of the project.

Task 12: Final Report Preparation and Translation

3.8.5.7. Resources Needed for the Fishing Estuary Study

A. Personnel:

- Fisheries biologist	4 months
- Hydraulic Engineer	6 months
- Technician (topographic and bathymetric surveys)	3 months
- Support personnel	3 or 4 months each
1 secretary	
1 draftsman	
2 cooks	
2 drivers	
2 surveyor's helpers	

B. Operating support

Most operating equipment will be supplied by the OMVS or under the IDP, including vehicles, field and office equipment, and some technical equipment. Other operating support would include vehicle operations and maintenance, travel and per diem, and field logistical support.

C. Work schedule

Field work requirements will dictate the starting date of the proposed study. Topographical surveys as well as a part of the planned biological survey should be conducted during the dry season. The timing of other biological surveys will be governed by the arrival of the annual flood. In light of these limitations, the best time span for the field work would be from June to August. We therefore propose that the starting date of the proposed study be set at June 1, and that the duration of the study be set at five and a half months.

3.8.6. Telecommunications Policy Study

3.8.6.1. Introduction

The lack of an adequate basic telecommunication infrastructure in the Senegal River Basin represents a serious impediment to the long-term economic and social development of the area. It impedes not only the effective implementation of donor-sponsored development projects, but the establishment of a healthy private commercial sector. Empirical studies and projections of the economic benefits of basic telephone services to small rural industries from Kenya and Egypt in particular indicate that effective telecommunication services between suppliers, customers, and other parties can aid significantly in overcoming productivity losses occasioned by manpower wastage, time loss in travel, and other sources of inefficiency in the economic sector. In the Bakel region, for example, several hectares of rice perimeters were lost when timely warranty maintenance service could not be obtained for a broken pump.

Such examples have led managers of development projects in the river basin to consider purchasing project-specific HF radio systems allowing the relay of

information and short messages to field operations. Although such systems respond effectively to immediate, specific, pressing needs, they do not solve the long-term telephone service requirements of the region as a whole. The systems communication services are limited to a specific number of sets and do not allow for interconnection with the larger telephone system. Access to the system is also limited to a defined number of clientele; thus overall private and commercial operators do not benefit from these services. Further, the proliferation of private systems constrains the efficient development of telephone infrastructure by removing consumer demand for system expansion and by diminishing the possibilities for achieving the economies of scale vital to a telecommunication infrastructure. Private systems also require regular maintenance by organizations often inadequately equipped; thus marginally-operating private systems proliferate while public systems remain inadequately developed.

3.8.6.2. The Problem

Of the three OMVS Member States, Senegal has the best telecommunications system in the Fleuve region. Unfortunately, this system has met with serious managerial and technical problems.

In response to the immediate pressure to provide reliable communication service to the most remote field development around Bakel, we propose that a satellite-based pilot project be established to create specially designed technologies, such as solar power generation, as well as modular earth station designs for limited extension to smaller sites. Field experience with these technical features would provide valuable first-hand experience with rural satellite technology.

In Mauritania, reliable telecommunication lines along the Fleuve, in the river basin, or even between key centers are virtually nonexistent. Kayes, Mali, is served by the Panaftel system, but this system does not extend into the rural areas. Before the existing systems are expanded or HF or other private, single-use systems proliferate, a comprehensive assessment should be made of long-term telecommunication requirements of the total river basin to ensure that long-term goals for the region materialize. For example, river basin development is expected to increase private commerce, river navigation and trade, and private sector product commercialization. It is also expected to promote intensive monitoring of groundwater levels and health conditions and dissemination of agricultural research and technologies. Effective telecommunication services can play an integral role in the entire development process.

Over the past decade, significant advances in thin-route satellite communication have been made. Systems are increasingly effective in fulfilling the communication requirements of areas whose needs are limited to a few telephone channels, radio, and possible television services. Over the past few years, a series of regional or continent-wide studies or proposals for satellite services have been undertaken by a wide variety of agencies and interests, including UAPT, PATU, ITU, and Eurospace. An African satellite system using high-powered transmission that allows for inexpensive earth stations is expected to be operating before the end of this decade. At present, however, the INTELSAT satellite system is available to provide some

of the services required in rural areas. One advantage of this system is that interested parties can lease INTELSAT service on an incremental basis, thus beginning with a minimum satellite lease that can be expanded as capacity requirements increase. This system requires heavy initial investments. Many countries, such as Columbia, Mexico, and India have taken this approach, initiating their domestic satellite system development with INTELSAT they will later consider purchase and operation of their own system once traffic demands warrant such investment. Today, seven African nations are using INTELSAT for domestic telecommunication services; four more, including Mali and Mauritania, have notified INTELSAT of their intent to lease capacity in 1984.

Satellite communication systems are unlikely to replace terrestial systems. Experience, cost, and traffic projections show that the two systems can jointly provide the best telecommunication structure for a country or region. An advantage of satellite communication is that one station's malfunction (for whatever reason) does not affect the performance of any of the other stations, as is the case with microwave services, for example. Satellite facilities can be installed according to demand and need not follow the systematic "branching" structure of terrestrial systems, which extends trunking from the most dense to the least populated areas in a linear manner. An advantage for rural environments is that satellite communications are insensitive to distance, i.e., a call from a nearby village could cost the same as from a distance one. In addition, relatively limited infrastructures (access roads, power grids) are required to install such services. Finally, the relatively low capacity of individual earth stations allows for wind or photovoltaic power sources, unattended operation, and relatively little maintenance.

Satellite installations are not suitable everywhere. For example, depending on traffic density, terrain, and socioeconomic and demographic characteristics, optional distances between earth stations may range to several hundred kilometers. Requirements between these earth stations are best served terrestially. Where a good microwave system exists and the supporting infrastructure is in place and functioning, it may be preferable to expand the existing system.

Many African States have undertaken analyses of their domestic satellite service requirements. The SRB activities, primarily regional in nature, necessitate a new approach to this kind of analysis. For example, the network of agricultural research stations in Senegal, Mauritania and Mali must not only be linked to the national domestic telecommunication system, but may ultimately warrant a subnetwork directly connecting each station with one another and with other institutions outside the region. The same argument applies even more strongly to the monitoring of groundwater levels, floods, and health and environmental factors. Thus, the OMVS, as the regional coordinating organization, will have a particular role in the development of a regional telecommunication system.

Developing such a regional approach to telecommunication services should be the concern of all OMVS donor agencies. Each developmental intervention of the SRB will be more effective if it can be developed, implemented, and monitored through a basic, reliable telecommunication service. As well as drawing direct benefits and service from such a system, donor agencies can

play a significant role in assisting OMVS countries to obtain the capital to initiate the system and in securing funds for its operation and maintenance until it becomes economically viable on the basis of tariff and service revenues. As stated earlier, the advantage of a largely satellite-based system is that it can be developed and funded in increments and thus would not require immediate vast expenditures.

It is important to note that the river basin telecommunication program is not designed to provide a high telephone density or to anticipate many private subscribers. The design objective is to ensure service to significant enterprises, entities, and other essential special users whose impact on the rural economy at a national level is catalytic or fundamental to the economic and social processes. For example, many sites of major development organizations or programs should be able to communicate with each other via reliable telephone services, and population centers should have access to public call office facilities.

3.8.6.3. Proposed Approach

The IDP will sponsor a policy study as part of the overall activities to analyze the comprehensive telecommunication requirements of the river basin both for the developmental and private commercial sectors.

One goal of the study would be to project requirements that must be met in the next decade for the effective administration of development outputs such as management information systems, project implementation and supervision, provision of inputs and services, monitoring of environmental conditions such as water levels and flood conditions, providing back-up services for agricultural research and agricultural extension work, providing back-up services for the basic primary and public health care service system, including monitoring of health conditions, and pharmaceutical supplies control, as well as support to the primary education system for managerial and logistic matters. In addition, the study would project and analyze requirements of the emerging private sector in the river basin. This information base would be established through discussions between and program analysis of all OMVS donors, as well through bilateral programs in the river basin. The study would set key private sector industrial and commercial requirements on the basis of OMVS goals and discussions with representatives from the key sectors such as banking, transportation, small-scale processing industries, and commerce. The analysis should consider policies and practices in each of the three countries regarding cross-border commerce, scientific exchanges, and other issues.

In addition, the analysis should identify potential economic and social development benfits of telecommunication to the SRB. Such benefits might include administrative effectiveness and efficiency, savings in productive management and labor time, transportation trade-offs, more effective use of existing transport resources, gain in industrial capacity efficiency, improved ties between producers and markets, and improved investment decisions regarding supplies.

The study should make as complete an inventory as possible of the existing and planned telecommunication system in the river basin, including systems in

place or planned by the public telephone carriers and of the private interests. It would identify performance, problems, and potential of these systems and assess their total capital as well as operation and maintenance (O&M) costs. Demographic and geographic data would be arranged in a suitable format for the analysis.

On the basis of the above needs assessment, the study would project the amount of telephone traffic and its flow between the key sites for the short- and long-term, and determine whether telephone, facsimile, telex, and data services are required, and whether radio or TV services are desirable. The best mix of satellite and terrestrial systems to satisfy these needs may be modeled using existing (INTELSAT and Telecom-1), planned (ABABSAT), and potential (AFSAT, AFRISAT) space segment capacity.

Models would be developed for financing capital and O&M costs. The revenues of the system can ultimately be expected to carry the O&M costs, and may allow back payment of capital costs. It would be a goal of the study, however, to project larger economic and social benefits of a reliable communication system extending beyond the issue of rate of return on the investment. These benefits should be factored into the model to demonstrate to donors and OMVS member states that telecommunication investments in rural areas can yield substantial secondary benefits for both the development and the private sector and to encourage them to develop fresh approaches to financing these systems. This study would relate past discussions on these issues to present conditions of the river basin. The proposed pilot project in Senegal included in the IDP would also be designed to gather data on telecommunication benefits.

Lastly the study would analyze and develop institutional arrangements for a regional and integrated approach to telecommunications. Just as a regional development coordination body such as the OMVS can only be as effective as its institutional structures, so the arrangement of appropriate structures is critical to an integrated and harmonious telecommunication system. The study should also address a series of policy matters, including INTELSAT rates for regional services and possible cost and revenue-sharing arrangements among participants. Member states can draw on existing models and past experience to some extent in these matters.

The administration of this study will be coordinated through the Applications Management Contractor of the AID Rural Satellite Program for USAID/OMVS. Appropriate authorities of the OMVS member states and a limited number of outside experts identified or sponsored by some of the key regional donors would participate in administration. The study would try to seek cooperation among a variety of sectors, including the AID telecommunication sector, the Export-Import Bank, OPIC, the World Bank, the African and Arab Development Banks, the ITU, UNDP, the French Caisse Centrale, the EEC-FAC, the KFW, the GTZ, CIDA, and regional concerned African organizations, including the Pan-African Telecommunication Unit, the Union de Postes et Telecommunications d'Afrique, and the Union des Radios et Televisions Nationales d'Afrique.

3.8.6.4. Expected Outcome

A key institutional outcome of the study would be to strengthen OMVS's role in donor and policy coordination. OMVS would be one of the primary beneficiaries of the resultant technical system, which would help the organization to administer, monitor, and evaluate the river basin activities and to operate a project implementation and financial monitoring system.

The study would set forth a series of recommendations on the design installation and operation of a regional telecommunication system. It would also identify donor interest in contributing to such a system, as well as assess the likelihood of member state agreement with and consent to institutional and financial recommendations, timelines, and system design.

	M 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
3 ag ec/dev planners at OMVS headquarters. Preparation of work plan.	—														
- Transfer to Bamako, Nouakchott and Saint Louis. Formal contacts established with host country institutions and USAID missions.		—	—	—	—	—	—	—	—	—	—	—			
- Primary data collection and compilation of existing data.															
- 1st regular meeting with host country institutions and USAID missions.	--------	x													
- 2nd regular meeting with host country institutions and USAID missions.	----------	----------	----------	----------	----------	x									
3rd regular meeting with host country institutions and USAID missions.	----------	----------	----------	----------	----------	----------	----------	----------	x						
- Agriculture and livestock studies									—	—	—	—			
- Preparation of first draft of subregional scenarios.										—	—	—			
- 4th regular meeting with host country institutions. Review of subregional scenarios.	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	x			
- Transfer of the 3 ag. ec. to OMVS headquarters. Arrival of the rest of the team. Review of subregional scenarios. Preparation of work plan to complete the scenarios.												—	—		
- Additional studies.													—	—	—
- Meeting with OMVS, and RBDO.														—	—
- Preparation of evaluation of SRB's situation and overall development scenarios.															—
- Review of scenarios by host country institutions, OMVS, RBDO, USAID missions. Choice of one scenario.															—
- Preparation of TOR for feasibility analyses for carrying out chosen scenario towards implementation.															—

FIGURE 2. SALT WATER INTRUSION IN THE SENEGAL RIVER BASIN

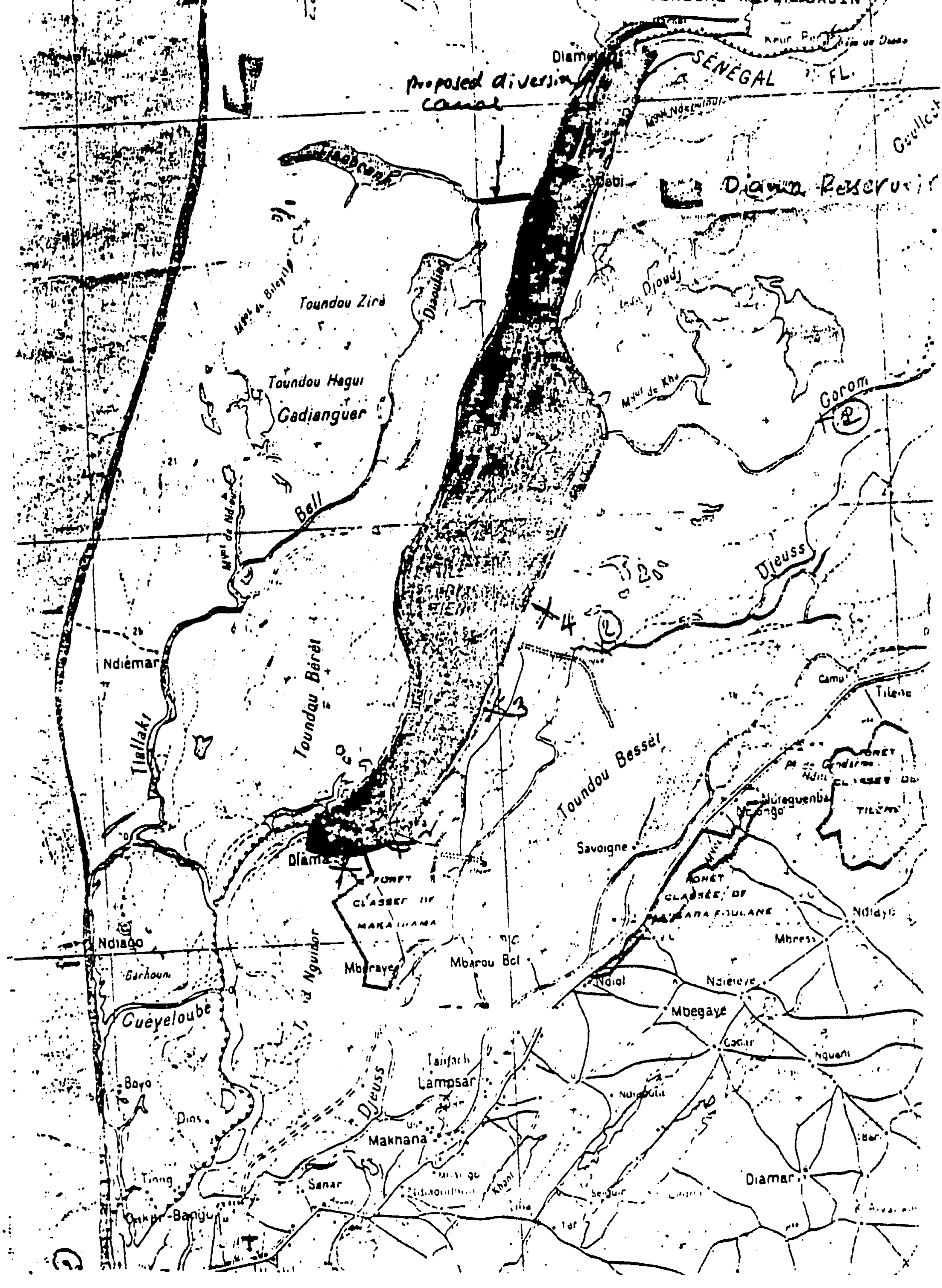
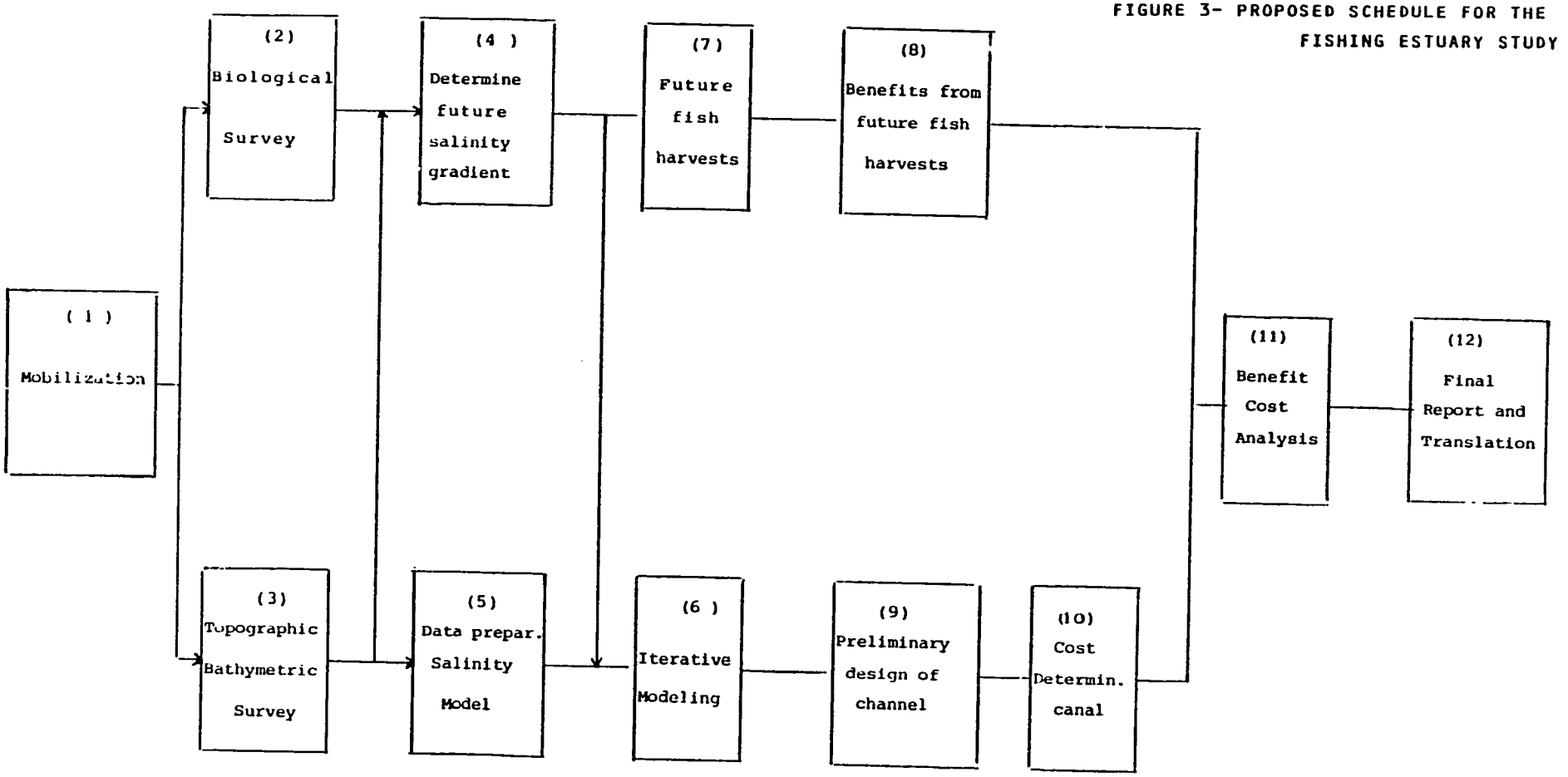
FIGURE 3- PROPOSED SCHEDULE FOR THE FISHING ESTUARY STUDY