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A USERS MANUAL FOR THE COST ALLOCATION MODEL SENEGAL RIVER BASIN DEVELOPMENT PROJECT

Prepared by
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October 1984

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TABLE OF CONTENTS

Page

INTRODUCTION..... 1

Overall Model Structure..... 2
Model Indirect Command Files..... 8

AGRICULTURAL BENEFITS..... 11

Input Data for the Agricultural Benefit Model (AGBEN)..... 11

The agricultural economic sector input data (AGTAB.PRE and AGDATA.OUT)..... 11
Revenues from animal husbandry..... 17
The agricultural area data (AREA.DAT) and AREA.OUT..... 18
Area program (AREA.FTN)..... 23
Interactive input data..... 23

Algorithms of the Agricultural Benefit Submodel (AGBEN.FTN)..... 25

Non-project costs..... 26
Water requirements..... 27

Output from the Agricultural Benefits Model AGBEN..... 28

NAVIGATION BENEFITS..... 33

Input Data for the Navigation Benefits Model (NBEN)..... 33
Navigation Volume Data (input data NAVTAB.PRE and AREA.DAT)..... 34
Navigation volume program (NVOL.FTN)..... 34
Output Data Files (NVOL.DAT and DELAY.DAT)..... 37

NVOL.DAT..... 46
DELAY.DAT..... 46

Navigation Benefits Program NBEN..... 46

Input data..... 46
Interactive data..... 46

Algorithm of NBEN.FTN..... 51

Detailed navigation benefit model..... 51
Output..... 52

TABLE OF CONTENTS (Continued)

Page

ENERGY BENEFITS 65

Energy Benefits Submodel (ENBEN) 65

Energy consumed 65
Detailed energy benefit model 65

Input data format for ENBEN (ENERGY.PRE) 67
Output of ENBEN model 67

PROJECT COSTS 75

Project Cost Model (COST.FTN) 75

Detailed cost model 75
Input data format 80

Output from the COST.FTN model 82

COST ALLOCATION 89

The Allocation Model 89

Allocation data 89
Allocation variables and methods of input 90
Calculation of separable costs 90
Calculation of alternative costs 92
Detailed description of cost allocation procedures 93

Input Data Format for the Allocation Model 93
Output from the Allocation Model (ALLOCA.OUT and ALLOCA.DAT) 94

LOAN SUBMODEL 97

Input data 97

MLOAN.PRE 97
MLOAN.FTN 104

Output 113

MPAY.OUT 113
MLOAN.DAT 113
MCOST.OUT 114

TABLE OF CONTENTS (Continued)

Page

USER FEES 117

Input Data..... 117

ALLOCA.DAT..... 117
AGBEN.OUT..... 118
NBEN.OUT..... 118
ENGBEN.OUT..... 118
Interactive input..... 118

Program FEES.FTN..... 118
Output data..... 119

PROJECT REVENUE..... 125

The Revenue Model (REVENU)..... 125
Input Data Format for the REVENU Model..... 125

Input Files PWQ.DAT, NAVG.DAT, and AGQ.DAT..... 125
Output from the REVENU Model..... 127

ACCOUNTING SUBMODEL..... 131

The Preaccount Program..... 139

Preaccount data..... 140
Input data format for the PREACC.FTN Model..... 140
Operation of PREACC.FTN..... 142
Output from the PREACC.FTN Model..... 142

Accounting Program (ACCOUN.FTN)..... 142

Input data..... 143
Output files..... 150
ACCOUN.OUT..... 150

Discussion of Selected Model Output..... 153
Key Calculation.. 154

INCLUSION OF THE ENVIRONMENTAL COSTS INTO THE COST ALLOCATION
OF THE SENEGAL RIVER DEVELOPMENT PROGRAM..... 157

Introduction..... 157
Description of Programs..... 157

FLOOD.FTN..... 158
Input files..... 160
Output file..... 161
FISH2.FTN..... 161

TABLE OF CONTENTS (CONTINUED)

Page

Input files FLOOD.OUT and FISH.IN..... 167
Output file FISH2.OUT..... 167
Program FOREST.FTN..... 167
Input files..... 175
FOREST.IN..... 175
Output FOREST.OUT..... 175

RECOMMENDATIONS..... 177

REFERENCES..... 179

Appendix A: Glossary of Terms..... 181

Appendix B: Demonstration Run of Model..... 183

Appendix C: General Discussion of Indirect Command Files and Command Line Commands..... 201

Appendix D: Supporting Data for Environment Cost Calculation from Gannett-Fleming (1979)..... 207

Appendix E: Computer Program Listing..... 215

LIST OF TABLES

Table		Table
1	Areas of wet and dry season crop as a percentage of the total agricultural area in the Senegal River Basin Development Programs	17
2	Composition of the irrigated theoretical hectare expressed as a percentage of the total agricultural area in the Senegal River Development Program	17
3	Livestock products per theoretical hectare	23
4	Accounting transactions	144
5	Key calculation	155
6	Forest production parameter for impounded areas	172

LIST OF FIGURES

Figure		Page
1	Linkage between model program and data files.....	3
2	Model flowchart.....	6
3a	Structure of MAIN.CMD.....	10
3b	Structure of KEY.CMD.....	10
3c	Structure of MANAGE.CMD.....	10
3d	Structure of BENEFITS.CMD.....	10
3e	Structure of COSTS.CMD.....	10
3f	Structure of LOAN.CMD.....	10
4	AGTAB.PRE.....	12
5	AGDATA.....	14
6a	AREA.DAT.....	19
6b	AREA.OUT.....	21
7	CHECK.OUT.....	29
8	AGBEN.OUT.....	30
9	AGQ.DAT.....	31
10	NAVTAB.PRE.....	35
11a	NVOL.DAT no delay.....	38
11.1a	NVOL.OUT no delay.....	40
11b	NVOL.DAT 5 year delay.....	42
11.2b	NVOL.OUT 5 year delay.....	44
12a	Delay.DAT no delay.....	47
12b	5 year delay.....	49
13a	NBEN.OUT no delay.....	54

LIST OF FIGURES (Continued)

Figure		Page
13b	NBEN.OUT 5 year delay	55
14a	NAVQ.DAT no delay	56
14b	NAVQ.DAT 5 year delay	58
15a	AGCOST.DAT no delay	60
15b	AGCOST.DAT 5 year delay	62
16	ENERGY.PRE	66
17a	PWQ.DAT no delay	68
17b	PWQ.DAT 7 year delay	70
18a	ENGBEN.OUT no delay	72
18b	ENGBEN.OUT 7 year delay	73
19	COSTND.PRE	76
20	COSTD.PRE	78
21	Sample file to illustrate format of COSTD.PRE, COSTND.PRE, and COST.PRE files	81
22a	DISSUM.OUT no delay	83
22b	DISSUM.OUT with delay	84
23	COST.DAT	85
24	COSTCK.OUT no delay	86
25	ALLOCA.OUT	95
26	ALLOCA.DAT	96
27	MLOAN.PRE	98
28	DLOAN.PRE	101
29	Sample data file illustrating format used for the file MLOAN.PRE and DLOAN.PRE	103
30	Sample of MPAY.OUT	104
31	MLOAN.DAT	111

LIST OF FIGURES (Continued)

Figure		Page
32	MCOST.OUT	115
33	DCOST.OUT	115
34a	FEES.OUT no delay	120
34b	FEES.OUT with delay	121
35a	FEES.OUT no delay	122
36	Delay	123
37	REVENU.DAT	129
38	ACCOUNT.OUT	132
39	ACCOUN.PRE	137
40	COST.DAT	141
41	VALUE.DAT	145
42	SUMMAR.OUT	151
43	Flow chart for FLOOD.FTN	159
44	Input data file FLOOD.IN	160
45	FLOOD.OUT	162
46	Format for file FLOOD.OUT	163
47	Flow chart for FISH2.FTN	165
48	Input data file FISH2.IN	166
49	Format and input variables for file FISH2.FTN	168
50	Output file FISH2.OUT	169
51	Flow chart for FOREST.FTN	170
52	FOREST.IN	173
53	Format and variable lit for FOREST.IN	173
54	Sample output file FOREST.OUT	174

INTRODUCTION

The CAM (Cost Allocation Model) is a general model that has been developed to evaluate cost allocation strategies for river basins. It can be used to calculate the discounted economic benefits, discounted project costs, user fees, revenues, and loan costs. The CAM model is an interactive package of independent FORTRAN programs linked by indirect command sequences and by data files. The model is very general in nature so that users may easily update the data files in order to test alternative management development strategies. Cash flow is reported in a conventional financial format and numerous other summary reports are generated to display information concisely and accurately. The purpose of this report is to describe the model structure, its capabilities, and its limitations. This can best be done by describing a demonstration run. The data used in the demonstration run are similar to the data used for the Senegal River Project in Reports 4 and 5 (USU 1980, USU 1981). However, some refinements were made to the data base and, consequently, the results reported herein cannot be expected to agree exactly with those of Reports 4 and 5. Therefore, the data presented herein are not intended to represent an actual cost allocation, but rather to demonstrate the flexibility and utility of the model.

The model uses the adjusted separable costs remaining benefits (ASCRB) method for allocating costs of the Diama and Manantali common works among the three services: water supply (irrigation), energy production, and navigation. A brief description of the (ASCRB) method is contained in Report 1 (USU 1978). The analysis is based on costs and benefits discounted over the 50 year planning period of the project. The discount rate represents the opportunity cost of capital. The opportunity cost can be estimated from the market rate of interest, the government borrowing rate, or the rate of return on alternative government investments. In no case should the discount rate be lower than the interest rate charged for project financing. All costs and revenue streams are discounted to 1981, the first year of project construction, although the values are expressed in 1979 CFAF. A discount rate of 5 percent was selected for the demonstration run of the model in order to agree with the discount rate in Report 5 (USU 1981), as adopted by the Council of Ministers in 1981. The effect of increasing the discount rate would be to lower the present (1981) value of future benefits and costs. Furthermore, an exchange rate of 245 F.CFA per dollar was assumed. Quite clearly, as the exchange rate changes, differential changes in input and output prices might be expected. If such changes cause the benefit cost rates to fall below 1.0, cost allocation procedures are inappropriate for any other charges.

The model calculates the user fee (unit repayment rate) for services for goods provided for each purpose: CFAF per cubic meter of water for water supply, CFAF per t km for navigation, and CFAF per kwh for energy production. The calculations for user fee are based on obtaining an equality between discounted project revenues and discounted project costs for each service over the 50 year planning period of the

project. In other words, a zero net present value is achieved. "Net present value" in this context is defined as the present value of future revenues, discounted at the appropriate discount rate, minus the present value of the costs of the investment. Inflation rates were not included in the model for several reasons, and so future costs are not inflated. Consequently, user fees are constant with time. In the event that actual costs do inflate in the future, then user fees will need to be inflated proportionately in order to achieve a zero net present value.

The CAM model includes an accounting submodel used to calculate and report the cash flow in conventional annual income statements and balance sheets. The revenues and expense streams are reported in nominal 1979 CFAF without discounting. The purpose of these reports is to simulate the future financial status of OMVS at the end of each year during the 50 year planning period. Under the assumptions of the demonstration run, a cash flow deficit will be experienced during years 4 through 15 followed by a cash flow excess during the remainder of the project.

An independent submodel is also provided to assist the user in scheduling grant and loan withdrawals (Liability Growth Schedule) to meet the costs of infrastructure construction (Capital Development Schedule). This subroutine also calculates loan costs and repayment schedules for the loan conditions specified in Report 4 (USU 1980). A glossary of terms is provided in Appendix A.

The CAM model includes two sets of cost data and interactive options to change the beginning year of a service. The demonstration cost data consist of a non-delayed case and a delayed case. In the delayed case, the start of navigation services is delayed by 5 years and the start of energy services is delayed by 7 years. Throughout this report the above delays in navigation and energy will be referred to as the delayed case. Both the delayed and non-delayed cases are necessary because in previous reports the non-delayed case data are used to calculate the user fee and the allocation of costs to each state; and this approach was agreed to by OMVS. The non-delayed case was used so as not to penalize those services which are not delayed by alternating a large share of the joint costs to non-delayed services. The delayed case is run to calculate cash flow over the duration of the project because it represents more realistic cost and income streams than the non-delayed case.

Overall Model Structure

A chart of the structure of the model is shown in Figure 1. Each item listed in Figure 1 represents a component in the overall model. There are four types of components: 1) submodels, 2) input data files prepared by the user, 3) input data files prepared by a submodel for use by other submodels, and 4) output files for printed reports. Each type of model component is identified by a suffix as follows:

	User prepared input data files	Data preparation programs	Computer generated data files	Model programs	Output data files
Benefit Section		Area.FTN	Area.DAT Area.OUT		
	AGTAB.PRE			AGBEN.FTN	AGQ.DAT[2] AGBEN.OUT[1] CHECK.OUT
				WRITE.FTN	AGDATA.OUT
	NAVTAB.PRE	NVOL.FTN	NVOL.OUT NVOL.DAT DELAY.DAT	NBEN.FTN	NAVQ.DAT[2] NBEN.OUT ACCOST.DAT[1]
	ENERGY.PRE			ENGBEN.FTN	PWQ.DAT[2] ENGBEN.OUT[1]
Cost Section	COSTD.PRE COSTND.PRE[6]		COST.PRE	COST.FTN	DISSUM.OUT[1] COST.DAT[3]
				COSTCK.FTN	COSTCK.OUT
Cost Allocation Section			AGQ.DAT PWQ.DAT AGCOST.DAT[1] NAVQ.DAT DISSUM.OUT[1]	ALLOCA.FTN	ALLOCA.DAT[4] ALLOCA.OUT
User Fees Section			ALLOCA.DAT	FEES.FTN	FEES.OUT FEES.DAT[2]
Revenue Section			AGQ.DAT[2] NAVQ.DAT[2] PWQ.DAT[2] FEES.DAT[2]	REVENU.FTN	REVENU.DAT[3] KEY.OUT
Account Preprocessing Section	ACCOUN.PRE		REVENU.DAT[3] COST.DAT[3] MLOAN.DAT[3] DLOAN.DAT	PREACC.FTN	VALUE.DAT[5]
Accounting Section			VALUE.DAT[5]	ACCOUN.FTN	HEADS.OUT SUMMAR.OUT ACCOUN.OUT
Loan Section	MLOAN.PRE			MLOAN.FTN	MCOST.OUT MPAY.OUT MLOAN.OUT
	DLOAN.PRE			DLOAN.FTN	DCOST.OUT MPAY.OUT MLOAN.OUT

Figure 1. Linkage between model program and data files.

	User prepared input data files	Data preparation programs	Computer generated data files	Model programs	Output data files
Environmental Section	User prepared input files	Data P.	Computer	Model programs	Output
	FLOOD.IN[7]		AREA.DAT	FLOOD.FTN	FLOOD.OUT
	FISH2.IN[7]		FLOOD.OUT	FISH2.FTN	FISH2.OUT
	FOREST.IN[7]		FLOOD.OUT	FOREST.FTN	FOREST.OUT

[1] Output data files which are used as input data files for program ALLOCA.FTN. DATA from file DISSUM.OUT are used to calculate separable, joint, and specific costs (interactive input for allocation and user fees programs).
[2] Output data files which are used as input files for REVENU.FTN.
[3] Output data files which are used as input files for PREACC.FTN.
[4] Output file used as input file for FEES.FTN.
[5] Output data file used as input for ACCOUN.FTN.
[6] Two cost schedules are provided:
(1) COSTN.PRE for the cost schedule with delay to the start of navigation and charge.
(2) COSTND.PRE for the cost schedule without delays to the start of navigation and energy.
The user decides which file is to be used by the COST.FTN program. The file chosen is renamed COST.PRE. COST.PRE is the actual file read by the COST.FTN program.
[7] DATA files with ending "IN" are user prepared and have same general structure as "PRE" files.

Figure 1. Continued.

.FTN indicates a submodel. These are independent segments of FORTRAN code which perform the calculations. The overall model is composed of 15 distinct submodels in order to provide maximum flexibility.

.PRE indicates a data file prepared by the user. There are eight of these files arranged to provide input for: agriculture, navigation, energy, infrastructure costs, accounting codes, and loan terms. Each of these files appears on Figure 1 as input to one submodel.

.DAT indicates a data file which has been prepared by a submodel for input to another submodel. There are 13 of these files needed to provide intermediate data linkages among submodels. These files appear on Figure 1 as output from some submodels and input to others.

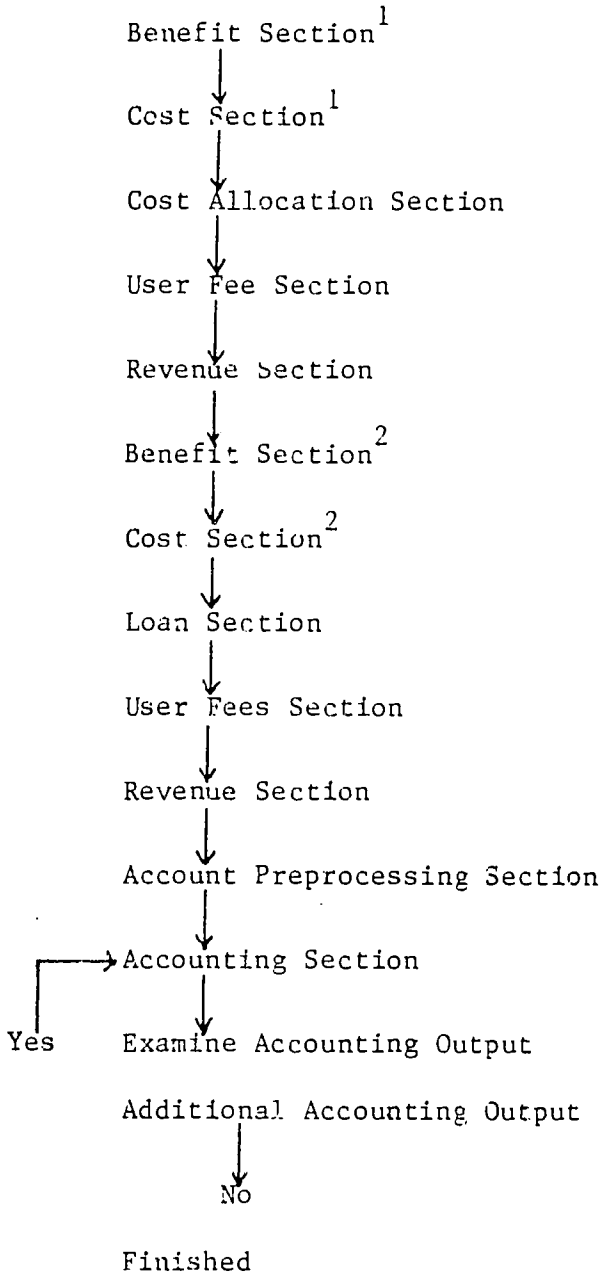
.OUT indicates a data file which has been formated for printing reports (hard copies). There are 20 of these files and they all appear on Figure 1 as outputs from submodels.

The model flow chart is shown in Figure 2. Starting at the top of Figure 2, a complete run of all components would begin with the Benefit Section. In this section, benefits and quantities for the delay case are calculated for each service (water supply, energy and navigation). The discounted benefits are passed on to the Cost Allocation Section, the discounted quantities are passed to the User Fee Section, and undiscounted quantities are passed to the Revenue Section.

The program next proceeds through the Cost Section. The cost streams for capital construction and O&M (operation and maintenance) are used to calculate the discounted sums of project costs for each service. The Cost Section and Benefit Section are encountered twice in Figure 2. The first time, costs, streams benefits, and quantities are entered for the development of navigation and energy without delay, and the discounted costs and benefits are carried forward to the Allocation Section. The second time the Cost and Benefit Section are encountered, the cost and benefit streams for the development of navigation with delay are used, and the yearly costs (capital and O&M) for each service are posted to the appropriate account codes. This information is passed forward to the Accounting Section.

In the Cost Allocation Section, the ASCRB Method is used to calculate the proportions of the joint costs to be allocated to each service. This information is passed forward to the Fees Section.

After the calculation of all costs and quantities, the user fees are calculated in the User Fee Section. Again, note that these user fees are the charges allocated to each service in order that discounted revenues equal discounted costs. They should not be confused with actual prices for services which may actually be charged to specific users of project services (see Report 6 for discussion of user fees and service fees). The user fees are passed forward to the Revenue Section. In the Revenue Section, the revenues for each service sector are calculated by country. The output from this section includes the breakdown of revenue by service and country, and may be used to calculate the distribution of infrastructure costs by country.



[1] In order to reproduce the results given in Report 5 the following option should be chosen the first time the Benefit and Cost Sections are run. COSTND.PRE should be selected as the data file. Navigation and energy are not delayed.

[2] In order to reproduce the results given in Report 5, the following option should be chosen the second time the Benefit and Cost Sections are run. COSTND.PRE should be selected. Navigation is delayed 5 years, Energy is delayed 7 years.

Figure 2. Model flowchart.

The user fees calculated above were based on the scenario of no delay in the development of navigation (Report 5). This position was adopted for the distribution of infrastructure costs among countries in order to eliminate incentive for countries to plan the delay of development in order to reduce their share of the costs (the discount rate will produce lower present value for delayed costs). However, in order to accurately simulate future cash flow in the accounting submodel, user fees should be based on the most likely scenario; and that is one which assumes delay in the development of navigation. Consequently, the program then returns to the Cost and Benefit Sections, this time using the delayed case data. The Cost Allocation Section is by-passed and the user goes directly to the Loan Section.

In the Loan Section, the discounted sum of the loan costs are calculated for use in the User Fee Section. Also the schedules of loan withdrawals, interest payments and principal repayments are posted to the proper accounting codes for the Accounting Section.

After the calculation of all costs and quantities for the delayed case, the user fees are calculated in the User Fee Section. The user fees are passed forward to the Revenue Section and then the project revenues are passed on to the Accounting Section.

The next section, Account Preprocessing Section, assembles cost and revenue data. This section outputs a list of accounts along with the amount credited to each account for use by the Accounting Section.

The last section is the Accounting Section. In this section the projected detailed financial condition of the project is printed out at intervals selected by the user. A summary file is also printed containing the annual values of several selected parameters over the history of the project. From this information, the user can examine cash flow, capital asset growth, growth and repayment of loan liabilities, and other items of financial interest.

The structure of the CAM model is modular. That is, each submodel generates data which must be transferred to other programs. While this approach requires user involvement, it provides flexibility in that each submodel can be run for various alternatives, or for sets of alternatives which may vary over the life of the project. For example, separation of costs and benefits to agriculture for each soil type or location can be accomplished using the model; the sum of these benefits are then entered into the cost of the cost allocation processes. Each data table prepared by the user can be examined within the submodels.

Each submodel and data file is described in detail in this report. Command files are provided to run the submodels in the proper sequence. Sample data files are provided, using values from Report 5 of the Senegal River Cost Allocation Study. A listing of the actual model interaction is provided in Appendix B. Before the model is used to calculate user fees, the user should study the sections of the manual describing the input requirements and assumptions used in the submodels. The user should be aware that changes in assumptions in one data file or submodel can sometimes lead to changes in other data files

or submodels. For example, changing the startng date of energy generation would lead to changes in two data files, COST.PRE and ENERGY.PRE. It is the responsibility of the user to be aware of these relationships and to make the changes in the data files or submodels when necessary.

The general operating procedure for the model is outlined below:

I. Prepare user-created data files necessary for the model or use the default data files provided (the default data are consistent with Report 5 of the Senegal River Cost Allocation Study). User created data files are given in Figure 1 and all have the suffix, PRE. It also is noted that some types of data are common to all data files. For example, written comments must precede each data file in order that alternative runs can be identified easily. The number of years of data must also be included on each file. Figure 1 shows the relationship of data files to the other model components.

II. Prepare data necessary for interactive input or use the default data (the default data are consistent with Report 5 of the Senegal River Cost Allocation Study). Almost every submodel will require the specification of a discount rate. A value of 5 percent was used in the demonstration run.

III. Start the model by entering "@ MAIN;" then answer the questions when prompted by the command file.

Model Indirect Command Files

Six indirect command files have been written to control the flow of the model and submodels. The command files control the sequence in which submodels are run and in which output is printed. They also control file management by deleting old files and naming new files. The user also has the option to enter commands during preprogrammed pauses or to suspend the execution of command files at any time. Any submodel can be run independently of the command file provided the necessary data files are present. New command files can be created easily if the user desires to change the sequence of the submodels or include additional output options. Changing the command files will not affect the internal operation of the individual submodels. A description of Indirect Command programming is contained in Appendix C.

The six command files are used in a nested fashion: command file MAIN invokes command files KEY or MANAGE. There are several advantages to this nested structure. The Benefits, Costs, and Loan packages can be run independently of the main model. If changes are made in the COSTS package, the change need be entered only once instead of twice. Therefore, the user can test various financing combinations without running the entire model.

The model has been divided into two main units 1) KEY and 2) MANAGE. Command file KEY is intended to be used for the calculation of the Cost Allocation. In the demonstration run the non-delayed data are

used in unit KEY. Command file MANAGE is organized for the calculation of user fees and project financial accounting.

Figure 3 illustrates the calling structure of the six command files with Figure 3a, 3b, 3c, 3d, 3e, and 3f, respectively, illustrating the calling structures of command files MAIN, KEY, MANAGE, BENEFITS, COSTS, and LOAN. The user is referred to Figure 1 for details of data files needed for each submodel, and the output data file from each submodel. After each submodel finishes running the user is asked if options were entered correctly. If the user responds "N", then the submodel is run again allowing the user to enter the correct data. At the end of each command file the user is asked to identify the files to be printed. If printed outputs for other files are needed, the user can enter his own Print Commands during pauses or after exiting from the command file.

```
MAIN

    msg
    Pause
    Invokes either command file
    Key or MANAGE

        msg
        Exit
```

Figure 3a. Structure of MAIN.CMD.

```
KEY

    msg
    Pause
    Invokes BENEFITS command file
    Pause
    Invokes COSTS command file
    Pause
    Run Cost Allocation program
    Output Options
    Pause
    Run User Fees program
    Pause
    Run Revenue program
    Output options
```

Figure 3b. Structure of KEY.CMD.

```
MANAGE

    msg
    Pause
    Invokes BENEFITS command file
    Pause
    Invokes COSTS command file
    Pause
    Invokes LOAN command file
    Run User Fees program
    Pause
    Run Revenue program
    Pause
    Run Preaccounting program
    Run Accounting program
    Pause
    Output options
```

Figure 3c. Structure of MANAGE.CMD.

```
1.  Run Area
2.  Run Write
3.  Run AGBEN
4.  Run NVOL
5.  Run NBEN
6.  Run ENGBEN
7.  Output options
```

Figure 3d. Structure of BENEFITS.CMD.

```
1.  Select cost schedule use either cost schedule
    with delay or cost schedule without delay
2.  Run COSTCK
3.  Run COST
4.  Output Print Options
```

Figure 3e. Structure of COSTS.CMD

```
1.  Run (MLOAN)
2.  Output Print Options
3.  Run (DLOAN)
4.  Output Print Options
5.  Run (Merge)
```

Figure 3f. Structure of LOAN.CMD.

AGRICULTURAL BENEFITS

This part of the manual includes descriptions for each component of the agricultural benefits model shown in the flow chart. Also included are descriptions of the input data, the algorithms used in the model, and sample outputs. For the purpose of determining the agricultural benefits and water requirements for the Senegal River Basin Development Program, an agricultural benefit model, AGBEN, was written using FORTRAN. This submodel is included in Figure 1. Agricultural benefits are defined by the additional net income from irrigated agriculture above that obtained by traditional recession and dry-land farming. Calculation of these benefits depends upon accurate representation of the costs and revenues to the agricultural sector. These data were obtained from existing farm budgets for representative irrigated perimeters and traditional agriculture. Information for the existing farm budgets was taken from the Groupement Manantali Report (1979), Annex 4. The budget for each crop is calculated on a per hectare basis, and the agricultural benefits are calculated from the proportions of the theoretical (average) hectare assigned to each crop. However, the numerical estimates of prices and costs are outdated, and improvement in these data would significantly increase the reliability of the model results.

In the model, all monetary values for the three states, Mali, Mauritania, and Senegal, are expressed in 1979 CFAF. Conversion from world prices to CFAF is made on the basis of $1.00 U.S. equaling 245 CFAF. Inflation is not considered because all prices and costs are assumed to change at the same rate.

Input Data for the Agricultural Benefit Model (AGBEN)

Running AGBEN requires two separate data tables, the Agricultural Economic Sector Data, AGTAB.PRE, and the Agricultural Area Data, AREA.DAT. In addition to these two data tables, some data are entered interactively on the computer terminal when running the program.

The agricultural economic sector input data (AGTAB.PRE and AGDATA.OUT)

Figure 4 shows the data table, AGTAB.PRE for agricultural prices, costs, yields, and water consumption. As for all .PRE type input files, these data are preceded by a specified number of lines of identification information. This file can be created easily because free-format input is used and values need only be separated by commas. Two data rows are required for each crop; one for the wet season and one for the dry season. Each row contains the following yields information: 1) row number, 2) world price, 3) irrigated yield, 4) artificial flooding, 5) recession yield, 6) rainfed yield, 7) production costs large perimeter, 8) percent large perimeter, 9) production costs small perimeter, 10) percent small perimeter, 11) cropping pattern irrigated area, 12) cropping pattern for artificial flood, 13) cropping pattern for recession, 14) cropping pattern for rainfed, and 15) water requirements.

```
 1,28,   NO. OF LINES IN TITLE,NO. OF PRODUCTS, (NEW PRICES),CFA(1979)
        AGRICULTURAL ECONOMIC SECTOR DATA TABLE,WATER REQUIREMENT IN RESULT M3
1,76270,4.0,0.,0.,0.,99527...67,63440...33,.306,0.,0.,0.,1.79,
2,76270,3.5,0.,0.,0.,109480...67,81631...33,.122,0.,0.,0.,2.03,
3,21180.,0.,0.,0. 0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,
4,21180.,54.,0.,0.,0.,259065...67,203185...33,.035,0.,0.,0...98,
5,109465.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,
6,109465.,3.5,0.,0.,0.,222955...67,105229...33,.173,0.,0.,0...88,
7,63540.,0.,0...175,.0875,0.,0.,0.,0.,0.,0...025,.025,0.,
8,63540...875,.175,0.,0.,78157...67,45604...33,.043,.025,0.,0.,1.18,
9,6038.,0.,0.,0.,0.,184825...67,72248.. 33,.027,0.,0.,0.,1.20,
10,6038.,100.,0.,0.,0.,201415...67,93859...33,.027,0.,0.,0.,1.96,
11,71925.,3.5,0...375,.1875,71724...67,37554...33,.286,0...255,.255,.64,
12,71925.,3.5,.375,0.,0.,78169,.67,45604...33,.125,.255,0.,0...93,
13,73230.,4.0,0...375,.1875,78503...67,43676...33,.165,0...0533,.0533,.74,
14,73230.,4.0,.375,0.,0.,85544...67,54193...33,.125,.0533,0.,0...88,
15,69156.,3.,0.,0.,0.,71724.,1.0,0.,0.0,.030,0.,0.,0...97,
16,69156.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,
17,83.,4075.,0.,0.,0.,0.,0.,0.,0...024,0.,0.,0.,0.,
18,83.,1100.,0.,0.,0.,0.,0.,0.,0...024,0.,0.,0.,0...0,
19,500.,1725.,0.,0.,0.,121287...67,72612.,33,.024,0.,0.,0.,1.20,
20,500.,460.,0.,0.,0.,132166...67,92847.,33,.024,0.,0.,0.,1.96,
21,83.,4130.,0.,0.,0.,0.,0.,0.,0...024,0.,0.,0...0,
22,83.,1100.,0.,0.,0.,0.,0.,0.,0...024,0.,0.,0...0,
23,700.,840.,0.,0.,0.,121287...67,72612.,33,.024,0.,0.,0.,1.20,
24,700.,225.,0.,0.,0.,132166...67,92847.,33,.024,0.,0.,0.,1.96,
25,83.,3040.,0.,0.,0.,0.,0.,0.,0...024,0.,0.,0...0,
26,83.,820.,0.,0.,0.,0.,0.,0.,0...024,0.,0.,0...0,
27,700.,440.,0.,0.,0.,121287...67,72612.,33,.024,0.,0.,0.,1.20,
28,700.,120.,0.,0.,0.,132166...67,92847.,33,.024,0.,0.,0.,1.96,
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Figure 4. AGTAB.PRE

World prices are in 1979 CFAF/metric ton (indicated as tonne) and yields are in tonnes per hectare, except for the livestock products (cattle, sheep, and goat milk and meat), which are in CFAF/liter and liters/ha or CFAF/kilogram and kilograms/ha, respectively.[1] Meat and milk yields shown in Figures 4 and 5 are considered as produced jointly and are based on preliminary estimates developed in the Groupement Manantali Report (1979). Production costs per hectare of crop are listed for both small and large perimeters. The entire production costs for livestock are allocated to the production of meat and none to the production of milk. The cropping pattern indicates the fraction of the theoretical hectare planted in each crop in each season, for irrigated, recession, artificial flood, and rainfed production. The water requirement (consumptive use) for each crop and season is given in meters of depth. The ratio of large perimeter area to small perimeter area is assumed to be 2 to 1, or 67 to 33 percent of the theoretical hectare, respectively.

The AGDATA.OUT file, shown in Figure 5 contains the same information as the AGTAB.PRE file. However, to assist the user in verifying the input data, the format of the AGDATA.OUT file is much easier to read than that of the AGTAB.PRE file. The following subparagraphs describe assumptions associated with the agricultural data used in the demonstration run.

Direct production costs. To update the production costs for all crops, all production costs were increased by the same proportion that rice production costs increased from values shown by the Groupement Manantali Report (1979) to 1980 values reported by SAED for the Lampsar, Dagna, and Nianga perimeters. The 1980 rice production costs as shown in Report 5 are:

Large perimeters	
Rainy season	109,480 CFAF/ha
Dry season	120,428 CFAF/ha
Small perimeters	
Rainy season	69,800 CFAF/ha
Dry season	89,800 CFAF/ha

These costs were then reduced by 10 percent to reflect 1979 costs.

[1]Note that the "World Prices" for inputs and products are farm gate (on farm) prices. These data were collected from UNDP Agricultural Reports. Actual in-country prices were compared with the UNDP prices by crops, where data existed. A 3-year average of farm gate prices and crops was used in the initial data development (Report 1). Those costs and prices have been updated to 1979 using appropriate agricultural price indices. Some attempt was made to compare Senegalese farm-gate prices with average port prices less transport costs for other nations, as reported by the UNDP. These data appeared to be consistent for most crops. The specific farm gate price received would, of course, depend on distance of transportation, mode of transport, etc.

AGRICULTURAL ECONOMIC SECTOR DATA TABLE,WATER REQUIREMENT IN RESULT M3

PRODUCT	WORLD PRICE	YIELDS (T/HA) IRRIG.	FLOODED	RECESSION	RAINFED	PRODUCTION COSTS LARGE PER.	%	SMALL PER.	%	CROPPING PATTERN (%) AREA	FLOODED	RECESSSION	RAINFED	WATER REQ.
RICE WET	76270.	4.000	0.0000	0.0000	0.0000	99527.	0.7	63440.	0.3	0.306	0.000	0.000	0.000	1.79
RICE DRY	76270.	3.500	0.0000	0.0000	0.0000	109480.	0.7	81631.	0.3	0.122	0.000	0.000	0.000	2.03
TOMATO W	21180.	0.000	0.0000	0.0000	0.0000	0.	0.0	0.	0.0	0.000	0.000	0.000	0.000	0.00
TOMATO D	21180.	54.000	0.0000	0.0000	0.0000	259065.	0.7	203185.	0.3	0.035	0.000	0.000	0.000	0.98
WHEAT W	109465.	0.000	0.0000	0.0000	0.0000	0.	0.0	0.	0.0	0.000	0.000	0.000	0.000	0.00
WHEAT D	109465.	3.500	0.0000	0.0000	0.0000	222955.	0.7	105229.	0.3	0.173	0.000	0.000	0.000	0.88
NIEBE W	63540.	0.000	0.0000	0.1750	0.0875	0.	0.0	0.	0.0	0.000	0.000	0.025	0.025	0.00
NIEBE D	63540.	0.875	0.1750	0.0000	0.0000	78157.	0.7	45604.	0.3	0.043	0.025	0.000	0.000	1.18
S.CANE W	6038.	0.000	0.0000	0.0000	0.0000	184825.	0.7	72248.	0.3	0.027	0.000	0.000	0.000	1.20
S.CANE D	6038.	100.000	0.0000	0.0000	0.0000	201415.	0.7	93859.	0.3	0.027	0.000	0.000	0.000	1.96
SORGHM W	71925.	3.500	0.0000	0.3750	0.1875	71724.	0.7	37554.	0.3	0.286	0.000	0.255	0.255	0.64
SORGHM D	71925.	3.500	0.3750	0.0000	0.0000	78169.	0.7	45604.	0.3	0.125	0.255	0.000	0.000	0.93
MAIZE W	73230.	4.000	0.0000	0.3750	0.1875	78503.	0.7	43676.	0.3	0.165	0.000	0.053	0.053	0.74
MAIZE D	73230.	4.000	0.3750	0.0000	0.0000	85544.	0.7	54193.	0.3	0.125	0.053	0.000	0.000	0.88
COTTON W	69156.	3.000	0.0000	0.0000	0.0000	71724.	1.0	0.	0.0	0.030	0.000	0.000	0.000	0.97
COTTON D	69156.	0.000	0.0000	0.0000	0.0000	0.	0.0	0.	0.0	0.000	0.000	0.000	0.000	0.00
C.MILK W	83.	4075.000	0.0000	0.0000	0.0000	0.	0.0	0.	0.0	0.024	0.000	0.000	0.000	0.00
C.MILK D	83.	1100.000	0.0000	0.0000	0.0000	0.	0.0	0.	0.0	0.024	0.000	0.000	0.000	0.00
C.MEAT W	500.	1725.000	0.0000	0.0000	0.0000	121287.	0.7	72612.	0.3	0.024	0.000	0.000	0.000	1.20
C.MEAT D	500.	460.000	0.0000	0.0000	0.0000	132166.	0.7	92847.	0.3	0.024	0.000	0.000	0.000	1.96
S.MILK W	83.	4130.000	0.0000	0.0000	0.0000	0.	0.0	0.	0.0	0.024	0.000	0.000	0.000	0.00
S.MILK D	83.	1100.000	0.0000	0.0000	0.0000	0.	0.0	0.	0.0	0.024	0.000	0.000	0.000	0.00
S.MEAT W	700.	840.000	0.0000	0.0000	0.0000	121287.	0.7	72612.	0.3	0.024	0.000	0.000	0.000	1.20
S.MEAT D	700.	225.000	0.0000	0.0000	0.0000	132166.	0.7	92847.	0.3	0.024	0.000	0.000	0.000	1.96
G.MILK W	83.	3040.000	0.0000	0.0000	0.0000	0.	0.0	0.	0.0	0.024	0.000	0.000	0.000	0.00
G.MILK D	83.	820.000	0.0000	0.0000	0.0000	0.	0.0	0.	0.0	0.024	0.000	0.000	0.000	0.00
G.MEAT W	700.	440.000	0.0000	0.0000	0.0000	121287.	0.7	72612.	0.3	0.024	0.000	0.000	0.000	1.20
G.MEAT D	700.	120.000	0.0000	0.0000	0.0000	132166.	0.7	92847.	0.3	0.024	0.000	0.000	0.000	1.96

Figure 5. AGDATA.OUT

Notes:

1. W and D in the product column represent wet and dry seasons, respectively. C., S., and G. are for cattle, sheep, and goats, respectively.
2. World prices are based on values from Groupement Manantali Report (1980) Annex 4 p. 120 and updated by the Council of OMVS Ministers in Nouakchott in March 1980.
3. Crop yields are from Groupement Manantali Report (1979) Annex 4, p. 120. Milk and meat products yields were discussed earlier in this report.
4. Yields for the entire Senegal River Basin are treated as equal although this is probably not true.
5. Yields for artificially flooded, recession, and rainfed agricultural area are based on a personal communique, Dr. Ba, Agriculture, OMVS, October 1979.
6. Sugar cane is an annual crop harvested in the dry season.
7. Total production costs for livestock are allocated to meat and none to milk.
8. Assumed equal distribution of the forage area between the six livestock products.
9. The cropping pattern for artifically flooded, recession, and rainfed agricultural areas are based on a personal communique, Dr. Ba, Agriculture, OMVS, October 1979.
10. Water requirements are adjusted to allow for irrigation system losses assuming an overall irrigation efficiency of 60 percent (the combined conveyance and application efficiency factor). They are assumed to be the same for small and large perimeters in the entire Senegal River Basin.

Figure 5. Continued.

The costs of production include seed, fertilizer, insecticides and the maintenance and operation costs for farm equipment and draft animals. The production costs are assumed to be constant for both large and small perimeters basin-wide. Note that returns to operator/owner labor and capital were not included in production cost. Where data were available, hired labor costs were included. In many cases, however, labor is assumed to be provided by operator, particularly in small perimeters. Where data on the division between hired and owner labor were not available no labor cost was included in the variable costs. Benefits then correspond to value-added rather than primary net farm income (as described in Report 1).

Fixed costs. The fixed costs associated with the development of the new irrigated lands are based on the estimates in the Groupement Manantali Report (1979) including a 6.5 percent interest charge on the investment (Annex 4: Agriculture, p. 123). These estimates were then revised using estimates made by SAED, SONADER, and the Malian Agricultural Engineering Directorate. These updated costs are shown in Report 5 as follows:

Mali	2,000,000 CFAF/ha
Mauritania	
large perimeters	3,000,000 CFAF/ha
small perimeters	1,000,000 CFAF/ha
Senegal	
large perimeters	2,750,000 CFAF/ha
small perimeters	1,000,000 CFAF/ha

For the basin as a whole, the weighted average is on the order of 2,800,000 CFAF/ha. The fixed cost for developing new irrigated lands is thus assumed to be 2,800,000 CFAF/ha with an additional fixed cost of 760,000 CFAF/ha for new pumping equipment every 5 years. The initial fixed cost of 3,560,000 CFAF/ha (2,800,000 + 760,000) is assumed for each new hectare developed. Another 760,000 CFAF/ha for replacing pumping equipment is added every 5 years thereafter. These estimates do not include taxes; thus, returns to agriculture include income received by the government through taxes leveed on the agricultural sector.

Theoretical hectare. The theoretical hectare represents the allocation of the agricultural area for each crop in the wet and dry season as a percentage of the total agricultural area (Table 1).

It is assumed that:

- 100 percent of the area is cultivated in the wet season.
- 75 percent of the area is planted in the dry season and produces in rice, wheat, maize, sorghum, and niebe. Percent areas in Table 2 for these crops reflect this reduction.
- Sugar cane is cultivated 80 percent of the time (i.e., 4 out of 5 years). Thus, the value of 3.4 percent for sugar cane in Table 1 becomes an average annual value of 2.7 percent in Table 2.

Table 1. Areas of wet and dry season crop as a percentage of the total agricultural area in the Senegal River Basin Development Program.

Crop	Wet Season (June-October) Percentage	Dry Season (November-May Percentage
Rice	30.6 %	16.3 %
Wheat	---	23.0
Maize	16.5	16.7
Sorghum	28.6	16.7
Niebe	---	5.8
Cotton	3.0	---
Tomato	---	3.5
Sugar Cane	3.4	3.4
Forage	14.5	14.5

Source: Groupement Manantali Report (1979), Annex 4.

Table 2. Composition of the irrigated theoretical hectare expressed as a percentage of the total agricultural area in the Senegal River Development Program.

Crop	Wet Season (June-October) Percentage	Dry Season (November-May) Percentage
Rice	30.6 %	12.2 %
Wheat	---	17.3
Maize	16.5	12.5
Sorghum	28.6	12.5
Niebe	---	4.3
Cotton	3.0	---
Tomato	---	3.5
Sugar Cane	2.7	2.7
Forage	14.5	14.5
Totals	95.9 %	79.5 %

Revenues from animal husbandry

The AGBEN model is structured to calculate net primary revenues by crop for the theoretical hectare. Revenues are obtained by the multiplication of four numbers: 1) price (CFAF/tonne), 2) yield (tonnes/ha), 3) total irrigated area (ha), and 4) fraction of the total area planted in the specified crop. Since the production of livestock products depends not only on forage crops, but also on utilizing the aftermath (residue) of other crops for feed, the yields for these products should reflect the total theoretical hectare. Forage crops appear to be the limiting factor in livestock production. Therefore, the production supported by forage crops is divided by the proportion of forage crops in the theoretical hectare to obtain the total livestock

production per hectare. Thus by artifically increasing the yields for the livestock products on irrigated pastures, the added livestock production obtained from using crop by-products as forage is accounted for (Table 3). For example, the revenues from goat milk, product 25, in year 50 would be:

(83 CFAF/l) x (73 l/ha) x (269,805 ha) = 1.63 billion CFAF

This is equivalent to using the submodel algorithm (Equation 2) with the artificially increased yields (i.e. 3040 l/ha = 73 l/ha/0.024) and the cropping pattern for forage:

(33 CFAF/l) x (3040 l/ha) x (269,805 ha) x (.024)
= 1.63 billion CFAF

The agricultural area data (AREA.DAT) and AREA.OUT

The agricultural area data (Figures 6a and 6b) are based upon the assumption of a basin wide average development rate of 4000 ha/yr through 1984, and 5000 ha/year thereafter. This table consists of the year, the agricultural development rate (RATE), the irrigated area (AI), the area of recession agriculture displaced (ARD), the area of dry-farm agriculture displaced (ADD), the area artifically flooded (AF), and the percentage developed of the total irrigated area in each country. All values are end-of-year totals.

Since unit agricultural costs and revenues are assumed identical for all countries, it was not necessary to separate out agricultural areas by countries nor to distinguish between land in the delta and in the valley for benefit calculations for the entire development program. However, agricultural development by country was needed in order to allocate irrigation water costs.

The initial proportions of agricultural area development in Mali, Mauritania, and Senegal are 0.1666, 0.3436, and 0.4898, respectively (Report 4 Table 9, p. 24). These proportions are maintained until Mali develops its full potential of 23,437 hectares. The development rate ratio between Mauritania and Senegal is held at 1:1.425 after Mali develops its full potential.

In the Senegal River Basin, there were 270 ha, 5305 ha, and 23,230 ha under irrigation in Mali, Mauritania, and Senegal, respectively. The total initial irrigated area is, therefore, 28,805 hectares. These initial areas are based on Les Amenagements Hydroagricoles dans le Bassin du Fleuve Senegal, Report ER/PC/79-12 (OMVS 1979) for Mauritania and Senegal and the Groupement Manantali Report (1979) Annex 4, for Mali (with the 1981-1984 development rate assumed for 1980). The total area expected to be irrigated from the Diama and Manantali dams combined is 375,000 hectares of which 315,000 ha is attributed in the Manantali Dam and 60,000 ha is attributed to the Diama Dam (Report 5 p. 10).

At the end of 1980 the potential areas of recession farming and dry farming which will be replaced by irrigation are 108,633 ha and 75,000

OUTPUT FROM AREA.FIN USED AS INPUT FOR AGBEN
VALUES OF OPTIONS USED FOR THIS RUN ARE
NEW DEVELOPMENT RATE 5000. TIME TO NEW DEVELOPMENT RATE 4.
NUMBER OF YEARS BEFORE THE FLOOD 9.
THE FOLLOWING VALUES WERE USED TO DISTRIBUTE HA DEVELOPED BETWEEN COUNTRIES
INITIAL MALI = .1666 MAUR .3436 SENEGAL .4898
TOTAL POSSIBLE HA IN MALI = 23437.
FINIAL MAUR .4125 SENEGAL .5875
INITIAL AREAS MALI 270. MAUR 5305. SENEGAL 23230.

AGRICULTURAL AREAS DATA TABLE

YEAR	RATE	AI	ARD	ADD	AF	MALI	MAUR	SENE
1980	0.	28805.	0.	0.	0.	0.0094	0.1842	0.8065
1981	4000.	32805.	4000.	0.	0.	0.0285	0.2036	0.7678
1982	4000.	36805.	8000.	0.	0.	0.0435	0.2188	0.7376
1983	4000.	40805.	12000.	0.	0.	0.0556	0.2311	0.7133
1984	4000.	44805.	16000.	0.	0.	0.0655	0.2411	0.6934
1985	5000.	49805.	21000.	0.	0.	0.0757	0.2514	0.6729
1986	5000.	54805.	26000.	0.	0.	0.0840	0.2598	0.6562
1987	5000.	59805.	31000.	0.	0.	0.0909	0.2668	0.6423
1988	5000.	64805.	36000.	0.	0.	0.0967	0.2727	0.6306
1989	5000.	69805.	41000.	0.	20195.	0.1017	0.2778	0.6205
1990	5000.	74805.	46000.	0.	15195.	0.1061	0.2822	0.6117
1991	5000.	79805.	51000.	0.	10195.	0.1099	0.2861	0.6041
1992	5000.	84805.	56000.	0.	5195.	0.1132	0.2894	0.5974
1993	5000.	89805.	61000.	0.	195.	0.1162	0.2925	0.5914
1994	5000.	94805.	66000.	0.	0.	0.1188	0.2952	0.5860
1995	5000.	99805.	71000.	0.	0.	0.1212	0.2976	0.5812
1996	5000.	104805.	76000.	0.	0.	0.1234	0.2998	0.5768
1997	5000.	109805.	81000.	0.	0.	0.1254	0.3018	0.5729
1998	5000.	114805.	86000.	0.	0.	0.1272	0.3036	0.5693
1999	5000.	119805.	91000.	0.	0.	0.1288	0.3053	0.5659
2000	5000.	124805.	96000.	0.	0.	0.1303	0.3068	0.5629
2001	5000.	129805.	101000.	0.	0.	0.1317	0.3082	0.5601
2002	5000.	134805.	106000.	0.	0.	0.1330	0.3095	0.5575
2003	5000.	139805.	108633.	2367.	0.	0.1342	0.3108	0.5550
2004	5000.	144805.	108633.	7367.	0.	0.1353	0.3119	0.5528
2005	5000.	149805.	108633.	12367.	0.	0.1364	0.3129	0.5507
2006	5000.	154805.	108633.	17367.	0.	0.1373	0.3139	0.5487
2007	5000.	159805.	108633.	22367.	0.	0.1383	0.3149	0.5469
2008	5000.	164805.	108633.	27367.	0.	0.1391	0.3157	0.5451
2009	5000.	169805.	108633.	32367.	0.	0.1380	0.3173	0.5446
2010	5000.	174805.	108633.	37367.	0.	0.1341	0.3201	0.5459
2011	5000.	179805.	108633.	42367.	0.	0.1303	0.3226	0.5470
2012	5000.	184805.	108633.	47367.	0.	0.1268	0.3251	0.5481
2013	5000.	189805.	108633.	52367.	0.	0.1235	0.3274	0.5491
2014	5000.	194805.	108633.	57367.	0.	0.1203	0.3296	0.5501
2015	5000.	199805.	108633.	62367.	0.	0.1173	0.3316	0.5511
2016	5000.	204805.	108633.	67367.	0.	0.1144	0.3336	0.5520
2017	5000.	209805.	108633.	72367.	0.	0.1117	0.3355	0.5528
2018	5000.	214805.	108633.	75000.	0.	0.1091	0.3373	0.5536
2019	5000.	219805.	108633.	75000.	0.	0.1066	0.3390	0.5544

Figure 6a. AREA.DAT

2020	5000.	224805.	108633.	75000.	0.	0.1043	0.3406	0.5551
2021	5000	229805.	108633.	75000.	0.	0.1020	0.3422	0.5558
2022	5000.	234805.	108633.	75000.	0.	0.0998	0.3437	0.5565
2023	5000.	239805.	108633.	75000.	0.	0.0977	0.3451	0.5571
2024	5000.	244805.	108633.	75000.	0.	0.0957	0.3465	0.5578
2025	5000.	249805.	108633.	75000.	0.	0.0938	0.3478	0.5584
2026	5000.	254805.	108633.	75000.	0.	0.0920	0.3491	0.5589
2027	5000.	259805.	108633.	75000.	0.	0.0902	0.3503	0.5595
2028	5000.	264805.	108633.	75000.	0.	0.0885	0.3515	0.5600
2029	5000.	269805.	108633.	75000.	0.	0.0869	0.3526	0.5605
2030	5000.	274805.	108633.	75000.	0.	0.0853	0.3537	0.5610

Figure 6. AREA.DAT

AGRICULTURAL AREAS DATA TABLE

CODE FOR COLUMN HEADINGS
AI= TOTAL AREA IRRIGATED, ARD= DISPLACED RECESSION AREA
ADD= DISPLACED RAINFED AREA, AF= AREA OF ARTIFICAL FLOOD
MALI PROPORTION OF IRRIGATED AREA IN MALI, MAUR IN MAURITAINA, SENE IN SENEGAL

YEAR	RATE	AI	ARD	ADD	AF	MALI	MAUR	SENE
1980	0.	28805.	0.	0.	0.	0.0094	0.1842	0.8065
1981	4000.	32805.	4000.	0.	0.	0.0285	0.2036	0.7678
1982	4000.	36805.	8000.	0.	0.	0.0435	0.2188	0.7376
1983	4000.	40805.	12000.	0.	0.	0.0556	0.2311	0.7133
1984	4000.	44805.	16000.	0.	0.	0.0655	0.2411	0.6934
1985	5000.	49805.	21000.	0.	0.	0.0757	0.2514	0.6729
1986	5000.	54805.	26000.	0.	0.	0.0840	0.2598	0.6562
1987	5000.	59805.	31000.	0.	0.	0.0909	0.2668	0.6423
1988	5000.	64805.	36000.	0.	0.	0.0967	0.2727	0.6306
1989	5000.	69805.	41000.	0.	20195.	0.1017	0.2778	0.6205
1990	5000.	74805.	46000.	0.	15195.	0.1061	0.2822	0.6117
1991	5000.	79805.	51000.	0.	10195.	0.1099	0.2861	0.6041
1992	5000.	84805.	56000.	0.	5195.	0.1132	0.2894	0.5974
1993	5000.	89805.	61000.	0.	195.	0.1162	0.2925	0.5914
1994	5000.	94805.	66000.	0.	0.	0.1188	0.2952	0.5860
1995	5000.	99805.	71000.	0.	0.	0.1212	0.2976	0.5812
1996	5000.	104805.	76000.	0.	0.	0.1234	0.2998	0.5768
1997	5000.	109805.	81000.	0.	0.	0.1254	0.3018	0.5729
1998	5000.	114805.	86000.	0.	0.	0.1272	0.3036	0.5693
1999	5000.	119805.	91000.	0.	0.	0.1288	0.3053	0.5659
2000	5000.	124805.	96000.	0.	0.	0.1303	0.3068	0.5629
2001	5000.	129805.	101000.	0.	0.	0.1317	0.3082	0.5601
2002	5000.	134805.	106000.	0.	0.	0.1330	0.3095	0.5575
2003	5000.	139805.	108633.	2367.	0.	0.1342	0.3108	0.5550
2004	5000.	144805.	108633.	7367.	0.	0.1353	0.3119	0.5528
2005	5000.	149805.	108633.	12367.	0.	0.1364	0.3129	0.5507
2006	5000.	154805.	108633.	17367.	0.	0.1373	0.3139	0.5487
2007	5000.	159805.	108633.	22367.	0.	0.1383	0.3149	0.5469
2008	5000.	164805.	108633.	27367.	0.	0.1381	0.3157	0.5451
2009	5000.	169805.	108633.	32367.	0.	0.1380	0.3173	0.5446
2010	5000.	174805.	108633.	37367.	0.	0.1341	0.3201	0.5459
2011	5000.	179805.	108633.	42367.	0.	0.1303	0.3226	0.5470
2012	5000.	184805.	108633.	47367.	0.	0.1268	0.3251	0.5481
2013	5000.	189805.	108633.	52367.	0.	0.1235	0.3274	0.5491
2014	5000.	194805.	108633.	57367.	0.	0.1203	0.3296	0.5501
2015	5000.	199805.	108633.	62367.	0.	0.1173	0.3316	0.5511
2016	5000.	204805.	108633.	67367.	0.	0.1144	0.3336	0.5520
2017	5000.	209805.	108633.	72367.	0.	0.1117	0.3355	0.5528
2018	5000.	214805.	108633.	75000.	0.	0.1091	0.3373	0.5536
2019	5000.	219805.	108633.	75000.	0.	0.1066	0.3390	0.5544
2020	5000.	224805.	108633.	75000.	0.	0.1043	0.3406	0.5551
2021	5000.	229805.	108633.	75000.	0.	0.1020	0.3422	0.5558
2022	5000.	234805.	108633.	75000.	0.	0.0998	0.3437	0.5565

Figure 6b. AREA.OUT

2023	5000.	239805.	108633.	75000.	0.	0.0977	0.3451	0.5571
2024	5000.	244805.	108633.	75000.	0.	0.0957	0.3465	0.5578
2025	5000.	249805.	108633.	75000.	0.	0.0938	0.3478	0.5584
2026	5000.	254805.	108633.	75000.	0.	0.0920	0.3491	0.5589
2027	5000.	259805.	108633.	75000.	0.	0.0902	0.3503	0.5595
2028	5000.	264805.	108633.	75000.	0.	0.0885	0.3515	0.5600
2029	5000.	269805.	108633.	75000.	0.	0.0869	0.3526	0.5605
2030	5000.	274805.	108633.	75000.	0.	0.0853	0.3537	0.5610

****

Figure 6b. Continued

Table 3. Livestock products per theoretical hectare.

Yields	Wet Season			Dry Season			Total
	Cattle	Sheet	Goats	Cattle	Sheep	Goats	
Milk (l)	97.8	99.1	73.0	26.2	26.5	19.6	342.2
Meat (kg)	41.4	20.1	10.5	11.1	5.4	2.8	91.3

Soruce: Groupement Manantali Report (1976)

ha, respectively. It is assumed that each hectare of new irrigated area will first reduce recession farming by a hectare until recession farming is totally eliminated. Then each hectare of new irrigated area will replace a hectare of rainfed farming until a total of 75,000 ha of rainfed farming are replaced. After that, irrigation expansion will open new land to cultivation.

The artificial flood described by Senegal Consult (1970) is assumed to commence in 1989 when the Manantali Dam is completed and to continue until the total irrigated area reaches 90,000 hectares (the estimated area available for the artificial flood [Groupement Manantali Report (1979), Annex 4, p. 82]. This flood will enable "recession" agriculture to continue until it is replaced by irrigated agriculture.

Area program (AREA.FTN)

The FORTRAN program AREA.FTN can be used to generate the agricultural area data table, AREA.DAT (Figure 6a), based on the assumptions presented above. Although this program generates the agricultural area data table, AREA.DAT, it should be noted that this table can be generated by hand. In addition, needed changes in the table can be made in the future to reflect current conditions. The file AREA.OUT (Figure 6b) is also generated by AREA.FTN. This file contains the same data file AREA.DAT but is in a format which is easier to read.

The program itself is basically an accounting procedure. It totals the area developed and the artificially flooded area, and it determines the areas of recession and dry-farmed agriculture displaced. It also determines the percent area irrigated in each country as a fraction of the total irrigated area.

Interactive input data

The AGBEN model can be operated with an existing data base already entered into the program and consistent with Reports 4 and 5 of the Senegal River Cost Allocation Study (USU 1980, 1981). If the user wishes to use other data, he can respond to the interactive questions presented by the programs. The data to be entered interactively and

their default values for the Agricultural Benefits Model, AGBEN, and the agricultural area program, AREA.FTN are as follows:

For AGBEN.FTN.

1. The development cost per new hectare (CFAF/ha). (Default is 3,560,000 CFAF/ha = 2,800,000 + 760,000.)
2. The pump replacement cost (CFAF/ha). (Default is 760,000 CFAF/ha.)
3. The effective life of the pump in years (the time to pump replacement). (Default is 5 years.)
4. The project life in years. (Default is 50 years.)
5. The discount rate in decimal fraction form. (Default is 0.05.)

For AREA.FTN.

1. The "new" development rate (ha/yr). (Default is 5000 ha/yr.) (The initial development rate is 4000 ha/yr.)
2. The time when the "new" development rate starts (years). (Default is 4 years.)
3. The time to begin artificial flood (years). (Default is 9 years.)
4. The initial proportion to Mali, Mauritania, and Senegal of area development in decimal fraction form. (Default is 0.1666, 0.3436, and 0.4898, respectively.)
5. The maximum number of hectares which can be developed in Mali (ha). (Default is 23,437 ha.)
6. The proportion to Mauritania and Senegal of area development after the potential development in Mali has been achieved, in decimal fraction form. (Default is 0.4125 and 0.5875, respectively.)
7. The initial irrigated area in Mali, Mauritania, and Senegal (ha). (Default is 270, 5305, and 23,230, respectively.)
8. The total initial irrigated area (ha). (The summation of the above areas.) (Default is 28,805 ha.)

Entering the data base. It is likely that as irrigated area increases, added information will provide a basis for improving the existing data base. If the user wishes to alter the data from the base data files, changes must be made to the data files themselves. The Agriculture Economic Sector data file shown in Figure 4, AGTAB.PRE is free formatted. Each row contains of the following information in the order stated: the row number corresponding to a crop each season as shown in Figure 5, the 1979 world price, yields from irrigated agriculture, yields from artifically flooded agriculture, yields from recession agriculture, yields from rainfed agriculture, production costs for large perimeters, the percent of a theoretical hectare in large perimeters for that crop, production cost for small perimeters, the percent of a theoretical hectare in small perimeters for that crop (the complement of the percent in large perimeters), the percent of a hectare for each of the following areas: artifically flooded areas, recession agriculture areas, rainfed agriculture areas, and finally the crop water requirements.

The Agricultural Economic Sector data file AGTAB.PRE (Figure 4) is difficult for the user to read in its free formatted form. For this reason, the WRITE program was developed to rewrite the AGTAB.PRE data file in a more readable form, AGDATA.OUT (Figure 5). However, it is

important to note that the AGTAB.PRE data file is the one used by the Agricultural Benefit Model, AGBEN, and changes to the data base must be made to the AGTAB.PRE file rather than to the AGDATA.OUT file.

The format for the Agricultural Areas Data table, AREA.DAT (Figure 6) is I10, F12.0, F11.0, F11.0, F11.0, F11.0, and F10.0 for the year, agricultural development rate, irrigated areas, area of recession agriculture reduced by irrigation, area of rainfed agriculture reduced by irrigation, and area artifically flooded, respectively. Note that the year is an integer variable while all other variables are real.

Algorithms of the Agricultural Benefit Submodel (AGBEN.FTN)

For the purpose of project justification and allocating the joint costs of the Manantali Dam, the agricultural benefits are taken as being the net primary returns to the land irrigated. The annual benefits for each crop are estimated for the 315,000 ha assigned to the Manantali Dam as:

$$AGBEN = RI + RF - RRL - RDL - FC - VC \quad (1)$$

in which

- AGBEN = annual agricultural benefits for each crop
- RI = farm revenues from irrigated areas
- RF = farm revenues from artifically flooded areas
- RRL = lost farm revenues from recession agricultural areas
- RDL = lost farm revenues from rainfed agricultural areas
- FC = fixed costs (land development plus pump replacement)
- VC = variable costs (production costs)

All values are expressed in 1979 CFAF.

Agricultural revenues. The annual revenues from the irrigated area for each crop are calculated as follows:

$$RI = WP * Y * (AI * CP) \quad (2)$$

in which

- RI = revenue from the irrigated crop (CFAF)
- WP = world price (CFAF/metric ton) of the crop
- Y = yield from irrigated agriculture (tonnes/ha)
- AI = irrigated area (ha)
- CP = fraction of the theoretical hectare used for the crop

Irrigated area (AI) is the number of hectares available for irrigation at the beginning of the cropping year under consideration. The annual revenues from the area artificially flooded (RF) are calculated in the same manner but using the prices, yields, and approximation of each crop associated with the artificially flooded area (AF).

No distinction in value is made between revenue crops sold for cash and crops consumed by the farmers. Thus, the benefit imputed to production consumed on the farm uses the world price as an opportunity cost.

Value of displaced production. The value of displaced production is the net benefit lost due to the replacement of recession and rainfed agricultural areas (RRL and RDL, respectively) by irrigation. It is calculated in the same manner as benefit from irrigated crops in Equation 2 above, except that AI is replaced with the agricultural area reduced. The displaced area is that area converted from recession (ARD) or rainfed agriculture (ADD) to irrigation at the beginning of the cropping year. It is assumed that areas being developed for irrigation in a given year will not be available for production, so that crop production is based on the available irrigated land at the end of the preceding year. Crop production costs for the rainfed/recession grown crops are not included because they were assumed to be negligible.

Non-project costs

Fixed costs. The annual fixed costs consist of development costs for new agricultural areas and the costs for pump replacements. They are calculated as follows:

$$TFC = (C_1 * R) + (C_3 * AI) \quad \text{.....(3)}$$

in which

- TFC = total annual fixed cost (CFAF)
- C_1 = development cost per new hectare (CFAF/ha)
- R = agricultural development rate (ha/yr)
- C_3 = annualized pump replacement cost (CFAF/ha/yr)
- AI = area of irrigated agriculture at the beginning of the year (ha)

The pump replacement costs are annualized over the expected life of the pump.

$$C_3 = C_2 * SFF \quad \text{.....(4)}$$

in which

- C_2 = pump costs (CFAF/ha)
- SFF = sinking fund factor

$$SFF = \frac{r}{(1 + r)^n - 1} \quad \text{.....(5)}$$

in which

- r = discount rate in decimal fraction form
- n = number of years to pump replacement

To determine the fixed cost for each crop (FC_j) the total fixed cost (TFC) from Equation 3 is multiplied by that crop's proportion of the theoretical hectare. The AGBEN program insures that 100 percent of the total fixed costs are proportionately distributed among all the products shown in Figure 5.

Variable costs. The total annual variable costs for each crop (VC) are calculated as follows:

$$VC = [(PC_L \cdot P_L . AI + PL_s \; P_s \; AI) * CP \ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

in which

- VC = variable costs (CFAF/ha)
- PC_L = production costs for large perimeters (CFAF/ha)
- P_L = percent of area in large perimeters (fraction)
- PC_s = production costs for small perimeters (CFAF/ha)
- P_s = percent of area in small perimeters (fraction)
- AI = area of irrigated agriculture at the beginning of the year (ha)
- CP = fraction of the theoretical hectare in that crop

The present value of the agricultural benefits is calculated as follows:

$$SUMB = \sum_{t=1}^{NYEAR} DISF_t * TAGBEN_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (7)$$

in which

- SUMB = discounted total agricultural benefit of the project (CFAF)
- NYEAR = project life in years
- $DISF_t$ = discount factor in the tth year
- $TAGBEN_t$ = total yearly agricultural benefits (CFAF/yr)

$$DISF_t = \frac{1}{(1 + r)^{t-1}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (8)$$

in which

- r = discount rate in decimal fraction form
- t = time in years

Water requirements

The total irrigation water requirement, TWR, for the entire basin is the sum of the water requirement for each crop, WR, and is calculated as follows:

$$TWR = \sum_{i=1}^{NCROP} WR * CP * (AI * 10^4) \ldots\ldots\ldots\ldots\ldots\ldots (9)$$

in which

- TWR = total irrigation water requirement (m^3)
- WR = crop water requirement (m/season)
- CP = cropping pattern (theoretical hectare) for each season
- AI = area of irrigation agriculture at the beginning of the year (ha or $m^2 \times 10^6$)
- NCROP = number of products or crops produced

To determine the irrigation water requirements for a specific country, the total irrigation water requirement, TWR, is multiplied by the ratio of the area developed in that specific country to the total area developed in the basin. The calculation of the irrigation water requirements for each crop is presented in Table 5-2 (USU 1984, Volume IV).

Output from the Agricultural Benefits Model (AGBEN)

The output from the AGBEN model consists of three files: CHECK.OUT, AGBEN.OUT, and AGQ.DAT.

CHECK.OUT (Figure 7) tabulates the individual product benefits and water requirements for each year specified by the user. The output is in nine columns which are listed as follows:

1. the crop number (I)
2. revenue generated from irrigated agriculture (RI)
3. revenue generated from areas artifically flooded (RF)
4. revenue lost from recession agriculture (RRL)
5. revenue lost from rainfed agriculture (RDL)
6. fixed costs (FC)
7. variable (production) costs (VC)
8. water requirement (WR)
9. product benefits (AGBEN)

The last row shows the column totals for the specified year, K.

AGBEN.OUT (Figure 8) indicates total water requirements and agricultural benefits by year. The first column is the year, the second the total annual agricultural water requirements, and the third the total annual agricultural benefits. Total project water requirements and agricultural benefits are discounted to 1981. The discounted project water requirements are used to calculate user fees on a consistent basis. User fees are calculated so as to repay the discounted water-related project costs incurred over the period of the project life within the water supply service sector.

The AGQ.DAT (Figure 9) output gives the annual agricultural water requirements for each of the three states, Mali, Mauritania, and Senegal plus their total for each year. AGQ.DAT also contains the total discounted quantities and benefits. The file AGQ.DAT is read by the cost allocation program and the user fees program.

CHECK.OUT OUTPUT FROM AGBEN.FTN
FILE CONTAINS DATA ON INDIVIDUAL CROPS FOR WET AND DRY SEASON
REFERE TO OUTPUT FILE AGDATA.OUT FROM WRITE.FTN FOR DATA ON CROPS AND YIELDS

CROP SEASON	REVENUE IRRIGATION	REVENUE A.FLOOD	REVENUE LOST RECESSION	REVENUE LOST DRY	COSTS FIXED	COSTS VARIABLE	WATER REQUIREMENT	BENEFIT
1	2.69E+09	0.00E-01	0.00E-01	0.00E-01	3.18E+09	7.72E+08	1.58E+08	-1.26E+09
2	9.38E+08	0.00E-01	0.00E-01	0.00E-01	1.27E+09	3.52E+08	7.13E+07	-6.82E+08
3	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
4	1.15E+09	0.00E-01	0.00E-01	0.00E-01	3.64E+08	2.43E+08	9.88E+06	5.47E+08
5	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
6	1.91E+09	0.00E-01	0.00E-01	0.00E-01	1.80E+09	9.17E+08	4.39E+07	-8.06E+08
7	0.00E-01	0.00E-01	1.11E+06	0.00E-01	0.00E-01	0.00E-01	0.00E-01	-1.11E+06
8	6.89E+07	0.00E-01	0.00E-01	0.00E-01	4.47E+08	8.35E+07	1.46E+07	-4.61E+08
9	0.00E-01	0.00E-01	0.00E-01	0.00E-01	2.81E+08	1.15E+08	9.33E+06	-3.95E+08
10	4.70E+08	0.00E-01	0.00E-01	0.00E-01	2.81E+08	1.29E+08	1.52E+07	6.00E+07
11	2.07E+09	0.00E-01	2.75E+07	0.00E-01	2.97E+09	4.98E+08	5.27E+07	-1.42E+09
12	9.06E+08	0.00E-01	0.00E-01	0.00E-01	1.30E+09	2.43E+08	3.35E+07	-6.35E+08
13	1.39E+09	0.00E-01	5.85E+06	0.00E-01	1.71E+09	3.18E+08	3.52E+07	-6.46E+08
14	1.05E+09	0.00E-01	0.00E-01	0.00E-01	1.30E+09	2.71E+08	3.17E+07	-5.15E+08
15	1.79E+08	0.00E-01	0.00E-01	0.00E-01	3.12E+08	6.20E+07	8.38E+06	-1.94E+08
16	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
17	2.34E+08	0.00E-01	0.00E-01	0.00E-01	2.49E+08	0.00E-01	0.00E-01	-1.55E+07
18	6.31E+07	0.00E-01	0.00E-01	0.00E-01	2.49E+08	0.00E-01	0.00E-01	-1.86E+08
19	5.96E+08	0.00E-01	0.00E-01	0.00E-01	2.49E+08	7.27E+07	8.30E+06	2.74E+08
20	1.59E+08	0.00E-01	0.00E-01	0.00E-01	2.49E+08	8.24E+07	1.35E+07	-1.73E+08
21	2.37E+08	0.00E-01	0.00E-01	0.00E-01	2.49E+08	0.00E-01	0.00E-01	-1.24E+07
22	6.31E+07	0.00E-01	0.00E-01	0.00E-01	2.49E+08	0.00E-01	0.00E-01	-1.86E+08
23	4.06E+08	0.00E-01	0.00E-01	0.00E-01	2.49E+08	7.27E+07	8.30E+06	8.44E+07
24	1.09E+08	0.00E-01	0.00E-01	0.00E-01	2.49E+08	8.24E+07	1.35E+07	-2.23E+08
25	1.74E+08	0.00E-01	0.00E-01	0.00E-01	2.49E+08	0.00E-01	0.00E-01	-7.49E+07
26	4.71E+07	0.00E-01	0.00E-01	0.00E-01	2.49E+08	0.00E-01	0.00E-01	-7.02E+08
27	2.13E+08	0.00E-01	0.00E-01	0.00E-01	2.49E+08	7.27E+07	8.30E+06	-1.09E+08
28	5.81E+07	0.00E-01	0.00E-01	0.00E-01	2.49E+08	8.24E+07	1.35E+07	-2.74E+08
YEAR	TRI	TRF	TRRL	TRDL	TFC	TVC	TWR	TAGBEN
1	1.52E+10	0.00E-01	3.45E+07	0.00E-01	1.82E+10	4.47E+09	5.49E+08	-7.51E+09

Figure 7. CHECK.OUT

FILE AGBEN.OUT AGRICULTURAL OUTPUT YEARLY VALUES X1E.0E9

YEAR	YEARLY TOTALS WATER REQUIRED	YEARLY TOTALS AGRICULTURAL BENEFIT	YEARLY WATER REQUIREMENTS BY COUNTRY MALI	MAURITANIA	SENEGAL
1	0.549	-7.511	0.000	0.000	0.000
2	0.625	-6.607	0.016	0.112	0.422
3	0.702	-5.702	0.027	0.137	0.461
4	0.778	-4.797	0.039	0.162	0.500
5	0.854	-7.461	0.051	0.188	0.539
6	0.949	-6.330	0.065	0.215	0.575
7	1.045	-5.200	0.080	0.247	0.623
8	1.140	-4.069	0.095	0.279	0.671
9	1.235	-2.938	0.110	0.311	0.719
10	1.330	-1.633	0.126	0.343	0.766
11	1.426	-0.545	0.141	0.375	0.814
12	1.521	0.543	0.157	0.408	0.861
13	1.616	1.630	0.172	0.440	0.909
14	1.712	2.718	0.188	0.473	0.956
15	1.807	3.847	0.203	0.505	1.003
16	1.902	4.978	0.219	0.538	1.050
17	1.998	6.109	0.235	0.570	1.097
18	2.093	7.240	0.250	0.603	1.144
19	2.188	8.371	0.266	0.635	1.191
20	2.283	9.502	0.282	0.668	1.238
21	2.379	10.632	0.298	0.701	1.285
22	2.474	11.763	0.313	0.733	1.332
23	2.569	12.904	0.329	0.766	1.379
24	2.665	14.057	0.345	0.799	1.426
25	2.760	15.209	0.361	0.831	1.473
26	2.855	16.361	0.376	0.864	1.520
27	2.951	17.514	0.392	0.896	1.567
28	3.046	18.666	0.408	0.929	1.614
29	3.141	19.819	0.424	0.962	1.660
30	3.237	20.971	0.433	0.997	1.711
31	3.332	22.123	0.434	1.036	1.767
32	3.427	23.276	0.434	1.075	1.822
33	3.522	24.428	0.435	1.114	1.878
34	3.618	25.581	0.435	1.153	1.934
35	3.713	26.733	0.435	1.192	1.990
36	3.808	27.885	0.436	1.231	2.046
37	3.904	29.038	0.436	1.270	2.102
38	3.999	30.200	0.436	1.310	2.158
39	4.094	31.374	0.436	1.349	2.214
40	4.190	32.548	0.436	1.388	2.270
41	4.285	33.722	0.437	1.427	2.326
42	4.380	34.896	0.437	1.466	2.381
43	4.475	36.070	0.437	1.505	2.438
44	4.571	37.244	0.437	1.544	2.493
45	4.666	38.418	0.437	1.584	2.550
46	4.761	39.592	0.438	1.623	2.605
47	4.857	40.766	0.438	1.662	2.661
48	4.952	41.940	0.438	1.701	2.717
49	5.047	43.114	0.438	1.741	2.773
50	5.143	44.288	0.439	1.780	2.829
TOTALS	140.573	813.280	15.568	45.656	79.348

DISCOUNTED TOTAL PROJECT AGRICULTURAL BENEFIT = 117.4339 X1.E9

DISCOUNTED TOTAL PROJECT WATER REQUIREMENT = 37.0542 X1.E9

THE DISCOUNT RATE=0.05

****

Figure 8. AGBEN.OUT

```
 21  50   3  NUMBER OF LINES IN TITLE,YEARS,COLUMNS READ BY REVENUE.FTN
AGQ.DAT OUTPUT FROM AGBEN USED IN REVENUE

OUTPUT FROM AREA.FTN USED AS INPUT FOR AGBEN
VALUES OF OPTIONS USED FOR THIS RUN ARE
NEW DEVELOPMENT RATE   5000.TIME TO NEW DEVELOPMENT RATE   4.
NUMBER OF YEARS BEFORE THE FLOOD   9.
THE FOLLOWING VALUES WERE USED TO DISTRIBUTE HA DEVELOPED BETWEEN COUNTRIES
 INITIAL   MALI = .1666 MAUR .3436 SENEGAL .4898
TOTAL POSSIBLE HA IN MALI =  23437.
FINIAL   MAUR .4125 SENEGAL .5875
INITIAL AREAS MALI     270. MAUR   5305. SENEGAL  23230.

                    AGRICULTURAL AREAS DATA TABLE
     YEAR        RATE        AI        ARD        ADD        AF      MALI    MAUR

        AGRICULTURAL ECONOMIC SECTOR DATA TABLE
VALUE OF OPTIONS ENTERED INTERACTIVELY ARE
DEVELOPMENT COST  3560000. REPLACEMENT COST   760000.TIME TO PUMP REPLACEMENT    5 DISCOUNT RATE 0.050
 YEARLY WATER REQUIREMENTS
      MALI        MAURITANIA      SENEGAL          TOTAL
   15647248.00   111781744.00   421542336.00   549026240.00        1
   27199100.00   136808352.00   461196736.00   625266688.00        2
   39003796.00   162118288.00   500385024.00   701507136.00        3
   50942464.00   187514944.00   539290176.00   777747584.00        4
   64646888.00   214692576.00   574648512.00   853987968.00        5
   79740224.00   246625104.00   622923008.00   949288384.00        6
   94953136.00   278696320.00   670939520.00  1044588992.00        7
  110227288.00   310847808.00   718814144.00  1139889280.00        8
  125618776.00   343135648.00   766435136.00  1235189504.00        9
  141160992.00   375464288.00   813860736.00  1330489984.00       10
  156694368.00   407918656.00   861320000.00  1425790464.00       11
  172187504.00   440203776.00   908699840.00  1521091072.00       12
  187824720.00   472794560.00   955934080.00  1616391680.00       13
  203340024.00   505291520.00  1003051648.00  1711692160.00       14
  219007504.00   537760960.00  1050224064.00  1806992512.00       15
  234742960.00   570307456.00  1097242624.00  1902292992.00       16
  250498256.00   602873792.00  1144421376.00  1997593600.00       17
  266216160.00   635402688.00  1191484672.00  2092894208.00       18
  281839456.00   668055808.00  1238299392.00  2188194560.00       19
  297539456.00   700576384.00  1285379584.00  2283495424.00       20
  313287424.00   733144960.00  1332363648.00  2378796032.00       21
  329054880.00   765732992.00  1379309056.00  2474096896.00       22
  344813056.00   798568448.00  1426015232.00  2569396736.00       23
  360533600.00   831119232.00  1473044992.00  2664697856.00       24
  376463744.00   863603456.00  1519931008.00  2759998208.00       25
  392032512.00   896278272.00  1566702336.00  2855298816.00       26
  408067840.00   929143616.00  1613682432.00  2950598912.00       27
  423684672.00   961590528.00  1660319872.00  3045899776.00       28
  439485632.00   996702848.00  1710697728.00  3141200384.00       29
  454014784.00  1036003968.00  1766805888.00  3236500992.00       30
  454133664.00  1074838912.00  1822494976.00  3331800832.00       31
  454556544.00  1114150912.00  1878394624.00  3427101952.00       32
  455016608.00  1153234304.00  1934150784.00  3522401792.00       33
```

Figure 9. AGQ.DAT

435209664.00	1192394880.00	1990098432.00	3617702912.00	34
435635264.00	1231731872.00	2046236160.00	3713003264.00	35
435869952.00	1270450176.00	2102185680.00	3808303872.00	36
436042576.00	1309669264.00	2157912320.00	3903604224.00	37
436290512.00	1348830592.00	2213793792.00	3998904832.00	38
436442240.00	1387935360.00	2268827328.00	4094204928.00	39
436665440.00	1426945792.00	2325594880.00	4189505792.00	40
437050208.00	1466676736.00	2381495296.00	4284806144.00	41
437134656.00	1505442688.00	2437529600.00	4380106752.00	42
437247264.00	1544462848.00	2493249024.00	4475406848.00	43
437416704.00	1583750144.00	2549940608.00	4570707456.00	44
437671552.00	1622837504.00	2605498[illegible]0.00	4666008064.00	45
438040320.00	1662172416.00	2661094912.00	4761307648.00	46
438066144.00	1701270272.00	2717272832.00	4856609280.00	47
438244032.00	1740596352.00	2773069568.00	4951909888.00	48
438602656.00	1779646592.00	2828961792.00	5047211008.00	49
438656064.00	1818805728.00	2884947712.00	5142509568.00	50
TOTALS .1556845466E+11	.4565578138E+11	.7934829363E+11	.1405730161E+12	

Figure 9. Continued.

NAVIGATION BENEFITS

For the purpose of calculating the navigation benefits and navigation volumes for the Senegal River Basin Development Project, a Navigation Benefit submodel was written. It consists of two FORTRAN programs, NVOL.FTN and NBEN.FTN, and six data files, NAVTAB.PRE, NVOL.DAT, DELAY.DAT, NAVQ.DAT, NBEN.OUT, and ACCOST.DAT. The submodel is included in the flow chart in Figure 1. This part of the manual includes descriptions of each component shown in the flow chart, along with a description of the input data, the algorithms used in the model, and sample outputs.

The calculation of navigation service benefits is different from that of agriculture because some of the economic sectors which use the navigation services have indeterminate benefit streams. For example, some of the river transportation is undertaken by households and non-agricultural businesses for which benefits and profits are difficult to determine. For that reason, benefits to navigation are calculated by using the least cost alternative method of providing the service. The alternative for water transport is either road or rail shipment. In both of these cases, the model uses 1980 price and cost data. These data have been collected for each country (Report 4, USU 1980), and significant differences were found among countries. As the transportation sector develops in the three countries, it is expected that the measurement of benefits resulting from navigation can be more accurately determined, and that the model can be updated accordingly. However, it is doubtful that realistic estimates of profits from navigation will be available in the near future, since considerable data collection on gains in profit to firms using navigation services would be required. Estimates of benefits to households also are difficult to obtain. The cost savings approach requires input of the cost of alternative transportation, and the necessary data are entered interactively. Note that foregone profits from existing transportation fees should be included as a cost where transport is displaced. However, no data were available for transport profits, and most, if not all, transportation is publically owned and/or heavily subsidized.

The modes and costs of alternative transport are summarized in Tables 15 through 18 in Report 4 (USU 1980). In order to make the Navigation Benefits Submodel compatible with the Agricultural Benefits Submodel, the agricultural navigation volumes are adjusted by the ratio of the development rate to the 5000 ha/year rate.

Input Data for the Navigation Benefit Model (NBEN)

The use of the Navigation Benefits Submodel, NBEN.FTN, requires two separate data files, the Navigation Volume data file (NVOL.DAT) and the Agricultural Volumes During Navigation Delay (DELAY.DAT). These data files can be created either by running the program NVOL.FTN or by independently developing a separate data file. The use of NVOL.FTN is recommended as long as the assumptions contained in NVOL.FTN are valid. In addition to these two data tables, some additional data are

entered interactively on the computer terminal and some data are generated by the program itself. The latter can be changed only by making changes within the NBEN.FTN program.

Navigation Volume Data (Input Data NAVTAB.PRE and AREA.DAT)

As mentioned above, execution of NBEN.FTN requires the prior preparation of two data files NVOL.DAT and DELAY.DAT which are produced by the NVOL.FTN program. The running of NVOL.FTN requires the preparation of two data files AREA.DAT and NAVTAB.PRE. In addition, interactive data are entered while the program NVOL.FTN is running.

AREA.DAT. Figure 6a shows the data table for the agricultural development rate, with the rate at which irrigated area is developed and appropriate totals in each agricultural class. This data file is discussed in some detail in the Agricultural Benefit Section. The NVOL.FTN program obtains the agricultural development rate from the AREA.DAT file.

NAVTAB.PRE. Figure 10 shows the data base for navigation volumes. Unless otherwise indicated as for all .PRE type input files, the first lines contain identification information. The volumes are divided into three categories: irrigation related agricultural products, "other" products and production from phosphate mines. Agricultural volumes include imports of machinery, fertilizer, seed, and other inputs and exports of commodities produced. Agricultural products produced by non-irrigated agriculture (recession and rainfed) were assumed to be either consumed domestically or transported by alternative means. The "other" products included domestic and industrial goods. These data are free formatted. The first nine rows of numbers, in order of appearance, are: 1) year; 2) volumes of "other" products transported for Mali; 3) volumes of agricultural products transported by Mali; 4) volumes of goods which would have been imported to Mali by rail, but are now transported by navigation; 5) volumes of "other" products transported by Mauritania, 6) volumes of agricultural products transported by Mauritania, 7) volumes of "other" products transported by Senegal, 8) volumes of agricultural products transported by Senegal, and 9) total volumes of products transported. The tenth row is the year phosphate transport is scheduled to begin if there is no navigational delay. The eleventh row is the year that phosphate transport is scheduled to end if there is no delay. The twelfth is the volume of phosphate transported. All volumes are expressed in millions of tonne-km. Values are from Table 8 of Report 5 (USU 1981).

Interactive input. The datum which is entered interactively to the program NVOL.FTN is:

The delay of navigation in years (Default = 5 years). User should enter 0 if cost allocation is being calculated, or the expected delay if user fees are being calculated.

Navigation volume program (NVOL.FTN)

In order to project navigation volumes by use sector and country, a procedure was used which is similar to that of Lackner (see Tables E2-1

```
2.50.
  NAVTAB.PRE INPUT FOR NVOL
  BREAKDOWN OF NAVIGATIONAL VOLUMES DATA
1985.      1990.     2000.      2025.
253.0.     534.1.   1332.3.    5135.9.
5.2.         9.8.     60..      131.7.
185.31.    360.95.   887.78.   3408.66.
4.3.         6.1.     13.6.      50.3.
30.6.       29.7.     58.6.     154.9.
11.8.       20.4.      54..     193.6.
25.6.       40.7.    111.1.     137.8.
330.5.     640.9.   1629.6.    5804.2.
1988.
2002.
425.6.
```

Figure 10. NAVTAB.PRE

through E2-11 and E4-11 of Mission A1.8, Tomme II). Assignment of benefits to the member states is made on the basis of the following rules: 1) cargo with both origin and destination in the same state is assigned to that country, 2) cargo transported between countries is divided equally between both countries for purposes of assignment, and 3) imports into and exports out of the basin are assigned to the country in which the destination (or the origin, respectively) is located. A detailed calculation of navigation volumes between member states was prepared by Lackner and dated October 15, 1980. However, this calculation does not include a division of navigation volumes between the agriculture and other use sectors. A comparison of Lackner and our estimates indicated exact agreement on the assignment of navigation volumes to the member states expressed as tonnes and within 1 percent (less than 0.3 percent in most cases) expressed as tonne-kilometers (t km). The other navigation volumes (in t km) were taken from the Lackner estimates. The resulting navigation volumes are summarized in Figure 10 (NAVTAB.PRE).

Navigation service may be delayed as a result of some development problems. The possibility for a delay is built into the model; the default delay is 5 years. This 5 year delay in the navigation service is assumed to have no effect on the growth of agricultural and "other" navigation demand volumes so that the volume in 1989, the first year of navigation in the event of a delay, is greater than the volume in 1984. It is assumed that during the period of delay alternative modes of transport would be used to carry the navigation traffic. While a delay in navigation development affects both the benefit stream and the financing costs, the specific costs of production used in the allocation model are based on the no delay case. Thus there is no incentive to delay navigation development. The agricultural navigation volumes presented in Figure 6a are based on an agricultural development rate given in the Agricultural Areas Data table, AREA.DAT.

Insufficient agricultural production in the basin (agricultural area data in Figure 6) likely would require increased imports of food, so that river transportation of these imports could somewhat offset accompanying reductions in the river transport of agricultural exports from the basin. The actual effect on navigation volumes of the development rate would depend on many factors, including population growth and agricultural yields. This effect is not represented in the model.

<u>Algorithms of the program NVOL.FTN.</u> The navigation volumes are calculated as follows:

$$VOL = SLOPE * YEAR + CROSS \qquad (10)$$

in which

- VOL = navigation volume of the use sector (t km/year)
- SLOPE = slope of the linear function relating navigation volume to time (t km/year)
- YEAR = the corresponding year
- CROSS = y-axis (navigation volume) intercept (t km)

The navigation quantities for each year are determined from this equation, the slope of which is calculated from a linear extrapolation between each data point (1983, 1990, 2000, 2025) for each use sector (given in NAVAGTAB.PRE). The volumes for the years after the last year of input data are determined by projecting the function beyond the last data point

$$SLOPE = \frac{VOL_j - VOL_i}{YEAR_j - YEAR_i} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(11)$$

in which

SLOPE = slope of the line function relating volume and time

VOL_i = navigation volume for the use sector in input data for year i

$YEAR_i$ = years corresponding to the data point, i

$$CROSS = VOL_i - SLOPE * YEAR_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(12)$$

in which

CROSS = y-axis (navigation volume) intercept, as represents the volume

VOL_i = navigation volume of the use sector given in NAVAGTAB.PRE data table in year i

SLOPE = slope of the function relating volume to year

$YEAR_i$ = corresponding year, i

As the data change, the program will adjust slopes, intercepts and volumes by year. The NVOL program will then adjust the agricultural navigation volumes for those years where the agricultural development rate is different than 5000 ha/yr (the development rate assumed in NAVTAB.PRE). This adjustment is performed by multiplying the ratio of the new development rate to 5000 ha/yr by the yearly change in agricultural navigation volume, then adding the result of the total agricultural volume transported up to that time.

$$AVNEW_t = AVNEW_{t-1} + (AVOLD_t - AVOLD_{t-1}) * DRATE/5000 \ldots(13)$$

in which

$AVNEW_t$ = adjusted total agricultural volume up to year t (tkm)

$AVOLD_t$ = total agricultural volume up to year t based upon a 5000 ha/yr development rate (tkm)

DRATE = development rate (ha/yr).

Output Data Files (NVOL.DAT, NVOL.OUT, and DELAY.DAT)

Figures 11a and 11b show NVOL.DAT and Figures 12a and 12b show DELAY.DAT. These two data files are output files from program NVOL.DAT which transfer navigation volume data to the navigation benefits program NBEN.FTN. The data contained in file 11a and 11b are also written to files 11.1a and 11.2b NVOL.OUT. NVOL.OUT is just presented in a format that is easier to read.

```
*****************************************************************************
OUTPUT FROM NVOL.FTN--NVOL.DAT FOR USE IN NBEN
  THE FOLLOWING INPUT FILES WERE USED

 NAVTAB.PRE INPUT FOR NVOL
 BREAKDOWN OF NAVIGATIONAL VOLUMES DATA,UNITS T-KM

OUTPUT FROM AREA.FTN USED AS INPUT FOR AGBEN
VALUES OF OPTIONS USED FOR THIS RUN ARE
NEW DEVELOPMENT RATE   5000.TIME TO NEW DEVELOPMENT RATE   4.
NUMBER OF YEARS BEFORE THE FLOOD   9.
THE FOLLOWING VALUES WERE USED TO DISTRIBUTE HA DEVELOPED BETWEEN COUNTRIES
 INITIAL  MALI = .1666 MAUR .3436 SENEGAL .4898
TOTAL POSSIBLE HA IN MALI =  23437.
FINIAL  MAUR .4125 SENEGAL .5875
INITIAL AREAS MALI    270. MAUR   5305. SENEGAL  23230.

                    AGRICULTURAL AREAS DATA TABLE
     YEAR        RATE        AI        ARD        ADD        AF      MALI    MAUR

INTERACTIVE OPTION DELAY SET TO        0 YEARS
```

YEAR	MIVOLO	MIVOLA	RVOL	MAVOLO	MAVOLA	PVOL	SEVOLO	SEVOLA	VOLT	AVOLD
1981	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1982	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1983	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	49.12
1984	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	51.27
1985	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	53.42
1986	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	56.10
1987	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	58.79
1988	453.78	7.18	310.77	5.59	23.89	0.00	17.94	30.40	538.78	0.00
1989	493.94	7.84	335.86	5.84	23.76	0.00	19.17	32.56	583.11	0.00
1990	534.09	8.50	360.95	6.10	23.63	0.00	20.40	34.72	627.44	0.00
1991	613.92	13.52	413.64	6.85	26.52	0.00	23.76	41.76	726.33	0.00
1992	693.73	18.54	466.32	7.60	29.41	0.00	27.12	48.80	825.20	0.00
1993	773.56	23.56	519.01	8.35	32.30	425.60	30.48	55.84	1343.69	0.00
1994	853.38	28.58	571.69	9.10	35.19	425.60	33.84	62.88	1448.56	0.00
1995	933.20	33.60	624.38	9.85	38.08	425.60	37.20	69.92	1547.45	0.00
1996	1013.02	38.62	677.05	10.60	40.97	425.60	40.56	76.96	1646.32	0.00
1997	1092.83	43.64	729.73	11.35	43.86	425.60	43.92	84.00	1745.19	0.00
1998	1172.66	48.66	782.42	12.10	46.75	425.60	47.28	91.04	1844.08	0.00
1999	1252.47	53.68	835.10	12.85	49.64	425.60	50.64	98.08	1942.95	0.00
2000	1332.31	58.70	887.78	13.60	52.53	425.60	54.00	105.12	2041.86	0.00
2001	1484.44	61.57	988.63	15.07	56.38	425.60	59.58	106.18	2208.82	0.00
2002	1636.59	64.43	1089.45	16.54	60.24	425.60	65.17	107.25	2375.82	0.00
2003	1788.75	67.30	1190.30	18.00	64.09	425.60	70.75	108.32	2542.82	0.00
2004	1940.88	70.17	1291.13	19.47	67.94	425.60	76.34	109.39	2709.78	0.00

Figure 11a. NVOL.DAT no delay.

2005	2093.03	73.04	1391.97	20.94	71.79	425.60	81.92	110.46	2876.78	0.00
2006	2245.16	75.91	1492.80	22.41	75.64	425.60	87.50	111.53	3043.74	0.00
2007	2397.31	78.77	1593.63	23.88	79.50	425.60	93.09	112.59	3210.74	0.00
2008	2549.47	81.64	1694.47	25.34	83.35	0.00	98.67	113.66	2952.13	0.00
2009	2701.59	84.51	1795.30	26.81	87.20	0.00	104.26	114.73	3119.10	0.00
2010	2853.75	87.33	1896.14	28.28	91.05	0.00	109.84	115.80	3286.10	0.00
2011	3005.91	90.25	1996.97	29.75	94.90	0.00	115.42	116.86	3453.09	0.00
2012	3158.03	93.11	2097.81	31.22	98.76	0.00	121.01	117.93	3620.06	0.00
2013	3310.19	95.98	2198.64	32.68	102.61	0.00	126.59	119.00	3787.05	0.00
2014	3462.31	98.85	2299.48	34.15	106.46	0.00	132.18	120.07	3954.02	0.00
2015	3614.47	101.72	2400.31	35.62	110.31	0.00	137.76	121.14	4121.01	0.00
2016	3766.63	104.59	2501.15	37.09	114.16	0.00	143.34	122.20	4288.01	0.00
2017	3918.75	107.45	2601.98	38.56	118.02	0.00	148.93	123.27	4454.98	0.00
2018	4070.91	110.32	2702.81	40.02	121.87	0.00	154.51	124.34	4621.97	0.00
2019	4223.03	113.19	2803.66	41.49	125.72	0.00	160.10	125.41	4788.94	0.00
2020	4375.19	116.06	2904.48	42.96	129.57	0.00	165.68	126.48	4955.93	0.00
2021	4527.34	118.93	3005.33	44.43	133.42	0.00	171.26	127.55	5122.93	0.00
2022	4679.47	121.79	3106.16	45.90	137.28	0.00	176.85	128.61	5289.90	0.00
2023	4831.63	124.66	3207.00	47.36	141.13	0.00	182.43	129.68	5456.89	0.00
2024	4983.75	127.53	3307.83	48.83	144.98	0.00	188.02	130.75	5623.86	0.00
2025	5135.91	130.40	3408.67	50.30	148.83	0.00	131.82	137.80	5790.85	0.00
2026	5288.06	133.27	3509.50	51.77	152.68	0.00	132.88	138.87	5957.85	0.00
2027	5440.19	136.13	3610.33	53.24	156.54	0.00	133.95	139.94	6124.81	0.00
2028	5592.34	139.00	3711.17	54.70	160.39	0.00	135.02	141.00	6291.81	0.00
2029	5744.47	141.87	3812.00	56.17	164.24	0.00	136.09	142.07	6458.78	0.00
2030	5896.63	144.74	3912.84	57.64	168.09	0.00	137.16	143.14	6625.77	0.00
2031	6048.78	147.61	4013.67	59.11	171.94	0.00	138.22	144.21	6792.77	0.00

Figure 11a. Continued

NAVIGATION VOLUMES FILE NVOL.OUT
FOLLOWING CODE IS USED FOR COLUMN HEADINS:

MIVOLO = VOLUME OTHER FOR MALI
MIVOLA = VOLUME AGRICULTURE MALI
RVOL = RAIL VOLUME
MAVOLO = VOLUME OTHER FOR MAURITANIA
MAVOLA = VOLUME AGRICULTURE MAURITANIA
PVOL = PHOSPHATE VOLUME
SEVOLO = VOLUME OTHER SENEGAL
SEVOLA = VOLUME AGRICULTURE SENEGAL
VOLT = TOTAL VOLUME
AVOLD = ADJUSTED AGRICULTURAL VOLUME OF PREVIOUS YEAR

YEAR	MIVOLO	MIVOLA	RVOL	MAVOLO	MAVOLA	PVOL	SEVOLO	SEVOLA	VOLT	AVOLD
1981	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1982	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1983	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	49.12
1984	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	51.27
1985	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	53.42
1986	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	56.10
1987	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	58.79
1988	453.78	7.18	310.77	5.59	23.89	0.00	17.94	30.40	538.78	0.00
1989	493.94	7.84	335.86	5.84	23.76	0.00	19.17	32.56	583.11	0.00
1990	534.09	8.50	360.95	6.10	23.63	0.00	20.40	34.72	627.44	0.00
1991	613.92	13.52	413.64	6.85	26.52	0.00	23.76	41.76	726.33	0.00
1992	693.73	18.54	466.32	7.60	29.41	0.00	27.12	48.80	825.20	0.00
1993	773.56	23.56	519.01	8.35	32.30	425.60	30.48	55.84	1349.69	0.00
1994	853.38	28.58	571.69	9.10	35.19	425.60	33.84	62.88	1448.56	0.00
1995	933.20	33.60	624.38	9.85	38.08	425.60	37.20	69.92	1547.45	0.00
1996	1013.02	38.62	677.05	10.60	40.97	425.60	40.56	76.96	1646.32	0.00
1997	1092.83	43.64	729.73	11.35	43.86	425.60	43.92	84.00	1745.19	0.00
1998	1172.66	48.66	782.42	12.10	46.75	425.60	47.28	91.04	1844.08	0.00
1999	1252.47	53.68	835.10	12.85	49.64	425.60	50.64	98.08	1942.95	0.00
2000	1332.31	58.70	887.78	13.60	52.53	425.60	54.00	105.12	2041.86	0.00
2001	1484.44	61.57	988.63	15.07	56.38	425.60	59.58	106.18	2208.82	0.00
2002	1636.59	64.43	1089.45	16.54	60.24	425.60	65.17	107.25	2375.82	0.00
2003	1788.75	67.30	1190.30	18.00	64.09	425.60	70.75	108.32	2542.82	0.00
2004	1940.88	70.17	1291.13	19.47	67.94	425.60	76.34	109.39	2709.78	0.00
2005	2093.03	73.04	1391.97	20.94	71.79	425.60	81.92	110.46	2876.78	0.00
2006	2245.16	75.91	1492.80	22.41	75.64	425.60	87.50	111.53	3043.74	0.00
2007	2397.31	78.77	1593.63	23.88	79.50	425.60	93.09	112.59	3210.74	0.00
2008	2549.47	81.64	1694.47	25.34	83.35	0.00	98.67	113.66	2952.13	0.00
2009	2701.59	84.51	1795.30	26.81	87.20	0.00	104.26	114.73	3119.10	0.00
2010	2853.75	87.38	1896.14	28.28	91.05	0.00	109.84	115.80	3286.10	0.00
2011	3005.91	90.25	1996.97	29.75	94.90	0.00	115.42	116.86	3453.09	0.00
2012	3158.03	93.11	2097.81	31.22	[illegible]	0.00	121.01	117.93	3620.06	0.00
2013	3310.19	95.98	2198.64	32.68	102.61	0.00	126.59	119.00	3787.05	0.00
2014	3462.31	98.85	2299.48	34.15	106.46	[illegible]	132.18	120.07	3954.02	0.00
2015	3614.47	101.72	2400.31	35.62	110.31	0.00	137.76	121.14	4121.01	0.00
2016	3766.63	104.59	2501.16	37.09	114.16	0.00	[illegible]	122.20	4288.01	0.00
2017	3918.75	107.45	2601.98	38.56	118.02	0.00	148.9[illegible]	123.27	4454.98	0.00
2018	4070.91	110.32	2702.81	40.02	121.87	0.00	154.51	124.34	4621.97	0.00

Figure 11.1a. NVOLT.OUT no delay

2019	4223.03	113.19	2803.66	41.49	125.72	0.00	160.10	125.41	4738.94	0.00
2020	4375.19	116.06	2904.48	42.96	129.57	0.00	165.68	126.48	4955.93	0.00
2021	4527.34	118.93	3005.33	44.43	133.42	0.00	171.26	127.55	5122.93	0.00
2022	4679.47	121.79	3106.16	45.90	137.28	0.00	176.85	128.61	5289.90	0.00
2023	4831.63	124.66	3207.00	47.36	141.13	0.00	182.43	129.68	5456.89	0.00
2024	4983.75	127.53	3307.83	48.83	144.98	0.00	188.02	130.75	5623.86	0.00
2025	5135.91	130.40	3408.67	50.30	148.83	0.00	131.82	137.80	5790.85	0.00
2026	5288.06	133.27	3509.50	51.77	152.68	0.00	132.88	138.87	5957.85	0.00
2027	5440.19	136.13	3610.33	53.24	156.54	0.00	133.95	139.94	6124.81	0.00
2028	5592.34	139.00	3711.17	54.70	160.39	0.00	135.02	141.00	6291.81	0.00
2029	5744.47	141.87	3812.00	56.17	164.24	0.00	136.09	142.07	6458.78	0.00
2030	5896.63	144.74	3912.84	57.64	168.09	0.00	137.16	143.14	6625.77	0.00
2031	6048.78	147.61	4013.67	59.11	171.94	0.00	138.22	144.21	6792.77	0.00

Figure 11.1a. Continued

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*****************************************************************************
 OUTPUT FROM NVOL.FTN--NVOL.DAT FOR USE IN NBEN
   THE FOLLOWING INPUT FILES WERE USED

  NAVTAB.PRE INPUT FOR NVOL
  BREAKDOWN OF NAVIGATIONAL VOLUMES DATA,UNITS T-KM

 OUTPUT FROM AREA.FTN USED AS INPUT FOR AGBEN
 VALUES OF OPTIONS USED FOR THIS RUN ARE
NEW DEVELOPMENT RATE   5000.TIME TO NEW DEVELOPMENT RATE   4.
 NUMBER OF YEARS BEFORE THE FLOOD   9.
 THE FOLLOWING VALUES WERE USED TO DISTRIBUTE HA DEVELOPED BETWEEN COUNTRIES
  INITIAL  MALI = .1666 MAUR .3436 SENEGAL .4898
 TOTAL POSSIBLE HA IN MALI =  23437.
 FINIAL  MAUR .4125 SENEGAL .5875
 INITIAL AREAS MALI     270. MAUR   5305. SENEGAL  23230.

                    AGRICULTURAL AREAS DATA TABLE
     YEAR        RATE        AI        ARD        ADD        AF      MALI    MAUR

INTERACTIVE OPTION DELAY SET TO        5 YEARS
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YEAR	MIVOLO	MIVOLA	RVOL	MAVOLO	MAVOLA	PVOL	SEVOLO	SEVOLA	VOLT	AVOLD
1981	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1982	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1983	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	49.12
1984	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	51.27
1985	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	53.42
1986	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	56.10
1987	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	58.79
1988	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	61.47
1989	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	64.16
1990	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	66.85
1991	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	81.80
1992	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	96.75
1993	773.56	23.56	519.01	8.35	32.30	0.00	30.48	55.84	924.09	0.00
1994	853.38	28.58	571.69	9.10	35.19	0.00	33.84	62.88	1022.96	0.00
1995	933.20	33.60	624.38	9.85	38.08	0.00	37.20	69.92	1121.85	0.00
1996	1013.02	38.62	677.05	10.60	40.97	0.00	40.56	76.96	1220.72	0.00
1997	1092.83	43.64	729.73	11.35	43.86	0.00	43.92	84.00	1319.59	0.00
1998	1172.66	48.66	782.42	12.10	46.75	425.60	47.28	91.04	1844.08	0.00
1999	1252.47	53.68	835.10	12.85	49.64	425.60	50.64	98.08	1942.95	0.00
2000	1332.31	58.70	887.78	13.60	52.53	425.60	54.00	105.12	2041.86	0.00
2001	1484.44	61.57	988.63	15.07	56.38	425.60	59.58	106.18	2208.82	0.00
2002	1636.59	64.43	1089.45	16.54	60.24	425.60	65.17	107.25	2375.82	0.00
2003	1788.75	67.30	1190.30	18.00	64.09	425.60	70.75	108.32	2542.82	0.00

Figure 11b. NVOL.DAT 5 year delay

2004	1940.88	70.17	1291.13	19.47	67.94	425.60	75.34	109.39	2709.78	0.00
2005	2093.03	73.04	1391.97	20.94	71.79	425.60	81.92	110.46	2876.78	0.00
2006	2245.16	75.91	1492.80	22.41	75.64	425.60	87.50	111.53	3043.74	0.00
2007	2397.31	78.77	1593.63	23.88	79.50	425.60	93.09	112.59	3210.74	0.00
2008	2549.47	81.64	1694.47	25.34	83.35	425.60	98.67	113.66	3377.73	0.00
2009	2701.59	84.51	1795.30	26.81	87.20	425.60	104.26	114.73	3544.70	0.00
2010	2853.75	87.38	1896.14	28.28	91.05	425.60	109.84	115.80	3711.70	0.00
2011	3005.91	90.25	1996.97	29.75	94.90	425.60	115.42	116.86	3878.69	0.00
2012	3158.03	93.11	2097.81	31.22	98.76	425.60	121.01	117.93	4045.66	0.00
2013	3310.19	95.98	2198.64	32.68	102.61	0.00	126.59	119.00	3787.05	0.00
2014	3462.31	98.85	2299.48	34.15	106.46	0.00	132.18	120.07	3954.02	0.00
2015	3614.47	101.72	2400.31	35.62	110.31	0.00	137.76	121.14	4121.01	0.00
2016	3766.63	104.59	2501.16	37.09	114.16	0.00	143.34	122.20	4288.01	0.00
2017	3918.75	107.45	2601.98	38.56	118.02	0.00	148.93	123.27	4454.98	0.00
2018	4070.91	110.32	2702.81	40.02	121.87	0.00	154.51	124.34	4621.97	0.00
2019	4223.03	113.19	2803.66	41.49	125.72	0.00	160.10	125.41	4788.94	0.00
2020	4375.19	116.06	2904.48	42.96	129.57	0.00	165.68	126.48	4955.93	0.00
2021	4527.34	118.93	3005.33	44.43	133.42	0.00	171.26	127.55	5122.93	0.00
2022	4679.47	121.79	3106.16	45.90	137.28	0.00	176.85	128.61	5289.90	0.00
2023	4831.63	124.66	3207.00	47.36	141.13	0.00	182.43	129.68	5456.89	0.00
2024	4983.75	127.53	3307.83	48.83	144.98	0.00	188.02	130.75	5623.86	0.00
2025	5135.91	130.40	3408.67	50.30	148.83	0.00	131.82	137.80	5790.85	0.00
2026	5288.06	133.27	3509.50	51.77	152.68	0.00	132.88	138.87	5957.85	0.00
2027	5440.19	136.13	3610.33	53.24	156.54	0.00	133.95	139.94	6124.81	0.00
2028	5592.34	139.00	3711.17	54.70	160.39	0.00	135.02	141.00	6291.81	0.00
2029	5744.47	141.87	3812.00	56.17	164.24	0.00	136.09	142.07	6458.78	0.00
2030	5896.63	144.74	3912.84	57.64	168.09	0.00	137.16	143.14	6625.77	0.00
2031	6048.78	147.61	4013.67	59.11	171.94	0.00	138.22	144.21	6792.77	0.00

Figure 11b. Continued

NAVIGATION VOLUMES FILE NVOL.OUT
FOLLOWING CODE IS USED FOR COLUMN HEADINS:

MIVOLO = VOLUME OTHER FOR MALI
MIVOLA = VOLUME AGRICULTURE MALI
RVOL = RAIL VOLUME
MAVOLO = VOLUME OTHER FOR MAURITANIA
MAVOLA = VOLUME AGRICULTURE MAURITANIA
PVOL = PHOSPHATE VOLUME
SEVOLO = VOLUME OTHER SENEGAL
SEVOLA = VOLUME AGRICULTURE SENEGAL
VOLT = TOTAL VOLUME
AVOLD = ADJUSTED AGRICULTURAL VOLUME OF PREVIOUS YEAR

YEAR	MIVOLO	MIVOLA	RVOL	MAVOLO	MAVOLA	PVOL	SEVOLO	SEVOLA	VOLT	AVOLD
1981	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1982	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1983	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	49.12
1984	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	51.27
1985	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	53.42
1986	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	56.10
1987	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	58.79
1988	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	61.47
1989	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	64.16
1990	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	66.85
1991	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	81.80
1992	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	96.75
1993	773.56	23.56	519.01	8.35	32.30	0.00	30.48	55.84	924.09	0.00
1994	853.38	28.58	571.69	9.10	35.19	0.00	33.84	62.88	1022.96	0.00
1995	933.20	33.60	624.38	9.85	38.08	0.00	37.20	69.92	1121.85	0.00
1996	1013.02	38.62	677.05	10.60	40.97	0.00	40.56	76.96	1220.72	0.00
1997	1092.83	43.64	729.73	11.35	43.86	0.00	43.92	84.00	1319.59	0.00
1998	1172.66	48.66	782.42	12.10	46.75	425.60	47.28	91.04	1844.08	0.00
1999	1252.47	53.68	835.10	12.85	49.64	425.60	50.64	98.08	1942.95	0.00
2000	1332.31	58.70	887.78	13.60	52.53	425.60	54.00	105.12	2041.86	0.00
2001	1484.44	61.57	988.63	15.07	56.38	425.60	59.58	106.18	2208.82	0.00
2002	1636.59	64.43	1089.45	16.54	60.24	425.60	65.17	107.25	2375.82	0.00
2003	1788.75	67.30	1190.30	18.00	64.09	425.60	70.75	108.32	2542.82	0.00
2004	1940.88	70.17	1291.13	19.47	67.94	425.60	76.34	109.39	2709.78	0.00
2005	2093.03	73.04	1391.97	20.94	71.79	425.60	81.92	110.46	2876.78	0.00
2006	2245.16	75.91	1492.80	22.41	75.64	425.60	87.50	111.53	3043.74	0.00
2007	2397.31	78.77	1593.63	23.88	79.50	425.60	93.09	112.59	3210.74	0.00
2008	2549.47	81.64	1694.47	25.34	83.35	425.60	98.67	113.66	3377.73	0.00
2009	2701.59	84.51	1795.30	26.81	87.20	425.60	104.26	114.73	3544.70	0.00
2010	2853.75	87.38	1896.14	28.28	91.05	425.60	109.84	115.80	3711.70	0.00
2011	3005.91	90.25	1996.97	29.75	94.90	425.60	115.42	116.86	3878.69	0.00
2012	3158.03	93.11	2097.81	31.22	98.76	425.60	121.01	117.93	4045.66	0.00
2013	3310.19	95.98	2198.64	32.68	102.61	0.00	126.59	119.00	3787.05	0.00
2014	3462.31	98.85	2299.48	34.15	106.46	0.00	132.18	120.07	3954.02	0.00
2015	3614.47	101.72	2400.31	35.62	110.31	0.00	137.76	121.14	4121.01	0.00
2016	3766.63	104.59	2501.16	37.09	114.16	0.00	143.34	122.20	4288.01	0.00
2017	3918.75	107.45	2601.98	38.56	118.02	0.00	148.93	123.27	4454.98	0.00
2018	4070.91	110.32	2702.81	40.02	121.87	0.00	154.51	124.34	4621.97	0.00
2019	4223.03	113.19	2803.66	41.49	125.72	0.00	160.10	125.41	4788.94	0.00

Figure 11.2b. NVOL.OUT 5 year delay

2020	4375.19	116.06	2904.48	42.96	129.57	0.00	165.68	126.48	4955.93	0.00
2021	4527.34	118.93	3005.33	44.43	133.42	0.00	171.26	127.55	5122.93	0.00
2022	4679.47	121.79	3106.16	45.90	137.28	0.00	176.85	128.61	5289.90	0.00
2023	4831.63	124.66	3207.00	47.36	141.13	0.00	182.43	129.68	5456.89	0.00
2024	4983.75	127.53	3307.83	48.83	144.98	0.00	188.02	130.75	5623.86	0.00
2025	5135.91	130.40	3408.67	50.30	148.83	0.00	131.82	137.80	5790.85	0.00
2026	5288.06	133.27	3509.50	51.77	152.68	0.00	132.88	138.87	5957.85	0.00
2027	5440.19	136.13	3610.33	53.24	156.54	0.00	133.95	139.94	6124.81	0.00
2028	5592.34	139.00	3711.17	54.70	160.39	0.00	135.02	141.00	6291.81	0.00
2029	5744.47	141.87	3812.00	56.17	164.24	0.00	136.09	142.07	6458.78	0.00
2030	5896.63	144.74	3912.84	57.64	168.09	0.00	137.16	143.14	6625.77	0.00
2031	6048.78	147.61	4013.67	59.11	171.94	0.00	138.22	144.21	6792.77	0.00

Figure 11.2b. Continued

NVOL.DAT

As in other data files, the first row of NVOL.DAT contains a number of lines of comment followed by lines of comment identifying the data file. Each row contains the following data read into NVOL.FTN using the FORMAT (I10, 9F10.2).

1) JYEAR, 2) MIVOLO, 3) MIVOLA, 4) RVOL, 5) MAVOLO,
6) MAVOLA, 7) PVOL, 8) SEVOLO, 9) SEVOLA, 10) TVOL
11) AVOID

Definitions of the above terms are given as follows:

JYEAR	=	project year
MIVOLO	=	Mali other navigation volume (t km)
MIVOLA	=	Mali agriculture navigation volume (t km)
RVOL	=	rail volume (t km) replaced by navigation (for Mali)
MAVOLO	=	Mauritania other navigation volume (t km)
MAVOLA	=	Mauritania agriculture navigation volume (t km)
PVOL	=	phosphate volume (t km)
SEVOLO	=	Senegal other navigation volume (t km)
SEVOLA	=	Senegal agriculture navigation volume (t km)
TVOL	=	total volume (t km)
AVOID	=	displaced agriculture volume due to navigation delay sector (t km).

Columns 10 and 11 (TVOL and AVOID) are not read by the program NBEN.FTN.

DELAY.DAT

Figures 12a and 12b show an example of the data file DELAY.DAT. The first line is the number of lines of comment, followed by the comment identifying the data file. For each project year there is a row of data containing estimates of the agricultural navigation volumes displaced by delay (if any) in implementing the navigation service. Each row contains 1) year, 2) displaced agricultural navigation volume in Mali, 3) displaced agricultural navigation volume in Mauritania, and 4) displaced agricultural navigation volume in Senegal. Each row is read in by NVOL.FTN under the FORMAT (10X, 3F10.2).

Navigation Benefits Program NBEN

Input data

The program NBEN.FTN reads two data files NVOL.DAT and DELAY.DAT. Data in addition to these on the two files are entered interactively and some data also are programmed directly into the model.

Interactive data

The following information must be entered:

1. The discount rate in decimal fraction form (default value is 0.05).
2. The project life in years (default value is 50 years).
3. The tariffs for alternative modes of transportation (CFAF/tkm) by sector and country are given in Tables 15 through 18 in Report 4 (USU

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OUTPUT FORM NVOL DELAY.DAT FOR USE IN NBEN
AGRICULTURAL VOLUMES DURING NAVIGATION DELAY

YEAR	MALI	MAURITANIA	SENEGAL
NAVIGATIONAL DELAY=		0 YEARS	
1981	0.00	0.00	0.00
1982	0.00	0.00	0.00
1983	4.16	24.48	20.48
1984	4.69	24.38	22.21
1985	5.21	24.27	23.93
1986	5.87	24.15	26.09
1987	6.53	24.02	28.25
1988	0.00	0.00	0.00
1989	0.00	0.00	0.00
1990	0.00	0.00	0.00
1991	0.00	0.00	0.00
1992	0.00	0.00	0.00
1993	0.00	0.00	0.00
1994	0.00	0.00	0.00
1995	0.00	0.00	0.00
1996	0.00	0.00	0.00
1997	0.00	0.00	0.00
1998	0.00	0.00	0.00
1999	0.00	0.00	0.00
2000	0.00	0.00	0.00
2001	0.00	0.00	0.00
2002	0.00	0.00	0.00
2003	0.00	0.00	0.00
2004	0.00	0.00	0.00
2005	0.00	0.00	0.00
2006	0.00	0.00	0.00
2007	0.00	0.00	0.00
2008	0.00	0.00	0.00
2009	0.00	0.00	0.00
2010	0.00	0.00	0.00
2011	0.00	0.00	0.00
2012	0.00	0.00	0.00
2013	0.00	0.00	0.00
2014	0.00	0.00	0.00
2015	0.00	0.00	0.00
2016	0.00	0.00	0.00
2017	0.00	0.00	0.00
2018	0.00	0.00	0.00
2019	0.00	0.00	0.00

Figure 12a. Delay.DAT no delay

2020	0.00	0.00	0.00
2021	0.00	0.00	0.00
2022	0.00	0.00	0.00
2023	0.00	0.00	0.00
2024	0.00	0.00	0.00
2025	0.00	0.00	0.00
2026	0.00	0.00	0.00
2027	0.00	0.00	0.00
2028	0.00	0.00	0.00
2029	0.00	0.00	0.00
2030	0.00	0.00	0.00
2031	0.00	0.00	0.00

Figure 12a. Continued

****

OUTPUT FORM NVOL DELAY.DAT FOR USE IN NBEN
AGRICULTURAL VOLUMES DURING NAVIGATION DELAY

YEAR	MALI	MAURITANIA	SENEGAL
NAVIGATIONAL DELAY=		5 YEARS	
1981	0.00	0.00	0.00
1982	0.00	0.00	0.00
1983	4.16	24.48	20.48
1984	4.69	24.38	22.21
1985	5.21	24.27	23.93
1986	5.87	24.15	26.09
1987	6.53	24.02	28.25
1988	7.18	23.89	30.40
1989	7.84	23.76	32.56
1990	8.50	23.63	34.72
1991	13.52	26.52	41.76
1992	18.54	29.41	48.80
1993	0.00	0.00	0.00
1994	0.00	0.00	0.00
1995	0.00	0.00	0.00
1996	0.00	0.00	0.00
1997	0.00	0.00	0.00
1998	0.00	0.00	0.00
1999	0.00	0.00	0.00
2000	0.00	0.00	0.00
2001	0.00	0.00	0.00
2002	0.00	0.00	0.00
2003	0.00	0.00	0.00
2004	0.00	0.00	0.00
2005	0.00	0.00	0.00
2006	0.00	0.00	0.00
2007	0.00	0.00	0.00
2008	0.00	0.00	0.00
2009	0.00	0.00	0.00
2010	0.00	0.00	0.00
2011	0.00	0.00	0.00
2012	0.00	0.00	0.00
2013	0.00	0.00	0.00
2014	0.00	0.00	0.00
2015	0.00	0.00	0.00
2016	0.00	0.00	0.00
2017	0.00	0.00	0.00
2018	0.00	0.00	0.00
2019	0.00	0.00	0.00

Figure 12b. 5 year delay

2020	0.00	0.00	0.00
2021	0.00	0.00	0.00
2022	0.00	0.00	0.00
2023	0.00	0.00	0.00
2024	0.00	0.00	0.00
2025	0.00	0.00	0.00
2026	0.00	0.00	0.00
2027	0.00	0.00	0.00
2028	0.00	0.00	0.00
2029	0.00	0.00	0.00
2030	0.00	0.00	0.00
2031	0.00	0.00	0.00

Figure 12b. Continued

1980). The following alternative modes of transportation are considered:

a. rail
b. trucking for phosphate
c. trucking in Mali
d. trucking in Mauritania
e. trucking in Senegal

4. NVOL program. The datum entered interactively is the delay of navigation in years (Default = 5 years).

Algorithms of NBEN.FTN

Detailed navigation benefit model

The cost of the alternatives to project navigation are used to estimate the project navigation benefits as follows:

$$SUMNB = \sum_{t=1}^{NYEAR} DISF_t * \left(\sum_{i=1}^{SECTOR} U_i^{AL} * NVOL_{i_t} * FACT_i\right) - TP_i \quad .....(14)$$

in which

SUMNB = discounted total navigation benefits (CFAF)
NYEAR = project life in years
$DISF_t$ = discount factor in decimal form in year t
SECTOR = type of transport (agricultural, other, rail imports replaced by navigation, and phosphate navigation volumes for each country)
U_i^{AL} = tariff for alternative mode of transport in the ith use sector (CFAF/tkm)
$NVOL_{i_t}$ = quantity of navigation volume in the respective i^{th} use sector in the tth year (t km)
$FACT_i$ = factor to adjust navigation volume in tkm to account for the distance difference between navigation and the alternative mode identified by index i [R(rail), T (trucking by road), TP (trucking phosphate by road)].
TP_i = Foregone profits from displaced truck or rail transport data not available.

The three adjustment factors which account for the distance difference between navigation and alternative means of transport are as follows:

FACTR = 750./925.
FACTT = .80
FACTTP = .893

in which

FACTR = ratio of distance by rail to distance by navigation
FACTT = ratio of distance by road to distance by navigation
FACTTP = ratio of distance by road for trucking phosphate to distance by navigation

The calculation of navigation project benefits is performed separately for each use sector and for Mali imports by rail because the alternative modes and cost savings are different for each. Particular values for U_i^{AL} and $FACT_i$ are found in Tables 15 through 18 of Report 4.

The navigation volume in each use sector is read in from the NVOL.DAT file (calculated by the NVOL program). The NVOL.DAT file can be generated by hand. The cost to agriculture of delayed navigation is calculated on the basis of the volume transported by road in each country during the delay period, multiplied by the appropriate tariff rate, as follows:

$$CAD = \sum_{t=1}^{NYEAR} DISF_t * \left(\sum_{i=1}^{3} U_i^{AL} * NVOL_i\right) \quad \ldots\ldots\ldots\ldots\ldots\ldots(15)$$

in which

- CAD = discounted cost of navigation delay to agriculture (CFAF)
- $DISF_t$ = discount factor in the tth year in decimal fraction form
- U_i^{AL} = cost of transportation of agricultural products by road in the ith courtry (CFAF/t km)
- $NVOL_i$ = navigational volume transported by road in the ith country (t km) in the tth year

Output

The output from the Navigational Benefits Model consists of three files: NBEN.OUT (Figures 13a and 13b), NAVQ.DAT (Figures 14a and 14b and AGCOST.DAT (Figures 15a and 15b).

NBEN.OUT. The NBEN.OUT indicates the navigational benefits for each use sector (in CFAF). It consists of nine columns in the following order: 1) year, 2) navigation benefits for Mali. 3) navigation benefits for imports to Mali, 4) navigation benefits for Mauritania, 5) navigation benefits for phosphate transport, 6) navigation benefits for Senegal, 7) total agricultural navigation benefits, 8) total navigation benefits, and 9) the total volume transported in tonne-kilometers. The discounted project navigational volume and benefits, and the discount rate also are given. Figure 13 shows a sample output. The time stream of navigation volumes is discounted in order to calculate the user fee for navigation.

NAVQ.DAT. The NAVQ.DAT output shows the total annual navigation volumes for each state plus the annual totals. It consists of five columns in the following order: 1) the total annual navigation volumes for Mali, 2) the total annual navigation volume for Mauritania, 3) the total annual navigation volume for Senegal, 4) the total annual navigation volume for all three states, and 5) the year. Figure 14 shows a sample output. NAVQ.DAT is used in the programs which calculate project revenues. Total discounted quantities and benefits are also given in NAVQ.DAT. NAVQ.DAT is used in the cost allocation subprogram and user fee subprogram.

AGCOST.DAT. The AGCOST.DAT output shows the annual cost for transporting the agricultural products by alternative means of transport

during those years in which navigation is delayed. It consists of two columns: the year and the cost of transporting the agricultural volume by alternative means during that year. The discounted total agricultural costs due to the navigation delay and the discount rate also are given. This discounted total agricultural cost is subtracted from the total agricultural benefits so that navigation delays reduce agricultural net benefits. Figure 15 shows a sample output. AGCOST.DAT is used to adjust the total agricultural benefits for transportation costs, and also is used in the cost allocation programs.

NAVIGATIONAL BENEFITS VALUES X1.E9
THE FOLLOWING CODE IS USED FOR COLUME HEADINGS:
MI = MALI, R = RAIL, MA = MAURTIANA, P = PHOSPHATE, SEN = SENEGAL N = NAVIGATION, TVOL TOTAL YEARLY VOLUME

	NAVIGATION VOLUMES BY COUNTRY AND SECTOR								VOLUMES BY COUNTRY		
YEAR	MIBEN	RBEN	MABEN	PBEN	SEBEN	AGBEN	NBEN	TVOL	MALI	MAUR	SEN
1981	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1982	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1983	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1984	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1985	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1986	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1987	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1988	6.98	3.65	0.91	0.00	0.82	1.41	8.70	0.54	0.00	0.00	0.00
1989	7.63	3.95	0.91	0.00	0.87	1.45	9.41	0.58	0.46	0.03	0.05
1990	8.27	4.24	0.91	0.00	0.93	1.50	10.11	0.63	0.50	0.03	0.05
1991	9.60	4.86	1.03	0.00	1.11	1.82	11.73	0.73	0.54	0.03	0.06
1992	10.93	5.48	1.14	0.00	1.28	2.14	13.35	0.83	0.63	0.03	0.07
1993	12.26	6.10	12.19	10.95	1.46	2.46	25.92	1.35	0.71	0.04	0.08
1994	13.60	6.72	12.31	10.95	1.63	2.78	27.54	1.45	0.80	0.47	0.09
1995	14.93	7.34	12.42	10.95	1.81	3.09	29.16	1.55	0.88	0.47	0.10
1996	16.26	7.96	12.53	10.95	1.98	3.41	30.77	1.65	0.97	0.47	0.11
1997	17.59	8.58	12.64	10.95	2.16	3.73	32.39	1.75	1.05	0.48	0.12
1998	18.92	9.20	12.75	10.95	2.33	4.05	34.01	1.84	1.14	0.48	0.13
1999	20.26	9.8[illegible]	12.87	10.95	2.51	4.37	35.63	1.94	1.22	0.48	0.14
2000	21.59	10.44	12.98	10.95	2.69	4.69	37.25	2.04	1.31	0.49	0.15
2001	23.97	11.62	13.14	10.95	2.80	4.89	39.91	2.21	1.39	0.49	0.16
2002	26.36	12.81	13.30	10.95	2.91	5.09	42.58	2.38	1.55	0.50	0.17
2003	28.75	13.99	13.47	10.95	3.02	5.29	45.24	2.54	1.70	0.50	0.17
2004	31.13	15.18	13.63	10.95	3.14	5.49	47.90	2.71	1.86	0.51	0.18
2005	33.52	16.37	13.79	10.95	3.25	5.69	50.56	2.88	2.01	0.51	0.19
2006	35.90	17.55	13.96	10.95	3.36	5.89	53.22	3.04	2.17	0.52	0.19
2007	38.29	18.74	14.12	10.95	3.47	6.09	55.88	3.21	2.32	0.52	0.20
2008	40.68	19.92	3.34	0.00	3.58	6.29	47.60	2.95	2.48	0.53	0.21
2009	43.06	21.11	3.50	0.00	3.70	6.49	50.26	3.12	2.63	0.11	0.21
2010	45.45	22.29	3.67	0.00	3.81	6.69	52.92	3.29	2.79	0.11	0.22
2011	47.84	23.48	3.83	0.00	3.92	6.89	55.59	3.45	2.94	0.12	0.23
2012	50.22	24.66	3.99	0.00	4.03	7.09	58.25	3.62	3.10	0.12	0.23
2013	52.61	25.85	4.16	0.00	4.15	7.29	60.91	3.79	3.25	0.13	0.24
2014	54.99	27.03	4.32	0.00	4.26	7.49	63.57	3.95	3.41	0.14	0.25
2015	57.38	28.22	4.48	0.00	4.37	7.69	66.23	4.12	3.56	0.14	0.25
2016	59.77	29.41	4.65	0.00	4.48	7.89	68.89	4.29	3.72	0.15	0.26
2017	62.15	30.59	4.81	0.00	4.59	8.09	71.56	4.45	3.87	0.15	0.27
2018	64.54	31.78	4.97	0.00	4.71	8.29	74.22	4.62	4.03	0.16	0.27
2019	66.92	32.96	5.14	0.00	4.82	8.49	76.88	4.79	4.18	0.16	0.28
2020	69.31	34.15	5.30	0.00	4.93	8.69	79.54	4.96	4.34	0.17	0.29
2021	71.70	35.33	5.46	0.00	5.04	8.89	82.20	5.12	4.49	0.17	0.29
2022	74.08	36.52	5.63	0.00	5.16	9.09	84.87	5.29	4.65	0.18	0.30
2023	76.47	37.70	5.79	0.00	5.27	9.29	87.53	5.46	4.80	0.18	0.31
2024	78.85	38.89	5.95	0.00	5.38	9.49	90.19	5.62	4.96	0.19	0.31
2025	81.24	40.07	6.12	0.00	4.55	9.79	91.91	5.79	5.11	0.19	0.32
2026	83.63	41.26	6.28	0.00	4.59	9.99	94.49	5.96	5.27	0.20	0.27
2027	86.01	42.45	6.44	0.00	4.62	10.19	97.08	6.12	5.42	0.20	0.27
2028	88.40	43.63	6.61	0.00	4.66	10.39	99.67	6.29	5.58	0.21	0.27
2029	90.78	44.82	6.77	0.00	4.70	10.59	102.25	6.46	5.73	0.22	0.28
2030	93.17	46.00	6.93	0.00	4.73	10.79	104.84	6.63	5.89	0.22	0.28

DISCOUNTED TOTAL PROJECT NAVIGATIONAL BENEFITS = 530.080 X1E9
DISCOUNTED TOTAL PROJECT NAVIGATIONAL VOLUME = 31.389 X1E9
DISCOUNTED TOTAL AGRICULTURAL COSTS DUE TO NAVIGATION DELAY = 6.529 X1.E9
THE DISCOUNT RATE =0.05
****

Figure 13a. NBEN.OUT no delay

NAVIGATIONAL BENEFITS VALUES X1.E9
THE FOLLOWING CODE IS USED FOR COLUME HEADINGS:
MI = MALI, R = RAIL, MA = MAURTIANA, P = PHOSPHATE, SEN = SENEGAL N = NAVIGATION, TVOL TOTAL YEARLY VOLUME

	NAVIGATION VOLUMES BY COUNTRY AND SECTOR								VOLUMES BY COUNTRY		
YEAR	MIBEN	RBEN	MABEN	PBEN	SEBEN	AGBEN	NBEN	TVOL	MALI	MAUR	SEN
1981	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1982	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1983	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1984	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1985	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1986	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1987	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1988	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1989	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1990	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1991	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1992	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1993	12.26	6.10	1.25	0.00	1.46	2.46	14.97	0.92	0.00	0.00	0.00
1994	13.60	6.72	1.36	0.00	1.63	2.78	16.59	1.02	0.80	0.04	0.09
1995	14.93	7.34	1.47	0.00	1.81	3.09	18.21	1.12	0.88	0.04	0.10
1996	16.26	7.96	1.58	0.00	1.98	3.41	19.83	1.22	0.97	0.05	0.11
1997	17.59	8.58	1.70	0.00	2.16	3.73	21.45	1.32	1.05	0.05	0.12
1998	18.92	9.20	12.75	10.95	2.33	4.05	34.01	1.84	1.14	0.06	0.13
1999	20.26	9.82	12.87	10.95	2.51	4.37	35.63	1.94	1.22	0.48	0.14
2000	21.59	10.44	12.98	10.95	2.69	4.69	37.25	2.04	1.31	0.49	0.15
2001	23.97	11.62	13.14	10.95	2.80	4.89	39.91	2.21	1.39	0.49	0.16
2002	26.36	12.81	13.30	10.95	2.91	5.09	42.58	2.38	1.55	0.50	0.17
2003	28.75	13.99	13.47	10.95	3.02	5.29	45.24	2.54	1.70	0.50	0.17
2004	31.13	15.18	13.63	10.95	3.14	5.49	47.90	2.71	1.86	0.51	0.18
2005	33.52	16.37	13.79	10.95	3.25	5.69	50.56	2.88	2.01	0.51	0.19
2006	35.90	17.55	13.96	10.95	3.36	5.89	53.22	3.04	2.17	0.52	0.19
2007	38.29	18.74	14.12	10.95	3.47	6.09	55.88	3.21	2.32	0.52	0.20
2008	40.68	19.92	14.28	10.95	3.58	6.29	58.55	3.38	2.48	0.53	0.21
2009	43.06	21.11	14.45	10.95	3.70	6.49	61.21	3.54	2.63	0.53	0.21
2010	45.45	22.29	14.61	10.95	3.81	6.69	63.87	3.71	2.79	0.54	0.22
2011	47.84	23.48	14.77	10.95	3.92	6.89	66.53	3.88	2.94	0.54	0.23
2012	50.22	24.66	14.94	10.95	4.03	7.09	69.19	4.05	3.10	0.55	0.23
2013	52.61	25.85	4.16	0.00	4.15	7.29	60.91	3.79	3.25	0.56	0.24
2014	54.99	27.03	4.32	0.00	4.26	7.49	63.57	3.95	3.41	0.14	0.25
2015	57.38	28.22	4.48	0.00	4.37	7.69	66.23	4.12	3.56	0.14	0.25
2016	59.77	29.41	4.65	0.00	4.48	7.89	68.89	4.29	3.72	0.15	0.26
2017	62.15	30.59	4.81	0.00	4.59	8.09	71.56	4.45	3.87	0.15	0.27
2018	64.54	31.78	4.97	0.00	4.71	8.29	74.22	4.62	4.03	0.16	0.27
2019	66.92	32.96	5.14	0.00	4.82	8.49	76.88	4.79	4.18	0.16	0.28
2020	69.31	34.15	5.30	0.00	4.93	8.69	79.54	4.96	4.34	0.17	0.29
2021	71.70	35.33	5.46	0.00	5.04	8.89	82.20	5.12	4.49	0.17	0.29
2022	74.08	36.52	5.63	0.00	5.16	9.09	84.87	5.29	4.65	0.18	0.30
2023	76.47	37.70	5.79	0.00	5.27	9.29	87.53	5.46	4.80	0.18	0.31
2024	78.85	38.89	5.95	0.00	5.38	9.49	90.19	5.62	4.96	0.19	0.31
2025	81.24	40.07	6.12	0.00	4.55	9.79	91.91	5.79	5.11	0.19	0.32
2026	83.63	41.26	6.28	0.00	4.59	9.99	94.49	5.96	5.27	0.20	0.27
2027	86.01	42.45	6.44	0.00	4.62	10.19	97.08	6.12	5.42	0.20	0.27
2028	88.40	43.63	6.61	0.00	4.66	10.39	99.67	6.29	5.58	0.21	0.27
2029	90.78	44.82	6.77	0.00	4.70	10.59	102.25	6.46	5.73	0.22	0.28
2030	93.17	46.00	6.93	0.00	4.73	10.79	104.84	6.63	5.89	0.22	0.28

DISCOUNTED TOTAL PROJECT NAVIGATIONAL BENEFITS = 481.620 X1E9
DISCOUNTED TOTAL PROJECT NAVIGATIONAL VOLUME = 28.719 X1E9
DISCOUNTED TOTAL AGRICULTURAL COSTS DUE TO NAVIGATION DELAY = 13.175 X1.E9
THE DISCOUNT RATE =0.05
****

Figure 13b. NBEN.OUT 5 year delay

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 38  50   3  NUMBER OF LINES IN TITLE,YEARS,AND COLUMNS READ BY REVENUE.FTN
*************************************************************************************
NAVQ.DAT -- OUTPUT FROM NBEN USED IN REVENUE
THE FOLLOWING VALUES  FOR INTERACTIVE VARIABLES  WERE USED
DISCOUNT RATE 0.050 NUMBER OF YEARS    50AND THE FOLLOWING TARIFFS
RAIL= 14.50 TRUCKING PHOSPHATE= 28.80 TRUCK MALI= 27.70 TRUCK MAUR.= 38.40TRUCK SEN.= 21.10

THE FOLLOWING INPUT FILES WERE USED
*************************************************************************************
OUTPUT FROM NVOL.FTN--NVOL.DAT FOR USE IN NBEN
  THE FOLLOWING INPUT FILES WERE USED

 NAVTAB.PRE INPUT FOR NVOL
 BREAKDOWN OF NAVIGATIONAL VOLUMES DATA,UNITS T-KM

OUTPUT FROM AREA.FTN USED AS INPUT FOR AGBEN
VALUES OF OPTIONS USED FOR THIS RUN ARE
NEW DEVELOPMENT RATE   5000.TIME TO NEW DEVELOPMENT RATE   4.
NUMBER OF YEARS BEFORE THE FLOOD   9.
THE FOLLOWING VALUES WERE USED TO DISTRIBUTE HA DEVELOPED BETWEEN COUNTRIES
 INITIAL  MALI = .1666 MAUR .3436 SENEGAL .4898
TOTAL POSSIBLE HA IN MALI =  23437.
FINIAL  MAUR .4125 SENEGAL .5875
INITIAL AREAS MALI    270. MAUR   5305. SENEGAL  23230.

                    AGRICULTURAL AREAS DATA TABLE
     YEAR        RATE        AI        ARD        ADD        AF      MALI    MAUR


INTERACTIVE OPTION DELAY SET TO       0 YEARS
     YEAR    MIVOLO     MIVOLA     RVOL     MAVOLO    MAVOLA     PVOL     SEVOL
*************************************************************************************
OUTPUT FORM NVOL DELAY.DAT FOR USE IN NBEN
 AGRICULTURAL VOLUMES DURING NAVIGATION DELAY
     YEAR      MALI   MAURITANIA  SENEGAL
 NAVIGATIONAL DELAY=   0 YEARS

 TOTAL YEARLY NAVIGATIONAL VOLUMES
      MALI        MAURITANIA       SENEGAL        TOTAL          YEAR
          0.00          0.00           0.00           0.00       1981
          0.00          0.00           0.00           0.00       1982
          0.00          0.00           0.00           0.00       1983
          0.00          0.00           0.00           0.00       1984
          0.00          0.00           0.00           0.00       1985
          0.00          0.00           0.00           0.00       1986
          0.00          0.00           0.00           0.00       1987
  460960000.00    29480000.00    48340000.00   538780032.00       1988
  501780000.00    29600000.00    51730004.00   583110016.00       1989
```

Figure 14a. NAVQ.DAT no delay

542590016.00	29730000.00	55120004.00	627440000.00	1990
627440000.00	33369998.00	65519996.00	726330048.00	1991
712269952.00	37010000.00	75920000.00	825200000.00	1992
797120000.00	466250016.00	86320000.00	1349689984.00	1993
881960000.00	469890016.00	96720000.00	1448560000.00	1994
966800000.00	473529984.00	107120000.00	1547449984.00	1995
1051640000.00	477170016.00	117520008.00	1646320000.00	1996
1136470016.00	480809984.00	127920000.00	1745189888.00	1997
1221320064.00	484450016.00	138320000.00	1844080000.00	1998
1306150016.00	488089984.00	148720000.00	1942949888.00	1999
1391010048.00	491730016.00	159120016.00	2041859968.00	2000
1546009856.00	497050016.00	165760016.00	2208819968.00	2001
1701020032.00	502380000.00	172420000.00	2375820032.00	2002
1856050048.00	507690016.00	179070000.00	2542820096.00	2003
2011050112.00	513010016.00	185730000.00	2709779968.00	2004
2166070016.00	518330016.00	192380000.00	2876780032.00	2005
2321069824.00	523650016.00	199030000.00	3043739904.00	2006
2476080128.00	528979968.00	205680000.00	3210739968.00	2007
2631109888.00	108690000.00	212330000.00	2952129792.00	2008
2786100224.00	114009992.00	218990000.00	3119100160.00	2009
2941129984.00	119330000.00	225640000.00	3286100224.00	2010
3096160000.00	124650000.00	232280000.00	3453090048.00	2011
3251140096.00	129979992.00	238940000.00	3620060160.00	2012
3406169856.00	135290016.00	245590000.00	3787049984.00	2013
3561160192.00	140610000.00	252250000.00	3954020096.00	2014
3716189952.00	145930000.00	258900000.00	4121009664.00	2015
3871219968.00	151250000.00	265540016.00	4288009728.00	2016
4026200064.00	156580000.00	272199968.00	4454980096.00	2017
4181230080.00	161890000.00	278850016.00	4621970432.00	2018
4336219648.00	167210000.00	285510016.00	4788939776.00	2019
4491250176.00	172530016.00	292160000.00	4955930112.00	2020
4646269952.00	177850000.00	298809984.00	5122930176.00	2021
4801260032.00	183180000.00	305460032.00	5289900032.00	2022
4956290048.00	188490000.00	312109984.00	5456890368.00	2023
5111279616.00	193810000.00	318770016.00	5623859712.00	2024
5266310144.00	199130000.00	269620032.00	5790850048.00	2025
5421329920.00	204450000.00	271750016.00	5957850112.00	2026
5576320000.00	209780000.00	273890016.00	6124810240.00	2027
5731339776.00	215090000.00	276020032.00	6291810304.00	2028
5886340096.00	220410000.00	278160000.00	6458779648.00	2029
6041370112.00	225730000.00	280300032.00	6625769984.00	2030
TOTALS 0.12540824E+12	0.11428069E+11	0.87425321E+10	0.14598131E+12	

****

Figure 14a. Continued

```
 38  50   3  NUMBER OF LINES IN TITLE,YEARS,AND COLUMNS READ BY REVENUE.FTN
*************************************************************************************
NAVQ.DAT -- OUTPUT FROM NBEN USED IN REVENUE
THE FOLLOWING VALUES  FOR INTERACTIVE VARIABLES  WERE USED
DISCOUNT RATE 0.050 NUMBER OF YEARS    50AND THE FOLLOWING TARIFFS
RAIL= 14.50 TRUCKING PHOSPHATE= 28.80 TRUCK MALI= 27.70 TRUCK MAUR.= 38.40TRUCK SEN.= 21.10

THE FOLLOWING INPUT FILES WERE USED
*************************************************************************************
OUTPUT FROM NVOL.FTN--NVOL.DAT FOR USE IN NBEN
  THE FOLLOWING INPUT FILES WERE USED

 NAVTAB.PRE INPUT FOR NV^
 BREAKDOWN OF NAVIGATIONAL VOLUMES DATA,UNITS T-KM

OUTPUT FROM AREA.FTN USED AS INPUT FOR AGBEN
VALUES OF OPTIONS USED FOR THIS RUN ARE
NEW DEVELOPMENT RATE   5000.TIME TO NEW DEVELOPMENT RATE   4.
NUMBER OF YEARS BEFORE THE FLOOD   9.
THE FOLLOWING VALUES WERE USED TO DISTRIBUTE HA DEVELOPED BETWEEN COUNTRIES
 INITIAL  MALI = .1666 MAUR .3436 SENEGAL .4898
TOTAL POSSIBLE HA IN MALI =  23437.
FINIAL  MAUR .4125 SENEGAL .5875
INITIAL AREAS MALI    270. MAUR   5305. SENEGAL  23230.

                    AGRICULTURAL AREAS DATA TABLE
     YEAR        RATE        AI        ARD        ADD        AF      MALI    MAUR

INTERACTIVE OPTION DELAY SET TO       5 YEARS
     YEAR    MIVOLO     MIVOLA     RVOL     MAVOLO    MAVOLA     PVOL     SEVOL
*************************************************************************************
OUTPUT FORM NVOL DELAY.DAT FOR USE IN NBEN
 AGRICULTURAL VOLUMES DURING NAVIGATION DELAY
     YEAR      MALI   MAURITANIA  SENEGAL
 NAVIGATIONAL DELAY=   5 YEARS

 TOTAL YEARLY NAVIGATIONAL VOLUMES
      MALI        MAURITANIA       SENEGAL        TOTAL          YEAR
         0.00          0.00          0.00          0.00         1981
         0.00          0.00          0.00          0.00         1982
         0.00          0.00          0.00          0.00         1983
         0.00          0.00          0.00          0.00         1984
         0.00          0.00          0.00          0.00         1985
         0.00          0.00          0.00          0.00         1986
         0.00          0.00          0.00          0.00         1987
         0.00          0.00          0.00          0.00         1988
         0.00          0.00          0.00          0.00         1989
```

Figure 14b. NAVQ.DAT 5 year delay.

0.00	0.00	0.00	0.00	1990
0.00	0.00	0.00	0.00	1991
0.00	0.00	0.00	0.00	1992
797120000.00	40650000.00	86320000.00	924090048.00	1993
881960000.00	44290000.00	96720000.00	1022960000.00	1994
966800000.00	47930004.00	107120000.00	1121849984.00	1995
1051640000.00	51570004.00	117520008.00	1220720000.00	1996
1136470016.00	55210004.00	127920000.00	1319590016.00	1997
1221320064.00	484450016.00	138320000.00	1844080000.00	1998
1306150016.00	488089984.00	148720000.00	1942949888.00	1999
1391010048.00	491730016.00	159120016.00	2041859968.00	2000
1546009856.00	497050016.00	165760016.00	2208819968.00	2001
1701020032.00	502380000.00	172420000.00	2375820032.00	2002
1856050048.00	507690016.00	179070000.00	2542820096.00	2003
2011050112.00	513010016.00	185730000.00	2709779968.00	2004
2166070016.00	518330016.00	192380000.00	2876780032.00	2005
2321069824.00	523650016.00	199030000.00	3043739904.00	2006
2476080128.00	528979968.00	205680000.00	3210739968.00	2007
2631109888.00	534290048.00	212330000.00	3377730048.00	2008
2786100224.00	539609984.00	218990000.00	3544699904.00	2009
2941129984.00	544929984.00	225640000.00	3711699968.00	2010
3096160000.00	550249984.00	232280000.00	3878690048.00	2011
3251140096.00	555580032.00	238940000.00	4045659904.00	2012
3406169856.00	135290016.00	245590000.00	3787049984.00	2013
3561160192.00	140610000.00	252250000.00	3954020096.00	2014
3716189952.00	145930000.00	258900000.00	4121009664.00	2015
3871219968.00	151250000.00	265540016.00	4288009728.00	2016
4026200064.00	156580000.00	272199968.00	4454980096.00	2017
4181230080.00	161890000.00	278850016.00	4621970432.00	2018
4336219648.00	167210000.00	285510016.00	4788939776.00	2019
4491250176.00	172530016.00	292160000.00	4955930112.00	2020
4646269952.00	177850000.00	298809984.00	5122930176.00	2021
4801260032.00	183180000.00	305460032.00	5289900032.00	2022
4956290048.00	188490000.00	312109984.00	5456890368.00	2023
5111279616.00	193810000.00	318770016.00	5623859712.00	2024
5266310144.00	199130000.00	269620032.00	5790850048.00	2025
5421329920.00	204450000.00	271750016.00	5957850112.00	2026
5576320000.00	209780000.00	273890016.00	6124810240.00	2027
5731339776.00	215090000.00	276020032.00	6291810304.00	2028
5886340096.00	220410000.00	278160000.00	6458779648.00	2029
6041370112.00	225730000.00	280300032.00	6625769984.00	2030
TOTALS 0.12256320E+12	0.11268880E+11	0.84459013E+10	0.14268044E+12	

Figure 14b. Continued

```
*****************************************************************************
AGCOST.DAT -- OUTPUT FROM NBEN INTERACTIVE INPUT FOR COST ALLOCATION
DISCOUNT RATE 0.050 NUMBER OF YEARS    50AND  HE FOLLOWING TARIFFS
RAIL= 14.50 TRUCKING PHOSPHATE= 28.80 TRUCK MALI= 27.70 TRUCK MAUR.= 38.40TRUCK SEN.= 21.10
*****************************************************************************
OUTPUT FROM NVOL.FTN--NVOL.DAT FOR USE IN NBEN
  THE FOLLOWING INPUT FILES WERE USED

 NAVTAB.PRE INPUT FOR NVOL
 BREAKDOWN OF NAVIGATIONAL VOLUMES DATA.UNITS T-KM

OUTPUT FROM AREA.FTN USED AS INPUT FOR AGBEN
VALUES OF OPTIONS USED FOR THIS RUN ARE
NEW DEVELOPMENT RATE   5000.TIME TO NEW DEVELOPMENT RATE   4.
NUMBER OF YEARS BEFORE THE FLOOD   9.
THE FOLLOWING VALUES WERE USED TO DISTRIBUTE HA DEVELOPED BETWEEN COUNTRIES
 INITIAL  MALI = .1666 MAUR .3436 SENEGAL .4898
TOTAL POSSIBLE HA IN MALI =  23437.
FINIAL  MAUR .4125 SENEGAL .5875
INITIAL AREAS MALI    270. MAUR   5305. SENEGAL  23230.

                    AGRICULTURAL AREAS DATA TABLE
     YEAR        RATE        AI        ARD        ADD        AF      MALI   MAUR


INTERACTIVE OPTION DELAY SET TO       0 YEARS
     YEAR    MIVOLO     MIVOLA     RVOL     MAVOLO    MAVOLA     PVOL     SEVOL
*****************************************************************************
OUTPUT FORM NVOL DELAY.DAT FOR USE IN NBEN
 AGRICULTURAL VOLUMES DURING NAVIGATION DELAY
     YEAR      MALI   MAURITANIA  SENEGAL
 NAVIGATIONAL DELAY=   0 YEARS

     YEAR   COSTS
     1981  0.00E-01
     1982  0.00E-01
     1983  1.49E+09
     1984  1.53E+09
     1985  1.58E+09
     1986  1.64E+09
     1987  1.70E+09
     1988  0.00E-01
     1989  0.00E-01
     1990  0.00E-01
     1991  0.00E-01
```

Figure 15a. AGCOST.DAT

```
1992  0.00E-01
1993  0.00E-01
1994  0.00E-01
1995  0.00E-01
1996  0.00E-01
1997  0.00E-01
1998  0.00E-01
1999  0.00E-01
2000  0.00E-01
2001  0.00E-01
2002  0.00E-01
2003  0.00E-01
2004  0.00E-01
2005  0.00E-01
2006  0.00E-01
2007  0.00E-01
2008  0.00E-01
2009  0.00E-01
2010  0.00E-01
2011  0.00E-01
2012  0.00E-01
2013  0.00E-01
2014  0.00E-01
2015  0.00E-01
2016  0.00E-01
2017  0.00E-01
2018  0.00E-01
2019  0.00E-01
2020  0.00E-01
2021  0.00E-01
2022  0.00E-01
2023  0.00E-01
2024  0.00E-01
2025  0.00E-01
2026  0.00E-01
2027  0.00E-01
2028  0.00E-01
2029  0.00E-01
2030  0.00E-01
6529140224.     = DISCOUNTED TOTAL AGRICULTURAL COSTS DUE TO DELAY
 THE COST SHOWN ABOVE SHOULD BE SUBTRACTED FROM THE TOTAL AGRICULTURAL BENEFITS!
 THE DISCOUNT RATE =0.05
*****************************************************************************************
```

Figure 15a. Continued

```
*****************************************************************************
AGCOST.DAT -- OUTPUT FROM NBEN INTERACTIVE INPUT FOR COST ALLOCATION
DISCOUNT RATE 0.050 NUMBER OF YEARS    50AND THE FOLLOWING TARIFFS
RAIL= 14.50 TRUCKING PHOSPHATE= 28.80 TRUCK MALI= 27.70 TRUCK MAUR.= 38.40TRUCK SEN.= 21.10
*****************************************************************************
OUTPUT FROM NVOL.FTN--NVOL.DAT FOR USE IN NBEN
  THE FOLLOWING INPUT FILES WERE USED

 NAVTAB.PRE INPUT FOR NVOL
 BREAKDOWN OF NAVIGATIONAL VOLUMES DATA,UNITS T-KM

OUTPUT FROM AREA.FTN USED AS INPUT FOR AGBEN
VALUES OF OPTIONS USED FOR THIS RUN ARE
NEW DEVELOPMENT RATE   5000.TIME TO NEW DEVELOPMENT RATE   4.
NUMBER OF YEARS BEFORE THE FLOOD   9.
THE FOLLOWING VALUES WERE USED TO DISTRIBUTE HA DEVELOPED BETWEEN COUNTRIES
 INITIAL  MALI = .1666 MAUR .3436 SENEGAL .4898
TOTAL POSSIBLE HA IN MALI =  23437.
FINIAL  MAUR .4125 SENEGAL .5875
INITIAL AREAS MALI    270. MAUR   5305. SENEGAL  23230.

                    AGRICULTURAL AREAS DATA TABLE
     YEAR        RATE        AI        ARD        ADD        AF      MALI    MAUR


INTERACTIVE OPTION DELAY SET TO       5 YEARS
     YEAR    MIVOLO     MIVOLA     RVOL     MAVOLO    MAVOLA     PVOL     SEVOL
*****************************************************************************
OUTPUT FORM NVOL DELAY.DAT FOR USE IN NBEN
 AGRICULTURAL VOLUMES DURING NAVIGATION DELAY
     YEAR      MALI   MAURITANIA  SENEGAL
 NAVIGATIONAL DELAY=   5 YEARS

     YEAR   COSTS
     1981  0.00E-01
     1982  0.00E-01
     1983  1.49E+09
     1984  1.53E+09
     1985  1.58E+09
     1986  1.64E+09
     1987  1.70E+09
     1988  1.76E+09
     1989  1.82E+09
     1990  1.88E+09
     1991  2.27E+09
```

Figure 15b. AGCOST.DAT 5 year delay.

```
1992  2.67E+09
1993  0.00E-01
1994  0.00E-01
1995  0.00E-01
1996  0.00E-01
1997  0.00E-01
1998  0.00E-01
1999  0.00E-01
2000  0.00E-01
2001  0.00E-01
2002  0.00E-01
2003  0.00E-01
2004  0.00E-01
2005  0.00E-01
2006  0.00E-01
2007  0.00E-01
2008  0.00E-01
2009  0.00E-01
2010  0.00E-01
2011  0.00E-01
2012  0.00E-01
2013  0.00E-01
2014  0.00E-01
2015  0.00E-01
2016  0.00E-01
2017  0.00E-01
2018  0.00E-01
2019  0.00E-01
2020  0.00E-01
2021  0.00E-01
2022  0.00E-01
2023  0.00E-01
2024  0.00E-01
2025  0.00E-01
2026  0.00E-01
2027  0.00E-01
2028  0.00E-01
2029  0.00E-01
2030  0.00E-01
.1317540352E+11 = DISCOUNTED TOTAL AGRICULTURAL COSTS DUE TO DELAY
 THE COST SHOWN ABOVE SHOULD BE SUBTRACTED FROM THE TOTAL AGRICULTURAL BENEFITS!
 THE DISCOUNT RATE =0.05
*****************************************************************************************
```

Figure 15b. Continued

ENERGY BENEFITS

Energy Benefits Submodel (ENBEN)

As in the case of the navigation, energy (power) benefits may be indeterminate. Both household consumers and mines are expected to use the power. Benefits to households are difficult to measure, even given adequate data bases. The mining industry has not been examined in detail for profitability. Consequently, power benefits are calculated on the basis of the best alternative project which, for this case, is thermal generation. Estimates for the 1980 costs of developing 800 gigawatt hours of thermal power, which would supply both households and mines, were obtained by updating cost estimates available from several project reports including those of Groupement Manantali, OMVS, and others. These data are preliminary estimates, at best, and should be updated as further information becomes available. The Energy Benefit Submodel, ENGBEN.FTN, requires one data table, ENERGY.PRE, and some interactive data.

Energy consumed

Energy consumed depends upon the use sector for which electricity is provided. Energy is used in mining in Senegal and domestic users in urban areas of Mali. Consumption rates are taken from Report 4 of the Senegal River Co't Allocation Study (USU 1980). Figure 16 (the ENERGY.PRE file) shows the energy development rate used for the Energy Submodel in the demonstration run. In Report 5 (USU 1981) it was assumed that 60 percent of the power consumption was provided for the domestic sector and 40 percent for the iron mine sector. However, because transmission losses were estimated to be approximately 16 percent higher for mining use than for the urban, the power at the dam site is apportioned 56.4 percent to urban and 43.6 percent to mining.

In the delayed case, energy production and consumption are assumed to be postponed until 1997 in accordance with Report 5 (USU 1981). However, as in the case of navigation, no delay in the investment costs for infrastructure capital or benefits is considered for purposes of allocating the joint costs.

Detailed energy benefit model

Energy benefits are calculated by:

$$SUMEB = \sum_{t=1}^{NYEAR} DISF_t * \left(\sum_i^{AL} U_i * ENERGY_{i_t}\right) \quad \ldots\ldots\ldots\ldots(16)$$

in which

SUMEB = present value of the stream of future benefits (CFAF)

$DISF_t$ = discount factor, $[(\frac{1}{1+r})^{t-1}]$

U_i = cost of thermal power for the ith use sector (CFAF/k wh)

```
5,50,                    !LINES OF HEADING; NUMBER OF YEARS
ENERGY.PRE     DATA FILE FOR POWER BENEFIT PROGRAM  BENPWR
THESE ARE THE VALUES USED BY DAVE BOWLES FOR REPORT 5
(EXCEPT TO OBTAIN 261 E 9 BENEFITS DAVE BOWLES STARTED
ENERGY GENERATION IN 1989, 151 GW WAS IN 1989 INSTEAD
OF 1995)
          0.00          1981                                800000000.00
          0.00          1982                                800000000.00
          0.00          1983                                800000000.00
          0.00          1984                                800000000.00
          0.00          1985                                800000000.00
          0.00          1986                                800000000.00
          0.00          1987                                800000000.00
          0.00          1988                                800000000.00
  151000000.00          1989                                800000000.00
  360000000.00          1990                                800000000.00
  439000000.00          1991                                800000000.00
  538000000.00          1992                                800000000.00
  567000000.00          1993                                800000000.00
  596000000.00          1994                                800000000.00
  634000000.00          1995                                800000000.00
  672000000.00          1996                                800000000.00
  710000000.00          1997                                800000000.00
  738000000.00          1998
  788000000.00          1999
  800000000.00          2000
  800000000.00          2001
  800000000.00
  800000000.00
  800000000.00
  800000000.00
  800000000.00
  800000000.00
  800000000.00
  800000000.00
  800000000.00
  800000000.00
  800000000.00
  800000000.00
  800000000.00
  800000000.00
  800000000.00
  800000000.00
  800000000.00
```

Figure 16. ENERGY.PRE

AL = number of use sectors, 2 in model run
$ENERGY_{i_t}$ = energy consumed by the ith use sector in the tth year = Total * PC_i
Total = total energy consumed during i^{th} year (kwh)
PC_i = fraction of total energy used in use sector i in the tth year

Input data format for ENBEN (ENERGY.PRE)

Figure 16 shows an example ENERGY.PRE data file. The first line contains two integers, 1) the number of lines of comment which preface the data file, and 2) the number of years of project data to be read in. The number of lines of comment and the number of years of data should be entered in free format. Next are the lines of comments which are read in using the FORMAT (80A1). Then for each project year the total energy consumed in that year (in kwh) is read i using Format (F15.2). The final column, the year, is not read by the submodel, but this information is included to make the file more understandable.

In addition to the energy development rate contained in ENERGY.PRE, the user must interactively supply the proportion of energy consumed among sectors as well as the alternative thermal power cost. If the default data are used, no change is required in ENERGY.PRE. For energy development rates other than the default, the user must supply the proportions of effective energy use among sectors, interactively, as well as the alternative thermal power cost. The user must also enter the length of delay in starting the energy services. The default value is 7 years (used in Report 5). When the user is calculating the cost allocation 0 delay should be entered. All of these required data inputs are prompted by the program. Defaults are 43.6 percent for mining and 56.4 percent for urban consumption, 31.28 CFAF/kwh for thermal power, and a delay until 1997.

Output of ENBEN Model

Two data files are output from the Energy Benefits Model. The first is PWQ.DAT (Figures 17a and 17b) which lists each year's energy consumption by use sector as used for the calculation of project revenues (REVENU.FTN). PWQ.DAT also contains discounted quantities and benefits. The second data file ENGBEN.OUT (Figures 18a and 18b) lists the annual quantities and benefits, and the total discounted quantities and benefits for energy production. The discounted benefits and quantities are read by the Cost Allocation and User Fees Submodels from the file PWQ.DAT.

```
 13  50   3
*****************************************************************************
   FILE PWQ.DAT OUTPUT FROM ENERGY BENEFIT PROGRAM
UNDISCOUNTED YEARLY QUANTITIES USED TO  CALCULATE REVENUE
 DISCOUNT RATE =   5.0000001E-02 ALTERNATIVE ENERGY COST    31.28000
 % MALI = 0.5645 % MAUR = 0.0000 % SENEGAL = 0.4355
 THE FOLLOWING INPUT FILE WERE USED IN ENGBEN
ENERGY.PRE    DATA FILE FOR POWER BENEFIT PROGRAM  BENPWR
THESE ARE THE VALUES USED BY DAVE BOWLES FOR REPORT 5
(EXCEPT TO OBTAIN 261 E 9 BENEFITS DAVE BOWLES STARTED
ENERGY GENERATION IN 1989, 151 GW WAS IN 1989 INSTEAD
OF 1995)
 ENERGY DELAY =       0
```

MALI	MAURITANIA	SENEGAL	TOTAL	
0.00	0.00	0.00	0.00	1
0.00	0.00	0.00	0.00	2
0.00	0.00	0.00	0.00	3
0.00	0.00	0.00	0.00	4
0.00	0.00	0.00	0.00	5
0.00	0.00	0.00	0.00	6
0.00	0.00	0.00	0.00	7
0.00	0.00	0.00	0.00	8
85239496.00	0.00	65760500.00	151000000.00	9
203219984.00	0.00	156780000.00	360000000.00	10
247815488.00	0.00	191184496.00	439000000.00	11
303700992.00	0.00	234298992.00	538000000.00	12
320071488.00	0.00	246928496.00	567000000.00	13
336441984.00	0.00	259558000.00	596000000.00	14
357892992.00	0.00	276107008.00	634000000.00	15
379343968.00	0.00	292655000.00	672000000.00	16
400794976.00	0.00	309204992.00	710000000.00	17
416600992.00	0.00	321399008.00	738000000.00	18
444825984.00	0.00	343173984.00	788000000.00	19
451599968.00	0.00	348400000.00	800000000.00	20
451599968.00	0.00	348400000.00	800000000.00	21
451599968.00	0.00	348400000.00	800000000.00	22
451599968.00	0.00	348400000.00	800000000.00	23
451599968.00	0.00	348400000.00	800000000.00	24
451599968.00	0.00	348400000.00	800000000.00	25
451599968.00	0.00	348400000.00	800000000.00	26
451599968.00	0.00	348400000.00	800000000.00	27
451599968.00	0.00	348400000.00	800000000.00	28
451599968.00	0.00	348400000.00	800000000.00	29
451599968.00	0.00	348400000.00	800000000.00	30
451599968.00	0.00	348400000.00	800000000.00	31
451599968.00	0.00	348400000.00	800000000.00	32
451599968.00	0.00	348400000.00	800000000.00	33

Figure 17a. PWQ.DAT no delay

451599968.00	0.00	348400000.00	800000000.00	34
451599968.00	0.00	348400000.00	800000000.00	35
451599968.00	0.00	348400000.00	800000000.00	36
451599968.00	0.00	348400000.00	800000000.00	37
451599968.00	0.00	348400000.00	800000000.00	38
451599968.00	0.00	348400000.00	800000000.00	39
451599968.00	0.00	348400000.00	800000000.00	40
451599968.00	0.00	348400000.00	800000000.00	41
451599968.00	0.00	348400000.00	800000000.00	42
451599968.00	0.00	348400000.00	800000000.00	43
451599968.00	0.00	348400000.00	800000000.00	44
451599968.00	0.00	348400000.00	800000000.00	45
451599968.00	0.00	348400000.00	800000000.00	46
451599968.00	0.00	348400000.00	800000000.00	47
451599968.00	0.00	348400000.00	800000000.00	48
451599968.00	0.00	348400000.00	800000000.00	49
451599968.00	0.00	348400000.00	800000000.00	50
TOTALS .1749555405E+11	.0000000000	.1349744742E+11	.3099300045E+11	

****

Figure 17a. Continued

```
 13  50   3
*****************************************************************************************
   FILE PWQ.DAT OUTPUT FROM ENERGY BENEFIT PROGRAM
UNDISCOUNTED YEARLY QUANTITIES USED TO  CALCULATE REVENUE
 DISCOUNT RATE =   5.0000001E-02 ALTERNATIVE ENERGY COST    31.28000
 % MALI = 0.5645 % MAUR = 0.0000 % SENEGAL = 0.4355
 THE FOLLOWING INPUT FILE WERE USED IN ENGBEN
ENERGY.PRE    DATA FILE FOR POWER BENEFIT PROGRAM  BENPWR
THESE ARE THE VALUES USED BY DAVE BOWLES FOR REPORT 5
(EXCEPT TO OBTAIN 261 E 9 BENEFITS DAVE BOWLES STARTED
ENERGY GENERATION IN 1989, 151 GW WAS IN L989 INSTAEAD
OF 1995)
 ENERGY DELAY =       7
```

MALI	MAURITANIA	SENEGAL	TOTAL	
0.00	0.00	0.00	0.00	1
0.00	0.00	0.00	0.00	2
0.00	0.00	0.00	0.00	3
0.00	0.00	0.00	0.00	4
0.00	0.00	0.00	0.00	5
0.00	0.00	0.00	0.00	6
0.00	0.00	0.00	0.00	7
0.00	0.00	0.00	0.00	8
0.00	0.00	0.00	0.00	9
0.00	0.00	0.00	0.00	10
0.00	0.00	0.00	0.00	11
0.00	0.00	0.00	0.00	12
0.00	0.00	0.00	0.00	13
0.00	0.00	0.00	0.00	14
85239496.00	0.00	65760500.00	151000000.00	15
203219984.00	0.00	156780000.00	360000000.00	16
247815488.00	0.00	191184496.00	439000000.00	17
303700992.00	0.00	234298992.00	538000000.00	18
320071488.00	0.00	246928496.00	567000000.00	19
336441984.00	0.00	259558000.00	596000000.00	20
357892992.00	0.00	276107008.00	634000000.00	21
379343968.00	0.00	292656000.00	672000000.00	22
400794976.00	0.00	309204992.00	710000000.00	23
416600992.00	0.00	321399008.00	738000000.00	24
444825984.00	0.00	343173984.00	788000000.00	25
451599968.00	0.00	348400000.00	800000000.00	26
451599968.00	0.00	348400000.00	800000000.00	27
451599968.00	0.00	348400000.00	800000000.00	28
451599968.00	0.00	348400000.00	800000000.00	29
451599968.00	0.00	348400000.00	800000000.00	30
451599968.00	0.00	348400000.00	800000000.00	31

Figure 17b. PWQ.DAT 7 year delay

451599968.00	0.00	348400000.00	800000000.00	32
451599968.00	0.00	348400000.00	800000000.00	33
451599968.00	0.00	348400000.00	800000000.00	34
451599968.00	0.00	348400000.00	800000000.00	35
451599968.00	0.00	348400000.00	800000000.00	36
451599968.00	0.00	348400000.00	800000000.00	37
451599968.00	0.00	348400000.00	800000000.00	38
451599968.00	0.00	348400000.00	800000000.00	39
451599968.00	0.00	348400000.00	800000000.00	40
451599968.00	0.00	348400000.00	800000000.00	41
451599968.00	0.00	348400000.00	800000000.00	42
451599968.00	0.00	348400000.00	800000000.00	43
451599968.00	0.00	348400000.00	800000000.00	44
451599968.00	0.00	348400000.00	800000000.00	45
451599968.00	0.00	348400000.00	800000000.00	46
451599968.00	0.00	348400000.00	800000000.00	47
451599968.00	0.00	348400000.00	800000000.00	48
451599968.00	0.00	348400000.00	800000000.00	49
451599968.00	0.00	348400000.00	800000000.00	50
TOTALS .1478595277E+11	.0000000000	.1140704973E+11	.2619300045E+11	

Figure 17b. Continued

ENERGY OUTPUT
VALUES X1.E9

UNDISCOUNTED BENEFIT	QUANTITY	QUANTITY BY COUNTRY MALI	MAURITANIA	SENEGAL
0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000
4.723	0.151	0.000	0.000	0.000
11.261	0.360	0.085	0.000	0.066
13.732	0.439	0.203	0.000	0.157
16.829	0.538	0.248	0.000	0.191
17.736	0.567	0.304	0.000	0.234
18.643	0.596	0.320	0.000	0.247
19.832	0.634	0.336	0.000	0.260
21.020	0.672	0.358	0.000	0.276
22.209	0.710	0.379	0.000	0.293
23.085	0.738	0.401	0.000	0.309
24.649	0.788	0.417	0.000	0.321
25.024	0.800	0.445	0.000	0.343
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348

261.237 X1.E9 = DISCOUNTED SUM OF BENEFITS
8.352 X1.E9 = DISCOUNTED SUM OF QUANTITY
****

Figure 18a. ENGBEN.OUT no delay

ENERGY OUTPUT
VALUES X1.E9

UNDISCOUNTED BENEFIT	QUANTITY	QUANTITY BY COUNTRY MALI	MAURITANIA	SENEGAL
0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000
4.723	0.151	0.000	0.000	0.000
11.261	0.360	0.085	0.000	0.066
13.732	0.439	0.203	0.000	0.157
16.829	0.538	0.248	0.000	0.191
17.736	0.567	0.304	0.000	0.234
18.643	0.596	0.320	0.000	0.247
19.832	0.634	0.336	0.000	0.260
21.020	0.672	0.358	0.000	0.276
22.209	0.710	0.379	0.000	0.293
23.085	0.738	0.401	0.000	0.309
24.649	.788	0.417	0.000	0.321
25.024	0.800	0.445	0.000	0.343
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348
25.024	0.800	0.452	0.000	0.348

183.309 X1.E9 = DISCOUNTED SUM OF BENEFITS
5.860 X1.E9 = DISCOUNTED SUM OF QUANTITY

****

Figure 18b. ENGBEN.OUT 7 year delay

PROJECT COSTS

The following sections describe the models and data bases which are used in the calculations of project costs.

Project Cost Model (COST.FTN)

The cost model, COST.FTN, generates the discounted sums of costs of various aspects of the project (DISSUM.OUT), and a table of costs accrued over time. It also requires the input of some data necessary for the financial model. Investment and O&M costs incurred by the project are entered in one of two cost tables. Since the cost allocation normally is accomplished assuming no delays in project services, while the user fees are calculated in such a way as to insure that actual costs are repayed (i.e. with delay), a cost table for each of these two conditions is required. COSTND.PRE (Figure 19) is the table which uses values based on no delays; COSTD.PRE (Figure 20) is the table which incorporates delayed development. The COST.FTN program uses either the COSTND.PRE or the COSTD.PRE tables as input (for the COST.PRE file).

Current input costs are taken from Report 5. The costs include: 1) the investment schedules for Manantali and Diama Dams, 2) hydropower generation specific costs (penstocks, turbines, and transmission lines), and 3) navigation specific costs (ports, channel dredging, etc.). Figures 20a and 20b indicate data given in Report 5 for both delay and non-delay assumptions. The delays are 5 years for navigation and 7 years for energy production. Any change in costs will require changes in these tables.

The accounts specified for the COSTND.PRE and COSTD.PRE input are linked with the Accounting Section so that costs can be posted to the appropriate accounts.

Detailed cost model

Discounted costs for each facility are calculated using the following:

$$\sum_{t=1}^{N} DISF_t \left[\Sigma_i FC_i + (O\&M)_{i_t}\right] \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (17)$$

in which

$DISF_t$ = discount factor $\left[\frac{1}{(1+r)^{t-1}}\right]$

FC_{i_t} = fixed cost associated with facility i in year t

$(O\&M)_{i_t}$ = operation and maintenance costs associated with facility i in year t.

```
7,50,                                        !LTITLE,NYEARS; REPORT 5 WITHOU
COSTND.PRE FINANCING SCHEDULE OF INFRASTRUCTURE, O AND M COSTS
COLUMNS HEADED WITH CAP ARE FOR CAPITAL EXPENSES
COLUMNS HEADED WITH OM ARE FOR OPERATION AND MAINTAINCE EXPENSES
M  MANATALI DAM     D DIAMA DAM    E ENERGY    N NAVIGATION
SUBTRACT ENE1 AND ENE2 FROM POWER BENEFITS AND ADD ENE1 AND ENE2 TO POWER COST
COST CALCUALTED BY ALLOCATION PROGRAM, ALSO ADD DIA1 ,DIA2 TO IRRIGATION
AND NAV1 AND NAV2 TO NAVIGATION COSTS; WITHOUT DELAY; URBAN AND MINES ENERGY
D1105 C1005
D3010 C1010  D5105 C6000
D1110 C1005
D3010 C1010  D5110 C6000
D1115 C1010  D3010 C3005  D5010 C6000
D3010 C1010  D5115 C6000
D1120 C1010  D3010 C3005  D5015 C6000
D3010 C1010  D5120 C6000
YEAR    CAPM     OMM      CAPD     OMD      CAPE     OME      CAPN     OMN
  1, 0.737E9,     0.0, 4.247E9,     0.0,     0.0,     0.0,     0.0,     0.0,
  2,15.367E9,     0.0, 7.624E9,     0.0,     0.0,     0.0,     0.0,     0.0,
  3,13.100E9,     0.0, 5.488E9,     0.0,     0.0,     0.0, 3.700E9,    .03E9,
  4,16.710E9,     0.0, 3.972E9,     0.0, .593E9,     0.0,13.655E9,   .039E9,
  5,17.641E9,     0.0, 5.137E9,     0.0,1.719E9,     0.0,17.528E9,   .085E9,
  6,12.409E9,     0.0, 2.818E9,     0.0,4.391E9,     0.0,  6.44E9, 0.236E9,
  7,07.411E9,     0.0,  .362E9, .245E9,9.119E9,     0.0, 5.348E9, 1.908E9,
  8,  .120E9, .309E9,  0.0000, .245E9,8.945E9,     0.0, 5.137E9, 1.908E9,
  9,     0.0,0.309E9,     0.0,0.245E9,7.013E9, .912E9, 3.851E9, 1.908E9,
 10,     0.0, .309E9,     0.0, .245E9,     0.0, .912E9, 1.859E9, 1.908E9,
 11,     0.0, .309E9,     0.0, .245E9, .493E9, .912E9, 1.695E9, 1.908E9,
 12,     0.0, .309E9,     0.0, .245E9, .654E9, .912E9, 1.605E9, 1.908E9,
 13,     0.0, .309E9,     0.0, .245E9  .781E9, .912E9,  .656E9, 1.913E9,
 14,     0.0, .309E9,     0.0, .245E9, .781E9, .912E9, 6.575E9, 1.913E9,
 15,     0.0, .309E9,     0.0, .245E9,     0.0, .994E9,  .674E9, 1.937E9,
 16,     0.0, .309E9,     0.0, .245E9,     0.0, .994E9,  .881E9, 1.947E9,
 17,     0.0, .309E9,     0.0, .245E9,     0.0, .994E9, 1.325E9, 2.081E9,
 18,     0.0, .309E9,     0.0, .245E9,     0.0, .994E9,  .663E9, 2.081E9,
 19,     0.0, .309E9,     0.0, .245E9,     0.0, .994E9, 2.650E9, 2.081E9,
 20,     0.0, .309E9,     0.0, .245E9,     0.0, .994E9, 3.713E9, 2.081E9,
 21,     0.0, .309E9,     0.0, .245E9,     0.0, .994E9, 3.325E9, 2.081E9,
 22,     0.0, .309E9,     0.0, .245E9,     0.0, .994E9,  .915E9, 2.451E9,
 23,     0.0, .309E9,     0.0, .245E9,     0.0, .994E9,  .956E9, 2.451E9,
 24,     0.0, .309E9,     0.0, .245E9,     0.0, .994E9, 1.404E9, 2.451E9,
 25,     0.0, .309E9,     0.0, .245E9,     0.0, .994E9, 2.230E9, 2.451E9,
 26,     0.0, .309E9,     0.0, .245E9,     0.0, .994E9, 1.987E9, 2.451E9,
 27,     0.0, .309E9,     0.0, .245E9,     0.0, .994E9,  .992E9, 2.459E9,
 28,     0.0, .309E9,     0.0, .245E9,     0.0, .994E9,  .956E9, 2.459E9,
 29,     0.0, .309E9,     0.0, .245E9,     0.0, .994E9,  .947E9, 2.459E9,
```

Figure 19. COSTND.PRE

30,	0.0,	.309E9,	0.0,	.245E9,	0.0,	.994E9,	.974E9,	2.459E9
31,	0.0,	.309E9,	0.0,	.245E9,	0.0,	.994E9,	.990E9,	2.459E9
32,	0.0,	.309E9,	0.0,	.245E9,	0.0,	.994E9,	1.020E9,	2.466E9
33,	0.0,	.309E9,	0.0,	.245E9,	0.0,	.994E9,	.963E9,	2.466E9
34,	0.0,	.309E9,	0.0,	.245E9	0.0,	.994E9,	3.736E9,	2.466E9
35,	0.0,	.309E9,	0.0,	.245E9,	0.0,	.994E9,	5.025E9,	2.466E9
36,	0.0,	.309E9,	0.0,	.245E9,	0.0,	.994E9,	4.492E9,	2.466E9
37,	0.0,	.309E9,	0.0,	.245E9,	0.0,	.994E9,	2.081E9,	3.026E9
38,	0.0,	.309E9,	0.0,	.245E9,	0.0,	.994E9,	1.448E9,	3.026E9
39,	0.0,	.309E9,	0.0,	.245E9,	0.0,	.994E9,	1.416E9,	3.026E9
40,	0.0,	.309E9,	0.0,	.245E9,	0.0,	.994E9,	1.419E9,	3.026E9
41,	0.0,	.309E9,	0.0,	.245E9,	5.56E9,	.994E9,	1.457E9,	3.026E9
42,	0.0,	.309E9,	0.0,	.245E9,	5.56E9,	.994E9,	1.488E9,	3.033E9
43,	0.0,	.309E9,	0.0,	.245E9,	5.56E9,	.994E9,	1.416E9,	3.033E9
44,	0.0,	.309E9,	0.0,	.245E9,	0.0,	.994E9,	1.889E9,	3.033E9
45,	0.0,	.309E9,	0.0,	.245E9,	0.0,	.994E9,	2.682E9,	3.033E9
46,	0.0,	.309E9,	0.0,	.245E9,	0.0,	.994E9,	2.463E9,	3.033E9
47,	0.0,	.309E9,	0.0,	245E9,	0.0,	.994E9,	1.487E9,	3.041E9
48,	0.0,	.309E9,	0.0,	.245E9,	0.0,	.994E9,	2.887E9,	3.041E9
49,	0.0,	.309E9,	0.0,	.245E9,	0.0,	.994E9,	1.487E9,	3.041E9
50,	0.0,	.309E9,	0.0,	.245E9,	0.0,	.994E9,	1.487E9,	3.041E9

Figure 19. Continued

```
7,50,                                        !LTITLE,NYEARS
COSTD.PRE FINANCING SCHEDULE OF INFRASTRUCTURE, O AND M COSTS
COLUMNS HEADED WITH CAP ARE FOR CAPITAL EXPENSES
COLUMNS HEADED WITH OM ARE FOR OPERATION AND MAINTAINCE EXPENSES
M  MANATALI DAM     D DIAMA DAM    E ENERGY    N NAVIGATION
SUBTRACT ENE1 AND ENE2 FROM POWER BENEFITS AND ADD ENE1 AND ENE2 TO POWER COST
COST CALCUALTED BY ALLOCATION PROGRAM, ALSO ADD DIA1 ,DIA2 TO IRRIGATION
AND NAV1 AND NAV2 TO NAVIGATION COSTS; WITH DELAY; URBAN AND MINES ENERGY
D1105 C1005
D3010 C1010  D5105 C6000
D1110 C1005
D3010 C1010  D5110 C6000
D1115 C1010  D3010 C3005  D5010 C6000
D3010 C1010  D5115 C6000
D1120 C1010  D3010 C3005  D5015 C6000
D3010 C1010  D5120 C6000
YEAR    CAPM     OMM      CAPD     OMD      CAPE     OME      CAPN     OMN
  1, 0.787E9,     0.0, 4.247E9,     0.0,     0.0,     0.0,     0.0,      0.0,
  2,15.367E9,     0.0, 7.624E9,     0.0,     0.0,     0.0,     0.0,      0.0,
  3,13.100E9,     0.0, 5.488E9,     0.0,     0.0,     0.0,     0.0,      0.0,
  4,16.710E9,     0.0, 3.972E9,     0.0, .433E9,      0.0, 6.05E9,       0.0,
  5,17.641E9,     0.0, 5.137E9,     0.0, .399E9,      0.0, 6.05[illegible]      0.0,
  6,12.409E9,     0.0, 2.818E9,     0.0,0.300E9,      0.0,     [illegible]      0.0,
  7,07.411E9,     0.0,  .362E9, .245E9, .233E9,       0.0,     [illegible]      .03E9,
  8,  .120E9, .309E9,  0.0000, .245E9,     0.0,       0.0, 9.75E9,    .039E9,
  9,      0.0,0.309E9,     0.0,0.245E9,     0.0,       0.0,7.605E9,    .085E9,
 10,      0.0,0.309E9,     0.0,0.245E9, .593E9,       0.0,5.478E9, 0.236E9,
 11,      0.0, .309E9,     0.0, .245E9,1.286E9,       0.0, 6.44E9, 1.908E9,
 12,      0.0, .309E9,     0.0, .245E9,1.992E9,       0.0,5.348E9, 1.908E9,
 13,      0.0, .309E9,     0.0, .245E9,8.819E9,       0.0,5.137E9, 1.908E9,
 14,      0.0, .309E9,     0.0, .245E9,8.712E9,       0.0,3.851E9, 1.908E9,
 15,      0.0, .309E9,     0.0, .245E9,7.018E9,.912E9,1.859E9, 1.908E9,
 16,      0.0, .309E9,     0.0, .245E9,     0.0,.912E9,1.695E9, 1.908E9,
 17,      0.0, .309E9,     0.0, .245E9, .493E9,.912E9,1.605E9, 1.913E9,
 18,      0.0, .309E9,     0.0, .245E9, .654E9,.912E9, .656E9, 1.913E9,
 19,      0.0, .309E9,     0.0, .245E9, .781E9,.912E9, .674E9, 1.937E9,
 20,      0.0, .309E9,     0.0, .245E9, .781E9,.912E9, .881E9, 1.947E9,
 21,      0.0, .309E9,     0.0, .245E9,     0.0,.994E9,1.325E9, 2.081E9,
 22,      0.0, .309E9,     0.0, .245E9,     0.0,.994E9, .663E9, 2.081E9,
 23,      0.0, .309E9,     0.0, .245E9,     0.0,.994E9, 2.65E9, 2.081E9,
 24,      0.0, .309E9,     0.0, .245E9,     0.0,.994E9,3.713E9, 2.081E9,
 25,      0.0, .309E9,     0.0, .245E9,     0.0,.994E9,3.325E9, 2.081E9,
 26,      0.0, .309E9,     0.0, .245E9,     0.0,.994E9,0.915E9, 2.451E9,
 27,      0.0, .309E9,     0.0, .245E9,     0.0,.994E9, .956E9, 2.451E9,
 28,      0.0, .309E9,     0.0, .245E9,     0.0,.994E9,1.404E9, 2.451E9,
 29,      0.0, .309E9,     0.0, .245E9,     0.0,.994E9, 2.23E9, 2.451E9,
```

Figure 20. COSTD.PRE

30,	0.0,	.309E9,	0.0,	.245E9,	0.0,	.994E9,	1.987E9,	2.451E9,
31,	0.0,	.309E9,	0.0,	.245E9,	0.0,	.994E9,	.992E9,	2.459E9,
32,	0.0,	.309E9,	0.0,	.245E9,	0.0,	.994E9,	.956E9,	2.459E9,
33,	0.0,	.309E9,	0.0,	.245E9,	0.0,	.994E9,	.947E9,	2.459E9,
34,	0.0,	.309E9,	0.0,	.245E9,	0.0,	.994E9,	.974E9,	2.459E9,
35,	0.0,	.309E9,	0.0,	.245E9,	0.0,	.994E9,	.99E9,	2.459E9,
36,	0.0,	.309E9,	0.0,	.245E9,	0.0,	.994E9,	1.02E9,	2.466E9,
37,	0.0,	.309E9,	0.0,	.245E9,	0.0,	.994E9,	.963E9,	2.466E9,
38,	0.0,	.309E9,	0.0,	.245E9,	0.0,	.994E9,	3.736E9,	2.466E9,
39,	0.0,	.309E9,	0.0,	.245E9,	0.0,	.994E9,	5.025E9,	2.466E9,
40,	0.0,	.309E9,	0.0,	.245E9,	0.0,	.994E9,	4.492E9,	2.466E9,
41,	0.0,	.309E9,	0.0,	.245E9,	0.0,	.994E9,	2.081E9,	3.026E9,
42,	0.0,	.309E9,	0.0,	.245E9,	0.0,	.994E9,	1.448E9,	3.026E9,
43,	0.0,	.309E9,	0.0,	.245E9,	0.0,	.994E9,	1.416E9,	3.026E9,
44,	0.0,	.309E9,	0.0,	.245E9,	0.0,	.994E9,	1.419E9,	3.026E9,
45,	0.0,	.309E9,	0.0,	.245E9,	0.0,	.994E9,	1.457E9,	3.026E9,
46,	0.0,	.309E9,	0.0,	.245E9,	0.0,	.994E9,	1.488E9,	3.033E9,
47,	0.0,	.309E9,	0.0,	.245E9,	0.0,	.994E9,	1.416E9,	3.033E9,
48,	0.0,	.309E9,	0.0,	.245E9,	5.565E9,	.994E9,	1.889E9,	3.033E9,
49,	0.0,	.309E9,	0.0,	.245E9,	5.565E9,	.994E9,	2.682E9,	3.033E9,
50,	0.0,	.309E9,	0.0,	.245E9,	5.565E9,	.994E9,	2.463E9,	3.033E9,

Figure 20. Continued

Input data format

The input data format for the cost model for the investment and O&M costs in both COSTND.PRE (Figure 19) and COSTD.PRE (Figure 20) data files are discussed in this section. Figure 21 illustrates the required format to enter the capital cost and O&M cost schedules. The user can change the number of lines of comment at the beginning of the file, but it is required that the remainder of the file be in the format given below. In addition, the account codes must be in the order given below. The user is referred to the Accounting Submodel Section for a discussion of the accounts used. The lines containing the annual costs must begin with the year and then contain the 8 values in the order given.

Each line in the sample data file is explained below:

Line 1 — two integer numbers, free format permitted,
LTITLE,NYEAR where
LTITLE = number of lines in the comment section
NYEARS = number of years of data contained in the file

Line 2 through Line 8 — FORMAT (80A1) comments used to identify data file

Line 9 — FORMAT (A1, I4, 1X, A1, I4)
account codes for Manantali Dam capital investment

Line 10 — FORMAT (A1, I4, 1X, A1, I4, 2X, A1, I4, 1X, A1, I4)
account codes for Manantali Dam Operation and Maintenance

Line 11 — FORMAT (A1,I4,1X,A1,I4)
account codes for Diama Dam capital investment

Line 12 — FORMAT (A1,I4,1X,A1,I4,2X,A1,I4,IX,A1,I4)
account codes for Diama Dam Operation and Maintenance

Line 13 — FORMAT (A1,I4,1X,A1,I4,2X,A1,I4,1X,A1,I4,2X,
A1,I4,1X,A1,I4)
account codes for Energy capital investment

Line 14 — FORMAT (A1,I4,1X,A1,I4,2X,A1,I4,1X,A1,I4)
account codes for Energy Operation and Maintenance

Line 15 — FORMAT (A1,I4,1X,A1,I4,2X,A1,I4,1X,A1,I4,2X,
A1,I4,1X,A1,I4)
account codes for Navigation capital investment

Line 16 — FORMAT (A1,I4,1X,A1,I4,2X,A1,I4,1X,A1,I4)
account codes for Navigation Operation and Maintenance

```
LINE  1  7,50,                                          !LTITLE,NYEARS
LINE  2  COSTD.PRE FINANCING SCHEDULE OF INFRASTRUCTURE, O AND M COSTS
LINE  3  COLUMNS HEADED WITH CAP ARE FOR CAPITAL EXPENSES
LINE  4  COLUMNS HEADED WITH OM ARE FOR OPERATION AND MAINTAINCE EXPENSES
LINE  5  M  MANATALI DAM     D DIAMA DAM    E ENERGY    N NAVIGATION
LINE  6  SUBTRACT ENE1 AND ENE2 FROM POWER BENEFITS AND ADD ENE1 AND ENE2 TO POWER COST
LINE  7  COST CALCUALTED BY ALLOCATION PROGRAM, ALSO ADD DIA1 ,DIA2 TO IRRIGATION
LINE  8  AND NAV1 AND NAV2 TO NAVIGATION COSTS; WITH DELAY; URBAN AND MINES ENERGY
LINE  9  D1105 C1005
LINE 10  D3010 C1010  D5105 C6000
LINE 11  D1110 C1005
LINE 12  D3010 C1010  D5110 C6000
LINE 13  D1115 C1010  D3010 C3005  D5010 C6000
LINE 14  D3010 C1010  D5115 C6000
LINE 15  D1120 C1010  D3010 C3005  D5015 C6000
LINE 16  D3010 C1010  D5120 C6000
LINE 17  YEAR    CAPM     OMM      CAPD     OMD      CAPE     OME      CAPN     OMN
LINE 18    1, 0.787E9,    0.0, 4.247E9,    0.0,     0.0,     0.0,     0.0,     0.0,
LINE 19    2,15.367E9,    0.0, 7.624E9,    0.0,     0.0,     0.0,     0.0,     0.0,
LINE 20    3,13.100E9,    0.0, 5.488E9,    0.0,     0.0,     0.0,     0.0,     0.0,
LINE 21    4,16.710E9,    0.0, 3.972E9,    0.0, .433E9,     0.0, 6.05E9,      0.0,
LINE 68   50,     0.0, .309E9,     0.0, .245E9,     0.0,.994E9,2.463E9, 3.033E9,
```

Figure 21. Sample file to illustrate format of COSTD.PRE, COSTND.PRE, and COST.PRE files.

Line 17	FORMAT (8X,8(A4,4X)) column headings, 4 characters are used to describe each column
Line 18 through Line 68	FREE FORMAT INTEGER, 8 REAL Variables YEAR (or row number), Manantali capital investment cases Manantali O&M cases, Diama capital, Diama O&M, Energy capital, Energy O&M, Navigation capital, Navigation O&M

Output from the COST.FTN Model

Output from the COST.FTN model consists of the discounted values of the investment and O&M project costs (DISSUM.OUT, Figures 22a and b), the schedule of costs incurred by the project, COST.DAT (Figure 23) and an echo of the input data in an easily read form, called COSTCK.OUT (Figure 24). DISSUM.OUT displays the discounted cost sums for Manantali Dam, Diama Dam, navigation related activities, and hydropower related activities, as indicated below. The columns are identified as CAPM, OMM, CAPPD, OMD, CAPE, OME, OME, CAPN, and OMN: where these symbols are defined as follows: CAP is computed cost, OM is O&M cost, D is Diama Dam, N is navigation, and E is energy.

DISSUM.OUT is used to calculate specific, separable, and joint costs in the cost allocation program. COST.DAT transfers cost information to the program PREACC.FTN for use by the Accounting Submodel.

An eight dimensional array which contains the cost values read in from COST.PRE is set up by the COST.FTN program. Associated with each of the eight elements in the array are two or more account codes, the account to be debited and the account to be credited. The order in which the account codes are entered in the input file COST.PRE is critical for maintaining proper accounting. The data file COST.DAT is described above. COSTCK.OUT is generated by calling the program COSTCK.FTN, similar to the WRITE program for the agricultural revenues and cost table. COSTCK.FTN simply reads the file COST.PRE and then prints it out in an easily read format.

```
      16     50
 ***************************************************************************
  DISSUM.OUT --  OUTPUT FILE FROM COST
DISCOUNTED SUMS USING INTEREST RATE OF  0.050
 DISCOUNTED SUMS --INTERACTIVE INPUT FOR ALLOCATE
 THE FOLLOWING INPUT FILES WERE USED
COSTND.PRE FINANCING SCHEDULE OF INFRASTRUCTURE, O AND M COSTS
COLUMNS HEADED WITH CAP ARE FOR CAPITAL EXPENSES
COLUMNS HEADED WITH OM ARE FOR OPERATION AND MAINTAINCE EXPENSES
M  MANATALI DAM     D DIAMA DAM    E ENERGY    N NAVIGATION
SUBTRACT ENE1 AND ENE2 FROM POWER BENEFITS AND ADD ENE1 AND ENE2 TO POWER COST
COST CALCUALTED BY ALLOCATION PROGRAM, ALSO ADD DIA1 ,DIA2 TO IRRIGATION
AND NAV1 AND NAV2 TO NAVIGATION COSTS; WITHOUT DELAY: URBAN AND MINES ENERGY

     CAPM            OMM            CAPD            OMD            CAPE            OME            CAPN            OMN
 71590616596.70  4045750671.32 26621225393.53  3390618671.89 27057813656.81 12012277980.73 67125960989.36 31286150110.86

  0.24314041E+12 = TOTAL DISCOUNTED COST

DISCOUNTED TOTALS INVESTMENT+O&M
 MANANTALI          DIAMA          ENERGY          NAVIGATION
.7563636736E+11  .3001184461E+11  .3908009165E+11  .9841210982E+11
 ***************************************************************************
```

Figure 22a. DISSUM.OUT no delay

```
      16      50
 ***********************************************************************
  DISSUM.OUT --  OUTPUT FILE FROM COST
DISCOUNTED SUMS USING INTEREST RATE OF  0.050
 DISCOUNTED SUMS --INTERACTIVE INPUT FOR ALLOCATE
 THE FOLLOWING INPUT FILES WERE USED
COSTD.PRE FINANCING SCHEDULE OF INFRASTRUCTURE, O AND M COSTS
COLUMNS HEADED WITH CAP ARE FOR CAPITAL EXPENSES
COLUMNS HEADED WITH OM ARE FOR OPERATION AND MAINTAINCE EXPENSES
M  MANATALI DAM     D DIAMA DAM    E ENERGY    N NAVIGATION
SUBTRACT ENE1 AND ENE2 FROM POWER BENEFITS AND ADD ENE1 AND ENE2 TO POWER COST
COST CALCUALTED BY ALLOCATION PROGRAM, ALSO ADD DIA1 ,DIA2 TO IRRIGATION
AND NAV1 AND NAV2 TO NAVIGATION COSTS; WITH DELAY; URBAN AND MINES ENERGY

     CAPM            OMM            CAPD            OMD            CAPE            OME            CAPN            OMN
 71590616596.70  4045750671.32 26621225393.53  3390618671.89 19274287683.05  8501786624.48 52501281681.66 24751840744.96

  0.21067740E+12 = TOTAL DISCOUNTED COST

DISCOUNTED TOTALS INVESTMENT+O&M
 MANANTALI           DIAMA           ENERGY           NAVIGATION
.7563636736E+11  .3001184461E+11  .2777607373E+11  .7725312410E+11
 ***********************************************************************
```

Figure 22b. DISSUM.OUT with delay

```
      12     50
 ********************************************************************************
 COST.DAT -- OUTPUT FROM COST PROGRAM
THESE YEARLY VALUES ARE NOT DISCOUNTED;RATE USED FOR CALCULATING DISCOUNTED TOTAL WAS 0.050
 THE FOLLOWING INPUT FILES WERE USED
COSTD.PRE FINANCING SCHEDULE OF INFRASTRUCTURE,'O AND M COSTS
COLUMNS HEADED WITH CAP ARE FOR CAPITAL EXPENSES
COLUMNS HEADED WITH OM ARE FOR OPERATION AND MAINTAINCE EXPENSES
M  MANATALI DAM     D DIAMA DAM    E ENERGY    N NAVIGATION
SUBTRACT ENE1 AND ENE2 FROM POWER BENEFITS AND ADD ENE1 AND ENE2 TO POWER COST
COST CALCUALTED BY ALLOCATION PROGRAM, ALSO ADD DIA1 ,DIA2 TO IRRIGATION
AND NAV1 AND NAV2 TO NAVIGATION COSTS; WITH DELAY; URBAN AND MINES ENERGY
      CAPM    OMM     CAPD    OMD     CAPE    OME     CAPN    OMN
YEAR      1  32
 D1105   787000000.00C1005 D3010          0.00C1010
 D5105          0.00C6000 D1110  4247000000.00C1005
 D3010          0.00C1010 D5110          0.00C6000
 D1115          0.00C1010 D3010          0.00C3005
 D5010          0.00C6000 D3010          0.00C1010
 D5115          0.00C6000 D1120          0.00C1010
 D3010          0.00C3005 D5015          0.00C6000
 D3010          0.00C1010 D5120          0.00C6000
YEAR      2  32
 D1105 15367000000.00C1005 D3010          0.00C1010
 D5105          0.00C6000 D1110  7624000000.00C1005
 D3010          0.00C1010 D5110          0.00C6000
 D1115          0.00C1010 D3010          0.00C3005
 D5010          0.00C6000 D3010          0.00C1010
 D5115          0.00C6000 D1120          0.00C1010
 D3010          0.00C3005 D5015          0.00C6000
 D3010          0.00C1010 D5120          0.00C6000
YEAR      3  32
 D1105 13100000000.00C1005 D3010          0.00C1010
 D5105          0.00C6000 D1110  5488000000.00C1005
 D3010          0.00C1010 D5110          0.00C6000
 D1115          0.00C1010 D3010          0.00C3005
 D5010          0.00C6000 D3010          0.00C1010
 D5115          0.00C6000 D1120          0.00C1010
 D3010          0.00C3005 D5015          0.00C6000
 D3010          0.00C1010 D5120          0.00C6000
YEAR      4  32
 D1105 16710000000.00C1005 D3010          0.00C1010
 D5105          0.00C6000 D1110  3972000000.00C1005
 D3010          0.00C1010 D5110          0.00C6000
 D1115   433000000.00C1010 D3010   433000000.00C3005
 D5010   433000000.00C6000 D3010          0.00C1010
 D5115          0.00C6000 D1120  6050000000.00C1010
 D3010  6050000000.00C3005 D5015  6050000000.00C6000
 D3010          0.00C1010 D5120          0.00C6000
YEAR      5  32
 D1105 17641000000.00C1005 D3010          0.00C1010
 D5105          0.00C6000 D1110  5137000000.00C1005
 D3010          0.00C1010 D5110          0.00C6000
 D1115   399000000.00C1010 D3010   399000000.00C3005
 D5010   399000000.00C6000 D3010          0.00C1010
```

Figure 23. COST.DAT

```
OUTPUT FROM COSTCK
ECHO OF COST.PRE FILE
 7     50
COSTND.PRE FINANCING SCHEDULE OF INFRASTRUCTURE, O AND M COSTS
COLUMNS HEADED WITH CAP ARE FOR CAPITAL EXPENSES
COLUMNS HEADED WITH OM ARE FOR OPERATION AND MAINTAINCE EXPENSES
M  MANATALI DAM      D DIAMA DAM     E ENERGY     N NAVIGATION
SUBTRACT ENE1 AND ENE2 FROM POWER BENEFITS AND ADD ENE1 AND ENE2 TO POWER COST
COST CALCUALTED BY ALLOCATION PROGRAM, ALSO ADD DIA1 ,DIA2 TO IRRIGATION
AND NAV1 AND NAV2 TO NAVIGATION COSTS; WITHOUT DELAY; URBAN AND MINES ENERG.
D1105 C1005
D3010 C1010  D5105 C6000
D1110 C1005
D3010 C1010  D5110 C6000
D1115 C1010  D3010 C3005  D5010 C6000
D3010 C1010  D5115 C6000
D1120 C1010  D3010 C3005  D5015 C6000
D3010 C1010  D5120 C6000
```

YEAR	CAPM	OMM	CAPD	OMD	CAPE	OME	CAPN	OMN
1	0.78700E+09	0.00000	0.42470E+10	[illegible]	0.00000	0.00000	0.00000	0.00000
2	0.15367E+11	0.00000	0.76240E+10	[illegible]	0.00000	0.00000	0.00000	0.00000
3	0.13100E+11	0.00000	0.54880E+10	0.00000	0.00000	0.00000	0.37000E+10	0.30000E+08
4	0.16710E+11	0.00000	0.39720E+10	0.00000	0.59300E+09	0.00000	0.13655E+11	0.39000E+08
5	0.17641E+11	0.00000	0.51370E+10	0.00000	0.17190E+10	0.00000	0.17528E+11	0.85000E+08
6	0.12409E+11	0.00000	0.28180E+10	0.00000	0.43910E+10	0.00000	0.64400E+10	0.23600E+09
7	0.74110E+10	0.00000	0.36200E+09	0.24500E+09	0.91190E+10	0.00000	0.53480E+10	0.19080E+10
8	0.12000E+09	0.30900E+09	0.00000	0.24500E+09	0.89450E+10	0.00000	0.51370E+10	0.19080E+10
9	0.00000	0.30900E+09	0.00000	0.24500E+09	0.70130E+10	0.91200E+09	0.38510E+10	0.19080E+10
10	0.00000	0.30900E+09	0.00000	0.24500E+09	0.00000	0.91200E+09	0.18590E+10	0.19080E+10
11	0.00000	0.30900E+09	0.00000	0.24500E+09	0.49300E+09	0.91200E+09	0.16950E+10	0.19080E+10
12	0.00000	0.30900E+09	0.00000	0.24500E+09	0.65400E+09	0.91200E+09	0.16050E+10	0.19080E+10
13	0.00000	0.30900E+09	0.00000	0.24500E+09	0.78100E+09	0.91200E+09	0.65600E+09	0.19130E+10
14	0.00000	0.30900E+09	0.00000	0.24500E+09	0.78100E+09	0.91200E+09	0.65750E+10	0.19130E+10
15	0.00000	0.30900E+09	0.00000	0.24500E+09	0.00000	0.99400E+09	0.67400E+09	0.19370E+10
16	0.00000	0.30900E+09	0.00000	0.24500E+09	0.00000	0.99400E+09	0.88100E+09	0.19470E+10
17	0.00000	0.30900E+09	0.00000	0.24500E+09	0.00000	0.99400E+09	0.13250E+10	0.20810E+10
18	0.00000	0.30900E+09	0.00000	0.24500E+09	0.00000	0.99400E+09	0.66300E+09	0.20810E+10
19	0.00000	0.30900E+09	0.00000	0.24500E+09	0.00000	0.99400E+09	0.26500E+10	0.20810E+10
20	0.00000	0.30900E+09	0.00000	0.24500E+09	0.00000	0.99400E+09	0.37130E+10	0.20810E+10
21	0.00000	0.30900E+09	0.00000	0.24500E+09	0.00000	0.99400E+09	0.33250E+10	0.20810E+10
22	0.00000	0.30900E+09	0.00000	0.24500E+09	0.00000	0.99400E+09	0.91500E+09	0.24510E+10
23	0.00000	0.30900E+09	0.00000	0.24500E+09	0.00000	0.99400E+09	0.95600E+09	0.24510E+10
24	0.00000	0.30900E+09	0.00000	0.24500E+09	0.00000	0.99400E+09	0.14040E+10	0.24510E+10
25	0.00000	0.30900E+09	0.00000	0.24500E+09	0.00000	0.99400E+09	0.22300E+10	0.24510E+10
26	0.00000	0.30900E+09	0.00000	0.24500E+09	0.00000	0.99400E+09	0.19870E+10	0.24510E+10
27	0.00000	0.30900E+09	0.00000	0.24500E+09	0.00000	0.99400E+09	0.99200E+09	0.24590E+10
28	0.00000	0.30900E+09	0.00000	0.24500E+09	0.00000	0.99400E+09	0.95600E+09	0.24590E+10
29	0.00000	0.30900E+09	0.00000	0.24500E+09	0.00000	0.99400E+09	0.94700E+09	0.24590E+10
30	0.00000	0.30900E+09	0.00000	0.24500E+09	0.00000	0.99400E+09	0.97400E+09	0.24590E+10
31	0.00000	0.30900E+09	0.00000	0.24500E+09	0.00000	0.99400E+09	0.99000E+09	0.24590E+10
32	0.00000	0.30900E+09	0.00000	0.24500E+09	0.00000	0.99400E+09	0.10200E+10	0.24660E+10

Figure 24a. COSTCK.OUT no delay

33	0.00000	0.30900E+09	0.00000	0.24500E+09	0.00000	0.99400E+09	0.96300E+09	0.24660E+10
34	0.00000	0.30900E+09	0.00000	0.24500E+09	0.00000	0.99400E+09	0.37360E+10	0.24660E+10
35	0.00000	0.30900E+09	0.00000	0.24500E+09	0.00000	0.99400E+09	0.50250E+10	0.24660E+10
36	0.00000	0.30900E+09	0.00000	0.24500E+09	0.00000	0.99400E+09	0.44920E+10	0.24660E+10
37	0.00000	0.30900E+09	0.00000	0.24500E+09	0.00000	0.99400E+09	0.20810E+10	0.30260E+10
38	0.00000	0.30900E+09	0.00000	0.24500E+09	0.00000	0.99400E+09	0.14480E+10	0.30260E+10
39	0.00000	0.30900E+09	0.00000	0.24500E+09	0.00000	0.99400E+09	0.14160E+10	0.30260E+10
40	0.00000	0.30900E+09	0.00000	0.24500E+09	0.00000	0.99400E+09	0.14190E+10	0.30260E+10
41	0.00000	0.30900E+09	0.00000	0.24500E+09	0.55600E+10	0.99400E+09	0.14570E+10	0.30260E+10
42	0.00000	0.30900E+09	0.00000	0.24500E+09	0.55600E+10	0.99400E+09	0.14880E+10	0.30330E+10
43	0.00000	0.30900E+09	0.00000	0.24500E+09	0.55600E+10	0.99400E+09	0.14160E+10	0.30330E+10
44	0.00000	0.30900E+09	0.00000	0.24500E+09	0.00000	0.99400E+09	0.18890E+10	0.30330E+10
45	0.00000	0.30900E+09	0.00000	0.24500E+09	0.00000	0.99400E+09	0.26820E+10	0.30330E+10
46	0.00000	0.30900E+09	0.00000	0.24500E+09	0.00000	0.99400E+09	0.24630E+10	0.30330E+10
47	0.00000	0.30900E+09	0.00000	0.24500E+09	0.00000	0.99400E+09	0.14870E+10	0.30410E+10
48	0.00000	0.30900E+09	0.00000	0.24500E+09	0.00000	0.99400E+09	0.28870E+10	0.30410E+10
49	0.00000	0.30900E+09	0.00000	0.24500E+09	0.00000	0.99400E+09	0.14870E+10	0.30410E+10
50	0.00000	0.30900E+09	0.00000	0.24500E+09	0.00000	0.99400E+09	0.14870E+10	0.30410E+10

Figure 24a. Continued

COST ALLOCATION

The following section describes the process of allocating costs among the project services:

The Allocation Model

The program ALLOCA.FTN computes the cost allocation table. The program uses the adjusted separable cost remaining benefit (ASCRB) method of cost allocation, as described in Report 1 (USU 1979) of the Senegal River Development Program Cost Allocation Study (see also Appendix 3). The cost allocation is calculated using cost and benefit data in which navigation and energy are not delayed).

Allocation data

The data required for the program may be entirely provided by the user, or partially supplied from data files and the program. The source for the default data is Report 5 (USU 1981). The ASCRB method requires the present value of the following for input: 1) the benefits to each sector, 2) the alternative costs of providing the same service, 3) the separable costs of the project, 4) the total cost of the project, 5) the quantity of service (water supply, navigation volume, and power consumption), and 6) any cost to agriculture resulting from delays in the development of navigation. The model allocates the joint costs using these and other user-supplied interactive data.

The ALLOCA.FTN model has been written with two main input options to help the user:

Option 1. The user inputs all values interactively through his response to appropriate questions. In this mode, the computer displays questions or prompts on the terminal screen, which require a response by the user. The user responses are the source of the input data. The data are used by the program, and also written to a data file, which may be used in other runs when only the total separable costs might change. To use this option the user must respond Y to the first prompt:
"ARE YOU ENTERING NEW BENEFIT DATA Y/N."
Then the user must respond N to the second prompt:
"BENEFIT DATA ARE TO BE READ FROM DATA FILE Y/N."
The user must then provide cost values when prompted.

Option 2. Some data values are input interactively, while other data are read from data files created by the benefit program package. For the interactive data, the user responds to messages which are printed out by the program requesting the user to enter data in the appropriate format. For the program to read values from the correct benefit data files, it is necessary for the user to have run the benefit and cost packages before running ALLOCA.FTN. The data from the benefit package appear on the screen, allowing the user to check the values and make changes if necessary.

To use this option the user must respond N to the first prompt:
"ARE YOU ENTERING NEW BENEFIT DATA Y/N?"
Then the user must respond Y to the next prompt:
"BENEFIT DATA ARE TO BE READ FROM DATA FILE (Y/N)."
The user then answers the remaining prompts and provides the alternative costs, separable costs, and the total cost.

Allocation variables and methods of input

Variable	Option 1	Option 2
Project Benefits	I FILES 1-3	DF FILES 1-3
Alternative Costs	I USER, File 4	I USER, File 4
Separable Costs	I USER, File 4	I USER, File 4
Total Cost	I USER, File 4	I USER, File 4
Discounted Quantity of Service	I FILES 1-3	DF FILES 1-3

Method I = Interactive prompts, D = read from data file, PR = written into the program.

Source of Data
USER = prepared by user independent of program
DF = Data File prepared by program
F 1 = AGBEN.DAT irrigation benefit and quantity data
F 2 = ENGBEN.DAT energy benefit and quantity data
F 3 = NBEN.DAT navigation benefit and quantity data
F 4 = DISSUM.DAT total discounted cost from finance table
PR = Report 5 values written into program

As indicated, discounted net benefits for each sector are calculated in each benefit program.

Calculation of separable costs

Separable costs are composed of two types: 1) those costs referred to as "specific costs" which are associated directly with the service provided, and 2) those which are a part of the common works (called "separable costs of the common works"). Sometimes "separable common cost" is shortened to "separable cost" which causes confusion. In this report, "separable costs" are the sum of "specific costs" and "separable costs of the common works".

Identification of costs in the first category (specific costs) is straight-forward. All project-related expenditures which are associated with a specific service are identified. For example, the penstocks and transmission lines which are needed only for hydropower production are specific costs and, therefore, are specific to energy. For the Senegal River Development Program, Diama Dam is assumed to provide services to agriculture only, and therefore, is a specific cost to water supply. Construction and operation, maintenance and repair are included for each specific feature. These costs are given in the output data file DISSUM.OUT.

The second type of separable cost (separable cost of the common works) is calculated by determining the added cost of providing each service over and above the cost of providing the remaining services. The calculation requires data regarding the cost of single and multiple purpose structures at the Manantali site. To calculate the separable costs of the common works, the cost of including a service to a dam which provides all other services must be determined. The cost of the dam to provide all but one purpose is subtracted from the total common work cost to get the cost of adding the excluded service, which is the separable costs of the common works of that service. It may be that the facility necessary to provide a single service is sufficient to provide other services as well. If such is the case, the separable costs of the common work for each of the other services must be calculated using the same approach for a multiple-purpose facility excluding the former single service.

For example, for Manantali Dam the height necessary to provide Energy (208 m) is also sufficient to provide navigation (N) and Water Supply (WS). Thus

$$\underset{(208\ m)}{(\text{Energy} + \text{Navigation} + \text{Water Supply})}_{\text{costs}} =$$

$$\underset{(208\ m)}{(\text{Energy} + \text{Navigation})}_{\text{costs}} = \underset{(208\ m)}{(\text{Energy} + \text{Water Supply})}_{\text{costs}}$$

The separable costs of the common works to energy (E)

$$\text{is } E = \underset{(208\ m)}{(E + N + WS)}_{\text{costs}} - \underset{(192\ m)}{(N + WS)}_{\text{costs}}$$

The separable costs of navigation and water supply are calculated by:

$$N_{\text{costs}} = \underset{(192\ m)}{(N + WS)}_{\text{costs}} - \underset{(189\ m)}{WS}_{\text{costs}}$$

and

$$E_{\text{costs}} = \underset{(192\ m)}{(N + WS)}_{\text{costs}} - \underset{(186\ m)}{N}_{\text{costs}}$$

The joint cost is the total cost of the common works less the separable costs of the common works. The calculation of the values used in the demonstration run are presented below:

Specific Costs	cu 10^9 FCFA
Specific Costs to Water Supply (Diama Dam)	30,012
Specific Costs to Hydropower (Lines, Stations, and Penstocks) (non-delayed case)	39,08

Specific Costs to Navigation (Channel, Ports, and Places of Call) (non-delayed case)	98,412
Separable Common Costs of Manantali Dam	
Project for Hydropower Only (208 m dam without flood control)	72,801
Project for Water Supply Only (189 m)	52,591
Project for Navigation Only (186 m)	49,324
Project for Water Supply and Navigation (192 m)	55,858
Separable Common Costs of the Works to Hydropower (72.801 - 55.858)	16,943
Separable Common Costs of the Works to Water Supply (55.858 - 49.324)	6,534
Separable Common Costs of the Works to Navigation (55.858 - 52.591)	3,267
Separable Costs	
Separable Costs to Hydropower (39.08 + 16.943)	56,023
Separable Costs to Water Supply (30.012 + 6.534)	36,546
Separable Costs to Navigation (98.412 + 3.267)	101,679

If other cost assumptions are made for the single purpose projects, the same procedure is followed to obtain new separable costs. It is noted, however, that the above values are consistent with Position 1 as outlined in Report 5 of the Senegal River Cost Allocation Project, which was adopted by the OMVS Council of Ministers at their March 1981 meeting in Nouackchott.

Calculation of alternative costs

The user must calculate the costs of the single purpose alternative projects which could provide each of the individual project services. Each alternative project chosen should be the least cost alternative. The selection of the single purpose alternative project for each service depends upon the available technical and cost data, as well as any assumptions which may be made. For example, the data used in the demonstrative run are based on the assumption that the Manantali site could

be used for any of the single purpose alternative projects. Details of these calculations are found in Report 5 (USU 1981). Single purpose alternative costs include both initial investments and discounted operation, and maintenance expenditures. Consequently, the alternative cost used in the demonstration run is the sum of the single purpose alternative (dam at Manantali Report 5 (USU 1981)) and the specific cost. The single purpose alternative project cost must be calculated by the user before the model is run. The specific costs are calculated by the model and are given in the data file DISSUM.OUT.

The following are the alternative costs used in the demonstration run:

Water Supply	
Single purpose alternative (Report 5 (USU 1981) based on a 189 m storage dam at the Manantali Site)	52.591×10^9 CFA
Specific cost (nondelayed case)	30.012×10^9 CFA
Total	82.603×10^9 CFA
Navigation	
Single purpose alternative (Report 5 (USU 1981) based on a 186 m project dam at the Manantali Site)	49.324×10^9 CFA
Specific cost (nondelayed case)	98.412×10^9 CFA
Total	147.736×10^9 CFA
Energy	
Single purposed alternative (Report 5 (USU 1981) based on a 206m project dam at the Manantali Site)	70.531×10^9 CFA
Specific cost (nondelayed case)	39.08×10^9 CFA
Total	109.61×10^9 CFA

Detailed description of cost allocation procedures

The approach to allocating joint costs is fully discussed in Report 1 of the Senegal River Cost Allocation Study. A brief review of the Adjusted Separable Costs Remaining Benefits (ASCRB) method is given in Appendix 3 of Report 1.

Input Data Format for the Allocation Model

Each item of input data is entered interactively in free format from the computer terminal. The user is referred to Appendix C for a demonstration run of the Allocation Model.

Output from the Allocation Model (ALLOCA.OUT and ALLOCA.DAT

The program ALLOCA.FTN writes two data files ALLOCA.OUT and ALLOCA.DAT. The format used in ALLOCA.OUT (Figure 25) is the same as that used in Reports 1 and 5. The user is referred to these reports for a detailed discussion of the cost allocation output.

Data file ALLOCA.DAT (Figure 26) passes the joint cost proportions to the program FEES.DAT.

COST ALLOCATION VALUES XE9

	IRRIGATION	ENERGY	NAVIGATION	TOTALS
PROJECT BENEFITS	110.90	261.24	530.08	902.22
ALTERNATIVE COSTS	82.60	109.61	147.74	339.95
JUSTIFIABLE COSTS	82.60	109.61	147.74	339.95
SEPARABLE COSTS	36.55	56.02	101.68	194.25
COSTS FOR OTHER PURPOSES	206.59	187.12	141.46	
JUSTIFIABLE COSTS FOR OTHER PURPOSES	206.59	187.12	141.46	
ADJUSTMENT FACTOR	1.19	1.22	1.19	
ADJUSTED SEPARABLE COSTS	43.47	68.37	120.94	
REMANINING BENEFITS	39.13	41.24	26.30	107.17
JOINT COST PROPORTION	0.37	0.38	0.25	0.00
ALLOCATED JOINT COSTS	17.85	18.81	12.22	48.89
TOTAL SERVICE SECTOR COSTS	54.40	74.84	113.90	243.14
PERCENTAGES	.223736	.307794	.468469	

Figure 25. ALLOCA.OUT

```
      3
ALLOCA.DAT CREATED BY PROGRAM ALLOCA.FTN
USED FOR INPUT TO ALLOCA.FTN AND FEES.FTN
IRRIGATION  ENERGY   NAVIGATION
  1.1090478E+11  2.6123736E+11  5.3008010E+11    BENEFITS
  8.2603000E+10  1.0961100E+11  1.4773600E+11    ALTERNATIVE COSTS
  3.6545999E+10  5.6022999E+10  1.0167900E+11    SEPARABLE COSTS
  3.7054169E+10  DISCOUNTED QUANTITY OF WATER
  8.3515766E+09    DISCOUNTED QUANTITY OF ENERGY
  3.1388619E+10    DISCOUNTED QUANTITY OF NAVIGATION
0.652914E+10  = AGCOST; IRRIGATION BENEFIT FROM AGBEN0.117434E+12
  0.3651565  0.3848101  0.2500334     PROPORTIONS OF JOINT COST
```

Figure 26. ALLOCA.DAT

LOAN SUBMODEL

The programs MLOAN.FTN and DLOAN.FTN are designed to calculate the loan costs and to generate a schedule of loan withdrawals and repayments to the accounting section. MLOAN.FTN (Manantali loans) reads in the data file MLOAN.PRE and prints out MCOST.OUT, MPAY.OUT, and MLOAN.OUT. DLOAN.FTN (Diama loans) reads in the data file DLOAN.PRE, and prints out DCOST.OUT, DPAY.OUT, and DLOAN.OUT. The two programs are the same except for the names of the input and output data files. The formats of the two data files are identical. In this section only MLOAN will be discussed. All comments regarding MLOAN.FTN and its data files also apply directly to DLOAN.FTN and to the files as well. Grants are treated as zero interest loans requiring no repayment.

The program MLOAN.FTN allows the user to choose up to 10 separate withdrawals of funds from any of the available loans with variable initial withdrawal dates and repayment times. The file MPAY.OUT provides the decision maker with information on loan sources and liabilities.

Input Data

MLOAN.PRE

The program MLOAN.FTN reads the data file MLOAN.PRE and prompts the user for interactive data.

Data file (MLOAN.PRE). MLOAN.PRE contains a list of loans along with the number of withdrawal and the amount withdrawn. The program MLOAN.FTN reads MLOAN.PRE (Figure 27), while the program DLOAN.FTN reads DLOAN.PRE (Figure 28). The two data files share the format illustrated in Figure 29 and described below. In order for the proper accounts to be posted all loans must precede grants in the sequence of input.

Format for data files DLOAN.PRE and MLOAN.PRE:

Line 1a Number of lines of comments
Line 1b Comments
Line 1 Two integer variables read in by FREE FORMAT; NLOAN, NGRANT where:
NLOAN = number of loans
NGRANT = number of grants

Line 2 FORMAT (I2,1X,8A2,F6.2,1X,I2,1X,I2,1X,F4.4,2X,3A2)
NUM,NAME,TAMNT,IDUR,IGR,BINT,TYPE where:
NUM = loan number (loans should be in same order in both MLOAN.PRE and DLOAN.PRE)
NAME = description of loan (up to 16 characters)
TAMNT = total amount of loan expressed in millions of CFA (i.e., value will be multiplied by 1,000,000 in the program)
IDUR = the duration of the loan
IGR = the grace period

```
1
MLOAN.PRE  DATA FILE CONTAINING LOAN AND GRANT DRAWS FOR MANATALI DAM
      14      4
 1 ARABIE SAOUDITE 150.00 40 10 .0075 SOFT
8
    1981  0.6160125
    1982   12.02829
    1983   10.25383
    1984   13.07950
    1985   13.80823
    1986   9.712958
    1987   5.800849
    1988  9.3928203E-02
 2 RFA-B             91.70 40 10 .0075 SOFT
8
    1981  0.3765889
    1982   7.353294
    1983   6.268507
    1984   7.995935
    1985   8.441431
    1986   5.937855
    1987   3.546252
    1988  5.7421442E-02
 3 FAD               28.10 40 10 .0075 SOFT
8
    1981  0.1153997
    1982   2.253299
    1983   1.920884
    1984   2.450227
    1985   2.586741
    1986   1.819561
    1987   1.086692
    1988  1.7595883E-02
 4 FED              100.70 30 10 .0100 HARD
8
    1981  0.4135497
    1982   8.074991
    1983   6.883737
    1984   8.780704
    1985   9.269924
    1986   6.520633
    1987   3.894303
    1988  6.3057132E-02
 5 KOWEIT           100.00 18  7 .0200 HARD
8
    1981  0.4106750
    1982   8.018860
    1983   6.835885
```

Figure 27. MLOAN.PRE

```
    1984   8.719668
    1985   9.205485
    1986   6.475306
    1987   3.867233
    1988  6.2618792E-02
 6 IQ                 40.00 20 10 .0200 HARD
8
    1981  0.1642700
    1982   3.207544
    1983   2.734354
    1984   3.487867
    1985   3.682194
    1986   2.590122
    1987   1.546893
    1988  2.5047522E-02
 7 BID                20.00 24  6 .0300 HARD
8
    1983   2.734354
    1984   3.487867
    1985   3.682194
    1986   2.590122
    1987   1.546893
    1988  2.5047522E-02
 7 BID                20.00 24  6 .0300 HARD
8
    1981  8.2134992E-02
    1982   1.603772
    1983   1.367177
    1984   1.743934
    1985   1.841097
    1986   1.295061
    1987  0.7734466
    1988  1.2523761E-02
 8 IRAN               4.00 20  5 .0700 HARD
8
    1981  1.6426997E-02
    1982  0.3207543
    1983  0.2734354
    1984  0.3487867
    1985  0.3682194
    1986  0.2590122
    1987  0.1546893
    1988  2.5047520E-03
 9 ABU DHABI         70.00 15  5 .0350 HARD
8
    1981  0.2874725
    1982   5.613202
    1983   4.785120
    1984   6.103767
    1985   6.443840
    1986   4.532714
    1987   2.707063
    1988  4.3833159E-02
```

Figure 27. Continued

```
10 CAISSE CENTRALE  46.70 15 10 .0350 HARD
8
    1981  0.1917852
    1982   3.744807
    1983   3.192359
    1984   4.072085
    1985   4.298962
    1986   3.023968
    1987   1.805998
    1988  2.9242979E-02
11 NIGERIA          8.50 20  5 .0400 HARD
8
    1981  3.4907367E-02
    1982  0.6816030
    1983  0.5810502
    1984  0.7411717
    1985  0.7824662
    1986  0.5504010
    1987  0.3287148
    1988  5.3225979E-03
12 ITALIE-B        12.00 10  2 .0400 HARD
8
    1981  4.9280990E-02
    1982  0.9622631
    1983  0.8203062
    1984   1.046360
    1985   1.104658
    1986  0.7770367
    1987  0.4640679
    1988  7.5142556E-03
13 BAD             32.10 20  5 .0600 HARD
8
    1981  0.1318267
    1982   2.574054
    1983   2.194319
    1984   2.799013
    1985   2.954961
    1986   2.078573
    1987   1.241382
    1988  2.0100635E-02
14 ITALIE-A        23.50 10  0 .0700 HARD
8
    1981  9.6508607E-02
    1982   1.884432
    1983   1.606433
    1984   2.049122
    1985   2.163289
    1986   1.521697
    1987  0.9087996
    1988  1.4715417E-02
```

```
15 RFA-A            6.30  0  0 .0000  GRANT
8
    1981  2.5872523E-02
    1982  0.5051881
    1983  0.4306608
    1984  0.5493391
    1985  0.5799456
    1986  0.4079443
    1987  0.2436357
    1988  3.9449846E-03
16 FAC             23.30  0  0 .0000  GRANT
8
    1981  9.5687255E-02
    1982   1.868394
    1983   1.592761
    1984   2.031682
    1985   2.144878
    1986   1.508746
    1987  0.9010652
    1988  1.4590179E-02
17 CANADA          17.20  0  0 .0000  GRANT
8
    1981  7.0636094E-02
    1982   1.379244
    1983   1.175772
    1984   1.499783
    1985   1.583344
    1986   1.113753
    1987  0.6651641
    1988  1.0770434E-02
18 UNDP            10.00  0  0 .0000  GRANT
8
    1981  4.1067496E-02
    1982  0.8018859
    1983  0.6835886
    1984  0.8719668
    1985  0.9205486
    1986  0.6475305
    1987  0.3867233
    1988  6.2618805E-03
```

Figure 27. Continued

```
                                   1
DLOAN.PRE DATA FILE CONTAINING LOAN AND GRANT DRAWS FOR DIAMA DAM
      14      4
 1 ARABIE SAOUDITE 150.00 40 10 .0075 SOFT
 8
    1981   3.324275
    1982   5.967571
    1983   4.295650
    1984   3.109023
    1985   4.020909
    1986   2.205747
    1987  0.2833501
    1988  0.0000000
 2 RFA-B            91.70 40 10 .0075 SOFT
 8
    1981   2.032241
    1982   3.648175
    1983   2.626074
    1984   1.900650
    1985   2.458116
    1986   1.348447
    1987  0.1732213
    1988  0.0000000
 3 FAD              28.10 40 10 .0075 SOFT
 8
    1981  0.6227477
    1982   1.117925
    1983  0.8047184
    1984  0.5824237
    1985  0.7532504
    1986  0.4132100
    1987  5.3080913E-02
    1988  0.0000000
 4 FED             100.70 30 10 .0100 HARD
 8
    1981   2.231697
    1982   4.006229
    1983   2.883813
    1984   2.087191
    1985   2.699370
    1986   1.480792
    1987  0.1902224
    1988  0.0000000
 5 KOWEIT          100.00 18  7 .0200 HARD
 8
    1981   2.216184
    1982   3.978381
    1983   2.863766
    1984   2.072682
    1985   2.680606
    1986   1.470498
    1987  0.1889000
    1988  0.0000000
 6 IQ               40.00 20 10 .0200 HARD
 8
    1981  0.8864735
    1982   1.591352
    1983   1.145507
    1984  0.8290729
    1985   1.072243
    1986  0.5881993
    1987  7.5560026E-02
    1988  0.0000000
 7 BID              20.00 24  6 .0300 HARD
 8
    1981  0.4432367
    1982  0.7956762
    1983  0.5727533
    1984  0.4145364
    1985  0.5361213
    1986  0.2940997
    1987  3.7780013E-02
    1988  0.0000000
 8 IRAN              4.00 20  5 .0300 HARD
 8
    1981  8.8647343E-02
    1982  0.1591352
    1983  0.1145507
    1984  8.2907289E-02
    1985  0.1072243
    1986  5.8819927E-02
    1987  7.5560012E-03
    1988  0.0000000
 9 ABU DHABI        70.00 15  5 .0350 HARD
 8
    1981   1.551328
    1982   2.784867
    1983   2.004637
    1984   1.450878
```

Figure 28. DLOAN.PRE

```
    1985   1.876424
    1986   1.029349
    1987  0.1322300
    1988  0.0000000
10 CAISSE CENTRALE  46.70 15 10 .0350 HARD
8
    1981   1.034958
    1982   1.857904
    1983   1.337379
    1984  0.9679427
    1985   1.251843
    1986  0.6867227
    1987  8.8216327E-02
    1988  0.0000000
11 NIGERIA          8.50 20  5 .0400 HARD
8
    1981  0.1883756
    1982  0.3381624
    1983  0.2434201
    1984  0.1761780
    1985  0.2278515
    1986  0.1249923
    1987  1.6056504E-02
    1988  0.0000000
12 ITALIE-B        12.00 10  2 .0400 HARD
8
    1981  0.2659420
    1982  0.4774057
    1983  0.3436519
    1984  0.2467219
    1985  0.3216728
    1986  0.1764598
    1987  2.2668002E-02
    1988  0.0000000
13 BAD             32.10 20  5 .0600 HARD
8
    1981  0.7113950
    1982   1.277060
    1983  0.9192689
    1984  0.6653310
    1985  0.8604746
    1986  0.4720299
    1987  6.0636912E-02
    1988  0.0000000
14 ITALIE-A        23.50 10  0 .0700 HARD
8
```

Figure 28. Continued

```
    1981  0.5208032
    1982  0.9349195
    1983  0.6729850
    1984  0.4870803
    1985  0.6299425
    1986  0.3455671
    1987  4.4391505E-02
    1988  0.0000000
15 RFA-A            6.30  0  0 .0000  GRANT
8
    1981  0.1396196
    1982  0.2506380
    1983  0.1804173
    1984  0.1305790
    1985  0.1688782
    1986  9.2641383E-02
    1987  1.1900703E-02
    1988  0.0000000
16 FAC             23.30  0  0 .0000  GRANT
8
    1981  0.5163708
    1982  0.9269627
    1983  0.6672575
    1984  0.4829350
    1985  0.6245812
    1986  0.3426261
    1987  4.4013709E-02
    1988  0.0000000
17 CANADA          17.20  0  0 .0000  GRANT
8
    1981  0.3811836
    1982  0.6842815
    1983  0.4925678
    1984  0.3565014
    1985  0.4610642
    1986  0.2529257
    1987  3.2490809E-02
    1988  0.0000000
18 UNDP            10.00  0  0 .0000  GRANT
8
    1981  0.2216184
    1982  0.3978381
    1983  0.2863767
    1984  0.2072682
    1985  0.2680607
    1986  0.1470498
    1987  1.8890006E-02
    1988  0.0000000
```

```
1
MLOAN.PRE DATA FILE CONTAINING LOAN AND GRANT DRAWS FOR MANATALI DAM
      14      4                                          LINE  1
 1 ARABIE SAOUDITE 150.00 40 10 .0075 SOFT               LINE  2
8                                                        LINE  3
    1981  0.6160125                                      LINE  4
    1982   12.02829                                      LINE  5
    1983   10.25383                                      LINE  6
    1984   13.07950                                      LINE  7
    1985   13.80823                                      LINE  8
    1986   9.712958                                      LINE  9
    1987   5.800849                                      LINE 10
    1988  9.3928203E-02                                  LINE 11
 2 RFA-B              91.70 40 10 .0075 SOFT             LINE  2
8                                                        LINE  3
    1981  0.3765889                                      LINE  4
    1982   7.353294                                      LINE  5
    1983   6.268507                                      LINE  6
    1984   7.995935                                      LINE  7
    1985   8.441431                                      LINE  8
    1986   5.937855                                      LINE  9
    1987   3.546252                                      LINE 10
    1988  5.7421442E-02                                  LINE 11

18 UNDP               10.00  0  0 .0000  GRANT           LINE  2
8                                                        LINE  3
    1981  4.1067496E-02                                  LINE  4
    1982  0.8018859                                      LINE  5
    1983  0.6835886                                      LINE  6
    1984  0.8719668                                      LINE  7
    1985  0.9205486                                      LINE  8
    1986  0.6475305                                      LINE  9
    1987  0.3867233                                      LINE 10
    1988  6.2613805E-03                                  LINE 11
```

Figure 29. Sample data file illustrating format used for file MLOAN.PRE and DLOAN.PRE.

BINT = the interest rate charged expressed as a decimal fraction

TYPE = the type of loan, SOFT,HARD,GRANT (IMPORTANT FORMAT NOTE***grant is entered with a leading space, the program checks for a "space G" so that Grants should be entered as shown).

Line 3 FREE FORMAT one integer NDR where:

NDR = the number of withdrawals (in order to maintain the proper posting of accounts all loans and grants must have the same number of withdrawals)

where there are no withdrawals enter 0[1]

Line 4 FREE FORMAT MNZ,LMN where

MNZ = Integer variable for year of withdrawal (e.g. 1994) or year 13

LMN = Real variable for amount of withdrawal expressed in millions of CFAF (value will be multiplied by 1,000,000 in the program)

Line 5 through Line 11 same format as Line 4, there will be one line for each withdrawal.

Interactive data. the user is asked whether the exchange rate between values given in MLOAN.PRE and the accounting section is 245 CFAF/$. If the user responds with Y, 245 CFAF/$ is used. If the user responds N, the user must then enter a different exchange rate. This charge would change cash flows, loan costs, and repayments in the model, but not the allocation of costs among countries. Similarly, the user is asked whether the discount rate is 0.05.

MLOAN.FTN

The purpose of MLOAN.FTN is to calculate loan costs, withdrawals and repayments. This program receives its basic data from file MLOAN.PRE, allows the user to select various combinations of that basic data for project financing, and outputs the resultant financial information in three files: MPAY.OUT, MLOAN.DAT, and MCOST.OUT.

MPAY.OUT (Figure 30) is a general information file (discussed below) which is meant for user evaluation and consideration. MLOAN.DAT is a file used to transfer financial information from MLOAN.FTN to PREACC.FTN in accordance with the appropriate format. MCOST.OUT contains the total discounted interest costs for loans for Manantali Dam. The details of the program and data files follow.

[1]Note that these withdrawals may or may not be discretionary. If they are not, expected withdrawals should be based upon projected project funding requirements and loan conditions.

```
XAMPLE OF MPAY.OUT
THIS FILE REPRESENTS A PART OF THE TOTAL FILE.
THE INFORMATION CONTAINED IN THIS FILE IS SUMMARIZED IN
ACCOUN.OUT IN THE LOAN AND INTEREST SECTIONS.

LOAN # 1   DUR=50   AMOUNT=   0.62   BEGINS: 1981   GRACE= 10
LOAN # 1   DUR=50   AMOUNT=  12.03   BEGINS: 1982   GRACE= 10
LOAN # 1   DUR=50   AMOUNT=  10.25   BEGINS: 1983   GRACE= 10
LOAN # 1   DUR=50   AMOUNT=  13.08   BEGINS: 1984   GRACE= 10
LOAN # 1   DUR=50   AMOUNT=  13.81   BEGINS: 1985   GRACE= 10
LOAN # 1   DUR=50   AMOUNT=   9.71   BEGINS: 1986   GRACE= 10
LOAN # 1   DUR=50   AMOUNT=   5.80   BEGINS: 1987   GRACE= 10
LOAN # 1   DUR=50   AMOUNT=   0.09   BEGINS: 1988   GRACE= 10
LOAN # 2   DUR=50   AMOUNT=   0.38   BEGINS: 1981   GRACE= 10
```

Figure 30. Sample of MPAY.OUT

LOAN # 1

YEAR	LOAN BALANCE(EOY)	PAYMENT	INTEREST	PRINCIPAL
1981	0.15092307E+09	1056461.5	1056461.5	0.00000000
1982	0.30978540E+10	21684980.	21684980.	0.00000000
1983	0.56100424E+10	39270300.	39270300.	0.00000000
1984	0.88145203E+10	61701644.	61701644.	0.00000000
1985	0.12197537E+11	85382760.	85382760.	0.00000000
1986	0.14577211E+11	0.10204049E+09	0.10204049E+09	0.00000000
1987	0.15998420E+11	0.11198894E+09	0.11198894E+09	0.00000000
1988	0.16021432E+11	0.11215003E+09	0.11215003E+09	0.00000000
1989	0.16021432E+11	0.11215003E+09	0.11215003E+09	0.00000000
1990	0.16021432E+11	0.11215003E+09	0.11215003E+09	0.00000000
1991	0.15672965E+11	0.46061677E+09	0.11215005E+09	0.34846672E+09
1992	0.15322061E+11	0.46061680E+09	0.10971294E+09	0.35090384E+09
1993	0.14968700E+11	0.46061677E+09	0.10725582E+09	0.35336096E+09
1994	0.14612866E+11	0.46061677E+09	0.10478316E+09	0.35583360E+09
1995	0.14254543E+11	0.46061680E+09	0.10229378E+09	0.35832301E+09
1996	0.13893704E+11	0.46061677E+09	99777384.	0.36083939E+09
1997	0.13530349E+11	0.46061677E+09	97261760.	0.36335501E+09
1998	0.13164446E+11	0.46061677E+09	94713504.	0.36590326E+09
1999	0.12795981E+11	0.46061677E+09	92151416.	0.36846534E+09
2000	0.12424934E+11	0.46061677E+09	89570712.	0.37104605E+09
2001	0.12051296E+11	0.46061677E+09	86978712.	0.37363805E+09
2002	0.11675039E+11	0.46061680E+09	84359376.	0.37625741E+09
2003	0.11296148E+11	0.46061677E+09	81726048.	0.37889072E+09
2004	0.10914607E+11	0.46061680E+09	79075440.	0.38154134E+09
2005	0.10530397E+11	0.46061677E+09	76407192.	0.38420957E+09
2006	0.10143489E+11	0.46061677E+09	73709024.	0.38690774E+09
2007	0.97538806E+10	0.46061677E+09	71007880.	0.38960890E+09
2008	0.93615442E+10	0.46061677E+09	68280352.	0.39233642E+09
2009	0.89664573E+10	0.46061677E+09	65529724.	0.39508704E+09
2010	0.85686093E+10	0.46061680E+09	62758752.	0.39784803E+09
2011	0.81679749E+10	0.46061677E+09	59982524.	0.40063424E+09
2012	0.77645322E+10	0.46061677E+09	57173920.	0.40344285E+09
2013	0.73582725E+10	0.46061677E+09	54356980.	0.40625978E+09
2014	0.69491594E+10	0.46061677E+09	51503852.	0.40911293E+09
2015	0.65371889E+10	0.46061677E+09	48645948.	0.41197082E+09
2016	0.61223319E+10	0.46061677E+09	45759380.	0.41485738E+09
2017	0.57045780E+10	0.46061677E+09	42863392.	0.41775358E+09
2018	0.52838963E+10	0.46061677E+09	39934804.	0.42068195E+09
2019	0.48602665E+10	0.46061677E+09	36987156.	0.42362960E+09
2020	0.44336676E+10	0.46061677E+09	34017732.	0.42659904E+09
2021	0.40041004E+10	0.46061677E+09	31049410.	0.42956736E+09
2022	0.35715054E+10	0.46061677E+09	28021786.	0.43259498E+09
2023	0.31358851E+10	0.46061677E+09	24996334.	0.43562045E+09
2024	0.26972232E+10	0.46061677E+09	21954866.	0.43866189E+09
2025	0.22554918E+10	0.46061677E+09	18885528.	0.44173123E+09
2026	0.18106636E+10	0.46061677E+09	15788507.	0.44482826E+09
2027	0.13627224E+10	0.46061677E+09	12675631.	0.44794115E+09
2028	0.91164262E+09	0.46061680E+09	9536976.0	0.45107981E+09
2029	0.45741389E+09	0.46061677E+09	6388018.0	0.45422874E+09
2030	704.00000	0.46061677E+09	3203589.2	0.45741318E+09

Figure 30. Continued

AGGREGATE LOAN DATA FOR SELECTED COMBINATIONS

YEAR	TOTAL PAYMENTS	TOTAL INTEREST CHARGE
1981	20004516.	16637857.
1982	0.40885066E+09	0.33973454E+09
1983	0.77040546E+09	0.58993357E+09
1984	0.11952881E+10	0.91173500E+09
1985	0.16525804E+10	0.12401969E+10
1986	0.20452899E+10	0.15248244E+10
1987	0.16827142E+10	0.15906196E+10
1988	0.23975785E+10	0.14791209E+10
1989	0.23975785E+10	0.14217810E+10
1990	0.23975785E+10	0.13633417E+10
1991	0.45338419E+10	0.13027162E+10
1992	0.42681083E+10	0.12184348E+10
1993	0.41567386E+10	0.11358762E+10
1994	0.40536532E+10	0.10560694E+10
1995	0.39048248E+10	0.97951027E+09
2036	0.00000000	0.00000000
2037	0.00000000	0.00000000
2038	0.00000000	0.00000000
2039	0.00000000	0.00000000
2040	0.00000000	0.00000000

NET PRESENT VALUE OF INTEREST CHARGES= 0.13419176E+11

Figure 30. Continued

Initialization. The beginning section of the program takes care of initialization and preliminary file management functions. Program working arrays are dimensioned and REAL and INTEGER data reassignments are made. This section of the program opens the data input file MLOAN.PRE which contains the conditions of up to 20 loans or grants. The program first reads in the variables LOANS and IGRAT which represent the number of loans and grants that are contained in the file MLOAN.PRE. This step is followed by the request that the user either approve or change the exchange rate so that financial data might represent the appropriate monetary base. The default value in the program is set in the variable NXR 245 CFAF/$. If the user desires another exchange rate (for example, if the financial information is desired in U.S. dollars), the variable NXR is revised accordingly. The program now reads in the data from MLOAN.PRE. These data are 1) the name of the loan or grant source, NAME (I,J), 2) the total amount available in the particular loan, TMNT(I), 3) the maximum duration of the loan, IDUR(I), 4) the grace period length for the loan, IGR(I), 5) the interest rate for the loan expressed as a decimal fraction, BINT(I), and 6) the type of loan (hard, soft, or grant), TYPE(I,K). This information is then echoed on the terminal for the user to verify. This section concludes by requesting user preference for a discount rate to be used in the calculation of net present value of interest costs. The program default rate is set at 5 percent. The user may change this rate by requesting a new rate and entering the new rate in the variable RATE. The input file LTERMS.PRE is closed at the end of this section and is not further used in the programs.

Loan withdrawals. This section of the program LONPAK.FTN begins by opening the output file MPAY.OUT (Figure 30). This file is used to provide financial information on the loans selected by the user following completion of the program. Another function of the program is reading of the number of withdrawals for each loan.

If the financial instrument under consideration is a loan, the program will identify loan duration, amount, and starting data, for each loan for up to ten entries per loan. If the financial instrument selected is a grant, only the amount and withdrawal starting date are used since there is no repayment period.

This portion of the program also precisely identifies placement of any loan arrangement in terms of both time and duration. The program uses some data entered by the user. This process can become complicated since the date of first loan withdrawal begins the grace period. Any additional withdrawals during the grace period will not require repayment until the end of the grace period. Withdrawals after the grace period is over require that repayments begin immediately after the withdrawal. The starting date of the loan (PQ) is the date of the first withdrawal. The end of the grace period (UP) is calculated from the starting date and grace period. For subsequent withdrawals, if subsequent withdrawals have starting dates earlier than LIP, then the beginning of the repayment (PW) is set equal to LIP. If the subsequent withdrawals are later than LIP, the beginning of loan repayment is simply the date of the withdrawal as entered by the user. The loan amount, which is the outstanding balance of the loan, is aggregated into

array TNSAMT. This outstanding balance is reduced by the principal contributions of the annual repayment, to be calculated later in the program.

Payment and interest calculations. This section of the program calculates the loan interest and repayment for each loan made from the loan for each withdrawal. The following algorithms are used:

$$DUMP(J,K) = \frac{AMNT(K) * BINT(K)}{(1+BINT(M)^{-LNDUR(K)}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(18)$$

$$FYDMP(J) = \frac{AMNT(K) - (DUMP(J,K) * BYN)}{(1-BINT(M))^{-IZ}} \quad \ldots\ldots\ldots\ldots\ldots\ldots(19)$$

$$BYN = \frac{1 - (1+BINT(M))^{-IZ}}{BINT(M)} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(20)$$

Equation 18 is a standard annuity (mortgage loan) formula which calculates an annual repayment obligation given the principal, [AMNT(K)], the interest rate of the loan, [BINT(K)], and the period of the loan [LNDUR(K)]. The array DUMP(J,K) contains the amount of repayment for each loan withdrawal for each year of the loan period.

Equation 19 is a variation of the standard annuity formula which is designed to calculate the amount of principal included in each annual total repayment. Each principal repayment reduces the outstanding balance of the loan. The formula calculates the reduction of the principal for each loan repayment using the loan withdrawal amount balance AMNT(K), the annual repayment DUMP(J,K), the loan interest rate BINT(M), the number of repayments which have been made on the loan, IZ, and an interest payment factor (BYN).

Equation 20 is simply the calculation of an interest payment charge factor. The equation uses the loan interest BINT(M), and the years into repayment IZ. A detailed discussion of these three equations is found in any standard finance text.

Following the calculations using the preceding three equations, the program derives an annual interest repayment by subtracting the annual principal repayment from the annual total repayment DUMP(J,K). The result is placed in the array FIDMP(J,M).

Aggregation routines. This section of the program aggregates the data derived from individual withdrawals from the separate loans calculated in the previous section. The array DUMP(J,K) is summed for each loan to create the array SDUMP(J,K). The array is further summed over all loans into the array TDUM(J). Similarly, the array of interest payments FIDMP(J,K) is summed for each loan. The array is further summed into an array FYDMP(J) which represents a summation of all interest charges for all the loans for each year. At this point in the

program, the net present value of interest costs for a given year is calculated (NPVIC) by dividing the interest charge by the discount factor (DISCR). This information subsequently appears at the computer terminal screen for the information of the user.

Link to PREACC. The purpose of this section of the program is to transfer the information on outstanding loan balances (TNSMT); interest charges (FIDMP(J,K)) and total annual repayments (SDUMP(J,K)) to the program PREACC.FTN for eventual use in the accounting program ACCOUN.FTN.

The first part of this section reduces the outstanding loan balances by the amounts of the principal reimbursed DMP. In this process, the array SDUMP(J,K) is changed from a sum of annual payments to a sum of annual principal reimbursements. The array TNSAMT is reduced to provide a true outstanding balance for the BALANCE SHEET. The user can choose not to send the financial information to the rest of the model for calculating cash flows, etc. In this case, the program skips to the creation of the file MPAY.OUT, which may be printed out or used by the model as input for other calculations.

Transferring financial information from the program LONPAK.FTN to the program PREACC.FTN begins with the selection of the number of years to be transferred. The general model currently seeks 50 years of information for the project life span. This may change, and the user has the terminal option of incorporating this change.

The output file MLOAN.DAT (Figure 31) transfers data in the format of other modules feeding the program PREACC.FTN. Initial information on this file contains a message and the number of accounts to be transferred each year. In the current model, 224 accounts are read for each year of record. This record is transferred in the variable NACC. The message length is specified in the variable MESAGE which indicates the number of lines of message that accompany the numerical data. Following this initial information the program formats the data for transfer in the following way. First the account code to be debited appears, followed by the value to be placed into the account, then the account code to be credited. This sequence is repeated again on the same line. Thus each line transfers two numerical values and four account codes to other programs. FIDMT(J,K) transfers interest data, SDUMP transfers loan principal expense data, and TNSMT(J,K) transfers outstanding balance data. The various indicies which accomplish the mechanics of this transfer are described in the LONPAK.FTN GLOSSARY. The grant draws are simply transferred as grant income (revenues) for the year in which they are withdrawn in TNSAMT(J,K).

Transfer to MPAY.OUT. This section of the program transfers the financial information to the output file MPAY.OUT (Figure 30) which can be used directly by the user for subsequent decisions or to modify the original loan withdrawals. Again, the user is given the option of not writing the file. If the user chooses not to write the file, the program is finished. If, however, the user decides to write the file, the financial information previously described in MLOAN.DAT is written in a different format on the file. The file first presents a

```
 4  50
*********************************************
ACCOUNT OUTPUT FROM MLOAN.M DAM DISCOUNT RATE:  5.0000001E-02
CONVERSION FACTOR USED EQUALS:      245
*********************************************
YEAR      1   224
 D5201     1056461.50C6000 D5202      645850.00C6000
 D3010     1056461.50C1010 D3010      645850.00C1010
 D5203      197910.50C6000 D5204     1013196.69C6000
 D3010      197910.50C1010 D3010     1013196.69C1010
 D5205     2012307.37C6000 D5206      804923.00C6000
 D3010     2012307.37C1010 D3010      804923.00C1010
 D5207      603692.19C6000 D5208      120738.42C6000
 D3010      603692.19C1010 D3010      120738.42C1010
 D5209     2465076.25C6000 D5210     1644558.00C6000
 D3010     2465076.25C1010 D3010     1644558.00C1010
 D5211      342092.19C6000 D5212      482953.72C6000
 D3010      342092.19C1010 D3010      482953.72C1010
 D5213     1937852.50C6000 D5214     3310243.75C6000
 D3010     1937852.50C1010 D3010     3310243.75C1010
 D5215           0.00C6000 D5216           0.00C6000
 D3010           0.00C1010 D3010           0.00C1010
 D5217           0.00C6000 D5218           0.00C6000
 D3010           0.00C1010 D3010           0.00C1010
 D5005           0.00C6000 D5005           0.00C6000
 D3010           0.00C3005 D3010           0.00C3005
 D2101           0.00C1010 D2102           0.00C1010
 D5005           0.00C6000 D5005           0.00C6000
 D3010           0.00C3005 D3010           0.00C3005
 D2103           0.00C1010 D2104           0.00C1010
 D5005           0.00C6000 D5005           0.00C6000
 D3010           0.00C3005 D3010           0.00C3005
 D2105           0.00C1010 D2106           0.00C1010
 D5005           0.00C6000 D5005           0.00C6000
 D3010           0.00C3005 D3010           0.00C3005
 D2107           0.00C1010 D2108           0.00C1010
 D5005           0.00C6000 D5005           0.00C6000
 D3010           0.00C3005 D3010           0.00C3005
 D2109           0.00C1010 D2110           0.00C1010
 D5005           0.00C6000 D5005           0.00C6000
 D3010           0.00C3005 D3010           0.00C3005
 D2111           0.00C1010 D2112           0.00C1010
 D5005           0.00C6000 D5005       56215.25C6000
 D3010           0.00C3005 D3010       56215.25C3005
 D2113           0.00C1010 D2114       56215.25C1010
 D5005           0.00C6000 D5005           0.00C6000
 D3010           0.00C3005 D3010           0.00C3005
```

Figure 31. MLOAN.DAT

```
D2115          0.00C1010 D2116          0.00C1010
D5005          0.00C6000 D5005          0.00C6000
D3010          0.00C3005 D3010          0.00C3005
D2117          0.00C1010 D2118          0.00C1010
D1005  150923072.00C2101 D1005   92264280.00C2102
D1005   28272928.00C2103 D1005  101319672.00C2104
D1005  100615368.00C2105 D1005   40246152.00C2106
D1005   20123074.00C2107 D1005    4024614.25C2108
D1005   70430752.00C2109 D1005   46987372.00C2110
D1005    8552305.00C2111 D1005   12073843.00C2112
D1005   32297542.00C2113 D1005   23644610.00C2114
D5005    6338768.00C4305 D1005    6338768.00C3005
D5005   23443378.00C4306 D1005   23443378.00C3005
D5005   17305844.00C4307 D1005   17305844.00C3005
D5005   10061537.00C4308 D1005   10061537.00C3005
YEAR    2   224
D5201   21684980.00C6000 D5202   13256749.00C6000
D3010   21684980.00C1010 D3010   13256749.00C1010
D5203    4062318.25C6000 D5204   20796924.00C6000
D3010    4062318.25C1010 D3010   20796924.00C1010
D5205   41304720.00C6000 D5206   16521889.00C6000
D3010   41304720.00C1010 D3010   16521889.00C1010
D5207   12391417.00C6000 D5208    2478282.50C6000
D3010   12391417.00C1010 D3010    2478282.50C1010
D5209   50598284.00C6000 D5210   33756280.00C6000
D3010   50598284.00C1010 D3010   33756280.00C1010
D5211    7021801.50C6000 D5212    9913132.00C6000
D3010    7021801.50C1010 D3010    9913132.00C1010
D5213   39776448.00C6000 D5214   66171300.00C6000
D3010   39776448.00C1010 D3010   66171300.00C1010
D5215          0.00C6000 D5216          0.00C6000
D3010          0.00C1010 D3010          0.00C1010
D5217          0.00C6000 D5218          0.00C6000
D3010          0.00C1010 D3010          0
```

Figure 31. Continued

description of the financing arrangements selected, including loan source, loan amounts, loan draw, year of loan draw, loan interest rate, loan grace period, and type of loan. This information is followed by detailed information on the repayment schedule for each loan, the outstanding balance, and the repayment of principal, SDUMP, and interest, FIDMP. The total annual repayment is represented by the variable, FPYMNT. Finally, the file includes the summary data for the aggregation of all loans and the net present value of the accrued interest charges, NPVIC.

Output

MPAY.OUT

Figure 30 presents a portion of MPAY.OUT. The first segment indicates those combinations of available loans and grants have been selected to meet the needs of the capital development schedule generated in the cost program. Loans listed with positive amounts and zero durations are grants.

Figure 30 also contains a partial listing of the conditions for loan #1 (which can be output for each loan selected by MPAY.OUT. For each year of record the file shows the balance of the loan remaining to be repaid (LOAN BALANCE EOY), the total annual repayment (taking into account duration and grace periods), and the division of the total annual repayment into interest and principal. For each year the loan balance outstanding is reduced by the amount of the principal payment during the previous year.

The last section of MPAY.OUT is the aggregate summation of all loans selected for use. This file shows the aggregate payments for all loans selected and the aggregate interest charge in each year. The net present value of the interest charges is also available.

MLOAN.DAT

A second file MLOAN.DAT (Figure 31) is also generated by MLOAN.FTN. This file presents much of the same information as contained in MPAY.OUT but in the standard format for direct transfer to other modules in the accounting system. This file is illustrated by the partial listing shown in Table 20. In this example, the year is identified (1) and the number of accounts being transferred (224) in that year is given. The first column indicates the accounts which are to be debited, followed by the value to be entered into the accounts, while the third column indicates those accounts which are to be credited. This format is repeated again on the same line. Thus, each line contains information for four accounts. The 6000 account is a dummy account used when transactions do not affect Income Statement Accounts. The file is directly read by the program PREACC.FTN.

MCOST.OUT

The file MCOST.OUT (Figure 32) contains the discounted costs of loans for Manantali Dam. Figure 33, DCOST.OUT shows the discounted costs of loans withdrawn for Diama Dam.

```
                    MCOST.OUT
 DISCOUNTED COST OF LOANS FOR MANANTALI DAM
****
                1.3419176E+10
```

Figure 32. MCOST.OUT.

```
                    DCOST.OUT
 DISCOUNTED COST OF LOANS FOR DIAMA DAM
****
                5.1536143E+09
```

Figure 33. DCOST.OUT.

USER FEES

User fees are calculated by the program FEES.FTN. The program reads four data files, ALLOCA.DAT, AGBEN.OUT, NBEN.OUT, and ENGBEN.OUT and requires some user inputs. The program has two output files, FEES.DAT and FEES.OUT. In the demonstration run, user fees are calculated twice: First for the non-delayed case, the results of which are used to calculate cost KEY and, secondly for the delayed case, the results of which are used in the accounting package.

Input Data

Interactive data plus data from the data files ALLOCA.DAT AGBEN.OUT, NBEN.OUT and ENGBEN.OUT are used by program FEES.FTN. These data are also found in Report 5. The actual costs are obtained by running COSTD.PRE through the program COST.FTN. The discounted costs are calculated for each service and presented in the data file DISSUM.OUT. The common works costs are included in file DISSUM.OUT. The loan costs are found in files MLOAN.OUT and DLOAN.OUT.

The separable portion of the common works costs and the joint costs from Report 5 are used in the demonstration run. If the cost of the Manantali Dam changes, the calculations of separable and joint costs will need to be changed.

ALLOCA.DAT.

FEES.FTN reads the following joint cost proportions from the data file ALLOCA.DAT (Figure 26). These values are printed on the terminal screen and the user can change them if necessary. All data are read in free format by submodel FEES.FTN from ALLOCA.DAT. The lines from the file ALLOCA.DAT are read in the following sequence. Note that some lines of data are not read.

1. Number of lines of comment
2. Lines of comments
3. Passed
4. Passed
5. Passed
6. Passed
7. PROWAT, PROPOW, PRONAV

where

PROWAT = Proportion of joint cost allocated to irrigation sector
PROPOW = Proportion of joint cost allocated to energy sector
PRONAV = Proportion of joint cost allocated to navigation sector

AGBEN.OUT

The discounted quantity of water used (QWATER) is read from the data file AGBEN.OUT. The user is referred to the Agricultural Benefit Section for a discussion of the data file AGBEN.OUT.

NBEN.OUT

The discounted quantity of navigation volume (QNAV) is read from the data file NBEN.OUT. The user is referred to the Navigation Benefit Section for a discussion of the data file NBEN.OUT.

ENGBEN.OUT

The discounted quantity of energy consumed (QPOW) is read from the data file ENGBEN.OUT. The user is referred to the Energy Benefit Section for a discussion of the data file ENGBEN.OUT.

Interactive input.

The user is prompted by the program to enter the following data:

1. Specific service sector costs.
2. Separable common costs for each service sector.
3. Joint costs.

For the demonstration run, costs used in FEES program are costs with delay of navigation and energy. The costs include those associated with loans to construct the Manantali and Diama Dams. The loan costs of Diama Dam are included in the specific cost to irrigation. The loan costs of the Manantali Dam were included in the allocated joint cost.

Program FEES.FTN

The program FEES.FTN calculates the user fees, by service, which are sufficient to pay back both the separable and allocated joint cost over the life of the project. Note that the use of discounted quantities ($D\ Q_i$) ensures a constant user fee over time, but also results in a surplus of revenues over repayments in the last years of the project repayment period. It is emphasized that this program uses the actual costs (including changes in costs due to delays). Because navigation or power delays cause changes in expenditures for specific costs (although not for joint costs) the user fees are calculated based on the separable costs plus the allocated joint costs. The program calculates the total cost of each service and the user fee for each service. The equation used to calculate the user fees is given below:

$$UF_i = \frac{\sum_{t=1}^{N} dC_i}{\sum_{t=1}^{N} dQ_i} \quad \text{.....(21)}$$

where

UF_i = user fee for service i
d = discount factor
$\Sigma\ dC_i$ = discounted sum of costs for service i

$$\Sigma\ dC_i = SP_i + SE_i + P_i * J \qquad (22)$$

SP_i = specific cost of service i
SE_i = separable common cost of service i
P_i = proportion of joint cost attributed to service i
$\Sigma\ dQ_i$ = discounted sum of quantities at service i

This program does not account for the fact that some specific costs may be incurred to provide only one country's services. For example, transmission lines are treated as a specific cost of energy production, and allocated to the energy service. User fees are charged based on energy consumption by costs, without regard to differential specific costs of energy by country.

Output Data

Two output data files are written: FEES.OUT (Figures 34a and b) and FEES.DAT (Figures 35a and b). FEES.DAT is read by the revenue program, REVENU.FTN. A detailed description of this data file is found in the Revenue Section. The data file FEES.OUT is intended to be read by the user. An example is shown below in Figure 34. This file summarizes the input data used by the FEES.FTN program and presents the user fees calculated by the program.

Note that these user fees are based upon the gross characterization of economic efficiency criteria suggested in Report 1 (USU 1978). Thus, for the given data, user fees will not exceed the benefits generated from the project. However, these fees are based on average benefits with no provision for normal returns to operator capital and labor. It is possible that these fees could cause lower than normal returns, particularly in marginal service users. Further data refinement is required to analyze these incentive (or disincentive) effects. In addition, the distinction between cost allocation and cost sharing, discussed in Report 1, suggests that actual prices charged to users for services fees may differ from those suggested by the cost allocation, and that countries may see fit to subsidize project users. In fact, the allocation of costs to countries by these user fees involves only the level of each country's obligation to the project.

```
OUTPUT FROM PROGRAM FEES
DISCOUNTED QUANTITY OF WATER CONSUMED  3.7054169E+10
THE DISCOUNTED QUANTITY OF POWER CONSUMED  8.3515766E+09
THE DISCOUNTED VOLUME OF NAVIGATION  3.1388619E+10
THE SPECIFIC COST TO IRRIGATION     3.0012000E+10
THE SPECIFIC COST TO ENERGY         3.9080002E+10
THE SPECIFIC COST TO NAVIGATION     9.8412003E+10
THE SEPARABLE COST TO IRRIGATION    6.5340001E+09
THE SEPARABLE COST TO ENERGY        1.6943000E+10
THE SEPARABLE COST TO NAVIGATION    3.2670001E+09
JOINT COST                           4.8891998E+10
PROPORTION OF JOINT TO IRRIGATION    0.3651565
PROPORTION OF JOINT TO ENERGY        0.3848101
PROPORTION OF JOINT TO NAVIGATION    0.2500334
TOTAL COST TO IRRIGATION            5.4399230E+10
TOTAL COST TO ENERGY          7.4837139E+10
TOTAL COST TO NAVIGATION              1.1390364E+11

THE USER FEES
IRRIGATION  ENERGY       NAVIGATION
1.46810      8.96084      3.62882
```

Figure 34a. FEES.OUT no delay

```
OUTPUT FROM PROGRAM FEES
DISCOUNTED QUANTITY OF WATER CONSUMED  3.7054169E+10
THE DISCOUNTED QUANTITY OF POWER CONSUMED  5.8602757E+09
THE DISCOUNTED VOLUME OF NAVIGATION  2.8719086E+10
THE SPECIFIC COST TO IRRIGATION    3.0012000E+10
THE SPECIFIC COST TO ENERGY        2.7776000E+10
THE SPECIFIC COST TO NAVIGATION    7.7253001E+10
THE SEPARABLE COST TO IRRIGATION   6.5340001E+09
THE SEPARABLE COST TO ENERGY       1.6943000E+10
THE SEPARABLE COST TO NAVIGATION   3.2670001E+09
JOINT COST                          6.2310998E+10
PROPORTION OF JOINT TO IRRIGATION   0.3651565
PROPORTION OF JOINT TO ENERGY       0.3848101
PROPORTION OF JOINT TO NAVIGATION   0.2500334
TOTAL COST TO IRRIGATION           5.9299267E+10
TOTAL COST TO ENERGY          6.8696904E+10
TOTAL COST TO NAVIGATION              9.6099836E+10

THE USER FEES
IRRIGATION  ENERGY       NAVIGATION
1.60034      11.7225      3.34620
```

Figure 34b. FEES.OUT with delay

```
*****************************************
 FEES.DAT FILE CREATED BY PROGRAM FEES
THIS FILE CREATED ON 13-JULY-83
PW
     12
D1010  8.9608C3010 D1010  8.9608C3010 D1010  8.9608C3010
D6000  8.9608C4205 D6000  8.9608C4210 D6000  8.9608C4215
AG
     12
D1010  1.4681C3010 D1010  1.4681C3010 D1010  1.4681C3010
D6000  1.4681C4005 D6000  1.4681C4010 D6000  1.4681C4015
NV
     12
D1010  3.6288C3010 D1010  3.6288C3010 D1010  3.6288C3010
D6000  3.6288C4105 D6000  3.6288C4110 D6000  3.6288C4115
*****************************
```

Figure 35a. FEES.DAT no delay

```
 ****************************************
 FEES.DAT FILE CREATED BY PROGRAM FEES
THIS FILE CREATED ON 12-JULY-83
PW
      12
D1010 11.7225C3010 D1010 11.7225C3010 D1010 11.7225C3010
D6000 11.7225C4205 D6000 11.7225C4210 D6000 11.7225C4215
AG
      12
D1010  1.6003C3010 D1010  1.6003C3010 D1010  1.6003C3010
D6000  1.6003C4005 D6000  1.6003C4010 D6000  1.6003C4015
NV
      12
D1010  3.3462C3010 D1010  3.3462C3010 D1010  3.3462C3010
D6000  3.3462C4105 D6000  3.3462C4110 D6000  3.3462C4115
 ****************************
```

Figure 35b. Delay

PROJECT REVENUE

The Revenue Model (REVENU)

The program REVENU.FTN calculates the project revenues from user fees from the three services. The running of REVENU requires the prior preparation of four data files: PWQ.DAT (Figure 17), AGQ.DAT (Figure 9), NAVQ.DAT (Figure 14), and FEES.DAT (Figure 34). All four of these files are created by other programs, as discussed previously. Although it is possible for the user to edit each of the four files, he is likely to do so only in the case of FEES.DAT. The user must be careful that the values are entered in the proper format. The format and a description of the file FEES.DAT are including in the following Data Input Section of this manual. For a description of the other input data, the user is referred to the Benefits Section of the manual. In the demonstration run the REVENU program is run twice, first for non-delayed data and second for delayed data.

The revenue is calculated by the following equation:

$$VALUE_{i,j} = QUAN_{i,j} * FEES_{i,j} \quad \text{.....(23)}$$

where

$VALUE_{i,j}$ = the revenue from country i for service j

$QUAN_{i,j}$ = the undiscounted quantity utilized by country i of service j

$FEES_{i,j}$ = the user fee charged to a $country_i$ for service.

If one of the following input errors is detected, the program will stop and write out a short error message: 1) if user fees are not given in the following order: a) energy, b) agriculture, c) navigation; 2) if the number of columns to be read from the quantity files does not match the number of user fees, and 3) if there is a mismatch in the number of years of data (for example, one data file contains 50 years of data while another contains only 25 years).

Input Data Format for the REVENU Model

Input files PWQ.DAT, NAVG.DAT, and AGQ.DAT

These three files normally are created by programs in the Benefits Section of the model. For this reason, the formats of these three files are discussed in detail in the Benefits Section of this report.

FEES.DAT. This input file (Figure 35) contains user fees and account codes. The file can be prepared by the user or by the ALLOCA Submodel. Free format is not used in this file, so if the file is edited by the user, the data must conform to the format given in the sample FEES.DAT below:

Line 1	FREE format number of lines of comment, number of years	
Line 2 through Line 4	Comments format (80A1)	
Line 5	ICHECK	format A2
Line 6	N	Integer variable free format
Line 7	3(NCORD ACC FEE NCORD ACC)	format 3(A1,I4,F8.2,A1, I4, 1X)
Line 8	3(NCORD ACC FEE NCORD ACC)	format 3(A1,I4,F8.2,A1, I4,1X)

Lines 6 through 7 are repeated for each service.

where

ICHECK = code check that service sectors are in proper order
PW ENERGY
AG AGRICULTURE
NV NAVIGATION
fees must be entered in this order otherwise the program will stop

N = number of years of data

NCORD = C for credit, D for debit

ACC = the account to be debited or credited. The revenue file must contain four accounts for each entry.

FEE = user fee for each account (ACC)

The block (Line 5 through Line 8) is repeated three times, once for each service (PW, AG, and NV).

REVENU.FTN. This submodel calculates the project revenues from user fees for the three services and associates these values with the proper accounting codes.

The discounted revenues are calculated by the following equation:

$$\sum_{t=1}^{N} d\ REV_{ij} = \sum_{t=1}^{N} d_t (UF_i * Q_{ijt}) \quad \text{.....(24)}$$

in which

$\sum_{t=1}^{N} d\ REV_{ij}$ = the discounted sum of revenues for service i for country j.

UF_i = user fee for service i

Q_{ijt} = quantity of service i used in member state j in year t

3. Proportions. The proportions are calculated by the following equation:

$$P_{ij} = \frac{R_{ij}}{total_i} \quad \text{.....(25)}$$

in which

P_{ij} = proportion service i charged to member state j

R_{ij} = discounted sum of revenues for service i paid by member state j

$total_i$ = discounted sum of revenues for service i

Output from the REVENU Model

KEY.OUT. The output file, KEY.OUT (Figure 36) contains the discounted project revenue distributed by country and by service. The revenue distribution also is given as percentages. As discussed earlier, specific costs of services which may be associated with a given country's use of these services are not considered in the calculation.[1] The data contained in KEY.OUT may be used to construct a table showing distribution of Manantali and Diama costs by country. The file also contains the choice of options used in the Benefit Section.

REVENU.DAT. The output file, REVENU.DAT (Figure 37) contains the project revenues and appropriate accounting codes. The file is read directly by the PREACC submodel which creates data for the accounting program. It is not necessary for the user to change or to print this file.

[1]Discussions were held with OMVS personnel with regard to the location, use, and allocation of costs in this case, and it was determined that the uncertainty associated with actual power users and the necessity for equality of user fees were sufficient reasons to ignore the problems. Lower model revision would be required to accomplish this re-allocation.

DATA FILE KEY.OUT FOLLOWING RESULTS ARE USED TO CALCUALTE COST KEY
DISCOUNTED REVENUE TO EACH COUNTRY BY USER SECTOR

	TOTAL	MALI	MAURITANIA	SENEGAL
PW	74836819968.00	42245382144.00	0.00	32591435776.00
PROPORTIONS		0.564	0.000	0.435
FEES		8.9608	8.9608	8.9608
WS	54399270912.00	6062768640.00	16678065152.00	31658434560.00
PROPORTIONS		0.111	0.307	0.582
FEES		1.4681	1.4681	1.4681
NV	113752940544.00	92970000384.00	13328809984.00	7454126080.00
PROPORTIONS		0.817	0.117	0.066
FEES		3.6288	3.6288	3.6288
TOTALS	242989023232.00	141278150656.00	30006876160.00	71704002560.00

Figure 36. KEY.OUT

```
      72      50
 OUTPUT FROM REVENUE PROGRAM
 ----------------------------------------
 FEES.DAT FILE CREATED BY PROGRAM FEES
THIS FILE CREATED ON 4-MARCH-83
 ----------------------------------------------------------------------------
    FILE PWO.DAT OUTPUT FROM ENERGY BENEFIT PROGRAM
UNDISCOUNTED YEARLY QUANTITIES USED TO  CALCULATE REVENUE
 DISCOUNT RATE =   5.0000001E-02 ALTERNATIVE ENERGY COST     31.28000
 % MALI = 0.5645 % MAUR = 0.0000 % SENEGAL = 0.4355
 THE FOLLOWING INPUT FILE WERE USED IN ENGBEN
ENERGY.PRE    DATA FILE FOR POWER BENEFIT PROGRAM  BENPWR
THESE ARE THE VALUES USED BY DAVE BOWLES FOR REPORT 5
 MALI            MAURITANIA       SENEGAL          TOTAL
 ----------------------------------------------------------------------------
 AGO.DAT OUTPUT FROM AGBEN USED IN REVENUE

 OUTPUT FROM AREA.FIN USED AS INPUT FOR AGBEN
 VALUES OF OPTIONS USED FOR THIS RUN ARE
NEW DEVELOPMENT RATE   5000.TIME TO NEW DEVELOPMENT RATE   4.
 NUMBER OF YEARS BEFORE THE FLOOD   9.
 THE FOLLOWING VALUES WERE USED TO DISTRIBUTE HA DEVELOPED BETWEEN COUNTRIES
  INITIAL  MALI = .1666 MAUR .3436 SENEGAL .4898
 TOTAL POSSIBLE HA IN MALI =  23437.
 FINIAL  MAUR .4125 SENEGAL .5875
 INITIAL AREAS MALI    270. MAUR   5305. SENEGAL  23230.

                    AGRICULTURAL AREAS DATA TABLE
      YEAR        RATE        AI        ARD        ADD        AF      MALI    MAUR

        AGRICULTURAL ECONOMIC SECTOR DATA TABLE
 VALUE OF OPTIONS ENTERED INTERACTIVELY ARE
 DEVELOPMENT COST  3560000. REPLACEMENT COST   760000.TIME TO PUMP REPLACEMENT
  YEARLY WATER REQUIREMENTS
       MALI       MAURITANIA     SENEGAL          TOTAL
 ----------------------------------------------------------------------------
 NAVO.DAT -- OUTPUT FROM NBEN USED IN REVENUE
 THE FOLLOWING VALUES  FOR INTERACTIVE VARIABLES  WERE USED
 DISCOUNT RATE 0.050 NUMBER OF YEARS    50AND THE FOLLOWING TARIFFS
 RAIL= 14.50 TRUCKING PHOSPHATE= 28.80 TRUCK MALI= 27.70 TRUCK MAUR.= 38.40TRUCK

 THE FOLLOWING INPUT FILES WERE USED
 ----------------------------------------------------------------------------
 OUTPUT FROM NVOL.FIN- NVOL.DAT FOR USE IN NBEN
   THE FOLLOWING INPUT FILES WERE USED

  NAVTAB.PRE INPUT FOR NVOL
  BREAKDOWN OF NAVIGATIONAL VOLUMES DATA

 OUTPUT FROM AREA.FIN USED AS INPUT FOR AGBEN
 VALUES OF OPTIONS USED FOR THIS RUN ARE
NEW DEVELOPMENT RATE   5000.TIME TO NEW DEVELOPMENT RATE   4.
 NUMBER OF YEARS BEFORE THE FLOOD   9.
 THE FOLLOWING VALUES WERE USED TO DISTRIBUTE HA DEVELOPED BETWEEN COUNTRIES
  INITIAL  MALI = .1666 MAUR .3436 SENEGAL .4898
```

Figure 37. REVENU.DAT

```
TOTAL POSSIBLE HA IN MALI =  23437.
FINAL  MAUR .4125 SENEGAL .5875
INITIAL AREAS MALI    270. MAUR   5305. SENEGAL  23230.

                    AGRICULTURAL AREAS DATA TABLE
     YEAR        RATE        AI        ARD        ADD        AF      MALI    MAUR


INTERACTIVE OPTION DELAY SET TO        5 YEARS
     YEAR    MIVOLO     MIVOLA     RVOL     MAVOLO    MAVOLA     PVOL     SEVOL
-----------------------------------------------------------------------------------

OUTPUT FORM NVOL DELAY.DAT FOR USE IN NBEN
 AGRICULTURAL VOLUMES DURING NAVIGATION DELAY
     YEAR      MALI   MAURITANIA  SENEGAL
 NAVIGATIONAL DELAY=   5 YEARS

 TOTAL YEARLY NAVIGATIONAL VOLUMES
      MALI        MAURITANIA       SENEGAL        TOTAL          YEAR
YEAR      1  36
 D1010          0.00C3010 D1010          0.00C3010
 D1010          0.00C3010 D6000          0.00C4205
 D6000          0.00C4210 D6000          0.00C4215
 D1010   26847548.00C3010 D1010  191795120.00C3010
 D1010  723282368.00C3010 D6000   26847548.00C4005
 D6000  191795120.00C4010 D6000  723282368.00C4015
 D1010          0.00C3010 D1010          0.00C3010
 D1010          0.00C3010 D6000          0.00C4105
 D6000          0.00C4110 D6000          0.00C4115
YEAR      2  36
 D1010          0.00C3010 D1010          0.00C3010
 D1010          0.00C3010 D6000          0.00C4205
 D6000          0.00C4210 D6000          0.00C4215
 D1010   46668216.00C3010 D1010  234735776.00C3010
 D1010  791321408.00C3010 D6000   46668216.00C4005
 D6000  234735776.00C4010 D6000  791321408.00C4015
 D1010          0.00C3010 D1010          0.00C3010
 D1010          0.00C3010 D6000          0.00C4105
 D6000          0.00C4110 D6000          0.00C4115
YEAR      3  36
 D1010          0.00C3010 D1010          0.00C3010
 D1010          0.00C3010 D6000          0.00C4205
 D6000          0.00C4210 D6000          0.00C4215
 D1010   66922716.00C3010 D1010  278162560.00C3010
 D1010  858560640.00C3010 D6000   66922716.00C4005
 D6000  278162560.00C4010 D6000  858560640.00C4015
```

Figure 37. Continued.

ACCOUNTING SUBMODEL

Every organization has to make decisions on how to distribute its resources. Accounting is the process which aids these decisions by classifying, summarizing, and reporting business transactions in a systematic way such that management can interpret their effects on achieving the goals of the business. Two of the most important reports produced in conventional accounting are the Income Statement and the Balance Sheet.

The Income Statement is a summary of the "revenues" and "expenses" of the organization for a specific period of time (e.g. one year in this study). Revenues include cash flow into the organization from user fees for services provided by the organization. Expenses include cash flow out of the organization in payment to others for goods and services. The difference between revenues and expenses is defined to be Net Income. An example of an Income Statement is shown in Figure 38 for the first year of the project life. Revenues from user fees are classified by service: Water Supply, Navigation and Power. These are further subclassified by member state. Each item at this level of classification is referred to as an "account". For example, revenues received from Mali for Water Supply represent one account. Each account is assigned an identification number called an "account number." Figure 39 shows the list of all accounts, and associated account numbers, used in this study. From this figure, the account number for the example above is seen to be 4005. A manager can use the Income Statement to keep informed about the cash flow through the organization and to ascertain which of the accounts were the most active during the period.

The Balance Sheet is a statement of the financial condition of the organization at a specific point in time. The Balance Sheet accounts are the net balances at the end of a period (e.g. year), rather than the total for the period as in the Income Statement. Thus, Balance Sheet accounts accumulate from year to year and Income Statement accounts start with zero at the beginning of each year. The second page of Figure 38 shows the Balance Sheet at the end of the third year of the project.

The Balance Sheet gives the manager information about the organization's "assets". Assets include everything which belongs to the organization that has monetary value; for instance, cash, equipment, buildup, and other physical facilities. "Current Assets" are assets which can be converted into cash on short notice; such as bank accounts and short term investments. "Long-term Assets" are assets which cannot be converted into cash on short notice; such as buildings and dams. The manager must plan for sufficient current assets to offset anticipated cash expenses.

The Balance Sheet also tells the manager who owns the assets. The assets are either owned by the members of the organization (in this case the member states) or they are owned by someone outside the organization (in this case the co-financers) and loaned to the organizations. Assets

INCOME STATEMENT FOR YEAR ENDING 1 ALL VALUES IN 1979 CFA X 1.E9

	ANNUAL AMMOUNT		ACCUMULATED AMMOUNT	
REVENUE	1.244		1.244	
WATER SUPPLY REVENUES	0.879		0.879	
WATER SUPPLY MALI		0.025		0.025
WATER SUPPLY MAURITANIA		0.179		0.179
WATER SUPPLY SENEGAL		0.675		0.675
NAVIGATION REVENUES	0.000		0.000	
NAVIGATION MALI		0.000		0.000
NAVIGATION MAURITANIA		0.000		0.000
NAVIGATION SENEGAL		0.000		0.000
POWER REVENUES	0.000		0.000	
POWER MALI		0.000		0.000
POWER MAURITANIA		0.000		0.000
POWER SENEGAL		0.000		0.000
GRANT REVENUES	0.366		0.366	
GRANT RFA-A		0.041		0.041
GRANT FAC		0.150		0.150
GRANT CANADA		0.111		0.111
GRANT UNDP		0.064		0.064
OTHER REVENUES	0.000		0.000	
INTEREST INCOME		0.000		0.000
SINKING FUND INCOME		0.000		0.000
OTHER INCOME		0.000		0.000
EXPENSES	0.472		0.472	
CAPITAL EXPENSES	0.366		0.366	
MANATALI & DIAMA CAPITAL		0.366		0.366
POWER CAPITAL		0.000		0.000
NAVIGATION CAPITAL		0.000		0.000
OTHER CAPITAL		0.000		0.000
OPERATION AND MAINTENANCE	0.000		0.000	
MANATALI DAM O&M		0.000		0.000
DIAMA DAM O&M		0.000		0.000
POWER O&M		0.000		0.000
NAVIGATON O&M		0.000		0.000
OTHER O&M		0.000		0.000
FEES AND INTEREST ON LOANS	0.106		0.106	
ARABIE SAOUDITE		0.007		0.007
RFA-B		0.004		0.004
FAD		0.001		0.001
FED		0.006		0.006
KOWEIT		0.013		0.013

Figure 38. ACCOUNT.OUT

IQ		0.005	0.005
BID		0.004	0.004
IRAN		0.001	0.001
ABU DHABI		0.016	0.016
CAISSE CENTRALE		0.011	0.011
NIGERIA		0.002	0.002
ITALIE-B		0.003	0.003
BAD		0.012	0.012
ITALIE-A		0.021	0.021
CHARGES OTHER LOANS		0.000	0.000
ADMINISTRATIVE EXPENSES	0.000		0.000
OMVS ADMINISTRATION		0.000	0.000

NET INCOME FOR YEAR = 0.772

BALANCE SHEET ALL VALUES IN 1979 CFA X 1.E9

	PREVIOUS AMMOUNT	NET CHANGE	NEW BALANCE
ASSETS	0.000	5.818	5.818
CURRENT ASSETS	0.000	0.784	0.784
CASH I	0.000	0.012	0.012
CASH II	0.000	0.772	0.772
ACCOUNTS RECEIVABLE	0.000	0.000	0.000
GENERAL SHORT TERM	0.000	0.000	0.000
LONG-TERM ASSETS	0.000	5.034	5.034
MANATALI DAM CAPITAL	0.000	0.787	0.787
DIAMA DAM CAPITAL	0.000	4.247	4.247
POWER CAPITAL	0.000	0.000	0.000
NAVIGATION CAPITAL	0.000	0.000	0.000
OTHER CAPITAL	0.000	0.000	0.000
LIABILITIES	0.000	4.680	4.680
CURRENT LIABILITIES	0.000	0.000	0.000
GENERAL ACCNTS PAYABLE	0.000	0.000	0.000
LONG-TERM LIABLIITIES	0.000	4.680	4.680
ARABIE SAOUDITE	0.000	0.965	0.965
RFA-B	0.000	0.590	0.590
FAD	0.000	0.181	0.181
FED	0.000	0.648	0.648
KOWEIT	0.000	0.644	0.644
IQ	0.000	0.257	0.257
BID	0.000	0.129	0.129

Figure 38. Continued

IRAN			
ABU DHABI	0.000	0.026	0.026
CAISSE CENTRALE	0.000	0.451	0.451
NIGERIA	0.000	0.301	0.301
ITALIE-B	0.000	0.055	0.055
BAD	0.000	0.077	0.077
ITALIE-A	0.000	0.207	0.207
OTHER NOTES PAYABLE	0.000	0.151	0.151
	0.000	0.000	0.000
OMVS EQUITY	0.000	1.138	1.138
OMVS EQUITY	0.000	1.138	1.138
CAPITAL EQUITY	0.000	0.366	0.366
LIQUID EQUITY	0.000	0.772	0.772
RETAINED EARNINGS	0.000	0.000	0.000
NOTES PAYABLE	0.000	0.000	0.000

INCOME STATEMENT FOR YEAR ENDING 50 ALL VALUES IN 1979 CFA X 1.E9

REVENUE	ANNUAL AMMOUNT		ACCUMULATED AMMOUNT	
	39.516		1016.316	
WATER SUPPLY REVENUES	8.230		224.958	
WATER SUPPLY MALI		0.702		24.914
WATER SUPPLY MAURITANIA		2.911		73.063
WATER SUPPLY SENEGAL		4.617		126.981
NAVIGATION REVENUES	21.909		476.091	
NAVIGATION MALI		20.216		410.121
NAVIGATION MAURITANIA		0.755		37.708
NAVIGATION SENEGAL		0.938		28.262
POWER REVENUES	9.378		307.047	
POWER MALI		5.294		173.328
POWER MAURITANIA		0.000		0.000
POWER SENEGAL		4.084		133.719
GRANT REVENUES	0.000		8.220	
GRANT RFA-A		0.000		0.912
GRANT FAC		0.000		3.372
GRANT CANADA		0.000		2.489
GRANT UNDP		0.000		1.447
OTHER REVENUES	0.000		0.000	
INTEREST INCOME		0.000		0.000
SINKING FUND INCOME		0.000		0.000
OTHER INCOME		0.000		0.000

Figure 38. Continued

EXPENSES	13.732		472.390	
CAPITAL EXPENSES	9.143		282.320	
MANATALI & DIAMA CAPITAL		1.115		113.030
POWER CAPITAL		5.565		49.189
NAVIGATION CAPITAL		2.463		120.101
OTHER CAPITAL		0.000		0.000
OPERATION AND MAINTENANCE	4.581		156.487	
MANATALI DAM O&M		0.309		13.287
DIAMA DAM O&M		0.245		10.780
POWER O&M		0.994		35.292
NAVIGATON O&M		3.033		97.128
OTHER O&M		0.000		0.000
FEES AND INTEREST ON LOANS	0.008		33.583	
ARABIE SAOUDITE		0.004		4.323
RFA-B		0.003		2.643
FAD		0.001		0.810
FED		0.000		3.391
KOWEIT		0.000		4.068
IQ		0.000		2.105
BID		0.000		1.476
IRAN		0.000		0.239
ABU DHABI		0.000		3.878
CAISSE CENTRALE		0.000		3.705
NIGERIA		0.000		0.693
ITALIE-B		0.000		0.477
BAD		0.000		4.095
ITALIE-A		0.000		1.679
CHARGES OTHER LOANS		0.000		0.000
ADMINISTRATIVE EXPENSES	0.000		0.000	
OMVS ADMINISTRATION		0.000		0.000

NET INCOME FOR YEAR = 25.785

Figure 38. Continued

BALANCE SHEET ALL VALUES IN 1979 CFA X 1.E9

	PREVIOUS AMMOUNT	NET CHANGE	NEW BALANCE
ASSETS	792.873	33.813	826.686
CURRENT ASSETS	518.418	25.785	544.203
CASH I	0.277	0.000	0.277
CASH II	518.141	25.785	543.926
ACCOUNTS RECEIVABLE	0.000	0.000	0.000
GENERAL SHORT TERM	0.000	0.000	0.000
LONG-TERM ASSETS	274.455	8.028	282.483
MANATALI DAM CAPITAL	83.545	0.000	83.545
DIAMA DAM CAPITAL	29.648	0.000	29.648
POWER CAPITAL	43.624	5.565	49.189
NAVIGATION CAPITAL	117.638	2.463	120.101
OTHER CAPITAL	0.000	0.000	0.000
LIABILITIES	1.554	-1.115	0.440
CURRENT LIABILITIES	0.000	0.000	0.000
GENERAL ACCNTS PAYABLE	0.000	0.000	0.000
LONG-TERM LIABLIITIES	1.554	-1.115	0.440
ARABIE SAOUDITE	0.620	-0.620	0.000
RFA-B	0.379	-0.379	0.000
FAD	0.116	-0.116	0.000
FED	0.000	0.000	0.000
KOWEIT	0.000	0.000	0.000
IQ	0.000	0.000	0.000
BID	0.006	0.000	0.006
IRAN	0.004	0.000	0.004
ABU DHABI	0.072	0.000	0.072
CAISSE CENTRALE	0.000	0.000	0.000
NIGERIA	0.010	0.000	0.010
ITALIE-B	0.052	0.000	0.052
BAD	0.057	0.000	0.057
ITALIE-A	0.238	0.000	0.238
OTHER NOTES PAYABLE	0.000	0.000	0.000
OMVS EQUITY	791.319	34.928	826.246
OMVS EQUITY	791.319	34.928	826.246
CAPITAL EQUITY	273.178	9.143	282.320
LIQUID EQUITY	518.141	25.785	543.926
RETAINED EARNINGS	0.000	0.000	0.000
NOTES PAYABLE	0.000	0.000	0.000

Figure 38. Continued

```
1
THIS IS A SAMPLE LIST OF ACCOUNT NUMBERS WITH DESCRIPTION
1000  CURRENT ASSETS
1005  CASH I
1010  CASH II
1015  ACCOUNTS RECEIVABLE
1020  GENERAL SHORT TERM
1100  LONG-TERM ASSETS
1105  MANATALI DAM CAPITAL
1110  DIAMA DAM CAPITAL
1115  POWER CAPITAL
1120  NAVIGATION CAPITAL
1125  OTHER CAPITAL
2000  CURRENT LIABILITIES
2005  GENERAL ACCNTS PAYABLE
2100  LONG-TERM LIABLIITIES
2101  ARABIE SAOUDITE
2102  RFA-B
2103  FAD
2104  FED
2105  KOWEIT
2106  IQ
2107  BID
2108  IRAN
2109  ABU DHABI
2110  CAISSE CENTRALE
2111  NIGERIA
2112  ITALIE-B
2113  BAD
2114  ITALIE-A
2130  OTHER NOTES PAYABLE
3000  OMVS EQUITY
3005  CAPITAL EQUITY
3010  LIQUID EQUITY
3015  RETAINED EARNINGS
3020  NOTES PAYABLE
4000  WATER SUPPLY REVENUES
4005  WATER SUPPLY MALI
4010  WATER SUPPLY MAURITANIA
4015  WATER SUPPLY SENEGAL
4100  NAVIGATION REVENUES
4105  NAVIGATION MALI
4110  NAVIGATION MAURITANIA
4115  NAVIGATION SENEGAL
4200  POWER REVENUES
4205  POWER MALI
```

Figure 39. ACCOUN.PRE

4210	POWER MAURITANIA
4215	POWER SENEGAL
4300	GRANT REVENUES
4305	GRANT RFA-A
4306	GRANT FAC
4307	GRANT CANADA
4308	GRANT UNDP
4400	OTHER REVENUES
4405	INTEREST INCOME
4410	SINKING FUND INCOME
4415	OTHER INCOME
5000	CAPITAL EXPENSES
5005	MANATALI & DIAMA CAPITAL
5010	POWER CAPITAL
5015	NAVIGATION CAPITAL
5020	OTHER CAPITAL
5100	OPERATION AND MAINTENANCE
5105	MANATALI DAM O&M
5110	DIAMA DAM O&M
5115	POWER O&M
5120	NAVIGATON O&M
5125	OTHER O&M
5200	FEES AND INTEREST ON LOANS
5201	ARABIE SAOUDITE
5202	RFA-B
5203	FAD
5204	FED
5205	KOWEIT
5206	IQ
5207	BID
5208	IRAN
5209	ABU DHABI
5210	CAISSE CENTRALE
5211	NIGERIA
5212	ITALIE-B
5213	BAD
5214	ITALIE-A
5231	CHARGES OTHER LOANS
5300	ADMINISTRATIVE EXPENSES
5305	OMVS ADMINISTRATION

Figure 39. Continued

owned by the members of the organizations are called "Equity". Assets owned by others are called "Liabilities". Thus, the sum of Liabilities and Equity must always equal the assets:

ASSETS = LIABILITIES + EQUITY

This is referred to as the accounting equation for the Balance Sheet. Assets must always balance the sum of Liabilities and Equity. Any time an Asset is either added or deducted, it must also be added or deducted from Liabilities or Equity. Thus, two entries are required for each transaction affecting the Balance Sheet, one to the left-hand-side and one to the right-hand-side of the accounting equation. This system is referred to as double entry accounting. The accounts and associated account numbers for the Balance Sheet are listed in Figure 39. Accounts are provided to distinguish between Current Liabilities and Long-Term Liabilities. Accounts are also provided to distinguish between Liquid Equity and Capital Equity. Liquid Equity is usually associated with Current Assets and Capital Equity with Long-term Assets.

The conventional double entry accounting system described above was adopted for reporting the cash flow information calculated by the model. Although numerous other report formats could have been adopted, this one was chosen because of years of favorable experience by many top executives for most businesses in the United States. It has been proven to provide the financial information necessary to plan and manage revenue producing organizations.

The following section describes the accounting submodel. This submodel consists of two programs, PREACC.FTN and ACCOUN.FTN, and eight data files, ACCOUN.PRE, COST.DAT, REVENU.DAT, MLOAN.DAT, DLOAN.OUT, VALUE.DAT, ACCOUN.OUT, and SUMMAR.OUT. The purpose of the accounting submodel is to provide the user with detailed or summary output of the financial condition of the project. The functions of program PREACC.FTN are to collect and summarize the many accounts which come from various parts of the general model. This program will transfer output (VALUE.DAT) into the program ACCOUN.FTN to be organized into a summary table and into a Balance Sheet and Income Statement Format.

The Preaccount Program

The program PREACC.FTN is a preprocessor program that reads in data files containing account information from several sources and prepares a single file in a condensed format which is read by the program ACCOUN.FTN. All input data files, except one (ACCOUN.PRE) are prepared by other programs. The user, who is prompted by the program, needs only to enter the number of years of output which he wants to see displayed. All entries are converted to a credit, so that the accounting program does not have to read the credit or debit variables.

Preaccount data

PREACC.FTN reads five data files: ACCOUN.PRE, COST.DAT, REVENU.DAT, MLOAN.DAT, and DLOAN.DAT. The user is referred to the section on Costs, Revenues, and Loans for discussions of the data files other than ACCOUN.PRE.

Input data format for the PREACC.FTN Model

ACCOUN.PRE. This input data file (Figure 39) contains a sequential list of all the account numbers and account descriptions used in the accounting package. The first line contains the number of lines of comment, which is followed by the lines of comment. The rest of the file contains the four digit integer account number. All numbers are read in from ACCOUN.PRE by I4 Format. PREACC.FTN reads only the account number, while ACCOUN.FTN reads both account number and account description. The accounts must be listed in ascending numerical order. The user is referred to the following discussion on ACCOUN.FTN for a description of account number organization. The file reads one number per line until an end-of-file marker is read, then the program exits from the read loop.

COST.DAT, REVENU.DAT, MLOAN.DAT, and DLOAN.DAT. PREACC.FTN reads cost and revenue data from these four data files. Each file has been discussed previously in this manual. Since the same format is used for each of these data files only COST.DAT will be illustrated (Figure 40) and discussed below.

Line 1	Two integers free format number of lines of comment number of years of data First line of comment is to be a row filled with "*"'s to mark beginning of file.
Line 2 through Line 12	lines of comments
Line 13	NACC format (13X, I4) NACC = number of accounts to be read in
Line 15 through Line 21	NCORD(K1-1),ACCIN(K1-1),VALUE(K1/2) NCORD(K1),ACCIN(K1),K1-2,NACC,2 NCORD = debit or credit code ACC = account number VALUE = amount to be posted

The block containing lines 13 through 21 is repeated for each year of the project simulation. It is apparent from the format that values and account codes must be packed 2 VALUES per line. The only line that could contain 1 VALUE is the last one in each year.

```
LINE  1        12      50
LINE A1  ********************************************************************************
LINE  2  COST.DAT -- OUTPUT FROM COST PROGRAM
LINE  3 THESE YEARLY VALUES ARE NOT DISCOUNTED;RATE USED FOR CALCULATING DISCOUNTED TOTAL WAS 0.050
LINE  4  THE FOLLOWING INPUT FILES WERE USED
LINE  5 COSTD.PRE FINANCING SCHEDULE OF INFRASTRUCTURE, O AND M COSTS
LINE  6 COLUMNS HEADED WITH CAP ARE FOR CAPITAL EXPENSES
LINE  7 COLUMNS HEADED WITH OM ARE FOR OPERATION AND MAINTAINCE EXPENSES
LINE  8 M  MANATALI DAM      D DIAMA DAM     E ENERGY     N NAVIGATION
LINE  9 SUBTRACT ENE1 AND ENE2 FROM POWER BENEFITS AND ADD ENE1 AND ENE2 TO POWER COST
LINE 10 COST CALCUALTED BY ALLOCATION PROGRAM, ALSO ADD DIA1 ,DIA2 TO IRRIGATION
LINE 11 AND NAV1 AND NAV2 TO NAVIGATION COSTS; WITH DELAY; URBAN AND MINES ENERGY
LINE 12          CAPM     OMM      CAPD     OMD      CAPE     OME      CAPN     OMN
LINE 13 YEAR       1  32
LINE 14  D1105   787000000.00C1005 D3010            0.00C1010
LINE 15  D5105            0.00C6000 D1110  4247000000.00C1005
LINE 16  D3010            0.00C1010 D5110            0.00C6000
LINE 17  D1115            0.00C1010 D3010            0.00C3005
LINE 18  D5010            0.00C6000 D3010            0.00C1010
LINE 19  D5115            0.00C6000 D1120            0.00C1010
LINE 20  D3010            0.00C3005 D5015            0.00C6000
LINE 21  D3010            0.00C1010 D5120            0.00C6000
LINE 13 YEAR       2  32
LINE 14  D1105 15367000000.00C1005 D3010            0.00C1010
LINE 15  D5105            0.00C6000 D1110  7624000000.00C1005
LINE 16  D3010            0.00C1010 D5110            0.00C6000
LINE 17  D1115            0.00C1010 D3010            0.00C3005
LINE 18  D5010            0.00C6000 D3010            0.00C1010
LINE 19  D5115            0.00C6000 D1120            0.00C1010
LINE 20  D3010            0.00C3005 D5015            0.00C6000
LINE 21  D3010            0.00C1010 D5120            0.00C6000
```

Figure 40. COST.DAT

Operation of PREACC.FTN

This program merges and consolidates the financial information. PREACC.FTN first establishes a master array containing the account codes from reading data file ACCOUN.PRE. Then for each year, each of the remaining data files is read. The subroutine MERGE then is called to add the value given in each account to the balance in that account. After values from the last data file are read and added to the balances, the program calls Subroutine Output and prints out the list of accounts and balances. The master array of account values is then set to zero and data for the next year are processed.

Output from the PREACC.FTN Model

The PREACC.FTN model generates a table of output, VALUE.DAT (Figure 40). VALUE.DAT contains the account codes and amounts to be passed on to the accounting program. The user does not need to print or to edit the file. A portion of a sample VALUE.DAT file is given below with its format. At the end of each year the following line is printed to signal the end of the year:

```
0                    0.005
```

The first line contains the number of comment lines and the number of years of data. The next lines contain the comments. The accounts and amount to be posted are written in a I4,8PG15.2,A1 format.

Accounting Program (ACCOUN.FTN)

The program ACCOUN.FTN when used with the CAM model for application to the Senegal River Basin Development Model, provides a management tool for responding to anticipated income streams and capital development schedules. ACCOUN.FTN organizes revenue streams, expense streams, and capital development schedules into a conventional accounting format to provide the decision maker with both detailed and summary data derived from anticipated conditions.

The modeling of anticipated conditions makes the accounting program somewhat different from conventional accounting programs. Conventional accounting deals with the actuarial monitoring of completed transactions. Consequently, because they are based on past management decisions the accounting models provide enormous detail and near complete accuracy in the financial statements. The accounting need in the CAM model is for the systematic presentation of anticipated financial conditions. Thus, the focus is on planning rather than on monitoring. One immediate consequence of this shift in focus is that there is significantly less detail with which to work since the many management decisions which will affect financial conditions have not yet been made. Thus, the planning system deals with more general accounting information.

The ACCOUN.FTN program is, however, based on the conventional double entry account system which is summarized as follows:

ASSETS	= LIABILITIES	+	EQUITY
NET INCOME	= REVENUES	-	EXPENSES
CHANGE IN EQUITY	= NET INCOME	+	CAPITAL EXPENSES

INCREASE	ACCOUNT	DECREASE
debit	ASSET	credit
credit	LIABILITY	debit
credit	EQUITY	debit
credit	REVENUE	debit
debit	EXPENSE	credit

Every debit entry is accompanied by a credit entry and every credit entry is accompanied by a debit entry. This preserves the balance in the BALANCE SHEET and the monitoring of cash flows in the Income Statement. For the accounting portion of the model the financial transactions are divided into eight categories. For each category example transactions showing the appropriate accounts to debit and credit are given in Table 5. The balance in the Balance Sheet is always maintained by the appropriate double entries. The Income Statement is calculated separately from the Balance Sheet, so that transactions involving expenses or revenue accounts will be posted to three accounts.

The program ACCOUN.FTN formats the financial information of the project into two easy to read data files, SUMMAR.OUT and ACCOUN.OUT. The program reads two data files VALUE.DAT and ACCOUN.PRE. VALUE.DAT contains the list of accounts and amount of credit to that account (see the section on PREACC.FTN for a detailed discussion of the data file VALUE.DAT). ACCOUN.PRE contains the master list of accounts along with the description of each account.

Input data

The program ACCOUN.FTN reads two data files VALUE.DAT and ACCOUN.PRE. In addition to the two data files the user must enter interactively the total number of Income Statements and Balance Sheets derived, and the specific years for which output is desired. For example, if the user would like output for years 1 and 10, and then at 10 year intervals the user would enter 6 for the number of balance sheets and income statements desired and then enter 1, 10, 20, 30, 40, 50 (the six years for which output is requested). However, the data file SUMMAR.OUT contains the summary information for each year regardless of the output requested.

VALUE.DAT. ACCOUN.FTN reads the data file VALUE.DAT (Figure 41) to obtain the amounts to be posted to each account. The format used in VALUE.DAT is described in the PREACC.OUT portion of the manual. ACCOUN.FTN simply reads the value to be posted. The arrays to be filled with amounts are set up to ACCOUN.FTN when this program reads the data file ACCOUN.PRE. If accounts are not in the proper order in ACCOUN.PRE accounts will not be correctly posted. It is important to add accounts to ACCOUN.PRE in the proper position if additional accounts are added to VALUE.DAT. The credit or debit code is also not read by ACCOUN.PRE.

Table 4. Accounting transactions.

I.D. No.	Transaction	Submodel	BALANCE SHEET: ASSETS Dr (+)	ASSETS Cr (-)	LIABILITES Dr (-)	LIABILITES Cr (+)	EQUITY Dr (-)	EQUITY Cr (+)	INCOME STATEMENT: REVENUES Dr (-)	REVENUES Cr (+)	EXPENSES Dr (+)	EXPENSES Cr (-)
1	Purchase of Diama and Manantali dam capital (from loans only)	COST	1105 1110	1005								
2	Purchase of capital for navigation and energy (cash)	COST	1115 1120	1010			3010	3005			5010 5015	
3	O & M expenses	COST		1010			3010				51nn	
4	Draw on loans for Diama and Manantali capital	MLOAN DLOAN	1005			21nn						
5	Draw on grant for Diama and Manantali capital	MLOAN DLOAN	1005					3005		43nn	5005	
6	Interest payment on loans	MLOAN DLOAN		1010			3010				52nn	
7	Principal payment on loans	MLOAN DLOAN		1010	21nn		3010	3005			5005	
8	Revenues from user fees	REVENUE FEE	1010					3010		40nn 42nn		

Notes:
1. An account number ending in nn means that one of several account numbers in the range is appropriate.
2. A set of brackets indicates that any one of the account numbers is appropriate.

ASSETS = LIABILITIES + EQUITY
(change in EQUITY) = REVENUES - EXPENSES + CAPITAL EXPENSES

```
 93  50
 THE FOLLOWING DATA FILES WERE USED IN PROGRAM PREACC
 ----------------------------------------------------------------------------
 COST.DAT -- OUTPUT FROM COST PROGRAM
THESE YEARLY VALUES ARE NOT DISCOUNTED;RATE USED FOR CALCULATING DISCOUNTED TOTA
 THE FOLLOWING INPUT FILES WERE USED
COSTD.PRE FINANCING SCHEDULE OF INFRASTRUCTURE, O AND M COSTS
COLUMNS HEADED WITH CAP ARE FOR CAPITAL EXPENSES
COLUMNS HEADED WITH OM ARE FOR OPERATION AND MAINTAINCE EXPENSES
M  MANATALI DAM      D DIAMA DAM    E ENERGY    N NAVIGATION
SUBTRACT ENE1 AND ENE2 FROM POWER BENEFITS AND ADD ENE1 AND ENE2 TO POWER COST
COST CALCULATED BY ALLOCATION PROGRAM, ALSO ADD DIA1 ,DIA2 TO IRRIGATION
AND NAV1 AND NAV2 TO NAVIGATION COSTS; WITH DELAY; URBAN AND MINES ENERGY
        CAPM    OMM     CAPD    OMD     CAPE    OME     CAPN    OMN
 OUTPUT FROM REVENUE PROGRAM
 ----------------------------------------
 FEES.DAT FILE CREATED BY PROGRAM FEES
THIS FILE CREATED ON 4-MARCH-83
 ----------------------------------------------------------------------------
    FILE PWO.DAT OUTPUT FROM ENERGY BENEFIT PROGRAM
UNDISCOUNTED YEARLY QUANTITIES USED TO  CALCULATE REVENUE
 DISCOUNT RATE =   5.0000001E-02 ALTERNATIVE ENERGY COST    31.28000
 % MALI = 0.5645 % MAUR = 0.0000 % SENEGAL = 0.4355
 THE FOLLOWING INPUT FILE WERE USED IN ENGBEN
ENERGY.PRE    DATA FILE FOR POWER BENEFIT PROGRAM  BENPWR
THESE ARE THE VALUES USED BY DAVE BOWLES FOR REPORT 5
 MALI            MAURITANIA      SENEGAL          TOTAL
 ----------------------------------------------------------------------------
 AGO.DAT OUTPUT FROM AGBEN USED IN REVENUE

 OUTPUT FROM AREA.FTN USED AS INPUT FOR AGBEN
 VALUES OF OPTIONS USED FOR THIS RUN ARE
NEW DEVELOPMENT RATE   5000.TIME TO NEW DEVELOPMENT RATE   4.
 NUMBER OF YEARS BEFORE THE FLOOD   9.
 THE FOLLOWING VALUES WERE USED TO DISTRIBUTE HA DEVELOPED BETWEEN COUNTRIES
  INITIAL  MALI = .1666 MAUR .3436 SENEGAL .4898
 TOTAL POSSIBLE HA IN MALI =  23437.
 FINIAL  MAUR .4125 SENEGAL .5875
 INITIAL AREAS MALI    270. MAUR   5305. SENEGAL  23230.

                    AGRICULTURAL AREAS DATA TABLE
      YEAR        RATE        AI        ARD        ADD        AF      MALI    MAUR

       AGRICULTURAL ECONOMIC SECTOR DATA TABLE
VALUE OF OPTIONS ENTERED INTERACTIVELY ARE
DEVELOPMENT COST  3560000. REPLACEMENT COST   760000.TIME TO PUMP REPLACEMENT
 YEARLY WATER REQUIREMENTS
       MALI        MAURITANIA     SENEGAL          TOTAL
 ----------------------------------------------------------------------------
NAVO.DAT -- OUTPUT FROM NBEN USED IN REVENUE
THE FOLLOWING VALUES  FOR INTERACTIVE VARIABLES  WERE USED
DISCOUNT RATE 0.050 NUMBER OF YEARS    50AND THE FOLLOWING TARIFFS
RAIL= 14.50 TRUCKING PHOSPHATE= 28.80 TRUCK MALI= 27.70 TRUCK MAUR.= 38.40TRUCK

THE FOLLOWING INPUT FILES WERE USED
```

Figure 41. VALUE.DAT

```
 ..............................................................................
 OUTPUT FROM NVOL.FTN--NVOL.DAT FOR USE IN NBEN
   THE FOLLOWING INPUT FILES WERE USED

  NAVTAB.PRE INPUT FOR NVOL
  BREAKDOWN OF NAVIGATIONAL VOLUMES DATA

 OUTPUT FROM AREA.FTN USED AS INPUT FOR AGBEN
 VALUES OF OPTIONS USED FOR THIS RUN ARE
NEW DEVELOPMENT RATE   5000.TIME TO NEW DEVELOPMENT RATE   4.
 NUMBER OF YEARS BEFORE THE FLOOD   9.
 THE FOLLOWING VALUES WERE USED TO DISTRIBUTE HA DEVELOPED BETWEEN COUNTRIES
  INITIAL  MALI = .1666 MAUR .3436 SENEGAL .4898
 TOTAL POSSIBLE HA IN MALI =  23437.
 FINIAL  MAUR .4125 SENEGAL .5875
 INITIAL AREAS MALI    270. MAUR   5305. SENEGAL  23230.

                    AGRICULTURAL AREAS DATA TABLE
      YEAR        RATE        AI        ARD        ADD        AF      MALI   MAUR


 INTERACTIVE OPTION DELAY SET TO       5 YEARS
      YEAR    MIVOLO     MIVOLA     RVOL     MAVOLO    MAVOLA     PVOL     SEVOL
 ..............................................................................
 OUTPUT FORM NVOL DELAY.DAT FOR USE IN NBEN
  AGRICULTURAL VOLUMES DURING NAVIGATION DELAY
      YEAR       MALI   MAURITANIA  SENEGAL
  NAVIGATIONAL DELAY=   5 YEARS

  TOTAL YEARLY NAVIGATIONAL VOLUMES
       MALI        MAURITANIA       SENEGAL        TOTAL          YEAR
 ..............................................
 ACCOUNT OUTPUT FROM DLOAN.D DAM DISCOUNT RATE:  5.0000001E-02
 CONVERSION FACTOR USED EQUALS:     245
 ..............................................
 ..............................................
 ACCOUNT OUTPUT FROM MLOAN.M DAM DISCOUNT RATE:  5.0000001E-02
 CONVERSION FACTOR USED EQUALS:     245
 ..............................................
1000       0.00    C
1005 -12313807.E+00C
1010 -83514238.E+01C
1015       0.00    C
1020       0.00    C
1100       0.00    C
1105 -78700000.E+01C
1110 -42470000.E+02C
1115       0.00    C
1120       0.00    C
1125       0.00    C
2000       0.00    C
2005       0.00    C
2100       0.00    C
2101  96537043.E+01C
2102  59016335.E+01C
```

Figure 41. Continued

2103	18084613.E+01C
2104	64308550.E+01C
2105	64558042.E+01C
2106	25743215.E+01C
2107	12871607.E+01C
2108	25743214.E+00C
2109	45050611.E+01C
2110	30054209.E+01C
2111	54704329.E+00C
2112	77229635.E+00C
2113	20658352.E+01C
2114	15093182.E+01C
2130	0.00 C
3000	0.00 C
3005	36591324.E+01C
3010	83514238.E+01C
3015	0.00 C
3020	0.00 C
4000	0.00 C
4005	26847548.E+00C
4010	19179512.E+01C
4015	72328237.E+01C
4100	0.00 C
4105	0.00 C
4110	0.00 C
4115	0.00 C
4200	0.00 C
4205	0.00 C
4210	0.00 C
4215	0.00 C
4300	0.00 C
4305	40545572.E+00C
4306	14995422.E+01C
4307	11069583.E+01C
4308	64358045.E+00C
4400	0.00 C
4405	0.00 C
4410	0.00 C
4415	0.00 C
5000	0.00 C
5005	-35957525.E-02C
5010	0.00 C
5015	0.00 C
5020	0.00 C
5100	0.00 C
5105	0.00 C
5110	0.00 C
5115	0.00 C
5120	0.00 C
5125	0.00 C
5200	0.00 C
5201	-67575930.E-01C
5202	-41311435.E-01C
5203	-12659229.E-01C
5204	-64308547.E-01C

Figure 41. Continued

PREACC.FTN converts all values to credits. If values are added to VALUE.DAT, they must be treated as credits to that account.

ACCOUN.PRE. Figure 39 illustrates an example ACCOUN.PRE data file. The user must understand the organization of the data file and program before accounts can be added or deleted. The organization of the data file is described below. ACCOUN.PRE as in other input data files contains on line one the number of lines of comment, N. The next N lines contain comments read in by 80A1 format. Next are the 4 digit account codes and description of accounts. The descriptions and account codes are read using the following format:

FORMAT (I4,2X,8A4)

I4 is used to read the account code. 8A4 is used to read the account description. The account description written in the Balance Sheet and Income Statement is thus limited to 32 characters. The four digit account code locates the account into one of three levels. The first digit identifies the major division of accounts: 1) Asset, 2) Liability, 3) Equity, 4) Revenue, and 5) Expense. The next digit identifies a subdivision within the main divisions. The last two digits identify the account within the subdivision. The second and third levels of accounts are defined in the following paragraphs.

Before the user can add or delete files it is necessary to understand the organization of accounts and the method used to set up the account handling arrays within the program ACCOUN.FTN. Accounts are identified in the program by a three dimensional array, VALUE(I,J,K) where:

I is the major division of accounts

I = 1	for accounts 1000's	ASSET
I = 2	for accounts 2000's	LIABILITY
I = 3	for accounts 3000's	EQUITY
I = 4	for accounts 4000's	REVENUE
I = 5	for accounts 5000's	EXPENSE

J represents the subdivisions (hundreds) within one of the major divisions (thousands)
for example in the REVENUE division are the following major subdivisions:

J = 1	4000	WATER SUPPLY REVENUE
J = 2	4100	REVENUE NAVIGATION
J = 3	4200	REVENUES
J = 4	4300	REVENUES
J = 5	4400	OTHER REVENUES

K represents the divisions (ones and tens) within a major subdivision (for example in the REVENUE DIVISION NAVIGATION SUBDIVISION) are the following entries:

K = 1	4100	REVENUE NAVIGATION
K = 2	4105	REVENUE NAVIGATION MALI
K = 3	4110	REVENUE NAVIGATION MAURITANIA
K = 4	4115	REVENUE NAVIGATION SENEGAL

An additional source of REVENUE could be added to the accounting program by either of two ways: 1) including it under the 4400 heading 4420, which would represent account (4,5,4), or 2) create another major division J-6.

The accounting program calculates the sums of each major division and subdivision in the following manner: the sum of the navigation revenue is contained in element (4,2,1) 4100 and is equal to

$$(4,2,1) = \sum_{K=1}^{4} (4,2,K) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (26)$$

The sum of the revenue is represented by the variable SUMREV and is equal to

$$SUMREV = (4,J,1) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (27)$$

In a similar manner:

Source of assets $$SUMA = \sum_{J=1}^{J_1} (1,J,1) \quad \ldots\ldots\ldots (28)$$

Sum of liabilities $$SUML = \sum_{J=1}^{J_2} (2,J,1) \quad \ldots\ldots\ldots (29)$$

Sum of equity $$SUME = \sum_{J=1}^{J_3} (3,J,1) \quad \ldots\ldots\ldots (30)$$

Sum of revenue $$SUMREV = \sum_{J=1}^{J_4} (4,J,1) \quad \ldots\ldots\ldots (31)$$

Sum of expenses $$SUMEXP = \sum_{J=1}^{J_5} (5,J,1) \quad \ldots\ldots\ldots (32)$$

J_i = number of subdivisions in division i

Accounts can be added or deleted provided the proper account number is used and the account number and description is entered in sequence in the file ACCOUN.PRE. For the purpose of organizing the data to be printed in the file, SUMMAR.OUT, ACCOUN.FTN assumes the following financial information is located at specific array locations:

CASH I	VALUE (1,1,2)
CASH II	VALUE (1,1,3)
LIQUID ASSETS	BAL (1,1,1)

CAPITAL ASSETS	BAL (1,2,1)
LIQUID EQUITY	BAL (3,1,3)
CAPITAL EQUITY	BAL (3,1,2)

Output files

SUMMAR.OUT (Figure 42). The following information is given for each project year:

1. Change in liquid assets. This column shows the combined annual change in the two cash accounts: CASH I and CASH II. CASH I is the cash account used to post draws from loan and grants. Funds are then debited in the CASH I account to pay for Manantali and Diama capital expenses. CASH II is the cash account for all revenue other than from loans. CASH II is used to record payment of all expenses other than Manantali and Diama capital expenses.

2. Liquid assets. This column shows the accumulated liquid assets which is the same as the combined amounts in CASH I and CASH II from the Balance Sheet.

3. Capital assets. This column shows the amount of capital assets from the Balance Sheet. This includes the capital assets of all three service sectors.

4. Capital liabilities. This column shows the sum of the liabilities from the Balance Sheet. This is the total outstanding loan principal.

5. Liquid equity. This column shows the amount of liquid equity from the Balance Sheet. Liquid equity is the cash owned by OMVS.

6. Capital equity. This column shows the amount of capital equity from the Balance Sheet. Capital equity is the value of capital assets which now fall under the ownership of OMVS whether through the result of direct purchase from cash, or the complete payment of liability obligations.

ACCOUN.OUT

The file ACCOUN.OUT shown in Figure 38 contains detailed financial information provided by the model. The output is divided into two sections for each year, the Income Statement and the Balance Sheet. Figure 38 is the report for the first year of the project and the 50th year of the project.

1. Income statement. The income statements shown in Figure 38 contain the yearly and the accumulated cash flows of revenues and expenses. Revenues are the incomes generated by user fees for the three services: Water Supply, Navigation, and Power (Energy). Revenues from each member state are recorded separately for each service sector. Incomes from grants are also recorded as revenues.

Expenses include all of the costs of doing business. The Capital Expenses account records the payments made to acquire capital (for example Diama and Manantali Dams). The OPERATION and MAINTENANCE account records costs associated with the operation and maintenance of the capital facilities. The FEES AND INTEREST ON LOANS account records the costs of borrowing money.

DATA FILE SUMMAR.OUT
ALL VALUES IN 1979 CFA X 1.E9

YEAR	CHANGE IN LIQUID ASSETS	LIQUID ASSETS	CAPITAL ASSETS	CAPITAL LIABILITIES	LIQUID EQUITY	CAPITAL EQUITY
1	0.784	0.784	5.034	4.680	0.772	0.366
2	0.462	1.246	28.025	26.045	1.178	2.049
3	0.120	1.366	46.613	43.213	1.252	3.514
4	-6.701	-5.335	73.778	62.253	-5.500	11.690
5	-7.052	-12.388	103.005	83.154	-12.608	20.072
6	-1.776	-14.164	118.532	96.370	-14.421	22.420
7	-2.158	-16.321	126.538	102.384	-16.598	24.430
8	-12.538	-28.860	136.408	100.472	-29.137	36.213
9	-10.287	-39.147	144.013	98.371	-39.424	45.919
10	-8.752	-47.898	150.084	96.190	-48.175	54.170
11	-13.761	-61.659	157.810	92.091	-61.936	65.996
12	-13.124	-74.784	165.150	87.977	-75.060	77.449
13	-16.328	-91.111	179.106	83.921	-91.388	95.462
14	-14.324	-105.435	191.669	79.886	-105.712	112.060
15	-9.156	-114.591	200.546	75.889	-114.868	124.934
16	1.053	-113.538	202.241	71.889	-113.815	130.629
17	2.103	-111.435	204.339	67.842	-111.712	136.774
18	5.960	-105.475	205.649	63.701	-105.752	142.225
19	6.614	-98.861	207.104	59.461	-99.138	147.920
20	7.220	-91.641	208.766	55.120	-91.917	153.923
21	9.316	-82.324	210.091	51.493	-82.601	158.875
22	11.195	-71.129	210.754	47.846	-71.406	163.185
23	10.366	-60.763	213.404	44.120	-61.040	169.561
24	10.342	-50.421	217.117	40.312	-50.698	177.082
25	12.028	-38.393	220.442	36.418	-38.670	184.301
26	16.969	-21.424	221.357	34.486	-21.701	187.148
27	17.676	-3.748	222.313	32.565	-4.025	190.024
28	17.939	14.192	223.717	30.623	13.915	193.371
29	17.825	32.016	225.947	28.658	31.739	197.566
30	18.780	50.796	227.934	26.669	50.519	201.542
31	21.002	71.798	228.926	25.182	71.521	204.021
32	21.750	93.548	229.882	23.682	93.271	206.477
33	21.046	114.594	230.829	22.171	114.317	208.935
34	21.730	136.324	231.803	20.647	136.047	211.433
35	22.426	158.749	232.793	19.111	158.472	213.959
36	23.100	181.849	233.813	17.563	181.572	216.527
37	23.868	205.717	234.776	16.002	205.440	219.051
38	21.806	227.523	238.512	14.429	227.247	224.360
39	21.229	248.752	243.537	12.843	248.475	230.971

Figure 42. SUMMAR.OUT

40	22.473	271.225	248.029	11.244	270.948	237.062
41	25.600	296.825	250.110	10.197	296.548	240.189
42	26.944	323.769	251.558	9.143	323.492	242.692
43	27.687	351.455	252.974	8.082	351.178	245.169
44	28.396	379.851	254.393	7.013	379.574	247.657
45	28.882	408.733	255.850	5.936	408.456	250.191
46	29.540	438.273	257.338	4.852	437.996	252.763
47	30.308	468.582	258.754	3.761	468.305	255.270
48	24.967	493.548	266.208	2.661	493.272	263.824
49	24.870	518.418	274.455	1.554	518.141	273.178
50	25.785	544.203	282.483	0.440	543.926	282.320

Figure 42. Continued

Capital Expenses are not incurred against Capital Assets acquired through loans until payments are made on the loan principal. Grant income is credited to Grant Revenues; it is also shown as a Capital Expense when used to acquire capital facilities.

2. Balance Sheet. The Balance Sheet contains a yearly and an accumulated summary of the OMVS assets, liabilities, and equity. The Balance Sheet contains an annual and an accumulated summary of the OMVS assets, liabilities, and equity.

Assets are made up of Current Assets (liquid assets) and Long-term Assets (capital assets). Current Assets are tracked in two important accounts: CASH I and CASH II. Project cash flow is monitored by means of these two accounts. All transactions involving cash must be recorded in one or the other of these accounts. CASH I receives cash only from loan or grant draws for Diama and Manantali construction. Loan draws exactly meet construction costs each year and so the account balance should always be zero. The CASH II account is credited with all revenues from user fees and is used to pay all expenses except for the construction of Diama and Manantali Dams. The balance in the CASH II account represents OMVS cash on-hand. When the balance is positive it indicates that revenues have been sufficient to cover expenses. However, if the balance goes negative, it means that OMVS cannot meet its financial commitments.

Long-Term Assets (capital assets) record the acquisition of capital facilities (project infrastructure). The capital assets will grow as construction progresses.

Liabilities represent funds owed to others. Long-Term Liabilities include accounts for loans from each co-financier. These accounts monitor the outstanding principal for each loan.

Equity is the net worth of the project to OMVS at any given time. It is the worth that remains when outstanding liabilities have been subtracted from the total assets. Equity is made up of two important accounts: CAPITAL EQUITY and LIQUID EQUITY. Capital Equity is the value of capital assets which now fall under the ownership of OMVS through the results of direct purchase from cash, or the completed payment of liability obligations. Liquid Equity is the value of cash that is owned by OMVS.

Discussion of Selected Model Output

The purpose of this section is to discuss some of the output from the CAM model and point out potential uses of the model as a management tool. The model output is used to calculate the allocation of Diama and Manantali costs between member states. The accounting output is discussed briefly, pointing out important cash flow considerations.

Accounting Output. Figure 42 shows the summary of six important financial parameters over the 50 year project life. Under the assumptions of the demonstration run, a cash flow deficit will be

experienced during years 4 through 26 followed by a cash flow surplus during the remainder of the project life.

ACCOUN.OUT (Figure 38) shows the detailed financial condition of the project for a given year. Both annual values and summations are given. The user can control which years are printed out, so as few as one or as many as all 50 years can be printed out. The output for year 50 can be used to compare undiscounted costs with undiscounted revenues for each economic sector. The accumulated revenues (1008.339×10^9 CFAF) are more than twice the accumulated expenses (455.695×10^9 CFAF). If the discount rate and average of the loan rates were the same, the total current values of revenues and costs would be the same. Since the user fee is calculated from discounted costs using 5 percent, but the average interest charge is only about 2 percent, the current value of total revenues will exceed the current value of total costs at the end of the project repayment period.

Key Calculation

The calculation of the key is summarized in Table 5. Data needed to complete the Table can be obtained from the model output. The total discounted project costs shown in column 1 can be obtained from the data file KEY.OUT. The discounted cost of Diama Dam shown in column 2 can be obtained by adding the discounted capital cost found in data file DISSUM.OUT to the discounted loan costs found in data file DCOST.OUT. The percentage distribution of water supply among countries (also in column 2) can be found in data file KEY.OUT. The total discounted cost of energy and navigation shown in columns 3 and 4 respectively can be found in data file DISSUM.OUT; there are no loan costs because energy and navigation are financed directly from revenues (equity financing). The percentage distribution of energy and navigation among countries shown in columns 3 and 4 respectively can be found in data file KEY.OUT.

Table 5. Key calculation.

Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Col 7
Total cost by country	Specific cost for irrigation (Diama)	Specific cost for energy	Specific cost for navigation	Cost of Manantali	Proportion of Manantali allocated to each country	Key
$C1_i$	$CSI*C2_i$	$CSE*C3_i$	$CSN*C4_i$	$C1_i$-Col 2-Col 3-Col 4	Col 5/Sum Col 5	[Col 2+Col 5]/[Sum Col 2+Sum Col 5]

where:

$C1_i$ = total cost of project charged to all user sectors in country i (from KEY.OUT)

$C2_i$ = proportion of irrigation costs paid by country i (from KEY.OUT)

$C3_i$ = proportion of energy costs paid by country i (from KEY.OUT)

$C4_i$ = proportion of navigation costs paid by country i (from KEY.OUT)

CSI = specific cost for service irrigation

CSE = specific cost for energy

CSN = Specific cost for navigation

INCLUSION OF THE ENVIRONMENTAL COSTS INTO THE COST ALLOCATION OF THE SENEGAL RIVER DEVELOPMENT PROGRAM

Introduction

The principal objective of this effort involved the enhancement of the cost allocation model to include environmental costs. Three quantifiable environmental impacts resulting from the Senegal River Development Program were identified in the Gannett-Fleming Environmental Impact Assessment (1979): 1) cost of resettlement, 2) cost of lost fish production, and 3) cost of lost forest production. Computer subprograms were written in FORTRAN to link these environmental impacts to the development rates used in the original cost allocation model. These subprograms are compatible with the overall model structure, and their relationship to the other subprograms is shown in Figure 1. The environmental costs may or may not be included in a cost allocation assessment, at the option of the user. The computer subprograms may be used to calculate the costs of the environmental disruptions. The calculated environmental costs are included in the cost allocation and a benefit/cost analysis. The output data files are not read by any of the programs previously described in CAM. To incorporate the results of the environmental progams into CAM, the user must edit the file ALLOCA.DAT and then run the program ALLOCA.FTN. Results from the environmental programs must be added to the total cost of the appropriate service sector.

The combined economic-environmental model was run using data from the AREA.FTN program discussed previously in this report and from the Gannett-Fleming Environmental Impact Assessment (1979). The inclusion of quantified environmental impacts such as fish and forest products did not significantly change the benefit/cost analysis for the Senegal River Basin project. The inclusion did result in a minor change (maximum change 1.3 percent in one service sector) in the cost allocation. Including the environmental costs as a disbenefit to agriculture reduced agriculture benefits below the alternate cost to agriculture. The model indicates that the agricultural sector of the project is sensitive to the inclusion of the environmental costs. The sensitivity of agriculture indicates that careful management and monitoring will be needed if the project is to succeed. All potential environmental disruptions identified by Gannett-Fleming (1979) are not quantifiable at this time. Gannett-Fleming (1979) identified potential environmental problems such as increased disease vectors, water treatment, and waste disposal problems which might develop. Further study and constant monitoring of environmental disruptions are needed to prevent these potential problems from having a negative impact on the welfare of the people in the basin. Further discussion regarding environmental costs are included in Report 6 (USU 1984).

Description of Programs

Three computer programs were written in FORTRAN 4 computer language linking the economic model and environmental impacts. These three programs are called:

1. FLOOD.FTN
2. FISH2.FTN
3. FOREST.FTN

Program FLOOD.FTN calculates the area in the floodplain inundated by the annual flood. FISH2.FTN calculates the value of disrupted fish production. FOREST.FTN calculates the value of disrupted forest production. Both forest and fish production are linked to the size of the annual flood and the size of the area irrigated. Forest growth is enhanced by the annual flood. Fish utilize the inundated floodplain for feeding and spawning. The Gannett-Fleming Environmental Assessment (1979) discusses the relationship between the size of annual flood and fish and forest production in greater detail. The input files and output files of the three programs are discussed below.

FLOOD.FTN

The FORTRAN program FLOOD.FTN calculates the size of the area to be flooded in the river basin. The difference between the size of the area flooded without the project and the size of the area flood with the project is calculated for each year. A flow chart summarizing the program is given in Figure 43. The program reads from two input files and writes to one output file. No interactive input is required. Results from the program are in close agreement with the tables given in Gannett-Fleming (1979) Tables 1-3 in Appendix D.

The program is based on data and the assumptions given in the River and Estuary report (Gannett-Fleming 1979) which relate development schemes to size of areas flooded in the basin. The average area flooded without the project is 550,000 ha. This value is used as the base to calculate production without the project. Table A2 in Appendix D (Gannett-Fleming 1979) provides the maximum area flooded by the artificial flood and the maximum area flooded by the project without artificial flood. The maximum area flooded for three different development schemes are:

1. Without project control 550,000 ha.
2. With project artificial flood 380,000 ha.
3. With project control and without artificial flood 230,000 ha.

The program calculates the area flooded in the basin by first determining from the data file (AREA.DAT) the current level of development. The maximum area flooded for that scheme is then used as the maximum possible value. The program then subtracts from this maximum value the developed recession area (obtained from data file AREA.DAT). The development of irrigation perimeters involves construction of canals and diking to protect the area from flooding. The assumption is made that once an area is developed it will not be flooded. The displaced recession area is subtracted from the maximum potential flooded value for that given scheme. Only the developed recession area is subtracted from the maximum. The development of rain-fed areas will not reduce the area flooded in the basin. Rain-fed areas are outside the floodplain and will not obstruct flood flow.

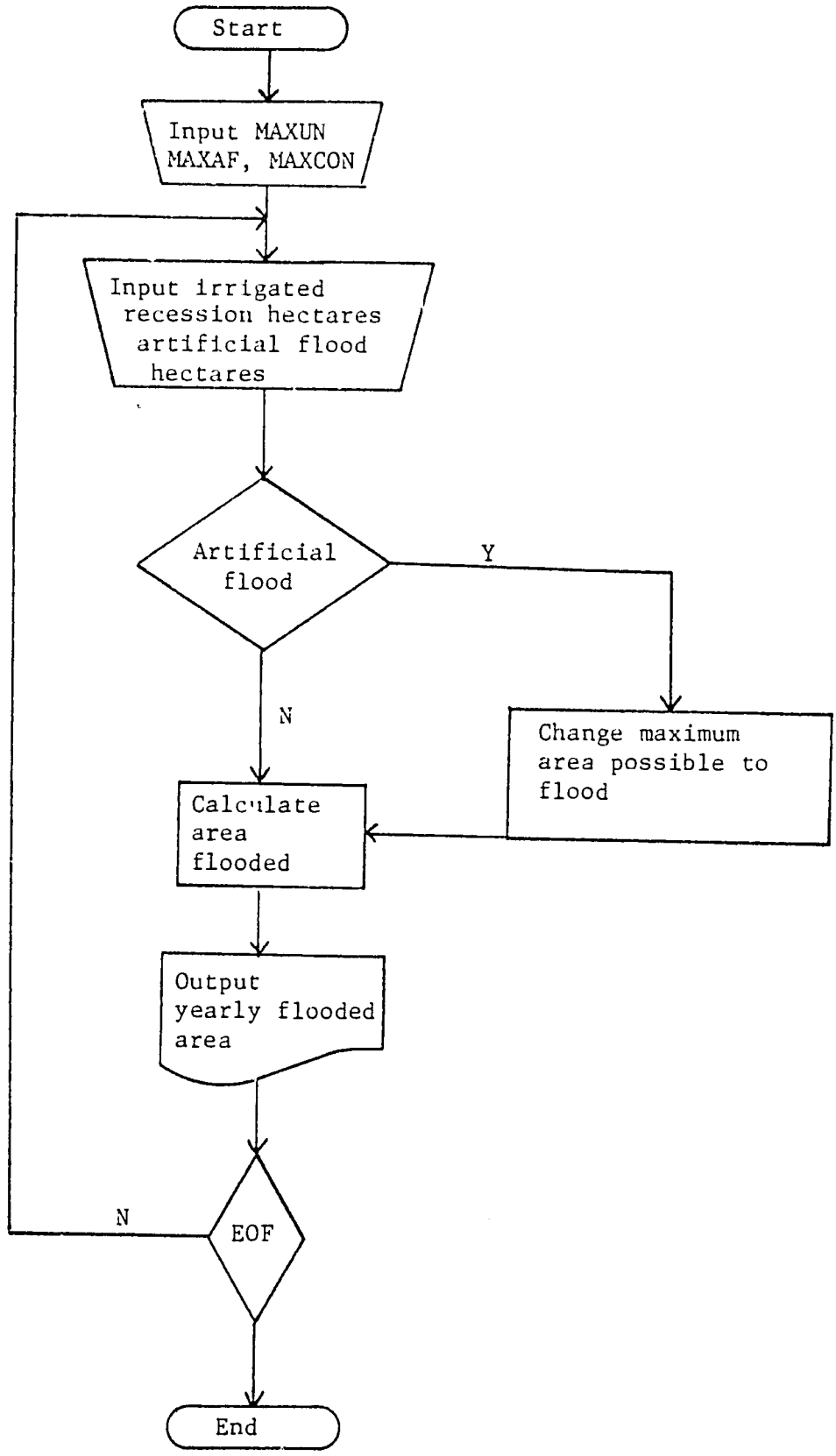

Figure 43. Flow chart for FLOOD.FTN.

The basic equations used in the program FLOOD.FTN are as follows:

$AREA=MAX_I$ .....(33)

FLOOD=AREA-ARD .....(34)

DIFF=ARD-ARDI .....(35)

FLOOD=AREA-DIFF .....(36)

where

AREA = current maximum possible area flooded
MAX_I = maximum possible area for given development scheme, I = 1 to 3
ARD = area of recession farms developed into irrigated perimeters by project
FLOOD = area flooded in floodplain
ARDI = area of recession farms developed into irrigated perimeters at the end of the artifical flood
DIFF = displaced recession area after end of artificial flood

Input files

Two data files are read by the program FLOOD.FTN: AREA.DAT and FLOOD.IN. AREA.DAT contains irrigation project development data. The presence and size of artificial flood is given in AREA.DAT. Also used from the data file is the displaced recession farming area. The data file used for this model run is given in Figure 6a (of Agriculture Section). The file AREA.DAT is generated by the program AREA.FTN and is described in detail in the CAM Agricultural Section of this report.

The second input file is FLOOD.IN. The file contains the maximum area flooded for each of the three development schemes. The three development schemes are: 1) without project control; 2) with project control and artificial flood, and 3) with project control without artificial flood. The input file used for this run is given in Figure 44.

```
1
flood.in  input file for flood.ftn MAXUN MAXAF MAXCON
550000.0
380000.0
230000.0
```

Figure 44. Input data file FLOOD.IN.

The first line of the file contains the number of lines (NL), of text used to identify the file. The next NL lines contain text identifying the data file. The next three lines contain real numbers to

be read in using free format (one value per line). The three numbers in sequence are:

1. MAXUN maximum area without project control.

2. MAXAF maximum area with project control and with artificial flood.

3. MAXCON maximum area with project control and without artificial flood.

Output file

The data file FLOOD.OUT contains the results of the program FLOOD.FTN. The results obtained for this run of the model are given in Figure 45. The file contains the assumptions and identifying text from the AREA.DAT file and the input from the file FLOOD.IN. The results of the program are contained in 7 columns after the echo of the input. The file contains from left to right: year since beginning of the project development rate, total irrigated area displaced recession area, area of artificial flood, potential area flooded, and area flooded. The format used in the file is given in Figure 46.

FISH2.FTN

The FORTRAN program FISH2.FTN calculates the discounted cost of lost fish production in the Senegal River Basin. Fish production is predicted to be reduced by the Senegal Basin Project (Gannett-Fleming 1979). Lower fish production is expected in the river and in the estuary at the mouth of the river. Fish production in the river will be reduced because of a reduction in area flooded due to irrigation perimeter development and reduced flood flows. Fish use the flooded area of the basin for spawning and feeding. When the river returns to its banks, the fish return to the main river channel (Fisheries). The project will control the flow in the Senegal River, reducing the size of the annual flood. The reduced annual floods will inundate less of the floodplain resulting in less fish habitat and food. The production of fish is enhanced by access to nutrients found on the floodplains. Fish production will be reduced in the ocean and the river mouth by the construction of Diama Dam. Some salt water fish and crustacean species presently enter the lower section of the river to spawn and feed. The construction of Diama Dam is expected to have a negative impact on these species. Diama Dam will reduce the size of the estuary and limit the movement of anadromus species. Two input files are read and results are written to one output file.

Not all impacts of the project on fish production will be negative. Increased production is expected in the depressions, which will receive water. The following depressions currently receive water sporadically: Lac de Guiers, Aftut es Sahel, and Lac R'Kiz. In some years enough water flows into the depressions to support fish growth. In other years insufficient water is available to support any fish life. The project will stabilize the flow into these depressions, creating a more dependable fishery. Additional fish production will

FLOOD.OUT output file from program FLOOD.FTN
MAXUN = MAXIMUM AREA FLOODED WITHOUT PROJECT
MAXAF = MAXIMUM AREA FLOODED WITH ARTIFICAL FLOOD
MAXCON = MAXIMUM AREA FLOODED UNDER CONTROL OF MANANTALI
550000. = MAXUN 380000. = MAXAF 230000. = MAXCON

YEAR	*IRR DEV* RATE	*IRR Ha* TOTAL	*DISPLACED* RECESSION	*ARTIFICIAL* FLOOD	*POTENTIAL* FLOODED	*FLOODED* Ha
1	0.	28805.	0.	0.	550000.	550000.
2	4000.	32805.	4000.	0.	550000.	546000.
3	4000.	36805.	8000.	0.	550000.	542000.
4	4000.	40805.	12000.	0.	550000.	538000.
5	4000.	44805.	16000.	0.	550000.	534000.
6	5000.	49805.	21000.	0.	550000.	529000.
7	5000.	54805.	26000.	0.	550000.	524000.
8	5000.	59805.	31000.	0.	550000.	519000.
9	5000.	64805.	36000.	0.	550000.	514000.
10	5000.	69805.	41000.	20195.	380000.	339000.
11	5000.	74805.	46000.	15195.	380000.	334000.
12	5000.	79805.	51000.	10195.	380000.	329000.
13	5000.	84805.	56000.	5195.	380000.	324000.
14	5000.	89805.	61000.	195.	380000.	319000.
14	5000.	94805.	66000.	0.	230000.	230000.
15	5000.	99805.	71000.	0.	230000.	225000.
16	5000.	104805.	76000.	0.	230000.	220000.
17	5000.	109805.	81000.	0.	230000.	215000.
18	5000.	114805.	86000.	0.	230000.	210000.
19	5000.	119805.	91000.	0.	230000.	205000.
20	5000.	124805.	96000.	0.	230000.	200000.
21	5000.	129805.	101000.	0.	230000.	195000.
22	5000.	134805.	106000.	0.	230000.	190000.
23	5000.	139805.	108633.	0.	230000.	187367.
24	5000.	144805.	108633.	0.	230000.	187367.
25	5000.	149805.	108633.	0.	230000.	187367.
26	5000.	154805.	108633.	0.	230000.	187367.
27	5000.	159805.	108633.	0.	230000.	187367.
28	5000.	164805.	108633.	0.	230000.	187367.
29	5000.	169805.	108633.	0.	230000.	187367.
30	5000.	174805.	108633.	0.	230000.	187367.
31	5000.	179805.	108633.	0.	230000.	187367.
32	5000.	184805.	108633.	0.	230000.	187367.
33	5000.	189805.	108633.	0.	230000.	187367.
34	5000.	194805.	108633.	0.	230000.	187367.
35	5000.	199805.	108633.	0.	230000.	187367.
36	5000.	204805.	108633.	0.	230000.	187367.
37	5000.	209805.	108633.	0.	230000.	187367.
38	5000.	214805.	108633.	0.	230000.	187367.
39	5000.	219805.	108633.	0.	230000.	187367.
40	5000.	224805.	108633.	0.	230000.	187367.
41	5000.	229805.	108633.	0.	230000.	187367.
42	5000.	234805.	108633.	0.	230000.	187367.
43	5000.	239805.	108633.	0.	230000.	187367.
44	5000.	244805.	108633.	0.	230000.	187367.
45	5000.	249805.	108633.	0.	230000.	187367.
46	5000.	254805.	108633.	0.	230000.	187367.
47	5000.	259805.	108633.	0.	230000.	187367.
48	5000.	264805.	108633.	0.	230000.	187367.
49	5000.	269805.	108633.	0.	230000.	187367.
50	5000.	274805.	108633.	0.	230000.	187367.

Figure 45. FLOOD.OUT.

VARIABLE	FORMAT	
NL	INTEGER FREE FORMAT	number of lines of text
ITEXT	character 80A1	text containing assumptions and column headings

I, RATE, AI, ARD, AF, AREA, FLOOD
(I4, 1X, 6(F11.0)

VARIABLE DESCRIPTION

AF = AREA artifical FLOOD
AI = TOTAL IRRIGATED AREA
ARD = AREA OF DISPLACED RECESSION FARMING
AREA = POTENTIAL AREA FLOODED GIVEN PROJECT DEVELOPMENT LEVEL
FLOOD = AREA FLOODED, AREA AVAILABLE FOR FISH OR FOREST PRODUCTION
I = NUMBER OF YEARS SINCE BEGINING OF PROJECT
ITEXT = INFORMATION FROM INPUT FILE
NL = NUMBER OF LINES OF TEXT FROM INPUT FILE

Figure 46. Format for file FLOOD.OUT.

become available behind the impoundments. The impoundments behind Manantali Dam and Diama Dam will increase the volume of water available for fish production in those areas.

The calculation of the project's cost to fish production is based on production rates, prices and assumptions from the Fisheries Report (Gannett-Fleming 1979). A flow chart for program "FISH2.FTN" is given in Figure 47. Calculations are separated into two categories:

1. In the first category gains and losses are independent of development rates. Gains and losses in this category are associated with dams, impoundments and the recharge of depressions. Diama Dam will reduce the size of the estuary and prevent the free movement of fish and crustaceans from the coastal water into the river. The expected loss due to Diama Dam is 10,000 kg/year (Gannett-Fleming 1979). In the Fisheries Report (Gannett-Fleming 1979), the yearly production rates of fisheries are given per ha for the flooded river basin and irrigated perimeters. Also the yearly production rates are given per Dams for Lac de Guiers, Aftout es Sahl, Lac R'Kiz and impoundments behind Diama and Manantali (1979). Fish production in the impoundment behind Diama is counted in the floodplain fishery. Values used in this model run are given in Figure 48. In the input data file FISH2.IN Equation 37 is used to calculate the discounted cost to fish production in category 1:

$$SUMCT_I = DIS*COL_I*PRIE+SUMCT_{I-1} \quad (37)$$

where

$SUMCT_I$ = discounted sum for gain or loss for category 1 type (depressions, impoundments, and estuary) I = 1 to 5
DIS = discount factor for given year
DIS = (1/(1+RATE))**(Y-1)
RATE = discount rate (5 percent) in Report 5 (USU 1984)
Y = year since beginning of project
COL_I = fish gain or loss in kg/year for Ith column (see Figure 48 input data file FISH2.IN).

2. For the second category gain and losses in fish production are a function of area flooded and irrigated perimeters. The lost fish production in the floodplain is calculated by Equations 38 and 39:

FLOSS=RFLOOD*(MAXUN-FLOOD).....(38)

SUMFT=SUMFT+FLOSS*DIS*PRICE.....(39)

where

FLOSS = lost fish production in flooded area lost due to flow regulation
MAXUN = maximum potential area flooded
FLOOD = calculated area flooded from program FLOOD.FTN
RFLOOD = production rate for floodplain area
SUMFT = sum of discounted lost production in floodplain
DIS = discount factor
PRICE = value of fish in cfa/kg

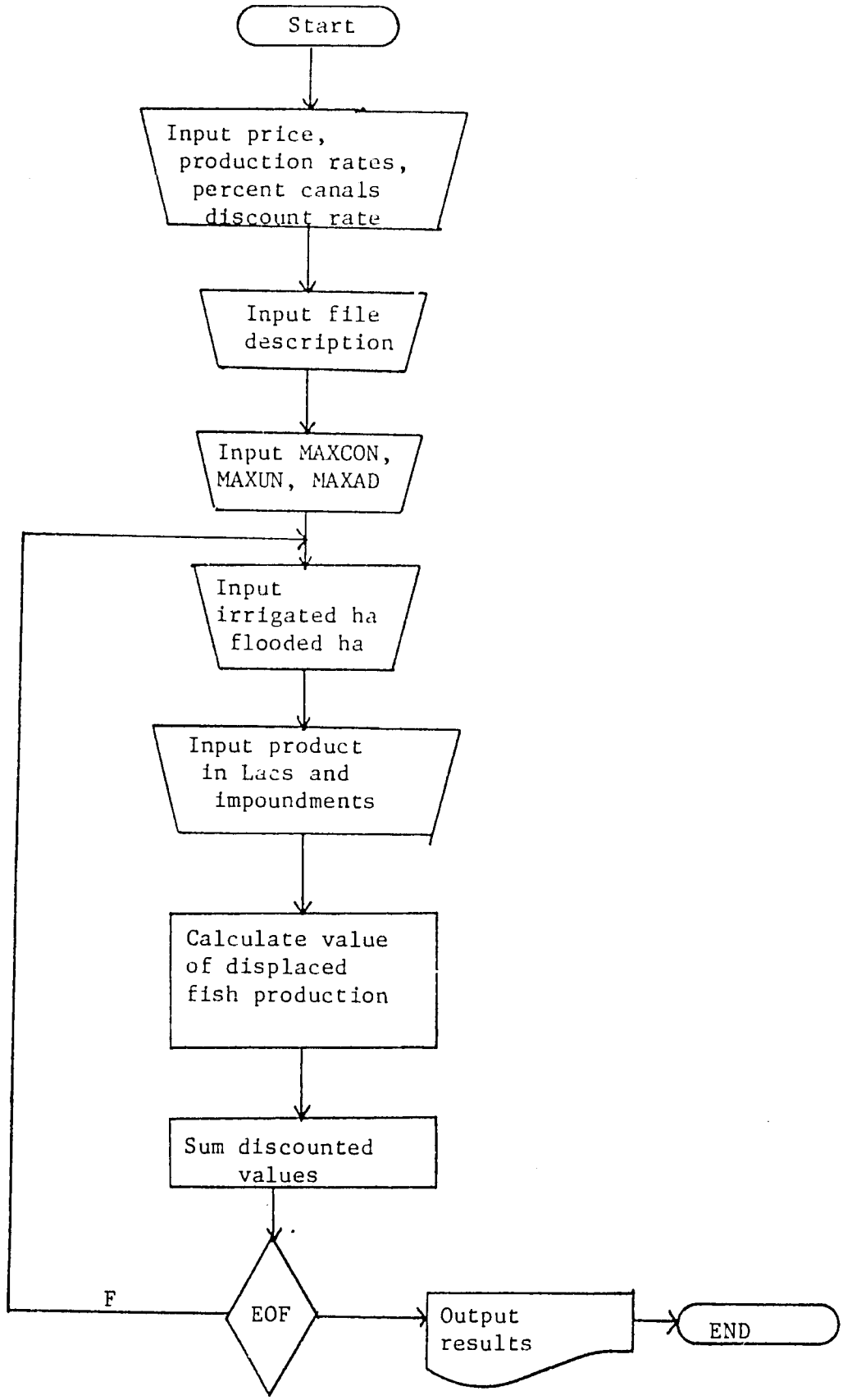

Figure 47. Flow chart for FISH2.FTN.

```
50.,0.05,-65.,15.,0.10,5
1
comments on input   FILE   FISH2.IN
col 1 Diama Dam loss in estuary
col 2, Lac de Giers gain
col 3 Lac R'Kiz
col 4 Aftout es Sahel gain
col 5 Manantali impoundment gain
1          0.0          0.0          0.0          0.0          0.0
2          0.0          0.0          0.0          0.0          0.0
3          0.0          0.0          0.0          0.0          0.0
4          0.0          0.0          0.0          0.0          0.0
5     -10000.0E3        0.0          0.0          0.0          0.0
6     -10000.0E3        0.0          0.0          0.0          0.0
7     -10000.0E3        0.0          0.0          0.0          0.0
8     -10000.0E3     500.0E3         0.0          0.0          0.0
9     -10000.0e3     500.0e3         0.0          0.0       2100.0E3
10    -10000.0e3     500.0e3       720.0e3     3000.0E3     2800.0E3
11    -10000.0e3     500.0e3       960.0e3     4000.0E3     3500.0E3
12    -10000.0e3     500.0e3      1200.0e3     5000.0E3     4025.0E3
13    -10000.0e3     500.0e3       960.0e3     4000.0E3     4375.0E3
14    -10000.0e3     500.0e3       720.0e3     3000.0E3     4025.0E3
15    -10000.0e3     500.0e3       720.0e3     3000.0E3     3500.0E3
16    -10000.0e3     500.0e3       720.0e3     3000.0E3     2100.0E3
17    -10000.0e3     500.0e3       720.0e3     3000.0E3     2100.0E3
18    -10000.0e3     500.0e3       720.0e3     3000.0E3     2100.0E3
19    -10000.0e3     500.0e3       720.0e3     3000.0E3     2100.0E3
20    -10000.0e3     500.0e3       720.0e3     3000.0E3     2100.0E3
21    -10000.0e3     500.0e3       720.0e3     3000.0E3     2100.0E3
22    -10000.0e3     500.0e3       720.0e3     3000.0E3     2100.0E3
23    -10000.0e3     500.0e3       720.0e3     3000.0E3     2100.0E3
24    -10000.0e3     500.0e3       720.0e3     3000.0E3     2100.0E3
25    -10000.0e3     500.0e3       720.0e3     3000.0E3     2100.0E3
26    -10000.0e3     500.0e3       720.0e3     3000.0E3     2100.0E3
27    -10000.0e3     500.0e3       720.0e3     3000.0E3     2100.0E3
28    -10000.0e3     500.0e3       720.0e3     3000.0E3     2100.0E3
29    -10000.0e3     500.0e3       720.0e3     3000.0E3     2100.0E3
30    -10000.0e3     500.0e3       720.0e3     3000.0E3     2100.0E3
31    -10000.0e3     500.0e3       720.0e3     3000.0E3     2100.0E3
32    -10000.0e3     500.0e3       720.0e3     3000.0E3     2100.0E3
33    -10000.0e3     500.0e3       720.0e3     3000.0E3     2100.0E3
34    -10000.0e3     500.0e3       720.0e3     3000.0E3     2100.0E3
35    -10000.0e3     500.0e3       720.0e3     3000.0E3     2100.0E3
36    -10000.0e3     500.0e3       720.0e3     3000.0E3     2100.0E3
37    -10000.0e3     500.0e3       720.0e3     3000.0E3     2100.0E3
38    -10000.0e3     500.0e3       720.0e3     3000.0E3     2100.0E3
39    -10000.0e3     500.0e3       720.0e3     3000.0E3     2100.0E3
40    -10000.0e3     500.0e3       720.0e3     3000.0E3     2100.0E3
41    -10000.0e3     500.0e3       720.0e3     3000.0E3     2100.0E3
42    -10000.0e3     500.0e3       720.0e3     3000.0E3     2100.0E3
43    -10000.0e3     500.0e3       720.0e3     3000.0E3     2100.0E3
44    -10000.0e3     500.0e3       720.0e3     3000.0E3     2100.0E3
45    -10000.0e3     500.0e3       720.0e3     3000.0E3     2100.0E3
46    -10000.0e3     500.0e3       720.0e3     3000.0E3     2100.0E3
47    -10000.0e3     500.0e3       720.0e3     3000.0E3     2100.0E3
48    -10000.0e3     500.0e3       720.0e3     3000.0E3     2100.0E3
49    -10000.0e3     500.0e3       720.0e3     3000.0E3     2100.0E3
50    -10000.0e3     500.0e3       720.0e3     3000.0E3     2100.0E3
```

Figure 48. Input data file FISH2.IN.

The irrigation canals will also support fish production. Production in the canals is a function of area irrigated. The assumption was made that 10 percent of the area developed would represent canals. Production in the canals is calculated by Equation 40:

CANALP=RIRR*PCANAL*(AI-AIIN).....(40)

where

CANALP = fish production gain due to canals
RIRR = fish production rate for canals
PCANAL = percent of irrigated development which is canals
AI = irrigated hectares
AIIN = irrigated hectares at the beginning of the project

Undiscounted yearly production totals and discounted values are kept for each column, floodplain and canals.

Production rates can represent either losses or gains. Losses in fish production are due to the reduction in area flooded and estuary losses. Reduced flooding is caused by controlling the release of water at Manantali and irrigated perimeter development on the flood plain. The loss in the estuary is caused by Diama Dam. Diama Dam will block salt water intrusion, thus reducing the size of the estuary. Also Diama Dam will block the movement of fish and shellfish up and down the river. Gains in fish production are due to the stabilization of recharge to three large depressions (Lac de Guiers, Aftout es Sahel, Lac R'Kiz) and creation of impoundments behind Diama and Manantali Dams.

Input files FLOOD.OUT and FISH2.IN

Two input files are read by program FISH2.FTN: FLOOD.OUT and FISH2.IN. FLOOD.OUT contains the irrigated area, maximum area flooded and areas flooded by the project. Values are given for each year of the project. The program will read in the data file until an end of file marker is reached. FLOOD.OUT is discussed above in the FLOOD.FTN section. An example FISH2.IN data file is given in Figure 48. The data is from the Fisheries Report (Gannett-Fleming 1979). The format is given in Figure 49.

Output file FISH2.OUT

Data file FISH2.OUT contains the discounted cost of loss fish production and an echo of input data. An example FISH2.UT file is given in Figure 50.

Program FOREST.FTN

The FORTRAN IV program (FOREST.FTN) calculates the cost of lost forest production due to the SRBV project. A flow chart for program FOREST.FTN is given in Figure 51. Forest growth in the Senegal River Basin is a function of water and nutrient availability. Forests on the floodplains are dependent upon water and nutrients from the Senegal River. Forest production in the basin is enhanced by the deposition of nutrients and water during the annual flood (Gannett-Fleming 1979). The

```
Line 1     PRICE,RATE,RFLOOD,RIRR,PCANAL,NCOL free format,5 reals, 1
           integer
Line 2     NL                          free format, 1 integer
Line 3     ITEXT                            40A2
Line 4     NAME                        40a1
LINE 5     IYEAR,(COL(I),I=1,NCOL)                free format,1 integer,
           NCOL reals
```

where:

```
AI     = AREA IRRIGATED
AIIN   = INITIAL IRRIGATED AREA
CANALP = PRODUCTION FROM IRRIGATION CANALS
COL    = PRODUCTION RATES EITHER LOSSES OR GAINS
FLOSS  = FLOODED AREA LOST DUE TO FLOW REGULATION
FLOOD  = AREA FLOODED
ITEXT  = TEXT IDENTIFYING INPUT FILE
IYEAR  = YEAR SINCE BEGINING OF PROJECT
MAXAF  = MAXIMUM AREA FLOODED WITH artifical FLOOD
MAXCON = MAXIMUM AREA FLOODED UNDER CONTROL OF MANANTALI
MAXUN  = MAXIMUM AREA FLOODED WITHOUT PROJECT
NAME   = DESCRIPTION OF SOUCE OF GAIN OR LOSS FOR COLUMNS
NCOL   = NUMBER OF COLUMNS OF PRODUCTION OR LOSS RATES
NL     = NUMBER OF LINES OF TEXT TO READ IN
PCANAL = PERCENT OF IRRIGATED AREA WHICH ARE CANALS
PRICE  = PRICE FOR UNIT WEIGHT OF FISH
RATE   = DISCOUNT RATE
RFLOOD = PRODUCTION RATE FOR RIVER FLOODPLAINS
RIRR   = PRODUCTION RATE FOR CANALS
SUMA   = SUM OF GAINS AND LOSSES FROM ALL SOURCES YEARLY
SUMC   = SUM OF GAINS AND LOSSES FROM INPUT COLUMNS YEARLY
SUMCT  = DISCOUNTED TOTAL FOR EACH COLUMN
SUMFT  = DISCOUNTED TOTAL FOR FLOODED AREA
SUMIT  = DISCOUNTED TOTAL FOR IRRIGATED AREA
TOTAL  = DISCOUNTED TOTAL
```

Figure 49. Format and input variables for file FISH2.IN.

```
FILE FISH2.OUT output file from program FISH2.FTN

 price for unit weight of fish =50.000
 discount   rate =0.050
 production rate for river floodplains = -65.000
 production rate for canals =15.000
 percent of   irrigated area which are canals = 0.10
 ****************************

  THE DISCOUNTED TOTAL COST TO FISHERIES = -0.159218E+11
  THE DISCOUNTED TOTAL LOSS FROM FLOOD PLAIN CONTROL =-0.125247E+11
  THE DISCOUNTED TOTAL FROM IRRIGATED AREA = 0.104394E+09
   THE DISCOUNTED TOTAL FOR THE INPUT COLUMNS ARE :
 -0.772274E+10 col 1 Diama Dam loss in estuary
  0.327326E+09 col 2, Lac de Giers gain
  0.449480E+09 col 3 Lac R'Kiz
  0.187283E+10 col 4 Aftout es Sahel gain
  0.157170E+10 col 5 Manantali impoundment gain
```

Figure 50. Output file FISH2.OUT.

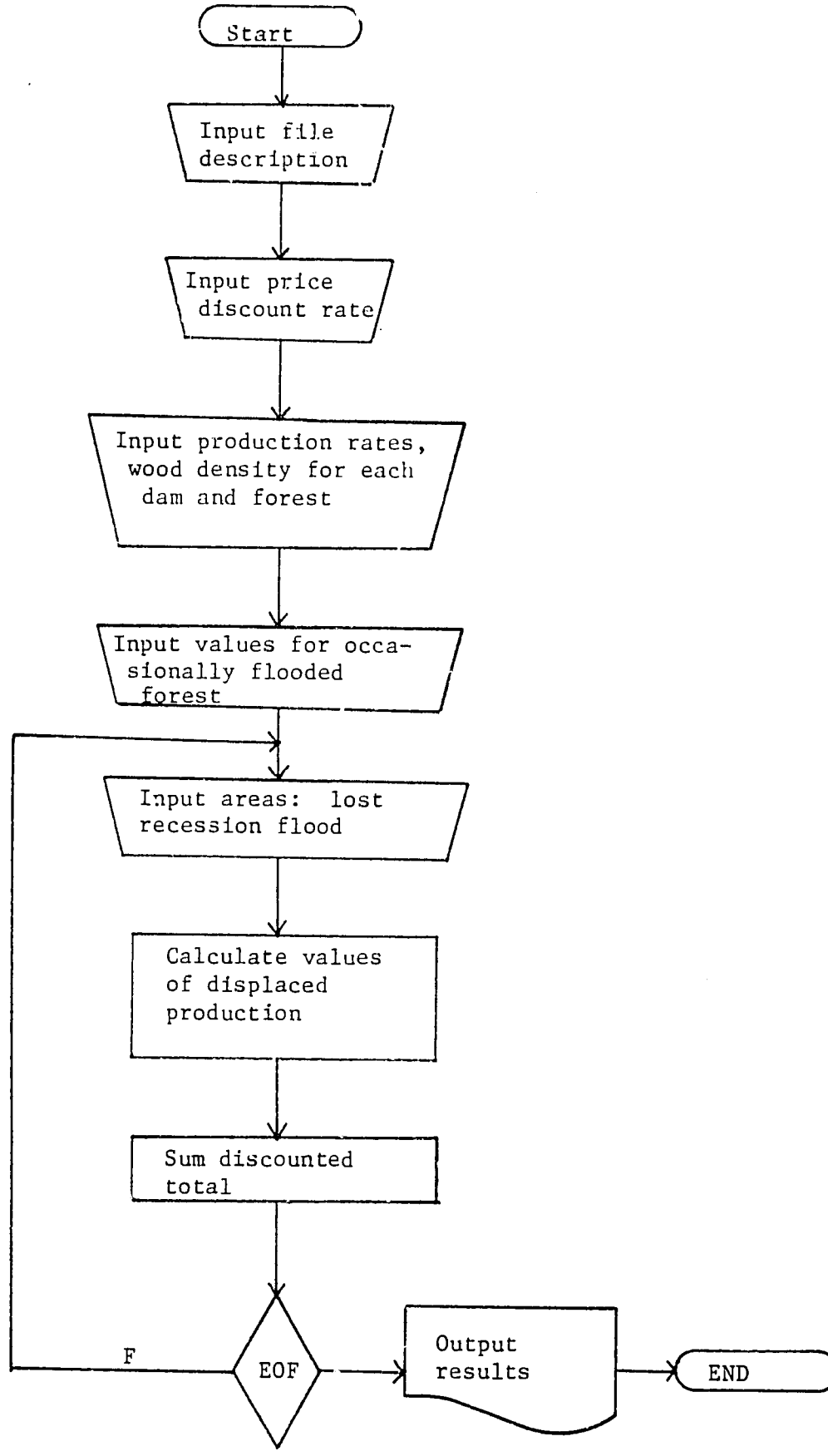

Figure 51. Flow chart for FOREST.FTN.

project will reduce the size of the annual flood thus decreasing forest production. FOREST.FTN reads two input files and writes results to one output file.

The program FOREST.FTN includes two of three impacts of the SRB project on forest production. The Forestry Report (Gannett-Fleming 1979) identified three impacts on forest production:

1. Inundation of forest behind Diama and Manantali Dams.
2. Reduction of forest growth rates due to flood control.
3. Increased pressures on forest resources.

The program, FOREST.FTN, includes impacts one and two. Impact three is discussed in the report only in a qualitative manner.

1. Impact number one is a clear result of the project and is relatively easy to quantify. Once the impoundments behind Diama and Manantali Dams are filled, forest growth in the flooded areas will stop. Surveys were done by Gannett-Fleming (1979) to determine the growth rates, density and area of forest affected by the impoundments. These data are given in Table 6 and are used in the model to calculate lost forest production by using Equation 41:

$$LOSS_{I,J} = PRO_{I,J}*AA_{I,J}*KGPCM_{I,J}*PRICE \quad \ldots\ldots\ldots\ldots\ldots\ldots (41)$$

$$I = 1,2 \quad J = 1,N$$

where

LOSS	=	lost production in flooded area I and forest type J
PRO	=	forest production rate for forest I,J
AA	=	area flooded for dam I and forest type J
KGPCM	=	density of wood produced in forest
I	=	1 for area inundated by Diama Dam
J	=	2 for area inundated by Manantali Dam for different
J=1,n		forest types identified in Gannett-Fleming (1979)
PRICE	=	value of wood produced.

2. Impact number two is linked to the area flooded. Growth rates in the occasionally flooded forest are linked to the annual flood. Nutrients are presenty being deposited on gonakie forests in the floodplain by the annual floods. Once the annual flood is controlled by Manantali, the area flooded will be reduced, thus reducing the forest area receiving these nutrients. It is estimated in the Forest Report (Gannett-Fleming 1979) that the reduced flooding will cause a 20 percent reduction in forest production. The minimum area will be flooded when the flow is controlled by Manantali Dam without the artificial flood and the maximum number of hectares have been developed on the floodplain. The following equations calculate the lost production in the floodplain forest:

$$AREA = MAX-MIN \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (42)$$

$$X = MAX-FLOOD \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (43)$$

Table 6. Forest production parametr for impounded areas.

Impoundment	Production Rate	Area	Density
Diama (floodplain)	6.45 m^3/ha	1065 ha	800 kg/m^3
Manantali (nonflood-plain)	.5115 m^3/ha	42400 ha	500 kg/m^3
Manantali (flood-plain)	1.009 m^3/ha	530 ha	500 kg/m^3

Y = X/AREA .....(44)

VOCC = Y*PCIMP*OCC*KG*PRICE*PRO.....(45)

SUMOC = SUMOC=SUMOC+DIS*VOCC.....(46)

DIS = (1/(1+RATE))**(YEAR-1).....(47)

where

AREA = area of occasionally flooded forest impacted by the project
MAX = maximum area flooded without project, no impact on forest
MIN = area flooded which results in a 20 percent reduction in forest output
FLOOD = area flooded in given year
X = area not flooded for given year
Y = proportion of 20 percent reduction for given year
VOCC = volume of occasionally flooded forest production lost
PCIMP = percent of floodplain forest growth reduction (20 percent)
OCC = maximum area of forest in floodplain
KG = density of wood kg
PRICE = value of wood cfa/kg
PRO = production rate of occasionally flooded forest
SUMCO = discounted sum of lost production in occasionally flooded forests
DIS = discount factor
RATE = discount rate (5 percent)
YEAR = year since beginning of project

3. Impact number three results from many causes, some connected to the project, others related to climatic conditions. The project is expected to spur population growth in the valley. The people are dependent upon forest resources for their energy needs. The forest in the valley will be cut to supply this increased need for energy. Yearly forest production is only marginally able to supply energy needs now and will be inadequate with the larger population. Livestock grazing is expected to intensify on forest lands. Irrigated perimeters will be off limits much of the year for livestock grazing, forcing livestock into the forest. Livestock grazing is especially damaging to the forest.

```
2,0.05,20.,
DATA FILE FOREST.IN
CONTAINING DISCOUNT RATE, cfa per kg, productivity,area,densiity of wood
2,
.0215,4300.,500.,
6.45,1065.,800.,
2
.5115,42400.,500.,
1.009,530.,500.,
550000.,187367.,0.2,4.85,37850.,800.
```

Figure 52. FOREST.IN.

```
NL,RATE,PRICE                FREE FORMAT INTEGER,2 REALS
LINE                    80A1
ND                      FREE FORMAT INTEGER
PROD(1,K),AA(1,K),KGPCM(1,K)  FREE FORMAT 3 REALS
NM                      FREE FORMAT INTEGER
PROD(1,K),AA(1,K),KGPCM(1,K)  FREE FORMAT 3 REALS

AA        = AREA AFFECTED BY DIAMA OR Manantali
KG        = DENSITY OF WOOD FOR occasionally FLOODED FOREST
KGPCM     = DENSITY OF WOOD IMPACTED BY DIAMA OR MANANTALI
LINE      = TEXT IDENTIFYING INPUT
ND        = NUMBER OF DIFFERENT FOREST TYPES DIRECTLY IMPACTED
            BY DIAMA
NL        =
NM        = NUMBER OF DIFFERENT FOREST TYPE DIRECTLY IMPACTED BY
              MANANTALI
PRICE     = VALUE OF WOOD
PRO       = PRODUCTION OF FOREST ON FLOOD PLAIN
PROD      = PRODUCTION OF FORESTS DIRECTLY IMPACTED BY DIAMA OR
            MANANTALI
RATE      = DISCOUNT RATE
```

Figure 53. Format and variable list for FOREST IN.

```
************* OUTPUT FROM FOREST *************
OUTPUT FROM FLOOD.FTN


OUTPUT FROM AREA.FTN USED AS INPUT FOR AGBEN
VALUES OF OPTIONS USED FOR THIS RUN ARE

NEW DEVELOPMENT RATE   5000. TIME TO NEW DEVELOPMENT RATE   4.
 NUMBER OF YEARS BEFORE THE FLOOD   9.
 THE FOLLOWING VALUES WERE USED TO DISTRIBUTE HA DEVELOPED BETWEEN
COUNTRIES
  INITIAL  MALI = .1666 MAUR .3436 SENEGAL .4898
 TOTAL POSSIBLE HA IN MALI =  23437.
 FINIAL  MAUR .4125 SENEGAL .5875
 INITIAL AREAS MALI    270.  MAUR   5305.  SENEGAL  23230.

                    AGRICULTURAL AREAS DATA TABLE
YEAR   RATE    AI        ARD        ADD        AF      MALI    MAUR

 MAXUN = MAXIMUM AREA FLOODED WITHOUT PROJECT
 MAXAF = MAXIMUM AREA FLOODED WITH artifical FLOOD
 MAXCON = MAXIMUM AREA FLOODED UNDER CONTROL OF   MANANTALI
    550000. = MAXUN      380000. = MAXAF      230000. = MAXCON
YEAR *IRR DEV*  *IRR Ha* *DISPLACED* *artifical* *POTENTIAL* *FLOODED*
         RATE      TOTAL    RECESSION     FLOOD      FLOODED       Ha
 DISCOUNT RATE =  5 0000001E-02 PRICE FOR KG FIREWOOD =   20.0000
DATA FILE FOREST.IN
CONTAINING DISCOUNT RATE, cfa per kg, productivity,area,density of
wood


PRODUCTION OF FOREST DIRECTLY IMPACTED BY DIAMA   0.02150
AREA AFFECTED 4300.0   DENSITY    500.0


PRODUCTION OF FOREST DIRECTLY IMPACTED BY DIAMA   6.45000
AREA AFFECTED   1065.0 DENSITY    800.


PRODUCTION OF FOREST DIRECTLY IMPACTED BY MANANTALI    0.51150
AREA AFFECTED  42400.0 DENSITY    500.0


PRODUCTION OF FOREST DIRECTLY IMPACTED BY MANANTALI    1.00000
AREA AFFECTED    530.0 DENSITY    500.0

*******************************
 COST TO FOREST RESOURCES FROM SENEGAL RIVER BASIN PROJECT
      DIAMA          MANANTALI   FLOW REGULATION   TOTAL
  0.624275E+10     0.212452E+10     0.425975E+10     0.126270E+11
```

Figure 54. Sample output file FOREST.OUT.

Herders cut branches off the trees to provide leaves and seed pods for livestock to feed on. At present this is done during time of stress when other forage is unavailable. Gannett-Fleming (1979) report the development of irrigated perimeters would cause an increased grazing of woodlands. The climate in the valley has been becoming increasingly dry. Droughts are coming closer together and are becoming more severe each time. With each drought more trees are cut for firewood and livestock forage and few young trees survive to replace the ones cut. The report discusses the importance of the project on desertification and reduction in forest cover. However, data are insufficient at present to predict the magnitude of the impact or develop a link between development rates and forest destruction.

Input files

The program, FOREST.IN, reads two input files: FLOOD.OUT and FOREST.IN. FLOOD.OUT is discussed above in the FLOOD.FTN section.

FOREST.IN

"FOREST.IN" contains the discount rate, price per kg of wood, productivity rates, area impacted and density of wood. A sample input file is given in Figure 52. The format and definition of variables are given in Figure 53.

Output FOREST.OUT

A sample FOREST.OUT file is illustrated in Figure 54. The file contains an echo of input values and assumptions along with the results. The SRB project's cost to forest resources is broken down by Diama, Manantali, and flow regulations. The values given represent the discounted sums for each category. The total cost to forest resources also is given.

RECOMMENDATIONS

To improve on the estimation of the agricultural benefits and irrigation water requirements, the following recommendations are made:

1. That more radiation data, RS, be collected basin-wide. If RS is not measured directly, it can be estimated from percent sunshine or temperature difference using the procedure outlined in Hargreaves (1983).
2. That the Senegal River Basin be subdivided into a minimum of three regions to determine the irrigation water requirements. These regions should consist of the following areas: Podor, Matam, and Kayes.
3. That the CAM model be used to evaluate the agricultural benefits and irrigation water requirements for each member state of the valley and delta regions, and the large irrigation perimeters.

To optimize the agricultural benefits and water use the following recommendations are made:

1. That a study be conducted to determine the optimum rainfall probability level to be used in determining irrigation water requirements. In other words, what is the allowable risk? This study should include crop economic production function analyses to evaluate the reduction of yields due to water shortages. The 75 percent level for probability of exceedance is generally a good level to use for design purposes.
2. That a comprehensive water management program be established to achieve the following:
   a. Determine the irrigation water requirements for each perimeter using the methodology presented in this report or another comparable method.
   b. Select the method of irrigation for each crop based upon the recommendations of a qualified irrigation specialist.
   c. Determine the irrigation schedule which best matches the multiple needs.
   d. Measure the amounts of irrigation water applied.
   e. Determine the water use efficiency and uniformity.
   f. Determine the optimum amount of fertilizer to be applied.
   g. Develop a program for evaluating the production costs and yield for large and small perimeters.
3. That a sensitivity analysis be conducted on the parameters presented in Figure 5 to help determine goals and methods for increasing the positive net benefits.
4. That an optimization scheme be developed to determine which crops should be produced and in what proportions to maximize benefits and satisfy social and political goals.
5. That an economic comparison be made between large and small perimeters to determine which would be more cost effective.
6. That some form of contract competition be set up for the construction of large perimeters to try to keep development costs down.
7. That purchase of project equipment include training and maintenance contracts.

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Appendix A

Glossary of Terms

ACCOUNT	A category, or classification, of financial information; an individual record of a financial item.
ACCOUNTING	The art of identifying, measuring, recording, and communicating financial information about an economic unit.
ALLOCATED JOINT COST	The portion of the joint cost allocated to a service (using the adjusted separable costs remaining-benefits method).
ALTERNATIVE COST	Lowest single purpose project cost for a service.
ASSETS	The properties or economic resources belonging to a company. May be liquid (cash and receivables) or capital (plant and equipment). In general, the ASSETS produce the income flow of an economic unit.
ASSET GROWTH	The accumulation of ASSETS in the continued operation of an economic unit. May refer to the growth of liquid accounts or the accumulation of plant and facilities.
BALANCE SHEET	A fundamental accounting statement, the purpose of which is to show the financial position of a business on a particular date. Financial position is shown by listing the ASSETS of the business, its LIABILITIES (or debts) and the EQUITY of the owner or owners. The two sides of the BALANCE SHEET must balance. That is, the sum of LIABILITIES + EQUITY must be equal to the total ASSETS of the company. This simply means that all ASSETS may be considered as those owned by the proprietors and stockholders plus those secured by borrowing from others.
BENEFITS	Benefits realized as the result of creating a service: 1. For Irrigation: the primary revenue from irrigated agriculture minus the net value of foregone production (net primary return method). 2. For Power: cost of the same output using the next best alternative single purpose project. 3. For Navigation: cost of the same output using the next best alternative single purpose project.
CAPITAL ASSETS	Assets composed of plant and equipment which cannot be converted (in a reasonable length of time) into liquid assets.
CAPITAL DEVELOPMENT SCHEDULE	The capital development schedule is an intended rate of capital, or ASSET GROWTH. This does not pertain directly to the accounting of an operation. This schedule may be derived from another source. For example, a project plan might suggest that certain

facilities should be constructed in specified years. The schedule then becomes the schedule of construction which will enable the plan to be met.

CAPITAL EQUITY — The value of capital assets which now fall under the ownership of a company whether through the result of direct purchase from cash, or the completed payment of liability obligations.

COMMON WORKS COST — Accumulated costs of infrastructure components which are required by two or more services (i.e. the dam structure).

CREDIT — Used in double entry accounting systems, a CREDIT represents an adjustment to an account. The effect of this adjustment depends upon the type of account. A CREDIT entry will have the effect of decreasing the value of an ASSET or EXPENSE account, while increasing the value of a LIABILITY, EQUITY, or REVENUE account.

DEBIT — Used in double entry accounting systems, a DEBIT represents an adjustment to an account. The effect of this adjustment depends upon the type of account. A DEBIT entry will have the effect of increasing the value of an ASSET or EXPENSE account, while decreasing the value of a LIABILITY, EQUITY, or REVENUE account.

DEBT FINANCING — Simply, the use of borrowed money to finance growth or operations. May involve the selling of bonds, the issuing of notes, or securing the loans. Debt may be secured by the pledging of assets or unsecured based on the reputation of the borrower. Does not transfer any of the ownership (equity) of the economic unit.

DISCOUNT RATE — A rate which deflates the value of financial and economic items in order to bring the real value of future amounts back to a present value (see Economics Section for further explanation).

DOUBLE ENTRY ACCOUNTING — A system of record keeping which is used primarily to preserve the balance in the BALANCE SHEET and add order to the INCOME STATEMENT by using two entries for each transaction.

ECONOMIC SECTOR — Revenues and expenditures associated with an identifiable industry: agriculture, mining transportation, other. Consumer of project services (also USE SECTOR).

EQUITY	An equity is the net worth of a business or public organization, consisting of capital stock, retained earnings, and, occasionally, reserves. It is the worth that remains when outstanding liabilities have been subtracted from total assets. It is what is owned in the business, whether by stockholders or by proprietors.
EQUITY FINANCING	The use of owned assets to provide for company growth or operation. Many involve diverting NET INCOME to the purchase of capital assets; or may involve the selling of company stock to raise money. When stock is sold, part ownership of the company is transferred to the stockholders.
EXPENSES	An EXPENSE is the cost of operation of the economic unit. It may result from the cost of borrowing money, or the payment of salaries, or many other aspects of operation.
FINANCING	The area of operation wherein money, or other financial instruments, is used to support the growth, operation, and existence of an economic unit.
FINANCING SCHEDULE	The schedule is one which correlates the finance methods and timing with the capital development schedule. Proper design of this schedule insures that sufficient funds are available when needed to allow for the desired construction and operation activities of the organization.
INCOME STATEMENT	A fundamental accounting statement in which all REVENUES are listed and summed and all EXPENSES are listed and summed. The subtraction of EXPENSES from REVENUES will yield the NET INCOME (if any) and indicate whether the company made money on the years operation.
INCREMENTAL CAPITAL GROWTH	The amount of capital growth which takes place each year. Must be paid for from either equity financing or debt financing.
INFRASTRUCTURE	Physical installations and facilities, as dams, power plants, roads, harbors, etc.
INTEREST	The cost of borrowing money. It is a percentage of the amount borrowed and can be considered a normal expense of operation.
JOINT COST	The portion of common works costs remaining after separable costs have been subtracted for each service.

JUSTIFIABLE COST	The lesser of the project benefits or the alternative cost for a service.
LIABILITIES	Represents a claim or right to be paid. The claim is for an investor who has loaned money to the organization and has a claim on the ASSETS of that company until the loan is completely repaid.
LIQUID ASSETS	Assets composed of cash, accounts receivable, or other securities which can be quickly converted to cash.
LIQUID EQUITY	Cash or other securities that are owned by the organization.
LOAN FEE	A charge made to secure a loan. May be related to the costs of processing and setting up the loan.
LOAN GRACE PERIOD	A period of time during which no principal repayments are made. For example, a loan may have a total duration of 50 years but carry a 10 year grace period. Consequently, the funds from the loan will be available in year 1, but repayment of the principle will not begin until year 11. Principle repayments are made between the end of the grace period and the total end of the loan period.
LOAN INTEREST RATE	The rate of interest which pays for the use of loaned money. May vary from loan to loan, and possibly within a single loan if provisions require.
NET INCOME	NET INCOME is produced when total EXPENSES are subtracted from total REVENUES. May be greater than, less than, or equal to zero. It is frequently considered the profit from operations.
NET PRESENT VALUE	The net present value is equal to the present value of future returns, discounted at the appropriate cost discount rate, minus the present value of the cost of the investment.
OUTSTANDING LIABILITY	The amount of a liability which has not been repaid. This is, or should become, a declining balance over the life of a project.
PRESENT VALUE	The present value of future costs or returns, discounted at the appropriate discount rate.
PROJECT BENEFITS	See BENEFITS

RESERVE ACCOUNTS	An account(s) found in EQUITY and ASSETS which simply is set up to reserve a specified amount of funds for a particular use. For example, a sinking fund is a reserve account in which money is being saved (accumulated) to pay for the eventual replacement of a piece of equipment.
REVENUES	All income derived from the normal operation of an economic unit whether from the sale of a continually produced good or service or the sale of assets or the receipt of grants.
SEPARABLE COST OF THE COMMON WORKS	The portion of common works cost which can be assigned to a service sector by: (separable costs for service W) = (common works cost with service W) - (common works cost without service W)
SERVICE	Infrastructure components, maintenance and operation and other activities which contribute to an identifiable service to society: water supply, energy production, navigation, etc.
SINGLE PURPOSE PROJECT COST	The costs of construction, maintenance, and operation of a distinct and independent service without participation in a common works project.
SINKING FUND	A reserve account in which money is being saved (accumulated) to pay for the eventual replacement of a piece of equipment. (See RESERVE ACCOUNT.)
SPECIFIC COST	Costs of infrastructure components, operation and maintenance which are required exclusively by an identifiable service and, therefore, are not included in the common works costs.
SPECIFIC SERVICE COST	See SPECIFIC COST
TOTAL PROJECT COST	Total cost of the project including specific costs, separable costs, and allocated joint costs: Total Cost = Σ (specific costs) + (common works) = Σ (specific costs) + Σ (separable costs) + Σ (allocated joint costs)

TOTAL SEPARABLE COSTS TO A SERVICE	Specific costs of a service plus separable costs of a service of the common costs
USER FEE	The unit price for services provided by each service: CFAF per cubic meter of water for Water Supply, CFAF per kwh for Energy, and CFAF per t km for Navigation.
USE SECTOR	See ECONOMIC SECTOR

Appendix B

Demonstration Run of Model

```
@MAIN
>:COMMAND FILE MAIN
>;       USER HAS OPTION OF 1) EXITING FROM COMMAND FILE
>;        AND RUNNING PROGRAMS INDIVIDUALLY
>;       2)INVOKING COMMAND FILE KEY USED TO CALCULATE
>;        BENEFITS,COSTS,COST ALLOCATION AND ALLOCATION KEY
>;       3)OR INVOKING COMMAND FILE MANAGE USED TO
>;       CALCULATE BENEFITS,COST,USER FEES,REVENUES,
>;       CASH FLOW, LOA   FORMATION AND DETAILED
>;       ACCOUNTING INF..  ATION.
>;
>"  DO YOU WANT TO INVOKE ONE OF THE COMMAND FILES? [Y/N]: Y
>;AVAILABLE COMMAND FILES ARE   "KEY"  AND "MANAGE"
>"       ENTER EITHER    "KEY" OR "MANAGE" (DO NOT ENTER ") (ST: KEY
>:COMMAND FILE MAIN
>:A  COMMAND FILE FOR CALCULATION OF KEY
>:THIS COMMAND FILE FOLLOWS THE FOLLOWING ORDER
>;
>;  BENEFITS -> COST WITHOUT DELAY ->COST ALLOCATION ->FEES->REV
>;  AND THEN KEY CALCULATION
>;  IN REPORT 5 ALL THESE CALCULATIONS WERE BASED ON COST AND QUANTITY
>;  STREAMS WITH NO DELAY
>;
>:REMEMBER IF YOU MAKE A MISTAKE:
>;1. BEFORE YOU HIT RETURN, USE THE DELETE KEY TO REMOVE THE CHARACTER
>;2. AFTER A RETURN A CONTROL Z WILL STOP THE
>;   PROGRAM AND THE OPTION WILL ALLOW YOU TO RUN THE PROGRAM AGAIN.
>;3. TO STOP THE COMMAND FILE, TYPE CONTROL Z TO A COMMAND FILE QUESTION.
>;   COMMAND FILE QUESTION START WITH  >;
>;4. ABORT AT.TN   WHERE N IS THE TERMINAL NUMBER WILL ABORT THE PACKAGE.
>:PAUSE TO READ THE ABOVE MESSAGE

AT.T17 --  PAUSING. TO CONTINUE TYPE "START AT.T17(ESC)"
>
START AT.T17

AT.T17 -- CONTINUING
>:COMMAND FILE BENEFITS.CMD
>:THIS FILE RUN THE BENEFIT SECTION OF THE COST
>:ALLOCATION PROGRAM
>RUN    AREA
IS THE NEW DEVELOPMENT RATE=5000. HA./YR? (Y/N)
Y
IS THE TIME TO NEW DEVELOPMENT RATE= 4 YEARS? (Y/N)
Y
IS THE TIME TO ARTIFICIAL FLOOD= 9 YEARS? (Y/N)
Y
IN REPORT 4 AND REPORT 5 THE FOLLOWING  PROPORTIONS WERE USED
TO SEPARATE TOTAL AREA DEVELOPED EACH YEAR BETWEEN THE 3 COUNTRIES
PROPORTION TO MALI 0.1666 PROPORTION TO MAUR 0.3436
PROPORTION TO SENEGAL 0.4898
AFTER  23437. HA HAS BEEN DEVELOPED IN MALI THE
PROPORTION TO MAUR 0.4125 PROPORTION TO SENEGAL 0.5875
THE INITIAL AREAS IRRIGATED ARE
MALI =    270. MAURITANIA =   5305. SENEGAL  23230. TOTAL =   28805.
ARE THESE VALUES TO BE USED FOR THIS MODEL RUN (Y/N)
Y
Y
TT17  --  STOP

>" DID YOU ENTER OPTIONS CORRECTLY? [Y/N]: Y
>RUN    WRITE
TT17  --  STOP
```

```
>RUN    AGBEN
DO YOU WANT INDIVIDUAL PRODUCT BENEFITS? (Y/N)
N
IS THE DEVELOPMENT COST PER NEW HECTAR =3560000 F.CFA?   (Y/N)
Y
IS THE REPLACEMENT COSTS FOR PUMPS =760000 F.CFA?  (Y/N)
Y
IS THE TIME TO PUMP REPLACEMENT =5 YEARS? (Y/N)
Y
IS THE PROJECT LIFE =50 YEARS? (Y/N)
Y
IS THE DISCOUNT RATE IN DECIMAL FORM=0.05? (Y/N)
Y
TT17  --  STOP

>" DID YOU ENTER OPTIONS CORRECTLY? [Y/N]: Y
>RUN    NVOL
IF THERE IS NO DELAY NAVIGATION STARTS IN 1988
USER SHOULD USE ZERO DELAY WHEN CALCULATING KEY
IS NAVIGATION DELAYED 5 YEARS? (Y/N)
N
ENTER NUMBER OF YEARS NAVIGATION IS DELAYED (DELAY)
0
TT17  --  STOP

>" DID YOU ENTER OPTIONS CORRECTLY? [Y/N]: Y
>RUN    NBEN
IS THE DISCOUNT RATE IN DECIMAL FORM=0.05? (Y/N)
Y
IS PROJECT LIFE =50 YEARS? (Y/N)
Y
IS THE TARIFF FOR RAIL=14.5  F.CFA/TKM? (Y/N)
Y
IS THE TARIFF FOR TRUCKING PHOSPHATE=28.8  F.CFA/TKM? (Y/N)
Y
IS THE TARIFF FOR TRUCKING IN MALI=27.7  F.CFA/TKM? (Y/N)
Y
IS THE TARIFF FOR TRUCKING IN MAURITANIA=38.4  F.CFA/TKM? (Y/N)
Y
IS THE TARIFF FOR TRUCKING IN SENEGAL=21.1  F.CFA/TKM? (Y/N)
Y
TT17  --  STOP

>" DID YOU ENTER OPTIONS CORRECTLY? [Y/N]: Y
>RUN    ENGBEN
IS THE DISCOUNT RATE IN DECIMAL FORM= 0.05. (Y/N) ? Y
IS THE ALTERNATIVE COST OF ENERGY GENERATION 31.28 KW- HR (Y/N) ? Y
IS THE EFFECTIVE ENERGY DISTRIBUTION  THE FOLLOWING PROPORTIONS
  TO  MALI(URBAN) = 0.5645TO MAURITANIA  = 0.0000
 TO SENEGAL(IRON MINE)  = 0.4355 (Y/N) ? Y
FOR CALCULATION OF KEY REPORT 5 USED NO DELAY START 1988
FOR CALCULATION OF USER FEES REPORT USED 7 YEAR DELAY
FOR THIS RUN USE A DELAY OF 7 YEARS Y/N  N
ENTER LENGTH OF DELAY ONE INTEGER   0
TT17  --  STOP

>PIP *.DAT/PU
>" DID YOU ENTER OPTIONS CORRECTLY? [Y/N]: Y
>" DO YOU WANT OUTPUT PRINTED? [Y/N]: Y
>PRINT AREA.DAT,AGTAB.PRE,AGDATA.OUT,CHECK.OUT,AGBEN.OUT/NOJOB/LENGTH:60.
PRI - JOB 579. NAME "AREA     ", SUBMITTED TO QUEUE "PRINT "
>PRINT NAVTAB.PRE,NVOL.DAT,DELAY.DAT/NOJOB/LENGTH:60.
PRI - JOB 580. NAME "NAVTAB   ", SUBMITTED TO QUEUE "PRINT "
>PRINT NBEN.OUT,AGCOST.DAT,ENERGY.PRE,ENGBEN.OUT/NOJOB/LENGTH:60.
PRI - JOB 581. NAME "NBEN     ", SUBMITTED TO QUEUE "PRINT "
```

```
PRI - JOB 582, NAME "NBEN     ", SUBMITTED TO QUEUE "PRINT "
>:THE PROCESSING OF THIS INDIRECT COMMAND FILE HAS
>:PAUSE HERE TO WAIT FOR THE OUTPUT FILE TO BE PRINTED
>:THE USER TYPES  [CRT AND MESSAGE WHEN THE OUTPUT FILE IS FINISHED PRINTING

AT.T17 --  PAUSING. TO CONTINUE TYPE "START AT.T17<ESC>"
>
START AT.T17

AT.T17 -- CONTINUING
>" DID YOU ENTER VALUES CORRECTLY IN BENEFITS? [Y/N]: Y
>;       THE COST PROGRAM WILL BE RUN TWO TIMES BY THE COMMAND PACKAGE.
>;       EACH TIME BEFORE THE COST PROGRAM IS RUN, YOU WILL BE ASKED TO
>;       CHOSE BETWEEN COST SCHEDULE WITH DELAY AND COST SCHEDULE WITHOUT
>;       DELAY.
>;       IN REPORT 5 THE COST SCHEDULE WITHOUT DELAY WAS USED IN THE
>;       COST ALLOCATION.  THE COST SCHEDULE WITH DELAY WAS
>;       USED TO CALCULATE USER FEES.
>;
>:PAUSE TO READ THE ABOVE MESSAGE

AT.T17 --  PAUSING. TO CONTINUE TYPE "START AT.T17<ESC>"
>
START AT.T17

AT.T17 -- CONTINUING
>:YOU ARE ON PASS ONE BEFORE COST ALLOCATION.
>:IN REPORT 5 THE COST SCHEDULE WITHOUT DELAY(COSTND.PRE) WAS USED HERE.
>;
>:RESPOND  N TO  TO THE FOLLOWING PROMPT TO USE COST SCHEDULE WITHOUT DELAY
>:COSTD.PRE? [Y/N]     SAMPLE PROMPT LINE WHICH WILL APPEAR
>;
>;       IF YOU ANSWER "Y" COSTD.PRE WILL BE USED
>;       IF YOU ANSWER "N" TO THE FOLLOWING QUESTION COSTND.PRE WILL BE USED
>;
>" USE DATA FILE COSTD.PRE? [Y/N]: N
>PIP COST.PRE=COSTND.PRE
>" DID YOU ENTER CORRECT OPTION? [Y/N]: Y
>RUN    COSTCK
TT17  --  STOP

>RUN    COST
IS THE DISCOUNT RATE IN DECMAL FORM 0.05 (Y/N) ? Y
TT17  --  STOP

>PIP *.DAT/PU
>PIP COST.PRE/PU
>" DID YOU ENTER OPTIONS CORRECTLY? [Y/N]: Y
>" DO  YOU WANT PRINTED OUTPUT? [Y/N]: Y
>PRINT COST.PRE.COSTCK.OUT.DISSUM.OUT/NO.JOB/LENGTH:60.
PRI - JOB 582, NAME "COST     ", SUBMITTED TO QUEUE "PRINT "
>:RESUME PROCESSING THE COMMAND FILE ONCE THE FILE HAS FINISHED PRINTING

AT.T17 --  PAUSING. TO CONTINUE TYPE "START AT.T17<ESC>"
>
START AT.T17

AT.T17 -- CONTINUING
>
>PIP *.*/PU
>:IN REPORT 5 THE FOLLOWING OPTIONS WOULD HAD BEEN USED ABOVE IN COSTS
>:FOR COST DATA   COSTND.PRE
>" DID YOU ENTER VALUES CORRECTLY IN COSTS? [Y/N]: Y
>;
>:PAUSE FOR GATHERING DATA NECESSARY TO RUN ALLOCATE

AT.T17 --  PAUSING. TO CONTINUE TYPE "START AT.T17<ESC>"
```

```
START AT.T17

AT.T17 -- CONTINUING
>RUN ALLOCA
                                COST ALLOCATION
SEE TABLE 9 IN REPORT 5 FOR EXAMPLE
****IMPORTANT USE ONLY DISCOUNTED VALUES IN THIS  PROGRAM

YOU HAVE 2 WAYS TO ENTER DATA
1. ALL INTERACTIVE
2. INTERACTIVE DATA PLUS DATA WRITTEN INTO PROGRAM PLUS
DATA READ IN FROM DATA FILES FROM BENEFIT PROGRAMS
ARE YOU  ENTERING NEW BENEFIT DATA (Y/N) ? Y


 ANSWER N TO THE FOLLOWING QUESTION TO INPUT ALL VALUES INTERACTIVELY
BENEFIT DATA IS TO BE READ FROM DATA FILES (Y/N) ? Y
COLUMN ONE IS ASSUMED TO BE FOR IRRIGATION
COLUMN TWO IS ASSUMED TO BE FOR ENERGY
COLUMN THREE IS ASSUMED TO BE FOR NAVIGATION
THE FOLLOWING BENEFIT VALUES WERE READ IN
IRRIGATION       ENERGY            NAVIGATION
 0.11743394E+12   0.26123736E+12   0.53008010E+12
PLEASE CHECK:  ARE THEY REASONABLE (Y/N) ? Y
THE FOLLOWING AGCOST VALUE(COST TO AGRICULTURE SECTOR DUE TO NAVIGATION)
 WAS READ IN:  0.65291402E+10
PLEASE CHECK:  IS IT REASONABLE (Y/N) ? Y
ENTER VALUES FOR ROW2; ALTERNATIVE COSTS
ENTER 3 REAL NUMBERS SEPARATED BY COMMAS
 ? 82.603E9.109.611E9.147.736E9
ENTER VALUES FOR ROW4; SEPARABLE COSTS
ENTER 3 REAL NUMBERS SEPARATED BY COMMAS
 ? 36.546E9.56.023E9.101.679E9
ENTER TOTAL COST FOR COST ALLOCATION
 ? 243.140E9
TT17  --  STOP

>PIP TI:=ALLOCA.OUT
```

	IRRIGATION	ENERGY	NAVIGATION	TOTALS
PROJECT BENEFITS	0.110905E+12	0.261237E+12	0.530080E+12	0.902222E+12
ALTERNATIVE COSTS	0.826030E+11	0.109611E+12	0.147736E+12	0.339950E+12
JUSTIFIABLE COSTS	0.826030E+11	0.109611E+12	0.147736E+12	0.339950E+12
SEPARABLE COSTS	0.365460E+11	0.560230E+11	0.101679E+12	0.194248E+12
COSTS FOR OTHER PURPOSES	0.206594E+12	0.187117E+12	0.141461E+12	
JUSTIFIABLE COSTS FOR OTHER PURPOSES	0.206594E+12	0.187117E+12	0.141461E+12	
ADJUSTMENT FACTOR	1.18943	1.22040	1.18943	
ADJUSTED SEPARABLE COSTS	0.434685E+11	0.683705E+11	0.120940E+12	
REMANINING BENEFITS	0.391342E+11	0.412405E+11	0.267964E+11	0.107171E+12
JOINT COST PROPORTION	0.365157	0.384810	0.250033	0.000000
ALLOCATED JOINT COSTS	0.178532E+11	0.188141E+11	0.122246E+11	0.488920E+11
TOTAL SERVICE SECTOR COSTS	0.543992E+11	0.748371E+11	0.113904E+12	0.243140E+12
PERCENTAGES	.223736	.307794	.468469	

```
>" DO YOU WANT TO PRINT A COPY OF ALLOCATE OUTPUT? [Y/N]: Y
>PRINT  ALLOCA.OUT/NO.JOB
PRI - JOB 583, NAME "ALLOCA   ", SUBMITTED TO QUEUE "PRINT "
>:PAUSE TO GET PRINT OUT WITH COST ALLOCATION

AT.T17 --  PAUSING. TO CONTINUE TYPE "START AT.T17<ESC>"
@`F`F`FX`FX~XF`X`F`3F~X`FFF~FFX3`FFFFFFF50F`LFFFFL`FF`FF`
```

```
START AT.T17

AT.T17 -- CONTINUING
>;
>RUN FEES
IS THE NUMBER OF YEARS THE MODEL WILL RUN 50 (Y/N) ? Y
ENTER TODAYS DATE   MAXIMUM 40 CHARACTERS
 ? 12-JULY 83
ARE DISCOUNTED QUANTITIES TO BE READ FROM DATA FILES(Y/N) ? Y
 37054169088.00 = DISCOUNTED QUANTITY OF WATER (Y/N) ? Y

  335157657 6.00 = DISCOUNTED QUANTITY OF ENERGY (Y/N) ? Y

 31388618752.00 = DISCOUNTED QUANTITY OF NAVIGATION (Y/N) ? Y

  0.3651565 = PROPORTION OF JOINT COST
ALLOCATED TO AGRICULTURE SECTOR (Y/N) ? Y

  0.3848101 = PROPORTION OF JOINT COST
ALLOCATED TO ENERGY SECTOR (Y/N) ? Y

  0.2500334 = PROPORTION OF JOINT COST
ALLOCATED TO NAVIGATION SECTOR (Y/N) ? Y

ENTER SPECIFIC COST
COSTS OF INFRASTRUCTURE
COMPONENTS.OPERATION AND MAINTENANCE WHICH
ARE REQUIRED EXCLUSIVELY BY AN IDENTIFIABLE
SERVICE SECTOR AND, THEREFORE, ARE NOT
INCLUDED IN THE COMMON WORKS COST
VALUES ARE FROM FILE DISSUM.OUT

ENTER ONE REAL NUMBER AFTER EACH PROMPT
ENTER SPECIFIC COST OF IRRIGATION
 ? 30.012E9

ENTER SPECIFIC COST OF ENERGY
 ? 39.08E9
ENTER SPECIFIC COST OF NAVIGATION
 ? 98.412E9

NEXT ENTER SEPARABLE COSTS
THE PORTION OF COMMON WORKS COSTS WHICH CAN
BE ASSIGNED TO A SERVICE SECTOR

SEPARBLE COSTw = COMMON WORKS WITHw - COMMON WORKS WITHOUTw

ENTER ONE REAL NUMBER AFTER EACH PROMPT
ENTER SEPARABLE COST OF IRRIGATION
 ? 6.534E9

ENTER SEPARABLE COST OF ENERGY
 ? 16.943E9

ENTER SEPARABLE COST OF NAVIGATION
 ? 3.267E9

NEXT ENTER JOINT COST
THE PORTION OF COMMON WORKS COSTS REMAINING
```

```
NEXT ENTER JOINT COST
THE PORTION OF COMMON WORKS COSTS REMAINING
AFTER SEPARABLE COSTS HAVE BEEN SUBSTRACTED
FOR EACH SERVICE SECTOR

ENTER JOINT COST -- ONE REAL NUMBER
 ? 48.892E9
TT17  --  STOP

>PIP TI:=FEES.OUT
 FEES.OUT
 FEES.OUT THIS FILE IS NOT READ BY OTHER PROGRAMS
THIS FILE CREATED ON 12-JULY-83
 ALLOCA.DAT CREATED BY PROGRAM ALLOCA.FTN
 USED FOR INPUT TO ALLOCA.FTN AND FEES.FTN
 IRRIGATION  ENERGY   NAVIGATION
 ----------------------------------------------------------------------
 OUTPUT FROM AGBEN

  OUTPUT FROM AREA.FTN USED AS INPUT FOR AGBEN
  VALUES OF OPTIONS USED FOR THIS RUN ARE
 NEW DEVELOPMENT RATE   5000.TIME TO NEW DEVELOPMENT RATE  .4.
  NUMBER OF YEARS BEFORE THE FLOOD   9.
  THE FOLLOWING VALUES WERE USED TO DISTRIBUTE HA DEVELOPED BETWEEN COUNTRIES
   INITIAL  MALI = .1666 MAUR .3436 SENEGAL .4898
  TOTAL POSSIBLE HA IN MALI =  23437.
  FINIAL  MAUR .4125 SENEGAL .5875
  INITIAL AREAS MALI    270. MAUR   5305. SENEGAL  23230.

                    AGRICULTURAL AREAS DATA TABLE
      YEAR        RATE        A1        ARD        ADD        AF      MALI   MAUR

         AGRICULTURAL ECONOMIC SECTOR DATA TABLE.WATER REQUIREMENT IN RESULT M3
 VALUE OF OPTIONS ENTERED INTERACTIVELY ARE
 DEVELOPMENT COST  3560000. REPLACEMENT COST   760000.TIME TO PUMP REPLACEMENT
  K          TWR          TAGBEN
 ----------------------------------------------------------------------
 ENGBEN.OUT  OUTPUT FILE FROM ENGBEN INTERACTIVE INPUT FOR COST ALLOCATION
 DISCOUNT RATE =   5.0000001E-02 ALTERNATIVE ENERGY COST    31.28000
 % MALI = 0.5645 % MAUR = 0.0000 % SENEGAL = 0.4355
 THE FOLLOWING INPUT FILES WERE USED IN ENGBEN
ENERGY.PRE    DATA FILE FOR POWER BENEFIT PROGRAM  BENPWR
THESE ARE THE VALUES USED BY DAVE BOWLES FOR REPORT 5
(EXCEPT TO OBTAIN 261 E 9 BENEFITS DAVE BOWLES STARTED
ENERGY GENERATION IN 1989. 151 GW WAS IN 1989 INSTAEAD
OF 1995)
 ENERGY DELAY =       0
       QUANTITY       UNDISCOUNTED BENEFIT
 ----------------------------------------------------------------------
 NBEN.OUT -- OUTPUT FROM NBEN INTERACTIVE INPUT FOR COST ALLOCATION
 DISCOUNT RATE 0.050 NUMBER OF YEARS    50AND THE FOLLOWING TARIFFS
 RATE= 14.50 TRUCKING PHOSPHATE= 28.80 TRUCK MALI= 27.70 TRUCK MAUR.= 38.40TRUCK
 ----------------------------------------------------------------------
 OUTPUT FROM NVOL.FTN--NVOL.DAT FOR USE IN NBEN
   THE FOLLOWING INPUT FILES WERE USED

  NAVTAB.PRE INPUT FOR NVOL
  BREAKDOWN OF NAVIGATIONAL VOLUMES DATA.UNITS T-KM

 OUTPUT FROM AREA.FTN USED AS INPUT FOR AGBEN
 VALUES OF OPTIONS USED FOR THIS RUN ARE
NEW DEVELOPMENT RATE   5000.TIME TO NEW DEVELOPMENT RATE   4.
 NUMBER OF YEARS BEFORE THE FLOOD   9.
 THE FOLLOWING VALUES WERE USED TO DISTRIBUTE HA DEVELOPED BETWEEN COUNTRIES
  INITIAL  MALI = .1666 MAUR .3436 SENEGAL .4898
 TOTAL POSSIBLE HA IN MALI =  23437.
 FINIAL  MAUR .4125 SENEGAL .5875
```

```
                    AGRICULTURAL AREAS DATA TABLE
     YEAR        RATE        AI        ARD        ADD        AF      MALI    MAUR

 INTERACTIVE OPTION DELAY SET TO        0 YEARS
      YEAR    MIVOLO     MIVOLA     RVOL     MAVOLO    MAVOLA     PVOL     SEVOL
 ---------------------------------------------------------------------------------
 OUTPUT FORM NVOL DELAY.DAT FOR USE IN NBEN
  AGRICULTURAL VOLUMES DURING NAVIGATION DELAY
      YEAR    MALI    MAURITANIA  SENEGAL
  NAVIGATIONAL DELAY=    0 YEARS

    NAVIGATIONAL BENEFITS
      YEAR    MIBEN       RBEN      MABEN       PBEN      SEBEN      AGBEN      NBEN
  DISCOUNTED QUANTITY OF WATER CONSUMED  3.7054169E+10
  THE DISCOUNTED QUANTITY OF POWER CONSUMED  8.3515766E+09
  THE DISCOUNTED VOLUME OF NAVIGATION  3.1388619E+10
  THE SPECIFIC COST TO IRRIGATION     3.0012000E+10
  THE SPECIFIC COST TO ENERGY         3.9080002E+10
  THE SPECIFIC COST TO NAVIGATION     9.8412003E+10
  THE SEPARABLE COST TO IRRIGATION    6.5340001E+09
  THE SEPARABLE COST TO ENERGY        1.6943000E+10
  THE SEPARABLE COST TO NAVIGATION    3.2676001E+09
  JOINT COST                          4.8891998E+10
  PROPORTION OF JOINT TO IRRIGATION   0.3651565
  PROPORTION OF JOINT TO ENERGY       0.3848101
  PROPORTION OF JOINT TO NAVIGATION   0.2500334
  TOTAL COST TO IRRIGATION            5.4399230E+10
  TOTAL COST TO ENERGY          7.4837139E+10
  TOTAL COST TO NAVIGATION              1.1390364E+11
 THE USER FEES

IRRIGATION  ENERGY       NAVIGATION
1.46810      8.96084      3.62882
>" DO YOU WANT A PRINTED COPY OF FEES.DAT TO CHECK INPUT FOR REVENUE? [Y/N]: N
>" DID YOU INPUT THE CORRECT VALUES TO FEES? [Y/N]: N
>;PAUSE TO GATHER DATA NECESSAY FOR RUNNING FEES PROGRAM

AT.T17 --  PAUSING. TO CONTINUE TYPE "START AT.T17<ESC>"
>
START AT.T17

AT T17 -- CONTINUING
```

```
>" DO YOU WANT A PRINTED COPY OF FEES.DAT TO CHECK INPUT FOR REVENUE? [Y/N]: Y
>PIP OUT.DUM=ALLOCA.OUT,FEES.DAT,FEES.OUT
>PRINT  OUT.DUM/NOJOB/LENGTH:60.
PRI - JOB 585, NAME "OUT      ", SUBMITTED TO QUEUE "PRINT "
>" DID YOU INPUT THE CORRECT VALUES TO FEES? [Y/N]: Y

AT.T17 --  PAUSING. TO CONTINUE TYPE "START AT.T17<ESC>"
>
START AT.T17

AT.T17 -- CONTINUING
>RUN REVENU
IS THE DISCOUNT RATE IN DECIMAL FORM .05 Y/N ? Y
TT17  --  STOP

>" DID YOU INPUT THE CORRECT OPTION IN REVENU? [Y/N]: Y
>PRINT/NOJOB KEY.OUT
PRI - JOB 586, NAME "KEY      ", SUBMITTED TO QUEUE "PRINT "
>;PAUSE TO GATHER DATA AND RUN KEYCAL PROGRAM

AT.T17 --  PAUSING. TO CONTINUE TYPE "START AT.T17<ESC>"
>
TYPE KEY.OUT
FILE  KEY.OUT
---------------------------------------------------------------------------------
   FILE PWO.DAT OUTPUT FROM ENERGY BENEFIT PROGRAM
NDISCOUNTED YEARLY QUANTITIES USED TO  CALCULATE REVENUE
DISCOUNT RATE =   5.0000001E-02 ALTERNATIVE ENERGY COST    31.28000
% MALI = 0.5645 % MAUR = 0.0000 % SENEGAL = 0.4355
THE FOLLOWING INPUT FILE WERE USED IN ENGBEN
NERGY.PRE    DATA FILE FOR POWER BENEFIT PROGRAM  BENPWR
HESE ARE THE VALUES USED BY DAVE BOWLES FOR REPORT 5
EXCEPT TO OBTAIN 261 E 9 BENEFITS DAVE BOWLES STARTED
NERGY GENERATION IN 1989, 151 GW WAS IN 1989 INSTAEAD
F 1995)
ENERGY DELAY =        0
MALI            MAURITANIA      SENECAL          TOTAL
---------------------------------------------------------------------------------
AGO.DAT OUTPUT FROM AGBEN USED IN REVENUE

OUTPUT FROM AREA.FTN USED AS INPUT FOR AGBEN
VALUES OF OPTIONS USED FOR THIS RUN ARE
EW DEVELOPMENT RATE   5000.TIME TO NEW DEVELOPMENT RATE   4.
NUMBER OF YEARS BEFORE THE FLOOD   9.
THE FOLLOWING VALUES WERE USED TO DISTRIBUTE HA DEVELOPED BETWEEN COUNTRIES
 INITIAL  MALI = .1666 MAUR .3436 SENEGAL .4893
TOTAL POSSIBLE HA IN MALI =  23437.
FINIAL  MAUR .4125 SENEGAL .5875
INITIAL AREAS MALI    270. MAUR   5305. SENEGAL  23230.

                    AGRICULTURAL AREAS DATA TABLE
     YEAR        RATE        AI        ARD        ADD        AF      MALI    MAUR

       AGRICULTURAL ECONOMIC SECTOR DATA TABLE,WATER REQUIREMENT IN RESULT M3
VALUE OF OPTIONS ENTERED INTERACTIVELY ARE
DEVELOPMENT COST  3560000. REPLACEMENT COST   760000.TIME TO PUMP REPLACEMENT
 YEARLY WATER REQUIREMENTS
       MALI        MAURITANIA     SENEGAL          TOTAL
---------------------------------------------------------------------------------
NAVO.DAT -- OUTPUT FROM NBEN USED IN REVENUE
THE FOLLOWING VALUES  FOR INTERACTIVE VARIABLES  WERE USED
DISCOUNT RATE 0.050 NUMBER OF YEARS    50AND THE FOLLOWING TARIFFS
```

```
THE FOLLOWING INPUT FILES WERE USED
-----------------------------------------------------------------------------
OUTPUT FROM NVOL.FTN--NVOL.DAT FOR USE IN NBEN
  THE FOLLOWING INPUT FILES WERE USED

 NAVTAB.PRE INPUT FOR NVOL
 BREAKDOWN OF NAVIGATIONAL VOLUMES DATA.UNITS T-KM

OUTPUT FROM AREA.FTN USED AS INPUT FOR AGBEN
VALUES OF OPTIONS USED FOR THIS RUN ARE
EW DEVELOPMENT RATE   5000.TIME TO NEW DEVELOPMENT RATE   4.
NUMBER OF YEARS BEFORE THE FLOOD   9.
THE FOLLOWING VALUES WERE USED TO DISTRIBUTE HA DEVELOPED BETWEEN COUNTRIES
 INITIAL  MALI - .1666 MAUR .3436 SENEGAL .4898
TOTAL POSSIBLE HA IN MALI -  23437.
FINIAL  MAUR .4125 SENEGAL .5875
INITIAL AREAS MALI    270. MAUR   5305. SENEGAL  23230.

                    AGRICULTURAL AREAS DATA TABLE
     YEAR        RATE        AI        ARD        ADD        AF      MALI    MAUR

INTERACTIVE OPTION DELAY SET TO      0 YEARS
     YEAR    MIVOLO     MIVOLA     RVOL     MAVOLO    MAVOLA     PVOL     SEVOL
-----------------------------------------------------------------------------
OUTPUT FORM NVOL DELAY.DAT FOR USE IN NBEN
 AGRICULTURAL VOLUMES DURING NAVIGATION DELAY
     YEAR      MALI   MAURITANIA  SENEGAL
 NAVIGATIONAL DELAY=   0 YEARS

 TOTAL YEARLY NAVIGATIONAL VOLUMES
      MALI        MAURITANIA        SENEGAL        TOTAL          YEAR

DATA FILE KEY.OUT
DISCOUNTED REVENUE TO EACH COUNTRY BY USER SECTOR

          TOTAL            MALI            MAURITANIA          SENEGAL

PW    74836819968.00   42245382144.00          0.00        32591435776.00
PROPORTIONS                0.564            0.000               0.435

FEES                      8.9608           8.9608              8.9603


WS    54399270912.00    6062768640.00   16678065152.00     31658434560.00
PROPORTIONS                0.111            0.307               0.582

FEES                      1.4681           1.4681              1.4681


NV   113752940544.00   92970000384.00   13328809984.00      7454126080.00
PROPORTIONS                0.817            0.117               0.066

FEES                      3.6288           3.6288              3.6288


TOTALS
     242989023232.00   141278150656.00   30006876160.00     71704002560.00
>START AT.T17
```

```
>START AT.T17

AT.T17 -- CONTINUING
>PIP *.OUT/PU
>PIP *.DAT/PU
>" DO YOU WANT ADDITIONAL PRINTED OUTPUT? [Y/N]: N
>:PAUSE TO ALLOW OUTPUT TO BE PRINTED TO RESUME TYPE [CR] AND THE FOLLOWING

AT.T17 --  PAUSING.  TO CONTINUE TYPE "START AT.T17<ESC>"
>
START AT.T17

AT.T17 -- CONTINUING
>" DO YOU WANT ADDITIONAL OUTPUT? [Y/N]: N
>PIP OUT.DUM:*/DE
>PIP *.*/PU
>" DO YOU WANT TO INVOKE ONE OF THE COMMAND FILES AGAIN? [Y/N]: Y
>:AVAILABLE COMMAND FILES ARE   "KEY"  AND "MANAGE"
>"        ENTER EITHER     "KEY" OR "MANAGE" (DO NOT ENTER ") [S]: MANAGE
>:COMMAND FILE MANAGE
>:A MASTER COMMAND FILE USED TO CALCULATE USER FEES AND EXAMINE CASH FLOW
>:AND ACCOUNTING OUTPUT
>:REMEMBER IF YOU MAKE A MISTAKE:
>:1. BEFORE YOU HIT RETURN, USE THE DELETE KEY TO REMOVE THE CHARACTER.
>:2. AFTER A RETURN A CONTROL Z WILL STOP THE
>:    PROGRAM AND THE OPTION WILL ALLOW YOU TO RUN THE PROGRAM AGAIN.
>:3. TO STOP THE COMMAND FILE, TYPE CONTROL Z TO A COMMAND FILE QUESTION.
>:    COMMAND FILE QUESTION START WITH  >:
>:4. ABORT AT.Tn   WHERE N IS THE TERMINAL NUMBER WILL ABORT THE PACKAGE.
>:
>: IN REPORT 5 COSTS AND BENEFITS WERE CALCULTED FOR THE DELAYED CASE
>: TO CALCULATE USER FEES.
>:
>:       THIS COMMAND FILE FOLLOWS THE FOLLOWING FLOW OF SECTIONS
>:
>:       BENEFITS->COSTS->LOANS->USER FEES->REVENUE->ACCOUNTING
>:
>:PAUSE TO READ THE ABOVE MESSAGE

AT.T17 --  PAUSING. TO CONTINUE TYPE "START AT.T17<ESC>"
>


START AT/T17

AT.T17 -- CONTINUING
>
>:COMMAND FILE BENEFITS.CMD
>:THIS FILE RUN THE BENEFIT SECTION OF THE COST
>:ALLOCATION PROGRAM
>RUN    AREA
IS THE NEW DEVELOPMENT RATE=5000. HA./YR? (Y/N)
Y
IS THE TIME TO NEW DEVELOPMENT RATE= 4 YEARS? (Y/N)
Y
IS THE TIME TO ARTIFICIAL FLOOD= 9 YEARS? (Y/N)
Y
IN REPORT 4 AND REPORT 5 THE FOLLOWING  PROPORTIONS WERE USED
TO SEPARATE TOTAL AREA DEVELOPED EACH YEAR BETWEEN THE 3 COUNTRIES
PROPORTION TO MALI 0.1666 PROPORTION TO MAUR 0.3436
PROPORTION TO SENEGAL 0.4898
AFTER  23437. HA HAS BEEN DEVELOPED IN MALI THE
PROPORTION TO MAUR 0.4125 PROPORTION TO SENEGAL 0.5875
THE INITIAL AREAS IRRIGATED ARE
MALI -     270. MAURITANIA -   5305. SENEGAL  23230. TOTAL =   28805.
ARE THESE VALUES TO BE USED FOR THIS MODEL RUN (Y/N)
>
```

```
>* DID YOU ENTER OPTIONS CORRECTLY? [Y/N]: Y
>RUN    WRITE
TT17  --  STOP

>RUN    AGBEN
DO YOU WANT INDIVIDUAL PRODUCT BENEFITS? (Y/N)
N
IS THE DEVELOPMENT COST PER NEW HECTAR =3560000 F.CFA?   (Y/N)
Y
IS THE REPLACEMENT COSTS FOR PUMPS =760000 F.CFA?  (Y/N)
Y
IS THE TIME TO PUMP REPLACEMENT =5 YEARS? (Y/N)
Y
IS THE PROJECT LIFE =50 YEARS? (Y/N)
Y
IS THE DISCOUNT RATE IN DECIMAL FORM=0.05? (Y/N)
Y
TT17  --  STOP

>* DID YOU ENTER OPTIONS CORRECTLY? [Y/N]: Y
>RUN    NVOL
IF THERE IS NO DELAY NAVIGATION STARTS IN 1988
USER SHOULD USE ZERO DELAY WHEN CALCULATING KEY
IS NAVIGATION DELAYED 5 YEARS? (Y/N)
Y
TT17  --  STOP

>* DID YOU ENTER OPTIONS CORRECTLY? [Y/N]: Y
>RUN    NBEN
IS THE DISCOUNT RATE IN DECIMAL FORM=0.05? (Y/N)
Y
IS PROJECT LIFE =50 YEARS? (Y/N)
Y
IS THE TARIFF FOR RAIL=14.5  F.CFA/TKM? (Y/N)
Y
IS THE TARIFF FOR TRUCKING PHOSPHATE=28.8  F.CFA/TKM? (Y/N)
Y
IS THE TARIFF FOR TRUCKING IN MALI=27.7  F.CFA/TKM? (Y/N)
Y
IS THE TARIFF FOR TRUCKING IN MAURITANIA=38.4  F.CFA/TKM? (Y/N)
Y
IS THE TARIFF FOR TRUCKING IN SENEGAL=21.1  F.CFA/TKM? (Y/N)
Y
TT17  --  STOP

>* DID YOU ENTER OPTIONS CORRECTLY? [Y/N]: Y
>RUN    ENGBEN
IS THE DISCOUNT RATE IN DECMAL FORM= 0.05, (Y/N) ? Y
IS THE ALTERNATIVE COST OF ENERGY GENERATION 31.28 KW- HR (Y/N) ? Y
IS THE EFFECTIVE ENERGY DISTRIBUTION  THE FOLLOWING PROPORTIONS
  TO  MALI(URBAN) = 0.5645TO MAURITANIA  = 0.0000
 TO SENEGAL(IRON MINE)  = 0.4355 (Y/N) ? Y
FOR CALCULATION OF KEY REPORT 5 USED NO DELAY START 1988
FOR CALCULATION OF USER FEES REPORT USED 7 YEAR DELAY
FOR THIS RUN USE A DELAY OF 7 YEARS Y/N  Y
TT17  --  STOP

>PIP *.DAT/PU
>* DID YOU ENTER OPTIONS CORRECTLY? [Y/N]: Y
>* DO YOU WANT OUTPUT PRINTED? [Y/N]: Y
>PRINT AREA.DAT.AGTAB.PRE.AGDATA.OUT.CHECK.OUT.AGBEN.OUT/NOJOB/LENGTH:60.
PRI - JOB 587, NAME "AREA     ", SUBMITTED TO QUEUE "PRINT "
>PRINT NAVTAB.PRE.NVOL.DAT.DELAY.DAT/NOJOB/LENGTH:60.
PRI - JOB 588, NAME "NAVTAB   ", SUBMITTED TO QUEUE "PRINT "
>PRINT NAVTAB.PRE.NVOL.DAT.DELAY.DAT/NOJOB/LENGTH:60.
PRI - JOB 588, NAME "NAVTAB   ", SUBMITTED TO QUEUE "PRINT "
>PRINT NBEN.OUT.AGCOST.DAT.ENERGY.PRE.ENGBEN.OUT/NOJOB/LENGTH:60.
PRI - JOB 589, NAME "NBEN     ", SUBMITTED TO QUEUE "PRINT "
>;THE PROCESSING OF THIS INDIRECT COMMAND FILE MUST
>;PAUSE HERE TO WAIT FOR THE OUTPUT FILE TO BE PRINTED
>;THE USER TYPES  [CR] AND MESSAGE WHEN THE OUTPUT FILE IS FINISHED PRINTING

AT.T17 --  PAUSING. TO CONTINUE TYPE "START AT.T17<ESC>"
>
START AT.T17

AT.T17 -- CONTINUING
>* DID YOU ENTER VALUES CORRECTLY IN BENEFITS? [Y/N]: Y
>;
>;YOU ARE NOW RUNING THE COST PACKAGE JUST BEFORE THE FEES PROGRAM AND
>;ACCOUNTING PACKAGE.
>;IN REPORT 5 THE COST SCHEDULE WITH DELAY WAS USED HERE.
>;RESPOND Y TO  USE DATA FILE COSTD.PRE
>;
>;       IF YOU ANSWER "Y" COSTD.PRE WILL BE USED
>;       IF YOU ANSWER "N" TO THE FOLLOWING QUESTION COSTND.PRE WILL BE USED
>;
>* USE DATA FILE COSTD.PRE? [Y/N]: Y
>PIP COST.PRE=COSTD.PRE
>* DID YOU ENTER CORRECT OPTION? [Y/N]: Y
>RUN    COSTCK
TT17  --  STOP

>RUN    COST
IS THE DISCOUNT RATE IN DECMAL FORM 0.05 (Y/N) ? Y
TT17  --  STOP

>PIP *.DAT/PU
>PIP COST.PRE/PU
>* DID YOU ENTER OPTIONS CORRECTLY? [Y/N]: Y
>* DO  YOU WANT PRINTED OUTPUT? [Y/N]: Y
>PRINT COST.PRE.COSTCK.OUT.DISSUM.OUT/NOJOB/LENGTH:60.
PRI - JOB 590, NAME "COST     ", SUBMITTED TO QUEUE "PRINT "
>;RESUME PROCESSING THE COMMAND FILE ONCE THE FILE HAS FINISHED PRINTING

AT.T17 --  PAUSING. TO CONTINUE TYPE "START AT.T17<ESC>"
>
START AT.T17

AT.T17 -- CONTINUING
>PIP *.*/PU
>;IN REPORT 5 THE OPTIONS CHOOSEN FOR THE ABOVE RUN OF THE COST PROGRAM WERE:
>;THE COST SCHEDULE WITH DELAY COSTD.PRE.
>* DID YOU ENTER CORRECT OPTIONS IN COST SECTION? [Y/N]: Y
>RUN MLOAN
 THIS PROGRAM GENERATES A REPAYMENT AND INTEREST
 SCHEDULE FOR SENEGAL RIVER PROJECT FINANCING.


 ARE AMOUNTS EXPRESSED IN -CFA- AT AN EXCHANGE RATE
 OF -245- APPROPRIATE? (Y/N) ? Y
IS THE DISCOUNT RATE 0.05 IN DECIMAL FORM ? (Y/N)
Y
PLEASE COPY ON PAPER THE DISCOUNTED COST OF THE
M DAM LOAN COSTS  THIS COST MUST BE ADDED TO
JOINT COSTS AND INPUT DURING THE USER FEES CALCULATION
THE INTEREST COST WILL BE CONTAINED IN FILE MCOST.OUT
NET PRESENT VALUE OF INTEREST CHARGES=  0.13419176E+11
TT17  --  STOP

>* DID YOU ENTER CORRECT OPTIONS IN MLOAN? [Y/N]: Y
```

```
THIS PROGRAM GENERATES A REPAYMENT AND INTEREST
 SCHEDULE FOR SENEGAL RIVER PROJECT FINANCING.


 ARE AMOUNTS EXPRESSED IN -CFA- AT AN EXCHANGE RATE
 OF -245- APPROPRIATE? (Y/N) ? Y
IS THE DISCOUNT RATE 0.05 IN DECIMAL FORM ? (Y/N)
Y
PLEASE COPY ON PAPER THE DISCOUNTED COST OF THE
D DAM LOAN COSTS  THIS COST MUST BE ADDED TO IRRIGATION
 COSTS AND INPUT DURING THE USER FEES CALCULATION
THE INTEREST COST WILL BE CONTAINED IN FILE DCOST.OUT
NET PRESENT VALUE OF INTEREST CHARGES=  0.51536143E+10
TT17  --  STOP

>" DID YOU ENTER CORRECT OPTIONS IN DLOAN? [Y/N]: Y
>;MLOAN.PRE.DLOAN.PRE.MCOST.OUT.DCOST.OUT
>" DO YOU WANT TO PRINT THE ABOVE FILES? [Y/N]: N
>;MPAY.OUT IS A LARGE FILE CONTAINING DETAILED
>;LOAN INFORMATION.  THIS INFORMATION IS
>;SUMMARIZED IN THE ACCOUNTING OUTPUT.
>;DO NOT PRINT MPAY.OUT UNLESS THE EXTRA DETAIL IS NEEDED
>" DO YOU WANT TO PRINT MPAY.OUT? [Y/N]: N
>;DPAY.OUT IS A LARGE FILE CONTAINING DETAILED
>;LOAN INFORMATION.  THIS INFORMATION IS
>;SUMMARIZED IN THE ACCOUNTING OUTPUT.
>;DO NOT PRINT DPAY.OUT UNLESS THE EXTRA DETAIL IS NEEDED
>" DO YOU WANT TO PRINT DPAY.OUT? [Y/N]: N
>" DID YOU ENTER CORRECT OPTION IN LOAN SECTION? [Y/N]: Y
>;
>;PAUSE TO GATHER DATA NECESSAY FOR RUNNING FEES PROGRAM

AT.T17 --  PAUSING. TO CONTINUE TYPE "START AT.T17<ESC>"
>
START AT.T17

AT.T17 -- CONTINUING
>;
>RUN FEES
IS THE NUMBER OF YEARS THE MODEL WILL RUN 50 (Y/N) ? Y
ENTER TODAYS DATE   MAXIMUM 40 CHARACTERS
 ? 12-JULY-85
ARE DISCOUNTED QUANTITIES TO BE READ FROM DATA FILES(Y/N) ? Y
 37054169088.00 = DISCOUNTED QUANTITY OF WATER (Y/N) ? Y

  5860275712.00 = DISCOUNTED QUANTITY OF ENERGY (Y/N) ? Y

 28719085568.00 = DISCOUNTED QUANTITY OF NAVIGATION (Y/N) ? Y

  0.3651565 = PROPORTION OF JOINT COST
ALLOCATED TO AGRICULTURE SECTOR (Y/N) ? Y

  0.3848101 = PROPORTION OF JOINT COST
ALLOCATED TO ENERGY SECTOR (Y/N) ? Y

  0.2500334 = PROPORTION OF JOINT COST
ALLOCATED TO NAVIGATION SECTOR (Y/N) ? Y

ENTER SPECIFIC COST
COSTS OF INFRASTRUCTURE
COMPONENTS.OPERATION AND MAINTENANCE WHICH
ARE REQUIRED EXCLUSIVELY BY AN IDENTIFIABLE
SERVICE SECTOR AND, THEREFORE, ARE NOT
INCLUDED IN THE COMMON WORKS COST
VALUES ARE FROM FILE DISSGM.OUT
```

```
ENERGY.PRE  DATA FILE FOR POWER BENEFIT PROGRAM  BENPWR
THESE ARE THE VALUES USED BY DAVE BOWLES FOR REPORT 5
(EXCEPT TO OBTAIN 261 E 9 BENEFITS DAVE BOWLES STARTED
ENERGY GENERATION IN 1989. 151 GW WAS IN 1989 INSTAEAD
OF 1995)
 ENERGY DELAY =        7
      QUANTITY        UNDISCOUNTED BENEFIT
 ------------------------------------------------------------------------
 NBEN.OUT -- OUTPUT FROM NBEN INTERACTIVE INPUT FOR COST ALLOCATION
 DISCOUNT RATE 0.050 NUMBER OF YEARS    50AND THE FOLLOWING TARIFFS
 RAIL= 14.50 TRUCKING PHOSPHATE= 28.80 TRUCK MALI= 27.70 TRUCK MAUR.= 38.40TRUCK
 ------------------------------------------------------------------------
 OUTPUT FROM NVOL.FTN--NVOL.DAT FOR USE IN NBEN
   THE FOLLOWING INPUT FILES WERE USED

  NAVTAB.PRE INPUT FOR NVOL
  BREAKDOWN OF NAVIGATIONAL VOLUMES DATA.UNITS T-KM

 OUTPUT FROM AREA.FTN USED AS INPUT FOR AGBEN
 VALUES OF OPTIONS USED FOR THIS RUN ARE
NEW DEVELOPMENT RATE   5000.TIME TO NEW DEVELOPMENT RATE   4.
 NUME   OF YEARS BEFORE THE FLOOD   9.
 THE FOLLOWING VALUES WERE USED TO DISTRIBUTE HA DEVELOPED BETWEEN COUNTRIES
  INITIAL  MALI = .1666 MAUR .3436 SENEGAL .4898
 TOTAL POSSIBLE HA IN MALI =  23437.
 FINIAL  MAUR .4125 SENEGAL .5875
 INITIAL AREAS MALI    270. MAUR   5305. SENEGAL  23230.

                    AGRICULTURAL AREAS DATA TABLE
      YEAR        RATE        AI        ARD        ADD        AF      MALI   MAUR


 INTERACTIVE OPTION DELAY SET TO        5 YEARS
      YEAR    MIVOLO     MIVOLA     RVOL     MAVOLO    MAVOLA     PVOL     SEVOL
 ------------------------------------------------------------------------
 OUTPUT FORM NVOL DELAY.DAT FOR USE IN NBEN
  AGRICULTURAL VOLUMES DURING NAVIGATION DELAY
      YEAR      MALI   MAURITANIA  SENEGAL
  NAVIGATIONAL DELAY=   5 YEARS

    NAVIGATIONAL BENEFITS
      YEAR   MIBEN      RBEN      MABEN      PBEN      SEBEN      AGBEN      NBEN
  DISCOUNTED QUANTITY OF WATER CONSUMED  3.7054169E+10
  THE DISCOUNTED QUANTITY OF POWER CONSUMED  5.8602757E+09
  THE DISCOUNTED VOLUME OF NAVIGATION  2.8719086E+10
  THE SPECIFIC COST TO IRRIGATION    3.0012000E+10
  THE SPECIFIC COST TO ENERGY        2.7776000E+10
  THE SPECIFIC COST TO NAVIGATION    7.7253001E+10
  THE SEPARABLE COST TO IRRIGATION   6.5340001E+09
  THE SEPARABLE COST TO ENERGY       1.6943000E+10
  THE SEPARABLE COST TO NAVIGATION   3.2670001E+09
  JOINT COST                          6.2310998E+10
  PROPORTION OF JOINT TO IRRIGATION   0.3651565
  PROPORTION OF JOINT TO ENERGY       0.3848101
  PROPORTION OF JOINT TO NAVIGATION   0.2500334
  TOTAL COST TO IRRIGATION           5.9299267E+10
  TOTAL COST TO ENERGY         6.8696904E+10
  TOTAL COST TO NAVIGATION             9.6099836E+10
 THE USER FEES

IRRIGATION  ENERGY       NAVIGATION
1.60034      11.7225      3.34620
>" DO YOU WANT A PRINTED COPY OF FEES.DAT TO CHECK INPUT FOR REVENUE? [Y/N]: Y
>PIP OUT.DUM=ALLOCA.OUT.FEES.DAT.FEES.OUT
>PRINT  OUT.DUM/NOJOB/LENGTH:60.
PRI - Job 591  name "OUT        "  SUBMITTED TO QUEUE "PRINT "
```

```
>PRINT OUT.DUM/NOJOB/LENGTH:60.
PRI - Job 591, name "OUT      ", submitted to queue "PRINT "
>* DID YOU INPUT THE CORRECT VALUES TO FEES? [Y/N]: Y
>* DO YOU WANT TO EDIT FEES.DAT? [Y/N]: N
>RUN REVENU
IS THE DISCOUNT RATE IN DECIMAL FORM .05 Y/N ? Y
TT17  --  STOP

>* DID YOU INPUT THE CORRECT OPTION IN REVENU? [Y/N]: Y
>RUN PREACC
ENTER NUMBER OF YEARS  OF INPUT ? 50
TT17  --  STOP

>* DID YOU ENTER OPTIONS CORRECTLY? [Y/N]: Y
>;
>;THE USER SHOULD DELETE PREVIOUS OUTPUT FILES FROM THE ACCOUNTING PROGRAM
>;TYPE  Y     TO DELETE OLD ACCOUNTING OUTPUT FILES
>PIP ACCOUN.OUT;*/SD
PIP -- No such file(s)
SY0:[217,103]ACCOUN.OUT;*
>RUN ACCOUN
PROMPT FOR USER TO ENTER WHICH YEARS TO PRINT OUTPUT
ENTER UP TO 25 INTEGERS IN ASSENDING ORDER
INDICATING YEARS FROM THE BEGINING TO PRINT
NUMBERS OF YEARS TO PRINT ? 10
INTEGERS ? 1,2,3,4,5,10,20,30,40,50 WILL PRINT YEAR 1 AND ETC.
NUMBER OF YEARS TO PRINT ?2
INTEGERS ?1,50
TT17  --  STOP

>PIP *.OUT/PU
>PIP *.DAT/PU
>PRINT ACCOUN.OUT/NOJOB/LENGTH:65.
PRI - Job 592, name "ACCOUN   ", submitted to queue "PRINT "
>PRINT SUMMAR.OUT/NOJOB
PRI - Job 593, name "SUMMAR   ", submitted to queue "PRINT "
>;PAUSE TO EXAMINE ACCOUNTING OUTPUT

AT.T17 -- Pausing. To continue type "START AT.T17<ESC>"
>
START AT.T17

AT.T17 -- Continuing
>;TO GET DIFFERENT YEARS IN THE ACCOUNTING OUTPUT RUN ACCOUNTING PROGRAM
>* DO YOU WANT TO RUN THE ACCOUNTING PROGRAM AGAIN ? [Y/N]: N
>* DO YOU WANT ADDITIONAL PRINTED OUTPUT? [Y/N]: N
>;PAUSE TO ALLOW OUTPUT TO BE PRINTED TO RESUME TYPE [CR] AND THE FOLLOWING

AT.T17 -- Pausing. To continue type "START AT.T17<ESC>"
>
START AT.T17

AT.T17 -- Continuing
>* DO YOU WANT ADDITIONAL OUTPUT? [Y/N]: N
>PIP OUT.DUM:*/DE
>PIP *.*/PU
>* DO YOU WANT TO INVOKE ONE OF THE COMMAND FILES AGAIN? [Y/N]: N
>@ <EOF>
>
>
>
>
>
>
>
>
>
>
```

```
;COMMAND FILE MAIN
;        USER HAS OPTION OF 1) EXITING FROM COMMAND FILE
;        AND RUNNING PROGRAMS INDIVIDUALLY
;        2)INVOKING COMMAND FILE KEY USED TO CALCULATE
;        BENEFITS,COSTS,COST ALLOCATION AND ALLOCATION KEY
;        3)OR INVOKING COMMAND FILE MANAGE USED TO
;        CALCULATE BENEFITS,COST,USER FEES,REVENUES,
;        CASH FLOW, LOAN INFORMATION AND DETAILED
;        ACCOUNTING INFORMATION.
;
.ENABLE SUBSTITUTION
.ASK    OK  DO YOU WANT TO INVOKE ONE OF THE COMMAND FILES
.IFF    OK       .GOTO 20
.10:
;AVAILABLE COMMAND FILES ARE    "KEY"  AND "MANAGE"
.ASKS   NAME    ENTER EITHER    "KEY" OR "MANAGE" (DO NOT ENTER ")
@'NAME'
.ASK OK DO YOU WANT TO INVOKE ONE OF THE COMMAND FILES AGAIN
.IFT    OK       .GOTO 10
.20:
.EXIT
```

```
;COMMAND FILE KEY
;A  COMMAND FILE FOR CALCULATION OF KEY
;THIS COMMAND FILE FOLLOWS THE FOLLOWING ORDER
;
;  BENEFITS -> COST WITHOUT DELAY ->COST ALLOCATION ->FEES->REV
;  AND THEN KEY CALCULATION
;  IN REPORT 5 ALL THESE CALCULATIONS WERE BASED ON COST AND QUANTITY
;  STREAMS WITH NO DELAY
;
;REMEMBER IF YOU MAKE A MISTAKE:
;1. BEFORE YOU HIT RETURN, USE THE DELETE KEY TO REMOVE THE CHARACTER.
;2. AFTER A RETURN A CONTROL Z WILL STOP THE
;   PROGRAM AND THE OPTION WILL ALLOW YOU TO RUN THE PROGRAM AGAIN.
;3. TO STOP THE COMMAND FILE, TYPE CONTROL Z TO A COMMAND FILE QUESTION.
;   COMMAND FILE QUESTION START WITH  >;
;4. ABORT ALLN   WHERE N IS THE TERMINAL NUMBER WILL ABORT THE PACKAGE.
;PAUSE TO READ THE ABOVE MESSAGE
.PAUSE
.5:
@BENEFITS
.ASK OK DID YOU ENTER VALUES CORRECTLY IN BENEFITS
.IFF OK .GOTO 5
.10:
;        THE COST PROGRAM WILL BE RUN TWO TIMES BY THE COMMAND PACKAGE.
;        EACH TIME BEFORE THE COST PROGRAM IS RUN. YOU WILL BE ASKED TO
;        CHOSE BETWEEN COST SCHEDULE WITH DELAY AND COST SCHEDULE WITHOUT
;        DELAY.
;        IN REPORT 5 THE COST SCHEDULE WITHOUT DELAY WAS USED IN THE
;        COST ALLOCATION.  THE COST SCHEDULE WITH DELAY WAS
;        USED TO CALCULATE USER FEES.
;
;PAUSE TO READ THE ABOVE MESSAGE
.PAUSE
;YOU ARE ON PASS ONE BEFORE COST ALLOCATION.
;IN REPORT 5 THE COST SCHEDULE WITHOUT DELAY(COSTND.PRE) WAS USED HERE.
;
;RESPOND  N TO  TO THE FOLLOWING PROMPT TO USE COST SCHEDULE WITHOUT DELAY
;COSTD.PRE? [Y/N]    SAMPLE PROMPT LINE WHICH WILL APPEAR
;
@COSTS
;IN REPORT 5 THE FOLLOWING OPTIONS WOULD HAD BEEN USED ABOVE IN COSTS
.FOR COST DATA   COSTND.PRE
.ASK OK DID YOU ENTER VALUES CORRECTLY IN COSTS
.IFF OK .GOTO 10
;
;PAUSE FOR GATHERING DATA NECESSARY TO RUN ALLOCATE
.PAUSE
.15:
RUN ALLOCA
PIP TI:=ALLOCA.OUT
.ASK PRINT DO YOU WANT TO PRINT A COPY OF ALLOCATE OUTPUT
.IFF PRINT       .GOTO 17
PRINT  ALLOCA.OUT/NOJOB
;PAUSE TO GET PRINT OUT WITH COST ALLOCATION
.PAUSE
.17:
.ASK OK DID YOU INPUT THE CORRECT VALUES TO  ALLOCATE
.IFF  OK .GOTO 15
.19:
;PAUSE TO GATHER DATA NECESSAY FOR RUNNING FEES PROGRAM
```

Appendix C

General Discussion of Indirect Command Files and Command Line Commands

The indirect command processor allows MCR, PIP, and DCL command lines to be placed in a file. The file is then executed as though the command lines were entered from a terminal. CMD is the default type for command files. Command files are invoked by typing @ filename. The indirect command processor can be stopped by typing a CTRL C and then ABORT taskname, often ... AT. The command file can also be stopped by typing a CTRL Z to a command file prompt. Indirect command processor commands and MCR commands used in the models command files are listed and discussed briefly in this section. A more detailed description of indirect command files can be found in the RSX11 MCR manual. The basic format used for indirect command processor commands in ".COMMAND" (example .ASKS). A ";" at the beginning of the line indicates a line of comment. A ".;" indicates a line of comment which will not be displayed at the terminal during the running of the command file. The following indirect commands were used in the model and will be discussed briefly.

.ASK
.ASKS
.ENABLE
.EXIT
.GOTO
.IFF
.IFT
.label of the form .n:
.PAUSE

.ASK

Defines or redefines a logical symbol and assigns it a true or false value.

Format:

```
.ASK sym txt
sym - logical symbol name consisting of 1 through 6
      alphanumeric characters
```

Example:

```
.ASK OK DID you enter correct option
Produces:
*DID you enter correct option [Y/N]?
```

.ASKS

Defines or redefines a string symbol and assigns it an ASCII test string up to 80(10) bytes in length.

Format:

```
.ASKS sym txt
where
```

sdm - logical symbol name consisting of 1 through 6 alphanumeric characters
txt - test to be displayed on the output display line.

Example:

```
.ASKS name Enter file to be printed
Produces:
*Enter file to be printed
```

ENABLE

With the .ENABLE and .DISABLE commands, several indirect operating modes can be controlled. These modes are:

Mode	Default setting	Scope	Default Effect
ATTACH	Enabled	G	Indirect attaches to TI; for command lines
CONTROL-Z	Disabled	G	CTRL/Z in response to .ASKS exits Indirect
DECIMAL	Disabled	G	Numeric symbols are created as OCTAL
DETACH	Enabled	L	Indirect detaches from TI; for command lines
LOWERCASE	Enabled	L	Indirect is not sensitive to the case of commands or strings.
MCR	Enabled	L	Commands not processed by Indirect are passed to the default CLI for the terminal
QUIET	Disabled	L	Comments and CLI commands are displayed on the terminal
SUBSTITUTION	Disab.	L	String substitution is not performed before command line evaluation.

.EXIT

Leaves a BEGIN-END block or a command file, optionally specifying exit status. The exit status value can be any 16-bit encoded value. This value will be available in the next outer command file as the value of <EXSTAT> or to the task that spawned Indirect as the exit status value (RSX-11M-Plus only).

Format:

```
.EXIT [n]
where n is the numeric expression for the exit status
```

.GOTO label

Branches to a label.

Format example:

```
GOTO ERROR
.EXIT 1
.ERROR: ; Warning, error encountered
```

Additional example

```
.GOTO 5
.5:  run Alloca
```

.IFT/.IFF

Determines whether a logical symbol is true or false.
Example:
.IFF OK .GOTO 5 produces a branch to label 5 if OK is false, falls through to next line if true.

.LABEL

Assigns a name to a line in the command file so that the line can be referenced. For example:

```
        .GOTO CLNUP          !  Jump to clean-up routine

                             !  Beginning of clean-up code
.CLNUP;
```

Labels that are placed alone on command lines are called Direct Access. Indirect remembers the exact location of these labels, and they can be used to decrease search time for .GOTO and .SOSUB directives.

.PAUSE

Suspends execution of the command file until user types message given on terminal when action suspended (usually of form UNS...AT2). While execution is suspended usually can use MCR, PIP, or DCL commands and edit files as need be. The only file that should not be changed is the command file itself.

MCR DCL commands

Hello and Run are the two MCR commands used. You must see your system manager for Log-in instructions. Help for Hello and other commands can be had by typing Help, Hello, or Help/MCR or Help/DCL. You need not be logged in to get help.

RUN

The RUN command can be used to initiate the execution of either an installed tasks or an uninstalled tasks from a task image file. Most RUN commands are of this variety. The RUN command in this case is a combination INSTALL-RUN-REMOVE command. The $ requests that the task be run from a file in the System Director (or Library Directory on RSC-11M-PLUS).
Example: RUN LONPAK

PIP commands

PIP performs Files-11 file manipulation function, such as copying, transferring, and renaming files. The general format for PIP commands involving two or more files is:
PIP Outfile/switches - Infile/switches
The command line most often used in the model is:
PIP Outfile = Infile1, Infile2, etc.
This command line copies files Infile1, Infile2, and the rest into one file outfile.

WILDCARDS

PIP also allows wildcards in file specifications to take the place of explicit specifications. The wildcard characters are as follows:

* - Match one or more alphanumeric character
% - Match exactly one alphanumeric character

Wildcard characters only have meaning in the filename and filetype fields of the file specification. You cannot use wildcard characters when a wildcard or null field would mean to default the field from the input file specification. You can use wildcards with date switches.

Examples:

*A.TMP = Match any file name that ends in A., such as A.TMP or CDA.TMP

A.TMP = Match any file name that contains an A anywhere in the file name, such as A.TMP, AB.TMP, or CFA.TMP.

%A.TMP = Match any file names that have exactly two characters and end with a, such as BA.TMP.

SPOOL (infile(s)/SP[:n])

Specifies a list of files to be printed, where n is the number of copies. File identification must be explicit, that is, filename, filetype; version must all be specified.

Example: PIP ALLOCA.OUT/SP

SELECTIVE DELETE (infile(s)/SD)

Prompts for user response before deleting the specified files. The version number must be explicit or wild (8). PIP prompts you with a candidate file from the close specified in the command line. Your response choices are the letters Y, N, G, or Q, followed by either a carriage return (<RET>) or a control-Z (CTRL/Z).

Example: OUT;*/SD

PURGE (infile(s)/PUC:n)[/LD]

Deletes a specified range of versions of a file (but never deletes the latest version). Specification of a file version is not necessary. Wildcards are valid for the file name and type. When you specify :n, PIP deletes all but the n latest contiguous versions of a file. Without :n, PIP deletes all but the latest version of the file.

Example: PIP *.*/PU

Appendix D

Supporting Data for Environment Cost Calculation from Gannett-Fleming (1979)

ble D.1. Value of wood lost from various forest types.

Forest Type	Productivity * (m^3/ha)	Area Affected (Ha)		Cubic Meters of Wood		Kg Per Cubic Meter		CFA per Kg		Total Value (CFA)	Value Per Year[1] (CFA)
Diéri	0.43	4,300	=	1,849	x	500	x	20	=	18,490,000	924,500
Forest Savanna (dryland)	10.23	42,400	=	433,752	x	500	x	20	=	4,337,520,000	216,876,000
Forest Savanna (fringing forest)	20.18	530	=	10,695	x	500	x	20	=	106,954,000	5,347,000
Gonakié	129	1,065	=	137,385	x	800	x	20	=	2,198,160,000	109,908,000
Gonakié (forest occasionally flooded)	97	7,570	=	734,290	x	800	x	20	=	11,748,640,000	587,432,000
								TOTAL			920,488,200

[1] Value/year (CFA) = Total Value (CFA) / 20 year Rotation Cycle.

* Estimated.

Table D.2. Maximum surface areas flooded by region during Five representative floods.

Flood	Region*	Maximum Surface Area Flooded, in 1000 ha.					
		Scenario 1 Present	Scenario 2 1986	Scenario 3 1987	Scenario 4 2002	Scenario 5 2003	Scenario 6 2028
Largest recorded flood (1924)	HMV	141	139	140	130	133	99
	CMV	291	269	270	230	234	157
	LMV	257	252	246	220	223	180
	Delta	174	153	150	130	133	142
	Total	838	797	777	680	690	560
Once-in-5-year high flood (1964)	HMV	139	138	119	110	125	99
	CMV	286	263	211	210	221	156
	LMV	240	236	185	160	178	143
	Delta	168	143	130	110	117	120
	Total	766	733	605	550	565	470
Average Flood (1969)	HMV	105	102	50	48	28	20
	CMV	212	187	119	114	66	50
	LMV	160	160	91	79	51	41
	Delta	143	124	110	98	91	92
	Total	549	525	340	320	230	190
Once-in-5-year low flood (1926)	HMV	25	25	50	48	10	9
	CMV	66	61	113	108	22	19
	LMV	47	53	78	70	16	13
	Delta	84	99	108	98	85	89
	Total	215	232	328	300	130	130

Table D.2. Continued.

Flood	Region	Maximum Surface Area Flooded, in 1000 ha.					
		Scenario 1 Present	Scenario 2 1986	Scenario 3 1987	Scenario 4 2002	Scenario 5 2003	Scenario 6 2028
Smallest recorded flood (1972	HMV	10	10	50	47	9	8
	CMV	22	21	100	93	16	14
	LMV	15	18	65	57	12	11
	Delta	60	84	103	91	77	81
	Total	104	130	300	280	107	110

* HMV : High Middle Valley; Matam - Bakel

CMV : Central Middle Valley; Boghé - Matam

LMV : Low Middle Valley; Dagana - Boghé

Delta : Saint-Louis - Dagana

Notes: (1) Flooding includes inundation of the main channels of the Senegal River and Doué Marigot.

(2) Total flooding does not equal the sum of areas flooded in the four regions, because the date of maximum flooding is different in each region.

Table D.3. Fish production, Senegal River basin, including gain of fishes from irrigation canals with project (Scenario 2).

Value 50 CFA/kg	Number of Fishermen*	Year	Gain in Irrigated Land (ha)**	Event	Production
15.0×10^8	15,000	1977	--	--	30,000
15.0×10^8	15,000	1978	--	--	30,000
15.0×10^8	15,000	1979	--	--	30,000
10.0×10^8	10,000	1980	--	Diama dam closes-lose fish	20,000
10.2×10^8	10,250	1981	5,000	--	--
10.2×10^8	10,250	1982	10,000	--	20,507
10.2×10^8	10,250	1983	15,000	--	20,514
10.2×10^8	10,250	1984	20,000	--	20,528
4.2×10^8	4,250	1985	25,000	Manantali Dam Closes	8,535
5.3×10^8	5,300	1986	30,000	--	10,642
7.4×10^8	7,395	1987	35,000	--	14,839
8.39×10^8	8,365	1988	40,000	--	16,786
9.27×10^8	9,248	1989	45,000	--	18,558
8.8×10^8	8,802	1990	50,000	--	17,675
8.0×10^8	8,007	1991	55,000	--	16,092

* Number of fisherman does not change because small field production gained from irrigation canals would be for self-consumption.

** Increments of 5,000 ha/yr, but only 10% would be usable canals, x 15kg of fish/ha/yr.

Table D.3. Continued.

Value 500 CFA/kg	Number of Fishermen*	Year	Gain in Irrigated Land (ha) **	Event	Production
7.7×10^8	7,745	1992	60,000	--	15,574
7.4×10^8	7,395	1993	65,000	--	14,871
7.08×10^8	7,035	1994	70,000	--	14,168
7.08×10^8		1995	75,000	--	14,175
7.09×10^8		1996	80,000	--	14,182
7.09×10^8		1997	85,000	--	14,189
7.09×10^8		1998	90,000	--	14,196
7.09×10^8		1999	95,000	--	14,203
7.1×10^8		2000	100,000	--	14,210
7.1×10^8		2001	105,000	--	14,217
		2002	110,000	--	14,224
		2003	115,000	--	14,231
		2004	120,000	--	14,238
		2005	125,000	--	14,245
		2006	130,000	--	14,252
		2007	135,000	--	14,259
		2008	140,000	--	14,266
		2009	145,000	--	14,273
		2010	150,000	--	14,280
					14,287

Table D.4. Production in the Senegal River after project implementation (in tons).

Year	Diama Dam Loss in Estuary	Manantali Dam - loss in Flood-plain	Manantali Impound-ment Gain	Lac de Guiers Gain	Aftout es Sahel Gain *	Lac R'Kiz Gain	Total Fish Pro-duction	Fishermen Required	Deficit in Senegal River Due to Project	Value of Production in CFA x 10^8
1979 * Through 1983							30,000	15,000	ø	15
1984	10,000						20,000	10,000	10,000	10
1985	10,000	12,000		500			8,500	4,250	21,000	4
1986	10,000	12,000	2100	500			10,600	5,300	19,400	5
1987	10,000	12,000	2800	500	3000	720	15,020	7,510	14,980	7
1988	10,000	12,000	3500	500	4000	960	16,960	8,480	13,040	8
1989	10,000	12,000	4025	500	5000	1200	18,725	9,363	11,275	9
1990	10,000	12,000	4375	500	4000	960	17,835	8,918	12,165	9
1991	10,000	12,000	4025	500	3000	720	16,245	8,123	13,755	8
1992	10,000	12,000	3500	500	3000	720	15,720	7,860	14,280	8
1993	10,000	12,000	2800	500	3000	720	15,020	7,510	14,980	7
1994* Through 2028	10,000	12,000	2100	500	3000	720	14,320	7,160	15,680	7

* each year

Appendix E

Computer Program Listing

```
C               PROGRAM    PREACC
C  PROGRAM TO READ IN ACCOUNT NUMBER, C OR D CODE
C  AND VALUES FROM DIFFERENT FILES AND OUTPUT
C  ACCOUNTS WITH VALUES MERGED, SO THAT ONLY ONE
C  VALUE FOR EACH ACCOUNT NUMBER IS OUTPUTED
C  IF THE VALUE IN THE ACCOUNT IS ZERO NO VALUE WILL BE PRINTED
C  OUT IN VALUE.DAT
C
C-----------------------------------------------------------------
C       PROGRAM MUST BE TASK BUILT WITH ACTFIL=7
C                                       UNITS=7
C               SUBROUTINE
C       ZERO    ZEROS THE ARRAY STOVAL AT THE BEGINING OF EACH YEAR
C
C       MERGE   MERGES AMOUNTS WITH SAME ACCOUNT NUMBER
C
C       OUTPUT  PUTS INTO FILE VALUE.DAT AMOUNT,ACCOUNT NUMBER AND C
C               IF ZERO AMOUNT NO LINE IS WRITTEN OUT
C               0000            S  is the line written out at the end
C               of each year
C
C-----------------------------------------------------------------
C  OUTPUT WILL ENTER THE ACCOUNTING,BALANCE SHEET
C  PROGRAM

C
C  NUMACC          200 IS THE MAXIMUM NUMBER OF ACCOUNTS IN THE
C                  ACCOUNTING BALANCE ALLOWED IN THE INPUT ACCOUNTS FILE
C                  AT PRESENT OCT 8,1982 185 ACCOUNTS ARE ON THE BALCE SHEET
C                  OUTPUT PROGRAM, IF THE NUMBER OF ACCOUNTS ARE CHANGED
C                  185 IN THE ACCOUN.PRE FILE MUST BE CHANGED
C                   IF MORE THAN 200 ARE USED THEN CHANGES MUST BE
C                  MADE IN THE DIMENSION AND DATA STATEMENTS
C
C
C       ACC(I)     = Array storing the list of account numbers
C       ACCIN(I)   = Array with the account numbers read in from input
C                    files COST.DAT,REVENU.DAT,LOAN.DAT
C
C       LOAN       = Logical variable T if loan cost data is to be read in
C       LTITLE(I)  = Array with the number of lines of comment read in
C                    from each data file
C       LSUM       = Total number of lines of comment to be written out
C       NCORD(I)   = ARRAY WITH THE CREDIT CODE
C       NACC       = NUMBER OF ACCOUNTS INPUT BY SPECIFIC INPUT
C                     DATA FILE,READ IN FOR EACH DATA FILE EACH YEAR
C                    THE NUMBER OF VALUES IS ONE HALF NACC
C       NDUM(I)    = Array storing the list of credit code all C for output
C       NFILES     = Number of files to read data from excluding ACCOUN.PRE
C       NUMACC     = Number of accounts read in from  ACCOUN.PRE
C       NYEARS     = Number of years of output data: set by user
C       STOVAL(I)  = Array storing the yearly sum of  account I
C                    values are read into VALUE then merged into STOVAL
C       REVIS      = Logical variable  T if revise cost data is to be read in
C       VALUE(I)   = ARRAY CONTAINING input from files COST.DAT,REVENU.DAT
C                    LOAN.DAT; the amount associated with ACCIN(i)
C
C ****************************************************************
C
      DOUBLE PRECISION VALUE(300),STOVAL(300)
      DIMENSION ACC(300),NDUM(300)
      DIMENSION ACCIN(300),NCORD(300)
      COMMON /STORE/ ACC,NDUM,STOVAL
      COMMON /INPUT/ ACCIN,NCORD,VALUE
      DATA NDUM/300*'C'/
      DIMENSION NTITLE(80),LTITLE(7)
      INTEGER ACC,ACCIN
      LOGICAL DLOAN,MLOAN
C  READ IN LIST OF ACCOUNT NUMBERS
      OPEN (UNIT=4,NAME='ACCOUN.PRE ',TYPE='OLD')
      READ(4,*)LTITLE(4)
      DO 21 I=1,LTITLE(4)
      READ(4,107)NTITLE
 21   CONTINUE
      NUMACC=0
      DO 613 I613=1,200
      READ(4,615,END=616)ACC(I613)
      NUMACC=NUMACC+1
613   CONTINUE
615   FORMAT(I4)
616   CONTINUE
      CLOSE (UNIT=4,DISP='KEEP')
      OPEN (UNIT=1,NAME='COST.DAT',TYPE='OLD')
      OPEN (UNIT=2,NAME='REVENU.DAT',TYPE='OLD')
C -----------------------------------------------------------------
C
C            ENTER OPEN STATEMENTS FOR EACH DATA FILES ADDED
C  USER INPUTS IF DLOAN COST FILE AND/OR MLOANE.DAT ARE TO
C  BE READ IN ON THIS RUN
C
      WRITE(5,6016)
6016  FORMAT(1X,'ENTER NUMBER OF YEARS  OF INPUT ? ',$)
      READ(5,*)NYEARS
C     LOAN=.FALSE.
C     REVIS=.FALSE.
C*****************************************MLOAN AND DLOAN WILL NOW BE READ
C                                          IN EACH RUN
C     WRITE(5,6017)
6017  FORMAT(1X,'READ IN  LOAN.DAT  (Y/N) ? ',$)
C     READ(5,460)INDAT
460   FORMAT(A1)
C     IF(INDAT.EQ.'Y')LOAN=.TRUE.
C     WRITE(5,*)'READ IN MLOANE.DAT (Y/N)'
C     READ(5,460)INDAT
C     IF(INDAT.EQ.'Y')MLOAN=.TRUE.
      DLOAN=.TRUE.
      MLOAN=.TRUE.
      IF(DLOAN)OPEN(UNIT=3,NAME='DLOAN.DAT',TYPE='OLD',ERR=801)
      IF(MLOAN)OPEN(UNIT=4,NAME='MLOAN.DAT',TYPE='OLD',ERR=802)
C-----------------------------------------------------------------
C
C OPEN OUTPUT FILE
      OPEN (UNIT=7,NAME='VALUE.DAT',TYPE='NEW',CARRIAGECONTROL='LIST')
D 2   WRITE(7,457)ACC
457   FORMAT(10(1X,I4))
C
C
C
C  FIRST READ HOW MANY LINES OF HEADING ARE AT THE FIRST OF EACH FILE
C  AND THEN READ AND WRITE OUT THE HEADING TO THE TOP OF THE OUTPUT FILE
C
C ***********************************************????????????????
C
C   I NEED TO SUM UP THE LENGTH OF THE TITLES AND THEN WRITE OUT SUM OF LINES
C   USED FOR INFORMATION AND THE TOP OF THE OUTPUT FILE
C   USE AN LTITLE( ) FOR EACH INPUT FILE
        READ(1,*)LTITLE(1)
      READ(2,*)LTITLE(2)
```

```
      NFILES=2
      IF(DLOAN)READ(3,*)LTITLE(3)
      IF(MLOAN)READ(4,*)LTITLE(4)
      IF(DLOAN)NFILES=NFILES+1
      IF(MLOAN)NFILES=NFILES+1
      DO 4 I=1,NFILES
      LSUM=LSUM+LTITLE(I)
 4    CONTINUE
C
      WRITE(7,104)LSUM+1,NYEARS
104   FORMAT(I4,I4)
C  INSERT SIMILAR LOOP FOR EACH INPUT FILE
C
C
      WRITE(7,*)'THE FOLLOWING DATA FILES WERE USED IN PROGRAM PREACC'
      DO 7 K=1,NFILES
      DO 5 I=1,LTITLE(K)
      READ(K,107)NTITLE
      WRITE(7,107)NTITLE
 107  FORMAT(80A1)
   5  CONTINUE
  7   CONTINUE
C
C88888888888888888888888888888888888888888888888888888888888888888888
C     IF(.NOT.DLOAN)GO TO 15
C     DO 12 I=1,LTITLE(3)
C     READ(3,107)NTITLE
C     WRITE(7,107)NTITLE
C 12  CONTINUE
C 15  CONTINUE
C88888888888888888888888888888888888888888888888888888888888888888888C
C
C              INPUT ACCOUNT NUMBER, C OR D CODE AND VALUE
C              LOOP FOR EACH YEAR
C
C
C
      DO 80 I80=1,NYEARS
C
C   ZERO ACCOUNTS FOR THE BEGINNING OF THE YEAR
C
      CALL ZERO(NUMACC)
C
C
      READ(1,108,ERR=700)NACC
108   FORMAT(13X,I4)
D     WRITE(5,*)'BEFORE READ TO TABLE1',NACC
      READ(1,110,ERR=701)(NCORD(K1-1),ACCIN(K1-1),VALUE(K1/2),
     * NCORD(K1),ACCIN(K1),K1=2,NACC,2)
D     WRITE(5,*)'AFTER READ TO TABLE1',NACC
 110  FORMAT(2(1X,A1,I4,F15.2,A1,I4))
D     WRITE(7,110)(NCORD(K1-1),ACCIN(K1-1),VALUE(K1/2),NCORD(K1),
D    *              ACCIN(K1),K1=2,NACC,2)
D     WRITE(7,*)'NUMBER OF ACCOUNTS',NACC
C
C  REMEMBER THAT ONE VALUE GOES TO TWO ACCOUNTS, CREDIT TO ONE ACCOUNT
C  A DEBIT TO ANOTHER ACCOUNT
C
      CALL MERGE (NACC,NUMACC)
C
C     READ FROM OTHER FILES CONTAINING ACCOUNT INFORMATION
      READ(2,108,ERR=702)NACC
D     WRITE(5,*)'BEFORE READ TO REVENUE',NACC
      READ(2,110,ERR=703)(NCORD(K1-1),ACCIN(K1-1),VALUE(K1/2),
     * NCORD(K1),ACCIN(K1),K1=2,NACC,2)
D     WRITE(5,*)'AFTER READ TO REVENUE'
      CALL MERGE(NACC,NUMACC)
      IF(DLOAN)READ(3,108,ERR=704)NACC
      IF(DLOAN)READ(3,110,ERR=705)(NCORD(K1-1),ACCIN(K1-1),VALUE(K1/2),
     * NCORD(K1),ACCIN(K1),K1=2,NACC,2)
      IF(DLOAN)CALL MERGE(NACC,NUMACC)
      IF(MLOAN)READ(4,108,ERR=706)NACC
      IF(MLOAN)READ(4,110,ERR=707)(NCORD(K1-1),ACCIN(K1-1),VALUE(K1/2),
     * NCORD(K1),ACCIN(K1),K1=2,NACC,2)
      IF(MLOAN)CALL MERGE(NACC,NUMACC)
C     ONCE YEARLY VALUES ARE MERGED WRITE TO OUTPUT FILE
      CALL OUTPUT(NUMACC,I80)
C
 80   CONTINUE
      CLOSE (UNIT=1,DISP='KEEP')
      CLOSE (UNIT=3,DISP='KEEP')
      STOP
700   WRITE(5,*)'ERROR READING NACC FROM FILE 1'
701   WRITE(5,*)'ERROR READING ACCOUNTS FILE 1 ',I
      WRITE(7,110)(NCORD(K1-1),ACCIN(K1-1),VALUE(K1/2),NCORD(K1),
     *              ACCIN(K1),K1=2,NACC,2)
      WRITE(7,*)'NUMBER OF ACCOUNTS',NACC
      STOP
702   WRITE(5,*)'ERROR READING NACC FROM FILE 2'
703   WRITE(5,*)'ERRORREADING ACCOUNTS FROM FILE 2 ',I
      WRITE(7,110)(NCORD(K1-1),ACCIN(K1-1),VALUE(K1/2),NCORD(K1),
     *              ACCIN(K1),K1=2,NACC,2)
      WRITE(7,*)'NUMBER OF ACCOUNTS',NACC
      STOP
704   WRITE(5,*)'ERROR READING NACC FROM FILE 3'
705   WRITE(5,*)'ERROR READING ACCOUNTS FROM FILE 3 ',I
      WRITE(7,110)(NCORD(K1-1),ACCIN(K1-1),VALUE(K1/2),NCORD(K1),
     *              ACCIN(K1),K1=2,NACC,2)
      WRITE(7,*)'NUMBER OF ACCOUNTS',NACC
      STOP
706   WRITE(5,*)'ERROR READING NACC FROM FILE 4'
707   WRITE(5,*)'ERROR READING ACCOUNTS FROM FILE 4 ',I
      WRITE(7,110)(NCORD(K1-1),ACCIN(K1-1),VALUE(K1/2),NCORD(K1),
     *              ACCIN(K1),K1=2,NACC,2)
      WRITE(7,*)'NUMBER OF ACCOUNTS',NACC
      STOP
801   WRITE(5,*)'OPEN ERROR WITH DLOAN.DAT PLEASE RUN LONPAK'
      STOP
802   WRITE(5,*)'OPEN ERROR ON MLOAN.DAT PLEASE RUN MLOANE'
      STOP
      END
C*********************************************************************
C              SUBROUTINE ZERO
C
      SUBROUTINE ZERO(NUMACC)
      DOUBLE PRECISION STOVAL(300)
      DIMENSION ACC(300),NDUM(300)
      COMMON /STORE/ ACC,NDUM,STOVAL
      INTEGER ACC
      DO 5 I=1,NUMACC
      STOVAL(I)=0.0
5     CONTINUE
      RETURN
      END
C
C*********************************************************************
C
      SUBROUTINE MERGE(NACC,NUMACC)
      DOUBLE PRECISION VALUE(300),STOVAL(300)
      DIMENSION ACC(300),NDUM(300)
      DIMENSION ACCIN(300),NCORD(300)
      COMMON /STORE/ ACC,NDUM,STOVAL
```

```
      COMMON /INPUT/ ACCIN,NCORD,VALUE
      INTEGER ACC,ACCIN
      K=0
      IEND=NACC/2
      DO 10 I=1,IEND
              DO 14 IT2=1,2
              K=K+1
              TEMP=ACCIN(K)
                      DO 15 I2=1,NUMACC
      IF(ACC(I2).NE.TEMP)GO TO 15
      IF(NDUM(I2).EQ.NCORD(K))STOVAL(I2)=STOVAL(I2)+VALUE(I)
      IF(NDUM(I2).NE.NCORD(K))STOVAL(I2)=STOVAL(I2)-VALUE(I)
                      GO TO 14
15                    CONTINUE
C
14            CONTINUE
C
C
 10   CONTINUE
      RETURN
      END
C
C
C*****************************************************************************
C
      SUBROUTINE OUTPUT(NUMACC,I80)
      DOUBLE PRECISION STOVAL(300)
      DIMENSION ACC(300),NDUM(300)
      COMMON /STORE/ ACC,NDUM,STOVAL
      INTEGER ACC
      DO 5 I=1,NUMACC
C                THE FOLLOWING WRITE STATEMENT IS TO BE USED WHEN SUPPRESSING
C                OF ZERO OUTPUT IS NOT ALLOWED
C     WRITE(7,100)ACC(I),STOVAL(I),NDUM(I)
C  THE FOLLOWING WRITE STATEMENT IS TO BE USED WHEN SUPPRESSED INPUT
C  IS PERMITED IN THE ACCOUNTS PROGRAM
      WRITE(7,100)ACC(I),STOVAL(I),NDUM(I)
C     IF(STOVAL(I).NE.0.0)WRITE(7,100)ACC(I),STOVAL(I),NDUM(I)
 5    CONTINUE
 100  FORMAT(I4,8PG15.2,A1)
C  WRITE CODE TO INDICATE END OF YEAR
C     K2=I80
C     VAR1=0.0
      WRITE(7,102)K2,VAR1
102  FORMAT(I4,F15.2,'S')
      RETURN
      END
```

```
C                PROGRAM COSTCK
C Used only to read and write data,no calculations
C Output is not used by any other program
C Output is just easier to read than free formated input COST.PRE
      DIMENSION LINE(80),HEAD(8)
      OPEN(UNIT=1,NAME='COST.PRE',TYPE='OLD')
      OPEN(UNIT=2,NAME='COSTCK.OUT',TYPE='NEW',CARRIAGECONTROL='LIST')
      WRITE(2,*)'      OUTPUT FROM COSTCK    '
      WRITE(2,*)'      ECHO OF COST.PRE FILE '
      READ(1,*)I1,I2
      WRITE(2,*)I1,I2
C          I3 WAS THE VARIABLE TO INPUT NUMBER OF COLUMNS IN INPUT FILE
C          IT WAS DECIDED THAT THE NUMBER OF COLUMNS WOULD LIKELY STAY AT
C          8  SO VARIABLE WAS REMOVED FROM THE INPUT FILE
C          IF THE NUMBER OF COLUMNS IN THE COST INPUT FILE CHANGES THEN
C          DIMENSION STATEMENTS AND FORMAT STATEMENTS IN THIS PROGRAM AND
C          IN COST.FTN WOULD NEED TO BE CHANGED
      I3=8
      ITOTM1=I1+I3
      DO 5,I=1,ITOTM1
      READ(1,100)LINE
      WRITE(2,100)LINE
 5    CONTINUE
 100  FORMAT(80A1)
      READ(1,102)YEAR1,YEAR2,HEAD
 102  FORMAT(2A4,8(A4,4X))
      WRITE(2,505)YEAR1,YEAR2,HEAD
 505  FORMAT(2A4,4X,8(A4,9X))
      DO 10 I=1,50
      READ(1,*)I1,C1,C2,C3,C4,C5,C6,C7,C8
      WRITE(2,105)I1,C1,C2,C3,C4,C5,C6,C7,C8
 10   CONTINUE
 500  FORMAT(I6,2X,8F8.1)
 105  FORMAT(I6,4X,8(G11.5,2X))
      STOP
      END
```

```
C     THIS PROGRAM WRITES OUT THE AG. ECONOMIC SECTOR DATA TABLE
C     THIS PROGRAM WRITEN BY GEORGE LEO HARGREAVES 1982
      DIMENSION NTITLE(80)
      REAL*8 NAME(28)
      DATA NAME/'RICE WET','RICE DRY','TOMATO W','TOMATO D',
     * 'WHEAT  W','WHEAT  D','NIEBE  W','NIEBE  D','S.CANE W',
     * 'S.CANE D','SORGHM W','SORGHM D','MAIZE  W','MAIZE  D',
     * 'COTTON W','COTTON D','C.MILK W','C.MILK D','C.MEAT W',
     * 'C.MEAT D','S.MILK W','S.MILK D','S.MEAT W','S.MEAT D',
     * 'G.MILK W','G.MILK D','G.MEAT W','G.MEAT D'/
      OPEN(UNIT=1,NAME='AGTAB.PRE',TYPE='OLD')
      OPEN(UNIT=2,NAME='AGDATA.OUT',TYPE='NEW')

C     ACCOUNT FOR THE TABLE TITLE AND WRITE IT OUT
      READ(1,*)LTITLE
        DO 67 I67=1,LTITLE
         READ(1,1001)NTITLE
      WRITE(2,2001)NTITLE
 67     CONTINUE
 1001 FORMAT(80A1)
 2001 FORMAT(80A1,/)

C     PRINT OUT COLUMN HEADINGS
      WRITE(2,2002)
 2002 FORMAT(30X,'YIELDS (t/ha)',15X,'PRODUCTION COSTS',
     * 13X,'CROPPING PATTERN (%)')

      WRITE(2,2003)
 2003 FORMAT('+',10X,'WORLD',3X,'_____________________________',2X,
     * '_____________________',2X,
     * '_____________________________')

      WRITE(2,2004)
 2004 FORMAT(2X,'PRODUCT',2X,'PRICE',3X,'IRRIG.',2X,
     * 'FLOODED',2X,'RECESSION',2X,'RAINFED',2X,'LARGE PER.',2X,
     * '%',2X,'SMALL PER.',2X,'%',2X,'AREA',2X,'FLOODED',2X,
     * 'RECESSION',2X,'RAINFED',2X,'WATER REQ.')

      WRITE(2,2005)
 2005 FORMAT('+','_____________________________________________
     *_____________________________________________________
     *__________',/)

      DO 100 I=1,14
        READ(1,*)K,B,C,D,E,F,G,H,O,P,Q,R,S,T,U
        WRITE(2,2006)NAME(K),B,C,D,E,F,G,H,O,P,Q,R,S,T,U
 2006   FORMAT(1X,A8,F8.0,F9.3,F8.4,2F10.4,F10.0,F6.1,F10.0,F5.1,F6.3,
     *   F7.3,F11.3,F11.3,F9.2)
        READ(1,*)K,B,C,D,E,F,G,H,O,P,Q,R,S,T,U
        WRITE(2,2007)NAME(K),B,C,D,E,F,G,H,O,P,Q,R,S,T,U
 2007   FORMAT(1X,A8,F8.0,F9.3,F8.4,2F10.4,F10.0,F6.1,F10.0,F5.1,F6.3,
     *  F7.3,F11.3,F11.3,F9.2,/)
 100 CONTINUE
      CLOSE(UNIT=1,DISP='KEEP')
      CLOSE(UNIT=2,DISP='KEEP')
      STOP
      END
```

```
C
C                        PROGRAM SPLIT.FTN
C                                INPUT FILES
C                                COSTD.PRE
C                                LTERMS.PRE
C                                OUTPUT FILES
C                                MLOAN.PRE
C                                DLOAN.PRE
C******* PROGRAM TO DIVIDE THE CAPITAL COSTS OF THE MANATALI*****
C*********** AND DIAMA DAMS FOR SEPARATE ENTRY INTO LONPAK *******

      DIMENSION XAM(8),BINT(18),IGR(18),IDUR(18),TAMNT(18)
      DIMENSION NAME(18,8),NUM(18),TYPE(18,3)
      DIMENSION XM(9),XD(9),PM(9),PD(9),AM(20),PL(20)
      OPEN(UNIT=1,NAME='COSTD.PRE',TYPE='OLD')

      DO 10 I=1,17
      READ(1,1000)JUNK              !GENERAL DATA IN COSTD.PRE
 10   CONTINUE

      DO 20 I=1,8
      READ(1,*)K,XM(I),XOMM,XD(I)    !CAPITAL COST DATA
      SUMM=SUMM+XM(I)                !FOR MANATALI AND
      SUMD=SUMD+XD(I)                !DIAMA IN COSTD.PRE
 20   CONTINUE

      TOTAL=SUMM+SUMD

      CLOSE(UNIT=1,DISP='KEEP')

      DO 30 I=1,8
      PM(I)=XM(I)/TOTAL              !YEARLY PERCENTAGE OF
      PD(I)=XD(I)/TOTAL              !TOTAL LOAN AMOUNT
 30   CONTINUE

      OPEN(UNIT=1,NAME='LTERMS.PRE',TYPE='OLD')
      READ(1,*)NLOANS,NGRANT
      LOANS=NLOANS+NGRANT
      DO 40 I=1,LOANS
      READ(1,999)AM(I)               !ENTRY OF LOAN AMOUNT
      AM(I)=(AM(I)*10**6)*245        !FROM LTERMS.PRE FILE
      TOTL=TOTL+AM(I)                !WITH ADJUSTMENT FOR
 40   CONTINUE                       !CURRENCY RATE

      DO 50 I=1,18
      PL(I)=AM(I)/TOTL
 50   CONTINUE

      REWIND 1
C
C             MUST READ NLOANS,NGRANT AGAIN
      READ(1,*)NLOANS,NGRANT

CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C             ENTER FACTOR TO REDUCE YEARLY LOANS IF
C             A LARGER AMOUNT IS AVAILABLE THAN NEEDED
C
      WRITE(5,*)'ENTER FACTOR TO DIVIDE YEARLY DRAWS BY'
      WRITE(5,*)'ENTER 1 TO HAVE NO EFFECT'
      READ(5,*)FAC
C********CREATION OF MANATALI DAM CAPITAL DRAWS FOR ENTRY*********
C*********************INTO LONPAK MODULE*************************
```

```
      OPEN(UNIT=2,NAME='MLOAN.PRE',TYPE='NEW',CARRIAGECONTROL='LIST')
      WRITE(2,*)NLOANS,NGRANT
      NDRAW=8
      DO 60 I=1,LOANS
      NBEGIN=1981
      READ(1,996)NUM(I),(NAME(I,J),J=1,8),TAMNT(I),IDUR(I),IGR(I),
     + BINT(I),(TYPE(I,M),M=1,3)
      WRITE(2,997)NUM(I),(NAME(I,J),J=1,8),TAMNT(I),IDUR(I),IGR(I),
     + BINT(I),(TYPE(I,M),M=1,3)

      WRITE(2,995)NDRAW
      DO 70 J=1,8
      XAM(J)=AM(I)*PM(J)
      XAM(J)=(XAM(J)/10**6)/245
      WRITE(2,*)NBEGIN,XAM(J)/FAC
      NBEGIN=NBEGIN+1
 70   CONTINUE

 60   CONTINUE

      REWIND 1
C            MUST READ IN NLOANS,NGRANTS
      READ(1,*)NLOANS,NGRANTS
C*******CREATION OF DIAMA DAM LOAN DRAWS FOR ENTRY INTO LONPAK******

      OPEN(UNIT=3,NAME='DLOAN.PRE',TYPE='NEW',CARRIAGECONTROL='LIST')

      NDRAW=8
      WRITE(3,*)NLOANS,NGRANT
      DO 80 I=1,LOANS
      NBEGIN=1981
      READ(1,996)NUM(I),(NAME(I,J),J=1,8),TAMNT(I),IDUR(I),IGR(I),
     + BINT(I),(TYPE(I,M),M=1,3)
      WRITE(3,997)NUM(I),(NAME(I,J),J=1,8),TAMNT(I),IDUR(I),IGR(I),
     + BINT(I),(TYPE(I,M),M=1,3)

      WRITE(3,995)NDRAW
      DO 90 J=1,8
      XAM(J)=AM(I)*PD(J)
      XAM(J)=(XAM(J)/10**6)/245
      WRITE(3,*)NBEGIN,XAM(J)/FAC
      NBEGIN=NBEGIN+1
 90   CONTINUE

 80   CONTINUE

 995  FORMAT(I1)
 996  FORMAT(I2,1X,8A2,F6.2,1X,I2,1X,I2,1X,F5.4,1X,3A2)
 997  FORMAT(I2,1X,8A2,F6.2,1X,I2,1X,I2,1X,F5.4,1X,3A2)
 998  FORMAT(I2)
 999  FORMAT(19X,F6.2)
1000  FORMAT(A2)

      CLOSE(UNIT=1,DISP='KEEP')
      CLOSE(UNIT=2,DISP='KEEP')
      CLOSE(UNIT=3,DISP='KEEP')
      STOP
      END
```

```
C                PROGRAM          MLOAN.FTN
C                        INPUT FILE
C                                 MLOAN.PRE
C                        OUTPUT FILE
C                                 MPAY.OUT
C                                 MLOAN.DAT
C                                 MCOST.OUT

C*************** INITIALIZATION ********************************

      VIRTUAL DUMP(60,10),LNDUR(10),AMNT(10)
      DIMENSION TDUMP(60),IGR(20),BINT(20),LNSTR(10)
      DIMENSION FIDMP(60,20),FYDMP(60),SDUMP(60,20)
      DIMENSION NUM(25), NAME(25,8), TYPE(25,3)
      DIMENSION TAMNT(20),IDUR(20),STNSMT(60)
      VIRTUAL TNSAMT(60,20),SNSAMT(60,20)
      INTEGER TYPE
      REAL LMN,NPVIC

      OPEN(UNIT=2,NAME='MLOAN.PRE',TYPE='OLD')
C                        READ IN LINES OF COMMENT
      READ(2,*)NCOMM
      DO 1001 IJ=1,NCOMM
      READ(2,1005)JUNK
1001  CONTINUE
1005  FORMAT(A1)
      DO 2 K=1,60
      STNSMT(K)=0.00
      DO 1 I=1,20
      FIDMP(K,I)=0.00
      SDUMP(K,I)=0.00
      SNSAMT(K,I)=0.00
      TNSAMT(K,I)=0.00
 1    CONTINUE
 2    CONTINUE

C********** USER PROMPT FOR EXCHANGE AND DISCOUNT RATES *********

      WRITE(5,605)
      NXR=245
700   CONTINUE
      WRITE(5,607)
      READ(5,625,ERR=700)IXR
701   CONTINUE
      IF(IXR.EQ.'N')WRITE(5,*)'PLEASE ENTER NEW EXCHANGE RATE'
      IF(IXR.EQ.'N')READ(5,683,ERR=701)NXR
      TAMNT(I)=TAMNT(I)*NXR
      IPJDUR=2040
      DISCR=.05
703   CONTINUE
      WRITE(5,*)'IS THE DISCOUNT RATE 0.05 IN DECIMAL FORM ? (Y/N)'
      READ(5,625,ERR=703)AW
704   CONTINUE
      IF(AW.EQ.'N')WRITE(5,*)'ENTER NEW RATE (X100):
      IF(AW.EQ.'N')READ(5,*,ERR=704)RATE
      IF(AW.EQ.'N')DISCR=RATE
      NPVIC=0.00
      K=0
      OPEN(UNIT=1,NAME='MPAY.OUT',TYPE='NEW')
      READ(2,*)LOAN,IGRANT
      LOANS=LOAN+IGRANT
      DO 77 L=1,LOANS
```

```
      READ(2,610)NUM(L),(NAME(L,J),J=1,8),TAMNT(L),IDUR(L),IGR(L),BINT(L),
     (TYPE(L,K),K=1,3)
      TAMNT(L)=TAMNT(L)*NXR
      KQ=0
      M=M+1
      DO 10 IK=1,10
      LNSTR(IK)=0
      DO 11 J=1,60
      DUMP(J,IK)=0.00
 11   CONTINUE
 10   CONTINUE
705   CONTINUE
      READ(2,*,ERR=705)NDR
      IF(TYPE(L,1).EQ.' G')GO TO 42
      IF(BINT(L).EQ.0.0)GO TO 43
 42   IF(NDR.GT.0)GO TO 55
 43   LNDUR(K)=0
      AMNT(K)=0.00
      LNSTR(K)=0
      GO TO 77
 55   DO 30 K=1,NDR
706   CONTINUE
691   FORMAT(1X,A2)
      IF(TYPE(L,1).NE.' G')READ(2,*,ERR=706)MNZ,LMN
      IF(TYPE(L,1).EQ.' G')READ(2,*,ERR=706)MNZ,LMN
      IF(TYPE(L,1).EQ.' G')IJK=0
      LNDUR(K)=IDUR(L)
      AMNT(K)=LMN*NXR*1000000.00
      LNSTR(K)=(MNZ-1981)+1
      INDX=LNSTR(K)
      IJK=IDUR(L)+IGR(M)
      WRITE(1,640)M,IJK,LMN,MNZ,IGR(M)
      TNSAMT(INDX,L)=AMNT(K)
      IF(TYPE(L,1).EQ.' G')SNSAMT(INDX,L)=AMNT(K)
      IF(TYPE(L,1).EQ.' G')AMNT(K)=0.00
      IF(TYPE(L,1).EQ.' G')GO TO 30
      DO 31 Z=INDX,60
      IF(TYPE(L,1).NE.' G')SNSAMT(Z,L)=SNSAMT(Z,L)+AMNT(K)
 31   CONTINUE
      IBASE=LNSTR(K)
      ITOP=(LNSTR(1)+IGR(M))-1

C$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
C  LOOP DO 29 CALCULATES THE INTEREST PAYMENT DURING THE GRACE TIME. $
C$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

      DO 29 N=IBASE,ITOP
      FIDMP(N,L)=FIDMP(N,L)+(AMNT(K)*BINT(L))
 29   CONTINUE
 30   CONTINUE
      IF(TYPE(L,1).EQ.' G')GO TO 77

C************** PAYMENT AND INTEREST CALCULATIONS ***********************

      DO 40 K=1,NDR
      LOP=0
      KMIGR=0
      KQ=KQ+1
      IF(KQ.GT.1)GO TO 33
 32   KMIGR=LNSTR(1)+IGR(M)
      ILNDR=IGR(M)+LNDUR(KQ)+LNSTR(KQ)-1
      GO TO 34
 33   IF(LNSTR(KQ).LE.LNSTR(1))GO TO 32
      LOP=LNSTR(1)+IGR(M)
      IF(LNSTR(KQ).GT.LNSTR(1).AND.LNSTR(KQ).LT.LOP)KMIGR=LOP
      IF(LNSTR(KQ).GT.LNSTR(1).AND.LNSTR(KQ).LT.LOP)ILNDR=LOP+LNDUR(KQ)
     -1
      IF(LNSTR(KQ).GE.LOP)KMIGR=LNSTR(KQ)
      IF(LNSTR(KQ).GE.LOP)ILNDR=LNSTR(KQ)+LNDUR(KQ)-1
 34   CONTINUE
      IZ=0

C$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
C  LOOP DO 41 CALCULATES THE ANNUAL TOTAL PAYMENTS (DUMP) AND INTEREST  $
C  PORTIONS (FIDMP) FOR THE DRAWS ON LOANS.  THE FORMULA IS THAT OF A   $
C  HARD LOAN.  FORMULA FOR SOFT LOAN CALCULATION WOULD BE INSERTED IN   $
C  THIS LOOP AND THE INDIVIDUAL FORMULAE WOULD BE SELECTED BY REFERENCE $
C  TO THE VARIABLE 'TYPE' CONTAINED IN LTERMS.PRE.  FOLLOWING THIS      $
C  INITIAL CALCULATION OF TOTAL PAYMENT AND INTEREST ACCOUNTING WOULD   $
C  HAVE TO KEEP LOANS TYPES SEPARATE UNTIL PRINCIPAL SEPARATION FROM    $
C  TOTAL PAYMENT HAD BEEN ACCOMPLISHED.                                 $
C$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

      DO 41 J=KMIGR,ILNDR
      IZ=IZ+1
      DUMP(J,K)=(AMNT(K)*BINT(M))/(1-(1+BINT(M))**(-LNDUR(K)))
      BYN=(1-(1+BINT(M))**(-IZ))/BINT(M)
      FYDMP(J)=(AMNT(K)-(DUMP(J,K)*BYN))/(1+BINT(M))**(-IZ)
      IF(FYDMP(J).GT.-0.0005.AND.FYDMP(J).LT..0005)FYDMP(J)=0.00
      IF(IZ.EQ.1)FLRED=AMNT(K)-FYDMP(J)
      IF(IZ.GT.1)FLRED=FYDMP(J-1)-FYDMP(J)
      FZ=DUMP(J,K)-FLRED
      FIDMP(J,M)=FIDMP(J,M)+FZ
 41   CONTINUE
 40   CONTINUE

C************** AGGREGATION ROUTINES **********************************

      DO 50 J=1,60
      DO 51 K=1,10
      SDUMP(J,M)=SDUMP(J,M)+DUMP(J,K)
 51   CONTINUE
      TDUMP(J)=TDUMP(J)+SDUMP(J,M)
 50   CONTINUE

 77   CONTINUE

      DO 52 J=1,60
      FYDMP(J)=0.00
      DO 53 K=1,LOANS
      FYDMP(J)=FYDMP(J)+FIDMP(J,K)
 53   CONTINUE
      NPVIC=NPVIC+(FYDMP(J)/((1+DISCR)**J))
 52   CONTINUE

C**************WRITE DISCOUNTED TOTAL COST OF LOANS**********************
      WRITE(5,*)'PLEASE COPY ON PAPER THE DISCOUNTED COST OF THE'
      WRITE(5,*)'M DAM LOAN COSTS  THIS COST MUST BE ADDED TO '
      WRITE(5,*)'JOINT COSTS AND INPUT DURING THE USER FEES CALCULATION'
      WRITE(5,*)'THE INTEREST COST WILL BE CONTAINED IN FILE MCOST.OUT'
      OPEN(UNIT=3,NAME='MCOST.OUT',TYPE='NEW')
      WRITE(3,*)'            MCOST.OUT'
      WRITE(3,*)' DISCOUNTED COST OF LOANS FOR MANATALI  DAM'
      WRITE(3,*)'****      ',NPVIC
      CLOSE(UNIT=3,DISP='SAVE')
      WRITE(5,696)NPVIC

C************** LINK TO PREACC. FILE THROUGH LOAN.DAT *******************

      DO 71 K=1,LOANS
      IF(TYPE(K,1).EQ.' G')GO TO 71
      DO 70 J=1,60
```

```
      IF(SDUMP(J,K).GT.0.0)SDUMP(J,K)=SDUMP(J,K)-FIDMP(J,K)
 70   CONTINUE

 71   CONTINUE
710   CONTINUE
      NYEARS=50
      MESAGE=4
      NACC=4*LOANS+6*LOANS+4*IGRANT+((LOAN+ )/2)*4

      OPEN(UNIT=4,NAME='MLOAN.DAT',TYPE='NEW',CARRIAGECONTROL='LIST')
      WRITE(4,690)MESAGE,NYEARS
      WRITE(4,*)'*********************************************'
      WRITE(4,*)'ACCOUNT OUTPUT FROM MLOAN, 1 DAM DISCOUNT RATE:',DISCR
      WRITE(4,*)'CONVERSION FACTOR USED EQUALS: ',NXR
      WRITE(4,*)'*********************************************'
      DO 76 J=1,NYEARS
      WRITE(4,692)J,NACC

C$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
C  THE DO 73 LOOP ENTERS THE INTEREST EXPENSE FOR THE LOANS.            $
C  DEBIT 5201+:INCREASE EXP.  CREDIT NOTHING.                           $
C  DEBIT 3010:LIQUID EQUITY.  CREDIT 1010:DECREASE CASH2.               $
C$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

      ICD1=5200
      ICD2=1010
      ICD3=3010
      ICD4=6000
      DO 73 K=1,LOANS,2
      ICD1=ICD1+K
      NSET=ICD1+1
      WRITE(4,694)ICD1,FIDMP(J,K),ICD4,NSET,FIDMP(J,K+1),ICD4
      WRITE(4,694)ICD3,FIDMP(J,K),ICD2,ICD3,FIDMP(J,K+1),ICD2
      ICD1=ICD1-K
 73   CONTINUE

C$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
C  THE DO 74 LOOP ENTERS THE PRINCIPAL EXPENSE FOR THE LOANS.           $
C  DEBIT 5005:INCREASE JOINT CAPITAL EXPENSE.  CREDIT NOTHING.          $
C  DEBIT 3010:DECREASE L EQUITY. CREDIT 3005:INCREASE C EQUITY.         $
C  DEBIT 2101:DECREASE LIABILITY. CREDIT 1010: DECREASE CASH2.          $
C$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

      ICD1=5005
      ICD2=6000
      ICD3=3010
      ICD4=3005
      ICD5=2100
      ICD6=1010
      DO 74 M=1,LOANS,2
      ICD5=ICD5+M
      ISET=ICD5+1
      WRITE(4,694)ICD1,SDUMP(J,M),ICD2,ICD1,SDUMP(J,M+1),ICD2
      WRITE(4,694)ICD3,SDUMP(J,M),ICD4,ICD3,SDUMP(J,M+1),ICD4
      WRITE(4,694)ICD5,SDUMP(J,M),ICD6,ISET,SDUMP(J,M+1),ICD6
      ICD5=ICD5-M
 74   CONTINUE

C$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
C  THE DO 75 LOOP ENTERS LIABILITIES VALUE AND GRANT REVENUES.          $
C  DEBIT 1005:INCREASE CASH1.  CREDIT 2101+:INCREASE NOTES PAYABLE.$
C  CREDIT 4305+:INCREASE GRANT INCOME.  DEBIT 5005.                     $
C  DEBIT  1005:INCREASE CASH1. CREDIT 3005:INCREASE C EQUITY.           $
C$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

      ICD1=1005
      ICD2=2100
      ISET=2100
      ICD3=6000
      ICD4=4304
      ICD5=3005
      ICD6=5005
      DO 75 K=1,LOANS,2
      ICD2=ISET+1
      ISET=ICD2+1
      IF((TYPE(K,1).NE.' G').AND.(TYPE(K+1,1).NE.' G'))GO TO 81
      IF((TYPE(K,1).EQ.' G').AND.(TYPE(K+1,1).EQ.' G'))GO TO 82
C
C     HANDLE CASE WHERE FIRST IS GRANT AND SECOND IS LOAN
C     THIS CASE DOES NOT OCCUR
C     ALL LOANS COME FIRST
C     THIS CASE ONLY REACHED AT END OF LIST ON LAST LOAN
C
      IF((TYPE(K,1).EQ.' G').AND.(TYPE(K+1,1).NE.' G'))GO TO 83
C
C             HANDLE CASE WHERE FIRS IS LOAN SECON IS GRANT
      IDC4=ICD4+1
      WRITE(4,694)ICD1,TNSAMT(J,K),ICD2,ICD3,XDUM,ICD3
      WRITE(4,694)ICD1,TNSAMT(J,K+1),ICD5,ICDY,TNSAMT(J,K+1),
     *        ICD4
      GO TO 87
 81   CONTINUE
C
C             CASE OF TWO LOANS
      WRITE(4,694)ICD1,TNSAMT(J,K),ICD2,ICD1,TNSAMT(J,K+1),ISET
      GO TO 87
 82   CONTINUE
C     CASE OF TWO GRANTS
      KI=K
      DO 86 I85=1,2
      ICD4=ICD4+1
      WRITE(4,694)ICD6,TNSAMT(J,KI),ICD4,ICD1,TNSAMT(J,KI),
     *        ICD5
      KI=KI+1
 86   CONTINUE
      GO TO 87
 83   CONTINUE
C             CASE WHERE FIRST TYPE IS GRANT SECON IS NOT
C             THIS CASE ONLY OCCURS AT END OF LIST.
C             NEED ONLY TO WRITE OUT GRANT
      ICD4=ICD4+1
      WRITE(4,694)ICD1,TNSAMT(J,K),ICD5,ICD6,TNSAMT(J,K),
     *        ICD4
 87   CONTINUE
 75   CONTINUE
 76   CONTINUE

C*************** TRANSFER TO PAYDAT.OUT *******************************

      DO 60 I=1,LOANS
      WRITE(1,655)I
      WRITE(1,660)
      DO 61 J=1,60
      IYR=1980+J
      DO 63 M=1,60
      SNSAMT(M,I)=SNSAMT(M,I)-SDUMP(J,I)
 63   CONTINUE
      TPYMNT=FIDMP(J,I)+SDUMP(J,I)
      WRITE(1,665)IYR,SNSAMT(J,I),TPYMNT,FIDMP(J,I),SDUMP(J,I)
 61   CONTINUE
 60   CONTINUE
      WRITE(1,670)
```

```
      DO 62 K=1,60
      IYR=1980+K
      IF(TDUMP(K).LT.FYDMP(K))TDUMP(K)=TDUMP(K)+FYDMP(K)
      WRITE(1,675)IYR,TDUMP(K),FYDMP(K)
62    CONTINUE
      WRITE(1,696)NPVIC
      CLOSE(UNIT=1,DISP='KEEP')

C*************** COMPLETION OF LONPAR.FTN PROGRAM ***************************

600     FORMAT(I2)
605   FORMAT(T3,'THIS PROGRAM GENERATES A REPAYMENT AND INTEREST',
     + /,T3,'SCHEDULE FOR SENEGAL RIVER PROJECT FINANCING.',//)
607   FORMAT(T3,'ARE AMOUNTS EXPRESSED IN -CFA- AT AN EXCHANGE RATE',
     + /,T3,'OF -245- APPROPRIATE? (Y/N) ? ',$)
610   FORMAT(I2,1X,8A2,F6.2,1X,I2,1X,I2,1X,F4.4,2X,3A2)
615   FORMAT(1X,I2,1X,8A2,F10.2,1X,I2,1X,I2,1X,F6.4,1X,3A2)
625   FORMAT(A1)
630   FORMAT(T3,'NO.',2X,'SOURCE',11X,'AMOUNT(X 10**6)',2X,'DURATION',
     + 2X,'GRACE'2X,'INTEREST',2X,'TYPE',/)
635   FORMAT(T3,I2,2X,8A2,2X,F10.2,8X,I2,8X,I2,4X,F6.4,6X,3A2,//)
640   FORMAT(1X,T3,'LOAN #',I2,3X,'DUR=',I2,3X,'AMOUNT=',F8.2,3X,
     + 'BEGINS: ',I4,2X,'GRACE= ',I2./)
655   FORMAT('1',T3,'LOAN #',I3,/)
660   FORMAT(T2,'YEAR',3X,'LOAN BALANCE(EOY)',4X,'PAYMENT',9X,'INTEREST',
     + 11X,'PRINCIPAL')
665   FORMAT(T2,I4,3X,G15.8,3X,G15.8,3X,G15.8,3X,G15.8)
670   FORMAT(1X,//,T5,'AGGREGATE LOAN DATA FOR SELECTED COMBINATIONS',/,
     + /,T2,'YEAR',4X,'TOTAL PAYMENTS',5X,'TOTAL INTEREST CHARGE',/)
675   FORMAT(T2,I4,5X,G15.8,10X,G15.8)
694   FORMAT(2(1X,'D',I4,F15.2,'C',I4))
680   FORMAT(I5)
683   FORMAT(I3)
692   FORMAT('YEAR',2X,I5,2X,I4)
688   FORMAT(I4,1X,I4)
690   FORMAT(2I4)
696   FORMAT(1X,'NET PRESENT VALUE OF INTEREST CHARGES= ',G15.8)
      CLOSE(UNIT=2,DISP='SAVE')
994   CLOSE(UNIT=4,DISP='KEEP')
999   STOP
      END

C*********************** END ***********************************************
```

```
C                PROGRAM     ACCOUN.FTN
C     FORMATS OUTPUT FROM PROGRAM PREACC.FTN INTO
C     INCOME STATEMENT AND BALANCE SHEET FORM
C     INCOME STATEMENT ACCOUNTS ARE SEPARATE FROM BALANCE SHEET
C     ACCOUNTS.  NO CALCULATATIONS ARE PASSED BETWEEN INCOME
C     STATEMENT AND BALANCE SHEET
C*****************************************************************
C
C                INPUT FILES
C                        ACCOUN.PRE
C                        VALUE.DAT
C                OUTPUT FILES
C                        HEADS.OUT
C                        ACCOUN.OUT
C                        SUMMAR.OUT
C
      DOUBLE PRECISION VALUE(5,5,22)
      DOUBLE PRECISION ACCUM(5,5,22),SUMREV,ACCREV,SUMEXP,ACCEXP
      DOUBLE PRECISION XNET,BAL(5,5,22),SUMA,SUML,SUME
      DOUBLE PRECISION SUMAP,SUMLP,SUMEP,DIFFA,DIFFL,DIFFE
      DIMENSION ICOUN2(5),ICOUN3(5,5),NACC(5,5,22),IOUT(25)
      VIRTUAL XLAB1(5,5,22),XLAB2(5,5,22),XLAB3(5,5,22)
     * ,XLAB4(5,5,22),XLAB5(5,5,22),XLAB6(5,5,22)
     * ,XLAB7(5,5,22),XLAB8(5,5,22)
      DIMENSION LCOM(40)
C
C
C
C*****************************************************************
C                        LIST OF MAJOR VARIABLES
C
C       ACCEXP  =        ACCUMULATED TOTAL EXPENSE
C       ACCUM   =        ACCUMULATION OF ARRAY VALUE,USED TO STORE
C                        ACCUMULATED VALUES FOR OUTPUT ON INCOME STATEMENT,
C                        PREVIOUS BALANCE FOR OUTPUT OF BALANCE SHEET
C       ACCREV  =        ACCUMULATED TOTAL REVENUE
C       BAL     =        BALANCE FOR OUTPUT ON BALANCE SHEET,ACCUMULATED TOTALS
C       DIFFA   =        NET CHANGE IN TOTAL ASSETS
C       DIFFE   =        NET CHANGE IN TOTAL EQUITY
C       DIFFL   =        NET CHANGE IN TOTAL LIABILITIES
C       ICOUN2  =        ARRAY CONTAINING NUMBER OF MAJOR SUBDIVISIONS
C                        FOR EACH OF THE 5 MAJOR DIVISIONS DIMENSIONED FOR 5
C       ICOUN3  =        ARRAY CONTAINING NUMBER OF DIVISIONS WITHIN EACH
C                        OF THE SUBDIVISIONS (EXAMPLE NUMBER OF LOANS UNDER
C                        LONG TERM LIABILITY)DIMENSIONED FOR 25
C       IOUT    =        ARRAY CONTAINING WHEN OUTPUT IS DESIRED
C       LCOM    =        COMMENTS AT BEGINING OF DATA FILE
C       NACC    =        ARRAY CONTAINING ACCOUNT NUMBERS (I,J,K)
C       SUMA    =        SUM OF ASSETS SUM OF VALUE(1,J,K)FOR ALL J AND K
C       SUMAP   =        SUM OF PREVIOUS ASSETS
C       SUME    =        SUM OF EQUITY
C       SUMEP   =        SUM OF PREVIOUS EQUITY
C       SUMEXP  =        SUM OF EXPENSES
C       SUML    =        SUM OF LIABILITY
C       SUMLP   =        SUM OF PREVIOUS LIABILITY
C       SUMREV  =        SUM OF REVENUE FOR YEAR
C       XLT     =        REALS USED TO READ IN 4 CHARACTERS OF THE ACCOUNT
C                        DESCRIPTIONS
C       XLAB    =        1-8,ARRAY CONTAINING ACCOUNT DESCRIPTIONS
C                        4 CHARACTERS EACH, 32 TOTAL CHARACTERS
C       XNET    =        NET INCOME FOR YEAR
C       VALUE   =        ARRAY CONTAINING POSTED VALUES READ IN FROM
```

```
C                    VALUE.DAT
C
C
C
C
C
C            ZERO VALUES
      ACCREV=0.0
      ACCEXP=0.0
      SUMA=0.0
      SUML=0.0
      SUME=0.0
      SUMAP=0.0
      SUMLP=0.0
      SUMEP=0.0
C
C                    READ IN YEARS FROM BEGINING THAT
C                    PRINTED OUTPUT IS DESIRED
C
      WRITE(5,3000)
3000  FORMAT(1X,'PROMPT FOR USER TO ENTER WHICH YEARS TO PRINT'
     * ,' OUTPUT ',/,1X,'ENTER UP TO 25 INTEGERS IN ASSENDING ORDER',
     * /,1X,'INDICATING YEARS FROM THE BEGINING TO PRINT',/,
     * 1X,'NUMBERS OF YEARS TO PRINT ? 10',/,
     * 1X,'INTEGERS ? 1,2,3,4,5,10,20,30,40,50 WILL PRINT YEAR'
     *    ' 1 AND ETC.',
     * /,1X,'NUMBER OF YEARS TO PRINT ?',$)
      READ(5,*)NOUT
      WRITE(5,3010)
3010  FORMAT(1X,'INTEGERS ?',$)
      READ(5,*)(IOUT(I),I=1,NOUT)
C
      OPEN(UNIT=1,NAME='ACCOUN.PRE',TYPE='OLD')
      OPEN(UNIT=3,NAME='ACCOUN.OUT',TYPE='NEW')

      READ(1,*)LTIT
      DO 3 I3=1,LTIT
      READ(1,5002)LC
3     CONTINUE
5002  FORMAT(A2)
      IL1=1
      IL2=1
      IL3=0
      L1=2000
      L2=1100
C
C
5     READ(1,1000,END=999)NUM,XLT1,XLT2,XLT3,XLT4,
     *                    XLT5,XLT6,XLT7,XLT8
      IF(NUM.NE.L1)GO TO 20
      L2=L1+100
      L1=L1+1000
      IL1=IL1+1
      IL2=1
      IL3=1
      ICOUN2(IL1)=IL2
      ICOUN3(IL1,IL2)=IL3
      NACC(IL1,IL2,IL3)=NUM
      XLAB1(IL1,IL2,IL3)=XLT1
      XLAB2(IL1,IL2,IL3)=XLT2
      XLAB3(IL1,IL2,IL3)=XLT3
      XLAB4(IL1,IL2,IL3)=XLT4
      XLAB5(IL1,IL2,IL3)=XLT5
      XLAB6(IL1,IL2,IL3)=XLT6
      XLAB7(IL1,IL2,IL3)=XLT7
      XLAB8(IL1,IL2,IL3)=XLT8
      GO TO 5
C
C
20    CONTINUE
      IF(NUM.NE.L2)GO TO 30
      L2=L2+100
      IL2=IL2+1
      IL3=1
      ICOUN2(IL1)=IL2
      ICOUN3(IL1,IL2)=IL3
      NACC(IL1,IL2,IL3)=NUM
      XLAB1(IL1,IL2,IL3)=XLT1
      XLAB2(IL1,IL2,IL3)=XLT2
      XLAB3(IL1,IL2,IL3)=XLT3
      XLAB4(IL1,IL2,IL3)=XLT4
      XLAB5(IL1,IL2,IL3)=XLT5
      XLAB6(IL1,IL2,IL3)=XLT6
      XLAB7(IL1,IL2,IL3)=XLT7
      XLAB8(IL1,IL2,IL3)=XLT8
      GO TO 5
C
C
30    CONTINUE
      IL3=IL3+1
      ICOUN3(IL1,IL2)=IL3
      NACC(IL1,IL2,IL3)=NUM
      XLAB1(IL1,IL2,IL3)=XLT1
      XLAB2(IL1,IL2,IL3)=XLT2
      XLAB3(IL1,IL2,IL3)=XLT3
      XLAB4(IL1,IL2,IL3)=XLT4
      XLAB5(IL1,IL2,IL3)=XLT5
      XLAB6(IL1,IL2,IL3)=XLT6
      XLAB7(IL1,IL2,IL3)=XLT7
      XLAB8(IL1,IL2,IL3)=XLT8
      GO TO 5
C
C
999   CONTINUE
      CLOSE(UNIT=1,DISP='KEEP')

      OPEN(UNIT=2,NAME='VALUE.DAT',TYPE='OLD')
      OPEN(UNIT=1,NAME='HEADS.OUT',TYPE='NEW')
      READ(2,*)LTITLE
      DO 960 I960=1,LTITLE
      READ(2,5011)LCOM
      WRITE(1,5012)LCOM
960   CONTINUE
      CLOSE(UNIT=1,DISP='KEEP')
C
C            OPEN SUMMARY DATA FILE
      OPEN(UNIT=1,NAME='SUMMAR.OUT',TYPE='NEW')
      WRITE(1,*)'      DATA FILE SUMMAR.OUT'
      WRITE(1,*)'      ALL VALUES IN 1979 CFA X 1.E9'
      WRITE(1,2115)
2115  FORMAT(1X,'YEAR',4X,'CHANGE IN',8X,'LIQUID',9X,
     * 'CAPITAL',9X,'CAPITAL',9X,'LIQUID',9X,'CAPITAL',/,
     * 1X,8X,'LIQUID ASSETS',4X,'ASSETS',9X,'ASSETS',10X,
     * 'LIABILITIES',5X,'EQUITY',9X,'EQUITY')
C
      IYEAR=1
      DO 970 NYEAR=1,50

      DO 100 I100=1,5
      I2END=ICOUN2(I100)
      DO 105 I105=1,I2END
```

```
      I3END=ICOUN3(I100,I105)
      DO 110 I110=1,I3END
      READ(2,5010,END=990)VALUE(I100,I105,I110)
      ISIGN=1
      IF((I100.EQ.1).OR.(I100.EQ.5))ISIGN=-1
      VALUE(I100,I105,I110)=ISIGN*VALUE(I100,I105,I110)
110   CONTINUE
105   CONTINUE
100   CONTINUE
      READ(2,5011)IY
5010  FORMAT(4X,F15.2)
5011  FORMAT(40A2)
5012  FORMAT(1X,40A2)
1000  FORMAT(I4,2X,8A4)
5000  FORMAT(1X,I4,5X,8A4)
C
C
C*****************************************************************
C
C                START OF INCOME STATEMENT
C
C
C                        REVENUE SECTION
C
C
      SUMREV=0.0
      IEND=ICOUN2(4)
      DO 200 I=1,IEND
      VALUE(4,I,1)=0.0
      KEND=ICOUN3(4,I)
      DO 205 K=2,KEND
      VALUE(4,I,1)=VALUE(4,I,1)+VALUE(4,I,K)
      ACCUM(4,I,K)=ACCUM(4,I,K)+VALUE(4,I,K)
205   CONTINUE
      ACCUM(4,I,1)=ACCUM(4,I,1)+VALUE(4,I,1)
      SUMREV=SUMREV+VALUE(4,I,1)
200   CONTINUE
      ACCREV=ACCREV+SUMREV
C
C
C
C                        EXPENSE SECTION
C
C
C
      SUMEXP=0.0
      IEND=ICOUN2(5)
      DO 210 I=1,IEND
      VALUE(5,I,1)=0.0
      KEND=ICOUN3(5,I)
      DO 220 K=2,KEND
      VALUE(5,I,1)=VALUE(5,I,1)+VALUE(5,I,K)
      ACCUM(5,I,K)=ACCUM(5,I,K)+VALUE(5,I,K)
220   CONTINUE
      SUMEXP=SUMEXP+VALUE(5,I,1)
      ACCUM(5,I,1)=ACCUM(5,I,1)+VALUE(5,I,1)
210   CONTINUE
      ACCEXP=ACCEXP+SUMEXP
      XNET=SUMREV-SUMEXP
C
C
C
C                END OF INCOME STATEMENT SECTION
C
C*****************************************************************
C
C                START OF BALANCE SHEET SECTION
C
C
C
C
C       THE ARRAY BAL WILL CONTAIN THE NEW BALANCE
C       THE ARRAY ACCUM WILL CONTAIN THE PREVIOUS BALANCE
C       THE ARRAY VALUE WILL CONTAIN THE NET CHANGE
C
C
C               CALULATE PREVIOUS SUMS
      SUMAP=SUMA
      SUMLP=SUML
      SUMEP=SUME
C               ASSETS
      IEND=ICOUN2(1)
      DO 400 I=1,IEND
      VALUE(1,I,1)=0.0
      KEND=ICOUN3(1,I)
      DO 410 K=2,KEND
      VALUE(1,I,1)=VALUE(1,I,1)+VALUE(1,I,K)
      ACCUM(1,I,K)=BAL(1,I,K)
      BAL(1,I,K)=BAL(1,I,K)+VALUE(1,I,K)
410   CONTINUE
      ACCUM(1,I,1)=BAL(1,I,1)
      BAL(1,I,1)=BAL(1,I,1)+VALUE(1,I,1)
      SUMA=SUMA+VALUE(1,I,1)
400   CONTINUE
      DIFFA=SUMA-SUMAP
C
C               LIABILITIES
      IEND=ICOUN2(2)
      DO 420 I=1,IEND
      VALUE(2,I,1)=0.0
      KEND=ICOUN3(2,I)
      DO 430 K=2,KEND
      VALUE(2,I,1)=VALUE(2,I,1)+VALUE(2,I,K)
      ACCUM(2,I,K)=BAL(2,I,K)
      BAL(2,I,K)=BAL(2,I,K)+VALUE(2,I,K)
430   CONTINUE
      ACCUM(2,I,1)=BAL(2,I,1)
      BAL(2,I,1)=BAL(2,I,1)+VALUE(2,I,1)
      SUML=SUML+VALUE(2,I,1)
420   CONTINUE
      DIFFL=SUML-SUMLP
C               EQUITY
      IEND=ICOUN2(3)
      DO 440 I=1,IEND
      VALUE(3,I,1)=0.0
      KEND=ICOUN3(3,I)
      DO 450 K=2,KEND
      VALUE(3,I,1)=VALUE(3,I,1)+VALUE(3,I,K)
      ACCUM(3,I,K)=BAL(3,I,K)
      BAL(3,I,K)=BAL(3,I,K)+VALUE(3,I,K)
450   CONTINUE
      ACCUM(3,I,1)=BAL(3,I,1)
      BAL(3,I,1)=BAL(3,I,1)+VALUE(3,I,1)
      SUME=SUME+VALUE(3,I,1)
440   CONTINUE
      DIFFE=SUME-SUMEP
C
      IF(NYEAR.NE.IOUT(IYEAR))GO TO 965

      IYEAR=IYEAR+1
C               WRITE INCOME STATEMENT
C
              WRITE(3,2000)NYEAR
2000  FORMAT(25X,'INCOME STATEMENT FOR YEAR',
     * ' ENDING',I6,' ALL VALUES IN 1979 CFA X 1.F9 ')
      WRITE(3,2002)
```

```
2002    FORMAT(55X,'ANNUAL AMMOUNT',32X,'ACCUMULATED AMMOUNT')
        WRITE(3,2010)SUMREV/1.E9,ACCREV/1.E9
2010    FORMAT(1X,'REVENUE',47X,F15.3,30X,F15.3,/)
        IEND=ICOUN2(4)
        DO 300 I=1,IEND
        WRITE(3,2015)XLAB1(4,I,1),XLAB2(4,I,1),XLAB3(4,I,1),
     *  XLAB4(4,I,1),XLAB5(4,I,1),XLAB6(4,I,1),XLAB7(4,I,1),
     *  XLAB8(4,I,1),VALUE(4,I,1)/1.E9,ACCUM(4,I,1)/1.E9
2015    FORMAT(1X,8A4,22X,F15.3,30X,F15.3)
        KEND=ICOUN3(4,I)
        DO 310 K=2,KEND
        WRITE(3,2020)XLAB1(4,I,K),XLAB2(4,I,K),XLAB3(4,I,K),
     *  XLAB4(4,I,K),XLAB5(4,I,K),XLAB6(4,I,K),XLAB7(4,I,K),
     *  XLAB8(4,I,K),VALUE(4,I,K)/1.E9,ACCUM(4,I,K)/1.E9
310     CONTINUE
300     CONTINUE
2020    FORMAT(6X,8A4,26X,F15.3,30X,F15.3)
C
C               EXPENSES
        WRITE(3,2025)SUMEXP/1.E9,ACCEXP/1.E9
2025    FORMAT(/,/,1X,'EXPENSES',46X,F15.3,30X,F15.3,/)
        IEND=ICOUN2(5)
        DO 320 I=1,IEND
        WRITE(3,2015)XLAB1(5,I,1),XLAB2(5,I,1),XLAB3(5,I,1),
     *  XLAB4(5,I,1),XLAB5(5,I,1),XLAB6(5,I,1),XLAB7(5,I,1),
     *  XLAB8(5,I,1),VALUE(5,I,1)/1.E9,ACCUM(5,I,1)/1.E9
        KEND=ICOUN3(5,I)
        DO 330 K=2,KEND
        WRITE(3,2020)XLAB1(5,I,K),XLAB2(5,I,K),XLAB3(5,I,K),
     *  XLAB4(5,I,K),XLAB5(5,I,K),XLAB6(5,I,K),XLAB7(5,I,K),
     *  XLAB8(5,I,K),VALUE(5,I,K)/1.E9,ACCUM(5,I,K)/1.E9
330     CONTINUE
320     CONTINUE
        WRITE(3,2030)XNET/1.E9
2030    FORMAT(/,/,1X,'NET INCOME FOR YEAR = ',F15.3,/,/)
C               PRINT BALANCE SHEET
C                       ASSETS
        WRITE(3,2040)
2040    FORMAT(45X,'BALANCE SHEET ALL VALUES IN 1979 CFA X 1.E9 ',/,/)
        WRITE(3,2041)
2041    FORMAT(51X,'PREVIOUS AMMOUNT',6X,'NET CHANGE',10X,'NEW BALANCE')
        WRITE(3,2050)SUMAP/1.E9,DIFFA/1.E9,SUMA/1.E9
2050    FORMAT(1X,'ASSETS',44X,F15.3,5X,F15.3,5X,F15.3,/)
        IEND=ICOUN2(1)
        DO 460 I=1,IEND
        WRITE(3,2060)XLAB1(1,I,1),XLAB2(1,I,1),XLAB3(1,I,1),
     *  XLAB4(1,I,1),XLAB5(1,I,1),XLAB6(1,I,1),XLAB7(1,I,1),
     *  XLAB8(1,I,1),ACCUM(1,I,1)/1.E9,VALUE(1,I,1)/1.E9
     *  ,BAL(1,I,1)/1.E9
2060    FORMAT(1X,8A4,18X,F15.3,5X,F15.3,5X,F15.3)
        KEND=ICOUN3(1,I)
        DO 470 K=2,KEND
        WRITE(3,2070)XLAB1(1,I,K),XLAB2(1,I,K),XLAB3(1,I,K),
     *  XLAB4(1,I,K),XLAB5(1,I,K),XLAB6(1,I,K),XLAB7(1,I,K),
     *  XLAB8(1,I,K),ACCUM(1,I,K)/1.E9,VALUE(1,I,K)/1.E9
     *  ,BAL(1,I,K)/1.E9
2070    FORMAT(6X,8A4,18X,F15.3,5X,F15.3,5X,F15.3)
470     CONTINUE
460     CONTINUE
        WRITE(3,2090)
2090    FORMAT(1X,/,/)
C

C                       LIABILITIES
        WRITE(3,2080)SUMLP/1.E9,DIFFL/1.E9,SUML/1.E9
2080    FORMAT(1X,'LIABILITIES',39X,F15.3,5X,F15.3,5X,F15.3,/)
        IEND=ICOUN2(2)
        DO 475 I=1,IEND
        WRITE(3,2060)XLAB1(2,I,1),XLAB2(2,I,1),XLAB3(2,I,1),
     *  XLAB4(2,I,1),XLAB5(2,I,1),XLAB6(2,I,1),XLAB7(2,I,1),
     *  XLAB8(2,I,1),ACCUM(2,I,1)/1.E9,VALUE(2,I,1)/1.E9
     *  ,BAL(2,I,1)/1.E9
        KEND=ICOUN3(2,I)
        DO 480 K=2,KEND
        WRITE(3,2070)XLAB1(2,I,K),XLAB2(2,I,K),XLAB3(2,I,K),
     *  XLAB4(2,I,K),XLAB5(2,I,K),XLAB6(2,I,K),XLAB7(2,I,K),
     *  XLAB8(2,I,K),ACCUM(2,I,K)/1.E9,VALUE(2,I,K)/1.E9
     *  ,BAL(2,I,K)/1.E9
480     CONTINUE
475     CONTINUE
        WRITE(3,2090)
C
C                       EQUITY
        WRITE(3,2085)SUMEP/1.E9,DIFFE/1.E9,SUME/1.E9
2085    FORMAT(1X,'OMVS EQUITY',39X,F15.3,5X,F15.3,5X,F15.3,/)
        IEND=ICOUN2(3)
        DO 485 I=1,IEND
        WRITE(3,2060)XLAB1(3,I,1),XLAB2(3,I,1),XLAB3(3,I,1),
     *  XLAB4(3,I,1),XLAB5(3,I,1),XLAB6(3,I,1),XLAB7(3,I,1),
     *  XLAB8(3,I,1),ACCUM(3,I,1)/1.E9,VALUE(3,I,1)/1.E9
     *  ,BAL(3,I,1)/1.E9
        KEND=ICOUN3(3,I)
        DO 490 K=2,KEND
        WRITE(3,2070)XLAB1(3,I,K),XLAB2(3,I,K),XLAB3(3,I,K),
     *  XLAB4(3,I,K),XLAB5(3,I,K),XLAB6(3,I,K),XLAB7(3,I,K),
     *  XLAB8(3,I,K),ACCUM(3,I,K)/1.E9,VALUE(3,I,K)/1.E9
     *  ,BAL(3,I,K)/1.E9
490     CONTINUE
485     CONTINUE
        WRITE(3,2095)
2095    FORMAT('1')
965     CONTINUE
C*************************WRITE TO SUMMARY DATA FILE
C
C               CASH I IS ASSUMED TO BE IN ELEMENT VALUE(1,1,2)
C               CASH II IS ASSUMED TO BE IN ELEMENT VALUE(1,1,3)
C               LIQUID ASSETS IS ASSUMED TO BE IN ELEMENT BAL(1,1,1)
C               CAPITAL ASSET IS ASSUMED TO BE IN ELEMENT BAL(1,2,1)
C               CAPITAL LIABILITY IS ASSUMED TO BE IN ELEMENT BAL(2,2,1)
C               LIQUID EQUITY IS ASSUMED TO BE IN ELEMENT BAL(3,1,3)
C               CAPITAL EQUITY IS ASSUMED TO BE IN ELEMENT BAL(3,1,2)
        WRITE(1,2105)NYEAR,(VALUE(1,1,2)+VALUE(1,1,3))/1.E9,
     *  BAL(1,1,1)/1.E9,BAL(1,2,1)/1.E9,BAL(2,2,1)/1.E9,
     *  BAL(3,1,3)/1.E9,BAL(3,1,2)/1.E9
970     CONTINUE
990     CONTINUE
2105    FORMAT(1X,I6,F15.3,F15.3,F15.3,F15.3,F15.3,F15.3)
        CLOSE (UNIT=3,DISP='KEEP')
        CLOSE (UNIT=1,DISP='KEEP')
        STOP
        END
```

```
C*****************************************************************
C*      KEYCAL: program to calculate the cost allocation key
C*****************************************************************
        DIMENSION TPC(4),PERCI(3),PERCE(3),PERCN(3),COL(4,6)
      OPEN(UNIT=1,NAME='KEYCAL.OUT',TYPE='NEW',CARRIAGECONTROL='LIST')
      OPEN(UNIT=2,NAME='KEYCAL.PRE',TYPE='OLD')
C*      WRITE(5,2000)
C*2000  FORMAT(1X,'ENTER TOTAL PROJECT COST CFA*E-9 (MA,MA,SL): ',$)
        READ(2,*)(TPC(I),I=1,3)
C*      WRITE(5,2002)
C*2002  FORMAT(1X,'ENTER IRRIGATION DATA (COST CFA*E-9, %ML,%MA,%SL): ',$)
        READ(2,*)COSTI,PERCI
C*      WRITE(5,2004)
C*2004  FORMAT(1X,'ENTER ENERGY DATA (COST CFA*E-9,%ML,%MA,%SL): ',$)
        READ(2,*)COSTE,PERCE
C*      WRITE(5,2006)
C*2006  FORMAT(1X,'ENTER NAVIGATION DATA (COST CFA*E-9,%MS,%MA,%SL): ',$)
        READ(2,*)COSTN,PERCN
        TPC(4)=TPC(3)+TPC(2)+TPC(1)
        DO 2 I=1,4
        DO 2 J=1,6
2       COL(I,J)=0.
        DO 4 I=1,3
        COL(I,1)=COSTI*PERCI(I)
4       COL(4,1)=COL(4,1)+COL(I,1)
        DO 6 I=1,3
        COL(I,2)=COSTE*PERCE(I)
6       COL(4,2)=COL(4,2)+COL(I,2)
        DO 8 I=1,3
        COL(I,3)=COSTN*PERCN(I)
8       COL(4,3)=COL(4,3)+COL(I,3)
        DO 10 I=1,3
        COL(I,4)=TPC(I)-COL(I,1)-COL(I,2)-COL(I,3)
10      COL(4,4)=COL(4,4)+COL(I,4)
        DO 12 I=1,3
        COL(I,5)=COL(I,1)+COL(I,4)
12      COL(4,5)=COL(4,5)+COL(I,5)
        DO 14 I=1,3
        COL(I,6)=COL(I,5)/COL(4,5)
14      COL(4,6)=COL(4,6)+COL(I,6)
        DO 16 I=1,4
        WRITE(1,2010)TPC(I),(COL(I,J),J=1,6)
2010    FORMAT(1X,7E16.4)
16      CONTINUE
        END
```

```
C       REVENU.FTN
C                       PROGRAM FOR CALCULATING THE REVENUE
C       INPUT QUANTITIES OF WATER, POWER AND NAVIGATION
C       USER FEES       ACCOUNTS NUMBER AND C OR D CODE
CXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
C
C               PROGRAM REVENU MUST BE TASK BUILT WITH ACTIF=8
C                                                       UNITS=8
C
C                       SUBROUTINES
C       WRONG   Terminates run if input on FEES.DAT file is not
C               in proper order
C       STATE   Terminates run if missmatch between quantities and number
C               of accounts
C       YEARS   Terminates run if missmatch between number of years
C               in FEES.DAT and quantity files
CXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
C
C  NCORD,ACC,FEES input from file FEES.DAT
C  QUAN                 input from files PWQ.DAT,AGQ.DAT,NAVQ.DAT
C       ACC(I) =    Integer array containing account numbers
C       FEES(I)=    Array containing user fees
C       ICHECK = variable to check if data is in proper order
C               in FEES.DAT file;1. PW 2. AG 3. NV
C       KCHECK = Compared to ICHECK; ICHECK read from data file, KCHECK set
C               by program
C       KTITLE(i,j) = Array to hold lines of comment from FEES.DAT
C       LTEMP   = Number of lines of comment
C       LTEMPi  = Number of lines of comment in file read from UNIT=i
C       LTITLE  = Number of lines of comment in output file
C       NAG     = Number of USER FEES for navigation from FEES.DAT
C               NAG must equal NS2
C       NAGAC   = Number of agriculture accounts 2*NAG
C       NAV     = Number of USER FEES for agriculture from FEES.DAT
C               NAV must equal NS3
C       NAVAC   = Number of navigation accounts 2*NAV
C       NB1     = startin point of DO reading from UNIT = 1, reading in
C               quantity data, used to pack revenue into array VALUE
C       NE1     = ending point of DO loop reading from UNIT = 1
C       NCORD(I)= Array contianing C credit or D debit CODE
C       NERROR  = Passes error status on read, code to tell what file
C       NPW     = Number of USER FEES read in from FEES.DAT for energy
C               must equal NS1,ACCUALLY 2*NPW IS READ IN
C       NPWAC   = Number of energy accounts
C       NS1     = Number of columns read in from energy file PWQ.DAT
C               must equal NPW
C       NS2     = Number of columns read in from navigation data NAVQ.DAT
C               must equal NAV
C       NS3     = Number of columns read in from agriculture data AGQ.DAT
C               must equal NAG
C       NTITLE(I)= Array containing one of line of comment form input files
C       NTOTAL    = Total number of accounts
C       NYEARS    = Number of years, read from FEES.DAT
C       NY1       = Number of years from UNIT 1,PWQ.DAT
C       NY2       = Number of years from UNIT 2,AGQ.DAT
C       NY3       = Number of years from UNIT 3,NAVQ.DAT
C       QUAN(I)    = The UNDISCOUNTED quantity of the service I
C                    used during the year
C       VALUE(I)   = The revenue for service I
C
C
C
```

```
      DIMENSION NTITLE(80),NCORD(36),QUAN(9),VALUE(36),FEES(36)
      DIMENSION KTITLE(10,80),DISSUM(9),SUMSEC(3),PRO(9),SUMSER(3)
      INTEGER ACC(36)
      DATA DISSUM,SUMSEC,SUMSER/9*0.0,3*0.0,3*0.0/
      WRITE(5,700)
      RATE=.05
700   FORMAT(1X,'IS THE DISCOUNT RATE IN DECIMAL FORM .05 Y/N ? ',$)
      READ(5,705)IOK
705   FORMAT(A1)
      IF(IOK.EQ.'Y')GO TO 2
      WRITE(5,710)
710   FORMAT(1X,'ENTER DISCOUNT RATE IN DECIMAL FORM ? ',$)
      READ(5,*)RATE
2     CONTINUE
      OPEN(UNIT=1,NAME='FEES.DAT',TYPE='OLD')
      OPEN(UNIT=4,NAME='REVENU.DAT',TYPE='NEW',CARRIAGECONTROL='LIST')
      READ(1,100,ERR=800)LTEMP,NYEARS
      LTITLE=LTEMP
              DO 5 I=1,LTEMP
              READ(1,102)(KTITLE(I,K),K=1,80)
 5    CONTINUE
C
C
100   FORMAT(5I4)
102   FORMAT(80A1)
C
C  ICHECK IS A VARIABLE TO CHECK IF POWER ACCOUNTING CODES ARE READ IN
C  FIRST
      KCHECK='PW'
      READ(1,103,ERR=805)ICHECK
103   FORMAT(A2)
      IF(KCHECK.NE.ICHECK)CALL WRONG
C  NPWAC IS THE NUMBER OF ACCOUNTS FOR POWER REVENUE
      READ(1,*,ERR=810)NPWAC
      READ(1,105,ERR=815)(NCORD(K-1),ACC(K-1),FEES(K/2),NCORD(K),
     *                    ACC(K),K=2,NPWAC,2)
D     WRITE(5,*)(ACC(JK),JK=1,12)
      KCHECK='AG'
      READ(1,103,ERR=820)ICHECK
      IF(KCHECK.NE.ICHECK)CALL WRONG
C  NAGAC IS THE NUMBER OF ACCOUNTS FOR AGICULTURAL REVENUES
      READ(1,*,ERR=825)NAGAC
      NB2=NPWAC+2
      NE2=NAGAC+NPWAC
      READ(1,105,ERR=830)(NCORD(K-1),ACC(K-1),FEES(K/2),NCORD(K),
     *                    ACC(K),K=NB2,NE2,2)
D     WRITE(5,*)(ACC(JK),JK=13,24)
      KCHECK='NV'
      READ(1,103,ERR=835)ICHECK
      IF(KCHECK.NE.ICHECK)CALL WRONG
C  NAVAC IS THE NUMBER OF ACCOUNTS FOR NAVIGATION REVENUES
      READ(1,*,ERR=840)NAVAC
      NB3=NE2+2
      NE2=NE2+NAVAC
      READ(1,105,ERR=845)(NCORD(K-1),ACC(K-1),FEES(K/2),NCORD(K),
     *                    ACC(K),K=NB3,NE2,2)
D     WRITE(5,*)(ACC(JK),JK=25,36)
105   FORMAT(3(A1,I4,F8.2,A1,I4,1X))
C
C
C  CLOSE FILE WITH ACCOUNT AND USER FEE INFORMATION
C  OPEN FILES CONTAINING QUANTITIES
C
      CLOSE(UNIT=1,DISP='KEEP')
C  OPEN FILE FOR KEY.OUT OPENED AT THIS POINT SO FILE WILL CONTAIN
C  RECORD OF INPUT OPTIONS USED IN BENEFIT PROGRAMS
      OPEN(UNIT=8,NAME='KEY.OUT',TYPE='NEW')
      WRITE(8,*)'FILE  KEY.OUT'
      OPEN(UNIT=1,NAME='PWQ.DAT',TYPE='OLD')
      OPEN(UNIT=2,NAME='AGQ.DAT',TYPE='OLD')
      OPEN(UNIT=3,NAME='NAVQ.DAT',TYPE='OLD')
      READ(1,100,ERR=865)LTEMP2,NY1,NS1
      IF(NY1.NE.NYEARS)CALL YEARS(1)
      READ(2,100,ERR=866)LTEMP3,NY2,NS2
      IF(NY2.NE.NYEARS)CALL YEARS(2)
      READ(3,100,ERR=867)LTEMP4,NY3,NS3
      IF(NY3.NE.NYEARS)CALL YEARS(3)
      LTITLE=LTITLE+LTEMP2+LTEMP3+LTEMP4+1
      WRITE(4,*)LTITLE,NYEARS
      WRITE(4,*)'OUTPUT FROM REVENUE PROGRAM '
      DO 7  I=1,LTEMP
      WRITE(4,102)(KTITLE(I,K),K=1,80)
 7    CONTINUE
      DO 20 I=1,LTEMP2
      READ(1,102)NTITLE
      WRITE(4,102)NTITLE
      WRITE(8,102)NTITLE
C
 20   CONTINUE
      DO 25 I=1,LTEMP3
      READ(2,102)NTITLE
      WRITE(4,102)NTITLE
      WRITE(8,102)NTITLE
C
 25   CONTINUE
      DO 35 I=1,LTEMP4
      READ(3,102)NTITLE
      WRITE(4,102)NTITLE
      WRITE(8,102)NTITLE
C
 35   CONTINUE
C
C
C
C     LOOP TO READ IN QUANTITIES AND CALCULATE REVENUE FOR EACH YEAR
C
C  FOLLOWING VALUES ARE USED WITH IN THE LOOP TO CONTROL THE NUMBER OF
C  QUANTITIES READ IN FROM EACH FILE
C
C                12 ACCOUNTS IS READ IN FOR EACH SECTOR
C                4  ACCOUNTS FOR EACH COUNTRY WITHIN A SECTOR
      NPW=NPWAC/4
      NPW2=NPWAC/2
      NERROR=1
      IF(NS1.NE.NPW)CALL STATE(NERROR)
      NAG=NAGAC/4
      NAG2=NAGAC/2
      NERROR=2
      IF(NAG.NE.NS2)CALL STATE(NERROR)
      NAV=NAVAC/4
      NAV2=NAVAC/2
      NERROR=3
      IF(NAV.NE.NS3)CALL STATE(NERROR)
C
C
      NB1=1
      NE1=NPW
      NB2=NPW+1
      NE2=NAG+NE1
      NB3=NE2+1
      NE3=NAV+NE2
C  THE TOTAL NUMBER OF ACCOUNT IS NTOTAL
```

```
      NTOTAL=NPWAC+NAGAC+NAVAC
      DO 50 I=1,NYEARS
      READ(1,1000,ERR=870)(QUAN(K),K=1,NPW)
              DO 52 I1=NB1,NE1
              VALUE(I1)=QUAN(I1)*FEES(I1)
D     WRITE(5,*)QUAN(I1),FEES(I1)
              VALUE(I1+NPW)=QUAN(I1)*FEES(I1+NPW)
D     WRITE(5,*)I1,I1+NPW,FEES(I1+NPW)
 52   CONTINUE
D     WRITE(5,*)'PWQ'
D     WRITE(5,*)(VALUE(KIU),KIU=1,6)
C
C
      READ(2,1000,ERR=880)(QUAN(K),K=NB2,NE2)
      I2B=1+NPW2
      DO 54 I2=NB2,NE2
              VALUE(I2B)=QUAN(I2)*FEES(I2B)
D     WRITE(5,*)'AG',I2,I2B,QUAN(I2),FEES(I2B)

              VALUE(I2B+NAG)=QUAN(I2)*FEES(I2B+NAG)
D     WRITE(5,*)I2B+NAG,FEES(I2B+NAG),VALUE(I2B+NAG)
              I2B=I2B+1
 54   CONTINUE
D     WRITE(5,*)'AG'
D     WRITE(5,*)(VALUE(KIU),KIU=7,12)
      READ(3,1000,ERR=890)(QUAN(K),K=NB3,NE3)
      I3B=1+NPW2+NAG2
              DO 56 I3=NB3,NE3
              VALUE(I3B)=QUAN(I3)*FEES(I3B)
D     WRITE(5,*)VALUE(I3),I3,NAV2
              VALUE(I3B+NAV)=QUAN(I3)*FEES(I3B+NAV)
D     WRITE(5,*)I3B+NAV,QUAN(I3),FEES(I3B+NAV),VALUE(I3B+NAV)
      I3B=I3B+1
 56   CONTINUE
D     WRITE(5,*)'NAV'
D     WRITE(5,*)(VALUE(KIU),KIU=13,18)
C
C                     CALCULATED DISCOUNTED SUMS BY SECTOR
      NT=I-1
      FAC=((1/(1+RATE))**NT)
      IK=0
      IL=0
      DO 61 I61=1,3
      DO 60 I60=1,3
      IK=IK+1
      IL=IL+1
      DISSUM(IL)=DISSUM(IL)+VALUE(IK)*FAC
 60   CONTINUE
      IK=IK+3
 61   CONTINUE
      WRITE(4,5010)I,NTOTAL
      WRITE(4,5000)(NCORD(K-1),ACC(K-1),VALUE(K/2),NCORD(K),ACC(K),
     *              K=2,NTOTAL,2)
C
C
  50  CONTINUE
C
C
C
      CLOSE(UNIT=1,DISP='KEEP')
      CLOSE(UNIT=2,DISP='KEEP')
      CLOSE(UNIT=3,DISP='KEEP')
      CLOSE(UNIT=4,DISP='KEEP')
      TOTAL=0.0
C             CALCULATE DISCOUNTED SUMS BY COUNTRY AND SERVICE
C             AND PERCENTAGE TO EACH
      I1=1
      I2=2
      I3=3
      DO 65 I65=1,3
      SUMSEC(I65)=DISSUM(I1)+DISSUM(I2)+DISSUM(I3)
      I1=I1+3
      I2=I2+3
      I3=I3+3
 65   CONTINUE
      K75=1
      DO 70 I70=1,3
              DO 75 I75=1,3
              PRO(K75)=DISSUM(K75)/SUMSEC(I70)
              K75=K75+1
 75   CONTINUE
 70   CONTINUE

      I1=1
      I2=4
      I3=7
      K1=1
      DO 62 K2=1,3
      SUMSER(K2)=DISSUM(I1)+DISSUM(I2)+DISSUM(I3)
      K1=I63
      TOTAL=TOTAL+SUMSER(K2)
      I1=I1+1
      I2=I2+1
      I3=I3+1
 62   CONTINUE
C                     OUTPUT VALUES FOR POWER TO KEY.OUT

      WRITE(8,5015)
      WRITE(8,5020)SUMSEC(1),(DISSUM(IK),IK=1,3)
      WRITE(8,5025)(PRO(IK),IK=1,3)
      WRITE(8,5040)(FEES(JK),JK=1,3)
      WRITE(8,5030)SUMSEC(2),(DISSUM(IK),IK=4,6)
      WRITE(8,5025)(PRO(IK),IK=4,6)
      WRITE(8,5040)(FEES(JK),JK=7,9)
      WRITE(8,5035)SUMSEC(3),(DISSUM(IK),IK=7,9)
      WRITE(8,5025)(PRO(IK),IK=7,9)
      WRITE(8,5040)(FEES(JK),JK=13,15)
      WRITE(8,5045)TOTAL,(SUMSER(JK),JK=1,3)
5015  FORMAT('1',1X,'DATA FILE KEY.OUT    FOLLOWING RESULTS ARE USED
     & TO CALCUALTE COST KEY',/,1X,'DISCOUNTED REVENUE'
     * ,' TO EACH COUNTRY BY USER SECTOR',/,/,
     * ,11X,'TOTAL',12X,'MALI',12X,'MAURITANIA',9X,'SENEGAL',/)
5020  FORMAT(1X,'PW',4(3X,F15.2),)
5025  FORMAT(1X,'PROPORTIONS',6X,F15.3,3X,F15.3,3X,F15.3,/)
5030  FORMAT(1X,'WS',4(3X,F15.2))
5035  FORMAT(1X,'NV',4(3X,F15.2))
5040  FORMAT(1X,'FEES',13X,F15.4,3X,F15.4,3X,F15.4,/,/,/)
5045  FORMAT(1X,'TOTALS',/,1X,2X,4(3X,F15.2))
C
 1000 FORMAT(4F15.2)
 5000 FORMAT(2(1X,A1,I4,F15.2,A1,I4))
 5010 FORMAT('YEAR',2X,I5,2X,I2)
      STOP
C     ERROR HANDLING SECTION
800   STOP 'ERROR IN FIRST LINE OF FEES.DAT FILE'
805   STOP 'ERROR READING  PW FROM FEES.DAT'
810   STOP 'ERROR READING NUMBER OF ACCOUNTS PW'
815   STOP 'ERROR READING USER FEE LINE PW'
820   STOP 'ERROR READING AG REVENEUE.IN'
825   STOP 'ERROR READING NUMBER OF ACCOUNTS AG'
```

```
830     STOP 'ERROR READING USER FEE LINE AG'
835     STOP  ERROR READING NV  FEES.DAT'
840     STOP 'ERROR READING NUMBER OF ACCOUNTS NV'
845     STOP 'ERROR READING USER FEE LINE NV'
865     STOP 'ERROR READING FIRST LINE PWQ.DAT'
866     STOP 'ERROR READING FIRST LINE AGQ.DAT'
867     STOP 'ERROR READING FIRST LINE NAVQ.DAT'
870     STOP 'ERROR READING VALUES PWQ.DAT'
880     STOP 'ERROR READING VAULES AGQ.DAT'
890     STOP 'ERROR READING VALUES NAVQ.DAT'
        END
C
C
        SUBROUTINE WRONG
        WRITE(5,*)'RUN TERMINATED BECAUSE'
        WRITE(5,*)'INPUT DATA IS NOT IN PROPER ORDER IN FEES.DAT FILE'
        WRITE(5,*)'THE ORDER SHOULD BE'
        WRITE(5,*)'POWER USER FEES AND ACCOUNTS  FIRST'
        WRITE(5,*)'AGRICULTURE SECOND'
        WRITE(5,*)'NAVIGATION THIRD'
        STOP
        END
        SUBROUTINE STATE(I)
        WRITE(5,*)'RUN TERMINATED BECAUSE '
        WRITE(5,*)'ERROR MISSMATCH BETWEEN QUANTITIES AND NUMBER OF ACCOUNTS'
        WRITE(5,*)'NUMBER OF QUANTITITES DOES NOT MATCH NUMBER OF ACCOUNTS'
        GO TO (1,2,3),I
1       WRITE(5,*)'EITHER IN PWQ.DAT OR FEES.DAT  POWER SECTION'
        GO TO 5
 2      WRITE(5,*)'EITHER IN AGQ.DAT OR FEES.DAT  AGRICULTURE SECTION'
        GO TO 5
 3      WRITE(5,*)'EITHER IN NAVQ.DAT OR FEES.DAT NAVIGATION SECTION'
 5      STOP
        END
        SUBROUTINE YEARS(I)
        WRITE(5,*)'RUN TERMINATED'
        WRITE(5,*)'MISSMATCH BETWEEN NUMBER OF YEARS IN FEES.DAT FILE AND'
        GO TO (1,2,3),I
1       WRITE(5,*)' PWQ.DAT FILE'
        GO TO 5
2       WRITE(5,*)' AGQ.DAT FILE'
        GO TO 5
3       WRITE(5,*)' NAVQ.DAT FILE'
5       CONTINUE
        STOP
        END
```

```
C  PROGRAM TO CALCULATE ENERGY BENEFIT-----ENGBEN
C
C               One input file ENERGY.PRE
C               Two output files ENGBEN.OUT(discounted benefit)
C               and PWQ.DAT (quantity of energy consumped in each country
C       SUBROUTINE NOT USED IN THIS VERSION OF PROGRAM
C               INPUT reads in historical benefit and quantity amounts
C
C       BEN     = The undiscounted value of the energy used,yearly total
C       DIS     = Discount factor
C*****************************************************************
C       HIST    = Logical variable to indiciate historical benefit values
C                 are being entered; T if historical data is available
C VARIABLE HIST IS NOT READ IN DATA FILE CAN BE CHANGED LATER TO HANDLE
C HISTORAL DATA
C*****************************************************************
C       INDEX   = Y discount rate remains at .05
C                 N user can enter different value
C       LTEMP   = Number of lines of comment
C       LTITLE  = The number of lines of comment in the INPUT FILE
C       NSTART  = Beging value of DO loop reading in data, 1 if
C                 no historical data are read in
C       NSTATE  = Number of columns to write out in PWQ.DAT, indicates
C                 the number of states the total quantity has been
C                 distributed to
C       NYEARS  = Number of years of data in input and output files
C       PALT    = The cost of the alternative method of energy production
C       PCMAL   = Fraction of total energy used in mali
C       PCMAU   = Fraction of total energy used in Mauritania
C       PCSEN   = Fraction of total energy used in Senegal
C       PQMAL   = Amount of energy used in Mali in one year
C       PQMAU   = Amount of energy used in Mauritania in one year
C       PQSEN   = Amount of energy used in Senegal in one year
C       PQUAN   = The quanty of energy use in a year KWHR;undiscounted
C       RATE    = The discount rate
C       SUMB    = The discounted sum of the benefits
C       SUMQ    = The discounted sum of the quantities used
C       TOTAL   = Total undiscounted quantity of energy consumed
C       TOTMAL  = Total undiscounted quantity consumed in Mali
C       TOTMAU  = Total undiscounted quantity consumed in Mauritania
C       TOTSEN  = Total undiscounted quantity consumed in Senegal
C
C
        DIMENSION NTITLE(80)
C       LOGICAL HIST
        OPEN(UNIT=1,NAME='ENERGY.PRE',TYPE='OLD')
        OPEN(UNIT=2,NAME='ENGBEN.OUT',TYPE='NEW')
        OPEN(UNIT=3,NAME='PWQ.DAT',TYPE='NEW',CARRIAGECONTROL='LIST')
        WRITE(5,300)
 300    FORMAT(1X,'IS THE DISCOUNT RATE IN DECMAL FORM= 0.05,',
     *  ' (Y/N) ? ',$)
        RATE=0.05
        READ(5,301)INDEX
301     FORMAT(A1)
        IF(INDEX.EQ.'Y')GO TO 33
        WRITE(5,*)'ENTER DISCOUNT RATE'
        READ(5,302)RATE
 302    FORMAT(F10.2)
 33     CONTINUE
        WRITE(5,303)
 303    FORMAT(1X,'IS THE ALTERNATIVE COST OF ENERGY GENERATION ',
     *  '31.26 KW- HR (Y/N) ? ',$)
```

```
      PALT=31.28
      READ(5,301)INDEX
      IF(INDEX.EQ.'Y')GO TO 34
      WRITE(5,^)' ENTER ALTERNATIVE ENERGY COST  FOR KW-HR
      READ(5,302)PALT
 34   CONTINUE
      PCMAL=.5645
      PCMAU=0.00
      PCSEN=.4355
      WRITE(5,220)PCMAL,PCMAU,PCSEN
220   FORMAT(1X,'IS THE EFFECTIVE ENERGY DISTRIBUTION ',
     ^ ' THE FOLLOWING PROPORTIONS',/,1X,
     ^ '  TO  MALI(URBAN) = ',F6.4,'TO MAURITANIA  = ',F6.4,/,
     ^'  TO SENEGAL(IRON MINE)  = ',F6.4,' (Y/N) ? ',$)
      READ(5,301)INDEX
      IF(INDEX.EQ.'Y')GO TO 36
      WRITE(5,^)'ENTER NUMBERS IN DECIMAL FORM 5%= .05'
      WRITE(5,^)'ENTER PROPORTION OF ENGERGY USED BY MALI'
      READ(5,^)PCMAL
      WRITE(5,^)'ENTER PROPORTION OF ENERGY USED BY MAURITANIA'
      READ(5,^)PCMAU
      WRITE(5,^)'ENTER PROPORTION OF ENERGY USED BY SENEGAL'
      READ(5,^)PCSEN
36    CONTINUE
C     READ(1,100)LTITLE,NYEARS,HIST
C 100 FORMAT(I2,I3,L1)
      READ(1,^)LTITLE,NYEARS
      LTEMP=LTITLE+7
      WRITE(2,101)LTEMP,NYEARS,
      WRITE(2,5000)
      WRITE(2,5010)
5010  FORMAT(' ENGBEN.OUT  OUTPUT FILE FROM ENGBEN ',
     ^ 'INTERACTIVE INPUT FOR COST ALLOCATION')
101   FORMAT(I4,I4,'      !LENGHT OF HEADING,NUMBER OF YEARS')
      WRITE(2,^)'DISCOUNT RATE = ',RATE,' ALTERNATIVE ENERGY COST ',PALT
      WRITE(2,219)PCMAL,PCMAU,PCSEN
      LTEMP2=LTITLE+8
      NSTATE=3
      WRITE(3,102)LTEMP2,NYEARS,NSTATE
102   FORMAT(I4,I4,I4)
      WRITE(3,5000)
5000  FORMAT(' ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^',
     ^ '^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^')
      WRITE(3,^)'   FILE PWQ.DAT OUTPUT FROM ENERGY BENEFIT PROGRAM '
      WRITE(3,305)
305   FORMAT('UNDISCOUNTED YEARLY QUANTITIES USED TO',
     ^          '  CALCULATE REVENUE')
      WRITE(3,^)'DISCOUNT RATE = ',RATE,' ALTERNATIVE ENERGY COST ',PALT
      WRITE(3,219)PCMAL,PCMAU,PCSEN
219   FORMAT(1X,'% MALI = ',F6.4,' % MAUR = ',F6.4,' % SENEGAL = ',F6.4)
      WRITE(2,^)'THE FOLLOWING INPUT FILES WERE USED IN ENGBEN'
      WRITE(3,^)'THE FOLLOWING INPUT FILE WERE USED IN ENGBEN'
      DO 5 I=1,LTITLE
      READ(1,105)NTITLE
      WRITE(2,105)NTITLE
      WRITE(3,105)NTITLE
 5    CONTINUE
      NDEL=7
      WRITE(5,^)'FOR CALCULATION OF KEY REPORT 5 USED NO DELAY START 1988'
      WRITE(5,^)'FOR CALCULATION OF USER FEES REPORT USED 7 YEAR DELAY'
      WRITE(5,601)
601   FORMAT(1X,'FOR THIS RUN USE A DELAY OF 7 YEARS Y/N  ',$)
      READ(5,301)INDEX
      IF(INDEX.EQ.'Y')GO TO 106
      WRITE(5,602)
602   FORMAT(1X,'ENTER LENGTH OF DELAY ONE INTEGER   ',$)
      READ(5,^)NDEL
106   CONTINUE
      WRITE(2,8001)NDEL
8001  FORMAT(1X,'ENERGY DELAY = ',I5,/,'1',2X,'ENERGY OUTPUT
      WRITE(3,^)'ENERGY DELAY = ',NDEL
105   FORMAT(80A1)
      WRITE(2,8005)
8005  FORMAT(1X,'VALUES X1.E9',40X,'QUANTITY BY COUNTRY',
     $ /,1X,'UNDISCOUNTED BENEFIT      QUANTITY     ',
     $ 8X,'MALI',12X,'MAURITANIA',6X,'SENEGAL')
      WRITE(3,230)
230   FORMAT(1X,'MALI',12X,'MAURITANIA',6X,'SENEGAL',9X,'TOTAL')
      NSTART=1
      SUMB=0.0
      SUMQ=0.0
      TOTAL=0.0
      TOTMAL=0.0
      TOTSEN=0.0
      ICOUNT=0
C     IF(HIST)CALL INPUT(NSTART,RATE,SUMQ,SUMB)
      DO 80 I=NSTART,NYEARS
      DIS=(1/(1+RATE))^^(I-1)
      ICOUNT=ICOUNT+1
      IF((ICOUNT.EQ.1).OR.(ICOUNT.GT.NDEL))READ(1,110)PQUAN
110   FORMAT(F15.2)
      BEN=PALT^PQUAN
      WRITE(2,500)BEN/1.E9,PQUAN/1.E9,PQMAL/1.E9,PQMAU/1.E9,PQSEN/1.E9
      PQMAL=PCMAL^PQUAN
      TOTMAL=TOTMAL+PQMAL
      PQMAU=PCMAU^PQUAN
      TOTMAU=TOTMAU+PQMAU
      PQSEN=PCSEN^PQUAN
      TOTSEN=TOTSEN+PQSEN
      TOTAL=TOTAL+PQUAN
      WRITE(3,502,PQMAL,PQMAU,PQSEN,PQUAN,I
      SUMB=SUMB+DIS^BEN
      SUMQ=SUMQ+DIS^PQUAN
 80   CONTINUE
      WRITE(2,505)SUMB/1.E9,SUMQ/1.E9
      WRITE(3,510)TOTMAL,TOTMAU,TOTSEN,TOTAL
      WRITE(3,515)SUMB,SUMQ
      WRITE(3,5000)
      WRITE(2,5000)
500    FORMAT(8X,F7.3,12X,F7.3,10X,F7.3,11X,F7.3,8X,F7.3)
502   FORMAT(4F15.2,3X.I5)
505   FORMAT(1X,F8.3,' X1.E9 =  DISCOUNTED SUM OF BENEFITS ',/,
     ^ 1X,F8.3, ' X1.E9 =  DISCOUNTED SUM OF QUANTITY ')
510   FORMAT(' TOTALS ',4(G15.10,1X))
515   FORMAT(G15.10' =  DISCOUNTED SUM OF BENEFITS ',/,
     ^ G15.10, ' =  DISCOUNTED SUM OF QUANTITY ')

      STOP
      END
C
C
C              THE FOLLOWING SUBROUTINE IS PROVIDED AS A
C              SAMPLE IF HISTORICAL DATA IS TO BE USED
C              AT A LATER TIME
      SUBROUTINE INPUT(NSTART,RATE,SUMQ,SUMB)
      READ(1,100)NHIST
 100  FORMAT(I3)
      NSTART=NHIST+1
      DO 5 I=1,NHIST
      DIS=(1/(1+RATE))^^I
      READ(1,105)PQUAN,BEN
      WRITE(2,500)BEN/1.E9,PQUAN/1.E9
```

```
      WRITE(3,505)PQUAN,I
      SUMB=SUMB+DIS*BEN
      SUMQ=SUMQ+DIS*PQUAN
5     CONTINUE
105   FORMAT(F15.2,F15.2)
500   FORMAT(8X,F7.3,8X,F7.3)
505   FORMAT(F15.2,2X,I5)
      RETURN
      END
```

```
C               FEES.FTN  Program to calculate user fees.
C               input file ALLOCA.DAT
C               output file FEES.OUT
C                           FEES.DAT
C               file        FEES.DAT is read by revenue program
C               input data
C                       from ALLOCA.DAT
C                       discounted quantities
C                       proportion of joint cost to each sector
C
C                       from Cost data, user prepared
C                       specific cost to sector
C                       separable cost to sector
C                       joint cost
C*****************************************************************
C               MAJOR VARIABLES USED IN FEES.FTN
C       CNAV    =       Total cost to navigation
C       CPOW    =       Total cost to energy
C       CWATER  =       Total cost to irrigation
C       JUNK    =       Dummy variable used to read lines of data
C                       not currently used be FEES.FTN
C       LTITLE  =       Number of lines of comment in ALLOCA.DAT
C       NAG     =       Number of accounts for irrigation revenue
C       NNV     =       Number of accounts for navigation revenue
C       NPW     =       Number of accounts for energy revenue
C       NYEARS  =       Number of years of data
C       QNAV    =       Discounted quantity of navigation used
C       QPOW    =       Discounted quantity of energy used
C       QWATER  =       Discounted quantity of water used
C       PRONAV  =       Proportion of joint cost to navigation
C       PROPOW  =       Proportion of joint cost to energy
C       PROWAT  =       Proportion of joint cost to irrigation
C       SENAV   =       Separable cost of navigation
C       SEPOW   =       Separable cost of energy
C       SEWAT   =       Separable cost of irrigation
C       SPNAV   =       Specific cost of navigation
C       SPPOW   =       Specific cost of energy
C       SPWAT   =       Specific cost of irrigation
C       USER1   =       User fee for irrigation
C       USER2   =       User feee for energy
C       USER3   =       User fee for navigation
C       XJOINT  =       Joint cost
C
C*****************************************************************
      DIMENSION DATE(40),NAME(80)
      QWATER=-9
      QPOW=-9
      QNAV=-9

C
C               OPEN FEES.DAT FILE, OUTPUT FILE READ BY REVENUE PROGRAM
      OPEN(UNIT=3,NAME='FEES.DAT',TYPE='NEW',CARRIAGECONTROL='LIST')
      NYEARS=50
      WRITE(5,7035)
7035  FORMAT(1X,'IS THE NUMBER OF YEARS THE MODEL WILL RUN 50 (Y/N) ? ',$)
      READ(5,4000)OK
      IF(OK.EQ.'Y')GO TO 80
      WRITE(5,*)'ENTER THE NUMBER OF YEARS THE MODEL'
      WRITE(5,*)'WILL BE RUN  I4'
      READ(5,*)NYEARS
80    CONTINUE
```

```
      LTITLE=3
      WRITE(3,450)LTITLE,NYEARS
450   FORMAT(2I4)
      WRITE(3,*)'*****************************************'
      WRITE(3,*)'FEES.DAT FILE CREATED BY PROGRAM FEES'
      WRITE(5,*)'ENTER TODAYS DATE   MAXIMUM 40 CHARACTERS'
      WRITE(5,7012)
      READ(5,410)DATE
      WRITE(3,415)DATE
 410  FORMAT(40A1)
 415  FORMAT('THIS FILE CREATED ON ',40A1)
C
      OPEN(UNIT=4,NAME='FEES.OUT',TYPE='NEW')
      WRITE(4,*)'FEES.OUT'
      WRITE(4,*)'FEES.OUT this file is not read by other programs'
      WRITE(4,415)DATE
C
      OPEN(UNIT=1,NAME='ALLOCA.DAT',TYPE='OLD',ERR=700)
      READ(1,*)LTITLE
      DO 5 I=1,LTITLE
      READ(1,4001)NAME
      WRITE(4,4001)NAME
 5    CONTINUE
4001  FORMAT(80A1)
      READ(1,4000)JUNK
      READ(1,4000)JUNK
      READ(1,4000)JUNK
      READ(1,*)QJUNK
      READ(1,*)QJUNK
      READ(1,*)QJUNK
      READ(1,4000)JUNK

C             ENTER PROPORTIONS
      READ(1,*)PROWAT,PROPOW,PRONAV
      CLOSE(UNIT=1,DISP='KEEP')
700   CONTINUE
C                    ENTER FROM BENEFIT DATA FILES THE QUANTITIES
      WRITE(5,8015)
8015  FORMAT(1X,'ARE DISCOUNTED QUANTITIES TO BE READ FROM DATA FILES'
     * , '(Y/N) ? ',$)
      READ(5,4000)OK
      IF(OK.EQ.'N') GO TO 10
C             INPUT AGRICULTURE WATER USED
      OPEN(UNIT=2,NAME='AGQ.DAT',TYPE='OLD')
      READ(2,*)LTITLE,NYEARS
      DO 91 I91=1,LTITLE
      READ(2,4001)NAME
      WRITE(4,4001)NAME
91    CONTINUE
      DO 92   I92=1,NYEARS
      READ(2,4001)NAME
92    CONTINUE
      READ(2,8010)XJUNK
      READ(2,8010)XJUNK
4010  FORMAT(F15.2)
      READ(2,4010)QWATER
      CLOSE(UNIT=2,DISP='KEEP')
C             INPUT ENERGY CONSUMED
      OPEN(UNIT=2,NAME='PWQ.DAT',TYPE='OLD')
      READ(2,*)LTITLE,NYEARS
      DO 93 I93=1,LTITLE
      READ(2,4001)NAME
      WRITE(4,4001)NAME
93    CONTINUE
      DO 94 I94=1,NYEARS
      READ(2,4001)NAME
94    CONTINUE
      READ(2,8010)XJUNK
      READ(2,8010)XJUNK
8010  FORMAT(A4)
      READ(2,4010)QPOW
      CLOSE(UNIT=2,DISP='KEEP')
C             INPUT NAVIGATION VOLUME
      OPEN(UNIT=2,NAME='NAVQ.DAT',TYPE='OLD')
      READ(2,*)LTITLE,NYEARS
      DO 95   I95=1,LTITLE
      READ(2,4001)NAME
      WRITE(4,4001)NAME
95    CONTINUE
      DO 96   I96=1,NYEARS
      READ(2,4001)NAME
96    CONTINUE
      READ(2,8010)XJUNK
      READ(2,8010)XJUNK
      READ(2,4010)QNAV
      CLOSE(UNIT=2,DISP='KEEP')
      IF(QWATER.LE.0.0)GO TO 10
      WRITE(5,7010)QWATER
7010  FORMAT(1X,F15.2,' = Discounted quantity of water (Y/N) ? ',$)
      READ(5,4000)OK
      IF(OK.EQ.'Y')GO TO 11
10    CONTINUE
      WRITE(5,*)'ENTER ONE REAL NUMBER'
      WRITE(5,*)'ENTER DISCOUNTED QUANTITY OF WATER USED'
      WRITE(5,7012)
7012  FORMAT(1X,' ? ',$)
      READ(5,*)QWATER
11    CONTINUE
      WRITE(5,*)'  '
      IF(QPOW.LE.0.0)GO TO 20
      WRITE(5,7013)QPOW
7013  FORMAT(1X,F15.2,' = Discounted quantity of energy (Y/N) ? ',$)
      READ(5,4000)OK
      IF(OK.EQ.'Y')GO TO 21
20    CONTINUE
      WRITE(5,*)'ENTER ONE REAL NUMBER'
      WRITE(5,*)'ENTER DISCOUNTED QUANTITY OF ENERGY CONSUMED'
      WRITE(5,7012)
      READ(5,*)QPOW
21    CONTINUE

      WRITE(5,*)'  '
      IF(QNAV.LE.0.0)GO TO 30
      WRITE(5,7014)QNAV
7014  FORMAT(1X,F15.2,' = Discounted quantity of navigation (Y/N) ? ',$)
      READ(5,4000)OK
      IF(OK.EQ.'Y')GO TO 31
30    CONTINUE
      WRITE(5,*)'ENTER ONE REAL NUMBER'
      WRITE(5,*)'ENTER DISCOUNTED QUANTITY OF NAVIGATION'
      WRITE(5,7012)
      READ(5,*)QNAV
31    CONTINUE
C
      WRITE(5,*)'  '
      IF(PROWAT.LE.0.0)GO TO 40
      WRITE(5,*)PROWAT,' = PROPORTION OF JOINT COST'
      WRITE(5,7015)
7015  FORMAT(1X,'ALLOCATED TO AGRICULTURE SECTOR (Y/N) ? ',$)
      READ(5,4000)OK
      IF(OK.EQ.'Y')GO TO 41
40    CONTINUE
```

```
      WRITE(5,*)'ENTER ONE REAL NUMBER'
      WRITE(5,*)'ENTER PROPORTION OF JOINT COST ALLOCATED TO'
      WRITE(5,*)'AGRICULTURE SECTOR'
      WRITE(5,7012)
      READ(5,*)PROWAT
41    CONTINUE
      WRITE(5,*)'  '
      IF(PROPOW.LE.0.0)GO TO 50
      WRITE(5,*)PROPOW,' = PROPORTION OF JOINT COST'
      WRITE(5,7016)
7016  FORMAT(1X,'ALLOCATED TO ENERGY SECTOR (Y/N) ? ',$)
      READ(5,4000)OK
      IF(OK.EQ.'Y')GO TO 51
50    CONTINUE
      WRITE(5,*)'ENTER ONE REAL NUMBER'
      WRITE(5,*)'ENTER PROPORTION OF JOINT COST ALLOCATED TO'
      WRITE(5,*)'ENERGY SECTOR'
      WRITE(5,7012)
      READ(5,*)PROPOW
51    CONTINUE
C     ENTER COSTS
      WRITE(5,*)'  '
      IF(PRONAV.LE.0.0)GO TO 60
      WRITE(5,*)PRONAV,' = PROPORTION OF JOINT COST'
      WRITE(5,7017)
7017  FORMAT(1X,'ALLOCATED TO NAVIGATION SECTOR (Y/N) ? ',$)
      READ(5,4000)OK
      IF(OK.EQ.'Y')GO TO 61
60    CONTINUE
      WRITE(5,*)'ENTER ONE REAL NUMBER'
      WRITE(5,*)'ENTER PROPORTION OF JOINT COST ALLOCATED TO'
      WRITE(5,*)'NAVIGATION SECTOR'
      WRITE(5,7012)
      READ(5,*)PRONAV
61    CONTINUE
      WRITE(5,*)'  '
      WRITE(5,*)'ENTER SPECIFIC COST '
      WRITE(5,*)'Costs of infrastructure'
      WRITE(5,*)'components,operation and maintenance which'
      WRITE(5,*)'are required exclusively by an identifiable'
      WRITE(5,*)'service sector and, therefore, are not'
      WRITE(5,*)'included in the common works cost'
      WRITE(5,*)'VALUES ARE FROM FILE DISSUM.OUT'
      WRITE(5,*)'  '
      WRITE(5,*)'ENTER ONE REAL NUMBER AFTER EACH PROMPT'
      WRITE(5,*)'ENTER SPECIFIC COST OF IRRIGATION'
      WRITE(5,7012)
      READ(5,*)SPWAT
      WRITE(5,*)'  '
      WRITE(5,*)'ENTER SPECIFIC COST OF ENERGY'
      WRITE(5,7012)
      READ(5,*)SPPOW
      WRITE(5,*)'ENTER SPECIFIC COST OF NAVIGATION'
      WRITE(5,7012)
      READ(5,*)SPNAV
      WRITE(5,*)'  '
      WRITE(5,*)'NEXT ENTER SEPARABLE COSTS'
      WRITE(5,*)'The portion of common works costs which can'
      WRITE(5,*)'be assigned to a service sector'
      WRITE(5,*)'  '
      WRITE(5,500)
500   FORMAT(1X,'SEPARBLE COSTw = COMMON WORKS WITHw -',
     *' COMMON WORKS WITHOUTw'  )
      WRITE(5,*)'  '
      WRITE(5,*)'ENTER ONE REAL NUMBER AFTER EACH PROMPT'
      WRITE(5,*)'ENTER SEPARABLE COST OF IRRIGATION'
      WRITE(5,7012)
      READ(5,*)SEWAT
      WRITE(5,*)'  '
      WRITE(5,*)'ENTER SEPARABLE COST OF ENERGY'
      WRITE(5,7012)
      READ(5,*)SEPOW
      WRITE(5,*)'  '
      WRITE(5,*)'ENTER SEPARABLE COST OF NAVIGATION'
      WRITE(5,7012)
      READ(5,*)SENAV
      WRITE(5,*)'  '
      WRITE(5,*)'NEXT ENTER JOINT COST'
      WRITE(5,*)'The portion of common works costs remaining'
      WRITE(5,*)'after separable costs have been substracted'
      WRITE(5,*)'for each service sector'
      WRITE(5,*)'  '
      WRITE(5,*)'ENTER JOINT COST -- ONE REAL NUMBER'
      WRITE(5,7012)
      READ(5,*)XJOINT
      CWATER=SPWAT+SEWAT+PROWAT*XJOINT
      CPOW  =SPPOW+SEPOW+PROPOW*XJOINT
      CNAV  =SPNAV+SENAV+PRONAV*XJOINT
      USER1=CWATER/QWATER
      USER2=CPOW/QPOW
      USER3=CNAV/QNAV

C                     OUTPUT TO UNIT 4 FEES.OUT

      WRITE(4,8001)
8001  FORMAT('1',1X,'OUTPUT FROM PROGRAM FEES')
      WRITE(4,*)' DISCOUNTED QUANTITY OF WATER CONSUMED',QWATER
      WRITE(4,*)' THE DISCOUNTED QUANTITY OF POWER CONSUMED',QPOW
      WRITE(4,*)' THE DISCOUNTED VOLUME OF NAVIGATION',QNAV
      WRITE(4,*)' THE SPECIFIC COST TO IRRIGATION  ',SPWAT
      WRITE(4,*)' THE SPECIFIC COST TO ENERGY      ',SPPOW
      WRITE(4,*)' THE SPECIFIC COST TO NAVIGATION  ',SPNAV
      WRITE(4,*)' THE SEPARABLE COST TO IRRIGATION ',SEWAT
      WRITE(4,*)' THE SEPARABLE COST TO ENERGY     ',SEPOW
      WRITE(4,*)' THE SEPARABLE COST TO NAVIGATION ',SENAV
      WRITE(4,*)' JOINT COST                       ',XJOINT
      WRITE(4,*)' PROPORTION OF JOINT TO IRRIGATION ',PROWAT
      WRITE(4,*)' PROPORTION OF JOINT TO ENERGY     ',PROPOW
      WRITE(4,*)' PROPORTION OF JOINT TO NAVIGATION ',PRONAV
      WRITE(4,*)' TOTAL COST TO IRRIGATION         ',CWATER
      WRITE(4,*)' TOTAL COST TO ENERGY             ',CPOW
      WRITE(4,*)' TOTAL COST TO NAVIGATION         ',CNAV
      WRITE(4,795)USER1,USER2,USER3
795   FORMAT(1X,/,/,1X,'THE USER FEES          ',/
     * 1X,'IRRIGATION  ENERGY       NAVIGATION',/,1X,4(G11.6,2X))
      CLOSE(UNIT=4,DISP='KEEP')

C
C*****************************************************************
C
C              PASS USER FEES TO FEES.DAT FILE
C              FEES.DAT FILE COULD BE EDITED BY HAND
C              A CHANGE IN THE NUMBER OF ACCOUNTS
C              HANDLED BY QUANTITY SCHEDULES WOULD RESULT
C              IN CHANGES HERE

      WRITE(3,420)
420   FORMAT('PW')
      NPW=12
      WRITE(3,*)NPW
      WRITE(3,400)USER2,USER2,USER2
```

```
      WRITE(3,401)USER2,USER2,USER2
400   FORMAT('D1010',F8.4,'C3010',1X,'D1010',F8.4,'C3010',
     ^ 1X,'D1010',F8.4,'C3010')
401   FORMAT('D6000',F8.4,'C4205',1X,'D6000',F8.4,'C4210',
     ^ 1X,'D6000',F8.4,'C4215')
      WRITE(3,425)
425   FORMAT('AG')
      NAG=12
      WRITE(3,^)NAG
      WRITE(3,402)USER1,USER1,USER1
      WRITE(3,403)USER1,USER1,USER1
402   FORMAT('D1010',F8.4,'C3010',1X,'D1010',F8.4,'C3010',
     ^ 1X,'D1010',F8.4,'C3010')
403   FORMAT('D6000',F8.4,'C4005',1X,'D6000',F8.4,'C4010',
     ^ 1X,'D6000',F8.4,'C4015')
      WRITE(3,430)
430   FORMAT('NV')
      NNV=12
      WRITE(3,^)NNV
      WRITE(3,404)USER3,USER3,USER3
      WRITE(3,405)USER3,USER3,USER3
404   FORMAT('D1010',F8.4,'C3010',1X,'D1010',F8.4,
     ^ 'C3010',1X,'D1010',F8.4,'C3010')
405   FORMAT('D6000',F8.4,'C4105',1X,'D6000',F8.4,
     ^ 'C4110',1X,'D6000',F8.4,'C4115')
      WRITE(3,^)'^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^'
      CLOSE(UNIT=3,DISP='KEEP')

4000  FORMAT(A1)
      STOP
      END
```

```
      DIMENSION M(5.3),AV(3)
      OPEN(UNIT=1,NAME='IN.TST',TYPE='OLD')
      OPEN(UNIT=2,NAME='OUT.TST',TYPE='NEW')
      S=0
      DO 10 I=1,5
      REWIND 1
      READ(1,20) (M(I,J),J=1,3)
20    FORMAT(3I2)
      S=S+M(I,J)
      WRITE(2,40)S
40    FORMAT(1X,I3,F2.0)
      AV(I)=S/FLOAT(J)
      WRITE(2,40) AV(I)
      S=0
10    CONTINUE
      STOP
      END
```

```
C     PROGRAM TO CALCULATE THE NAVIGATIONAL BENEFITS
C     THIS PROGRAM WAS WRITEN BY GEORGE LEO HARGREAVES 1982
C     THIS PROGRAM REQUIRES SPECIAL INSTRUCTIONS TO LINK
      REAL NBENR,NBENMI,NBENP,NBENMA,NBENSE,NBEN,MAVOLO,MAVOLA
      REAL NBMIA,NBMIO,NBMAO,NBMAA,NBSEO,NBSEA,MIVOLO,MIVOLA,NBENA
      REAL MIAVD,MAAVD
        DIMENSION HEAD(80)

      OPEN(UNIT=2,NAME='NVOL.DAT',TYPE='OLD')
      OPEN(UNIT=1,NAME='NBEN.OUT',TYPE='NEW')
      OPEN(UNIT=3,NAME='NAVQ.DAT',TYPE='NEW',CARRIAGECONTROL='LIST')
      OPEN(UNIT=4,NAME='DELAY.DAT',TYPE='OLD')
      OPEN(UNIT=7,NAME='AGCOST.DAT',TYPE='NEW',CARRIAGECONTROL='LIST')

CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
C     PARAMETER DEFINITIONS
C
C       AVOLD= AGRICULTURAL VOLUME DURING DELAYED PERIOD
C       DISF = DISCOUNT FACTOR
C       LT   = LINES IN TITLE IN NAVQ.DAT DATA TABLE
C       NCOL = NUMBER OF COLUMNS READ BY THE REVENUE PROGRAM (# OF COUNTRIES)
C       N    = NO
C       NYEAR= PROJECT LIFE (NUMBER OF YEARS)
C       RATE = DISCOUNT RATE IN DECIMAL FORM
C       Y    = YES
C
C       THE FOLLOWING CHARACTERS ARE USED TO BUILD VARIABLE NAMES
C         example: NBMIA=NAVIGATIONAL BENEFITS FOR MALI'S AGRICULTURE
C                : UALTTP=ALTERNATE TARIFFS FOR TRUCKING PHOSPHATE
C       A    = AGRICULTURE
C       B    = BENEFITS
C       BEN  = BENEFITS
C       C    = COSTS
C       D    = DISCOUNTED
C       FACT= ADJUSTMENT FACTOR TO ACCOUNT FOR DISTANCE DIFFERENCE (LAND/WATER)
C       MA   = MUARITANIA
C       MI   = MALI
C       N    = NAVIGATIONAL
C       O    = OTHER
C       P    = PHOSPHATE
C       R    = RAIL
C       SUM  = DISCOUNTED SUM
C       SE   = SENEGAL
C       T(prefix)=YEARLY TOTALS
C       T(suffix)=TRUCKING
C       UAL  = TARIFFS FOR ALTERNATIVE MODES OF TRANSPORTATION (F.CFA/t)
C       VOL  = VOLUME OF NAVIGATION IN YEAR 'T' (Mt*km)
C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC

C     INITIALIZE PARAMETERS

      SUMCAD=0.
      SUMNB=0.
      SUMNBA=0.
      SUMVOL=0.
        TOTMAL=0.0
        TOTMAU=0.0
        TOTSEN=0.0
        TOTAL=0.0
      FACTR=750./925.
      FACTT=.80
      FACTTP=.893

C*************************************************************************
C           PARAMETERS ENTERED INTERACTIVELY

      WRITE(5,*)'IS THE DISCOUNT RATE IN DECIMAL FORM=0.057 (Y/N)'
      READ(5,1002)NTEST
      RATE=0.05
      IF(NTEST.EQ.'Y')GO TO 10
      WRITE(5,*)'ENTER DISCOUNT RATE IN DECIMAL FORM (RATE)'
      READ(5,*)RATE
   10 CONTINUE

      WRITE(5,*)'IS PROJECT LIFE =50 YEARS? (Y/N)'
      READ(5,1002)NTEST
      NYEAR=50
      IF(NTEST.EQ.'Y')GO TO 11
      WRITE(5,*)'ENTER PROJECT LIFE IN YEARS (NYEAR)'
      READ(5,*)NYEAR
   11 CONTINUE

      WRITE(5,*)'IS THE TARIFF FOR RAIL=14.5  F.CFA/tkm? (Y/N)'
      READ(5,1002)NTEST
      UALR=14.5
      IF(NTEST.EQ.'Y')GO TO 12
      WRITE(5,*)'ENTER THE TARIFF FOR RAIL (UALR)'
      READ(5,*)UALR
   12 CONTINUE

      WRITE(5,*)'IS THE TARIFF FOR TRUCKING PHOSPHATE=28.8
     *  F.CFA/tkm? (Y/N)'
      READ(5,1002)NTEST
      UALTP=28.8
      IF(NTEST.EQ.'Y')GO TO 13
      WRITE(5,*)'ENTER THE TARIFF FOR TRUCKING PHOSPHATE (UALTP)'
      READ(5,*)UALTP
   13 CONTINUE

      WRITE(5,*)'IS THE TARIFF FOR TRUCKING IN MALI=27.7
     *  F.CFA/tkm? (Y/N)'
      READ(5,1002)NTEST
      UALTMI=27.7
      IF(NTEST.EQ.'Y')GO TO 14
      WRITE(5,*)'ENTER THE TARIFF FOR TRUCKING IN MALI (UALTMI)'
      READ(5,*)UALTMI
   14 CONTINUE

      WRITE(5,*)'IS THE TARIFF FOR TRUCKING IN MAURITANIA=38.4
     *  F.CFA/tkm? (Y/N)'
      READ(5,1002)NTEST
      UALTMA=38.4
      IF(NTEST.EQ.'Y')GO TO 15
      WRITE(5,*)'ENTER THE TARIFF FOR TRUCKING IN MAURITANIA (UALTMI)'
      READ(5,*)UALTMA
   15 CONTINUE

      WRITE(5,*)'IS THE TARIFF FOR TRUCKING IN SENEGAL=21.1
     *  F.CFA/tkm? (Y/N)'
      READ(5,1002)NTEST
      UALTSE=21.1
      IF(NTEST.EQ.'Y')GO TO 16
      WRITE(5,*)'ENTER THE TARIFF FOR TRUCKING IN SENEGAL (UALTSE)'
      READ(5,*)UALTSE
   16 CONTINUE
```

```
 1002 FORMAT(A1)
C*************************************************************************
C      ACCOUNT FOR  HEADINGS IN NVOL.DAT AND DELAY.DAT
         READ(2,*)LT2
         READ(4,*)LT4
         LT3=LT2+LT4+10
         LT1=LT2+LT4+7
C      PRINT OUTPUT TITLE AND COLUMN HEADINGS FOR NAVQ.DAT
       NCOL=3
       WRITE(3,2003)LT3,NYEAR,NCOL
         WRITE(1,2003)LT1,NYEAR
         WRITE(3,5000)
         WRITE(1,5000)
         WRITE(7,5000)
 5000    FORMAT(' ********************************************'
     * ,'**************************************')
         WRITE(3,*)'NAVQ.DAT -- OUTPUT FROM NBEN USED IN REVENUE'
         WRITE(1,5030)
 5030    FORMAT(' NBEN.OUT -- OUTPUT FROM NBEN INTERACTIVE',
     *    ' INPUT FOR COST ALLOCATION')
         WRITE(7,5035)
 5035    FORMAT(' AGCOST.DAT -- OUTPUT FROM NBEN INTERACTIVE',
     * ' INPUT FOR COST ALLOCATION ')
         WRITE(3,5010)
 5010    FORMAT(' THE FOLLOWING VALUES  FOR INTERACTIVE VARIABLES '
     *' WERE USED')
         WRITE(1,5015)RATE,NYEAR
         WRITE(1,5020)UALR,UALTP,UALTMI,UALTMA,UALTSE
         WRITE(3,5015)RATE,NYEAR
         WRITE(3,5020)UALR,UALTP,UALTMI,UALTMA,UALTSE
         WRITE(7,5015)RATE,NYEAR
         WRITE(7,5020)UALR,UALTP,UALTMI,UALTMA,UALTSE
 5015    FORMAT(' DISCOUNT RATE ',F5.3,' NUMBER OF YEARS ',I5,
     *   'AND THE FOLLOWING TARIFFS')
 5020    FORMAT(' RAIL=',F6.2,' TRUCKING PHOSPHATE=',F6.2,
     * ' TRUCK MALI=',F6.2,' TRUCK MAUR.=',F6.2,'TRUCK SEN.=',F6.2)
         WRITE(3,*)'    '
         WRITE(3,*)'THE FOLLOWING INPUT FILES WERE USED'
         DO 5 I5=1,LT2
         READ(2,1000)HEAD
         WRITE(3,1000)HEAD
         WRITE(1,1000)HEAD
         WRITE(7,1000)HEAD
 5       CONTINUE
         DO 6 I6=1,LT4
         READ(4,1000)HEAD
         WRITE(3,1000)HEAD
         WRITE(1,1000)HEAD
         WRITE(7,1000)HEAD
 6       CONTINUE
         WRITE(3,*) '
         WRITE(1,*) '
         WRITE(7,*) '
       WRITE(3,2004)
       WRITE(3,2005)
 2003 FORMAT(3I4,'  NUMBER OF LINES IN TITLE.YEARS,AND COLUMNS READ BY
     * REVENUE.FTN')
 2004 FORMAT(2X,'TOTAL YEARLY NAVIGATIONAL VOLUMES')
 2005 FORMAT(7X,'MALI',8X,'MAURITANIA',7X,'SENEGAL',8X,'TOTAL',10X,
     * 'YEAR')
 1000 FORMAT(80A1)
C      PRINT OUTPUT TITLE AND COLUMN HEADINGS FOR NBEN.OUT
       WRITE(1,2001)
       WRITE(1,2002)
 2001 FORMAT('1',/,4X,'NAVIGATIONAL BENEFITS VALUES X1.E9',/,
     $  1X,' THE FOLLOWING CODE IS USED FOR COLUME HEADINGS:',
     $  /,1X,'MI = MALI, R = RAIL, MA = MAURTIANA, P = PHOSPHATE,'
     $  ' SEN = SENEGAL'
     $  ,' N = NAVIGATION, TVOL TOTAL YEARLY VOLUME ',/,
     $  /,15X,'NAVIGATION VOLUMES BY COUNTRY AND SECTOR',24X,
     $  'VOLUMES BY COUNTRY')
 2002 FORMAT(6X,'YEAR',3X,'MIBEN',4X,'RBEN',3X,'MABEN',4X,'PBEN',
     * 3X,'SEBEN',3X,'AGBEN',4X,'NBEN',4X,'TVOL',4X,'MALI',4X,
     $  'MAUR',4X,'SEN')

C      PRINT OUTPUT COLUMN HEADINGS FOR AGCOST.DAT
       WRITE(7,2006)
 2006 FORMAT(6X,'YEAR',3X,'COSTS')

       DO 100 I=1,NYEAR
         DISF=1./((1.+RATE)**(I-1))
         READ(2,1003)JYEAR,MIVOLO,MIVOLA,RVOL,MAVOLO,MAVOLA
     *    ,PVOL,SEVOLO,SEVOLA,TVOL
 1003    FORMAT(I10,9F10.2)
C        ****THE 1000000 IS FOR UNIT CONSISTANCY *********
       NBENR=UALR*RVOL*FACTR*1000000.
       NBMIO=UALTMI*(MIVOLO-RVOL)*FACTT*1000000.
       NBMIA=UALTMI*MIVOLA*FACTT*1000000.
       NBENMI=NBMIO+NBMIA+NBENR
       NBENP=UALTP*PVOL*FACTTP*1000000.
       NBMAO=UALTMA*MAVOLO*FACTT*1000000.
       NBMAA=UALTMA*MAVOLA*FACTT*1000000.
       NBENMA=NBMAO+NBMAA+NBENP
       NBSEO=UALTSE*SEVOLO*FACTT*1000000.
       NBSEA=UALTSE*SEVOLA*FACTT*1000000.
       NBENSE=NBSEO+NBSEA
       NBEN=NBENMI+NBENMA+NBENSE
       NBENA=NBMIA+NBMAA+NBSEA

       TVOL=TVOL*1000000.
       SUMNB=SUMNB+NBEN*DISF
       SUMNBA=SUMNBA+NBENA*DISF
       SUMVOL=SUMVOL+TVOL*DISF
       WRITE(1,2007)JYEAR,NBENMI/1.E9,NBENR/1.E9,NBENMA/1.E9,
     $ NBENP/1.E9,
     $ NBENSE/1.E9,NBENA/1.E9,NBEN/1.E9,
     *   TVOL/1.E9,TVOLMI/1.E9,TVOLMA/1.E9,TVOLSE/1.E9
 2007  FORMAT(I10,11F8.2)
C      PRINT OUT THE NAVQ.DAT TABLE
       TVOLMI=(MIVOLO+MIVOLA)*1000000
       TVOLMA=(MAVOLO+MAVOLA+PVOL)*1000000
       TVOLSE=(SEVOLO+SEVOLA)*1000000
       WRITE(3,2008)TVOLMI,TVOLMA,TVOLSE,TVOL,JYEAR
C              CALCULATE TOTALS
       TOTMAL=TOTMAL+TVOLMI
       TOTMAU=TOTMAU+TVOLMA
       TOTSEN=TOTSEN+TVOLSE
       TOTAL=TOTAL+TVOL
 2008  FORMAT(4F15.2,I10)
C      CALCULATE THE AGRICULTURAL COSTS DUE TO THE DELAY
       READ(4,1004)MIAVD,MAAVD,SEAVD
 1004  FORMAT(10X,3F10.2)
       CMIA=UALTMI*MIAVD*1000000
       CMAA=UALTMA*MAAVD*1000000
       CSEA=UALTSE*SEAVD*1000000
       CAD=CMIA+CMAA+CSEA
       WRITE(7,2009)JYEAR,CAD
```

```
 2009    FORMAT(I10,1PE10.2)
         SUMCAD=SUMCAD+CAD*DISF
  100 CONTINUE
       WRITE(1,8011)SUMNB/1.E9
 8011    FORMAT(1X,'DISCOUNTED TOTAL PROJECT NAVIGATIONAL',
      $  ' BENEFITS =',F9.3,' X1E9')
       WRITE(1,8010)SUMVOL/1.E9
 8010    FORMAT(1X,'DISCOUNTED TOTAL PROJECT NAVIGATIONAL',
      $  ' VOLUME =',F9.3,' X1E9')
         WRITE(1,8012)SUMCAD/1.E9
 8012    FORMAT(1X,'DISCOUNTED TOTAL AGRICULTURAL COSTS DUE TO
      $  NAVIGATION DELAY =',F9.3,' X1.E9')
       WRITE(1,2013)RATE
         WRITE(3,2040)TOTHAL,TOTHAU,TOTSEN,TOTAL
       WRITE(3,2011)SUMNB
       WRITE(3,2010)SUMVOL
         WRITE(3,2012)SUMCAD
       WRITE(3,2013)RATE
 2040    FORMAT(1X,'TOTALS ',4(G15.8,2X))
  2010 FORMAT(G15.10' = DISCOUNTED TOTAL PROJECT NAVIGATIONAL',
      *'  VOLUME')
  2011 FORMAT(G15.10,' = DISCOUNTED TOTAL PROJECT NAVIGATIONAL',
      *' BENEFITS')
       WRITE(7,2012)SUMCAD
       WRITE(7,2014)
       WRITE(7,2013)RATE
  2012 FORMAT(G15.10,' = DISCOUNTED TOTAL AGRICULTURAL',
      *' COSTS DUE TO DELAY ')
  2013 FORMAT(2X,'THE DISCOUNT RATE =',F4.2)
  2014 FORMAT(2X,'THE COST SHOWN ABOVE SHOULD BE SUBTRACTED FROM THE
      * TOTAL AGRICULTURAL BENEFITS!')

         WRITE(7,5000)
         WRITE(1,5000)
         WRITE(3,5000)
        CLOSE(UNIT=2,DISP='KEEP')
        CLOSE(UNIT=1,DISP='KEEP')
        CLOSE(UNIT=3,DISP='KEEP')
        CLOSE(UNIT=4,DISP='KEEP')
        CLOSE(UNIT=7,DISP='KEEP')
        STOP
        END
```

```
C      PROGRAM TO CALCULATE AGRICULTURAL AREAS
C      THIS PROGRAM WRITEN BY GEORGE LEO HARGREAVES 1982
       INTEGER T
       OPEN(UNIT=1,NAME='AREA.DAT',TYPE='NEW',CARRIAGECONTROL='LIST')
       open(unit=2,name='area.out',type='new')

CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
C         VARIABLE DEFINITIONS
C         *******ALL AREAS ARE IN HECTARS***********
C         AD=AREA OF DRY FARMING
C         ADD=AREA OF DRY FARM DISPLACED
C         AF=AREA ARTIFICIALLY FLOODED
C         AFMAX=MAXIMUM POTENTIAL AREA FOR  ARTIFICIAL FLOOD
C         AI=IRRIGATED AREA
C         AII=INITIAL IRRIGATED AREA
C         AIMAX=MAXIMUM IRRIGATED AREA
C         AR=AREA OF RECESSION AGRICULTURAL
C         ARD=AREA OF RECESSION AGRICULTURE DISPLACED
C         R1=INITIAL DEVELOPMENT RATE
C         R2=NEW DEVELOPMENT RATE
C         T=YEARLY COUNTER
C         TF=TIME TO WHEN  ARTIFICIAL FLOODING BEGINS (IN YEARS)
C         TNEW=TIME TO WHEN NEW DEVELOPMENT RATE STARTS (IN YEARS)
C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC

C       INITIALIZE PARAMETERS (EXCEPT FOR R1 WHICH IS INITIALIZED LATER)
        T=0
        AI=0.
        AII=28805.
        AIMAX=315000.
        AR=108633.
        AD=75000.
        AFMAX=90000.

C***************************************************************************
C       PARAMETERS INITIALIZED INTERACTIVELY

        WRITE(5,*)'IS THE NEW DEVELOPMENT RATE=5000. ha./yr? (Y/N)'
        READ(5,10)NTEST
        R2=5000.
        IF(NTEST.EQ.'Y')GO TO 20
          WRITE(5,*)'ENTER THE NEW DEVELOPMENT RATE IN ha./yr (R2)'
          READ(5,*)R2
          IF(R2.EQ.5000.)GO TO 20
    20 CONTINUE

        WRITE(5,*)'IS THE TIME TO NEW DEVELOPMENT RATE= 4 YEARS? (Y/N)'
        READ(5,10)NTEST
        TNEW=4
        IF(NTEST.EQ.'Y')GO TO 21
          WRITE(5,*)'ENTER THE NUMBER OF YEARS BEFORE NEW DEVELOPMENT'
          WRITE(5,*)'RATE IS EFFECTIVE (TNEW)'
          READ(5,*)TNEW
    21 CONTINUE

        WRITE(5,*)'IS THE TIME TO ARTIFICIAL FLOOD= 9 YEARS? (Y/N)'
        READ(5,10)NTEST
        TF=9
        IF(NTEST.EQ.'Y')GO TO 22
```

```
      WRITE(5,*)'ENTER AREA FOR MALI'
      READ(5,*)AMALI
      WRITE(5,*)'ENTER AREA FOR MAURITANIA'
      READ(5,*)AMAUR
      WRITE(5,*)'ENTER AREA FOR SENEGAL'
      READ(5,*)ASENE
      WRITE(5,*)'ENTER TOTAL INITIAL AREA IRRIGATED'
      READ(5,*)AII
23    CONTINUE

C             PRINT OUT THE NUMBER OF LINES IN THE TITLE HEADING
      WRITE(1,*)'14'
C     PRINT OUTPUT HEADINGS
      WRITE(1,2015)
      WRITE(2,*)'AREA.OUT OUTPUT FROM AREA.FTN'
      WRITE(1,*)'AREA.DAT OUTPUT FROM AREA.FTN USED AS INPUT FOR
     $ AGEEN'
      WRITE(1,*)'VALUES OF OPTIONS USED FOR THIS RUN ARE'
      WRITE(1,2004)R2,TNEW
      WRITE(1,2005)TF
      WRITE(1,2030)RMALII,RMAURI,RSENEI,TOTMAL,RMAURF,RSENEF
     *,AMALI,AMAUR,ASENE
      WRITE(1,2015)
     WRITE(1,2000)
     WRITE(1,2001)
      WRITE(1,2015)
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
      WRITE(2,*)'VALUES OF OPTIONS USED FOR THIS RUN ARE'
      WRITE(2,2004)R2,TNEW
      WRITE(2,2005)TF
      WRITE(2,2030)RMALII,RMAURI,RSENEI,TOTMAL,RMAURF,RSENEF
     *,AMALI,AMAUR,ASENE
      WRITE(2,2015)
      WRITE(2,5000)
5000  FORMAT('1',/)
     WRITE(2,2000)
      WRITE(2,5002)
5002  FORMAT(/,1X,' CODE FOR COLUMN HEADINGS ',/ 1X,'AI= TOTAL AREA
     $ IRRIGATED, ARD= DISPLACED RECESSION AREA',/,1X,'ADD= DISPLACED
     $ RAINFED AREA, AF= AREA OF ARTIFICAL FLOOD',/,1X,'MALI PROPORTION
     $ OF IRRIGATED AREA IN MALI, MAUR IN MAURITAINA, SENE IN SENEGAL')
     WRITE(2,2001)
      WRITE(2,2015)
 2000 FORMAT(20X,'AGRICULTURAL AREAS DATA TABLE')
 2001 FORMAT(6X,'YEAR',7X,'RATE',8X,'AI',8X,'ARD',8X,'ADD',8X,'AF'
     *,2X,'   MALI    MAUR    SENE')
 2004 FORMAT(1X,'NEW DEVELOPMENT RATE',F8.0,'TIME TO NEW DEVELOPMENT
     $ RATE',F5.0)
 2005 FORMAT(' NUMBER OF YEARS BEFORE THE FLOOD',F5.0)
 2015 FORMAT('              ')
 2030 FORMAT(' THE FOLLOWING VALUES WERE USED TO DISTRIBUTE'
     *,' HA DEVELOPED BETWEEN COUNTRIES',/,1X,
     *' INITIAL  MALI = ',F5.4,' MAUR ',F5.4,' SENEGAL ',F5.4,
     */,' TOTAL POSSIBLE HA IN MALI = ',F7.0,
     */,' FINIAL  MAUR ',F5.4, ' SENEGAL ',F5.4,
     */,' INITIAL AREAS MALI ',F7.0,' MAUR ',F7.0,' SENEGAL ',F7.0)
C*************************************************************************

     DO 100 K=1980,2030
      IF(K.NE.1980)GO TO 200
        R1=0.
        AI=AII
        ARD=0.
        ADD=0.
        AF=0.
        GO TO 500
```

```
      WRITE(5,*)'ENTER NUMBER OF YEARS BEFORE FLOODING BEGINS (TF)'
      READ(5,*)TF
 22 CONTINUE

 10 FORMAT(A1)
C*******************************************************************

C
C INITIALIZATION OF VALUES USED TO SEPARATE IRRIGATED AREAS BETWEEN COUNTRIES
C              VARIABLE CODE USED
C       VARIABLES BEGINING WITH R ARE PROPORTION  OF AREA DEVELOPED IN EACH
C       COUNTRY
C       R1 IS THE AREA DEVELOPED IN A GIVEN YEAR
C       THUS AREA DEVELOPED EACH YEAR IN MALI = RMALII * R1
C       R VARIABLES ENDING IN I ARE INITIAL PROPORTION
C       R VARIABLES ENDING IN F ARE FINAL PROPORTION (VALUES AFTER
C       THE MAXIMUM NUMBER OF HA HAS BEEN DEVELOPED IN MALI)
C       TOTMAL = THE MAXIMUM NUMBER OF HA THAT CAN BE DEVELOPED IN MALI
C       VARIABLES BEGINING WITH A ARE AREA VARIABLES
C       VARIABLES BEGINING WITH PC ARE THE PROPORTION VARIABLES(THE
C       PROPORTION OF THE TOTAL AREA IRRIGATED IN A GIVEN COUNTRY
C       VARIABLES ENDING WITH T ARE TEMPORARY STORAGE VARIABLES
      RMALII=.1666
      RMAURI=.3436
      RSENEI=.4898
      RMALIF=0.0
      RMAURF=.4125
      RSENEF=.5875
      TOTMAL=23437.
      AMALI=270.
      AMAUR=5305.
      ASENE=23230.
      RMALI=RMALII
      RMAUR=RMAURI
      RSENE=RSENEI
C                 CHECK WITH USER ON SEPARATION BETWEEN COUNTRIES
      WRITE(5,2020)RMALII,RMAURI,RSENEI,TOTMAL,RMAURF,RSENEF,
     *AMALI,AMAUR,ASENE,AII
2020  FORMAT(1X,'IN REPORT 4 AND REPORT 5 THE FOLLOWING ',
     *' PROPORTIONS WERE USED',/,' TO SEPARATE TOTAL AREA DEVELOPED',
     *1X,'EACH YEAR BETWEEN THE 3 COUNTRIES',/,1X,
     *'PROPORTION TO MALI ',F6.4,' PROPORTION TO MAUR ',F6.4
     *,/,1X,'PROPORTION TO SENEGAL ',F6.4,/,1X,
     *'AFTER ',F7.0,' HA HAS BEEN DEVELOPED IN MALI THE ',/,
     *' PROPORTION TO MAUR ',F6.4,' PROPORTION TO SENEGAL ',F6.4,/
     *,1X,'THE INITIAL AREAS IRRIGATED ARE',/,
     *1X,'MALI = ',F7.0,' MAURITANIA = ',F7.0,' SENEGAL ',F7.0,
     *' TOTAL = ',F8.0,/
     *,1X,'ARE THESE VALUES TO BE USED FOR THIS MODEL RUN (Y/N)')
      READ(5,10)OK
      IF(OK.EQ.'Y')GO TO 23
      WRITE(5,*)'ENTER VALUES IN DECIMAL FORM 50% = 0.50'
      WRITE(5,*)'ENTER NEW PROPORTION'
      WRITE(5,*)'FIRST INITIAL PROPORTION TO MALI'
      READ(5,*)RMALII
      WRITE(5,*)'ENTER INITAL PROPORTION TO MAUR'
      READ(5,*)RMAURI
      WRITE(5,*)'ENTER INITAL PROPORTION TO SENEGAL'
      READ(5,*)RSENEI
      WRITE(5,*)'ENTER MAXIMUM NUMBER OF HA POSSIBLE FOR MALI'
      READ(5,*)TOTMAL
      WRITE(5,*)'ENTER FINAL PROPORTION TO MAUR'
      READ(5,*)RMAURF
      WRITE(5,*)'ENTER FINAL PROPORTION TO SENEGAL'
      READ(5,*)RSENEF
      WRITE(5,*)'ENTER INITIAL AREAS IRRIGATED'
```

```
  200    CONTINUE
C        INITIALIZE THE DEVELOPMENT RATE
         R1=4000.
         IF(T.GT.TNEW)R1=R2
C        IRRIGATED AREA
         AI=AI+R1
         IF(AI.GE.AIMAX)AI=AIMAX
C        RECESSION AREA DISPLACED
         ARD=AI-AI1
         IF(ARD.LT.AR)GOTO 300
           ARD=AR
C          DRY FARM AREA DISPLACED
           ADD=AI-ARD-AI1
           IF(ADD.GT.AD)ADD=AD
  300    CONTINUE
C        ARTIFICIAL FLOOD AREA
         IF(T.LT.TF)GOTO 400
         IF(AI.GE.AFMAX)GOTO 400
         AF=AFMAX-AI
         GOTO 500
  400    AF=0
  500    CONTINUE
C
C                DISTRIBUTE THE AREA DEVELOPED IN A GIVEN YEAR
C                BETWEEN THE 3 COUNTRIES
C        FIRST CHECK TO SEE IF MALI IS AT MAXIMUM
C        IF AT MAXIMUM CHANGE PROPORTIONS
         R1T=R1
         AMALIT=AMALI+R1T*RMALI
         IF(AMALIT LT.TOTMAL)GO TO 50
         XADD=TOTMAL-AMALI
         AMALI=TOTMAL
         RMALI=0.0
         RMAUR=RMAURF
         RSENE=RSENEF
         R1T=R1-XADD
 50      CONTINUE
         AMALI=AMALI+R1T*RMALI
         AMAUR=AMAUR+R1T*RMAUR
         ASENE=ASENE+R1T*RSENE
C                CALCULATE THE PROPORTION OF TOTAL AREA IRRIGATED
C                IN EACH COUNTRY
         PCMAL=AMALI/AI
         PCMAU=AMAUR/AI
         PCSEN=ASENE/AI
         WRITE(2,2003)K,R1,AI,ARD,ADD,AF,PCMAL,PCMAU,PCSEN
         WRITE(1,2003)K,R1,AI,ARD,ADD,AF,PCMAL,PCMAU,PCSEN
 2003    FORMAT(I10,F12.0,3F11.0,F10.0,2X,3(F6.4,1X))
         T=T+1
  100 CONTINUE
         WRITE(2,2010)
 2010    FORMAT(' ********************************************************'
     * '************************************')
      CLOSE(UNIT=1,DISP='KEEP')
      STOP
      END
```

```
C     THIS MAIN PROGRAM IS TO CALCULATE AG. BENEFITS AND WATER REQUIREMENTS
C     THIS PROGRAM WRITEN BY GEORGE LEO HARGREAVES 1982
C     THIS PROGRAM REQUIRES SPECIAL INSTRUCTIONS TO LINK
      DIMENSION TAB(28,15),RI(28),RF(28),RRL(28),RDL(28),VC(28),WR(28)
      DIMENSION AGBEN(28),FC(28)
      DIMENSION LTITLE(2),NTITLE(80),HEAD(80)
      OPEN(UNIT=2,NAME='AREA.DAT',TYPE='OLD')
      OPEN(UNIT=3,NAME='AGTAB.PRE',TYPE='OLD')
      OPEN(UNIT=4,NAME='AGBEN.OUT',TYPE='NEW')
      OPEN(UNIT=1,NAME='CHECK.OUT',TYPE='NEW')
      OPEN(UNIT=7,NAME='AGQ.DAT',TYPE='NEW',CARRIAGECONTROL='LIST')

        WRITE(1,5030)
5030    FORMAT(1X,'CHECK.OUT OUTPUT FROM AGBEN.FTN ',/,' FILE CONTAINS
     $  DATA ON INDIVIDUAL CROPS FOR WET AND DRY SEASON ',/,1X,'REFERE
     $  TO OUTPUT FILE AGDATA.OUT FROM WRITE.FTN FOR DATA ON CROPS AND
     $  YIELDS',/,/)
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
C     PARAMETER DEFINITIONS
C
C     *******ALL MONITARY VALUES ARE IN F.CFA*******
C     ADD    = AREA OF DRY FARM DISPLACED
C     AF     = AREA ARTIFICIALLY FLOODED
C     AFM1   = AREA ARTIFICIALLY FLOODED IN THE PREVIOUS YEAR
C     AGBEN  = AGRICULTURAL BENEFITS
C     AI     = IRRIGATED AREA
C     AIM1   = IRRIGATED AREA IN THE PREVIOUS YEAR
C     ARD    = AREA OF RECESSION AGRICULTURE DISPLACED
C     C1     = DEVELOPMENT COSTS PER NEW HECTAR IN F.CFA
C     C2     = COSTS FOR PUMPS IN F.CFA
C     C3     = ANNUAL REPLACEMENT COSTS PER HECTAR IN F.CFA
C     CP     = CROPPING PATTERN FRACTION
C     DISF   = DISCOUNT FACTOR
C     FC     = FIXED COSTS
C     I      = ARRAY COUNTER FOR EACH PRODUCT OR CROP
C     IOUT   = VARIABLE CONTROLING INDIVIDUAL PRODUCT OUTPUT
C     KCHECK = NUMBER OF YEARS BETWEEN YEARLY OUTPUTS
C     LT     = NUMBER OF LINES IN HEADING
C     N      = PUMP LIFE OR TIME TO PUMP REPLACEMENT
C     NCOL   = NUMBER OF COLUMNS IN OUTPUT READ BY THE REVENUE PROGRAM
C     NPROD  = NUMBER OF PRODUCTS PER YEAR
C     NYEAR  = PROJECT LIFE IN YEARS
C     PCMAL  = PROPORTION OF TOTAL AREA IN MALI
C     PCMAU  = PROPORTION  OF TOTAL AREA IN MAURITANIA
C     PCSEN  = PROPORTION  OF TOTAL AREA IN SENEGAL
C     R1     = AGRICULTURAL DEVELOPMENT RATE
C     RATE   = DISCOUNT RATE IN DECIMAL FORM
C     RDL    = LOST REVENUES FROM DRY FARM AREAS
C     RF     = REVENUES FROM ARTIFICIALLY FLOODED AREAS
C     RI     = REVENUES FROM IRRIGATED AREAS
C     RRL    = LOST REVENUES FROM RECESSION AGRICULTURAL AREAS
C     SFF    = SINKING FUND FACTOR
C     SUMB   = DISCOUNTED TOTAL PROJECT AGRICULTURAL BENEFITS IN F.CFA
C     SUMQ   = DISCOUNTED TOTAL PROJECT WATER REQUIREMENTS IN CUBIC METERS
C     VC     = VARIABLE COSTS
C     WR     = WATER REQUIREMENTS IN CUBIC METERS
C     WRMAL  = WATER REQUIREMENT FOR MALI
C     WRMAU  = WATER REQUIREMENT FOR MAURITANIA
C     WRSEN  = WATER REQUIREMENT FOR SENEGAL
C
C     IF THE PARAMETER BEGINS WITH A "T" IT REFERS TO A YEARLY TOTAL
```

```
C       (example: TRI=YEARLY TOTAL REVENUES FROM IRRIGATED AREAS)
C       YTFC=YEARLY TOTAL FIXED COST
C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC

CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C               WRITE KEY TO CHECK.OUT
C
C     FC     = FIXED COSTS
C     I      = ARRAY COUNTER FOR EACH PRODUCT OR CROP
C     RDL    = LOST REVENUES FROM DRY FARM AREAS
C     RF     = REVENUES FROM ARTIFICIALLY FLOODED AREAS
C     RI     = REVENUES FROM IRRIGATED AREAS
C     RRL    = LOST REVENUES FROM RECESSION AGRICULTURAL AREAS
C     SFF    = SINKING FUND FACTOR
C     SUMB   = DISCOUNTED TOTAL PROJECT AGRICULTURAL BENEFITS IN F.CFA
C     SUMQ   = DISCOUNTED TOTAL PROJECT WATER REQUIREMENTS IN CUBIC METERS
C     VC     = VARIABLE COSTS
C     WR     = WATER REQUIREMENTS IN CUBIC METERS
C     WRMAL  = WATER REQUIREMENT FOR MALI
C     WRMAU  = WATER REQUIREMENT FOR MAURITANIA
C     WRSEN  = WATER REQUIREMENT FOR SENEGAL
C
C     IF THE PARAMETER BEGINS WITH A "T" IT REFERS TO A YEARLY TOTAL
C       (example: TRI=YEARLY TOTAL REVENUES FROM IRRIGATED AREAS)
C       YTFC=YEARLY TOTAL FIXED COST

CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C     INITIALIZE VALUES
      CP=0.
      SUMB=0.
      SUMQ=0.

        TOTBEN=0.0
        TWRMAL=0.0
        TWRMAU=0.0
        TWRSEN=0.0
C************************************************************************
C       PARAMETERS ENTERED INTERACTIVELY

      WRITE(5,*)'DO YOU WANT INDIVIDUAL PRODUCT BENEFITS? (Y/N)'
      READ(5,1003)IOUT
      IF(IOUT.EQ.'N')GO TO 10
        WRITE(5,*)'ENTER NUMBER OF YEARS BETWEEN YEARLY OUTPUTS'
        READ(5,*)KCHECK
   10 CONTINUE

      WRITE(5,*)'IS THE DEVELOPMENT COST PER NEW HECTAR =3560000 F.CFA?
     *  (Y/N)'
      READ(5,1003)NTEST
      C1=2800000.+760000.
      IF(NTEST.EQ.'Y')GO TO 11
        WRITE(5,*)'ENTER THE DEVELOPMENT COST PER NEW HECTAR IN F.CFA
     *  (C1)'
        READ(5,*)C1
   11 CONTINUE

      WRITE(5,*)'IS THE REPLACEMENT COSTS FOR PUMPS =760000 F.CFA?
     *  (Y/N)'
      READ(5,1003)NTEST
      C2=760000.
      IF(NTEST.EQ.'Y')GO TO 12
        WRITE(5,*)'ENTER THE REPLACEMENT COSTS IN F.CFA (C2)'
        READ(5,*)C2
   12 CONTINUE
```

```
      WRITE(5,*)'IS THE TIME TO PUMP REPLACEMENT =5 YEARS? (Y/N)'
      READ(5,1003)NTEST
      N=5
      IF(NTEST.EQ.'Y')GO TO 13
        WRITE(5,*)'ENTER THE TIME TO PUMP REPLACEMENT IN YEARS (N)'
        READ(5,*)N
   13 CONTINUE

      WRITE(5,*)'IS THE PROJECT LIFE =50 YEARS? (Y/N)'
      READ(5,1003)NTEST
      NYEAR=50
      IF(NTEST.EQ.'Y')GO TO 14
        WRITE(5,*)'ENTER THE PROJECT LIFE IN YEARS (NYEAR)'
        READ(5,*)NYEAR
   14 CONTINUE

      WRITE(5,*)'IS THE DISCOUNT RATE IN DECIMAL FORM=0.05? (Y/N)'
      READ(5,1003)NTEST
      RATE=.05
      IF(NTEST.EQ.'Y')GO TO 15
        WRITE(5,*)'ENTER THE DISCOUNT RATE IN DECIMAL FORM (RATE)'
        READ(5,*)RATE
   15 CONTINUE

 1003 FORMAT(A1)
C************************************************************************

C------------------------------------------------------------------------
C       PRINT OUT THE HEADINGS FOR THE AGQ.DAT DATA TABLE
      READ(2,*)LTITLE(2)
        READ(3,*)LTITLE(1),NPROD
        LT=LTITLE(2)+LTITLE(1)+6
        LT4=LTITLE(2)+LTITLE(1)+5
        NCOL=3
        WRITE(7,2001)LT,NYEAR,NCOL
        WRITE(7,2015)
        WRITE(7,*)'AGQ.DAT OUTPUT FROM AGBEN USED IN REVENUE'
        WRITE(4,*)LT4,NYEAR
        WRITE(4,2015)
        WRITE(4,*)'OUTPUT FROM AGBEN FILE AGBEN.OUT '
 2001   FORMAT(3I4,'  NUMBER OF LINES IN TITLE,YEARS,COLUMNS READ BY
     * REVENUE.FTN')
C     ACCOUNT FOR THE AREA DATA TABLE TITLE

        DO 60 I60=1,LTITLE(2)
      READ(2,1001)HEAD
        WRITE(7,1001)HEAD
        WRITE(4,1000)HEAD
60      CONTINUE
 1000   FORMAT(1X,80A1)
 1001 FORMAT(80A1)

C     ACCOUNT FOR THE AG. ECONOMIC SECTOR DATA TABLE TITLE
        DO 61 I61=1,LTITLE(1)
      READ(3,1002)NTITLE
        WRITE(7,1002)NTITLE
        WRITE(4,1000)NTITLE
61      CONTINUE
C
C               PRINT OUT VALUES OF OPTIONS ENTERED INTERACTIVELY
        WRITE(4,*)'VALUE OF OPTIONS ENTERED INTERACTIVELY ARE'
        WRITE(7,*)'VALUE OF OPTIONS ENTERED INTERACTIVELY ARE'
        WRITE(4,2000)C1,C2,N,RATE
        WRITE(7,2000)C1,C2,N,RATE
 2000   FORMAT(' DEVELOPMENT COST ',F9.0,' REPLACEMENT COST ',F9.0,
     *  'TIME TO PUMP REPLACEMENT',I5,' DISCOUNT RATE ',F5.3)
```

```
      WRITE(7,2002)
      WRITE(7,2030)
 2002 FORMAT(2X,'YEARLY WATER REQUIREMENTS')
 2030 FORMAT(8X,'MALI',7X,'MAURITANIA',5X,'SENEGAL',10X,'TOTAL')

C-----------------------------------------------------------------
 1002 FORMAT(80A1)
C     PRINT OUTPUT HEADINGS FOR AGBEN.OUT
      WRITE(4,1004)
 1004 FORMAT('1',1X,'FILE AGBEN.OUT ARGICULTURAL OUTPUT YEARLY VALUES'
     $ ' X1E.0E9',/,
     $ 29X,'YEARLY TOTALS',18X,'YEARLY WATER REQUIREMENTS BY  COUNTRY ',
     $ /,2X,'YEAR',6X,'WATER REQUIRED',4X,
     $ 'AGRICULTURAL BENEFIT',8X,'MALI',7X,'MAURITANIA',9X,'SENEGAL')

C     IF YEARLY PRODUCTS WANTED PRINT OUTPUT HEADINGS FOR CHECK.OUT
        IF(IOUT.EQ.1)GO TO 75
        IF((MOD(K,KCHECK).NE.0).AND.(K.NE.1))GO TO 75
          WRITE(1,1005)
C 1005     FORMAT(2X,'I',5X,'RI',7X,'RF',6X,'RRL',6X,'RDL',6X,
C    ^       'FC',6X,'VC',8X,'WR',6X,'AGBEN')
1005  FORMAT(1X,'CROP',7X,'REVENUE',4X,'REVENUE',5X,'REVENUE',8X,
     $ 'REVENUE',5X,'COSTS',6X,'COSTS',8X,'WATER',6X,'BENEFIT',
     $ /,1X,'SEASON',3X,'IRRIGATION',3X,'A.FLOOD',3X,'LOST RECESSION',
     $ 3X,'LOST DRY',
     $ 5X,'FIXED',5X,'VARIABLE',4X,'REQUIREMENT')
   75   CONTINUE

C     CALCULATE FIXED COSTS FOR PUMP REPLACEMENTS
      SFF=RATE/(((1.+RATE)**N)-1.)
      C3=C2*SFF

      READ(3,*)((TAB(I,J),J=1,15),I=1,NPROD)

C     CALCULATE ALLOCATED FIXED COSTS
      DO 100 I=1,NPROD
        CP=CP+TAB(I,11)
 100  CONTINUE

      READ(2,1006)R1,AI,ARD,ADD,AF,PCMAL,PCMAU,PCSEN

      DO 150 K=1,NYEAR
        AIM1=AI
        AFM1=AF

        READ(2,1006)R1,AI,ARD,ADD,AF,PCMAL,PCMAU,PCSEN
 1006 FORMAT(10X,F12.0,3F11.0,F10.0,2X,3(F6.4,1X))

C     INITIALIZE TOTAL YEARLY VALUES
      TRI=0
      TRF=0
      TRRL=0
      TRDL=0
      TVC=0
      TWR=0
      TAGBEN=0
      YTFC=0

C     CALCULATE TOTAL FIXED COSTS FOR IRRIGATED AREA
      TFC=C1*R1+C3*AIM1

      DO 200 I=1,NPROD
C       CALCULATE THE FIXED COSTS PER PRODUCT
        FC(I)=TFC*TAB(I,11)/CP

C       CALCULATE VARIABLE COST
        VC(I)=(TAB(I,7)*TAB(I,8)+TAB(I,9)*TAB(I,10))*TAB(I,11)*AIM1

C       CALCULATE REVENUES

C       REVENUE FROM IRRIGATION
        RI(I)=TAB(I,2)*TAB(I,3)*TAB(I,11)*AIM1
C       REVENUE FROM ARTIFICIAL FLOODING
        RF(I)=TAB(I,2)*TAB(I,4)*TAB(I,12)*AFM1
C       LOST REVENUE FROM RECESSION
        RRL(I)=TAB(I,2)*TAB(I,5)*TAB(I,13)*ARD
C       LOST REVENUE FROM DRY FARMING
        RDL(I)=TAB(I,2)*TAB(I,6)*TAB(I,14)*ADD

C       CALCULATE WATER REQUIREMENTS (*10000 TO GET CUBIC METERS)
        WR(I)=TAB(I,15)*TAB(I,11)*AIM1*10000.

C       CALCULATE AGRICULTURAL BENEFITS
        AGBEN(I)=RI(I)+RF(I)-FC(I)-VC(I)-RRL(I)-RDL(I)

C       CALCULATE YEARLY TOTALS
        TRI=TRI+RI(I)
        TRF=TRF+RF(I)
        TRRL=TRRL+RRL(I)
        TRDL=TRDL+RDL(I)
        YTFC=YTFC+FC(I)
        TVC=TVC+VC(I)
        TWR=TWR+WR(I)
        TAGBEN=TAGBEN+AGBEN(I)

        IF(IOUT.EQ.1)GO TO 200
        IF((MOD(K,KCHECK).NE.0).AND.(K.NE.1))GO TO 200
          WRITE(1,1)I,RI(I),RF(I),RRL(I),RDL(I),FC(I),VC(I),
     ^    WR(I),AGBEN(I)
C    1     FORMAT(I3,1P7E9.2,1PE10.2)
 1    FORMAT(1X,I4,4X,1X,1PE9.2,3X,1PE9.2,3X,1PE9.2,7X,1PE9.2,1X,
     $ 3(2X,1PE9.2),3X,1PE10.2)
  200 CONTINUE
      IF(IOUT.EQ.1)GO TO 300
      IF((MOD(K,KCHECK).NE.0).AND.(K.NE.1))GO TO 300
        WRITE(1,1007)
 1007   FORMAT(1X,'YEAR',8X,'TRI',9X,'TRF',9X,'TRRL',12X,'TRDL',
     ^  8X,'TFC',8X,'TVC',10X,'TWR',8X,'TAGBEN')
        WRITE(1,1)K,TRI,TRF,TRRL,TRDL,YTFC,TVC,TWR,TAGBEN
C        WRITE(1,2)K,TRI,TRF,TRRL,TRDL,YTFC,TVC,TWR,TAGBEN
C    2    FORMAT(I3,1P7E9.2,1PE10.2,/,'1')
  300 CONTINUE
      WRITE(4,3)K,TWR/1.E9,TAGBEN/1.E9,WRMAL/1.E9,WRMAU/1.E9,
     $ WRSEN/1.E9
    3 FORMAT(1X,I4,9X,F7.3,16X,F7.3,12X,F7.3,7X,F7.3,10X,F7.3)
      TOTBEN=TOTBEN+TAGBEN
      DISF=1./((1.+RATE)**(K-1))
      SUMQ=SUMQ+DISF*TWR
      SUMB=SUMB+DISF*TAGBEN
      WRMAL=TWR*PCMAL
      WRMAU=TWR*PCMAU
      WRSEN=TWR*PCSEN
      WRITE(7,2003)WRMAL,WRMAU,WRSEN,TWR,K
      TWRMAL=TWRMAL+WRMAL
      TWRMAU=TWRMAU+WRMAU
      TWRSEN=TWRSEN+WRSEN
      TOTTWR=TOTTWR+TWR
 2003 FORMAT(4F15.2,I10)
  150 CONTINUE
      WRITE(7,2103)TWRMAL,TWRMAU,TWRSEN,TOTTWR
2103  FORMAT(' TOTALS ',4(G15.10,2X))
      WRITE(4,8015)TOTTWR/1.E9,TOTBEN/1.E9,TWRMAL/1.E9,TWRMAU/1.E9,
```

```
     $  THRSEN/1.E9
8015    FORMAT(1X,'TOTALS',7X,F7.3,16X,F7.3,12X,F7.3,7X,F7.3,10X,F7.3)
      WRITE(4,8006)SUMB/1.E9
      WRITE(4,8005)SUMQ/1.E9
8005    FORMAT(1X,'DISCOUNTED TOTAL PROJECT WATER REQUIREMENT =',
     $  F9.4,' X1.E9')
8006    FORMAT(1X,'DISCOUNTED TOTAL PROJECT AGRICULTURAL BENEFIT =',
     $  F9.4,' X1.E9')
      WRITE(4,2006)RATE
      WRITE(7,2005)SUMB
      WRITE(7,2004)SUMQ
      WRITE(7,2006)RATE
        WRITE(4,2015)
 2004 FORMAT(G15.8,' = DISCOUNTED TOTAL PROJECT',
     * ' WATER REQUIREMENTS')
 2005 FORMAT(G15.8,' = DISCOUNTED TOTAL PROJECT',
     *' AGRICULTURAL BENEFITS')
 2006 FORMAT(2X,'THE DISCOUNT RATE=',F4.2)
 2015   FORMAT(' *******************************************************',
     * '*********************************')
      CLOSE(UNIT=1,DISP='KEEP')
      CLOSE(UNIT=2,DISP='KEEP')
      CLOSE(UNIT=3,DISP='KEEP')
      CLOSE(UNIT=4,DISP='KEEP')
      CLOSE(UNIT=7,DISP='KEEP')
      STOP
      END
```

```
C     THIS PROGRAM CALCULATES NAVIGATION VOLUMES
C     THIS PROGRAM WRITEN BY GEORGE LEO HARGREAVES 1982
C     THIS PROGRAM REQUIRES SPECIAL INSTRUCTIONS TO LINK
      INTEGER YEAR(4),DELAY,YEARPB,YEARPE
      REAL MIVOLO,MIVOLA,MAVOLO,MAVOLA,MIAVD,MAAVD
      REAL MIANEW,MAANEW,MIAOLD,MAAOLD
      DIMENSION VOLMIA(4),VOLMIR(4),VOLMAA(4),VOLSEA(4),TVOL(4)
      DIMENSION VOLMIO(4),VOLMAO(4),VOLSEO(4)
      DIMENSION SLOPE1(4),SLOPE2(4),SLOPE3(4),SLOPE4(4),SLOPET(4)
      DIMENSION SLOPE5(4),SLOPE6(4),SLOPE7(4)
      DIMENSION CROSS1(4),CROSS2(4),CROSS3(4),CROSS4(4),CROSST(4)
      DIMENSION CROSS5(4),CROSS6(4),CROSS7(4)
        DIMENSION HEAD(80)
      OPEN(UNIT=1,NAME='NVOL.DAT',TYPE='NEW',CARRIAGECONTROL='LIST')
      OPEN(UNIT=2,NAME='DELAY.DAT',TYPE='NEW',CARRIAGECONTROL='LIST')
      OPEN(UNIT=3,NAME='NAVTAB.PRE',TYPE='OLD')
      OPEN(UNIT=4,NAME='AREA.DAT',TYPE='OLD')
        OPEN(UNIT=8,NAME='NVOL.OUT',TYPE='NEW')

CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
C       PARAMETER DEFINITIONS
C
C       AVOLD = AGRICULTURAL VOLUME IN DELAYED PERIOD
C       CROSS = Y-AXIS INTERCEPT
C       DELAY = NUMBER OF YEARS NAVIGATION IS DELAYED
C       DRATE = AGRICULTURAL DEVELOPMENT RATE IN HECTARS/YEAR
C       I     = ARRAY COUNTER
C       IYEAR = YEAR READ FORM AREA.DAT
C       J     = YEARLY COUNTER
C       K     = YEARLY COUNTER
C       N     = NO
C       PVOL  = PHOSPHATE NAVIGATION VOLUME
C       SLOPE = SLOPE OF THE VOLUME VS. TIME LINE
C       TVOL  = TOTAL NAVIGATION VOLUMES OMITTING PHOSPHATE NAV. (Mt/km)
C         ****NOTE THAT ALL VOLUMES ARE IN MILLIONS (E6)****
C       Y     = YES
C       YEAR  = SPECIFIED YEAR
C       YEARPB= YEAR PHOSPHATE NAVIGATION BEGINS
C       YEARPE= YEAR PHOSPHATE NAVIGATION ENDS
C
C       THE FOLLOWING NUMBERS ARE SUFFIXES TO SLOPE & CROSS
C         1=MALI OTHER
C         2=MALI AGRICULTURAL
C         3=MALI RAIL
C         4=MAURITANIA OTHER
C         5=MAURITANIA AGRICULTURAL
C         6=SENEGAL OTHER
C         7=SENEGAL AGRICULTURAL
C
C       THE FOLLOWING CHARACTERS ARE USED TO BUILD VARIABLE NAMES
C         example: MIVOLA=AGRICULTURAL VOLUME FOR MALI
C                : SEAVD=AGRICULTURAL VOLUME DISPLACED IN SENEGAL
C       A  = AGRICULTURE
C       D  = DISPLACED (NOT TRANSPORTED BY NAVIGATION)
C       MA = MUARITANIA
C       MI = MALI
C       N  = NAVIGATION
C       NEW= ADJUSTED AGRICULTURAL VOLUME OF CURRENT YEAR
C       O  = OTHER
C       OLD= ADJUSTED AGRICULTURAL VOLUME OF PREVIOUS YEAR
C       P  = PHOSPHATE
```

```
C        R  = RAIL
C        SE = SENEGAL
C        T  = YEARLY TOTAL
C        V  = VOLUME
C        VOL= VOLUME
C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C***************************************************************************
C          PARAMETERS INITIALIZED INTERACTIVELY

        WRITE(5,*)'IF THERE IS NO DELAY NAVIGATION STARTS IN 1988'
        WRITE(5,*)'USER SHOULD USE ZERO DELAY WHEN CALCULATING KEY'
      WRITE(5,*)'IS NAVIGATION DELAYED 5 YEARS? (Y/N)'
      READ(5,1002)NTEST
      DELAY=5
C       BASE YEAR IS 1988 INSTEAD OF 1983,SO TO GET 5 YEAR DELAY MUST
C       ADD 5 TO LENGTH OF DELAY
        DELAY=DELAY+5
      IF(NTEST.EQ.'Y')GO TO 10
        WRITE(5,*)'ENTER NUMBER OF YEARS NAVIGATION IS DELAYED (DELAY)'
        READ(5,*)DELAY
        DELAY=DELAY+5
   10 CONTINUE

 1002 FORMAT(A1)

C     ACCOUNT FOR THE TITLE AND HEADINGS IN AREA.DAT AND NAVTAB.PRE
        READ(4,*)LT4
        READ(3,*)LT3,NYEARS
        LT1=LT3+LT4+7
        WRITE(1,5002)LT1
5002    FORMAT(I4)
        WRITE(1,5000)
5000    FORMAT(' ********************************************************'
     *   '********************************')
        WRITE(1,*)'OUTPUT FROM NVOL.FTN--NVOL.DAT FOR USE IN NBEN'
        WRITE(1,*)'  THE FOLLOWING INPUT FILES WERE USED'
        WRITE(1,*)'          '
        WRITE(8,*)'OUTPUT FROM NVOL.FTN--NVOL.OUT '
        WRITE(8,*)'  THE FOLLOWING INPUT FILES WERE USED'
        DO 4 I4=1,LT3
        READ(3,1000)HEAD
        WRITE(1,1000)HEAD
        WRITE(8,1000)HEAD
 4      CONTINUE
        DO 5 I5=1,LT4
        READ(4,1000)HEAD
        WRITE(1,1000)HEAD
        WRITE(8,1000)HEAD
 5      CONTINUE
        WRITE(1,*)'        '
        IDEL=DELAY-5
        WRITE(1,*)'INTERACTIVE OPTION DELAY SET TO ',IDEL,' YEARS'
        WRITE(8,*)'INTERACTIVE OPTION DELAY SET TO ',IDEL,' YEARS'
      READ(4,1001)IYEAR,DRATE
      READ(4,1001)IYEAR,DRATE

 1000 FORMAT(80A1)
 1001 FORMAT(I10,F12.0)
C     PRINT OUTPUT HEADINGS FOR NVOL.DAT
        WRITE(8,4000)
4000    FORMAT('1',1X,'NAVIGATION VOLUMES FILE NVOL.OUT',/,2X,
     $  ' FOLLOWING CODE IS USED FOR COLUMN HEADINS:',
     $  /,1X,'MIVOLO = VOLUME OTHER FOR MALI',
     $  /,1X,'MIVOLA = VOLUME AGRICULTURE MALI',
     $  /,1X,'RVOL   = RAIL VOLUME',
     $  /,1X,'MAVOLO = VOLUME OTHER FOR MAURITANIA',
     $  /,1X,'MAVOLA = VOLUME AGRICULTURE MAURITANIA',
     $  /,1X,'PVOL   = PHOSPHATE VOLUME',
     $  /,1X,'SEVOLO = VOLUME OTHER SENEGAL',
     $  /,1X,'SEVOLA = VOLUME AGRICULTURE SENEGAL',
     $  /,1X,'VOLT   = TOTAL VOLUME'
     $  /,1X,'AVOLD  = ADJUSTED AGRICULTURAL VOLUME OF PREVIOUS YEAR')

      WRITE(8,2000)
      WRITE(1,2000)
 2000 FORMAT(6X,'YEAR',4X,'MIVOLO',5X,'MIVOLA',5X,'RVOL',5X,'MAVOLO',4X,
     * 'MAVOLA',5X,'PVOL',5X,'SEVOLO',4X,'SEVOLA',5X,'VOLT',5X,'AVOLD')

C     PRINT OUTPUT TITLE AND COLUMN HEADINGS FOR DELAY.DAT
        LT2=5
        WRITE(2,5002)LT2
        WRITE(2,5000)
        WRITE(2,*)'OUTPUT FORM NVOL DELAY.DAT FOR USE IN NBEN'
      WRITE(2,2001)
      WRITE(2,2002)
        WRITE(2,2011)IDEL
 2011   FORMAT(2X,'NAVIGATIONAL DELAY=',I4,' YEARS')
 2001 FORMAT(2X,'AGRICULTURAL VOLUMES DURING NAVIGATION DELAY')
 2002 FORMAT(6X,'YEAR',6X,'MALI',3X,'MAURITANIA',2X,'SENEGAL')

C***************************************************************************

      READ(3,*)YEAR
      READ(3,*)VOLMIO
      READ(3,*)VOLMIA
      READ(3,*)VOLMIR
      READ(3,*)VOLMAO
      READ(3,*)VOLMAA
      READ(3,*)VOLSEO
      READ(3,*)VOLSEA
      READ(3,*)TVOL
      READ(3,*)YEARPB
      READ(3,*)YEARPE
      READ(3,*)VOLP
 1003 FORMAT(4I10)
 1004 FORMAT(4F10.2)
 1005 FORMAT(I10)
 1006 FORMAT(F10.2)

      J=1981
      MIVOLO=0.
      MIVOLA=0.
      RVOL=0.
      MAVOLO=0.
      MAVOLA=0.
      PVOL=0.
      SEVOLO=0.
      SEVOLA=0.
      VOLT=0.
      AVOLD=0.
      WRITE(1,2003)J,MIVOLO,MIVOLA,RVOL,MAVOLO,MAVOLA,PVOL,SEVOLO,
     * SEVOLA,VOLT,AVOLD
      WRITE(8,2003)J,MIVOLO,MIVOLA,RVOL,MAVOLO,MAVOLA,PVOL,SEVOLO,
     * SEVOLA,VOLT,AVOLD
 2003 FORMAT(I10,10F10.2)
      MIAVD=0.
      MAAVD=0.
      SEAVD=0.
      WRITE(2,2004)J,MIAVD,MAAVD,SEAVD
 2004 FORMAT(I10,3F10.2)
```

```
      J=1982
      MIVOLO=0.
      MIVOLA=0.
      RVOL=0.
      MAVOLO=0.
      MAVOLA=0.
      PVOL=0.
      SEVOLO=0.
      SEVOLA=0.
      VOLT=0.
      AVOLD=0.
      WRITE(1,2005)J,MIVOLO,MIVOLA,RVOL,MAVOLO,MAVOLA,PVOL,SEVOLO,
     * SEVOLA,VOLT,AVOLD
      WRITE(8,2005)J,MIVOLO,MIVOLA,RVOL,MAVOLO,MAVOLA,PVOL,SEVOLO,
     * SEVOLA,VOLT,AVOLD
 2005 FORMAT(I10,10F10.2)
      MIAVD=0.
      MAAVD=0.
      SEAVD=0.
      WRITE(2,2006)J,MIAVD,MAAVD,SEAVD
 2006 FORMAT(I10,3F10.2)

      DO 100 I=1,3
        SLOPE1(I)=(VOLMIO(I+1)-VOLMIO(I))/FLOAT(YEAR(I+1)-YEAR(I))
        SLOPE2(I)=(VOLMIA(I+1)-VOLMIA(I))/FLOAT(YEAR(I+1)-YEAR(I))
        SLOPE3(I)=(VOLMIR(I+1)-VOLMIR(I))/FLOAT(YEAR(I+1)-YEAR(I))
        SLOPE4(I)=(VOLMAO(I+1)-VOLMAO(I))/FLOAT(YEAR(I+1)-YEAR(I))
        SLOPE5(I)=(VOLMAA(I+1)-VOLMAA(I))/FLOAT(YEAR(I+1)-YEAR(I))
        SLOPE6(I)=(VOLSEO(I+1)-VOLSEO(I))/FLOAT(YEAR(I+1)-YEAR(I))
        SLOPE7(I)=(VOLSEA(I+1)-VOLSEA(I))/FLOAT(YEAR(I+1)-YEAR(I))

        CROSS1(I)=VOLMIO(I)-SLOPE1(I)*FLOAT(YEAR(I))
        CROSS2(I)=VOLMIA(I)-SLOPE2(I)*FLOAT(YEAR(I))
        CROSS3(I)=VOLMIR(I)-SLOPE3(I)*FLOAT(YEAR(I))
        CROSS4(I)=VOLMAO(I)-SLOPE4(I)*FLOAT(YEAR(I))
        CROSS5(I)=VOLMAA(I)-SLOPE5(I)*FLOAT(YEAR(I))
        CROSS6(I)=VOLSEO(I)-SLOPE6(I)*FLOAT(YEAR(I))
        CROSS7(I)=VOLSEA(I)-SLOPE7(I)*FLOAT(YEAR(I))

        DO 200 J=YEAR(I),YEAR(I+1)-1
          IF(J.NE.YEAR(1))GO TO 225
            MIVOLO=SLOPE1(I)*FLOAT(J)+CROSS1(I)
            MIVOLA=SLOPE2(I)*FLOAT(J)+CROSS2(I)
            RVOL=SLOPE3(I)*FLOAT(J)+CROSS3(I)
            MAVOLO=SLOPE4(I)*FLOAT(J)+CROSS4(I)
            MAVOLA=SLOPE5(I)*FLOAT(J)+CROSS5(I)
            SEVOLO=SLOPE6(I)*FLOAT(J)+CROSS6(I)
            SEVOLA=SLOPE7(I)*FLOAT(J)+CROSS7(I)
            READ(4,1007)DRATE
 1007       FORMAT(10X,F12.0)
            MIANEW=MIVOLA*DRATE/5000.
            MAANEW=MAVOLA*DRATE/5000.
            SEANEW=SEVOLA*DRATE/5000.
            VOLT=MIVOLO+MIANEW+MAVOLO+MAANEW+SEVOLO+SEANEW
            PVOL=VOLP
            IF((J.LT.YEARPB+DELAY).OR.(J.GT.YEARPE+DELAY))PVOL=0.
            VOLT=VOLT+PVOL
            AVOL=MIANEW+MAANEW+SEANEW
            MIAVD=0.
            MAAVD=0.
            SEAVD=0.
            AVOLD=0.
            IF(J.GE.YEAR(1)+DELAY)GO TO 250
              MIAVD=MIANEW
              MAAVD=MAANEW
              SEAVD=SEANEW
              MIVOLO=0.
              MIANEW=0.
              RVOL=0.
              MAVOLO=0.
              MAANEW=0.
              PVOL=0.
              SEVOLO=0.
              SEANEW=0.
              VOLT=0.
              AVOLD=AVOL
 250        CONTINUE
            WRITE(1,2007)J,MIVOLO,MIANEW,RVOL,MAVOLO,MAANEW,PVOL,
             SEVOLO,SEANEW,VOLT,AVOLD
            WRITE(8,2007)J,MIVOLO,MIANEW,RVOL,MAVOLO,MAANEW,PVOL,
             SEVOLO,SEANEW,VOLT,AVOLD

            WRITE(2,2008)J,MIAVD,MAAVD,SEAVD
            IF(DELAY.EQ.0)GO TO 200
            MIANEW=MIAVD
            MAANEW=MAAVD
            SEANEW=SEAVD
            GO TO 200
 225      CONTINUE

          MIAOLD=MIVOLA
          MAAOLD=MAVOLA
          SEAOLD=SEVOLA
          MIVOLO=SLOPE1(I)*FLOAT(J)+CROSS1(I)
          MIVOLA=SLOPE2(I)*FLOAT(J)+CROSS2(I)
          RVOL=SLOPE3(I)*FLOAT(J)+CROSS3(I)
          MAVOLO=SLOPE4(I)*FLOAT(J)+CROSS4(I)
          MAVOLA=SLOPE5(I)*FLOAT(J)+CROSS5(I)
          SEVOLO=SLOPE6(I)*FLOAT(J)+CROSS6(I)
          SEVOLA=SLOPE7(I)*FLOAT(J)+CROSS7(I)
          READ(4,1008)DRATE
 1008     FORMAT(10X,F12.0)
          MIANEW=MIANEW+(MIVOLA-MIAOLD)*DRATE/5000.
          MAANEW=MAANEW+(MAVOLA-MAAOLD)*DRATE/5000.
          SEANEW=SEANEW+(SEVOLA-SEAOLD)*DRATE/5000.
          VOLT=MIVOLO+MIANEW+MAVOLO+MAANEW+SEVOLO+SEANEW
          PVOL=VOLP
          IF((J.LT.YEARPB+DELAY).OR.(J.GT.YEARPE+DELAY))PVOL=0.
          VOLT=VOLT+PVOL
          AVOL=MIANEW+MAANEW+SEANEW
          MIAVD=0.
          MAAVD=0.
          SEAVD=0.
          AVOLD=0.
          IF(J.GE.YEAR(1)+DELAY)GO TO 260
            MIAVD=MIANEW
            MAAVD=MAANEW
            SEAVD=SEANEW
            MIVOLO=0.
            MIANEW=0.
            RVOL=0.
            MAVOLO=0.
            MAANEW=0.
            PVOL=0.
            SEVOLO=0.
            SEANEW=0.
            VOLT=0.
            AVOLD=AVOL
 260      CONTINUE
          WRITE(1,2007)J,MIVOLO,MIANEW,RVOL,MAVOLO,MAANEW,PVOL,
           SEVOLO,SEANEW,VOLT,AVOLD
```

```
      WRITE(8,2007)J,MIVOLO,MIANEW,RVOL,MAVOLO,MAANEW,PVOL,
       SEVOLO,SEANEW,VOLT,AVOLD
      WRITE(2,2008)J,MIAVD,MAAVD,SEAVD
2007  FORMAT(I10,10F10.2)
2008  FORMAT(I10,3F10.2)
      IF(J.GE.YEAR(1)+DELAY)GO TO 255
        MIANEW=MIAVD
        MAANEW=MAAVD
        SEANEW=SEAVD
255   CONTINUE
200 CONTINUE
100 CONTINUE

C     THE FOLLOWING ALGORITHMS PROJECT THE VOLUMES OUT TO 50 YEARS
      DO 300 K=J,2031

      MIAOLD=MIVOLA
      MAAOLD=MAVOLA
      SEAOLD=SEVOLA

      MIVOLO=SLOPE1(3)*FLOAT(K)+CROSS1(3)
      MIVOLA=SLOPE2(3)*FLOAT(K)+CROSS2(3)
      RVOL=SLOPE3(3)*FLOAT(K)+CROSS3(3)
      MAVOLO=SLOPE4(3)*FLOAT(K)+CROSS4(3)
      MAVOLA=SLOPE5(3)*FLOAT(K)+CROSS5(3)
      SEVOLO=SLOPE6(3)*FLOAT(K)+CROSS6(3)
      SEVOLA=SLOPE7(3)*FLOAT(K)+CROSS7(3)
      READ(4,1009)DRATE
1009  FORMAT(10X,F12.0)
      MIANEW=MIANEW+(MIVOLA-MIAOLD)*DRATE/5000.
      MAANEW=MAANEW+(MAVOLA-MAAOLD)*DRATE/5000.
      SEANEW=SEANEW+(SEVOLA-SEAOLD)*DRATE/5000.
      VOLT=MIVOLO+MIANEW+MAVOLO+MAANEW+SEVOLO+SEANEW
      PVOL=VOLP
      IF(K.LT.YEARPB.OR.K.GT.YEARPE)PVOL=0.
      VOLT=VOLT+PVOL
      AVOL=MIVOLA+MAVOLA+SEVOLA
      MIAVD=0.
      MAAVD=0.
      SEAVD=0.
      AVOLD=0.
      IF(K.GE.YEAR(1)+DELAY)GO TO 275
        MIAVD=MIANEW
        MAAVD=MAANEW
        SEAVD=SEANEW
        MIVOLO=0.
        MIVOLA=0.
        RVOL=0.
        MAVOLO=0.
        MAVOLA=0.
        PVOL=0.
        SEVOLO=0.
        SEVOLA=0.
        VOLT=0.
        AVOLD=AVOL
275   CONTINUE
      WRITE(1,2009)K,MIVOLO,MIANEW,RVOL,MAVOLO,MAANEW,PVOL,
     *  SEANEW,SEVOLA,VOLT,AVOLD
      WRITE(8,2009)K,MIVOLO,MIANEW,RVOL,MAVOLO,MAANEW,PVOL,
     *  SEANEW,SEVOLA,VOLT,AVOLD
      WRITE(2,2010)K,MIAVD,MAAVD,SEAVD
2009  FORMAT(I10,10F10.2)
2010  FORMAT(I10,3F10.2)
      IF(J.GE.YEAR(1)+DELAY)GO TO 285
        MIANEW=MIAVD
        MAANEW=MAAVD
        SEANEW=SEAVD
285   CONTINUE
300 CONTINUE
      WRITE(1,5000)
      WRITE(2,5000)
    CLOSE(UNIT=1,DISP='KEEP')
    CLOSE(UNIT=2,DISP='KEEP')
    CLOSE(UNIT=3,DISP='KEEP')
    CLOSE(UNIT=4,DISP='KEEP')
    STOP
    END
```

```
C               PROGRAM    COST.FTN   FOR COST TABLE
C
C               PROGRAM TO OUTPUT FINANCING SCHEDULE TO INCLUDE
C               ACCOUNTING CODE AND C OR D
C               one input file COST.PRE; two output files COST.DAT
C               AND DISSUM.OUT


C
C************************************************************************
C                         MAJOR VARIABLES USED IN THIS PROGRAM

C               DIS    = Discount factor for a given year
C               HEAD(I) Array containing  column headings
C               ICHAN =Y to switch from account 12110 to account 16000
C                        N leaves account 12110(other notes payable)in output
C               IHEAD = Number of lines of comment in output files different
C                        value for COST.DAT AND DISSUM.OUT
C               INDEX = For user option  Y retains the value
C                        programed in, N user can change value
C               LTITLE= Number of lines of comment in COST.PRE
C               NACC  = number of account codes to be read in 32
C               NAME  = 5 digit integer account code
C               NBEG  = Index of first element in array X(j) that needs
C                        account 12110 switched to 16000 for the second pass
C               NCAP  = Number of capital accounts 1/2 the NCOL
C               NCOL =  NUMBER OF COLUMNS TO BE READ IN FROM
C                        FINANCE TABLE: SET TO 8
C               NCORD = C for credit D for debit
C               NP     = Index of array X(j), used for storage of capital
C                        accounts. Used to locate capital accounts in X(j)
C               NTITLE= Array containing one line of comment
C               NYEARS= Number of years of data to read in from COST.PRE
C               RATE =  DISCOUNT RATE: USER OPTION TO CHANGE FROM .05
C               SUM(I)= Array contain discounted sums,for each column
C               TOTAL = Total discounted sum
C               TOT    = Individual discounted sum, Man Manatilita
C                        Dia Diama, ENE energy, NAV navigation includes
C                        capital and O&M
C               X(J)   = Array contains expenses and capital, yearly values
C                        only
C
CXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
      DIMENSION NTITLE(80),HEAD(8),NCORD(32),NAME(32)
      DOUBLE PRECISION SUM(8),X(16),CAP(4),XTEM(8)
      OPEN (UNIT=1,NAME='COST.PRE',TYPE='OLD')
      OPEN (UNIT=2,NAME='COST.DAT',TYPE='NEW',CARRIAGECONTROL='LIST')
      OPEN (UNIT=3,NAME='DISSUM.OUT',TYPE='NEW',CARRIAGECONTROL='LIST')
C               THE NUMBER OF COLUMNS IN THE INPUT FILE IS ASSUMED TO BE
C               8  IF CHANGES ARE MADE IN THE NUMBER OF COLUMNS
C               CHANGES MUST BE MADE IN TABCHECK.FTN AND THIS PROGRAM
      NCOL=8
      WRITE(5,410)
      RATE=.05
 410  FORMAT(1X,'IS THE DISCOUNT RATE IN DECMAL FORM 0.05 (Y/N) ? ',$)
      READ(5,411)INDEX
 411  FORMAT(A1)
      IF(INDEX.EQ.'Y')GO TO 413
      WRITE(5,*)' ENTER DISCOUNT RATE '
      READ(5,412)RATE
 412  FORMAT(F10.2)
 413  CONTINUE
      READ(1,100)LTITLE,NYEARS
 100  FORMAT(I4,I6)
C
C PRINT HEADING FOR OUTPUT FILE CONTAINING THE DISCOUNTED SUMS OF THE
C VALUES TO BE READ IN
C
C PRINT NUMBER OF LINES OF HEADING TO BE READ IN FROM DISSCOUNTED SUMS
C DATA FILE
      IHEAD=LTITLE+9
      WRITE(3,*)IHEAD,NYEARS
      WRITE(3,6000)
      WRITE(3,*)' DISSUM.OUT --  OUTPUT FILE FROM COST '
 6000 FORMAT(' *******************************************',
     * '*********************************')
      WRITE(3,201)RATE
201   FORMAT('DISCOUNTED SUMS USING INTEREST RATE OF  ',F5.3)
C
C  PRINT THE NUMBER OF LINES OF HEADING TO BE IN FROM THE COST.DAT
C  FILE BY THE ACCOUNTS PROCESSING PROGRAM NUMBER OF LINES OF TITLE + ONE LINE
C  FOR COLUMN HEADINGS + TWO LINES ADDED BY THIS PROGRAM
      IHEAD=LTITLE+5
      WRITE(2,*)IHEAD,NYEARS
C
      WRITE(2,6000)
      WRITE(3,*)'DISCOUNTED SUMS --INTERACTIVE INPUT FOR ALLOCATE'
      WRITE(2,*)'COST.DAT -- OUTPUT FROM COST PROGRAM '
      WRITE(2,415)RATE
415   FORMAT('THESE YEARLY VALUES ARE NOT DISCOUNTED;',
     * 'RATE USED FOR CALCULATING DISCOUNTED TOTAL WAS ',F5.3)
      WRITE(2,*)'THE FOLLOWING INPUT FILES WERE USED'
      WRITE(3,*)'THE FOLLOWING INPUT FILES WERE USED'
            DO 5 I=1,LTITLE
            READ(1,101)NTITLE
            WRITE(2,200)NTITLE
            WRITE(3,200)NTITLE
 5    CONTINUE
 101  FORMAT(80A1)
 200  FORMAT(80A1)
C
C NACC    IS THE NUMBER OF ACCOUNT CODES TO BE READ IN
C         FIRST C OR D IS READ THEN ACCOUNT CODE
C         THERE ARE TWICE THE NUMBER OF ACCOUNTS AS THERE ARE
C         COLUMNS MUST BE A CREDIT AND A DEBIT FOR EACH ACCOUNT
C
C         IN ADDITION TO 2 ACCOUNTS FOR EACH COLUMN THERE IS ALSO AN
C         ADDITIONAL 2 ACCOUNTS FOR EACH CAPITAL COLUMN
C         THERE IS ONE-HALF THE NUMBER OF CAPITAL COLUMNS AS TOTAL
C         COLUMNS SINCE THEY ARE ALL IN PAIRS  CAPITAL  OM
C         IT IS ASSUMED THAT OM ARE ALSO THE SECOND VALUE IN THE PAIR
C
C NCAP   2 TIMES NCAP IS THE NUMBER OF CAPITAL ACCOUNTS
C       NCAP IS NUMBER OF CAPITAL COLUMNS
C
      NCAP=NCOL/2
      NACC=32
C
C            INPUT ACCOUNT CODES FOR MANATALI DAM CAPITAL
      READ(1,103)NCORD(1),NAME(1),NCORD(2),NAME(2)
C            INPUT ACCOUNT CODES FOR MANATALI O&M
      I1=3
      READ(1,102)NCORD(I1),NAME(I1),NCORD(I1+1),NAME(I1+1),
     *   NCORD(I1+2),NAME(I1+2),NCORD(I1+3),NAME(I1+3)
C            INPUT ACCOUNT CODES FOR DIAMA DAM CAPITAL
      READ(1,103)NCORD(7),NAME(7),NCORD(8),NAME(8)
```

```
C               INPUT ACCOUNT CODES FOR DIAMA O&M
        I1=9
        READ(1,102)NCORD(I1),NAME(I1),NCORD(I1+1),NAME(I1+1),
     *      NCORD(I1+2),NAME(I1+2),NCORD(I1+3),NAME(I1+3)
C               INPUT ACCOUNT CODES FOR ENERGY CAPITAL
        I1=13
        READ(1,105)NCORD(I1),NAME(I1),NCORD(I1+1),NAME(I1+1),
     *      NCORD(I1+2),NAME(I1+2),NCORD(I1+3),NAME(I1+3),
     *      NCORD(I1+4),NAME(I1+4),NCORD(I1+5),NAME(I1+5)
C               INPUT ACCOUNT CODES FOR ENERGY O&M
        I1=19
        READ(1,102)NCORD(I1),NAME(I1),NCORD(I1+1),NAME(I1+1),
     *      NCORD(I1+2),NAME(I1+2),NCORD(I1+3),NAME(I1+3)
C               INPUT ACCOUNT CODES FOR NAVIGATION CAPITAL
        I1=23
        READ(1,105)NCORD(I1),NAME(I1),NCORD(I1+1),NAME(I1+1),
     *      NCORD(I1+2),NAME(I1+2),NCORD(I1+3),NAME(I1+3),
     *      NCORD(I1+4),NAME(I1+4),NCORD(I1+5),NAME(I1+5)
C               INPUT ACCOUNT CODES FOR NAVIGATION O&M
        I1=29
        READ(1,102)NCORD(I1),NAME(I1),NCORD(I1+1),NAME(I1+1),
     *      NCORD(I1+2),NAME(I1+2),NCORD(I1+3),NAME(I1+3)
102     FORMAT(A1,I4,1X,A1,I4,2X,A1,I4,1X,A1,I4)
105     FORMAT(A1,I4,1X,A1,I4,2X,A1,I4,1X,A1,I4,2X,A1,I4,1X,A1,I4)
103     FORMAT(A1,I4,1X,A1,I4)
C
D       WRITE(5,*)(NAME(I),I=1,NACC)
C
C
C READ IN COLUMN HEADINGS
        READ(1,104)(HEAD(I),I=1,NCOL)
 104    FORMAT(8X,8(A4,4X))
        WRITE(2,202)(HEAD(I),I=1,NCOL)
 202    FORMAT(8X,8(A4,4X))
C
C SET DISCOUNTED SUMS EQUAL TO ZERO
C
        DO 10 I=1,NCOL
        SUM(I)=0.0
 10     CONTINUE
C
C
C  READ IN VALUES FOR COLUMN BY YEAR, OUTPUT VALUES WITH NECESSARY ACCOUNTING
C  CODE, KEEP RUNNING TOTAL OF DISCOUNTED VALUES FOR EACH COLUMN
C
C
        DO 50 I=1,NYEARS
        READ(1,*,END=55)J,(XTEM(I1),I1=1,NCOL)
C
C               LOAD CAPITAL & O&M VALUES INTO ARRAY FOR
C               MANATALI AND DIAMA DAMS
        I1=1
        I2=2
        I3=3
        DO 51 I51=1,4,2
        X(I1)=XTEM(I51)
D       WRITE(5,*)I1,X(I1)
        I51P1=I51+1
        X(I2)=XTEM(I51P1)
D       WRITE(5,*)I2,X(I2)
        X(I3)=XTEM(I51P1)
D       WRITE(5,*)I3,X(I3)
        I1=I1+3
        I2=I2+3
        I3=I3+3
51      CONTINUE
C
C               LOAD CAPITAL AND O&M ACCOUNTS FOR ENERGY AND NAVIGATION
        I1=7
        I2=8
        I3=9
        I4=10
        I5=11
        DO 52 I51=5,8,2
        X(I1)=XTEM(I51)
D       WRITE(5,*)I1,X(I1)
        X(I2)=XTEM(I51)
D       WRITE(5,*)I2,X(I2)
        X(I3)=XTEM(I51)
D       WRITE(5,*)I3,X(I3)
        I51P1=I51+1
        X(I4)=XTEM(I51P1)
D       WRITE(5,*)I4,X(I4)
        X(I5)=XTEM(I51P1)
D       WRITE(5,*)I5,X(I5)
        I1=I1+5
        I2=I2+5
        I3=I3+5
        I4=I4+5
        I5=I5+5
52      CONTINUE
C               THE ACCOUNTING PROGRAM WILL DO THE ACCUMULATING
C               OF CAPITAL
C
        WRITE(2,5000)J,NACC
        WRITE(2,5002)(NCORD(K1-1),NAME(K1-1),X(K1/2),NCORD(K1),NAME(K1),
     *                  K1=2,NACC,2)
C
C INNER LOOP TO CALCULATE RUNNING TOTAL OF DISCOUNTED VALUES
C
                DIS=(1/(1+RATE))**(I-1)
                DO 45 I2=1,NCOL
C                               XTEM CONTAINES A ARRAY OF 8 VALUES
C                               IN THE ORDER GIVEN IN THE DATA TABLE
C                               WHILE X( ) CONTAINS 2 FOR EACH CAPITAL
C                               AND 1 FOR EACH O&M COLUMN
                SUM(I2)=SUM(I2)+DIS*XTEM(I2)
 45     CONTINUE
C
C
 50     CONTINUE
 55     CONTINUE
C
C  OUTPUT DISCOUNTED SUMS
C
        WRITE(3,*)' '
        WRITE(3,*)' '
        WRITE(3,5100)(HEAD(I),I=1,NCOL)
5100    FORMAT(5X,A4,11X,A4,11X,A4,11X,A4,11X,A4,
     *  11X,A4,11X,A4,11X,A4)
        WRITE(3,*)' '
        WRITE(3,5004)(SUM(I),I=1,NCOL)
C               CALCULATE TOTAL COST
        TOTAL=0.0
        DO 65 I=1,NCOL
        TOTAL=TOTAL+SUM(I)
 65     CONTINUE
        TOTMAN=SUM(1)+SUM(2)
        TOTDIA=SUM(3)+SUM(4)
        TOTENE=SUM(5)+SUM(6)
        TOTNAV=SUM(7)+SUM(8)
        WRITE(3,*)' '
```

```
      WRITE(3,*)' '
      WRITE(3,5030)TOTAL
5030  FORMAT(1X,G15.8,' = TOTAL DISCOUNTED COST ')
      WRITE(3,5031)TOTMAN,TOTDIA,TOTENE,TOTNAV
5031  FORMAT(1X,/,'DISCOUNTED TOTALS INVESTMENT+O&M',/,
     *1X,'MANANTALI',11X,'DIAMA',11X,'ENERGY',12X,'NAVIGATION',
     */,4(G15.10,2X))
      WRITE(3,6000)
      WRITE(2,6000)
5004  FORMAT(8F15.2)
C
C
C1000 FORMAT(I4,3X,8F8.1)
1000  FORMAT(I6,8F8.1)
5000  FORMAT('YEAR',2X,I5,2X,I2)
 5002 FORMAT(2(1X,A1,I4,F15.2,A1,I4))
      CLOSE(UNIT=1,DISP='KEEP')
      CLOSE(UNIT=2,DISP='KEEP')
      CLOSE(UNIT=3,DISP='KEEP')
      STOP
      END
```

```
C                 COST ALLOCATION PROGRAM FOLLOWS TABLE 2.3
C                 OF REPORT ONE
C                 ADJUSTED SEPARABLE COSTS-REMAINING BENEFITS METHOD


C         NSERV=NUMBER OF COLUMNS,IF MORE THAN 3, DIMENSION STATEMENTS
C               MUST BE INCREASED; THE NUMBER OF SERVICE SECTORS, IN MAIN
C               AND IN SUBROUTINES
C
C         2 SUBROUTINES
C         SUBROUTINE  BENIN    reads in benefit data and quantities
C                              from Benefit data files PWQ,NAVQ,AGQ
C         SUBROUNTINE INPUT    reads in cost allocation data from ALLOCA.DAT
C                              Data file created by first pass through ALLOCATION
C
C
CXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
C                 MAJOR VARIABLES USE IN ALLOCATE.FTN
C         AGCOST  =      Discounted total cost to irrigation due to
C                        delay in navigation
C         IN      =      If equal N then read data from ALLOCA.DAT
C                        if  Y  then option to input all data interactively
C                        or read some from benefit data files
C         IN2     =      If equal Y read from benefit files and interactive
C                        if N all values entered interactively
C         LTITLE  =      Number of lines of comment to be read in or written
C         NAG     =      Number of accounts written out to FEES.DAT for
C                        agriculture
C         NAME    =      dummy variable, used when reading comments from
C                        benefit files
C         NNV     =      Number of accounts written out to FEES.DAT for
C                        navigation
C         NPW     =      Number of accounts written out to FEES.DAT for
C                        energy
C         NSERV   =      NUMBER OF COLUMNS,IF MORE THAN 3, DIMENSION STATEMENTS
C                        MUST BE INCREASED; THE NUMBER OF SERVICE SECTORS, IN
C                        MAIN AND IN SUBROUTINES
C         NYEARS  =      Number of years of data to be processed by the model
C         OK      =      User sets to  Y  if values written agrees with user
C         QNAV    =      Discounted sum of navigational volume
C         QPOW    =      Discounted sum of energy consumed
C         QWATER  =      Discounted sum of water used
C         PER(I)  =      Array containing percentage of total for sector i
C
C                        ROWk  referres to a row of the cost allocation
C                        table report 1 table 2.3
C         ROW1(I) =      project benefits
C         ROW2(I) =      alternative costs(single purpose project)
C         ROW3(I) =      justifiable costs
C         ROW4(I) =      separable costs
C         ROW5(I) =      Cost for all other purposes(total-row 4 )
C         ROW6(I) =      justifiable cost for all other purposes
C                        (lesser of row 5 or sum of row 3 - justifiable cost
C                        for that purpose row3(i))
C         ROW7(I) =      Adjustment factor ((row 3 + row 6)/total cost)
C         ROW8(I) =      Adjusted separable costs (row 4 X row 7)
C         ROW9(I) =      Remaining benefits (row 3 - row 8)
C         ROW10(I)=      Joint cost proportions(row 3 - row 8)
C         ROW11(I)=      Allocated joint cost(row10X(total-sum row4)
C         ROW12(I)=      Total allocated costs(row4+ row 11)
C         SUMx    =      Sum of row x
```

```
C       TOTAL   =       Total discounted cost
Cxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
        DIMENSION ROW1(3),ROW2(3),ROW3(3),ROW4(3),ROW5(3)
        DIMENSION ROW6(3),ROW7(3),ROW8(3),ROW9(3),ROW10(3)
        DIMENSION ROW11(3),ROW12(3),PER(3)
        DATA SUM1,SUM2,SUM3,SUM4,SUM9,SUM10,SUM11,SUM12/8*0.0/
        OPEN(UNIT=3,NAME='ALLOCA.OUT',TYPE='NEW',CARRIAGECONTROL='LIST')
        WRITE(3,*)'COST ALLOCATION VALUES     XE9'
        NSERV=3
C       INITIALIZE QWATER,QPOW,QNAV FOR CASE WHEN THEY ARE NOT
C       READ FROM BENEFIT DATA FILES
        QWATER=-9.
        QPOW  =-9.
        QNAV  =-9.
C
C       OPTION TO READ DATA FROM A DATA FILE INSTEAD OF FROM THE TERMINAL
C
C               TOTAL COST WILL BE INTERACTIVE INPUT EITHER WAY
        WRITE(5,200)
200     FORMAT(30X,'COST ALLOCATION',/,1X,'SEE TABLE 9 IN REPORT 5',
     *         ' FOR EXAMPLE ',/,
     * '*****IMPORTANT USE ONLY DISCOUNTED VALUES IN THIS '
     * ' PROGRAM',/)
        WRITE(5,201)
201     FORMAT(1X,'You have 2 ways to enter data',
     */,1X,'1. all interactive',
     */,1X,'2. interactive data plus data written into program plus ',
     */,1X,'data read in from data files from benefit programs')
        WRITE(5,202)
202     FORMAT(1X,'ARE YOU  ENTERING NEW BENEFIT',
     *' DATA (Y/N) ? ',$)
        READ(5,4000)IN
        IF(IN.EQ.'N')GO TO 5
C
C********************OPTION TO READ IN FROM DATA FILES*****************
C
C               WILL READ IN FROM AGBEN,BENPWR AND NAVBEN
C               USER MUST STILL INPUT ALTERNATIVE COSTS, SEPARABLE COSTS
C               AND TOTAL COSTS
C.......................................................................
        WRITE(5,300)
300     FORMAT(/,/,1X,' ANSWER N TO THE FOLLOWING QUESTION TO INPUT'
     *  ,' ALL VALUES INTERACTIVELY')
        WRITE(5,7010)
7010    FORMAT(1X,'BENEFIT DATA IS TO BE READ FROM DATA FILES',
     * ' (Y/N) ? ',$)
        READ(5,4000)IN2
        IF(IN2.NE.'Y')GO TO 6
        CALL BENIN(ROW1,ROW2,QWATER,QPOW,QNAV,AGCOST)
        GO TO 8
6       CONTINUE
        WRITE(5,*)'COLUMN ONE IS ASSUMED TO BE FOR IRRIGATION'
        WRITE(5,*)'COLUMN TWO IS ASSUMED TO BE FOR ENERGY'
        WRITE(5,*)'COLUMN THREE IS ASSUMED TO BE FOR NAVIGATION'
        WRITE(5,*)'ENTER VALUES FOR ROW1; PROJECT BENEFITS'
        WRITE(5,*)'ENTER 3 REAL NUMBERS SEPARATED BY COMMAS'
        WRITE(5,7012)
7012    FORMAT(1X,' ? ',$)
        READ(5,*)(ROW1(I),I=1,NSERV)
        WRITE(5,*)'ENTER DISCOUNTED COST TO IRRIGATION'
        WRITE(5,*)'DUE TO NAVIGATION DELAY FROM AGCOST.DAT'
        WRITE(5,7012)
        READ(5,*)AGCOST
8       CONTINUE
C       ROW2(1)=82.791E9
C       ROW2(2)=109.285E9
C       ROW2(3)=147.362E9
C       WRITE(5,301)ROW2
C301    FORMAT(1X,'THE ALTERNATIVE COSTS GIVEN IN REPORT 5 ARE',
C    * /,' IRRIGATION',6X,'ENERGY',12X,'NAVIGATION',
C    * /,2X,3(G15.10,2X),/,
C    * ' DO YOU WANT  THE ALTERNATIVE COSTS USED'
C    *,' IN REPORT 5 (Y/N) ? ',$)
C       READ(5,4000)OK
C       IF(OK.EQ.'Y')GO TO 60
        WRITE(5,*)'ENTER VALUES FOR ROW2; ALTERNATIVE COSTS'
        WRITE(5,*)'ENTER 3 REAL NUMBERS SEPARATED BY COMMAS'
        WRITE(5,7012)
        READ(5,*)(ROW2(I),I=1,NSERV)
60      CONTINUE
        WRITE(5,*)'ENTER VALUES FOR ROW4; SEPARABLE COSTS'
        WRITE(5,*)'ENTER 3 REAL NUMBERS SEPARATED BY COMMAS'
        WRITE(5,7012)
        READ(5,*)(ROW4(I),I=1,NSERV)
C       IF IN2 IS YES THEN DISCOUNTED QUANTITIES ALLREADY ENTERED
C       IN SUBROUTINE BENIN  THE ARE READ FROM DATA FILES
C       IF NOT READ FROM BENEFIT PROGRAMS, THE USER WILL
C       ENTER IN PROGRAM FEES.FTN
C               DUMMY QUANTITIES ARE ENTERED HERE TO BE CHANGED
C               IN FEES.FTN
C               CALCULATE IRRIGATION BENEFIT USED IN COST ALLOCATION
C               THE VALUE FROM AGBEN-COST DUE TO NAVIGATION DELAY
        ROW1(1)=ROW1(1)-AGCOST
C
C               WRITE DATA TO  FILE ALLOCA.DAT
C
5       IF(IN.EQ.'N')CALL INPUT(ROW1,ROW2,ROW4,QWATER,QPOW,QNAV,AGCOST)
        OPEN(UNIT=2,NAME='ALLOCA.DAT',TYPE='NEW',CARRIAGECONTROL='LIST')
        LTITLE=3
        WRITE(2,*)LTITLE
        WRITE(2,*)'ALLOCA.DAT CREATED BY PROGRAM ALLOCA.FTN'
        WRITE(2,*)'USED FOR INPUT TO ALLOCA.FTN AND FEES.FTN'
        WRITE(2,*)'IRRIGATION  ENERGY   NAVIGATION'
        WRITE(2,*)(ROW1(I),I=1,NSERV),'     BENEFITS'
        WRITE(2,*)(ROW2(I),I=1,NSERV),'     ALTERNATIVE COSTS'
        WRITE(2,*)(ROW4(I),I=1,NSERV),'     SEPARABLE COSTS'
        WRITE(2,*)QWATER,'    DISCOUNTED QUANTITY OF WATER'
        WRITE(2,*)QPOW,'      DISCOUNTED QUANTITY OF ENERGY'
        WRITE(2,*)QNAV,'      DISCOUNTED QUANTITY OF NAVIGATION'
        WRITE(2,303)AGCOST,AGCOST+ROW1(1)
303     FORMAT(G12.6,'  = AGCOST; irrigation benefit from AGBEN',G12.6)
        WRITE(5,*)'ENTER TOTAL COST FOR COST ALLOCATION'
        WRITE(5,7012)
        READ(5,*)TOTAL
C
C
C
C
C   CALCULATE JUSTIFIABLE COSTS AND TOTALS OF ROW 1 THROUGH 4
C
        DO 10 I=1,NSERV
                ROW3(I)=ROW2(I)
                IF(ROW2(I).GT.ROW1(I))ROW3(I)=ROW1(I)
                SUM1=SUM1+ROW1(I)
                SUM2=SUM2+ROW2(I)
                SUM3=SUM3+ROW3(I)
                SUM4=SUM4+ROW4(I)
C
C   CALCULATE THE COST FOR ALL OTHER PURPOSESE
C
```

```
              ROW5(I)=TOTAL-ROW4(I)
10      CONTINUE
C
C  CALCULATE JUSTIFIABLE COSTS FOR ALL OTHER PURPOSES
C  ADJUSTMENT FACTOR
C  ADJUSTED SEPARABLE COSTS
C  REMAINING BENEFITS
C
        DO 20 I =1,NSERV
              ROW6(I)=ROW5(I)
              IF(ROW5(I).GT.(SUM3-ROW3(I)))
     *       ROW6(I)=SUM3-ROW3(I)
              ROW7(I)=(ROW6(I)+ROW3(I))/TOTAL
              ROW8(I)=ROW4(I)*ROW7(I)
              ROW9(I)=ROW3(I)-ROW8(I)
              SUM9=SUM9+ROW9(I)
20            CONTINUE
C
C  CALCULATE JOINT COST PROPORTIONS ALLOCATED JOINT COST AND
C  TOTAL ALLOCATED COSTS; THE TOTAL SERVICE SECTOR COSTS
C
        DO 30 I=1,NSERV
              ROW10(I)=ROW9(I)/SUM9
              ROW11(I)=ROW10(I)*(TOTAL-SUM4)
              ROW12(I)=ROW4(I)+ROW11(I)
              SUM11=SUM11+ROW11(I)
              SUM12=SUM12+ROW12(I)
30      CONTINUE
C             WRITE JOINT COST PROPORTIONS TO ALLOCA.DAT FOR
C             USE IN FEES PROGRAM
        WRITE(2,*)ROW10,'     PROPORTIONS OF JOINT COST'
C                     START WRITE TO ALLOCA.OUT
        WRITE(3,210)
210     FORMAT(21X,'IRRIGATION',3X,'ENERGY',7X,'NAVIGATION  TOTALS')
        WRITE(3,700)ROW1(1)/1.E9,ROW1(2)/1.E9,ROW1(3)/1.E9,
     $  SUM1/1.E9
700     FORMAT(1X,'PROJECT BENEFITS       ',4(F10.2,2X))
        WRITE(3,710)ROW2(1)/1.E9,ROW2(2)/1.E9,ROW2(3)/1.E9,
     $  SUM2/1.E9
710     FORMAT(1X,'ALTERNATIVE COSTS      ',4(F10.2,2X))
        WRITE(3,715)ROW3(1)/1.E9,ROW3(2)/1.E9,ROW3(3)/1.E9,
     $  SUM3/1.E9
715     FORMAT(1X,'JUSTIFIABLE COSTS      ',4(F10.2,2X))
        WRITE(3,720)ROW4(1)/1.E9,ROW4(2)/1.E9,ROW4(3)/1.E9,
     $  SUM4/1.E9
720     FORMAT(1X,'SEPARABLE COSTS        ',4(F10.2,2X))
        WRITE(3,725)
725     FORMAT(1X,'COSTS FOR OTHER        ')
        WRITE(3,730)ROW5(1)/1.E9,ROW5(2)/1.E9,ROW5(3)/1.E9
730     FORMAT(1X,'PURPOSES               ',4(F10.2,2X))
        WRITE(3,*)'JUSTIFIABLE COSTS      ',
        WRITE(3,735)ROW6(1)/1.E9,ROW6(2)/1.E9,ROW6(3)/1.E9

735     FORMAT(1X,'FOR OTHER PURPOSES     ',4(F10.2,2X))
        WRITE(3,740)ROW7(1),ROW7(2),ROW7(3)
740     FORMAT(1X,'ADJUSTMENT FACTOR      ',4(F10.2,2X))
        WRITE(3,*)'ADJUSTED SEPARABLE',
        WRITE(3,745)ROW8(1)/1.E9,ROW8(2)/1.E9,ROW8(3)/1.E9
745     FORMAT(1X,'COSTS                  ',4(F10.2,2X))
        WRITE(3,750)ROW9(1)/1.E9,ROW9(2)/1.E9,ROW9(3)/1.E9,
     $  SUM9/1.E9
750     FORMAT(1X,'REMANINING BENEFITS    ',4(F10.2,2X))
        WRITE(3,*)'JOINT COST             ',
        WRITE(3,760)ROW10,SUM10
760     FORMAT(1X,'PROPORTION             ',4(F10.2,2X))
        WRITE(3,770)ROW11(1)/1.E9,ROW11(2)/1.E9,ROW11(3)/1.E9,
     $  SUM11/1.E9

770     FORMAT(1X,'ALLOCATED JOINT COSTS ',4(F10.2,2X))
        WRITE(3,780)ROW12(1)/1.E9,ROW12(2)/1.E9,ROW12(3)/1.E9,
     $  SUM12/1.E9

780     FORMAT(1X,'TOTAL SERVICE SECTOR  ',/
     *        ,1X,'COSTS                  ',4(F10.2,2X))
C
C  CALCULATE PERCENTAGES
        DO 85 I=1,NSERV
        PER(I)=ROW12(I)/TOTAL
 85     CONTINUE
        WRITE(3,790)PER
790     FORMAT(1X,'PERCENTAGES            ',4(G11.6,2X))
 4000   FORMAT(A1)
        CLOSE(UNIT=3,DISP='KEEP')
C
        CLOSE(UNIT=2,DISP='KEEP')
        CLOSE(UNIT=3,DISP='KEEP')
        STOP
        END
        SUBROUTINE INPUT(ROW1,ROW2,ROW4,QWATER,QPOW,QNAV,AGCOST)
        DIMENSION ROW1(3),ROW2(3),ROW4(3)
        OPEN(UNIT=2,NAME='ALLOCA.DAT',TYPE='OLD',ERR=99)
        READ(2,*)LTITLE
        DO 5 I=1,LTITLE
        READ(2,4000)JUNK
5       CONTINUE
        WRITE(5,*)'THE FOLLOWING VALUES ARE READ IN FROM ALLOCA.DAT'
        WRITE(5,*)'IRRIGATION  ENERGY   NAVIGATION'
        READ(2,*,ERR=99)ROW1
        WRITE(5,*)'BENEFITS            ',ROW1
        READ(2,*)ROW2
        WRITE(5,*)'ALTERNATIVE COSTS ',ROW2
        READ(2,*)ROW4
        READ(2,*)QWATER
        READ(2,*)QPOW
        READ(2,*)QNAV
        READ(2,303)AGCOST
303     FORMAT(G12.6)
        CLOSE(UNIT=2,DISP='KEEP')
        WRITE(5,100)ROW4
100     FORMAT(1X,'THE FOLLOWING SEPARABLE COSTS WERE READ IN'
     *  ,/,1X,'IRRIGATION       ENERGY            NAVIGATION',
     *  /,1X,3(G15.8,2X)/,1X,
     *  'DO YOU WANT TO ADD TO THESE VALUES (Y/N) ? ',$)
        READ(5,4000)OK
        IF(OK.EQ.'N')GO TO 35
C               ALLOW USER TO INPUT DIFFERNT VALUES
C
        WRITE(5,*)'ENTER SEPARABLE COSTS'
        WRITE(5,*)'IRRIGATION,ENERGY,NAVIGATION'
        WRITE(5,*)'ENTER 3 REAL NUMBERS SEPARATED BY COMMAS'
7012    FORMAT(1X,' ? ',$)
        WRITE(5,7012)
        READ(5,*)ROW4
35      CONTINUE
        WRITE(5,7013)
7013    FORMAT(1X,'HAVE ALL VALUES BEEN ENTERED CORRECTLY (Y/N) ? ',$)
        READ(5,4000)OK
        IF(OK.EQ.'N')GO TO 98
        RETURN
 99     CONTINUE
        WRITE(5,500)
500     FORMAT(1X,'ERROR ON INPUT FILE ALLOCA.DAT DOES NOT EXIST',
```

```
     *'IN PROPER FORM',/,1X,'RUN ALLOCATE AGAIN INPUTTING DATA',
     *' INTERACTIVELY')
4000 FORMAT(A1)
     STOP
98   WRITE(5,*)'PROGRAM STOPPED BY USER '
     WRITE(5,*)'RUN ALLOCATE AGAIN ENTERING CORRECT DATA'
     STOP
     END
CXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
C
     SUBROUTINE BENIN(ROW1,ROW2,QWATER,QPOW,QNAV,AGCOST)
     DIMENSION ROW1(3),ROW2(3),ROW3(3)
     WRITE(5,*)'COLUMN ONE IS ASSUMED TO BE FOR IRRIGATION'
     WRITE(5,*)'COLUMN TWO IS ASSUMED TO BE FOR ENERGY'
     WRITE(5,*)'COLUMN THREE IS ASSUMED TO BE FOR NAVIGATION'
C
C              INPUT AGRICULTURE BENEFITS AND WATER USED
     OPEN(UNIT=2,NAME='AGQ.DAT',TYPE='OLD')
     READ(2,*,ERR=97)LTITLE,NYEARS
D    WRITE(5,*)LTITLE,NYEARS
     DO 5 I5=1,LTITLE
     READ(2,4000)NAME
4000 FORMAT(A1)
5    CONTINUE
     DO 10 I10=1,NYEARS
     READ(2,4000)NAME
10   CONTINUE
     READ(2,4000)NAME
     READ(2,4010,ERR=97)ROW1(1)
     READ(2,4010,ERR=97)QWATER
D    WRITE(5,*)ROW1,QWATER
     CLOSE(UNIT=2,DISP='KEEP')
4010 FORMAT(F15.2)
C
C              INPUT ENERGY CONSUMED AND ENERGY BENEFIT
     OPEN(UNIT=2,NAME='PWQ.DAT',TYPE='OLD',ERR=98)
     READ(2,*,ERR=98)LTITLE,NYEARS
D    WRITE(5,*)LTITLE,NYEARS
     DO 15 I15=1,LTITLE
     READ(2,4000)NAME
15   CONTINUE
     DO 20 I20=1,NYEARS
     READ(2,4000)NAME
20   CONTINUE
     READ(2,4000)NAME
     READ(2,4010,ERR=98)ROW1(2)
     READ(2,4010,ERR=98)QPOW
D    WRITE(5,*)ROW1,QPOW
     CLOSE(UNIT=2,DISP='KEEP')
C
C              INPUT NAVIGATIONAL BENEFITS,NAV VOLUME AND AGCOST
C
     OPEN(UNIT=2,NAME='NAVQ.DAT',TYPE='OLD',ERR=99)
     READ(2,*,ERR=99)LTITLE,NYEARS
D    WRITE(5,*)LTITLE,NYEARS
     DO 25 I25=1,LTITLE
     READ(2,4000)NAME
25   CONTINUE
     DO 30 I30=1,NYEARS
     READ(2,4000)NAME
30   CONTINUE
     READ(2,4000)NAME
     READ(2,4010,ERR=99)ROW1(3)
     READ(2,4010,ERR=99)QNAV
     READ(2,4010,ERR=99)AGCOST
D    WRITE(5,*)ROW1,QNAV,AGCOST
     CLOSE(UNIT=2,DISP='KEEP')
C
C                    CHECK INPUT VALUES
C
     WRITE(5,100)ROW1
100  FORMAT(1X,'THE FOLLOWING BENEFIT VALUES WERE READ IN'
    *,/,1X,'IRRIGATION      ENERGY          NAVIGATION',
    */,1X,3(G15.8,2X)/,1X,
    *'PLEASE CHECK:  ARE THEY REASONABLE (Y/N) ? ',$)
     READ(5,4000)OK
     IF(OK.EQ.'Y')GO TO 35
C            ALLOW USER TO INPUT DIFFERNT VALUES OR
C            STOP AND GO BACK TO BENEFIT SECTION
C
     WRITE(5,*)'DO YOU WANT TO ENTER DIFFERENT VALUES OR STOP'
     WRITE(5,7014)
7014 FORMAT(1X,'ENTER NEW VALUES (Y/N) ? ',$)
     READ(5,4000)OK
     IF(OK.EQ.'Y')GO TO 45
     WRITE(5,*)'PROGRAM ALLOCATE STOPPED BY USER'
     WRITE(5,*)'CHECK BENEFIT INPUT DATA CHANGE DATA IF ERRORS'
     WRITE(5,*)'@BENEFIT IF NECESSARY AND RERUN BENEFITS'
     STOP
45   CONTINUE
     WRITE(5,*)'Separate numbers with comma ","'
     WRITE(5,*)'REMEMBER THE FOLLOWING CONVENTION '
     WRITE(5,*)'COLUMN ONE IS ASSUMED TO BE FOR IRRIGATION'
     WRITE(5,*)'COLUMN TWO IS ASSUMED TO BE FOR ENERGY'
     WRITE(5,*)'COLUMN THREE IS ASSUMED TO BE FOR NAVIGATION'
     WRITE(5,*)'ENTER BENEFITS 3 REAL VALUES ON NEXT LINE'
     WRITE(5,7012)
7012 FORMAT(1X,' ? ',$)
     READ(5,*)ROW1
35   CONTINUE
C
C            CHECK AGCOST DUE TO NAVIGATIONAL DELAY
C
     WRITE(5,110)AGCOST
110  FORMAT(1X,'THE FOLLOWING AGCOST VALUE(COST TO AGRICULTURE'
    * ' SECTOR DUE TO NAVIGATION)',/,1X' WAS READ IN:'
    *,1X,G15.8,/,1X,
    *'PLEASE CHECK:  IS IT REASONABLE (Y/N) ? ',$)
     READ(5,4000)OK
     IF(OK.EQ.'Y')GO TO 50
C            ALLOW USER TO INPUT DIFFERNT VALUE OR
C            STOP AND GO BACK TO BENEFIT SECTION
C
     WRITE(5,*)'DO YOU WANT TO ENTER DIFFERENT VALUE OR STOP'
     WRITE(5,7014)
     READ(5,4000)OK
     IF(OK.EQ.'Y')GO TO 55
     WRITE(5,*)'PROGRAM ALLOCATE STOPPED BY USER'
     WRITE(5,*)'BECAUSE OF ERROR WITH AGCOST'
     STOP
55   CONTINUE
     WRITE(5,*)'ENTER AGCOST THE COST TO IRRIGATION SECTOR'
     WRITE(5,*)'DUE TO NAVIGATIONAL DELAY '
     WRITE(5,7012)
     READ(5,*)AGCOST
50   CONTINUE

     RETURN
C
C            ERROR HANDLING
97   WRITE(5,*)'ERROR IN AGQ.DAT  FILE'
```

```
      GO TO 1000
98    WRITE(5,*)'ERROR IN PWQ.DAT  FILE'
      GO TO 1000
99    WRITE(5,*)'ERROR IN NAVQ.DAT FILE'
1000  STOP
      END
```