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Democratic Socialist Republic of Sri Lanka

Ministry of Mahaweli Development

Maduru Oya Project

Feasibility Report

Annex L
Economic and Financial Analysis

ACRES Acres International Limited, Niagara Falls, Canada

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FOREWORD

The Feasibility Report on the Maduru Oya Project, of which this Annex forms a part, is made up as follows:

Main Report

Annex A - The Project Area

Annex B - Soils and Land Classification

Annex C - Hydrology and Water Balance

Annex D - Engineering Works

Annex E - Agronomic Studies

Annex F - Livestock

Annex G - Agroeconomic Studies

Annex H - Forestry

Annex I - Settlement Planning

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SUMMARY

The economic analysis of the Maduru Oya project is undertaken through a 40-yr cash flow projection from which the economic internal rate of return for the project is determined. The economic analysis is conducted with economic costs and benefits calculated from economic prices instead of market or financial prices. This is necessary as market prices may not adequately reflect the actual cost to the economy or the true value of the inputs or agricultural products grown.

The financial return to the farmer is calculated with existing financial prices and is therefore representative of the return which the farmer would receive today. Farm financial and economic returns differ, as in some cases, financial prices include subsidies which may be extremely difficult to remove or phase out in the future. Thus the study differentiates between the economic and financial return which the farmer will receive under the project.

The project will be operational in the future and thus the economic prices of inputs and outputs should be expressed at their future levels and not today's levels. For internationally traded commodities, price forecasts for 1990 are used as representative of these future prices and are expressed in 1979 currency.

The economic and financial prices for the major items in the analyses are shown below:

	Financial Price		Economic Price	
Fertilizer:				
Urea	Rs	980.00/t	Rs	3,899.00/t
TSP	Rs	1,335.00/t	RS	4,145.00/t
Muriate of Potash	Rs	1,065.00/t	Rs	2,649.00/t
Farm Power:				
Two-wheel Tractor	Rs	20.00/h	Rs	24.70/h
Pair of Buffalo	Rs	50.00/d	Rs	50.00/d
Farm Labor:				
Hired	Rs	16.00/d	Rs	6.00/d
On-farm		-	Rs	6.00/d
Agricultural Produce:				
Paddy	Rs	1,900.00/t	Rs	3,500.00/t
Soybeans	Rs	5,100.00/t	Rs	5,100.00/t
Groundnuts	Rs	5,600.00/t	Rs	5,600.00/t

The economic analysis is undertaken in Sri Lankan currency and foreign exchange costs are converted to local currency using the following exchange rates:

$1 U.S. = Rs 16.00
$1 Canadian = Rs 13.00

The decision to use rates which approximately existing official exchange rate implies no overvaluation of the Sri Lanka Rupee and negates the necessity to shadow price foreign cost components.

Shadow pricing has been employed in the calculation of three economic costs--cement, diesel fuel, and farm labor--as follows

Cement (delivered)	- Rs 1,220.00/t
Diesel fuel	- Rs 21.50/gal
Farm labor (including hired)	- Rs 6.00/d

For the economic analysis, all construction and operational labor is valued at this actual cost.

Economic analysis was undertaken for 2 rates of development --Scenarios A and B-- with initial harvesting in the 1983/84 Maha season. Scenario A involves development in 8 seasons (last area is developed in the 1987 Yala season) while Scenario B involves development in 13 seasons (last area in Maha 1989/90).

Project costs used in the economic analyses are summarized below.

	Rs Million (1979 Prices)
Headworks (dam and tunnel)	1,703.0
Main and branch canals	1,712.0
Tertiary system, drainage, land development	740.0
Subtotal - Irrigation Works	4,155.0
Experimental Demonstration farm	13.0
Roads	311.0
Settlement costs	165.0
Project management infrastructure	145.0
Upstream costs	150.0
TOTAL COSTS	4,939.0

The upstream costs shown above are System B's share of the Minipe-Ratkinda diversion works and are based on 25 percent of the cost of the canal works. Annual operating and maintenance costs for the entire project are estimated at Rs 61 million.

Agriculture benefits are derived primarily from paddy production. In new areas these benefits have been calculated on the basis of paddy yields of 4.6 and 4.1 tonnes/ha on Land Classes 1R and 2R respectively. These yields apply to both Maha and Yala crops.

In addition, benefits result from the production of the representative upland crops at the yield levels shown below.

Groundnuts	1.5 t/ha
Soybeans	1.6 t/ha

Additional project benefits result from homestead crop production, livestock, fisheries, forestry, and power production. The following tabulation shows the benefits estimated for the Base Case (both Scenarios A and B) after full development has been achieved. With the exception of paddy, all benefits are summarized as incremental benefits.

	Million Rs			
	Without Project	With Project	Net	Percent of Total
Paddy	79	679	600	80.4
Upland	-	13	13	1.8
Homesteads	-	64	64	8.6
Livestock	-	39	39	5.2
Fisheries	-	2	2	0.3
Forestry (average annual)	-	9	9	1.2
Power	-	19	19	2.5
	79	825	746	100.0

The economic internal rate of return is calculated for each scenario at three paddy yield levels (± 10 percent from the Base Case Levels). The Base Case includes a buildup to the realization of the maximum economic benefit--from 60 percent to 100 percent in 5 yr. The sensitivity of a longer buildup period--8 yr--was also tested. Other sensitivity tests included a different cost allocation of the Right Bank Transbasin Canal, varying the capital costs and total benefits, and comparing Scenario A's cost phasing with Scenario B's benefit phasing. The results of these and other analysis are as follows.

SUMMARY OF PROJECT IRR ESTIMATES
(Percent)

	Scenario A	Scenario B
Base case	10.1	9.8
Higher yields	11.6	11.2
Lower yields	8.6	8.4
8 yr to maximum paddy benefits (with Base Case yields)	9.8	9.4
Capital cost up 5 percent	9.7	9.4
10 percent	9.4	9.1
15 percent	9.1	8.8
20 percent	8.8	8.5
Project benefits down 5 percent	9.6	9.3
10 percent	9.1	8.8
15 percent	8.6	8.3
20 percent	8.0	7.7
50 percent share of Right Bank Transbasin Canal	9.4	9.0
Full development	10.6	-
Nelugala Corridor	10.3	-
Unplanned delay in Implementation Schedule	9.1	-

Secondary benefits have not been considered in the above analyses, although they are substantial for a project like the Maduru Oya project. Their inclusion could add significantly to the Base Case IRR.

After allowing for basic food requirements, financial farm incomes are about Rs 4-5,000/yr for both paddy and upland farmers. The farmer's repayment capacity will depend upon the farm standard of living which is acceptable to policy-makers.

Project economic capital costs for purposes of economic analysis are Rs 4,939 million (1979 prices). Project financial costs included the agricultural processing and services costs and the costs of the social infrastructure. Total financial costs (1979 prices) are Rs 5,674 million (Scenario A).

1 - INTRODUCTION AND APPROACH

This annex details the approach taken for the economic evaluation of the Maduru Oya project. In addition, the key parameters for the financial analysis are identified and some of the main issues discussed.

Section 2 delineates the major assumptions made for project evaluation including the main economic parameters. An important issue here is the difference between economic and financial prices and the economic and financial return to the farmer. In this study the financial and economic farm returns from paddy production differ due to the assumption regarding the continuation of subsidies in the Sri Lankan economy.

Section 3 discusses the economic and financial prices used in the analysis for various inputs, agricultural outputs, construction materials, transport, and labor. The calculations for the various economic prices are relegated to an appendix.

In Section 4 the project costs and benefits are calculated and the project economic internal rate of return (IRR) is calculated. Project benefits included are those from crop production, homesteads, fisheries, forestry, livestock and power production. Various sensitivity analyses are included in this section. The project costs and benefits are basically those which have been derived in other annexes and are considered to be direct project costs and benefits.

Because the project will also generate indirect benefits, Section 5 discusses their inclusion in the project evaluation procedure. These include income equality

considerations, direct and indirect regional impacts, and other less quantifiable factors which are discussed on a qualitative basis. These considerations tend to emphasize that numerous decision-making criteria can be incorporated into project evaluation.

Finally, Section 6 identifies and summarizes some of the financial parameters for the project, the key one being the financial return to the Maduru Oya farmer/settler. A financial budget, incorporating both local and foreign exchange components, is also included in this section.

2 - KEY EVALUATION PARAMETERS

This section of the annex details the major assumptions used in the economic and financial analysis of the Maduru Oya project. These include

- foreign exchange rate
- accounting rate of interest
- basis for economic and financial analysis
- project analysis period
- opportunity cost of labor
- allocation of upstream costs.

2.1 - Foreign Exchange Rate

Until 1977, the Sri Lanka Rupee was overvalued and numerous measures were necessary to ensure that serious shortages of foreign exchange did not occur. In November 1977, the Rupee was devalued and foreign exchange controls were removed. As of mid-1979, the Rupee traded at a level of about Rs 15.60 to the United States dollar and about Rs 13.00 to the Canadian dollar.

The NEDECO Implementation Strategy Study(1) have adopted an exchange rate of $1 U.S. = Rs 18.00 for use in their analysis--a rate approximately 15 percent higher than the present exchange rate. NEDECO indicate that because of the concentration of projects under the Accelerated Mahaweli Programme, inflationary pressures may result which will impact the future exchange rate. Consequently they have employed a shadow exchange rate in their analysis although they indicate that "macro-economic models are insufficiently detailed to enable a correct estimation of the shadow rate of exchange to be applied in economic analysis".

Hunting Technical Services Ltd., the consultants studying System C, the area adjacent to the Maduru Oya project area, have opted for exchange rates which approximate official rates, i.e. Rs 16.00 to the United States dollar. In the preliminary Feasibility Report,(2) the impact of a higher exchange rate was tested in a sensitivity test with no appreciable impact on the results.

On balance then, it appears unnecessary to shadow price the foreign exchange cost component in the economic analysis. Thus for purposes of converting foreign cost components in the economic analysis, exchange rates have been adopted in this study as follows.

$1 U.S.	= Rs 16.00
$1 Canadian	= Rs 13.00

The use of exchange rates which approximate official exchange rates implies that the Sri Lanka Rupee is not overvalued to any great extent at its present level. This approach is in general agreement with the present project evaluation guidelines of both the Ministry of Finance and Planning and the Central Bank of Ceylon.

2.2 - Accounting Rate of Interest

In project evaluation, a number of methodological approaches can be employed to compare the project cost and benefit streams. The two most popular approaches are the internal rate of return technique and the net present value technique. The latter requires that an accounting rate of interest or discount rate be chosen so that the net present value of the project can be calculated. The internal rate of return technique, on the other hand, calculates the discount rate

that makes the cost and benefit streams sum to zero when discounted. Both the Ministry of Finance and Planning, and the Central Bank of Ceylon as well as the World Bank have used a discount rate of 10 percent for project evaluation in Sri Lanka in the past.

Recent analysis by Mr. Deepak Lal(3) who worked as an advisor on project evaluation to the Ministry of Finance and Planning, has suggested that a rate of 13 percent be used in project evaluation. NEDECO has indicated that because of the long-term characteristics of the Mahaweli Programme, a somewhat lower discount rate is warranted and have therefore chosen a discount rate of 12 percent for use in the economic analysis.

Agricultural projects and settlement schemes which are of a long-term nature and for which many of the social benefits are difficult to quantify, may well justify the use of even a lower discount rate. For settlement schemes like the Maduru Oya project for which maximization of returns is not the primary objective, it is considered that a discount rate in the area of 10 percent is appropriate.

2.3 - Basis for Economic and Financial Analysis

The economic analysis is conducted with economic costs and benefits calculated from economic prices instead of market or financial prices. This is necessary as market prices may be affected by subsidies, taxes, guaranteed support prices etc and thus may not adequately reflect the actual cost to the economy or the true value of the inputs and the agricultural products grown.

The major area of financial analysis in this study is the calculation of the financial return to the farmer. This calculation employs existing financial prices and is therefore representative of the return which the farmer would receive today. This is a minor departure from the approach taken to date by consultants on other Mahaweli Development projects. Their approach has been to assume that by the time the project is implemented, all subsidies which now exist will have been removed. This assumption is based on the fact that a number of international organizations have expressed the desirability of the removal of the subsidies which exist in the Sri Lanka economy. This would result in financial prices being equal to economic prices. However, the evidence would suggest that present subsidies may be extremely difficult to remove or phase out. Thus the study differentiates between the economic and financial return which the farmer will receive under the project.

The Maduru Oya project will be operational in the future and thus the prices of both inputs and outputs should be expressed with a view toward their future levels and not today's levels. As representative of these future price levels, commodity price forecasts for the year 1990 have been used as the basis for the calculation of the economic analysis period. These prices are expressed in 1979 currency.

2.4 - Project Analysis Period

The comparison of costs and benefits is undertaken over a 40-year time frame, a period considered to be representative of the economic life of the project. Thus the analysis period is 1980 to 2019. Although project costs and benefits will occur after 2019, their inclusion will have little impact on the project evaluation results because of the discounting procedures employed in the analysis.

2.5 - Opportunity Cost of Labor

Because there is considerable unemployment in Sri Lanka, there is an argument for shadow-pricing labor because it would be nonproductive otherwise. For farm labor (both hired and family) NEDECO[1] guidelines after adjustment to 1979 levels have been used in the economic analysis. All other construction and operational labor is taken at its actual cost. This is due to the fact that although there may be a case for decreasing the unskilled labor cost component because of high unemployment, there is a balancing factor which suggests that the market rates for skilled labor do not adequately reflect its scarcity and thus its cost component should be increased when expressed in economic terms. These two offsetting factors led to the decision to value construction and operational labor at market or financial rates for purposes of economic analysis.

2.6 - Allocation of Upstream Costs

In the consideration of the cost sharing of certain structures which benefit System B as well as other schemes in the Mahaweli Programme, two items can be considered as potentially chargeable to the Maduru Oya project. The first is the Right Bank Transbasin Canal at Minipe which serves both Systems B and C. The second is the storage function provided by Victoria and Kotmale dams. The costs of these dams and reservoirs can potentially be allocated between irrigation and power.

The total cost of the Right Bank Transbasin Canal, including the Minipe diversion works and the Ulhitiya and Ratkinda reservoirs, was originally[4] estimated by the System C team to be Rs 1,267 million (see Table L-2.1). Recently

TABLE L-2.1

RIGHT BANK TRANSBASIN CANAL
AND ASSOCIATED WORKS
(Rs Millions)

	Total
Minipe Transbasin Canal (0 to km 5.16), Siphon	77
Tunnel	16
Transbasin Canal (km 7.37 to end), Level crossings	854
Ulhitiya Dam	208
Ratkinda Dam	112
TOTAL	1,267

Source: Reference 4

tenders have been received for the Right Bank Transbasin Canal.* Using the average of the six lowest bids, the total cost is taken to be about Rs 1,000 million for analytical purposes. Of this total, an amount of Rs 600 million is estimated to represent the cost of those parts of the works (the canal itself plus the level crossings) the size of which vary directly with the flow conveyed.

As indicated previously, the conveyance system serves both Systems B and C, and thus its costs must be allocated between the two systems. Two methods of cost allocation can be considered. First, the incremental cost of sizing the canal for both systems as compared with the cost of sizing it only for System C is considered.** It is estimated that 75 percent of the cost of the flow-related works (the Transbasin Canal and level crossings which amounts to Rs 600 million) would be incurred if the canal were sized only for System C. Thus 25 percent of this cost - Rs 150 million - is allocated to System B using this first method. All other components of this conveyance system are necessary to supply System C demands and thus are not allocated to System B.

A second procedure allocates costs of the entire conveyance system (including the Ulhitiya and Ratkinda dams) according to the costs involved if either System B or C were built alone.*** For either system, the cost of the Transbasin Canal would be roughly 75 percent of the combined

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* Excluding Ulhitiya and Ratkinda reservoirs including the tunnel and part of the section from Mir.

** This approach can be justified if System C garded as the "first" project due to its physical location upstream of System B, and due to its higher IRR.

*** This approach can be justified if Systems B and C are regarded as "equal" projects - no clear order of development is evident from physical location or IRR.

cost (Rs 1,000 million) because of the approximately equal required canal capacity. Other costs would be the same. This results in an approximate equal sharing of conveyance system costs and thus Rs 504 million would be charged to System B (50 percent of the total cost).

The cost of upstream storage provision has not been charged to the Maduru Oya project. In their analysis of cost allocation using 1978 prices, NEDECO estimated that power benefits would pay for only a portion of the cost of the Victoria and Kotmale dams, and that the remainder of their costs should be allocated to the irrigation system benefiting from the storage. Recent dramatic increases in fuel costs, however, would change the results of the analysis. In fact, it is anticipated that economic power benefits alone would then cover the cost of these dams leaving no further costs to be allocated to irrigation systems. Consequently, the cost of upstream storage has been considered as a "sunk cost" and no cost allocation has been made to the Maduru Oya project. In their study of System C, Hunting Technical Services concluded on a similar note indicating that since power benefits alone would justify the Victoria dam, no upstream storage costs should be included in the economic analysis of System C.

3 - ECONOMIC PRICES

3.1 - Introduction

Economic prices are used to calculate project economic returns which are used for purposes of economic analysis. As indicated previously, for internationally traded commodities, these prices are based on forecasts for 1990. For commodities not traded internationally, their present price level is deemed to be indicative of their future level under the project, when expressed in terms of 1979 constant currency.

Financial prices, on the other hand, are used in this study to calculate the financial return to the individual farmer (see Annex G). This financial return is based on present price levels and thus represents today's financial farm income. Thus, although financial prices of agricultural produce and inputs may change, the current financial farm return is felt to be indicative of that obtainable during the project evaluation period, when expressed at 1979 price levels.

This section of the annex details the economic price calculations for transport, labor, certain construction materials, farm power, agriculture inputs, agriculture produce, livestock products, forest products, and fish which are used in the economic analysis. Financial prices are also included - these are used to calculate the financial farm incomes detailed in Annex G, Agroeconomic Studies.

3.2 - Transport

The cost of transport must be calculated as it is an important component in the determination of farm-gate prices for inputs and outputs and the delivered price for certain construction items.

NEDECO(1) have calculated an average economic transportation cost of Rs 1.86/ton-km based on 25 percent utilization of a 15-ton truck and 75 percent utilization of a 5-ton truck. This is based on an economic diesel fuel price of Rs 9.66/gal, whereas the economic diesel fuel price used in this study is Rs 21.50/gal. However, the cost of fuel accounts for only 16.5 percent of the total transportation cost and the increased fuel cost would have only marginal impact on the total cost. NEDECO's estimate is for 1978 but an exchange rate of Rs 18 = $1 U.S. has been used in the calculation.

A consultant team from the Asian Development Bank conducted a study in October/November 1979 of the primary road network for Systems A, B and C. Their calculation of economic transportation costs for a medium lorry on various class roads varied from Rs 1.57/ton-km to Rs 1.83/ton-km. These calculations were based on an economic diesel fuel price of Rs 22.23/gal.

Thus NEDECO's transportation cost of Rs 1.86/ton-km is accepted as being representative of the 1979 midyear level and is used in the economic analysis.

3.3 - Labor

NEDECO's[1] estimate of the mid 1978 value of the shadow cost of farm labor (both hired and on-farm) was Rs 5.50/day and was based on the updating of the rate calculated by the World Bank in 1977.[5] The bank's rate was based on an analysis of labor requirements on the farm and alternative employment possibilities.

For purposes of this study, a further 10 percent increase has been applied to NEDECO's shadow wage rate to reach mid 1979 levels. Consequently a rate of Rs 6.00/day is used for both hired and on-farm labor in the economic analysis. This compares to a financial cost of Rs 16.00/day for hired farm labor. Family labor, of course, has a financial cost of zero.

As indicated previously, all other labor (skilled and unskilled) including both construction and operational labor is valued at its financial or market cost in this study. NEDECO, on the other hand, have shadow-priced unskilled labor based on a formula relating to the composition of this category of worker. For skilled labor, NEDECO have used the financial wage rates as economic costs.

In their macroeconomic studies, NEDECO indicate that a number of factors have placed heavy demands on the semiskilled and skilled component of the construction sector. These include the expansion plans of the private sector, government investment programs outside the Mahaweli Programme, (e.g. the Investment Promotion Zone), and the employment lure of the Middle East countries. This may indicate the possibility of increasing this labor cost component because of its relative scarcity.

NEDECO's studies also indicate that even unskilled labor may be in short supply in the remote areas of the Mahaweli construction sites, which would argue against its shadow pricing.

On balance then, because of the various unknowns, it has been felt preferable to value all construction and operational labor at its actual market or financial cost. Cost estimates for the main and branch canals and tertiary irrigation system therefore utilize the following local labor rates

		Rs/day (8 hour)
Unskilled labor		12.33
Semiskilled labor		19.72
Skilled labor:	Class I	24.65 (e.g. mason)
	Class II	28.35 (e.g. heavy equipment operator)

Examples of rates used for the operational or ongoing labor include the following.

Field officers	Rs 9,000/year
Unit Managers	Rs 12,000/year
Service Team Specialists	RS 15,000/year

3.4 - Fuel

In the past, fuel prices in Sri Lanka have been heavily subsidized. Retail prices did not reflect the true cost of fuel to the country. In 1978 and 1979, the government made moves to increase the price of gasoline, diesel fuel, and kerosene

toward world prices. The price of gasoline increased three-fold, while the prices of diesel fuel and kerosene approximately doubled. Still, prices are below world prices in some cases (e.g. diesel fuel).

The Ceylon Petroleum Corporation (CPC) operates a refinery which produces mainly middle distillates for use in the country. Despite this, diesel fuel must still be imported to meet the country's demands. Thus the economic price of diesel fuel should be based on an import price.

At mid year 1979, CPC was importing crude oil from Saudi Arabia and diesel fuel from both Kuwait and China. The cost of diesel fuel was approximately U.S.$ 325/tonne, CIF Colombo. It is assumed that this price is at least equivalent to and quite possibly even above* the long-term parity price when expressed in terms of 1979 currency as forecasts made by the World Bank(7) indicate minor real price increases for crude oil between 1979 and 1990 (about half of 1 percent/yr in this period). This price of U.S.$ 325/tonne converts to Rs 21.50/gal in the project area (see Appendix I for calculation) and is more than double the present price of about Rs 10.00 per gallon (October 1979).

Developments in the latter half of 1979 would suggest rather strongly that, at least in the short term, oil prices will increase at a much faster rate than that anticipated. Despite this no attempt has been made to consider a higher price for diesel fuel as the evidence suggests that the mid 1979 price for diesel is above the long-term parity price when expressed in terms of 1979 currency.

*In early 1979 CPC paid 27 percent more for diesel than crude oil. By mid-year it was paying 130 percent more for diesel than crude, implying that the diesel price might be well above the long-term parity price (when expressed at 1979 levels).

Higher oil prices will, however, significantly impact the project in the area of fertilizer prices. Sri Lanka is currently completing the construction of a urea factory which will be in production in 1980 and will rely on feedstock from the world market. Other fertilizers must be imported. The fertilizer prices* used in this study incorporate significant real price increases above present levels as follows.

Urea	- 26 percent
TSP	- 50 percent
Muriate of Potash	- 34 percent.

3.5 - Cement

NEDECO have indicated the need for imported cement to supplement domestic supply during the construction phase of the Mahaweli Programme. The NEDECO economic price was based on an assumption that 50 percent of the total Mahaweli requirement would come from domestic sources and 50 percent would be imported. This has been used as a basic assumption for purposes of calculating the economic price of cement for this study.

The Ceylon Cement Corporation (CCC) is currently operating at capacity and cement is being imported by the Building Materials Corporation (BMC) to meet domestic demand. The CCC has excess grinding capacity and intends to secure additional clinker supplies to help meet domestic demand. Domestic cement prices have varied considerably in 1979 as the following record indicates.

*These prices are based on IBRD forecasts, May 1979.

	Rs/50-kg bag
January-February	22.02*
October	28.75
Early November	53.00
Mid November	45.00
Late November	43.00

The sharp fluctuations in the latter part of the year are indicative of shortages that occurred during that period and not the cost of producing the cement. The mid year financial price of Rs 28.75 per 50-kg bag is chosen as indicative of the economic cost of producing cement in Sri Lanka. This is slightly above the economic price of domestic cement calculated by NEDECO - Rs 27.35/bag.

For imported cement, the price of Rs 80 per 50-kg bag retailed by BMC is used for the import supply component. Using equal supply amounts from domestic and foreign sources, a price of Rs 1,215/metric tonne or Rs 61 per 50-kg bag is used as the economic price of cement in this study. It is a site-delivered price. Appendix I contains detailed calculations.

The financial price of cement is based on domestic sourcing. This assumption is based on the fact that the total quantity of cement to be used in the construction of the dam, tunnel, and main and branch canals is only about 10 percent of the effective annual installed capacity of the Ceylon Cement Corporation. The financial, site-delivered price of cement used in this study is Rs 42 per 50-kg bag.

*Based on Rs 18.50 for a 42-kg bag cement.

3.6 - Farm Power

Land preparation can be undertaken with buffalo, tractors, or in some cases mamoties. For an agricultural development project with the scope and size of that of the Maduru Oya project, large-scale land preparation by way of mamoty is not feasible. In most cases, land preparation will be undertaken by buffaloes or tractors. Annex F outlines a program for the development of sufficient draft buffalo for the majority of farmers in System B. However, this cannot be achieved for several years and thus a considerable amount of tractor power will be needed in the early years and some will always be needed. (See Annex G.)

Rates for buffalo hire in 1979 are about Rs 50/day for a pair of draft buffalo. This amount includes the driver's remuneration. This rate of Rs 50/day is used in both the economic and financial analysis in the study.

Because of increases in fuel costs, the economic cost of tractor hire has risen considerably. In 1978, NEDECO calculated the cost of a two-wheel tractor at Rs 17.10/hour. By 1979 this had risen to about Rs 25.00/hour (see Appendix I) using the same methodology, primarily due to the fuel price increases. This compares with a financial cost of about Rs 20.00/hour, the difference arising from the subsidized fuel prices in effect in the latter rate.

In summary then, the cost of the land preparation and other farm power requirements are developed from the following farm power charges:

	Economic (Financial) Cost	
Pair of buffalo	Rs 50/day	(Rs 50/day)
Two-wheel tractor	Rs 25/hour	(Rs 20/hour)

3.7 - Agricultural Inputs

Other agricultural inputs include fertilizers and agrochemicals. At present, fertilizer prices are heavily subsidized by the government, which provides it to the farmer at about one-third of its actual cost. Crop protection chemicals, on the other hand, are not subsidized and the farmer pays the full market or economic price.

Prices of crop protection chemicals were obtained from local suppliers and since there are no subsidies, the economic price is taken as equivalent to the financial price. Prices of various agrochemicals which are used in the crop budgets are shown in Table L-3.1.

Economic prices for fertilizer are based on IBRD price forecasts for 1990. Sri Lanka will have a urea factory operational by the time the project is implemented and thus the economic price of urea is based on export as an alternative. All other fertilizer prices are based on import. The financial prices of all fertilizers are based on existing (see Section 3.1) prices of the Ceylon Fertilizer Corporation. The economic and financial prices of various fertilizers are summarized below and the economic price calculations are detailed in Appendix I.

	Rs/tonne	
	Economic	Financial
Urea	3,899	980
Triple Super Phosphate	4,145	1,335
Muriate of Potash	2,649	1,065
Sulphate of Potash	3,532	1,420
Diammonium Phosphate	5,331	

TABLE L-3.1

CROP PROTECTION CHEMICALS
FINANCIAL/ECONOMIC PRICES

Agrochemical	Rs/Unit
Monocrotophos	189/L
Diomethoate	11/113 mL
Thiodan	87/L
BHC 10 percent dust	4.40/kg
Tamuron	167/L
Carbaryl	62/kg
Paraquat	70.50/L
Diazinon	22/kg
Saturn 6 percent Granules	8/kg
Linuron	40/kg
Furodan	12/kg
Perenox	23/kg

Source: Lankem Ceylon Ltd.

3.8 - Agricultural Produce

For internationally traded commodities, economic prices are calculated from IBRD price forecasts for 1990 which are assumed to be indicative of prices which will prevail under the project. The price calculations are based on either import substitution or export, depending upon whether Sri Lanka is expected to be a net importer or an exporter of that product during the project period.

To determine the financial prices for the above commodities, a comparison of the economic price calculated is made with the current financial producer price and unless there are wide discrepancies, the financial price is taken as equivalent to the economic price.

For commodities not traded internationally, the existing local financial price is used. In this case the economic price is taken as equivalent to the financial one. Pulses, chillies, onions, fresh cassava, and vegetables fall into this category.

The economic prices of rice, sugar and cotton are based on import substitution as Sri Lanka imports considerable quantities of these items and will continue to do so in the foreseeable future. The financial paddy price is based on the current price paid by the Paddy Marketing Board (PMB) which is Rs 40/bushel* and which converts to about Rs 1,900/tonne.

*One bushel = 46 lb.

The economic prices of tobacco, soybeans, groundnuts, maize, cassava chips, sorghum, and limes are based on export. In the case of groundnuts, the current price is considerably less than the economic price calculated. This is due to the fact that groundnuts are consumed locally and there is relatively little demand. If significant quantities of groundnuts are grown in System B, or any other area under the Mahaweli Programme, an efficient export marketing organization must be set up. In this case, world prices could be realized and the financial price paid to the farmer could be very close to the economic price calculated.

The economic and financial prices for agricultural produce are summarized in Table L-3.2 and the economic price calculations for internationally traded commodities are detailed in Appendix I. Further details on market assessments to determine the future import/export situation can be found in Annex G.

3.9 - Other Items

Economic prices for livestock products, forest products and fish have been developed in Annexes F (Livestock), H (Forestry) and G (Agroeconomic Studies) and are summarized in Table L-3.3.

TABLE L-3.2

AGRICULTURAL PRODUCE

	Economic Price (Rs/tonne)	Financial Price (Rs/tonne)
Paddy	3,500	1,900
Cotton	13,011	13,011
Sugar (cane)	229	229
Tobacco (green leaf)	1,961	1,961
Groundnuts	5,600	5,600
Soybeans	5,100	5,100
Pulses	5,300	5,300
Maize	2,000	2,000
Sorghum	1,700	1,700
Chillies	19,000	19,000
Cassava (fresh)	500	500
Cassava chips	1,500	1,500
Vegetables	1,000	1,000
Bananas	11/bunch	11/bunch
Limes	4,500	4,500

TABLE L-3.3

ECONOMIC AND FINANCIAL PRICES
LIVESTOCK, FORESTRY AND FISHERIES

	Economic Price	Financial Prices
Livestock Products		
Milk	Rs 1.31/L	Rs 2.21/L
Beef culls	Rs 3.30/kg L.W.	Rs 3.30/kg L.W.
Beef heifers	Rs 6.60/kg L.W.	Rs 6.60/kg L.W.
Forest Products		
Commercial timber	Rs 4/ft^3	Rs 4/ft^3
Firewood	Rs 0.30/ft^3	Rs 0.30/ft^3
Poles and posts	Rs 3 ea	Rs 3 ea
Fish		
Tilapia	Rs 4/kg	Rs 4/kg

Note: L.W. = Live Weight

4 - ECONOMIC EVALUATION OF THE PROJECT

4.1 - Analysis of Marginal Areas

In Annex B (Soils and Land Classification), studies which led to the estimation of gross irrigable area within gravity command of the proposed irrigation system are described. These studies showed that gross areas of 48 820 ha and 3,150* ha of paddy lands and uplands respectively are within command and irrigable. These areas would convert to 37 180 ha and 2,580 ha, respectively, of net irrigable area, after allowing for reserves and irrigation infrastructure. Studies of the water balance (Annex C), however, indicate that only about 92 percent of the water demands calculated for this "full development" area can be met, given the headworks capacities now committed for the project. It was, therefore, necessary to consider the options available to reduce the project's irrigated area to achieve a water balance, considering the following factors

- the reduction in irrigation water demand in comparison with the needs indicated in Annex C
- the contribution of the area eliminated to the project's economic viability
- land use planning and project implementation considerations.

Four possible area reductions (see Figure 14 in the Main Report for their locations) were subjected to economic analysis. The first three were chosen because of the relatively high cost of the branch canals serving them, while the fourth has been proposed as a wildlife protection measure. The four areas are as follows.

*Uplands in blocks of 35 to 40 ha or more.

1 - The area commanded by Branch Canals LB-L7 and LB-R8. Eliminating these two separate areas would reduce the net irrigable area by 4,000 ha, consisting of 3,060 ha of paddy land and 940 ha of upland. A satisfactory water balance would be achieved.

2 - The area commanded by Branch Canals LB-L10 and LB-R8. Eliminating this contiguous area would reduce the net irrigable area by 3,630 ha, consisting of 2,850 ha of paddy land and 780 ha of upland. A satisfactory water balance would be achieved.

3 - The area commanded by Branch Canal RB-R1. Eliminating this area would reduce the net irrigable area by 4,790 ha, consisting of 4,600 ha of paddy land and 190 ha of upland. A water surplus would result, as more land than necessary would be eliminated.

4 - The area occupied by the Nelugala Jungle Corridor. Eliminating this area would reduce the net irrigable area by 2,410 ha, consisting of 2,270 ha of paddy land and 140 ha of upland. A satisfactory water balance would be achieved.

Options 1 through 3* were analyzed to assess the effect on the project's viability of eliminating each area in turn. The approach used was to compute the change in the project's Net Present Value (NPV) at a 10 percent discount rate brought about by eliminating the area, and then comparing the results. In this analysis, the cost of the branch canal concerned and the tertiary system costs were compared against the loss of project benefits brought about by eliminating the commanded area from production.

*Option 4 is considered separately as a sensitivity test. The results are reported in Section 4.7.

The results of the analysis can be summarized as follows.

- Each of the three options has a positive net effect on the project's NPV. In other words, given an adequate water supply, the development of each of the areas is justified.

- The elimination of Branch Canal RB-R1 (option 3) has the greatest negative effect on the project NPV. This is because, in spite of the relatively high cost of this canal, the effect of the elimination of more irrigable land than is necessary to achieve a water balance dominates the calculation. The elimination of this area is not, therefore, recommended.

- The elimination of Branch Canals LB-L7 and LB-R8 (option 1) has a slightly less detrimental effect on the project's NPV than the elimination of Branch Canals LB-L10 and LB-R8 (option 2). This is because Branch Canal LB-L7 is more expensive than Branch Canal LB-L10.

Because of land use planning and project implementation considerations, discussed in the Main Report, option 2 is chosen as the "base case" for the economic analysis in this report. Annex D presents calculations of net irrigable areas for this option and the Nelugala Jungle Corrider option, both of which are subjected to IRR analysis later in this annex. The "full development" case is analyzed as well, since it is recommended (see Annex C and Main Report) that actual water usage rates be carefully monitored and the area initially eliminated be developed later if sufficient water proves to be available.

4.2 - Economic Analysis Methodology

To assess project viability, the economic costs and benefits of the Maduru Oya project over its life are calculated and the economic internal rate of return is determined. Benefits include not only direct benefits from irrigated crop production but also incremental benefits from homesteads, livestock, fisheries, forestry and power production. Calculation of these project benefits are detailed in other annexes and only a brief summary is included here. The costs included in the economic evaluations are all direct economic costs necessary to achieve the benefits as well as basic settlement and infrastructure costs. Again these are detailed in other annexes and summarized here.

Benefits from crop production (both irrigated and nonirrigated) in System B are calculated on an overall bas and therefore the "without the project" benefits must be determined so that only those directly attributable to the project are considered in the economic analysis. All other benefits are determined on an incremental basis and thus the "without the project" or present situation need not be determined in a quantifiable fashion.

The analysis is conducted for two development scenarios which are based on the rate of land development and the rate of settlement. The first (Scenario A) involves the last group of settlers harvesting their first crop in Yala 1987. For the second (Scenario B) this occurs in Maha 1989/90. Both scenarios involve the first group of settlers harvesting their first crop in Maha 1983/84.

Scenario A reflects the government's proposed timetable for development of System B. Scenario B involves a slower rate of development with the agricultural production development

rate spread over 13 growing seasons as compared to the 8 growing seasons of Scenario A.

Based on the two development scenarios, Table L-4.1 indicates the rates at which different sectors and land classes in each sector come into agricultural production. The areas of various land classes are based on the land classification studies detailed in Annex B. These areas include small tanks and rainfed areas which presently exist but exclude the major schemes - Pimburettewa, Vakaneri and Punanai - which are treated separately. Under the project, the small tanks will be rehabilitated and supplementary water will be supplied from the irrigation system. The upland areas in Table L-4.1 do not include homestead allocations and thus the area is representative of that which will be under irrigated crop production* once the project is operational.

4.3 - Situation Without the Project

The present agricultural activity in System B has been described in Annexes A and E. The major activities are paddy production under major and minor tanks, and rainfed paddy and chena cultivation. In addition, some crops are grown on homestead plots.

In order to quantify the current level of existing benefits from crop production for purposes of economic analysis, it is assumed that the economic return from paddy production is similar to the economic return for the "with the project"

[1]With the exception of the three major tank schemes - Pimburettewa, Vakaneri and Punanai.

TABLE L-4.1

INITIAL AGRICULTURAL PRODUCTION

Year		Area Hectares (Sector) 1R	2R	Uplands (1U+2U)	Total
Scenario A					
1984	M	3 220 (1)	1 680 (1)		4 900
	Y	1 730 (1)	2 390 (1)		4 120
1985	M	1 902 (2)	2 995 (2)		4 897
	Y	2 389 (2)	4 007 (2)		6 396
1986	M	782 (3)	2 577 (3)	625 (1)	3 984
	Y	1 923 (3)	2 672 (3)	630 (2)	5 225
1987	M	2 035 (3)	2 313 (3)		4 348
	Y	974 (3)	741 (3)	245 (3)	1 960
TOTALS		14 955	19 375	1 500	35 830
Scenario B					
1984	M	1 680 (1)	640 (1)		2 320
	Y	1 770 (1)	1 450 (1)		3 220
1985	M	1 210 (1)	1 370 (1)		2 580
	Y	1 267 (1, 2)	1 468 (1, 2)		2 735
1986	M	929 (2)	2 260 (2)		3 189
	Y	779 (2)	1 701 (2)		2 480
1987	M	1 604 (2)	2 183 (2)		3 787
	Y	431 (3)	1 546 (3)		1 977
1988	M	589 (3)	2 489 (3)	625 (1)	3 703
	Y	1 300 (3)	816 (3)		2 116
1989	M	824 (3)	1 682 (3)	630 (2)	3 136
	Y	1 598 (3)	1 029 (3)		2 627
1990	M	974 (3)	741 (3)	245 (3)	1 960
TOTALS		14 955	19 375	1 500	35 830

Note: M = Maha - 1984 M = Maha 1983/84
Y = Yala - 1984 Y = Yala 1984

situation with comparable yields. Cropping intensities are unlikely to change significantly in the future, as they primarily reflect low water availability in the Yala season and very high land utilization rates in Maha when water is plentiful. Although some minor yield improvements may be expected in the situation where the project does not exist, the net economic return is not adjusted for these minor yield increases. In effect, this means that additional returns from yield improvements are offset by lower product prices or higher production costs. This is in line with the "with the project" situation where net returns remain unchanged once the target yields have been achieved.

Table L-4.2 shows the estimated economic return from the current level of paddy production in System B. The areas cropped in each season and the yields achieved are also indicated. Areas cropped in each category are taken from the map of present land-use in System B (see Annex A) and may differ marginally from those indicated by official statistics. However, overall agreement among the various sources of data has been obtained.

About 33 000 ha or 25 percent of the gross project area is under rotational chena cultivation with about 20 percent of this area actually under cultivation in any given year. About 4,000 families are engaged in this activity. However, because of the long-term detrimental effects of chena cultivation, the net economic return from this form of cultivation is considered to be zero in both the "without the project" and "with the project" situations. Much of the present chena cultivation takes place in areas which are not to be developed in any case.

The present financial return to chena cultivation is very low primarily due to lack of marketing channels and available

TABLE L-4.2

ESTIMATED AREA, YIELD, AND NET RETURN OF EXISTING PADDY PRODUCTION IN SYSTEM B

Area	Net Irrigable Area (ha)[1] Maha	Yala	Yields Maha/Yala (t/ha)	Net Return/yr (Rs millions
Pimburettewa	1 260	1 160	4.4/4.4[2]	23
Vakaneri/ Punanai	3 530	880	2.8/2.8[3]	18
Small tanks	2 700	540	3.2/2.4[4]	16
Rainfed	4 000	-	3.2/0[5]	22
Totals	11 490	2 580		79

Notes:

[1]Areas estimated by referring to the map of present land use and official statistics.

[2]Estimated crop-cutting experiments by the consultants (see Annex E) indicated yields of over 4.4 tons/ha, but this figure was adopted to be consistent with "with the project" assumptions.

[3]Latest 5-yr "mean" DCS - Batticaloa District - Major Tanks and confirmed by Maha 1979/80 crop-cutting experiments on the Vakaneri Scheme.

[4]Latest 5-yr "mean" DCS - Polonnaruwa + Batticaloa Districts - Minor Tanks.

[5]Latest 5-yr "mean" DCS - Polonnaruwa + Batticaloa Districts - Rainfed.

markets. The project may even result in increased chena cultivation pressure as access and the marketing situation will be improved.

4.4 - Project Economic Costs

Direct project costs include the cost of the irrigation works consisting of the dam, link tunnel, main and branch canals, and the tertiary irrigation system. In addition, the cost of certain upstream facilities required to convey water to the reservoir are charged against the project (see Section 2.6). Other less direct costs which are considered as chargeable to the project include those associated with the Experimental Demonstration Farm, primary and access roads, certain settlement costs, and the project management infrastructure.

The costs of marketing and processing facilities are accounted for in the calculation of economic prices of various agricultural products. The costs of certain inputs such as tractors and threshing machines are accounted for in the crop budgets. The costs of the social infrastructure such as health and education facilities are not considered as direct project costs on the basis that these facilities would be supplied elsewhere in Sri Lanka if not in the project area and thus are not project-specific.

The economic cost estimate for the headworks (dam and tunnel) is based on the tender of November 1979 (see Annex D). The cost estimates for the main and branch canals have been prepared assuming that an expatriate contractor will be engaged for these works. The cost estimates for the tertiary irrigation works, including drainage and on-farm development, are based on construction by local forces. The estimates for

the main and branch canals and tertiary irrigation works are based on 1979 mid year costs.

As indicated in Section 3.3, actual labor costs have been used in the latter cost estimates. Economic cost estimates for all above items have included adjustments for the economic price of cement and diesel fuel.

As indicated previously, the cost estimates for the tertiary irrigation works assume construction by local forces. These estimates are based on unit rates published by the Ministry of Mahaweli Development,(6) and have a duty component in their composition. As the duties are very small in most cases (about 5 percent), the unit rates have been used directly as a basis for the cost estimates.

All economic project costs used in the economic analysis, including operation and maintenance costs after project implementation, are summarized in Table L-4.3. Both the financial and economic cost estimates for the major irrigation works are detailed in Annex D (Engineering Works).

No differentiation between economic and financial costs has been made for other costs included in Table L-4.3. These include costs of the Experimental Demonstration Farm, roads, settlement assistance, project management, infrastructure, and certain upstream costs.

The Experimental Demonstration Farm of about 40 ha is to be established under FAO sponsorship in System B near the Pimburettewa Tank Scheme. The farm will enable research to be carried out on the Noncalcic Brown Soil Group. Its cost is estimated at Rs 13 million.

TABLE L-4.3

ECONOMIC PROJECT COSTS
(mid 1979 prices)

Capital Costs	Million Rupees
Irrigation Works	
Headworks (dam and tunnel)*	1,703.0
Main and Branch canals	1,712.0
Tertiary system, drainage, land development	740.0
Subtotal Irrigation Works	4,155.0
Other Costs	
Experimental Demonstration Farm	13.0
Roads (including access roads)	311.0
Settlement	165.0
Project management infrastructure	145.0
Upstream costs	150.0
Subtotal - Other Costs	784.0
Total Capital Costs	4,939.0
Annual Operating Expenses	
Dam and tunnel	8
Irrigation system	36
Mahaweli Economic Agency**	14
Overheads	3
Total Annual Operating Expenses	61

Note: Costs for the irrigation works include contingencies and engineering and construction supervision.

* Based on the tender of November 1979.
**Includes project management, extension, settler assistance, community development, etc.

The cost of roads includes access, primary, irrigation system, and link roads, as well as roads within settlements. The full cost of access roads, link roads, irrigation system roads, and settlement roads have been included as project costs in the economic analysis. The primary road network in System B has been the subject of a recent consultant study sponsored by the Asian Development Bank. The costs of the 155 km of primary roads for System B are included at 50 percent of their cost. Total road costs for purposes of economic analysis are estimated at Rs 311 million (see Annex I).

The costs of settler assistance (see Annex I) include settler selection, transportation, temporary camps, tools, housing allowances, wells, food aid, physical planning and surveying, and are estimated at Rs 165 million for purposes of economic analysis.

Project management infrastructure costs (see Annex K) relate to capital expenditure for those engaged in project organization and management--water and irrigation management, agricultural extension, and settler assistance. They include the cost of dwellings, offices, transportation, and other equipment and amount to Rs 145 million.

The upstream costs include the shared cost of the Right Bank Transbasin Canal and associated works discussed in Section 2.6. The incremental cost allocation approach results in a cost of Rs 150 million as a project charge in the economic analysis.

Tables L-4.4 and L-4.5 show the annual phasing of the capital and operating costs for Scenarios A and B respectively.

TABLE L-4.4

SCENARIO A - ECONOMIC COSTS
CAPITAL AND OPERATING COSTS
(million Rs)

Year	Headworks	Main and Branch Canals	Tertiary Irrigation System	Upstream Costs	Experimental Demonstration Farm	Roads	Settlement	Project Management Infrastructure	O+M	Total
1(1980)	204	-	-	18	-	-	-	20	-	242
2	562	123	49	49	6	51	-	20	1	861
3	596	292	125	53	7	52	24	20	4	1,173
4	341	457	206	30	-	52	44	20	5	1,155
5	-	411	172	-	-	52	46	20	25	726
6	-	252	96	-	-	52	42	20	36	498
7	-	177	76	-	-	52	9	20	49	383
8	-	-	16	-	-	-	-	5	61	82
9-over	-	-	-	-	-	-	-	-	61	61

TABLE L-4.5

SCENARIO B - ECONOMIC COSTS
CAPITAL AND OPERATING COSTS
(million Rs)

Year	Headworks	Main and Branch Canals	Tertiary Irrigation System	Upstream Costs	Experimental Demonstration Farm	Roads	Settlement	Project Management Infrastructure	O+M	Total
1(1980)	204	-	-	18	-	-	-	14	-	236
2	562	92	39	49	6	31	-	14	1	794
3	596	153	61	53	7	35	11	14	3	933
4	341	251	105	30	-	35	27	14	4	807
5	-	251	119	-	-	35	28	14	20	467
6	-	301	124	-	-	35	30	14	28	532
7	-	239	113	-	-	35	24	14	35	460
8	-	142	70	-	-	35	24	14	44	329
9	-	142	65	-	-	35	21	14	53	330
10	-	142	44	-	-	35	-	14	61	296
11	-	-	-	-	-	-	-	5	61	66
12-over	-	-	-	-	-	-	-	-	61	61

4.5 - Project Benefits

Project benefits include returns from irrigated crop production, homestead plots, livestock, fisheries, forestry and power production. The return from irrigated crops is calculated on the basis of the "without the project" and "with the project" situation (see Section 4.3 for an explanation of the "without the project" situation) while other project benefits are calculated as incremental benefits directly attributable to the project.

4.5.1 - Irrigated Crop Production

Under project conditions, the benefits from irrigated agriculture will accrue primarily from the production of paddy in newly irrigated areas, but also from an increase in the production from existing tank schemes and from the production of upland crops. The upland areas account for only about 4 percent of the total projected area under irrigated agriculture in System B. Annex E (Agronomic Studies) details those crops which can be grown successfully from an agronomic point of view on the upland soils. Because the upland areas represent such a small proportion of the total irrigated area and since agricultural returns from upland crops are more uncertain than the returns from paddy production (due to marketing factors, infrastructure requirements, etc) a representative return for the upland crops is calculated on the basis of a groundnuts/soybean rotation in Maha/Yala on Class 2U upland soil, but applied to the total area allocated to upland crops (i.e. both 1U and 2U Land Classes).

Agricultural benefits from paddy production in new areas have been calculated on the basis of paddy yields of 4.6 and 4.1

tonnes/ha on Land Classes 1R and 2R respectively. These yields apply to both Maha and Yala crops.

Maximum economic returns will not be achieved in the first year of agricultural production. For paddy, a 5-yr development period is used, while for upland crops, an 8-yr development period is anticipated. Each begins with 60 percent of the net benefit achieved in the first year of production. These build-up factors reflect not only lower yields but other factors which may affect the economic return, such as poor initial leveling of the land, water stress due to start-up problems with the delivery system, shortage of inputs, etc. The economic return per hectare of paddy and the representative upland crop rotation are shown in Table L-4.6. This table also illustrates the return during the build-up period. After the target economic return is reached, no further increases are assumed. Economic benefits of improved yields (beyond the target yield) are assumed to be offset by lower paddy prices or higher production costs. To calculate the annual economic return from each 1-ha farm, a cropping intensity of 98 percent in Maha and 90 percent in Yala is used. This return is further reduced by 5 percent to account for bunds and other minor land losses on each farm. Economic and financial crop budgets are developed in Annex G.

Agricultural benefits also result from increased areas which can be cultivated in the Pimburettewa, Vakaneri and Punanai schemes. These benefits are felt primarily in the Yala season, with Maha 1983/84 being the first season for which they are calculated. The net irrigable areas (and projected yields) for these schemes, which can be cropped in Maha and Yala when additional irrigation water is available, are shown on page 42.

TABLE L-4.6

PROJECTED ECONOMIC
CROP BUDGET SUMMARY
(Rs/ha)

	Paddy (Maha/Yala) 1R	Paddy (Maha/Yala) 2R	Groundnuts (Maha) 2U	Soybeans (Yala) 2U
Target Yield (t/ha)	4.6	4.1	1.5	1.6
Economic Price (Rs/t)	3,467	3,467	5,572	5,143
A - Gross Value of Production (Rs)	15,948	12,481	8,358	8,229
Cost of Production (Rs)				
Fertilizer	1,281	1,281	1,028	882
Crop Protection	399	399	156	192
Farm Power	1,800	1,800	741	741
Labor	1,050	1,050	678	774
Miscellaneous (seeds, bags, etc.)	863	863	1,045	836
B - Total Cost of Production	5,393	5,393	3,648	3,425
C - Net Value of Production/Crop (A-B)	10,555	8,822	4,710	4,804
Net Value Year 1	6,333	5,293	2,826	2,882
Year 2	7,389	6,175	3,062	3,123
Year 3	8,444	7,058	3,297	3,363
Year 4	9,500	7,940	3,533	3,603
Year 5	10,555	8,822	4,004	4,083
Year 6	10,555	8,822	4,239	4,324
Year 7	10,555	8,822	4,475	4,564
Year 8	10,555	8,822	4,710	4,804

Area	Net Irrigable Area (ha)	Projected Yields Maha and Yala (t/ha)
Pimburettewa	1,660	4.4*
Vakaneri/Punanai	3,530	4.2**

For Pimburettewa, Vakaneri and Punanai schemes, a similar 5-yr build up from present yield levels to the above levels is assumed.

Using the areas for the two development scenarios in Table L-4.1 and returns shown in Table L-4.6, net economic returns from irrigated crop production in the "with the project" situation are calculated and summarized in Table L-4.7. Returns from small tank and rainfed paddy areas are included until they are developed under the project. In the case of the small tanks, some rehabilitation will be necessary and costs for this have been included in the capital cost estimates.

4.5.2 - Homestead Food Crop Benefits

Using the available data on existing production and consumption patterns, the net revenue from each homestead plot has been estimated at Rs 1,800 (see Annex G, Agroeconomic Studies). This is an implicit economic value for homestead production, irrespective of its final destination. This estimate is based on the residual area after allocations from the 0.4-ha homestead plot have been made for livestock, buildings, and "living space".

* Weighted average of 65 percent Land Class 1R and 35 percent Land Class 2R.

**Weighted average of 25 percent Land Class 1R and 75 percent Land Class 2R.

TABLE L-4.7

IRRIGATED CROP PRODUCTION
NET ECONOMIC BENEFITS WITH THE PROJECT
(million Rs)

Year	Scenario A					Scenario B				
	A	B	C	D	E	A	B	C	D	E
1(1980)	38	41	-	-	79	38	41	-	-	79
2	38	41	-	-	79	38	41	-	-	79
3	38	41	-	-	79	38	41	-	-	79
4	34	41	-	-	75	34	41	-	-	75
5	26	67	-	72	165	30	67	-	41	138
6	6	74	-	191	271	26	74	-	109	209
7	-	81	5	315	401	20	81	-	186	287
8	-	90	8	441	539	6	90	-	275	371
9	-	92	9	510	611	-	92	3	365	460
10	-	92	10	552	654	-	92	7	452	551
11	-	92	11	576	679	-	92	8	521	621
12	-	92	11	587	690	-	92	9	551	652
13	-	92	12	587	691	-	92	10	572	674
14	-	92	13	587	692	-	92	11	584	687
15	-	92	13	587	692	-	92	12	587	691
16	-	92	13	587	692	-	92	12	587	691
17	-	92	13	587	692	-	92	13	587	692
18-over	-	92	13	587	692	-	92	13	587	692

A - Small tanks, rainfed areas.

B - Pimburettewa, Vakaneri, Punanai Schemes

C - Upland crops

D - New Paddy Areas (includes areas previously included under Category "A" after additional irrigation water is available)

E - Total.

Total benefits would be realized after either 4 or 7 years (beginning in 1984), depending on the project development rate of Scenarios A and B. Two alternative schedules are provided in Table L-4.8.

4.5.3 - Livestock Production

Only the Murrah buffalo development plan was evaluated to determine the economic contribution of such a program to total project benefits from agriculture. These buffalo would supply draft power and would supplement farm incomes with milk and the revenue from surplus stock disposal.

The principal objective of the livestock program is eventually to generate all the draft power required by paddy farmers in System B. The projected deficiency is 29 000 head. In total, about 8,600 buffalo cows would be assigned to approximately one out of every four settlers at the time of their arrival in the project area.

The economic benefits from livestock production are detailed in Annex F (Livestock) and are summarized for the development scenarios in Table L-4.9.

4.5.4 - Fisheries

Fish production is to be developed in System B for approximately 5,000 ha of reservoir area as follows.

Maduru Oya Reservoir	3,900 ha
Pimburettewa Tank	580 ha
Vakaneri Tank	240 ha
Various small tanks	280 ha
TOTAL	5,000 ha

TABLE L-4.8

PROJECTED HOMESTEAD
BENEFITS FROM FOOD CROPS

Year	Scenario A		Scenario B	
	Number of Settlers (cumulative)	Net Benefits (million Rs)	Number of Settlers (cumulative)	Net Benefits (million Rs)
1(1984)	9 020	16.2	5 540	10.0
2	20 313	36.6	10 855	19.5
3	29 104	52.4	16 524	29.7
4	35 330	63.6	22 288	40.1
5	-	-	27 899	50.2
6	-	-	33 452	60.2
7	-	-	35 330	63.6

Note:

Total number of settlers is based on 34 330 paddy farmers and 1,000 upland farmers.

TABLE L-4.9

POTENTIAL LIVESTOCK BENEFITS WITH PROJECT
(million Rs)

Year	Scenario A	Scenario B
1 (1984)	(9.9)	(5.2)
2	(11.8)	(4.2)
3	(5.2)	(3.7)
4	(0.4)	(2.3)
5	10.9	0.5
6	13.4	2.9
7	16.2	10.4
8	18.9	15.2
9	21.5	18.0
10	24.3	20.6
11	27.1	23.4
12	30.6	26.1
13	32.2	28.6
14	35.0	31.4
15	37.1	33.7
16	38.3	35.7
17	39.0	37.2
18	39.0	38.1
19	39.0	38.7
20 - over	39.0	39.0

Notes: Year 1 corresponds to the first year of agricultural production.

Livestock benefits include an amount which represents the improved utilization (from 2 crops/yr) of 5,000 existing draft animals in the project area.

The resulting cash flow for the fisheries activities in System B is detailed in Annex J (Environmental Aspects) and in Table L-4.10.

The cash flow schedule shown in Table L-4.10 is applicable to both development scenarios.

4.5.5 - Forestry

Annex H Forestry, identifies two types of forestry benefits

- benefits from clearing forest
- benefits from reforestation.

The clearing benefits result from the harvest of commercial timber, poles and posts, and firewood from an estimated 28 000 ha, with total project benefits of about Rs 48.7 million. These have been applied over the period 1981 to 1985 for Scenario A and over the period 1981 to 1988 for Scenario B.

The reforestation benefits result from the harvest of firewood from about 11 000 ha of fuel wood plantation. For both scenarios, initial planting is spread over 7 yr (1,375 ha/yr).

Table L-4.11 illustrates the net cash flow for forestry benefits resulting from clearing and reforestation for both Scenarios A and B.

4.5.6 - Power Benefits

The estimated annual output from the Maduru Oya powerhouses is 31 GW·h and is classed as secondary energy. NEDECO(1)

TABLE L-4.10

FISHERIES PROJECT BENEFITS

Year	Net Benefits (Rs million)
1 (1984)	(1)
2	(1)
3	(1)
4	1
5	1
6 onward	2

TABLE L-4.11

FORESTRY BENEFITS CASH FLOW SUMMARY
(Rs million)

Year	Reforestation Cash Flow (Both Scenarios)	Clearing Cash Flow Scenario A	Clearing Cash Flow Scenario B	Total Cash Flow Scenario A	Total Cash Flow Scenario B
1(1980)		-	-	-	-
2	(2.2)	9.7	6.1	7.5	3.9
3	(2.2)	9.7	6.1	7.5	3.9
4	(2.2)	9.7	6.1	7.5	3.9
5	(2.2)	9.7	6.1	7.5	3.9
6	(2.2)	9.7	6.1	7.5	3.9
7	(2.2)	-	6.1	(2.2)	3.9
8	(2.2)	-	6.1	(2.2)	3.9
9	9.4	-	6.1	9.4	15.5
10	9.4	-	-	9.4	9.4
11	9.4	-	-	9.4	9.4
12	9.4	-	-	9.4	9.4
13	9.4	-	-	9.4	9.4
14	9.4	-	-	9.4	9.4
15	9.4	-	-	9.4	9.4
16-22	7.2	-	-	7.2	7.2
23-29	9.4	-	-	9.4	9.4
30-36	7.2	-	-	7.2	7.2
37-40	9.4	-	-	9.4	9.4

has indicated the necessity for thermal capacity in the system by 1983 and thus this secondary energy has been assumed to be 100 percent usable throughout the life of the project. This power is valued at the cost savings resulting in its use (i.e. the variable costs of thermal generation, which are primarily fuel). Updating NEDECO's estimate to mid 1979 level results in a valuation of Rs 0.61/kW·h, or an annual benefit of Rs 19 million over the life of the project, beginning in Project Year 5 (1984). This applies to both Scenarios A and B.

4.5.7 - Summary of Project Benefits

Project benefits for Scenarios A and B are summarized in Tables L-4.12 and L-4.13 respectively. For irrigated crops, the benefits are calculated on a "net" basis.

4.6 - Benefit-Cost Assessment

The cash flow summaries for Scenarios A and B are shown in Tables L-4.14 and L-4.15 respectively (see Annex E - Agroeconomic Studies). The resulting economic IRR for Scenario A is 10.1 percent while for Scenario B, a project economic IRR of 9.8 percent results (these are referred to as the Base Case results). Thus the slower development schedule in Scenario B results in about a 0.3 percent decline in the project economic IRR. Only direct project benefits have been included in the evaluation. Section 5 reviews some of the indirect project benefits and indicates how they may be incorporated into the analysis.

4.7 - Sensitivity Analyses

A number of sensitivity tests have been undertaken for Scenarios A and B. In addition, the sensitivity of the

TABLE L-4.12

SCENARIO A
SUMMARY OF PROJECT ECONOMIC BENEFITS
(million Rs)

Year	Irrigated Crops Without*	With	Net	Homestead	Livestock	Fisheries	Forestry	Power	Total
1	79	79	-	-	-	-	-	-	-
2	79	79	-	-	-	-	8	-	8
3	79	79	-	-	-	-	8	-	8
4	79	75	(4)	-	-	-	8	-	4
5	79	165	86	16	(10)	(1)	8	19	118
6	79	271	192	37	(12)	(1)	8	19	243
7	79	401	322	32	(5)	(1)	(2)	19	385
8	79	539	460	64	-	1	(2)	19	542
9	79	611	537	64	11	1	9	19	635
10	79	654	575	64	13	2	9	19	682
11	79	679	600	64	16	2	9	19	710
12	79	690	611	64	19	2	9	19	724
13	79	691	612	64	22	2	9	19	728
14	79	692	613	64	24	2	9	19	730
15	79	692	613	64	27	2	9	19	734
16	79	692	613	64	31	2	7	19	736
17	79	692	613	64	32	2	7	19	737
18	79	692	613	64	35	2	7	19	740
19	79	692	613	64	37	2	7	19	742
20	79	692	613	64	38	2	7	19	743
21	79	692	613	64	39	2	7	19	744
22	79	692	613	64	39	2	7	19	744
23-29	79	692	613	64	39	2	9	19	746
30-36	79	692	613	64	39	2	7	19	744
37-40	79	692	613	64	39	2	9	19	746

*Includes rainfed paddy.

TABLE L-4.13

SCENARIO B
SUMMARY OF PROJECT ECONOMIC BENEFITS
(million Rs)

Year	Irrigated Crops Without*	With	Net	Homestead	Livestock	Fisheries	Forestry	Power	Total
1(1980)	79	79	-	-	-	-	-	-	-
2	79	79	-	-	-	-	4	-	4
3	79	79	-	-	-	-	4	-	4
4	79	75	(4)	-	-	-	4	-	-
5	79	138	59	10	(5)	(1)	4	19	86
6	79	209	130	20	(4)	(1)	4	19	167
7	79	287	208	30	(4)	(1)	4	19	256
8	79	371	292	40	(2)	1	4	19	354
9	79	460	381	50	1	1	16	19	468
10	79	551	472	60	3	2	9	19	565
11	79	621	542	64	10	2	9	19	647
12	79	652	573	64	15	2	9	19	682
13	79	674	595	64	18	2	9	19	707
14	79	687	608	64	21	2	9	19	723
15	79	691	612	64	23	2	9	19	728
16	79	691	612	64	26	2	7	19	730
17	79	692	613	64	29	2	7	19	733
18	79	692	613	64	31	2	7	19	736
19	79	692	613	64	34	2	7	19	739
20	79	692	613	64	36	2	7	19	741
21	79	692	613	64	37	2	7	19	742
22	79	692	613	64	38	2	7	19	743
23-29	79	692	613	64	39	2	9	19	746
30-36	79	692	613	64	39	2	7	19	744
37-40	79	692	613	64	39	2	9	19	746

*Includes rainfed paddy.

TABLE L-4.14

SCENARIO A
NET CASH FLOW SUMMARY
(million Rs)

Year	Economic Capital and Operating Costs	Total Project Economic Benefits	Net Cash Flow
1	242	-	(242)
2	861	8	(853)
3	1,173	8	(1,165)
4	1,155	4	(1,151)
5	726	118	(607)
6	498	243	(255)
7	383	385	2
8	82	542	461
9	61	635	514
10	61	682	621
11	61	710	649
12	61	724	663
13	61	728	667
14	61	730	669
15	61	734	673
16	61	736	675
17	61	737	676
18	61	740	679
19	61	742	681
20	61	743	682
21	61	744	683
22	61	744	683
23-29	61	746	685
30-36	61	744	683
37-40	61	746	685

Sources: Tables L-4.4 and L-4.12.

TABLE L-4.15

SCENARIO B
NET CASH FLOW SUMMARY

Year	Economic Capital and Operating Costs	Total Project Economic Benefits	Net Cash Flow
1	236	-	(236)
2	794	4	(790)
3	933	4	(929)
4	807	-	(807)
5	467	86	(379)
6	532	167	(365)
7	460	256	(204)
8	329	354	25
9	330	468	138
10	296	565	269
11	66	647	581
12	61	682	621
13	61	707	646
14	61	723	662
15	61	728	667
16	61	730	669
17	61	733	672
18	61	736	675
19	61	739	678
20	61	741	680
21	61	742	681
22	61	743	682
23-29	61	746	685
30-36	61	744	683
37-40	61	746	685

Source: Tables L-4.5 and L-4.13.

economic IRR with respect to different areas under irrigated agriculture has been calculated for Scenario A.

Project benefits were recalculated for both scenarios assuming higher and lower paddy yields (±10 percent) as compared to those detailed in Section 4.5. These were as follows.

	Lower Yields Maha/Yala (t/ha)	Higher Yields Maha/Yala (t/ha)
Land Class 1R	4.1	5.1
Land Class 2R	3.7	4.5

The results discussed in Section 4.5 are based on maximum economic benefits from paddy being realized in the fifth year after initial planting. An 8-year period for achievement of maximum benefits has also been considered. The results of the yield sensitivity calculations are shown below.

	Project IRR (percent)*	
	Scenario A	Scenario B
Base case	10.1	9.8
Higher yields	11.6	11.2
Lower yields	8.6	8.4
Eight yr to maximum paddy benefit (with Base Case yields)	9.8	9.4

The IRR estimate is sensitive to assumed yield levels. A 10 percent change in yields would change the IRR by about 1.5 percent. Changes in paddy prices and cropping intensities would have similar effects on the resulting IRR estimate.

*Details can be found in Appendix II.

On the other hand, increasing the length of time required to realize maximum paddy benefits from 5 to 8 years has a relatively minor impact on the project IRR.

A number of sensitivity tests were also undertaken to determine the impact of increases in capital costs for the main irrigation system (headworks, main and branch canals, and tertiary system which together represent 84 percent of the total costs used in the economic analysis) on the project IRR. The results indicated an approximately linear relationship in which the project IRR falls about 0.7 percent for every 10 percent increase in capital costs. Thus a 10 percent increase in capital costs for the Base Case would result in a project IRR of 9.4 and 9.1 percent for Scenarios A and B respectively.

In addition, the impact of a decline in overall project benefits was examined. Again, an approximately linear relationship was established wherein the project IRR would fall by 1.0 percent for every 10 percent decline in project benefits. Thus if total project benefits are actually overestimated by 10 percent in the Base Case, the IRR would drop to 9.1 and 8.8 percent for Scenarios A and B respectively.

It is noted that the approximately linear relationships established in the sensitivity tests for capital cost increases and reductions decline in project benefits are indicative and either a decrease in capital costs or an increase in project benefits would have equal and opposite impacts on the economic IRR of the project.

In Section 2.6, two cost allocation methods for the Right Bank Canal from Minipe to Ratkinda were discussed. The incremental cost approach, in which the sum of Rs 150 million is charged to the Maduru Oya project, has been used in the

calculation of the Base Case IRR for Scenarios A and B. If costs are allocated equally between Systems B and C, Rs 504 million would be charged to the project and the IRR would fall about 0.7 percent.

The impact of an unplanned delay in project implementation was examined. The unplanned delay scenario was simulated by combining the capital and operating cost streams from Scenario A with the project benefit stream from Scenario B. This resulted in a project IRR of 9.1 percent. Clearly a planned rescheduling of project implementation yields more attractive economic results than does an unplanned delay.

Two sensitivity tests were undertaken on Scenario A for the inclusion of alternate development areas in the project analysis. The first relates to the full development of System B, where all areas identified as irrigable in land classification studies would be developed. This could be achieved if water usage rates in System B are lower than estimated in Annex C. In this case the project IRR would increase to 10.6 percent. The second sensitivity test is based on the inclusion of the Nelugala Jungle Corridor (see Annex J) as a wildlife protection measure. In this case, the areas commanded by Branch Canals LB-L10 and LB-R8 would be developed, as a water balance could be achieved by not developing land within the Nelugala Corridor. Cost savings arising from the elimination of Branch Canals LB-L7B, LB-L7C, LB-L8 and RB-L4 would also result. For this option, the project IRR would increase slightly from the Base Case level of 10.1 percent to 10.3 percent.

The results of the Base Case analysis and various sensitivity tests are summarized in Table L-4.16.

TABLE L-4.16

SUMMARY OF PROJECT IRR ESTIMATES
(percent)

	Scenario A	Scenario B
Base Case	10.1	9.8
Higher yields	11.6	11.2
Lower yields	8.6	8.4
Eight years to maximum paddy benefits (with Base Case yield)	9.8	9.4
Capital costs up 5 percent	9.7	9.4
10 percent	9.4	9.1
15 percent	9.1	8.8
20 percent	8.8	8.5
Project benefits down 5 percent	9.6	9.3
10 percent	9.1	8.8
15 percent	8.6	8.3
20 percent	8.0	7.7
50 percent share of Right Bank Transbasin Canal	9.4	9.0
Full development	10.6	-
Nelugala Corridor	10.3	-
Unplanned delay in Implementation Schedule	9.1	

5 - ASSESSMENT OF INDIRECT PROJECT BENEFITS

The project evaluation procedures detailed in Section 4 only consider direct or primary benefits and costs. It is recognized that a project of this nature can also lead to indirect or secondary costs and benefits. This section examines the inclusion of some of the more readily quantifiable socio-economic factors into the evaluation procedure and discusses some other benefits on a qualitative basis.

Before examining the calculations and discussions in this section, the reader is cautioned that the subject of including secondary costs and benefits in the evaluation process is one of continuing discussion and methodologies are not well developed, nor is acceptance of their inclusion universal. At the very least a certain element of skepticism persists. A well-known project analysis manual(8) expresses the following opinion.

"It seems best to conclude that for the present for most projects in developing countries it is better not to try to allow for secondary effects through the use of a multiplier... The practice of the World Bank and that of most other international lending agencies reflects this conclusion."

Despite the above opinion, this section attempts to quantify some of the indirect benefits for use by those examiners whose evaluation guidelines allow their inclusion in project analyses. It is felt that indirect project benefits are considerably higher than indirect project costs and thus their inclusion will make a positive contribution to the economic IRR calculations detailed in Section 4.

5.1 - Income Equality Considerations

There are two existing income distribution characteristics of the project area which are particularly pertinent to the subject of income equality. These are intraregional and interregional income disparities. An analysis of existing incomes in the project area indicates that

- the distribution of incomes is less egalitarian in the project area than in the country as a whole, and

- the average family income level in the region is equal to about two-thirds of the national average.

The following statistics illustrate the project area situation as compared to that elsewhere in Sri Lanka:

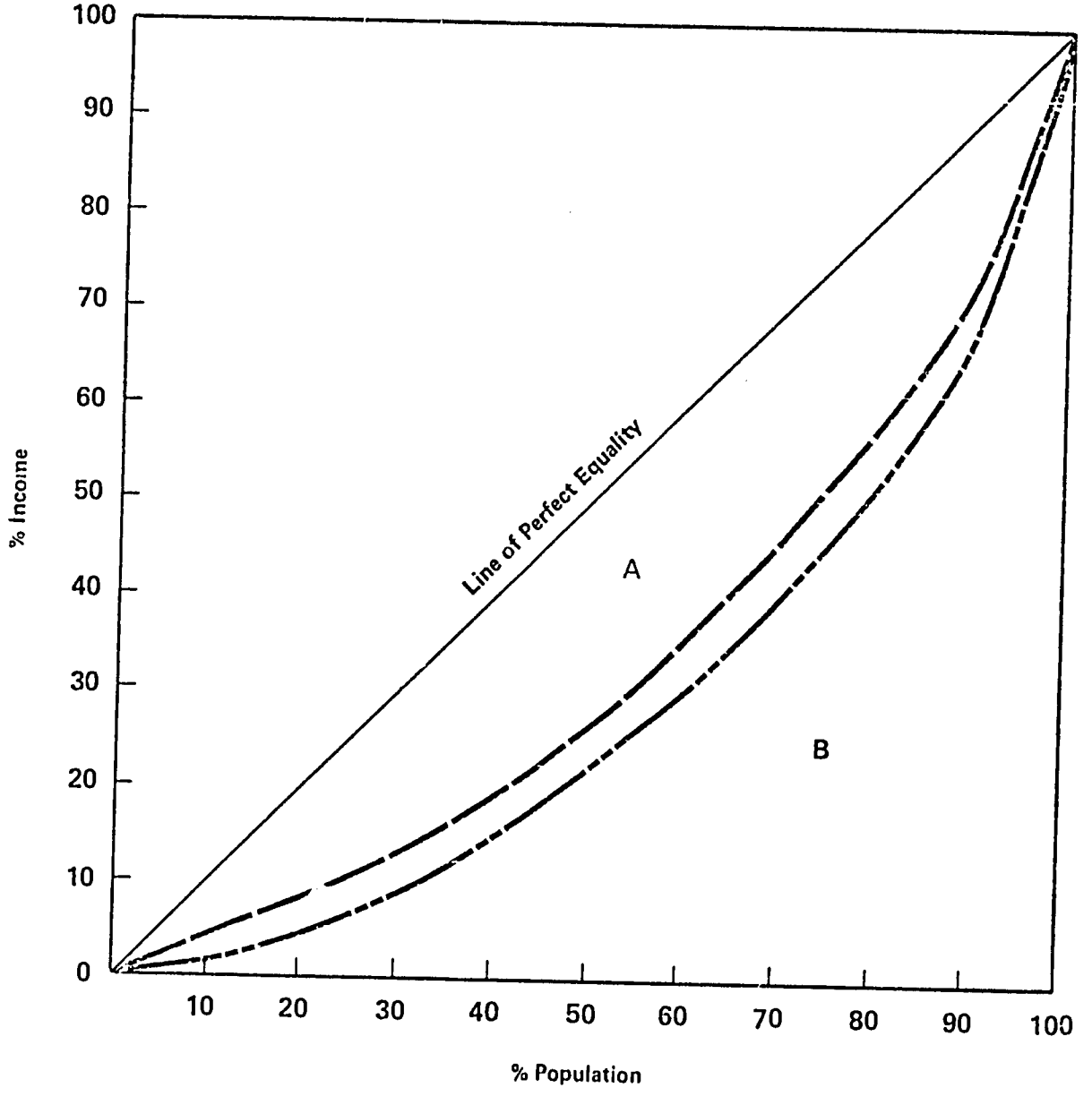
Percent of Private Incomes Received by	Project Area[9]	Sri Lanka
Highest 5 percent of households	20.0	18.6
Highest 20 percent of households	48.0	42.8
Lowest 20 percent of households	4.0	7.3
Lowest 40 percent of households	15.0	19.3

Graphically this difference can be illustrated as shown in the following figure.

*World Bank, Unpublished social indicators for Sri Lanka, Colombo, November 8, 1979. Very similar data were reported by the Central Bank of Ceylon in their Consumer Finance Survey of 1973.

INCOME DISTRIBUTION IN SRI LANKA AND MADURU OYA REGION

1979



LEGEND

Sri Lanka

Maduru Oya

Gini Coefficient:	A/(A + B)
Sri Lanka	0.35
Maduru Oya	0.40

The comparative Gini Coefficients* are

National	0.35
Regional	0.40

As other analysts have pointed out, however, private income disparities in Sri Lanka as a whole are relatively modest, particularly when "public income" to the relatively disadvantaged is taken into consideration. Most countries in Asia (and North America) have a less egalitarian income distribution than that of Sri Lanka.** There is also considerable evidence to suggest that, generally speaking, rural income disparities are less acute than urban income differentials.(10)

Thus it is likely that income disparities will become much less acute when the proposed project becomes a reality. In essence, improved income levels for the target group (i.e. lower income settlement recruits) would tend to generate a much larger "middle class" than now characterizes the project area.

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* The Gini coefficient, a measure of income dispersion, is equal to:

$$\frac{\text{Area A}}{\text{Area A + Area B}} \qquad \text{(see figure)}$$

A Gini Coefficient of zero represents perfect equality; a value of one represents perfect inequality.

**For comparative estimates in Asia, see Reference 10. The Gini Coefficients in Canada and the United States are about .50 and .60 respectively.

Despite the fact that in Sri Lanka national income is fairly evenly spread among persons as well as among regions,(1) project area is still a somewhat depressed region of the country. Current average annual (mean) family income levels (for 5.3 persons) for the Maduru Oya region and Sri Lanka are approximately as follows.

Maduru Oya*	Rs 9,400
Sri Lanka**	Rs 13,780

Both estimates include income-in-kind; for the Maduru Oya area, this is substantial.

There there is ample evidence to suggest that existing incomes in the project area (including income-in-kind) do not exceed 75 percent of the national average. Since public services in the project area are somewhat "thinner" than in the country as a whole, this proportion probably underestimates the real income disparities which prevail.

The rationale for adjusting the economic rate of return to account for the relative income level of the settler target group is that the incremental value of an additional rupee in income to a relatively poor man is assumed to be greater than an additional rupee in income to a relatively rich man. In technical terms, the marginal utility of money diminishes as incomes increase, at least above some threshold level where all basic human needs are satisfied.

To adjust projected economic benefits so that they reflect the distribution of benefits to relatively disadvantaged

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* Derived from Reference 9.

**Gross National Product at factor cost, projected to represent mid 1979 nominal income levels.

families, a multiplier is calculated according to the following formula.(11)

$$w_i = \left(\frac{Y}{Y_i}\right)^n$$

Where w_i = income distribution weight for the target group
Y = base level of consumption (income)
Y_i = consumption (income) level of target group
n = elasticity of the marginal utility of income.

To evaluate the elasticity of the marginal utility of income, the inverse of the unadjusted income tax rates* for Sri Lanka have been employed (see Table L-5.1). For simplicity, an average elasticity of the marginal utility of income has been derived and is equal to 0.41. This estimate corresponds very closely to the professional judgment of other analysts.** The base level of consumption (income)-- Rs 12,000/yr--is also taken from the income tax structure and is only slightly less than the average family income level in Sri Lanka.

Consider two target groups from which settler selection can be made.

Case A - Project settlers will be chosen from two different socioeconomic strata, including the existing population in the project area. The balance (the majority), which will come from outside System B,

* These rates were changed in the 1979/80 budget, November 14, 1979. The maximum rate applicable will be changed to 55 percent. For the purposes of this analysis, these changes are not significant.
**A value of 0.35 is considered "typical". See Reference 11.

TABLE L-5.1

UNADJUSTED MARGINAL INCOME TAX RATES
FOR RESIDENTS FOR SRI LANKA, 1978-1979

Annual Gross Income (Rs)	Gross Rate (percent)	100 - Gross Rate
0 - 12,000	Exempt	100.0
12,001 - 16,800	7.5	92.5
16,801 - 21,600	10.0	90.0
21,601 - 26,400	15.0	85.0
26,401 - 31,200	20.0	80.0
31,201 - 36,000	25.0	75.0
36,001 - 40,800	30.0	70.0
40,801 - 45,600	35.0	65.0
45,601 - 50,400	40.0	60.0
50,401 - 57,600	45.0	55.0
57,601 - 64,800	50.0	50.0
64,801 - 72,000	55.0	45.0
72,001 - 79,200	60.0	40.0
79,201 - 86,400	65.0	35.0
Balance	70.0	30.0

Source: Department of Inland Revenue
Colombo, November 11, 1979

will be selected from the poorest 40 percent of the people in Sri Lanka. The weighted mean target group income is Rs 1,356 per capita/yr or Rs 7,187 per family.*

Case B - All project settlers will come from a socioeconomic background similar to that of the existing population in the project area with an income of Rs 1,774 per capita/yr or Rs 9,400 per family.

Cases A and B provide a range of multiplier values which can be applied to the direct benefits of the project. The multipliers are calculated as follows.

$$\text{Case A} = W_A = \left[\frac{12,000}{7,187}\right]^{.41} = 1.24$$

$$\text{Case B} = W_B = \left[\frac{12,000}{9,400}\right]^{.41} = 1.11$$

As is readily evident, if selected settlers are presently very poor, the eventual social benefits will be greater than if they already have an annual income which is approaching the national average. Thus, as a first approximation, if the estimated economic IRR is calculated to be 10.0 percent/yr, income distribution considerations would inflate this to somewhere between 11.1 percent and 12.4 percent/yr, depending on the current income level of the people selected for settlement in the project area.

*Assuming a family size of 5.3 persons.

5.2 - Regional Impacts

The conventional discounted cash flow analysis generally adopts a national perspective. Implicitly this perspective further assumes that there are no underutilized resources in the economy despite the fact that there is a nominal unemployment level of perhaps 20 percent of the total labor force (ignoring underemployment) and a utilization level of 75 percent of existing physical capacity.(12, 13, 14)

A regional benefit-cost analysis which acknowledges the existence and mobility of some underemployed resources in the country suggests the consideration of

- the initial construction impact in the Maduru Oya region

- the general magnitude of the "spin-offs" (or indirect benefits) which will likely accompany the direct benefits calculated in the conventional IRR estimates.

5.2.1 - Construction Impact

Some general indicators of how important the Polonnaruwa-Trincomalee-Batticaloa triangle is in a national context are shown below.

	P-T-B Triangle	Sri Lanka	P-T-B Percent
G.N.P. (Rs x 10^6)	884	37,200	2.4
Population ('000)	400	14 300	2.8
G.N.P./capita (Rs)	2,210	2,600	85.0
Area (mi^2)	1 500	24 960	6.0
Population density	267	573	46.5

The project area is a relatively small, relatively low-density, and relatively poor area of the country. Table L-5.2 indicates the construction impact of the Maduru Oya project on the area. Clearly the local impact will be substantial, with the local economy receiving a direct stimulus of some 6 percent/yr. If this local expenditure is included as a regional benefit in the basic IRR calculations, the IRR would be increased by approximately 15 percent--for example, from 10 percent to 11.5 percent/yr.

Further evidence is provided by NEDECO(1) research which utilized an open input-output model to obtain full interindustry final demand multipliers for the whole of Sri Lanka for the 6-year Accelerated Programme development period. The multipliers obtained were as follows.

Year	Multiplier Without Labor Constraints	With Labor Constraints
1	3.44	2.99
2	3.06	2.63
3	2.90	2.51
4	2.69	2.32
5	2.30	2.01
6	1.60	1.43

The above multipliers suggest that in the initial years of the Accelerated Programme, these indirect benefits should be at least twice as large as the direct benefits. By the sixth year the indirect benefits are expected to drop to about 50 percent of the value of the direct benefits. In short, the anticipated "spin-offs" are very large, particularly in the initial years of the proposed Programme.

TABLE L-5.2

CONSTRUCTION IMPACT OF MADURU OYA PROJECT

Year	Number of Local Construction Employees (Inc. O&M)	Local* Expenditure (million Rs)	Percent of Region Population	Percent of Region Income
1	2 500	7	0.6	0.1
2-7	20 000 (average)	60	5.0	6.8
8-40	2 500	30	0.6	3.4

*Estimated at 40 percent of construction wages and salaries and 100 percent of wages and salaries for operation and maintenance personnel.

5.2.2 - Long-Run Impact

The concept of a long-run multiplier can be used to determine the indirect benefits from the sustainable indirect activity which will be generated once the Maduru Oya project is operational. The theory of the development of these multipliers is based on the fact that activity in one sector of the economy will create related activity in other sectors. The relationship between various sectors is defined by input-output models which are a set of linear equations which describe the flows of goods and services from one sector to another. Because of interindustry forward and backward linkages, secondary benefits in other sectors are created from the primary benefits in a related sector.

In the case of the Maduru Oya project, increased production of paddy and upland crops will result in increased activity for millers, transportation companies, and marketing concerns (forward linkages). In addition, there will be increased activity for organizations which sell inputs to the farmers (backward linkages). Thus increased production in the agricultural sector (primary benefit) will result in related activity in other sectors (indirect or secondary benefits).

The data for the calculation of simple interindustry final demand multipliers is again based on NEDECO(1) input-output analysis and results in the following sustainable multiplier estimates.

Sector	Multiplier
1 - Tea, rubber, coconut	1.183
2 - Paddy	1.140
3 - Other agriculture	1.145
4 - Mining	1.241
5 - Manufacturing	1.664
6 - Construction	1.532
7 - Trade and transport	1.162
8 - Other services	1.209
Weighted Average	1.515

The weighted average multiplier of 1.52 for Sri Lanka suggests that the long-term indirect benefits are about 50 percent of the direct benefits. However, the Maduru Oya region has a less complex regional economy dominated by sectors 2 and 3 and therefore this national estimate is too high. With regard to the regional structure, the corresponding weighted average multiplier is equal to approximately 1.20 as calculated below.

Sectors	Percent Share Regional G.N.P.	Multiplier
1-4 Primary	70	1.15
5-6 Secondary	10	1.60
7-8 Tertiary	20	1.19
Totals	100	1.20

The Asian Development Bank(10) has suggested that the elasticity of the G.N.P. with respect to agricultural production in Sri Lanka is somewhere between 1.18 and 1.50 depending on agricultural growth rates. These two estimates closely approximate the regional estimate above and the NEDECO estimate for year 6 of the Accelerated Programme. The implied range is 1.43 to 1.60.

The simple interindustry final demand multiplier for the Maduru Oya project area should be at least 1.20--the indirect benefits should amount to at least 20 percent of the direct benefit calculation. Applying a multiplier of 1.2 to the direct benefit calculations results in the basic IRR increasing from 10 percent to about 12 percent/yr.

5.3 - Other Considerations

Employment generation is one of the most frequently mentioned indirect benefits for developing countries where substantial unemployment and underemployment exists. Unemployment in Sri

Lanka currently represents about 20 percent of the total labor force.* Accordingly, a priority objective of government policy is employment generation. The overriding objective of the Maduru Oya project is one of maximizing settlement numbers; this objective may not be consistent with profit maximization or improved per capita income levels in the region. Thus it might easily be argued the conventional IRR criteria should not be applied to the Maduru Oya project.

The issue here is whether the Maduru Oya project will generate employment in a relatively efficient fashion. This can be evaluated by comparing the capital-labor ratio with that for other industries in the country. An approximate calculation for the Maduru Oya project indicates the cost of U.S.$ 3,100 per work place as calculated below.

$$\frac{\text{Total Project Cost}}{\text{employment generation}} = \frac{\text{U.S.\$309 million}}{35{,}330 \times 2.8} = \text{U.S.\$3,100/work place}$$

The above estimate assumes 2.8 workers per settlement family.

The estimated average national capital investment per work place is also about U.S.$ 3,000 per job.** The cost of job creation in industry, manufacturing, and tourism is generally much higher. For example, by the end of 1978, the Greater Colombo Economic Commission (GCEC) which is developing the Free Trade Zone, had approved 52 projects for Rs 1,624 million. These projects would create 26,500 jobs for a cost

* Recent figures from the 1978 Annual Report of the Central Bank of Ceylon suggest 16 percent but the report states that estimates have been made from preliminary data and should be used with caution.

**Estimated from incomplete data. See Reference 14.

of U.S.$ 3,800 per work place. Another example is a proposed hotel in Colombo, which is expected to cost nearly U.S.$ 9 million and only generate 1,000 direct job opportunities, for a cost per work place of U.S.$ 9,000.

These estimates suggest that the Maduru Oya project is a relatively inexpensive and efficient means of generating employment opportunities in Sri Lanka.

Consideration of spatial settlement patterns is also relevant to the Maduru Oya project. These include factors associated with regional balance and the social costs of rural migration to urban centers. It is socially undesirable to have an extremely high concentration of economic activity in the Colombo axis. In fact, a recent survey indicated that over 80 percent of the value of production and 81 percent of the work force was located in the Colombo District.(14) The Maduru Oya project would help shift economic activity toward the "hinterland", in this case the Polonnaruwa-Trincomalee-Batticaloa triangle.

The anticipated "quality of life" for future generations of Sri Lankans is of the utmost importance to policymakers. Conventional economic analysis does not acknowledge that the value of incomes generated in different environments may not be equivalent in real terms. Evidence in the United States indicates that urbanization has an accompanying social cost which amounts to about 5 percent of G.N.P. Thus consideration may be given to attaching premiums to incomes generated in an environment without the environmental problems characteristic of living conditions in congested urban centers.

In the final analysis, for projects like the Maduru Oya project, the additional considerations described above may

supplement the pure resource allocation efficiency criteria used in conventional economic analysis. Application of one or more of the indirect benefit calculations described would increase the project IRR significantly above the level obtained from conventional analysis.

6 - FINANCIAL ASPECTS

6.1 - Farm Financial Returns

Financial farm incomes and cash flow projections are discussed in Annex G (Agroeconomic Studies). The calculations indicate that paddy farmers and upland crop farmers will have approximately equivalent disposable incomes in the order of Rs 4-5,000/yr, once basic cost of living expenses have been deducted from the farm cash flow.

Once an allowance is made for consumption and investment over-and-above the farmer's basic cost of living, very little in the way of farm liquidity remains. This amount (about Rs 1,000/farm) could be considered the farmer's repayment capacity.

Annual operating and maintenance costs for the Maduru Oya project are estimated at Rs 61 million at full development. If allocated on a per-farm basis, this would result in a farm* charge of Rs 1,700/farm/yr. It is probable that the annual operating and maintenance costs could only be partially recovered through a water tax or land charge or other similar feature.

The emphasis placed on cost recovery will depend upon what farm standard-of-living is acceptable to policymakers. It is important to consider that earnings must be sufficiently large to provide adequate incentives to the farmer so that he will participate in the project. In this context, the choosing of an income level which provides an allowance

*Paddy farms are 1 ha in size, and upland farms are 1.5 ha.

for consumption and investment over-and-above the basic cost of living is a matter of informed, subjective judgment and is best made by the policymaker.

6.2 - Total Financial Project Costs

Project economic capital costs for purposes of economic analysis are Rs 4,939 million (see Table L-4.3). For the irrigation works, both financial and economic costs have been developed in Annex D (Engineering Works). For the other costs detailed in Table L-4.3, the financial costs have been calculated and used in the economic analysis.

The above costs are not the total financial project capital costs. The costs of social infrastructure and agriculture processing and services infrastructure have not been included directly in the economic analysis. The former are not considered as project charges and the latter are accounted for in the crop budgets and the pricing of the various agriculture commodities. This section provides a 10-yr summary of the financial costs for the Maduru Oya project, broken down into both local and foreign currency components. This is provided for both Scenarios A and B.

As indicated previously, the financial costs of the headworks, main and branch canals, and tertiary irrigation system are detailed in Annex D. The total financial cost expressed in 1979 prices is Rs 3,997.1 million, of which the foreign exchange component is about 60 percent. Tables L-6.1 and L-6.2 illustrate the phasing of these costs over the construction period for Scenarios A and B respectively.

The costs of roads, settlement and social infrastructure are detailed in Annex I (Settlement Planning). These costs total

MADURU OYA PROJECT
CAPITAL ITEMS - FINANCIAL CASH FLOW (1979 PRICES)
SCENARIO A

Category	1980 L	1980 F	1980 T	1981 L	1981 F	1981 T	1982 L	1982 F	1982 T	1983 L	1983 F	1983 T	1984 L	1984 F	1984 T	1985 L	1985 F
Headworks	52.0	149.3	201.3	142.9	410.7	553.6	151.6	435.6	587.2	86.6	248.9	335.5					
Main & Branch Canals				42.6	74.8	117.4	100.1	179.8	279.9	155.0	282.1	437.1	137.6	254.4	392.0	84.4	155.9
Tertiary Irrigation System				41.4	4.6	46.0	104.1	11.6	115.7	171.9	19.1	191.0	142.6	15.9	158.5	79.6	8.8
Experimental Farm				5.4	0.6	6.0	6.3	0.7	7.0								
Roads				60.3	10.7	71.0	60.3	10.7	71.0	60.3	10.7	71.0	60.3	10.7	71.0	60.3	10.7
Settlement							16.8	7.2	24.0	30.8	13.2	44.0	32.2	13.8	46.0	29.4	12.6
Project Management Infra.	14.0	6.0	20.0	14.0	6.0	20.0	14.0	6.0	20.0	14.0	6.0	20.0	14.0	6.0	20.0	14.0	6.0
Agricultural Processing & Services										82.4	91.1	173.5	105.5	115.1	220.6	75.8	90.1
Social Infrastructure				12.6	5.4	18.0	22.4	9.6	32.0	40.6	17.4	58.0	41.3	17.7	59.0	37.1	15.9
TOTAL L	66.0			319.2			475.6			641.6			533.5			380.6	
F		155.3			512.8			661.2			688.5			433.6			300.0
T			221.3			832.0			1136.8			1330.1			967.1		

		1985			1986			1987			1988			1989			TOTAL		
F	T	L	F	T	L	F	T	L	F	T	L	F	T	L	F	T	L	F	T
254.4	392.0	84.4	155.9	240.3	59.8	109.6	169.4										433.1	1244.5	1677.6
15.9	158.5	79.6	8.8	88.4	62.7	7.0	69.7	12.8	1.4	14.2							579.5	1056.5	1636.0
																	615.1	68.4	683.5
10.7	71.0	60.3	10.7	71.0	61.2	10.8	72.0										11.7	1.3	13.0
13.8	46.0	29.4	12.6	42.0	6.3	2.7	9.0										362.7	64.3	427.0
6.0	20.0	14.0	6.0	20.0	14.0	6.0	20.0	3.5	1.5	5.0							115.5	49.5	165.0
15.1	220.6	75.8	90.1	165.9	56.5	59.5	116.0	0.8	2.5	3.3	0.6	2.1	2.7	0.5	1.8	2.3	101.5	43.5	145.0
17.7	59.0	37.1	15.9	53.0	16.1	6.9	23.0										322.1	362.2	684.3
																	170.1	72.9	243.0
13.6	967.1	380.6	300.0	680.6	276.6	202.5	479.1	17.1	5.4	22.5	0.6	2.1	2.7	0.5	1.8	2.3	2711.3	2963.1	5674.4

TABLE L-6.2

MADURU OYA PROJECT
CAPITAL ITEMS - FINANCIAL CASH FLOW (1979 PRICES)
SCENARIO B

Category	1980			1981			1982			1983			1984			1985			
	L	F	T	L	F	T	L	F	T	L	F	T	L	F	T	L	F	T	
Headworks	52.0	149.3	201.3	142.9	410.7	553.6	151.6	435.6	587.2	86.6	248.9	335.5							
Main and Branch Canals				32.0	56.1	88.1	53.3	93.5	146.8	85.2	154.6	239.8	85.1	154.6	239.7	101.0	186.0	287.0	
Tertiary Irrigation System				33.1	3.7	36.8	50.6	5.6	56.2	87.6	9.7	97.3	98.9	11.0	109.9	103.0	11.4	114.4	
Experimental Farm				5.4	0.6	6.0	6.3	0.7	7.0										
Roads				36.5	6.5	43.0	40.8	7.2	48.0	40.8	7.2	48.0	40.8	7.2	48.0	40.8	7.2	48.0	4
Settlement							7.7	3.3	11.0	18.9	8.1	27.0	19.6	8.4	28.0	21.0	9.0	30.0	1
Project Management Infra.	9.8	4.2	14.0	9.8	4.2	14.0	9.8	4.2	14.0	9.8	4.2	14.0	9.8	4.2	14.0	9.8	4.2	14.0	
Agricultural Processing and Services										51.9	55.2	107.1	47.4	54.2	101.6	54.5	58.6	113.1	5
Social Infrastructure				7.0	3.0	10.0	15.4	6.6	22.0	28.7	12.3	41.0	30.1	12.9	43.0	28.7	12.3	41.0	2.
TOTAL L	61.8			266.7			335.5			409.5			331.7			358.8			31
F		153.5			484.8			556.7			500.2			252.5			288.7		
T			215.3			751.5			892.2			909.7			584.2			647.5	

* Further expenditures in 1990 would bring the total cost of this item to Rs145 million, as for Scenario A.

	1985			1986			1987			1988			1989			TOTAL		
T	L	F	T	L	F	T	L	F	T	L	F	T	L	F	T	L	F	T
																433.1	1244.5	1677.6
239.7	101.0	186.0	287.0	79.8	148.6	228.4	47.7	87.7	135.4	47.7	87.7	135.4	47.7	87.7	135.4	579.5	1056.5	1636.0
109.9	103.0	11.4	114.4	93.6	10.4	104.0	58.2	6.5	64.7	53.7	6.0	59.7	36.4	4.1	40.5	615.1	68.4	683.5
																11.7	1.3	13.0
48.0	40.8	7.2	48.0	40.8	7.2	48.0	40.8	7.2	48.0	40.8	7.2	48.0	40.8	7.2	48.0	362.9	64.1	427.0
28.0	21.0	9.0	30.0	16.8	7.2	24.0	16.8	7.2	24.0	14.7	6.3	21.0				115.5	49.5	165.0
14.0	9.8	4.2	14.0	9.8	4.2	14.0	9.8	4.2	14.0	9.8	4.2	14.0	9.8	4.2	14.0	98.0	42.0	140.0
101.6	54.5	58.6	113.1	53.9	55.8	109.7	46.6	51.2	97.8	45.6	47.3	92.9	14.7	9.1	23.8	314.6	331.4	646.0
43.0	28.7	12.3	41.0	24.5	10.5	35.0	21.7	9.3	31.0	14.0	6.0	20.0				170.1	72.9	243.0
584.2	358.8	288.7	647.5	319.2	243.9	563.1	241.6	173.3	414.9	226.3	164.7	391.0	149.4	112.3	261.7	2700.5	2930.6	5631.1

Rs 835 million and their phasing is shown in Tables L-6.1 and L-6.2.

The capital costs of the project management infrastructure total Rs 145 million and are detailed in Annex K (Implementation, Organization and Management).

The agricultural processing and services category includes tractor and thresher hire services, village hullers, collection centers and paddy milling complexes. Requirements for these facilities and services have been discussed in Annex G Agroeconomic Studies and their cost over the 10-yr period are shown below for Scenarios A and B.

	Rs millions	
	Scenario A	Scenario B
Tractor services	268.7	231.2
Thresher services	12.2	11.4
Village hullers	5.6	5.6
Collection centers	22.8	22.8
Milling, drying, storage complexes	375.0	375.0
Totals	684.3	646.0

Tables L-6.1 and L-6.2 show the phasing of these costs over the 10-yr period for Scenarios A and B.

Also included in the financial capital costs of the project is the Experimental Demonstration Farm at a cost of Rs 13 million (see Annex E Agronomic Studies).

Table L-6.3 illustrates a 10-yr summary of annual financial capital costs for Scenarios A and B with local and foreign cost components shown separately. The financial costs shown in Table L-6.3 are in 1979 prices. It is instructive to

TABLE L-6.3

SUMMARY OF ANNUAL COSTS
1979 FINANCIAL PRICES
(million Rs)

	Scenario A	Scenario B
1980 - Local	66.0	61.8
- Foreign	155.3	153.5
- Total	221.2	215.3
1981 - Local	319.2	266.7
- Foreign	512.8	484.8
- Total	832.0	751.5
1982 - Local	475.6	335.5
- Foreign	661.2	556.7
- Total	1,136.8	892.2
1983 - Local	641.6	409.5
- Foreign	688.5	500.2
- Total	1,330.1	909.7
1984 - Local	533.5	331.7
- Foreign	433.6	252.5
- Total	967.1	584.2
1985 - Local	380.6	358.8
- Foreign	300.0	288.7
- Total	680.6	647.5
1986 - Local	276.6	319.2
- Foreign	202.5	243.9
- Total	479.1	563.1
1987 - Local	17.1	241.6
- Foreign	5.4	173.3
- Total	22.5	414.9
1988 - Local	0.6	226.3
- Foreign	2.1	164.7
- Total	2.7	391.0
1989 - Local	0.5	149.4
- Foreign	1.8	112.3
- Total	2.3	261.7

Source: Tables L-6.1 and L-6.2

examine these costs in the light of expected future inflation in both Sri Lanka and the rest of the world. Table L-6.4 shows the local and foreign component expenditure over the next 5 years, assuming an annual rate of domestic inflation of 15 percent* and an annual rate of international inflation of 10 percent.

*A recent IBRD report[15] indicates that inflation accelerated to an annual rate of 32 percent in 1979.

TABLE L-6.4

FINANCIAL COSTS, 1980 to 1984
(Current* prices, Rs millions)

	Scenario A			Scenario B		
	Local	Foreign	Total	Local	Foreign	Total
1980	75.9	170.8	246.7	71.1	168.9	240.0
1981	422.1	620.5	1,042.6	352.7	586.6	939.3
1982	723.3	880.1	1,603.4	510.3	741.0	1,251.3
1983	1,122.2	1,008.0	2,130.2	716.2	732.3	1,448.5
1984	1,073.1	698.3	1,771.4	667.2	406.7	1,073.9
Totals	3,416.6	3,377.7	6,794.3	2,317.5	2,635.5	4,953.0

Notes: Assumes a domestic inflation rate of 15 percent and an international inflation rate of 10 percent.

Refer to Tables L-6.1 and L-6.2 for (1979 currency) costs from 1985 onward.

*Year of expenditure.

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APPENDIX I

ECONOMIC PRICES

ECONOMIC PRICES: DIESEL FUEL

Projected 1990 price[1] CIF Trincomalee	US$ 325.00/metric tonne
Converted to gallons[2]	US$ 1.25/gal
Converted to local currency[3]	Rs 20.00
Plus: overhead and distribution[4]	Rs 0.55
transportation to project[5] area from Trincomalee	Rs 0.92
TOTAL	Rs 21.47/gal

[1]Mid 1979 CPC buying price

[2]1 metric tonne = 260 gal

[3]U.S.$1 = Rs 16

[4]CPC estimated 1978 rate plus 10 percent

[5]CPC rate (115 m at Rs 0.8/gal-mile)

ECONOMIC PRICES: CEMENT

	Rs/metric tonne
CCC midyear price from domestic plants[1]	575.00
Estimated midyear import price[2]	1,440.00
Average price assuming 50/50 split between domestic and import supply	1,008.00
Plus transport:	
1 - Rail	
Domestic - Rail to Manampitiya from plant at Rs 159/m.t.	
Import - Rail to Manampitiya from Trincomalee at Rs 55/m.t.	
Average domestic and import	107.00
2 - Road	
To site including loading and unloading	100.00
TOTAL	Rs 1,215.00
Or Rs 61/50-kg bag	

[1]Based on a retail price of Rs 28.75/bag of 5 kg.

[2]Based on a retail price of Rs 80.00/bag from the Building Materials Corporation, less 10 percent for transport and margin to get an estimated CIF port price.

ECONOMIC PRICES: TWO-WHEEL TRACTOR PER HOUR

	Rs
CIF Colombo price U.S. 1,705[1]	27,280
Local port costs, comissions and transport	7,040
Total capital costs	34,320
Fixed Costs	
Annual Capital Charge[2]	9,521
Shelter	77
Insurance and license	374
Total fixed costs	9,972
or per hour[3]	Rs 6.65
Variable Costs (per hour)	
Fuel[4] (.5 gal)	10.75
Lube -25 percent of fuel	2.70
Operator wages	2.50
Repairs[5]	2.10
Total variable costs	Rs 18.05/hour
Total fixed and variable costs	Rs 24.70/hour

[1]U.S.$1 = Rs 16

[2]CRF (i = 12 percent, n = 5) = .2774

[3]Based on 1,500 h/yr

[4]Fuel at Rs 21.47/gal

[5]Six percent of investment cost per 1,000 h.

ECONOMIC PRICES: UREA (Based on Export)

	U.S.$/tonne
Projected 1990 FOB Colombo Export price[1]	180.00
Conversion to 1979 prices[2]	195.48
	Rs/tonne
Conversion to local currency[3]	3,128
Less: shore handling, harbour dues[4]	83
Economic price at fertilizer plant - Colombo	3,045
Plus: transport from plant to project area[5]	462
marketing fee[6]	372
transport from retail outlet to farm	20
Economic farm-gate price	3,899

[1]FOB W. Europe, IBRD May 1979 in 1978 currency. Colombo export price assumed to be comparable.

[2]1979 Index of International Inflation - 8.6 percent.

[3]U.S.$1 = Rs 16

[4]1978 rate plus 10 percent

[5]248 km at Rs 1.86/ton km

[6]Agrarian Service Department and retail outlet.

ECONOMIC PRICES: MURIATE OF POTASH (M/P)

	U.S.$/tonne
Projected 1990 price[1]	83.00
Freight to Trincomalee	35.00
CIF Trincomalee Import Price	118.00
Conversion to 1979 prices[2]	128.15
	Rs/tonne
Conversion to local currency[3]	2,050
Plus: shore handling, harbour dues[4]	83
Economic price at Tricomalee	2,133
Plus: transport from port to project area[5]	344
marketing fees[6]	152
transport from retail outlet to farm	20
Economic farm-gate price	2,649

[1]FOB Vancouver, IBRD May 1979 in 1978 currency.

[2]1979 Index of International Inflation - 8.6 percent.

[3]U.S.$1 = Rs 16

[4]1978 rate plus 10 percent

[5]185 km at Rs 1.86/ton km

[6]Agrarian Services Department and retail outlet.

ECONOMIC PRICES: TRIPLE SUPER PHOSPHATE (TSP)

	U.S.$/tonne
Projected 1990 price[1]	165.00
Freight to Trincomalee	35.00
CIF Trincomalee Import Price	200.00
Conversion to 1979 Prices[2]	217.20
	Rs/tonne
Conversion to local currency[3]	3,475
Plus: shore handling, harbor dues[4]	83
Economic price at Trincomalee	3,558
Plus: transport from port to project area[5]	344
marketing fee[6]	223
transport from retail outlet to farm	20
Economic farm-gate price	4,145

[1]FOB U.S. Gulf Coast, IBRD May 1979 in 1978 currency.

[2]1979 Index of International Inflation - 8.6 percent.

[3]U.S.$1 = Rs 16

[4]1978 rate plus 10 percent

[5]185 km at Rs 1.86/ton km

[6]Agrarian Service Department and retail outlet.

ECONOMIC PRICES: DIAMMONIUM PHOSPHATE (DAP)

	U.S.$/tonne
Projected 1990 price[1]	230.00
Freight to Trincomalee	35.00
CIF Trincomalee Import Price	265.00
Conversion to 1979 prices[2]	287.80
	Rs/tonne
Conversion to local currency[3]	4,605
Plus: shore handling, harbor dues[4]	83
Economic price at Trincomalee	4,688
Plus: transport from port to project area[5]	344
marketing fees[6]	279
transport from retail outlet to farm	20
Economic farm-gate price	5,331

[1]FOB U.S. Gulf Coast, IBRD May 1979 in 1978 currency

[2]1979 Index of International Inflation - 8.6 percent

[3]U.S.$1 = Rs 16

[4]1978 rate plus 10 percent

[5]185 km at Rs 1.86/ton km

[6]Agrarian Services Department and retail outlet

ECONOMIC PRICES: PADDY
Based on Import Substitution

	U.S.$/tonne
Projected 1990 price[1]	306.32
Freight to Colombo	16.00
CIF Colombo Import Price	322.32
Conversion to 1979 prices[2]	350.04
	Rs/tonne
Conversion to local currency[3]	5,601
Plus shore handling, harbor dues[4]	83
Economic Price at Colombo	5,684
Conversion to Paddy Basis[5]	3,865
Less: milling and storage costs[6]	378
transport from farm gate to mill	20
Economic farm-gate price	3,467

[1]FOB Bangkok, IBRD May 1979, adjusted to "Thai 25 to 35 percent broken" expressed in 1978 currency

[2]1979 Index of International Inflation - 8.6 percent

[3]U.S.$1 = Rs 16

[4]1978 rate plus 10 percent

[5]Converted at 68 percent

[6]PMB 1978 milling and storage rates adjusted to 1979 levels.

ECONOMIC PRICES: COTTON
Based on Import Substitution

	U.S.$/tonne
Projected 1990 price[1] - CIF Colombo-Lint	1,853.00
Conversion to 1979 prices[2]	2,012.00
	Rs/tonne
Conversion to local currency[3]	32,192
Plus shore handling, harbor dues[4]	83
Economic price at Colombo	32,275
	U.S.$/tonne
Projected 1990 price[1] - CIF Colombo-Seed	232
Conversion to 1979 prices[2]	242
	Rs/tonne
Conversion to local currency[3]	3,872
Plus shore handling, harbor dues[4]	83
Economic price at Colombo	3,955

3 tonnes seed cotton = 1 ton lint + 2 tonnes of seed
therefore economic price of seed cotton
= 1/3 (32,275) + 2/3 (3,955) = 13,392 tonne.

Economic price	13,392
Less ginnery cost	293
Transport and storage	88
Economic farm-gate price	13,011

[1]CIF Europe, IBRD May 1979 in 1978 currency

[2]1979 Index of International Inflation - 8.6 percent

[3]U.S.$1 = Rs 16

[4]1978 rate plus 10 percent

ECONOMIC PRICES: SUGAR
Based on Import Substitution

	U.S.$/tonne
Projected 1990 price[1]	311.10
Plus freight to Colombo	15.00
CIF Colombo Import price	326.10
Conversion to 1979 prices[2]	354.14
	Rs/tonne
Conversion to local prices[3]	5,666
Plus shore handling, harbor dues[4]	83
Economic price at Colombo	5,749
Conversion to cane equivalent[5]	529
Less: capital and operating costs of mill[6]	280
transport to mill	20
Economic farm-gate price (cane)	229

[1]FOB Caribbean port, IBRD May 1979 in 1978 currency

[2]Index of International Inflation - 8.6 percent

[3]U.S.$1 = Rs 16

[4]1978 rate plus 10 percent

[5]At 9.2 percent yield

[6]Estimated

ECONOMIC PRICES: TOBACCO
Based on Exports

	U.S.$/tonne
Projected 1990 FOB Trincomalee Export Price[1]	2,130.10
Conversion to 1979 prices[2]	2,313.29
	Rs/tonne
Conversion to local currency[3]	37,013
Less: shore handling, harbor dues[4]	83
transport from project area to port[5]	344
cost of curing per tonne of cured leaf[6]	4,192
Economic price, project area, cured leaf	32,394
Conversion to green leaf[7]	3,239
Less: transport to barn[8]	164
Ceylon Tobacco Corp. supervision commission[9]	461
Quality correction in relation to Indian flue-cured leaf - 75 percent[10]	1,961

[1]Indian flue-cured leaf, FOB price, IBRD May 1979 in 1978 currency

[2]1979 Index of International Inflation - 8.6 percent

[3]U.S.$1 = Rs 16

[4]1978 rate plus 10 percent

[5]185 km at Rs 1.86/ton km

[6]Ceylon Tobacco Co. - 1978 rate plus 10 percent

[7]At 10 percent (1 kg of cured leaf per 10 kg of green leaf)

[8]NEDECO estimate

[9]At 15 percent

[10]Estimate

ECONOMIC PRICES: GROUNDNUTS
Based on Export

	U.S.$/tonne
Projected 1990 price[1]	518.00
Less freight from Colombo	27.00
FOB Colombo export price	491.00
Conversion to 1979 price[2]	533.23
	Rs/tonne
Conversion to local currency[3]	8,532
Conversion to unshelled - at 75 percent	6,399
Less: shore handling, harbor dues[4]	83
transport from farm-gate to port[5]	344
storage, handling, commissions[6]	400
Economic farm-gate price	5,572

[1]CIF Europe, IBRD May 1979, in 1978 currency

[2]1979 Index of International Inflation - 8.6 percent

[3]U.S.$1 = Rs 16

[4]1978 rate plus 10 percent

[5]185 km at Rs 1.86/ton km

[6]Estimate

ECONOMIC PRICES: SOYBEANS
Based on Export

	U.S.$/tonne
Projected 1990 price[1]	370.60
Less freight to Colombo	27.00
FOB Colombo export price	343.60
Conversion to 1979 prices[2]	373.15
	Rs/tonne
Conversion to local currency[3]	5,970
Less: shore handling, harbor dues[4]	83
transport from farm gate to port[5]	344
storage, handling and commissions[6]	400
Economic farm-gate price	5,143

[1]CIF Europe, IBRD May 1979, in 1978 currency

[2]1979 Index of International Inflation - 8.6 percent

[3]U.S.$1 = Rs 16

[4]1978 rate plus 10 percent

[5]185 km at Rs 1.86/ton km

[6]Estimate

ECONOMIC PRICES: MAIZE
Based on Export

	U.S.$/tonne
Projected 1990 price[1]	170.00
Less freight to Colombo	20.00
FOB Colombo price	150.00
Conversion to 1979 prices[2]	162.90
	Rs/tonne
Conversion to local currency[3]	2,606
Less: shore handling, harbor dues[4]	83
transport farm gate to port[5]	344
storage, handling/commissions[6]	175
Economic farm-gate price	2,004

[1]Estimated CIF Japan price based on IBRD May 1979 in 1978 currency

[2]1979 Index of International Inflation - 8.6 percent

[3]U.S.$1 = Rs 16

[4]1978 rate plus 10 percent

[5]185 km at Rs 1.86/ton km

[6]Estimate

ECONOMIC PRICES: SORGHUM
Based on Export

	U.S.$/tonne
Projected 1990 price[1]	150.00
Less freight to Colombo	20.00
FOB Colombo price	130.00
Conversion to 1979 prices[2]	141.18
	Rs/tonne
Conversion to local currency[3]	2,259
Less: shore handling, harbor dues[4]	83
transport farm gate to port[5]	344
storage, handling, commissions[6]	175
Economic farm-gate price	1,657

[1]Estimated CIF Japan price based on IBRD May 1979 in 1978 currency

[2]1979 Index of International Inflation - 8.6 percent

[3]U.S.$1 = Rs 16

[4]1978 rate plus 10 percent

[5]185 km at Rs 1.86/ton km.

[6]Estimate.

ECONOMIC PRICES: CASSAVA CHIPS
Based on Export

	U.S.$/tonne
Projected 1990 price of maize[1]	150.00
Equivalent cassava chip/pellet price,[2] FOB Colombo	120.00
Conversion to 1979 prices[3]	130.00
	Rs/tonne
Conversion to local currency[4]	2,085
Less: shore handling, harbor dues[5]	83
transport, farm gate to port[6]	344
storage, handling, pelletizing and commissions[7]	165
Economic farm-gate price	1,493

[1]FOB Colombo price based on IBRD May 1979 in 1978 currency

[2]Value of cassava chips/pellets is forecast at about 80 percent of the value of maize

[3]1979 Index of International Inflation - 8.6 percent

[4]U.S.$1 = Rs 16

[5]1978 rate plus 10 percent

[6]185 km at Rs 1.86/ton km

[7]Estimate

ECONOMIC PRICES: LIMES
Based on Export

	U.S.$/tonne
Projected 1990 price[1]	322.40
Freight to Colombo	27.00
FOB Colombo export price	295.40
Conversion to 1979 prices[2]	320.80
	Rs/tonne
Conversion to local currency[3]	5,133
Less: shore handling, harbor dues[4]	33
transport, farm gate to port[5]	344
storage, handling, commissions[6]	228
Economic farm-gate price	4,478

[1]EEC Reference Price, IBRD May 1979 in 1978 currency

[2]1979 Index of International Inflation - 8.6 percent

[3]U.S.$1 = Rs 16

[4]1978 rate plus 10 percent

[5]185 km at Rs 1.86/ton km

[6]Estimate

APPENDIX II

PROJECT IRR CALCULATIONS

1 - SCENARIO A - MEDIUM YIELDS (BASE CASE)

MADURU OYA PROJECT - AGRICULTURAL BENEFITS

	PRODUCTION (TONNES)					NET ECONOMIC RETURNS (000 RP)				
YEAR	1R	2R	2U	TOTAL	TOTAL PADDY	1R	2R	2U	TOTAL	TOTAL PADDY
1980	-	-	-	-	-	-	-	-	-	-
1981	-	-	-	-	-	-	-	-	-	-
1982	-	-	-	-	-	-	-	-	-	-
1983	-	-	-	-	-	-	-	-	-	-
1984	19,955	12,408	-	32,363	32,363	45,759	26,676	-	72,435	72,435
1985	43,480	42,449	-	85,929	85,929	99,704	91,262	-	190,966	190,966
1986	65,604	76,676	1,554	143,833	142,279	150,435	164,847	4,737	320,019	315,282
1987	92,689	106,467	2,456	201,612	199,156	212,544	228,887	7,531	448,972	441,441
1988	107,478	122,352	2,869	232,699	229,830	246,457	263,048	8,813	518,317	509,504
1989	115,698	133,559	3,076	252,333	249,257	265,305	287,142	9,450	561,897	552,447
1990	120,392	139,639	3,457	263,488	260,031	276,070	300,214	10,620	586,803	576,294
1991	122,864	141,875	3,698	268,438	264,740	281,739	305,022	11,361	598,121	586,760
1992	122,864	141,875	3,906	268,645	264,740	281,739	305,022	11,997	598,758	586,760
1993	122,864	141,875	4,113	268,853	264,740	281,739	305,022	12,634	599,395	586,760
1994	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
1995	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
1996	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
1997	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
1998	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
1999	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2000	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2001	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2002	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2003	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2004	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2005	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2006	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2007	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2008	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2009	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2010	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2011	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2012	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2013	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2014	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2015	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2016	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2017	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2018	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2019	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760

1 - SCENARIO A - MEDIUM YIELDS (BASE CASE)

MADURU OYA PROJECT - TOTAL PROJECT BENEFITS

(MILLION RPS)

YEAR	WITHOUT PROJECT	PADDY UNDER PROJECT ST/RF	PIMB/VAK	NEW AREA	UPLAND CROPS	NET AGRIC BENEFITS	HOME-STEAD	LIVE-STOCK	FISHERY	FORESTRY	POWER	TOTAL BENEFITS
1980	79.0	38.0	41.0	-	-	-	-	-	-	-	-	-
1981	79.0	38.0	41.0	-	-	-	-	-	-	8.0	-	8.0
1982	79.0	38.0	41.0	-	-	-	-	-	-	8.0	-	8.0
1983	79.0	34.0	41.0	-	-	-4.0	-	-	-	8.0	-	4.0
1984	79.0	26.0	67.0	72.4	-	86.4	16.0	-10.0	-1.0	8.0	19.0	118.4
1985	79.0	6.0	74.0	191.0	-	192.0	37.0	-12.0	-1.0	8.0	19.0	243.0
1986	79.0	-	81.0	315.3	4.7	322.0	52.0	-5.0	-1.0	-2.0	19.0	385.0
1987	79.0	-	80.0	441.4	7.5	460.0	64.0	-	1.0	-2.0	19.0	542.0
1988	79.0	-	92.0	509.5	8.8	531.3	64.0	11.0	1.0	9.0	19.0	635.3
1989	79.0	-	92.0	552.4	9.4	574.9	64.0	13.0	2.0	9.0	19.0	681.9
1990	79.0	-	92.0	576.3	10.6	599.0	64.0	16.0	2.0	9.0	19.0	709.9
1991	79.0	-	92.0	586.8	11.4	611.1	64.0	19.0	2.0	9.0	19.0	724.1
1992	79.0	-	92.0	586.8	12.0	611.8	64.0	22.0	2.0	9.0	19.0	727.8
1993	79.0	-	92.0	586.8	12.6	612.4	64.0	24.0	2.0	9.0	19.0	730.4
1994	79.0	-	92.0	586.8	12.7	612.5	64.0	27.0	2.0	9.0	19.0	733.5
1995	79.0	-	92.0	586.8	12.7	612.5	64.0	31.0	2.0	7.0	19.0	735.5
1996	79.0	-	92.0	586.8	12.7	612.5	64.0	32.0	2.0	7.0	19.0	736.5
1997	79.0	-	92.0	586.8	12.7	612.5	64.0	35.0	2.0	7.0	19.0	739.5
1998	79.0	-	92.0	586.8	12.7	612.5	64.0	37.0	2.0	7.0	19.0	741.5
1999	79.0	-	92.0	586.8	12.7	612.5	64.0	38.0	2.0	7.0	19.0	742.5
2000	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	7.0	19.0	743.5
2001	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	7.0	19.0	743.5
2002	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	9.0	19.0	745.5
2003	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	9.0	19.0	745.5
2004	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	9.0	19.0	745.5
2005	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	9.0	19.0	745.5
2006	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	9.0	19.0	745.5
2007	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	9.0	19.0	745.5
2008	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	9.0	19.0	745.5
2009	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	9.0	19.0	745.5
2010	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	7.0	19.0	743.5
2011	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	7.0	19.0	743.5
2012	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	7.0	19.0	743.5
2013	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	7.0	19.0	743.5
2014	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	7.0	19.0	743.5
2015	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	7.0	19.0	743.5
2016	79.0		92.0	586.8	12.7	612.5	64.0	39.0	2.0	9.0	19.0	745.5
2017	7[illegible]		[illegible].0	586.8	12.7	612.5	64.0	39.0	2.0	9.0	19.0	745.5
2018	7[illegible]		[illegible].0	586.8	12.7	612.5	64.0	39.0	2.0	9.0	19.0	745.5
2019	7[illegible]		[illegible]2.0	586.8	12.7	612.5	64.0	39.0	2.0	9.0	19.0	745.5

1 - SCENARIO A - MEDIUM YIELDS (BASE CASE)

MADURU OYA PROJECT - TOTAL PROJECT COSTS

(MILLION RPS)

YEAR	DAM AND TUNNEL	BRANCH CANALS	TERTIARY IRRIG.	UPSTREAM COSTS	EXPER FARM	ACCESS ROADS	SETTLE-MENT	PROJ MGT INFRA.	SUB TOTAL	O AND M	TOTAL COSTS
1980	204.3	-	-	18.0	-	-	-	20.0	242.3	-	242.3
1981	562.0	122.6	49.3	49.0	6.0	51.0	-	20.0	859.9	1.0	860.9
1982	596.0	292.4	124.8	53.0	7.0	52.0	24.0	20.0	1,169.2	4.0	1,173.2
1983	340.6	457.4	206.4	30.0	-	52.0	44.0	20.0	1,150.4	5.0	1,155.4
1984	-	410.6	171.8	-	-	52.0	46.0	20.0	700.4	25.0	725.4
1985	-	251.8	96.1	-	-	52.0	42.0	20.0	461.9	36.0	497.9
1986	-	177.3	75.7	-	-	52.0	9.0	20.0	334.0	49.0	383.0
1987	-	-	15.5	-	-	-	-	5.0	20.5	61.0	81.5
1988	-	-	-	-	-	-	-	-	-	61.0	61.0
1989	-	-	-	-	-	-	-	-	-	61.0	61.0
1990	-	-	-	-	-	-	-	-	-	61.0	61.0
1991	-	-	-	-	-	-	-	-	-	61.0	61.0
1992	-	-	-	-	-	-	-	-	-	61.0	61.0
1993	-	-	-	-	-	-	-	-	-	61.0	61.0
1994	-	-	-	-	-	-	-	-	-	61.0	61.0
1995	-	-	-	-	-	-	-	-	-	61.0	61.0
1996	-	-	-	-	-	-	-	-	-	61.0	61.0
1997	-	-	-	-	-	-	-	-	-	61.0	61.0
1998	-	-	-	-	-	-	-	-	-	61.0	61.0
1999	-	-	-	-	-	-	-	-	-	61.0	61.0
2000	-	-	-	-	-	-	-	-	-	61.0	61.0
2001	-	-	-	-	-	-	-	-	-	61.0	61.0
2002	-	-	-	-	-	-	-	-	-	61.0	61.0
2003	-	-	-	-	-	-	-	-	-	61.0	61.0
2004	-	-	-	-	-	-	-	-	-	61.0	61.0
2005	-	-	-	-	-	-	-	-	-	61.0	61.0
2006	-	-	-	-	-	-	-	-	-	61.0	61.0
2007	-	-	-	-	-	-	-	-	-	61.0	61.0
2008	-	-	-	-	-	-	-	-	-	61.0	61.0
2009	-	-	-	-	-	-	-	-	-	61.0	61.0
2010	-	-	-	-	-	-	-	-	-	61.0	61.0
2011	-	-	-	-	-	-	-	-	-	61.0	61.0
2012	-	-	-	-	-	-	-	-	-	61.0	61.0
2013	-	-	-	-	-	-	-	-	-	61.0	61.0
2014	-	-	-	-	-	-	-	-	-	61.0	61.0
2015	-	-	-	-	-	-	-	-	-	61.0	61.0
2016	-	-	-	-	-	-	-	-	-	61.0	61.0
2017	-	-	-	-	-	-	-	-	-	61.0	61.0
2018	-	-	-	-	-	-	-	-	-	61.0	61.0
2019	-	-	-	-	-	-	-	-	-	61.0	61.0

1 - SCENARIO A - MEDIUM YIELDS (BASE CASE)

MADURU OYA PROJECT - NET BENEFITS

(MILLION RPS)

YEAR	TOTAL BENEFITS	TOTAL COSTS	NET BENEFITS
1980	-	242.3	-242.3
1981	8.0	860.9	-852.9
1982	8.0	1,173.2	-1,165.2
1983	4.0	1,155.4	-1,151.4
1984	118.4	725.4	-607.0
1985	243.0	497.9	-254.9
1986	385.0	383.0	2.0
1987	542.0	81.5	460.5
1988	635.3	61.0	574.3
1989	681.9	61.0	620.9
1990	709.9	61.0	648.9
1991	724.1	61.0	663.1
1992	727.8	61.0	666.8
1993	730.4	61.0	669.4
1994	733.5	61.0	672.5
1995	735.5	61.0	674.5
1996	736.5	61.0	675.5
1997	739.5	61.0	678.5
1998	741.5	61.0	680.5
1999	742.5	61.0	681.5
2000	743.5	61.0	682.5
2001	743.5	61.0	682.5
2002	745.5	61.0	684.5
2003	745.5	61.0	684.5
2004	745.5	61.0	684.5
2005	745.5	61.0	684.5
2006	745.5	61.0	684.5
2007	745.5	61.0	684.5
2008	745.5	61.0	684.5
2009	743.5	61.0	682.5
2010	743.5	61.0	682.5
2011	743.5	61.0	682.5
2012	743.5	61.0	682.5
2013	743.5	61.0	682.5
2014	743.5	61.0	682.5
2015	743.5	61.0	682.5
2016	745.5	61.0	684.5
2017	745.5	61.0	684.5
2018	745.5	61.0	684.5
2019	745.5	61.0	684.5

INTERNAL RATE OF RETURN: 0.1010342918

2 - SCENARIO A - HIGHER YIELDS (+10% FROM BASE CASE)

MADURU OYA PROJECT - AGRICULTURAL BENEFITS

	PRODUCTION (TONNES)					NET ECONOMIC RETURNS (000 RP)				
YEAR	1R	2R	2U	TOTAL	TOTAL PADDY	1R	2R	2U	TOTAL	TOTAL PADDY
1980	-	-	-	-	-	-	-	-	-	-
1981	-	-	-	-	-	-	-	-	-	-
1982	-	-	-	-	-	-	-	-	-	-
1983	-	-	-	-	-	-	-	-	-	-
1984	22,124	13,619	-	35,743	35,743	53,279	30,873	-	84,152	84,152
1985	48,206	46,590	-	94,796	94,796	116,089	105,620	-	221,709	221,709
1986	72,734	84,156	1,554	158,444	156,891	175,157	190,782	4,737	370,677	365,939
1987	102,764	116,854	2,456	222,074	219,618	247,473	264,908	7,531	519,913	512,382
1988	119,161	134,289	2,869	256,318	253,449	286,960	304,432	8,813	600,205	591,392
1989	128,274	146,589	3,076	277,939	274,863	308,906	332,318	9,450	650,673	641,223
1990	133,478	153,262	3,457	290,198	286,741	321,433	347,446	10,620	679,505	668,885
1991	136,219	155,717	3,698	295,634	291,936	328,040	353,010	11,361	692,410	681,050
1992	136,219	155,717	3,906	295,842	291,936	328,040	353,010	11,997	693,047	681,050
1993	136,219	155,717	4,113	296,049	291,936	328,040	353,010	12,634	693,684	681,050
1994	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
1995	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
1996	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
1997	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
1998	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
1999	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
2000	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
2001	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
2002	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
2003	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
2004	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
2005	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
2006	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
2007	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
2008	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
2009	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
2010	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
2011	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
2012	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
2013	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
2014	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
2015	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
2016	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
2017	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
2018	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
2019	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050

2 - SCENARIO A - HIGHER YIELDS (+10% FROM BASE CASE)

MADURU OYA PROJECT - TOTAL PROJECT BENEFITS

(MILLION RPS)

YEAR	WITHOUT PROJECT	PADDY UNDER PROJECT ST/RF	PIMB/YAK	NEW AREA	UPLAND CROPS	NET AGRIC BENEFITS	HOME-STEAD	LIVE-STOCK	FISHERY	FORESTRY	POWER	TOTAL BENEFITS
1980	79.0	38.0	41.0	-	-	-	-	-	-	-	-	-
1981	79.0	38.0	41.0	-	-	-	-	-	-	8.0	-	8.0
1982	79.0	38.0	41.0	-	-	-	-	-	-	8.0	-	8.0
1983	79.0	34.0	41.0	-	-	-4.0	-	-	-	8.0	-	4.0
1984	79.0	26.0	70.0	84.2	-	101.2	16.0	-10.0	-1.0	8.0	19.0	133.2
1985	79.0	6.0	81.0	221.7	-	229.7	37.0	-12.0	-1.0	8.0	19.0	280.7
1986	79.0	-	91.0	365.9	4.7	382.7	52.0	-5.0	-1.0	-2.0	19.0	445.7
1987	79.0	-	101.0	512.4	7.5	541.9	64.0	-	1.0	-2.0	19.0	623.9
1988	79.0	-	110.0	591.4	8.8	631.2	64.0	11.0	1.0	9.0	19.0	735.2
1989	79.0	-	110.0	641.2	9.4	681.7	64.0	13.0	2.0	9.0	19.0	788.7
1990	79.0	-	110.0	668.9	10.6	710.5	64.0	16.0	2.0	9.0	19.0	820.5
1991	79.0	-	110.0	681.0	11.4	723.4	64.0	19.0	2.0	9.0	19.0	836.4
1992	79.0	-	110.0	681.0	12.0	724.0	64.0	22.0	2.0	9.0	19.0	840.0
1993	79.0	-	110.0	681.0	12.6	724.7	64.0	24.0	2.0	9.0	19.0	842.7
1994	79.0	-	110.0	681.0	12.7	724.8	64.0	27.0	2.0	9.0	19.0	845.8
1995	79.0	-	110.0	681.0	12.7	724.8	64.0	31.0	2.0	7.0	19.0	847.8
1996	79.0	-	110.0	681.0	12.7	724.8	64.0	32.0	2.0	7.0	19.0	848.8
1997	79.0	-	110.0	681.0	12.7	724.8	64.0	35.0	2.0	7.0	19.0	851.8
1998	79.0	-	110.0	681.0	12.7	724.8	64.0	37.0	2.0	7.0	19.0	853.8
1999	79.0	-	110.0	681.0	12.7	724.8	64.0	38.0	2.0	7.0	19.0	854.8
2000	79.0	-	110.0	681.0	12.7	724.8	64.0	39.0	2.0	7.0	19.0	855.8
2001	79.0	-	110.0	681.0	12.7	724.8	64.0	39.0	2.0	7.0	19.0	855.8
2002	79.0	-	110.0	681.0	12.7	724.8	64.0	39.0	2.0	9.0	19.0	857.8
2003	79.0	-	110.0	681.0	12.7	724.8	64.0	39.0	2.0	9.0	19.0	857.8
2004	79.0	-	110.0	681.0	12.7	724.8	64.0	39.0	2.0	9.0	19.0	857.8
2005	79.0	-	110.0	681.0	12.7	724.8	64.0	39.0	2.0	9.0	19.0	857.8
2006	79.0	-	110.0	681.0	12.7	724.8	64.0	39.0	2.0	9.0	19.0	857.8
2007	79.0	-	110.0	681.0	12.7	724.8	64.0	39.0	2.0	9.0	19.0	857.8
2008	79.0	-	110.0	681.0	12.7	724.8	64.0	39.0	2.0	9.0	19.0	857.8
2009	79.0	-	110.0	681.0	12.7	724.8	64.0	39.0	2.0	7.0	19.0	855.8
2010	79.0	-	110.0	681.0	12.7	724.8	64.0	39.0	2.0	7.0	19.0	855.8
2011	79.0	-	110.0	681.0	12.7	724.8	64.0	39.0	2.0	7.0	19.0	855.8
2012	79.0	-	110.0	681.0	12.7	724.8	64.0	39.0	2.0	7.0	19.0	855.8
2013	79.0	-	110.0	681.0	12.7	724.8	64.0	39.0	2.0	7.0	19.0	855.8
2014	79.0	-	110.0	681.0	12.7	724.8	64.0	39.0	2.0	7.0	19.0	855.8
2015	79.0	-	110.0	681.0	12.7	724.8	64.0	39.0	2.0	9.0	19.0	857.8
2016	79.0	-	110.0	681.0	12.7	724.8	64.0	39.0	2.0	9.0	19.0	857.8
2017	79.0	-	110.0	681.0	12.7	724.8	64.0	39.0	2.0	9.0	19.0	857.8
2018	79.0	-	110.0	681.0	12.7	724.8	64.0	39.0	2.0	9.0	19.0	857.8
2019	79.0	-	110.0	681.0	12.7	724.8	64.0	39.0	2.0	9.0	19.0	857.8

2 - SCENARIO A - HIGHER YIELDS (+10% FROM BASE CASE)

MADURU OYA PROJECT - TOTAL PROJECT COSTS

(MILLION RPS)

YEAR	DAM AND TUNNEL	BRANCH CANALS	TERTIARY IRRIG.	UPSTREAM COSTS	EXPER FARM	ACCESS ROADS	SETTLE-MENT	PROJ MGT INFRA.	SUB TOTAL	O AND M	TOTAL COSTS
1980	204.3	-	-	18.0	-	-	-	20.0	242.3	-	242.3
1981	562.0	122.6	49.3	49.0	6.0	51.0	-	20.0	859.9	1.0	860.9
1982	596.0	292.4	124.8	53.0	7.0	52.0	24.0	20.0	1,169.2	4.0	1,173.2
1983	340.6	457.4	206.4	30.0	-	52.0	44.0	20.0	1,150.4	5.0	1,155.4
1984	-	410.6	171.8	-	-	52.0	46.0	20.0	700.4	25.0	725.4
1985	-	251.8	96.1	-	-	52.0	42.0	20.0	461.9	36.0	497.9
1986	-	177.3	75.7	-	-	52.0	9.0	20.0	334.0	49.0	383.0
1987	-	-	15.5	-	-	-	-	5.0	20.5	61.0	81.5
1988	-	-	-	-	-	-	-	-	-	61.0	61.0
1989	-	-	-	-	-	-	-	-	-	61.0	61.0
1990	-	-	-	-	-	-	-	-	-	61.0	61.0
1991	-	-	-	-	-	-	-	-	-	61.0	61.0
1992	-	-	-	-	-	-	-	-	-	61.0	61.0
1993	-	-	-	-	-	-	-	-	-	61.0	61.0
1994	-	-	-	-	-	-	-	-	-	61.0	61.0
1995	-	-	-	-	-	-	-	-	-	61.0	61.0
1996	-	-	-	-	-	-	-	-	-	61.0	61.0
1997	-	-	-	-	-	-	-	-	-	61.0	61.0
1998	-	-	-	-	-	-	-	-	-	61.0	61.0
1999	-	-	-	-	-	-	-	-	-	61.0	61.0
2000	-	-	-	-	-	-	-	-	-	61.0	61.0
2001	-	-	-	-	-	-	-	-	-	61.0	61.0
2002	-	-	-	-	-	-	-	-	-	61.0	61.0
2003	-	-	-	-	-	-	-	-	-	61.0	61.0
2004	-	-	-	-	-	-	-	-	-	61.0	61.0
2005	-	-	-	-	-	-	-	-	-	61.0	61.0
2006	-	-	-	-	-	-	-	-	-	61.0	61.0
2007	-	-	-	-	-	-	-	-	-	61.0	61.0
2008	-	-	-	-	-	-	-	-	-	61.0	61.0
2009	-	-	-	-	-	-	-	-	-	61.0	61.0
2010	-	-	-	-	-	-	-	-	-	61.0	61.0
2011	-	-	-	-	-	-	-	-	-	61.0	61.0
2012	-	-	-	-	-	-	-	-	-	61.0	61.0
2013	-	-	-	-	-	-	-	-	-	61.0	61.0
2014	-	-	-	-	-	-	-	-	-	61.0	61.0
2015	-	-	-	-	-	-	-	-	-	61.0	61.0
2016	-	-	-	-	-	-	-	-	-	61.0	61.0
2017	-	-	-	-	-	-	-	-	-	61.0	61.0
2018	-	-	-	-	-	-	-	-	-	61.0	61.0
2019	-	-	-	-	-	-	-	-	-	61.0	61.0

2 - SCENARIO A - HIGHER YIELDS (+10% FROM BASE CASE)

MADURU OYA PROJECT - NET BENEFITS

(MILLION RPS)

YEAR	TOTAL BENEFITS	TOTAL COSTS	NET BENEFITS
1980	-	242.3	-242.3
1981	8.0	860.9	-852.9
1982	8.0	1,173.2	-1,165.2
1983	4.0	1,155.4	-1,151.4
1984	133.2	725.4	-592.2
1985	280.7	497.9	-217.2
1986	445.7	383.0	62.7
1987	623.9	81.5	542.4
1988	735.2	61.0	674.2
1989	788.7	61.0	727.7
1990	820.5	61.0	759.5
1991	836.4	61.0	775.4
1992	840.0	61.0	779.0
1993	842.7	61.0	781.7
1994	845.8	61.0	784.8
1995	847.8	61.0	786.8
1996	848.8	61.0	787.8
1997	851.8	61.0	790.8
1998	853.8	61.0	792.8
1999	854.8	61.0	793.8
2000	855.8	61.0	794.8
2001	855.8	61.0	794.8
2002	857.8	61.0	796.8
2003	857.8	61.0	796.8
2004	857.8	61.0	796.8
2005	857.8	61.0	796.8
2006	857.8	61.0	796.8
2007	857.8	61.0	796.8
2008	857.8	61.0	796.8
2009	855.8	61.0	794.8
2010	855.8	61.0	794.8
2011	855.8	61.0	794.8
2012	855.8	61.0	794.8
2013	855.8	61.0	794.8
2014	855.8	61.0	794.8
2015	855.8	61.0	794.8
2016	857.8	61.0	796.8
2017	857.8	61.0	796.8
2018	857.8	61.0	796.8
2019	857.8	61.0	796.8

INTERNAL RATE OF RETURN: 0.1155892281

3 - SCENARIO A - LOWER YIELDS (-10% FROM BASE CASE)

MADURU OYA PROJECT - AGRICULTURAL BENEFITS

	PRODUCTION (TONNES)					NET ECONOMIC RETURNS (000 RP)				
YEAR	1R	2R	2U	TOTAL	TOTAL PADDY	1R	2R	2U	TOTAL	TOTAL PADDY
1980	-	-	-	-	-	-	-	-	-	-
1981	-	-	-	-	-	-	-	-	-	-
1982	-	-	-	-	-	-	-	-	-	-
1983	-	-	-	-	-	-	-	-	-	-
1984	17,786	11,198	-	28,983	28,983	38,239	22,479	-	60,718	60,718
1985	38,754	38,307	-	77,062	77,062	83,319	76,904	-	160,222	160,222
1986	58,473	69,195	1,554	129,222	127,668	125,712	138,912	4,737	269,361	264,624
1987	82,614	96,080	2,456	181,150	178,694	177,614	192,885	7,531	378,030	370,499
1988	95,796	110,415	2,869	209,080	206,211	205,954	221,663	8,813	436,429	427,617
1989	103,122	120,529	3,076	226,727	223,651	221,705	241,967	9,450	473,121	463,671
1990	107,306	126,016	3,457	236,779	233,322	230,700	252,982	10,620	494,302	483,682
1991	109,509	128,034	3,698	241,242	237,543	235,437	257,033	11,361	503,831	492,471
1992	109,509	128,034	3,906	241,449	237,543	235,437	257,033	11,997	504,468	492,471
1993	109,509	128,034	4,113	241,656	237,543	235,437	257,033	12,634	505,105	492,471
1994	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
1995	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
1996	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
1997	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
1998	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
1999	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
2000	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
2001	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
2002	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
2003	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
2004	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
2005	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
2006	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
2007	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
2008	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
2009	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
2010	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
2011	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
2012	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
2013	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
2014	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
2015	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
2016	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
2017	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
2018	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
2019	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471

3 - SCENARIO A - LOWER YIELDS (-10% FROM BASE CASE)

MADURU OYA PROJECT - TOTAL PROJECT BENEFITS

(MILLION RPS)

YEAR	WITHOUT PROJECT	PADDY UNDER PROJECT ST/RP	PIMB/VAK	NEW AREA	UPLAND CROPS	NET AGRIC BENEFITS	HOME-STEAD	LIVE-STOCK	FISHERY	FORESTRY	POWER	TOTAL BENEFITS
1980	79.0	38.0	41.0	-	-	-	-	-	-	-	-	-
1981	79.0	38.0	41.0	-	-	-	-	-	-	8.0	-	8.0
1982	79.0	38.0	41.0	-	-	-	-	-	-	8.0	-	8.0
1983	79.0	34.0	41.0	-	-	-4.0	-	-	-	8.0	-	4.0
1984	79.0	26.0	65.0	60.7	-	72.7	16.0	-10.0	-1.0	8.0	19.0	104.7
1985	79.0	6.0	69.0	160.2	-	156.2	37.0	-12.0	-1.0	8.0	19.0	207.2
1986	79.0	-	74.0	264.6	4.7	264.4	52.0	-5.0	-1.0	-2.0	19.0	327.4
1987	79.0	-	78.0	370.5	7.5	377.0	64.0	-	1.0	-2.0	19.0	459.0
1988	79.0	-	83.0	427.6	8.8	440.4	64.0	11.0	1.0	9.0	19.0	544.4
1989	79.0	-	83.0	463.7	9.4	477.1	64.0	13.0	2.0	9.0	19.0	584.1
1990	79.0	-	83.0	483.7	10.6	498.3	64.0	16.0	2.0	9.0	19.0	608.3
1991	79.0	-	83.0	492.5	11.4	507.8	64.0	19.0	2.0	9.0	19.0	620.8
1992	79.0	-	83.0	492.5	12.0	508.5	64.0	22.0	2.0	9.0	19.0	624.5
1993	79.0	-	83.0	492.5	12.6	509.1	64.0	24.0	2.0	9.0	19.0	627.1
1994	79.0	-	83.0	492.5	12.7	509.2	64.0	27.0	2.0	9.0	19.0	630.2
1995	79.0	-	83.0	492.5	12.7	509.2	64.0	31.0	2.0	7.0	19.0	632.2
1996	79.0	-	83.0	492.5	12.7	509.2	64.0	32.0	2.0	7.0	19.0	633.2
1997	79.0	-	83.0	492.5	12.7	509.2	64.0	35.0	2.0	7.0	19.0	636.2
1998	79.0	-	83.0	492.5	12.7	509.2	64.0	37.0	2.0	7.0	19.0	638.2
1999	79.0	-	83.0	492.5	12.7	509.2	64.0	38.0	2.0	7.0	19.0	639.2
2000	79.0	-	83.0	492.5	12.7	509.2	64.0	39.0	2.0	7.0	19.0	640.2
2001	79.0	-	83.0	492.5	12.7	509.2	64.0	39.0	2.0	7.0	19.0	640.2
2002	79.0	-	83.0	492.5	12.7	509.2	64.0	39.0	2.0	9.0	19.0	642.2
2003	79.0	-	83.0	492.5	12.7	509.2	64.0	39.0	2.0	9.0	19.0	642.2
2004	79.0	-	83.0	492.5	12.7	509.2	64.0	39.0	2.0	9.0	19.0	642.2
2005	79.0	-	83.0	492.5	12.7	509.2	64.0	39.0	2.0	9.0	19.0	642.2
2006	79.0	-	83.0	492.5	12.7	509.2	64.0	39.0	2.0	9.0	19.0	642.2
2007	79.0	-	83.0	492.5	12.7	509.2	64.0	39.0	2.0	9.0	19.0	642.2
2008	79.0	-	83.0	492.5	12.7	509.2	64.0	39.0	2.0	9.0	19.0	642.2
2009	79.0	-	83.0	492.5	12.7	509.2	64.0	39.0	2.0	7.0	19.0	640.2
2010	79.0	-	83.0	492.5	12.7	509.2	64.0	39.0	2.0	7.0	19.0	640.2
2011	79.0	-	83.0	492.5	12.7	509.2	64.0	39.0	2.0	7.0	19.0	640.2
2012	79.0	-	83.0	492.5	12.7	509.2	64.0	39.0	2.0	7.0	19.0	640.2
2013	79.0	-	83.0	492.5	12.7	509.2	64.0	39.0	2.0	7.0	19.0	640.2
2014	79.0	-	83.0	492.5	12.7	509.2	64.0	39.0	2.0	7.0	19.0	640.2
2015	79.0	-	83.0	492.5	12.7	509.2	64.0	39.0	2.0	7.0	19.0	640.2
2016	79.0	-	83.0	492.5	12.7	509.2	64.0	39.0	2.0	9.0	19.0	642.2
2017	79.0	-	83.0	492.5	12.7	509.2	64.0	39.0	2.0	9.0	19.0	642.2
2018	79.0	-	83.0	492.5	12.7	509.2	64.0	39.0	2.0	9.0	19.0	642.2
2019	79.0	-	83.0	492.5	12.7	509.2	64.0	39.0	2.0	9.0	19.0	642.2

3 - SCENARIO A - LOWER YIELDS (-10% FROM BASE CASE)

MADURU OYA PROJECT - TOTAL PROJECT COSTS

(MILLION RPS)

YEAR	DAM AND TUNNEL	BRANCH CANALS	TERTIARY IRRIG.	UPSTREAM COSTS	EXPER FARM	ACCESS ROADS	SETTLE-MENT	PROJ MGT INFRA.	SUB TOTAL	O AND M	TOTAL COSTS
1980	204.3	-	-	18.0	-	-	-	20.0	242.3	-	242.3
1981	562.0	122.6	49.3	49.0	6.0	51.0	-	20.0	859.9	1.0	860.9
1982	596.0	292.4	124.8	53.0	7.0	52.0	24.0	20.0	1,169.2	4.0	1,173.2
1983	340.6	457.4	206.4	30.0	-	52.0	44.0	20.0	1,150.4	5.0	1,155.4
1984	-	410.6	171.8	-	-	52.0	46.0	20.0	700.4	25.0	725.4
1985	-	251.8	96.1	-	-	52.0	42.0	20.0	461.9	36.0	497.9
1986	-	177.3	75.7	-	-	52.0	8.0	20.0	334.0	49.0	383.0
1987	-	-	15.5	-	-	-	-	5.0	20.5	61.0	81.5
1988	-	-	-	-	-	-	-	-	-	61.0	61.0
1989	-	-	-	-	-	-	-	-	-	61.0	61.0
1990	-	-	-	-	-	-	-	-	-	61.0	61.0
1991	-	-	-	-	-	-	-	-	-	61.0	61.0
1992	-	-	-	-	-	-	-	-	-	61.0	61.0
1993	-	-	-	-	-	-	-	-	-	61.0	61.0
1994	-	-	-	-	-	-	-	-	-	61.0	61.0
1995	-	-	-	-	-	-	-	-	-	61.0	61.0
1996	-	-	-	-	-	-	-	-	-	61.0	61.0
1997	-	-	-	-	-	-	-	-	-	61.0	61.0
1998	-	-	-	-	-	-	-	-	-	61.0	61.0
1999	-	-	-	-	-	-	-	-	-	61.0	61.0
2000	-	-	-	-	-	-	-	-	-	61.0	61.0
2001	-	-	-	-	-	-	-	-	-	61.0	61.0
2002	-	-	-	-	-	-	-	-	-	61.0	61.0
2003	-	-	-	-	-	-	-	-	-	61.0	61.0
2004	-	-	-	-	-	-	-	-	-	61.0	61.0
2005	-	-	-	-	-	-	-	-	-	61.0	61.0
2006	-	-	-	-	-	-	-	-	-	61.0	61.0
2007	-	-	-	-	-	-	-	-	-	61.0	61.0
2008	-	-	-	-	-	-	-	-	-	61.0	61.0
2009	-	-	-	-	-	-	-	-	-	61.0	61.0
2010	-	-	-	-	-	-	-	-	-	61.0	61.0
2011	-	-	-	-	-	-	-	-	-	61.0	61.0
2012	-	-	-	-	-	-	-	-	-	61.0	61.0
2013	-	-	-	-	-	-	-	-	-	61.0	61.0
2014	-	-	-	-	-	-	-	-	-	61.0	61.0
2015	-	-	-	-	-	-	-	-	-	61.0	61.0
2016	-	-	-	-	-	-	-	-	-	61.0	61.0
2017	-	-	-	-	-	-	-	-	-	61.0	61.0
2018	-	-	-	-	-	-	-	-	-	61.0	61.0
2019	-	-	-	-	-	-	-	-	-	61.0	61.0

3 - SCENARIO A - LOWER YIELDS (-10% FROM BASE CASE)

MADURU OYA PROJECT - NET BENEFITS

(MILLION RPS)

YEAR	TOTAL BENEFITS	TOTAL COSTS	NET BENEFITS
1980	-	242.3	-242.3
1981	8.0	860.9	-852.9
1982	8.0	1,173.2	-1,165.2
1983	4.0	1,155.4	-1,151.4
1984	104.7	725.4	-620.7
1985	207.2	497.9	-290.7
1986	327.4	383.0	-55.6
1987	459.0	81.5	377.5
1988	544.4	61.0	483.4
1989	584.1	61.0	523.1
1990	608.3	61.0	547.3
1991	620.8	61.0	559.8
1992	624.5	61.0	563.5
1993	627.1	61.0	566.1
1994	630.2	61.0	569.2
1995	632.2	61.0	571.2
1996	633.2	61.0	572.2
1997	636.2	61.0	575.2
1998	638.2	61.0	577.2
1999	639.2	61.0	578.2
2000	640.2	61.0	579.2
2001	640.2	61.0	579
2002	642.2	61.0	581.2
2003	642.2	61.0	581.2
2004	642.2	61.0	581.2
2005	642.2	61.0	581.2
2006	642.2	61.0	581.2
2007	642.2	61.0	581.2
2008	642.2	61.0	581.2
2009	640.2	61.0	579.2
2010	640.2	61.0	579.2
2011	640.2	61.0	579.2
2012	640.2	61.0	579.2
2013	640.2	61.0	579.2
2014	640.2	61.0	579.2
2015	640.2	61.0	579.2
2016	642.2	61.0	581.2
2017	642.2	61.0	581.2
2018	642.2	61.0	581.2
2019	642.2	61.0	581.2

INTERNAL RATE OF RETURN: 0.08641947012

4 - SCENARIO A - MEDIUM YIELDS (8 YR TO MAXIMUM BENEFIT)

MADURU OYA PROJECT - AGRICULTURAL BENEFITS

	PRODUCTION (TONNES)					NET ECONOMIC RETURNS (000 RP)				
YEAR	1R	2R	2U	TOTAL	TOTAL PADDY	1R	2R	2U	TOTAL	TOTAL PADDY
1980	-	-	-	-	-	-	-	-	-	-
1981	-	-	-	-	-	-	-	-	-	-
1982	-	-	-	-	-	-	-	-	-	-
1983	-	-	-	-	-	-	-	-	-	-
1984	19,955	12,408	-	32,363	32,363	45,759	26,676	-	72,435	72,435
1985	41,447	40,959	-	82,405	82,405	95,041	88,058	-	183,099	183,099
1986	59,774	71,132	1,554	132,460	130,906	137,068	152,928	4,737	294,733	289,995
1987	81,952	94,948	2,456	179,356	176,900	187,924	204,131	7,531	399,586	392,055
1988	92,632	105,229	2,869	200,729	197,860	212,413	226,234	8,813	447,459	438,647
1989	100,538	114,886	3,076	218,500	215,424	230,541	246,997	9,450	486,988	477,538
1990	107,792	123,902	3,457	235,151	231,694	247,1[illegible]	266,380	10,620	524,175	513,556
1991	115,171	132,114	3,698	250,983	247,285	264,098	2[illegible]4,035	11,361	559,493	548,132
1992	119,281	137,717	3,906	260,904	256,998	273,522	296,082	11,997	581,601	569,604
1993	121,628	140,757	4,113	266,498	262,385	278,904	302,618	12,634	594,156	581,[illegible]
1994	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
1995	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
1996	122,864	141,875	4,147	268,886	264,740	281,739	305-022	12,738	599,499	586,760
1997	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
1998	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
1999	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2000	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2001	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2002	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2003	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2004	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2005	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2006	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2007	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2008	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2009	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2010	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2011	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2012	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2013	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2014	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2015	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2016	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2017	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2018	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2019	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760

4 - SCENARIO A - MEDIUM YIELDS (8 YR TO MAXIMUM BENEFIT)

MADURU OYA PROJECT - TOTAL PROJECT BENEFITS

(MILLION RPS)

YEAR	WITHOUT PROJECT	PADDY UNDER PROJECT ST/RP	PIMB/VAK	NEW AREA	UPLAND CROPS	NET AGRIC BENEFITS	HOME-STEAD	LIVE-STOCK	FISHERY	FORESTRY	POWER	TOTAL BENEFITS
1980	79.0	38.0	41.0	-	-	-	-	-	-	-	-	-
1981	79.0	38.0	41.0	-	-	-	-	-	-	8.0	-	8.0
1982	79.0	38.0	41.0	-	-	-	-	-	-	8.0	-	8.0
1983	79.0	34.0	41.0	-	-	-4.0	-	-	-	8.0	-	4.0
1984	79.0	26.0	67.0	72.4	-	86.4	16.0	-10.0	-1.0	8.0	19.0	118.4
1985	79.0	6.0	74.0	183.1	-	184.1	37.0	-12.0	-1.0	8.0	19.0	235.1
1986	79.0	-	81.0	290.0	4.7	296.7	52.0	-5.0	-1.0	-2.0	19.0	359.7
1987	79.0	-	90.0	392.1	7.5	410.6	64.0	-	1.0	-2.0	19.0	492.6
1988	79.0	-	92.0	438.6	8.8	460.5	64.0	11.0	1.0	9.0	19.0	564.5
1989	79.0	-	92.0	477.5	9.4	500.0	64.0	13.0	2.0	9.0	19.0	607.0
1990	79.0	-	92.0	513.6	10.6	537.2	64.0	16.0	2.0	9.0	19.0	647.2
1991	79.0	-	92.0	548.1	11.4	572.5	64.0	19.0	2.0	9.0	19.0	685.5
1992	79.0	-	92.0	569.6	12.0	594.6	64.0	22.0	2.0	9.0	19.0	710.6
1993	79.0	-	92.0	581.5	12.6	607.2	64.0	24.0	2.0	9.0	19.0	725.2
1994	79.0	-	92.0	586.8	12.7	612.5	64.0	27.0	2.0	9.0	19.0	733.5
1995	79.0	-	92.0	586.8	12.7	612.5	64.0	31.0	2.0	7.0	19.0	735.5
1996	79.0	-	92.0	586.8	12.7	612.5	64.0	32.0	2.0	7.0	19.0	736.5
1997	79.0	-	92.0	586.8	12.7	612.5	64.0	35.0	2.0	7.0	19.0	739.5
1998	79.0	-	92.0	586.8	12.7	612.5	64.0	37.0	2.0	7.0	19.0	741.5
1999	79.0	-	92.0	586.8	12.7	612.5	64.0	38.0	2.0	7.0	19.0	742.5
2000	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	7.0	19.0	743.5
2001	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	7.0	19.0	743.5
2002	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	9.0	19.0	745.5
2003	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	9.0	19.0	745.5
2004	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	9.0	19.0	745.5
2005	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	9.0	19.0	745.5
2006	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	9.0	19.0	745.5
2007	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	9.0	19.0	745.5
2008	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	9.0	19.0	745.5
2009	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	7.0	19.0	743.5
2010	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	7.0	19.0	743.5
2011	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	7.0	19.0	743.5
2012	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	7.0	19.0	743.5
2013	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	7.0	19.0	743.5
2014	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	7.0	19.0	743.5
2015	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	7.0	19.0	743.5
2016	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	9.0	19.0	745.5
2017	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	9.0	19.0	745.5
2018	79.0	-	92.0	586.8	2.7	612.5	64.0	39.0	2.0	9.0	19.0	745.5
2019	79.0	-	92.0	586.8	2.7	612.5	64.0	39.0	2.0	9.0	19.0	745.5

4 - SCENARIO A - MEDIUM YIELDS (8 YR TO MAXIMUM BENEFIT)

MADURU OYA PROJECT - TOTAL PROJECT COSTS

(MILLION RPS)

YEAR	DAM AND TUNNEL	BRANCH CANALS	TERTIARY IRRIG.	UPSTREAM COSTS	EXPER FARM	ACCESS ROADS	SETTLE-MENT	PROJ MGT INFRA.	SUB TOTAL	O AND M	TOTAL COSTS
1980	204.3	-	-	18.0	-	-	-	20.0	242.3	-	242.3
1981	562.0	122.6	49.3	49.0	6.0	51.0	-	20.0	859.9	1.0	860.9
1982	596.0	292.4	124.8	53.0	7.0	52.0	24.0	20.0	1,169.2	4.0	1,173.2
1983	340.6	457.4	206.4	30.0	-	52.0	44.0	20.0	1,150.4	5.0	1,155.4
1984	-	410.6	171.8	-	-	52.0	46.0	20.0	700.4	25.0	725.4
1985	-	251.8	96.1	-	-	52.0	42.0	20.0	461.9	36.0	497.9
1986	-	177.3	75.7	-	-	52.0	9.0	20.0	334.0	49.0	383.0
1987	-	-	15.5	-	-	-	-	5.0	20.5	61.0	81.5
1988	-	-	-	-	-	-	-	-	-	61.0	61.0
1989	-	-	-	-	-	-	-	-	-	61.0	61.0
1990	-	-	-	-	-	-	-	-	-	61.0	61.0
1991	-	-	-	-	-	-	-	-	-	61.0	61.0
1992	-	-	-	-	-	-	-	-	-	61.0	61.0
1993	-	-	-	-	-	-	-	-	-	61.0	61.0
1994	-	-	-	-	-	-	-	-	-	61.0	61.0
1995	-	-	-	-	-	-	-	-	-	61.0	61.0
1996	-	-	-	-	-	-	-	-	-	61.0	61.0
1997	-	-	-	-	-	-	-	-	-	61.0	61.0
1998	-	-	-	-	-	-	-	-	-	61.0	61.0
1999	-	-	-	-	-	-	-	-	-	61.0	61.0
2000	-	-	-	-	-	-	-	-	-	61.0	61.0
2001	-	-	-	-	-	-	-	-	-	61.0	61.0
2002	-	-	-	-	-	-	-	-	-	61.0	61.0
2003	-	-	-	-	-	-	-	-	-	61.0	61.0
2004	-	-	-	-	-	-	-	-	-	61.0	61.0
2005	-	-	-	-	-	-	-	-	-	61.0	61.0
2006	-	-	-	-	-	-	-	-	-	61.0	61.0
2007	-	-	-	-	-	-	-	-	-	61.0	61.0
2008	-	-	-	-	-	-	-	-	-	61.0	61.0
2009	-	-	-	-	-	-	-	-	-	61.0	61.0
2010	-	-	-	-	-	-	-	-	-	61.0	61.0
2011	-	-	-	-	-	-	-	-	-	61.0	61.0
2012	-	-	-	-	-	-	-	-	-	61.0	61.0
2013	-	-	-	-	-	-	-	-	-	61.0	61.0
2014	-	-	-	-	-	-	-	-	-	61.0	61.0
2015	-	-	-	-	-	-	-	-	-	61.0	61.0
2016	-	-	-	-	-	-	-	-	-	61.0	61.0
2017	-	-	-	-	-	-	-	-	-	61.0	61.0
2018	-	-	-	-	-	-	-	-	-	61.0	61.0
2019	-	-	-	-	-	-	-	-	-	61.0	61.0

4 - SCENARIO A - MEDIUM YIELDS (8 YR TO MAXIMUM BENEFIT)

MADURU OYA PROJECT - NET BENEFITS

(MILLION RPS)

YEAR	TOTAL BENEFITS	TOTAL COSTS	NET BENEFITS
1980	-	242.3	-242.3
1981	8.0	860.9	-852.9
1982	8.0	1,173.2	-1,165.2
1983	4.0	1,155.4	-1,151.4
1984	118.4	725.4	-607.0
1985	235.1	497.9	-262.8
1986	359.7	383.0	-23.3
1987	492.6	81.5	411.1
1988	564.5	61.0	503.5
1989	607.0	61.0	546.0
1990	647.2	61.0	586.2
1991	685.5	61.0	624.5
1992	710.6	61.0	649.6
1993	725.2	61.0	664.2
1994	733.5	61.0	672.5
1995	735.5	61.0	674.5
1996	736.5	61.0	675.5
1997	739.5	61.0	678.5
1998	741.5	61.0	680.5
1999	742.5	61.0	681.5
2000	743.5	61.0	682.5
2001	743.5	61.0	682.5
2002	745.5	61.0	684.5
2003	745.5	61.0	684.5
2004	745.5	61.0	684.5
2005	745.5	61.0	684.5
2006	745.5	61.0	684.5
2007	745.5	61.0	684.5
2008	745.5	61.0	684.5
2009	743.5	61.0	682.5
2010	743.5	61.0	682.5
2011	743.5	61.0	682.5
2012	743.5	61.0	682.5
2013	743.5	61.0	682.5
2014	743.5	61.0	682.5
2015	743.5	61.0	682.5
2016	745.5	61.0	684.5
2017	745.5	61.0	684.5
2018	745.5	61.0	684.5
2019	745.5	61.0	684.5

INTERNAL RATE OF RETURN: 0.09746549318

5 - SCENARIO B - MEDIUM YIELDS (BASE CASE)

MADURU OYA PROJECT - AGRICULTURAL BENEFITS

	PRODUCTION (TONNES)					NET ECONOMIC RETURNS (000 RP)				
YEAR	1R	2R	2U	TOTAL	TOTAL PADDY	1R	2R	2U	TOTAL	TOTAL PADDY
1980	-	-	-	-	-	-	-	-	-	-
1981	-	-	-	-	-	-	-	-	-	-
1982	-	-	-	-	-	-	-	-	-	-
1983	-	-	-	-	-	-	-	-	-	-
1984	12,458	5,862	-	18,320	18,320	28,568	12,602	-	41,170	41,170
1985	28,795	19,820	-	48,615	48,615	66,030	42,611	-	108,641	108,641
1986	43,338	40,298	-	83,635	83,635	99,377	86,637	-	186,014	186,014
1987	60,536	63,545	-	124,081	124,081	138,814	136,618	-	275,432	275,432
1988	75,559	88,978	1,037	165,573	164,536	173,263	191,295	3,185	367,743	364,558
1989	93,394	110,530	2,168	206,092	203,924	214 161	237,631	6,660	458,452	451,792
1990	108,918	126,179	2,748	237,845	235,097	249,759	271,275	8,441	529,475	521,034
1991	114,932	133,857	2,955	251,745	248,789	263,549	287,783	8,078	560,411	551,332
1992	119,274	138,805	3,249	261,328	258,079	273,506	298,421	8,981	581,907	571,926
1993	122,064	141,333	3,543	266,940	263,397	279,904	303,855	10,985	594,644	583,759
1994	122,864	141,875	3,785	268,524	264,740	281,739	305,022	11,626	598,386	586,760
1995	122,864	141,875	3,992	268,732	264,740	281,739	305,022	12,263	599,023	586,760
1996	122,864	141,875	4,113	268,853	264,740	281,739	305,022	12,634	599,395	586,760
1997	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
1998	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
1999	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2000	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2001	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2002	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2003	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2004	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2005	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2006	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2007	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2008	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2009	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2010	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2011	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2012	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2013	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2014	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2015	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2016	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2017	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2018	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2019	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760

5 - SCENARIO B - MEDIUM YIELDS (BASE CASE)

MADURU OYA PROJECT - TOTAL PROJECT BENEFITS

(MILLION RPS)

YEAR	WITHOUT PROJECT	PADDY UNDER PROJECT ST/RF	PIMB/VAK	NEW AREA	UPLAND CROPS	NET AGRIC BENEFITS	HOME-STEAD	LIVE-STOCK	FISHERY	FORESTRY	POWER	TOTAL BENEFITS
1980	79.0	38.0	41.0	-	-	-	-	-	-	-	-	-
1981	79.0	38.0	41.0	-	-	-	-	-	-	-	-	-
1982	79.0	38.0	41.0	-	-	-	-	-	-	4.0	-	4.0
1983	79.0	34.0	41.0	-	-	-4.0	-	-	-	4.0	-	4.0
1984	79.0	30.0	67.0	41.2	-	59.2	10.0	-5.0	-1.0	4.0	19.0	86.2
1985	79.0	26.0	74.0	108.6	-	129.6	20.0	-4.0	-1.0	4.0	19.0	167.6
1986	79.0	20.0	81.0	186.0	-	208.0	30.0	-4.0	-1.0	4.0	19.0	256.0
1987	79.0	6.0	90.0	275.4	-	292.4	40.0	-2.0	1.0	4.0	19.0	354.4
1988	79.0	-	92.0	364.6	3.2	380.7	50.0	1.0	1.0	16.0	19.0	467.7
1989	79.0	-	92.0	451.8	6.7	471.5	60.0	3.0	2.0	9.0	19.0	564.5
1990	79.0	-	92.0	521.0	8.4	542.5	64.0	10.0	2.0	9.0	19.0	646.5
1991	79.0	-	92.0	551.3	9.1	573.4	64.0	15.0	2.0	9.0	19.0	682.4
1992	79.0	-	92.0	571.9	10.0	594.9	64.0	18.0	2.0	[illegible]	19.0	706.9
1993	79.0	-	92.0	583.8	10.9	607.6	64.0	21.0	2.0	9.0	19.0	722.6
1994	79.0	-	92.0	586.8	11.6	611.4	64.0	23.0	2.0	9.0	19.0	728.4
1995	79.0	-	92.0	586.8	12.3	612.0	64.0	26.0	2.0	7.0	19.0	730.0
1996	79.0	-	92.0	586.8	12.6	612.4	64.0	29.0	2.0	7.0	19.0	733.4
1997	79.0	-	92.0	586.8	12.7	612.5	64.0	31.0	2.0	7.0	19.0	735.5
1998	79.0	-	92.0	586.8	12.7	612.5	64.0	34.0	2.0	7.0	19.0	738.5
1999	79.0	-	92.0	586.8	12.7	612.5	64.0	36.0	2.0	7.0	19.0	740.5
2000	79.0	-	92.0	586.8	12.7	612.5	64.0	37.0	2.0	7.0	19.0	741.5
2001	79.0	-	92.0	586.8	12.7	612.5	64.0	38.0	2.0	7.0	19.0	742.5
2002	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	9.0	19.0	745.5
2003	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	9.0	19.0	745.5
2004	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	9.0	19.0	745.5
2005	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	9.0	19.0	745.5
2006	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	9.0	19.0	745.5
2007	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	9.0	19.0	745.5
2008	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	9.0	19.0	745.5
2009	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	7.0	19.0	743.5
2010	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	7.0	19.0	743.5
2011	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	7.0	19.0	743.5
2012	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	7.0	19.0	743.5
2013	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	7.0	19.0	743.5
2014	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	7.0	19.0	743.5
2015	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	9.0	19.0	745.5
2016	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	9.0	19.0	745.5
2017	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	9.0	19.0	745.5
2018	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	9.0	19.0	745.5
2019	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	9.0	19.0	745.5

5 - SCENARIO B - MEDIUM YIELDS (BASE CASE)

MADURU OYA PROJECT - TOTAL PROJECT COSTS

(MILLION RPS)

YEAR	DAM AND TUNNEL	BRANCH CANALS	TERTIARY IRRIG.	UPSTREAM COSTS	EXPER FARM	ACCESS ROADS	SETTLE-MENT	PROJ MGT INFRA.	SUB TOTAL	O AND M	TOTAL COSTS
1980	204.3	-	-	18.0	-	-	-	14.0	236.3	-	236.3
1981	562.0	92.0	39.4	49.0	6.0	31.0	-	14.0	793.4	1.0	794.4
1982	596.0	153.3	60.5	53.0	7.0	35.0	11.0	14.0	929.8	3.0	932.8
1983	340.6	250.7	105.1	30.0	-	35.0	27.0	14.0	802.4	4.0	806.4
1984	-	250.7	118.6	-	-	35.0	28.0	14.0	446.3	20.0	466.3
1985	-	300.5	124.1	-	-	35.0	30.0	14.0	503.6	28.0	531.6
1986	-	239.2	112.9	-	-	35.0	24.0	14.0	425.1	35.0	460.1
1987	-	141.9	70.3	-	-	35.0	24.0	14.0	285.2	44.0	329.2
1988	-	141.9	64.9	-	-	35.0	21.0	14.0	276.8	53.0	329.8
1989	-	141.9	43.8	-	-	35.0	-	14.0	234.7	61.0	295.7
1990	-	-	-	-	-	-	-	5.0	5.0	61.0	66.0
1991	-	-	-	-	-	-	-	-	-	61.0	61.0
1992	-	-	-	-	-	-	-	-	-	61.0	61.0
1993	-	-	-	-	-	-	-	-	-	61.0	61.0
1994	-	-	-	-	-	-	-	-	-	61.0	61.0
1995	-	-	-	-	-	-	-	-	-	61.0	61.0
1996	-	-	-	-	-	-	-	-	-	61.0	61.0
1997	-	-	-	-	-	-	-	-	-	61.0	61.0
1998	-	-	-	-	-	-	-	-	-	61.0	61.0
1999	-	-	-	-	-	-	-	-	-	61.0	61.0
2000	-	-	-	-	-	-	-	-	-	61.0	61.0
2001	-	-	-	-	-	-	-	-	-	61.0	61.0
2002	-	-	-	-	-	-	-	-	-	61.0	61.0
2003	-	-	-	-	-	-	-	-	-	61.0	61.0
2004	-	-	-	-	-	-	-	-	-	61.0	61.0
2005	-	-	-	-	-	-	-	-	-	61.0	61.0
2006	-	-	-	-	-	-	-	-	-	61.0	61.0
2007	-	-	-	-	-	-	-	-	-	61.0	61.0
2008	-	-	-	-	-	-	-	-	-	61.0	61.0
2009	-	-	-	-	-	-	-	-	-	61.0	61.0
2010	-	-	-	-	-	-	-	-	-	61.0	61.0
2011	-	-	-	-	-	-	-	-	-	61.0	61.0
2012	-	-	-	-	-	-	-	-	-	61.0	61.0
2013	-	-	-	-	-	-	-	-	-	61.0	61.0
2014	-	-	-	-	-	-	-	-	-	61.0	61.0
2015	-	-	-	-	-	-	-	-	-	61.0	61.0
2016	-	-	-	-	-	-	-	-	-	61.0	61.0
2017	-	-	-	-	-	-	-	-	-	61.0	61.0
2018	-	-	-	-	-	-	-	-	-	61.0	61.0
2019	-	-	-	-	-	-	-	-	-	61.0	61.0

5 - SCENARIO B - MEDIUM YIELDS (BASE CASE)

MADURU OYA PROJECT - NET BENEFITS

(MILLION RPS)

YEAR	TOTAL BENEFITS	TOTAL COSTS	NET BENEFITS
1980	-	236.3	-236.3
1981	4.0	794.4	-790.4
1982	4.0	932.8	-928.8
1983	-	806.4	-806.4
1984	86.2	466.3	-380.1
1985	167.6	531.6	-364.0
1986	256.0	460.1	-204.1
1987	354.4	329.2	25.2
1988	467.7	329.8	137.9
1989	564.5	295.7	268.8
1990	646.5	66.0	580.5
1991	682.4	61.0	621.4
1992	706.9	61.0	645.9
1993	722.6	61.0	661.6
1994	728.4	61.0	667.4
1995	730.0	61.0	668.0
1996	733.4	61.0	672.4
1997	735.5	61.0	674.5
1998	738.5	61.0	677.5
1999	740.5	61.0	679.5
2000	741.5	61.0	680.5
2001	742.5	61.0	681.5
2002	745.5	61.0	684.5
2003	745.5	61.0	684.5
2004	745.5	61.0	684.5
2005	745.5	61.0	684.5
2006	745.5	61.0	684.5
2007	745.5	61.0	684.5
2008	745.5	61.0	684.5
2009	743.5	61.0	682.5
2010	743.5	61.0	682.5
2011	743.5	61.0	682.5
2012	743.5	61.0	682.5
2013	743.5	61.0	682.5
2014	743.5	61.0	682.5
2015	743.5	61.0	682.5
2016	745.5	61.0	684.5
2017	745.5	61.0	684.5
2018	745.5	61.0	684.5
2019	745.5	61.0	684.5

INTERNAL RATE OF RETURN: 0.0075521058

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6 - SCENARIO B - HIGHER YIELDS (+10% FROM BASE CASE)

MADURU OYA PROJECT - AGRICULTURAL BENEFITS

	PRODUCTION (TONNES)					NET ECONOMIC RETURNS (000 RP)				
YEAR	1R	2R	2U	TOTAL	TOTAL PADDY	1R	2R	2U	TOTAL	TOTAL PADDY
1980	-	-	-	-	-	-	-	-	-	-
1981	-	-	-	-	-	-	-	-	-	-
1982	-	-	-	-	-	-	-	-	-	-
1983	-	-	-	-	-	-	-	-	-	-
1984	13,812	6,434	-	20,246	20,246	33,263	14,585	-	47,847	47,847
1985	31,925	21,753	-	53,678	53,678	76,881	49,315	-	126,196	126,196
1986	48,048	44,229	-	92,277	92,277	115,709	100,267	-	215,976	215,976
1987	67,116	69,745	-	136,861	136,861	161,627	158,111	-	319,738	319,738
1988	83,772	97,658	1,037	182,467	181,430	201,737	221,391	3,185	426,313	423,128
1989	103,546	121,313	2,168	227,027	224,859	249,356	275,017	6,660	531,034	524,374
1990	120,757	138,489	2,748	261,994	259,246	290,805	313,954	8,441	613,200	604,759
1991	127,425	146,916	2,955	277,296	274,341	306,861	333,059	8,078	648,899	639,921
1992	132,239	152,347	3,249	287,835	284,586	318,454	345,371	9,981	673,805	663,825
1993	135,332	155,121	3,543	293,997	290,453	325,903	351,660	10,885	688,448	677,563
1994	136,219	155,717	3,785	295,721	291,936	328,040	353,010	11,626	692,676	681,050
1995	136,219	155,717	3,992	295,928	291,936	328,040	353,010	12,263	693,313	681,050
1996	136,219	155,717	4,113	296,049	291,936	328,040	353,010	12,634	693,684	681,050
1997	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
1998	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
1999	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
2000	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
2001	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
2002	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
2003	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
2004	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
2005	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
2006	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
2007	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
2008	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
2009	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
2010	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
2011	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
2012	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
2013	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
2014	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
2015	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
2016	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
2017	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
2018	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050
2019	136,219	155,717	4,147	296,083	291,936	328,040	353,010	12,738	693,788	681,050

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6 - SCENARIO B - HIGHER YIELDS (+10% FROM BASE CASE)

MADURU OYA PROJECT - TOTAL PROJECT BENEFITS

(MILLION RPS)

YEAR	WITHOUT PROJECT	PADDY UNDER PROJECT ST/RP	PIMB/VAK	NEW AREA	UPLAND CROPS	NET AGRIC BENEFITS	HOME-STEAD	LIVE-STOCK	FISHERY	FORESTRY	POWER	TOTAL BENEFITS
1980	79.0	38.0	41.0	-	-	-	-	-	-	-	-	-
1981	79.0	38.0	41.0	-	-	-	-	-	-	4.0	-	4.0
1982	79.0	38.0	41.0	-	-	-	-	-	-	4.0	-	4.0
1983	79.0	34.0	41.0	-	-	-4.0	-	-	-	4.0	-	-
1984	79.0	30.0	70.0	47.8	-	68.8	10.0	-5.0	-1.0	4.0	19.0	95.8
1985	79.0	26.0	81.0	126.2	-	154.2	20.0	-4.0	-1.0	4.0	19.0	192.2
1986	79.0	20.0	91.0	216.0	-	248.0	30.0	-4.0	-1.0	4.0	19.0	296.0
1987	79.0	6.0	101.0	319.7	-	347.7	40.0	-2.0	1.0	4.0	19.0	409.7
1988	79.0	-	110.0	423.1	3.2	457.3	50.0	1.0	1.0	16.0	19.0	544.3
1989	79.0	-	110.0	524.4	6.7	562.0	60.0	3.0	2.0	9.0	19.0	655.0
1990	79.0	-	110.0	604.8	8.4	644.2	64.0	10.0	2.0	9.0	19.0	748.2
1991	79.0	-	110.0	639.9	9.1	680.0	64.0	15.0	2.0	9.0	19.0	789.0
1992	79.0	-	110.0	655.8	10.0	704.8	64.0	18.0	2.0	9.0	19.0	816.8
1993	79.0	-	110.0	677.6	10.9	719.4	64.0	21.0	2.0	9.0	19.0	834.4
1994	79.0	-	110.0	681.0	11.6	723.7	64.0	23.0	2.0	9.0	19.0	840.7
1995	79.0	-	110.0	681.0	12.3	724.3	64.0	26.0	2.0	7.0	19.0	842.3
1996	79.0	-	110.0	681.0	12.6	724.7	64.0	29.0	2.0	7.0	19.0	845.7
1997	79.0	-	110.0	681.0	12.7	724.8	64.0	31.0	2.0	7.0	19.0	847.8
1998	79.0	-	110.0	681.0	12.7	724.8	64.0	34.0	2.0	7.0	19.0	850.8
1999	79.0	-	110.0	681.0	12.7	724.8	64.0	36.0	2.0	7.0	19.0	852.8
2000	79.0	-	110.0	681.0	12.7	724.8	64.0	37.0	2.0	7.0	19.0	853.8
2001	79.0	-	110.0	681.0	12.7	724.8	64.0	38.0	2.0	7.0	19.0	854.8
2002	79.0	-	110.0	681.0	12.7	724.8	64.0	39.0	2.0	9.0	19.0	857.8
2003	79.0	-	110.0	681.0	12.7	724.8	64.0	39.0	2.0	9.0	19.0	857.8
2004	79.0	-	110.0	681.0	12.7	724.8	64.0	39.0	2.0	9.0	19.0	857.8
2005	79.0	-	110.0	681.0	12.7	724.8	64.0	39.0	2.0	9.0	19.0	857.8
2006	79.0	-	110.0	681.0	12.7	724.8	64.0	39.0	2.0	9.0	19.0	857.8
2007	79.0	-	110.0	681.0	12.7	724.8	64.0	39.0	2.0	9.0	19.0	857.8
2008	79.0	-	110.0	681.0	12.7	724.8	64.0	39.0	2.0	9.0	19.0	857.8
2009	79.0	-	110.0	681.0	12.7	724.8	64.0	39.0	2.0	7.0	19.0	855.8
2010	79.0	-	110.0	681.0	12.7	724.8	64.0	39.0	2.0	7.0	19.0	855.8
2011	79.0	-	110.0	681.0	12.7	724.8	64.0	39.0	2.0	7.0	19.0	855.8
2012	79.0	-	110.0	681.0	12.7	724.8	64.0	39.0	2.0	7.0	19.0	855.8
2013	79.0	-	110.0	681.0	12.7	724.8	64.0	39.0	2.0	7.0	19.0	855.8
2014	79.0	-	110.0	681.0	12.7	724.8	64.0	39.0	2.0	7.0	19.0	855.8
2015	79.0	-	110.0	681.0	12.7	724.8	64.0	39.0	2.0	9.0	19.0	857.8
2016	79.0	-	110.0	681.0	12.7	724.8	64.0	39.0	2.0	9.0	19.0	857.8
2017	79.0	-	110.0	681.0	12.7	724.8	64.0	39.0	2.0	9.0	19.0	857.8
2018	79.0	-	110.0	681.0	12.7	724.8	64.0	39.0	2.0	9.0	19.0	857.8
2019	79.0	-	110.0	681.0	12.7	724.8	64.0	39.0	2.0	9.0	19.0	857.8

6 - SCENARIO B - HIGHER YIELDS (+10% FROM BASE CASE)

MADURU OYA PROJECT - TOTAL PROJECT COSTS

(MILLION RPS)

YEAR	DAM AND TUNNEL	BRANCH CANALS	TERTIARY IRRIG.	UPSTREAM COSTS	EXPER FARM	ACCESS ROADS	SETTLE-MENT	PROJ MGT INFRA.	SUB TOTAL	O AND M	TOTAL COSTS
1980	204.3	-	-	18.0	-	-	-	14.0	236.3	-	236.3
1981	562.0	92.0	39.4	49.0	6.0	31.0	-	14.0	793.4	1.0	794.4
1982	596.0	153.3	60.5	53.0	7.0	35.0	11.0	14.0	929.8	3.0	932.8
1983	340.6	250.7	105.1	30.0	-	35.0	27.0	14.0	802.4	4.0	806.4
1984	-	250.7	118.6	-	-	35.0	28.0	14.0	446.3	20.0	466.3
1985	-	300.5	124.1	-	-	35.0	30.0	14.0	503.6	28.0	531.6
1986	-	239.2	112.9	-	-	35.0	24.0	14.0	425.1	35.0	460.1
1987	-	141.9	70.3	-	-	35.0	24.0	14.0	285.2	44.0	329.2
1988	-	141.9	64.9	-	-	35.0	21.0	14.0	276.8	53.0	329.8
1989	-	141.9	43.8	-	-	35.0	-	14.0	234.7	61.0	295.7
1990	-	-	-	-	-	-	-	5.0	5.0	61.0	66.0
1991	-	-	-	-	-	-	-	-	-	61.0	61.0
1992	-	-	-	-	-	-	-	-	-	61.0	61.0
1993	-	-	-	-	-	-	-	-	-	61.0	61.0
1994	-	-	-	-	-	-	-	-	-	61.0	61.0
1995	-	-	-	-	-	-	-	-	-	61.0	61.0
1996	-	-	-	-	-	-	-	-	-	61.0	61.0
1997	-	-	-	-	-	-	-	-	-	61.0	61.0
1998	-	-	-	-	-	-	-	-	-	61.0	61.0
1999	-	-	-	-	-	-	-	-	-	61.0	61.0
2000	-	-	-	-	-	-	-	-	-	61.0	61.0
2001	-	-	-	-	-	-	-	-	-	61.0	61.0
2002	-	-	-	-	-	-	-	-	-	61.0	61.0
2003	-	-	-	-	-	-	-	-	-	61.0	61.0
2004	-	-	-	-	-	-	-	-	-	61.0	61.0
2005	-	-	-	-	-	-	-	-	-	61.0	61.0
2006	-	-	-	-	-	-	-	-	-	61.0	61.0
2007	-	-	-	-	-	-	-	-	-	61.0	61.0
2008	-	-	-	-	-	-	-	-	-	61.0	61.0
2009	-	-	-	-	-	-	-	-	-	61.0	61.0
2010	-	-	-	-	-	-	-	-	-	61.0	61.0
2011	-	-	-	-	-	-	-	-	-	61.0	61.0
2012	-	-	-	-	-	-	-	-	-	61.0	61.0
2013	-	-	-	-	-	-	-	-	-	61.0	61.0
2014	-	-	-	-	-	-	-	-	-	61.0	61.0
2015	-	-	-	-	-	-	-	-	-	61.0	61.0
2016	-	-	-	-	-	-	-	-	-	61.0	61.0
2017	-	-	-	-	-	-	-	-	-	61.0	61.0
2018	-	-	-	-	-	-	-	-	-	61.0	61.0
2019	-	-	-	-	-	-	-	-	-	61.0	61.0

6 - SCENARIO B - HIGHER YIELDS (+10% FROM BASE CASE)

MADURU OYA PROJECT - NET BENEFITS

(MILLION RPS)

YEAR	TOTAL BENEFITS	TOTAL COSTS	NET BENEFITS
1980	-	236.3	-236.3
1981	4.0	794.4	-790.4
1982	4.0	932.8	-928.8
1983	-	806.4	-806.4
1984	95.8	466.3	-370.5
1985	192.2	531.6	-339.4
1986	296.0	460.1	-164.1
1987	409.7	329.2	80.5
1988	544.3	329.8	214.5
1989	655.0	295.7	359.3
1990	748.2	66.0	682.2
1991	789.0	61.0	728.0
1992	816.8	61.0	755.8
1993	834.4	61.0	773.4
1994	840.7	61.0	779.7
1995	842.3	61.0	781.3
1996	845.7	61.0	784.7
1997	847.8	61.0	786.8
1998	850.8	61.0	789.8
1999	852.8	61.0	791.8
2000	853.8	61.0	792.8
2001	854.8	61.0	793.8
2002	857.8	61.0	796.8
2003	857.8	61.0	796.8
2004	857.8	61.0	796.8
2005	857.8	61.0	796.8
2006	857.8	61.0	796.8
2007	857.8	61.0	796.8
2008	857.8	61.0	796.8
2009	855.8	61.0	794.8
2010	855.8	61.0	794.8
2011	855.8	61.0	794.8
2012	855.8	61.0	794.8
2013	855.8	61.0	794.8
2014	855.8	61.0	794.8
2015	855.8	61.0	794.8
2016	857.8	61.0	796.8
2017	857.8	61.0	796.8
2018	857.8	61.0	796.8
2019	857.8	61.0	796.8

INTERNAL RATE OF RETURN: 0.1116158416

7 - SCENARIO B - LOWER YIELDS (-10% FROM BASE CASE)

MADURU OYA PROJECT - AGRICULTURAL BENEFITS

	PRODUCTION (TONNES)					NET ECONOMIC RETURNS (000 RP)				
YEAR	1R	2R	2U	TOTAL	TOTAL PADDY	1R	2R	2U	TOTAL	TOTAL PADDY
1980	-	-	-	-	-	-	-	-	-	-
1981	-	-	-	-	-	-	-	-	-	-
1982	-	-	-	-	-	-	-	-	-	-
1983	-	-	-	-	-	-	-	-	-	-
1984	11,104	5,290	-	16,394	16,394	23,873	10,619	-	34,492	34,492
1985	25,665	17,886	-	43,551	43,551	55,178	35,907	-	91,085	91,085
1986	38,627	36,366	-	74,993	74,993	83,045	73,007	-	156,052	156,052
1987	53,956	57,346	-	111,302	111,302	116,001	115,124	-	231,125	231,125
1988	67,346	80,297	1,037	148,679	147,643	144,789	161,199	3,185	309,173	305,988
1989	83,243	99,747	2,168	185,157	182,989	178,9[illegible]	200,245	6,660	385,871	379,211
1990	97,079	113,869	2,748	213,696	210,948	208,714	2[illegible]8,596	8,441	445,751	437,309
1991	102,440	120,798	2,955	226,193	223,237	220,237	242,507	8,078	471,822	462,744
1992	106,310	125,263	3,249	234,822	231,573	228,558	251,471	9,981	490,009	480,028
1993	108,796	127,544	3,543	239,884	236,340	233,904	256,050	10,885	500,839	489,954
1994	109,509	128,034	3,785	241,328	237,543	235,437	257,033	11,626	504,096	492,471
1995	109,509	128,034	3,992	241,535	237,543	235,437	257,033	12,263	504,733	492,471
1996	109,509	128,034	4,113	241,656	237,543	235,437	257,033	12,634	505,105	492,471
1997	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
1998	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
1999	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
2000	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
2001	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
2002	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
2003	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
2004	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
2005	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
2006	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
2007	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
2008	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
2009	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
2010	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
2011	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
2012	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
2013	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
2014	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
2015	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
2016	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
2017	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
2018	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471
2019	109,509	128,034	4,147	241,690	237,543	235,437	257,033	12,738	505,209	492,471

7 - SCENARIO B - LOWER YIELDS (-10% FROM BASE CASE)

MADURU OYA PROJECT - TOTAL PROJECT BENEFITS

(MILLION RPS)

YEAR	WITHOUT PROJECT	PADDY UNDER PROJECT ST/RF	PIMB/VAK	NEW AREA	UPLAND CROPS	NET AGRIC BENEFITS	HOME-STEAD	LIVE-STOCK	FISHERY	FORESTRY	POWER	TOTAL BENEFITS
1980	79.0	38.0	41.0	-	-	-	-	-	-	-	-	-
1981	79.0	38.0	41.0	-	-	-	-	-	-	4.0	-	4.0
1982	79.0	38.0	41.0	-	-	-	-	-	-	4.0	-	4.0
1983	79.0	34.0	41.0	-	-	-4.0	-	-	-	4.0	-	-
1984	79.0	30.0	65.0	34.5	-	50.5	10.0	-5.0	-1.0	4.0	19.0	77.5
1985	79.0	26.0	69.0	91.1	-	107.1	20.0	-4.0	-1.0	4.0	19.0	145.1
1986	79.0	20.0	74.0	156.1	-	171.1	30.0	-4.0	-1.0	4.0	19.0	219.1
1987	79.0	6.0	78.0	231.1	-	236.1	40.0	-2.0	1.0	4.0	19.0	298.1
1988	79.0	-	83.0	306.0	3.2	313.2	50.0	1.0	1.0	16.0	19.0	400.2
1989	79.0	-	83.0	379.2	6.7	389.9	60.0	3.0	2.0	9.0	19.0	482.9
1990	79.0	-	83.0	437.3	8.4	449.8	64.0	10.0	2.0	9.0	19.0	553.8
1991	79.0	-	83.0	462.7	9.1	475.8	64.0	15.0	2.0	9.0	19.0	584.8
1992	79.0	-	83.0	480.0	10.0	494.0	64.0	18.0	2.0	9.0	19.0	606.0
1993	79.0	-	83.0	490.0	10.9	504.8	64.0	21.0	2.0	9.0	19.0	619.8
1994	79.0	-	83.0	492.5	11.6	508.1	64.0	23.0	2.0	9.0	19.0	625.1
1995	79.0	-	83.0	492.5	12.3	508.7	64.0	26.0	2.0	7.0	19.0	626.7
1996	79.0	-	83.0	492.5	12.6	509.1	64.0	29.0	2.0	7.0	19.0	630.1
1997	79.0	-	83.0	492.5	12.7	509.2	64.0	31.0	2.0	7.0	19.0	632.2
1998	79.0	-	83.0	492.5	12.7	509.2	64.0	34.0	2.0	7.0	19.0	635.2
1999	79.0	-	83.0	492.5	12.7	509.2	64.0	36.0	2.0	7.0	19.0	637.2
2000	79.0	-	83.0	492.5	12.7	509.2	64.0	37.0	2.0	7.0	19.0	638.2
2001	79.0	-	83.0	492.5	12.7	509.2	64.0	38.0	2.0	7.0	19.0	639.2
2002	79.0	-	83.0	492.5	12.7	509.2	64.0	39.0	2.0	9.0	19.0	642.2
2003	79.0	-	83.0	492.5	12.7	509.2	64.0	39.0	2.0	9.0	19.0	642.2
2004	79.0	-	83.0	492.5	12.7	509.2	64.0	39.0	2.0	9.0	19.0	642.2
2005	79.0	-	83.0	492.5	12.7	509.2	64.0	39.0	2.0	9.0	19.0	642.2
2006	79.0	-	83.0	492.5	12.7	509.2	64.0	39.0	2.0	9.0	19.0	642.2
2007	79.0	-	83.0	492.5	12.7	509.2	64.0	39.0	2.0	9.0	19.0	642.2
2008	79.0	-	83.0	492.5	12.7	509.2	64.0	39.0	2.0	9.0	19.0	642.2
2009	79.0	-	83.0	492.5	12.7	509.2	64.0	39.0	2.0	7.0	19.0	640.2
2010	79.0	-	83.0	492.5	12.7	509.2	64.0	39.0	2.0	7.0	19.0	640.2
2011	79.0	-	83.0	492.5	12.7	509.2	64.0	39.0	2.0	7.0	19.0	640.2
2012	79.0	-	83.0	492.5	12.7	509.2	64.0	39.0	2.0	7.0	19.0	640.2
2013	79.0	-	83.0	492.5	12.7	509.2	64.0	39.0	2.0	7.0	19.0	640.2
2014	79.0	-	83.0	492.5	12.7	509.2	64.0	39.0	2.0	7.0	19.0	640.2
2015	79.0	-	83.0	492.5	12.7	509.2	64.0	39.0	2.0	7.0	19.0	640.2
2016	79.0	-	83.0	492.5	12.7	509.2	64.0	39.0	2.0	9.0	19.0	642.2
2017	79.0	-	83.0	492.5	12.7	509.2	64.0	39.0	2.0	9.0	19.0	642.2
2018	79.0	-	83.0	492.5	12.7	509.2	64.0	39.0	2.0	9.0	19.0	642.2
2019	79.0	-	83.0	492.5	12.7	509.2	64.0	39.0	2.0	9.0	19.0	642.2

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7 - SCENARIO B - LOWER YIELDS (-10% FROM BASE CASE)

MADURU OYA PROJECT - TOTAL PROJECT COSTS

(MILLION RPS)

YEAR	DAM AND TUNNEL	BRANCH CANALS	TERTIARY IRRIG.	UPSTREAM COSTS	EXPER FARM	ACCESS ROADS	SETTLE-MENT	PROJ MGT INFRA.	SUB TOTAL	O AND M	TOTAL COSTS
1980	204.3	-	-	18.0	-	-	-	14.0	236.3	-	236.3
1981	562.0	92.0	39.4	49.0	6.0	31.0	-	14.0	793.4	1.0	794.4
1982	596.0	153.3	60.5	53.0	7.0	35.0	11.0	14.0	929.8	3.0	932.8
1983	340.6	250.7	105.1	30.0	-	35.0	27.0	14.0	802.4	4.0	806.4
1984	-	250.7	118.6	-	-	35.0	28.0	14.0	446.3	20.0	466.3
1985	-	300.5	124.1	-	-	35.0	30.0	14.0	503.6	28.0	531.6
1986	-	239.2	112.9	-	-	35.0	24.0	14.0	425.1	35.0	460.1
1987	-	141.9	70.3	-	-	35.0	24.0	14.0	285.2	44.0	329.2
1988	-	141.9	64.9	-	-	35.0	21.0	14.0	276.8	53.0	329.8
1989	-	141.9	43.8	-	-	35.0	-	14.0	234.7	61.0	295.7
1990	-	-	-	-	-	-	-	5.0	5.0	61.0	66.0
1991	-	-	-	-	-	-	-	-	-	61.0	61.0
1992	-	-	-	-	-	-	-	-	-	61.0	61.0
1993	-	-	-	-	-	-	-	-	-	61.0	61.0
1994	-	-	-	-	-	-	-	-	-	61.0	61.0
1995	-	-	-	-	-	-	-	-	-	61.0	61.0
1996	-	-	-	-	-	-	-	-	-	61.0	61.0
1997	-	-	-	-	-	-	-	-	-	61.0	61.0
1998	-	-	-	-	-	-	-	-	-	61.0	61.0
1999	-	-	-	-	-	-	-	-	-	61.0	61.0
2000	-	-	-	-	-	-	-	-	-	61.0	61.0
2001	-	-	-	-	-	-	-	-	-	61.0	61.0
2002	-	-	-	-	-	-	-	-	-	61.0	61.0
2003	-	-	-	-	-	-	-	-	-	61.0	61.0
2004	-	-	-	-	-	-	-	-	-	61.0	61.0
2005	-	-	-	-	-	-	-	-	-	61.0	61.0
2006	-	-	-	-	-	-	-	-	-	61.0	61.0
2007	-	-	-	-	-	-	-	-	-	61.0	61.0
2008	-	-	-	-	-	-	-	-	-	61.0	61.0
2009	-	-	-	-	-	-	-	-	-	61.0	61.0
2010	-	-	-	-	-	-	-	-	-	61.0	61.0
2011	-	-	-	-	-	-	-	-	-	61.0	61.0
2012	-	-	-	-	-	-	-	-	-	61.0	61.0
2013	-	-	-	-	-	-	-	-	-	61.0	61.0
2014	-	-	-	-	-	-	-	-	-	61.0	61.0
2015	-	-	-	-	-	-	-	-	-	61.0	61.0
2016	-	-	-	-	-	-	-	-	-	61.0	61.0
2017	-	-	-	-	-	-	-	-	-	61.0	61.0
2018	-	-	-	-	-	-	-	-	-	61.0	61.0
2019	-	-	-	-	-	-	-	-	-	61.0	61.0

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7 - SCENARIO B - LOWER YIELDS (-10% FROM BASE CASE)

MADURU OYA PROJECT - NET BENEFITS

(MILLION RPS)

YEAR	TOTAL BENEFITS	TOTAL COSTS	NET BENEFITS
1980	-	236.3	-236.3
1981	4.0	794.4	-790.4
1982	4.0	932.8	-928.8
1983	-	806.4	-806.4
1984	77.5	466.3	-388.8
1985	145.1	531.6	-386.5
1986	219.1	460.1	-241.0
1987	298.1	329.2	-31.1
1988	400.2	329.8	70.4
1989	482.9	295.7	187.2
1990	553.8	66.0	487.8
1991	584.8	61.0	523.8
1992	606.0	61.0	545.0
1993	619.8	61.0	558.8
1994	625.1	61.0	564.1
1995	626.7	61.0	565.7
1996	630.1	61.0	569.1
1997	632.2	61.0	571.2
1998	635.2	61.0	574.2
1999	637.2	61.0	576.2
2000	638.2	61.0	577.2
2001	639.2	61.0	578.2
2002	642.2	61.0	581.2
2003	642.2	61.0	581.2
2004	642.2	61.0	581.2
2005	642.2	61.0	581.2
2006	642.2	61.0	581.2
2007	642.2	61.0	581.2
2008	642.2	61.0	581.2
2009	640.2	61.0	579.2
2010	640.2	61.0	579.2
2011	640.2	61.0	579.2
2012	640.2	61.0	579.2
2013	640.2	61.0	579.2
2014	640.2	61.0	579.2
2015	640.2	61.0	579.2
2016	642.2	61.0	581.2
2017	642.2	61.0	581.2
2018	642.2	61.0	581.2
2019	642.2	61.0	581.2

INTERNAL RATE OF RETURN: 0.08345365787

8 - SCENARIO B - MEDIUM YIELDS (8 YR TO MAXIMUM BENEFIT)

MADURU OYA PROJECT - AGRICULTURAL BENEFITS

	PRODUCTION (TONNES)					NET ECONOMIC RETURNS (000 RP)				
YEAR	1R	2R	2U	TOTAL	TOTAL PADDY	1R	2R	2U	TOTAL	TOTAL PADDY
1980	-	-	-	-	-	-	-	-	-	-
1981	-	-	-	-	-	-	-	-	-	-
1982	-	-	-	-	-	-	-	-	-	-
1983	-	-	-	-	-	-	-	-	-	-
1984	12,458	5,862	-	18,320	18,320	28,568	12,602	-	41,170	41,170
1985	27,378	19,055	-	46,432	46,432	62,780	40,966	-	103,746	103,746
1986	39,486	37,728	-	77,214	77,214	90,545	81,113	-	171,657	171,657
1987	53,548	57,721	-	111,269	111,269	122,789	124,096	-	246,886	246,886
1988	66,016	79,299	1,037	146,351	145,315	151,380	170,487	3,185	325,051	321,866
1989	82,955	97,591	2,168	182,714	180,546	190,222	209,813	6,660	406,695	400,035
1990	98,307	111,476	2,748	212,531	209,783	225,426	239,665	8,441	473,532	465,091
1991	105,286	119,935	2,955	228,176	225,221	241,429	257,852	9,078	508,359	499,281
1992	110,788	127,474	3,249	241,510	238,261	254,046	274,059	9,981	538,086	528,105
1993	115,491	133,756	3,543	252,790	249,247	264,831	287,565	10,885	563,281	552,396
1994	118,898	137,866	3,785	260,549	256,764	272,644	296,402	11,626	580,672	569,046
1995	121,069	140,340	3,992	265,401	261,409	277,622	301,721	12,263	591,606	579,343
1996	122,464	141,604	4,113	268,181	264,068	280,821	304,438	12,634	597,894	585,259
1997	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
1998	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
1999	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2000	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2001	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2002	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2003	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2004	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2005	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2006	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2007	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2008	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2009	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2010	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2011	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2012	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2013	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2014	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2015	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2016	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2017	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2018	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760
2019	122,864	141,875	4,147	268,886	264,740	281,739	305,022	12,738	599,499	586,760

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8 - SCENARIO B - MEDIUM YIELDS (8 YR TO MAXIMUM BENEFIT)

MADURU OYA PROJECT - TOTAL PROJECT BENEFITS

(MILLION RPS)

YEAR	WITHOUT PROJECT	PADDY UNDER PROJECT ST/RF	PIMB/VAK	NEW AREA	UPLAND CROPS	NET AGRIC BENEFITS	HOME-STEAD	LIVE-STOCK	FISHERY	FORESTRY	POWER	TOTAL BENEFITS
1980	79.0	38.0	41.0	-	-	-	-	-	-	-	-	-
1981	79.0	38.0	41.0	-	-	-	-	-	-	4.0	-	4.0
1982	79.0	38.0	41.0	-	-	-	-	-	-	4.0	-	4.0
1983	79.0	34.0	41.0	-	-	-4.0	-	-	-	4.0	-	-
1984	79.0	30.0	67.0	41.2	-	58.2	10.0	-5.0	-1.0	4.0	19.0	86.2
1985	79.0	20.0	74.0	103.7	-	124.7	20.0	-4.0	-1.0	4.0	19.0	162.7
1986	79.0	20.0	81.0	171.7	-	193.7	30.0	-4.0	-1.0	4.0	19.0	241.7
1987	79.0	6.0	90.0	246.8	-	263.8	40.0	-2.0	1.0	4.0	19.0	325.8
1988	79.0	-	92.0	321.8	3.2	338.1	50.0	1.0	1.0	16.0	19.0	425.1
1989	79.0	-	92.0	400.0	6.7	418.7	60.0	3.0	2.0	8.0	19.0	512.7
1990	79.0	-	92.0	465.1	8.4	486.5	64.0	10.0	2.0	8.0	19.0	590.5
1991	79.0	-	92.0	499.3	9.1	521.4	64.0	15.0	2.0	8.0	19.0	630.4
1992	79.0	-	92.0	528.1	10.0	551.1	64.0	18.0	2.0	8.0	19.0	663.1
1993	79.0	-	92.0	552.4	10.9	576.3	64.0	21.0	2.0	8.0	19.0	691.3
1994	79.0	-	92.0	569.0	11.6	593.7	64.0	23.0	2.0	9.0	19.0	710.7
1995	79.0	-	92.0	579.3	12.3	604.6	64.0	26.0	2.0	7.0	19.0	722.6
1996	79.0	-	92.0	585.3	12.6	610.8	64.0	29.0	2.0	7.0	19.0	731.8
1997	79.0	-	92.0	586.8	12.7	612.5	64.0	31.0	2.0	7.0	19.0	735.5
1998	79.0	-	92.0	586.8	12.7	612.5	64.0	34.0	2.0	7.0	19.0	738.5
1999	79.0	-	92.0	586.8	12.7	612.5	64.0	36.0	2.0	.0	19.0	740.5
2000	79.0	-	92.0	586.8	12.7	612.5	64.0	37.0	2.0	7.0	19.0	741.5
2001	79.0	-	92.0	586.8	12.7	612.5	64.0	38.0	2.0	7.0	19.0	742.5
2002	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	8.0	19.0	745.5
2003	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	8.0	19.0	745.5
2004	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	9.0	19.0	745.5
2005	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	9.0	19.0	745.5
2006	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	9.0	19.0	745.5
2007	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	9.0	19.0	745.5
2008	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	9.0	19.0	745.5
2009	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	9.0	19.0	745.5
2010	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	7.0	19.0	743.5
2011	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	7.0	19.0	743.5
2012	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	7.0	19.0	743.5
2013	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	7.0	19.0	743.5
2014	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	7.0	19.0	743.5
2015	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	7.0	19.0	743.5
2016	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	8.0	19.0	745.5
2017	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	8.0	19.0	745.5
2018	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	8.0	19.0	745.5
2019	79.0	-	92.0	586.8	12.7	612.5	64.0	39.0	2.0	8.0	19.0	745.5

8 - SCENARIO B - MEDIUM YIELDS (8 YR TO MAXIMUM BENEFIT)

MADURU OYA PROJECT - TOTAL PROJECT COSTS

(MILLION RPS)

YEAR	DAM AND TUNNEL	BRANCH CANALS	TERTIARY IRRIG.	UPSTREAM COSTS	EXPER FARM	ACCESS ROADS	SETTLE-MENT	PROJ MGT INFRA.	SUB TOTAL	O AND M	TOTAL COSTS
1980	204.3	-	-	18.0	-	-	-	14.0	236.3	-	236.3
1981	562.0	92.0	39.4	49.0	6.0	31.0	-	14.0	793.4	1.0	794.4
1982	596.0	153.3	60.5	53.0	7.0	35.0	11.0	14.0	929.8	3.0	932.8
1983	340.6	250.7	105.1	30.0	-	35.0	27.0	14.0	802.4	4.0	806.4
1984	-	250.7	118.6	-	-	35.0	28.0	14.0	446.3	20.0	466.3
1985	-	300.5	124.1	-	-	35.0	30.0	14.0	503.6	28.0	531.6
1986	-	239.2	112.9	-	-	35.0	24.0	14.0	425.1	35.0	460.1
1987	-	141.9	70.3	-	-	35.0	24.0	14.0	285.2	44.0	329.2
1988	-	141.9	64.9	-	-	35.0	21.0	14.0	276.8	53.0	329.8
1989	-	141.9	43.8	-	-	35.0	-	14.0	234.7	61.0	295.7
1990	-	-	-	-	-	-	-	5.0	5.0	61.0	66.0
1991	-	-	-	-	-	-	-	-	-	61.0	61.0
1992	-	-	-	-	-	-	-	-	-	61.0	61.0
1993	-	-	-	-	-	-	-	-	-	61.0	61.0
1994	-	-	-	-	-	-	-	-	-	61.0	61.0
1995	-	-	-	-	-	-	-	-	-	61.0	61.0
1996	-	-	-	-	-	-	-	-	-	61.0	61.0
1997	-	-	-	-	-	-	-	-	-	61.0	61.0
1998	-	-	-	-	-	-	-	-	-	61.0	61.0
1999	-	-	-	-	-	-	-	-	-	61.0	61.0
2000	-	-	-	-	-	-	-	-	-	61.0	61.0
2001	-	-	-	-	-	-	-	-	-	61.0	61.0
2002	-	-	-	-	-	-	-	-	-	61.0	61.0
2003	-	-	-	-	-	-	-	-	-	61.0	61.0
2004	-	-	-	-	-	-	-	-	-	61.0	61.0
2005	-	-	-	-	-	-	-	-	-	61.0	61.0
2006	-	-	-	-	-	-	-	-	-	61.0	61.0
2007	-	-	-	-	-	-	-	-	-	61.0	61.0
2008	-	-	-	-	-	-	-	-	-	61.0	61.0
2009	-	-	-	-	-	-	-	-	-	61.0	61.0
2010	-	-	-	-	-	-	-	-	-	61.0	61.0
2011	-	-	-	-	-	-	-	-	-	61.0	61.0
2012	-	-	-	-	-	-	-	-	-	61.0	61.0
2013	-	-	-	-	-	-	-	-	-	61.0	61.0
2014	-	-	-	-	-	-	-	-	-	61.0	61.0
2015	-	-	-	-	-	-	-	-	-	61.0	61.0
2016	-	-	-	-	-	-	-	-	-	61.0	61.0
2017	-	-	-	-	-	-	-	-	-	61.0	61.0
2018	-	-	-	-	-	-	-	-	-	61.0	61.0
2019	-	-	-	-	-	-	-	-	-	61.0	61.0

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8 - SCENARIO B - MEDIUM YIELDS (8 YR TO MAXIMUM BENEFIT)

MADURU OYA PROJECT - NET BENEFITS

(MILLION RPS)

YEAR	TOTAL BENEFITS	TOTAL COSTS	NET BENEFITS
1980	-	236.3	-236.3
1981	4.0	784.4	-780.4
1982	4.0	932.8	-928.8
1983	-	806.4	-806.4
1984	66.2	466.3	-380.1
1985	162.7	531.6	-368.9
1986	241.7	460.1	-218.4
1987	325.9	329.2	-3.3
1988	425.1	329.8	95.3
1989	512.7	295.7	217.0
1990	590.5	66.0	524.5
1991	630.4	61.0	569.4
1992	663.1	61.0	602.1
1993	691.3	61.0	630.3
1994	710.7	61.0	649.7
1995	722.6	61.0	661.6
1996	731.9	61.0	670.9
1997	735.5	61.0	674.5
1998	738.5	61.0	677.5
1999	740.5	61.0	679.5
2000	741.5	61.0	680.5
2001	742.5	61.0	681.5
2002	745.5	61.0	684.5
2003	745.5	61.0	684.5
2004	745.5	61.0	684.5
2005	745.5	61.0	684.5
2006	745.5	61.0	684.5
2007	745.5	61.0	684.5
2008	745.5	61.0	684.5
2009	743.5	61.0	682.5
2010	743.5	61.0	682.5
2011	743.5	61.0	682.5
2012	743.5	61.0	682.5
2013	743.5	61.0	682.5
2014	743.5	61.0	682.5
2015	743.5	61.0	682.5
2016	745.5	61.0	684.5
2017	745.5	61.0	684.5
2018	745.5	61.0	684.5
2019	745.5	61.0	684.5

INTERNAL RATE OF RETURN: 0.09420921705