PRIVATE SECTOR PARTICIPATION IN REHABILITATION OF IRRIGATION PROJECTS IN SRI LANKA

By

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Abstract

The functioning of irrigation schemes at optimum efficiency levels will contribute immensely towards the economic development of Sri Lanka. The efficiency of irrigation schemes can be improved by effective designing, planning and construction and equally important proper operation and maintenance (O & M). At present, the investments to build, operate and maintain irrigation schemes are borne by the public sector organizations in Sri Lanka. Since the Government of Sri Lanka (GOSL) faces financial difficulties for improving infrastructure facilities, even O & M works cannot be executed properly due to the lack of funds.

The main objectives of this study are to explore the viability of private sector participation (PSP) in rehabilitating irrigation schemes and to explore feasibility of recovery of O&M costs as Irrigation Service Fees (ISF) and the possibility of recovery of rehabilitation cost as Cost Recovery Fees (CRF) from the beneficiaries.

The study utilises two case studies to analyse rehabilitation of a major and a medium scale irrigation schemes in Badulla District through PSP. The case studies are analysed from the point of view of farmers, investors and national economy. The viability of implementation of project from the point of view of farmers and investors depend on the financial analysis and implementation of project by the GOSL is based on the economic analysis.

This study shows that viability of PSP and the possible recovery of ISF due to improved benefits in rehabilitating irrigation schemes. The national economy can benefit through PSP in the rehabilitation of existing irrigation projects in Sri Lanka.

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1.0 Introduction

1.1 Background

The agriculture sector plays an important role in the economy of Sri Lanka. Undisputedly agricultural development in Sri Lanka is dependent on effective irrigation systems, particularly in the Dry and Intermediate Zones, which constitute about two-thirds of the country.

The government of Sri Lanka (GOSL) is spending considerable amount of money for the development of the irrigation sector. However, this is comparatively small to that which is actually required. As a result, there is a tendency in recent times to neglect, the Operation and Maintenance (O & M) function in view of the high level of capital expenditure required by these projects. This has resulted in the progressive deterioration of existing irrigation schemes. Under these conditions, it has not been possible to operate and maintain the existing irrigation facilities at the optimum level of efficiency

Due to the poor O & M works, problems in irrigation systems have been accumulating over a long period. For example, some of the schemes have not been rehabilitated for over 15-20 years under a major rehabilitation programme. As a result, the efficiency of the systems has gone down causing reduction in agricultural productivity and economic losses to the country. It is necessary that these schemes should be rehabilitated to function at optimum level of efficiency. Once these schemes are rehabilitated, efficiency should increase and there will be less regular O & M works.

1.2 Research Problem

The insufficient funds from traditional sources for the proper O&M and the resulting deterioration of irrigation systems is the main problem. For example, the GOSL has allocated approximately Rs. 140 ~ 150 per acre in year 2000 for regular O & M works of the schemes in the study area whereas the actual requirement is about Rs. 900 per acre (Appendix A). However, to obtain optimum level of efficiency from these schemes, successful rehabilitation works are essential. Other options such as private sector participation (PSP) in rehabilitation of irrigation schemes should be considered to find the necessary funds. Clearly, this is a controversial consideration given the fact that historically the responsibility for providing irrigation services has been with the public sector.

1.3 Research Objectives

The main objectives of the research are

1. to explore the viability of PSP in rehabilitation of irrigation schemes.
2. to explore the use of Irrigation Service Fees (ISF) and Cost Recovery Fees (CRF) to recover Operation and Maintenance (O & M) costs and invested capital in rehabilitation from the beneficiaries during the return period.
3. to develop case studies from major and medium irrigation schemes, which are now taken up under the Irrigation Systems Rehabilitation Programme (ISRP) in the Badulla District to analyse the first two objectives.

1.4 Main Findings

The following are the major findings of this study

1. the investments to rehabilitate the two schemes selected as case studies are worthwhile as the projects are economically feasible at the 20% discount rate (Table 20(a) and Table 35(a)).
2. the case studies demonstrate that the GOSL can get the benefits of rehabilitation through the PSP (Table 20(b) to Table 20(f), Table 35(b) to Table 35(f)).
3. the regular O&M works can be attended at low cost once the major rehabilitation works are completed in the schemes.
4. theoretically farmers can afford to pay both ISF and CRF at the 20% discount rate (Table 20(b) to Table 20(f), Table 35(b) to Table 35(f)).
5. the recovery of ISF at 20% discount rate is viable considering farmers' willingness to pay (Table 20(b) and Table 35(b)). This is by assuming that O&M works can be done at 50% of the cost of theoretical requirement after rehabilitation.

6. ISF can further be reduced by increasing incentives to PSP until farmers are familiar with the system and subsequent increase of ISF is possible.
7. the GOSL will get the economical benefits only if productivity and profitability of the farmers are increased as a result of rehabilitation.
8. the farmers in these schemes do cultivations without knowing or following the correct agricultural techniques and instructions given by the Department of Irrigation and Department of Agriculture.
9. yield of the paddy and other crops(OFCC) such as Chilli, Maize, Green gram, Soya bean, which are at low levels in the selected schemes can be increased by proper seasonal planning, transplanting, using improved seeds against diseases, organic fertilizer, pest control and recommended fertilizer in correct proportions.
10. the change of cultivation practices, proper seasonal planning and introduction of OFCC are needed to mitigate water shortages and to increase farmer productivity and profitability.
11. contribution of family labour for agriculture is significant in these areas and it is not taken into account of their costs by most of the farmers. However, it should be and is considered in this study.

1.5 Structure of Report

This report is structured as follows.

The next chapter includes the literature review on investment in infrastructure and private sector participation in infrastructure projects. The third chapter describes the methodology adopted to analyse the financial and economic feasibility of PSP in irrigation projects. The forth chapter includes the different methods adopted to collect data and other information. The case studies to outline the methodology, which analyze the viability of PSP in existing irrigation schemes, a discussion on the suggested method and some issues that may come across in rehabilitation irrigation schemes through PSP and limitations of the study are presented in the fifth chapter. Finally, the last chapter contains the conclusions and recommendations of this study.

2.0 Literature Review

2.1 General

This chapter describes the literature review carried out for this study. For discussion purposes, it is classified under

- investment in infrastructure
- private sector participation in infrastructure projects

2.2 Investment in Infrastructure

The developing countries need to embark on extensive infrastructure provision in order to achieve and sustain economic growth and aspire towards the standards of the developed economics. In order to achieve these objectives, developing countries face two major constraints: unavailability of indigenous technological expertise and financial resources (Quartey, 1996). The traditional methods of project development, financing, implementation, management and operation do not fully alleviate these constraints.

Developing countries unfortunately have become associated with stigma of badly managed and operated public infrastructure, and the resulting unreliability carries cost implications. First, there is the cost of higher maintenance, operation and inevitably rehabilitation of construction (Quartey, 1996). Then there is the cost of making alternative provisions for the service the infrastructure facility has failed to provide, e.g electricity, water etc. There is also the cost of idle labour. While the facility is inoperable, those employed to utilize it to provide a service are idle, but still have to be remunerated. Finally, there is the cost of lost production and the revenue forfeited (Quartey, 1996).

Bazin (1986) notes that a World Bank study in 1980 of 60 developing countries found that half the utilities had very low rates of return and that several incurred losses. Inevitably, sooner than anticipated, the reliability of the facilities are jeopardized and the cost ramifications outlined above experienced. Plamer (1986) also concurs with the view that in developing countries, projects run down much faster due to the general absence of routine maintenance. According to Aschauer (1991), the lack of funds to finance infrastructure projects is one of the major causes for the economy's faltering productivity, profitability and private sector capital formation.

The importance in uplifting infrastructure facilities is so essential because

- The world bank states every 1% of growth in national out put requires a 1% increase in transport investment
- 1% increase in the stock of infrastructure capital would raise American productivity by 0.24% (Aschaner, 1991).

The infrastructure capital requirement is massive in the world and not only developing countries but also some of the developed countries face severe budget deficits to meet the needs in this field. In the United States, for example, the availability of federal grants for public works projects has been constrained by budget deficits, while the ability of state and municipal governments to finance construction through bond issues has been affected by changes in tax laws and limits on debt capacity imposed by law, political considerations, and capital markets (Beidleman et al. 1991).

The private sector advisory panel on infrastructure financing to the senate budget committee estimated that the shortage of infrastructure funds between 1988 and the year 2000 would be $ 240-488 billion nation wide with many localities already experiencing budget deficits (Lammie 1988). Other estimates range from $ 30 billion to simply recuperate the bridges and roads in the worst condition, to $ 500 billion to rebuild highways and airports and to help create digital data networks (Dias and Ioannou, 1996).

The shortage of public funds to finance the construction of new infrastructure projects and the rehabilitation of existing facilities, coupled with increased demands for capital on traditional alternative sources has contributed to the creation of alternative forms of project development (Dias and Ioannou, 1996). The need of alternative forms of project development has more intensified as the population grows, environmental regulation increases and infrastructure ages (Dias and Ioannou, 1996). The traditional forms of investments for infrastructure projects in most of the developing countries are budgetary allocations, bilateral and or multilateral donor funds. These sources are constrained and not adequately available to coup up the requirements with the fast changing economic conditions in the world. The budget deficits are increasing in most of the developing countries and challenging to find other options such as PSP.

To over come these constrains alternative forms of project developments such as build, operate and transfer (BOT) and build, operate and own (BOO) projects are being adopted in most of the developing countries with the private sector participation expecting improved efficiency and innovation (Liddle, 1997).

Liddle (1997) identified the following benefits from build-operate schemes in developing countries.

- Increased private sector participation in projects.
- Reduction in the debt burden on government and necessity for foreign sovereign guarantees.
- Scope for development of local capital markets.
- Ensuring rigorous and through appraisal, implementation and operation projects.
- Allowing speedy introduction of appropriate technology in developing countries.
- Providing a platform for effective technology transfer and training.

The project-financing pattern of recent in most of the developing countries in South and South East Asia have taken the form of BOT(Tam, 1995).

According to the International Finance Corporation (IFC), developing countries will require more than $ 3 trillion in new infrastructure over the next 10 years (Dias and Ioannou, 1996). The World Bank estimates that developing countries worldwide spend a total of US $ 200 billion annually on infrastructure development, and Asian Countries alone will account for about 80% of this expenditure.

Since these massive capital requirements cannot be found from public sector through the traditional sources of funding, the GOSL too has focused attention on PSP (Daily News, 1996) as practiced by other countries under different contractual arrangements.

2.3 Private Sector Participation in Infrastructure Projects

Private infrastructure projects have boomed around the world since the 1980s, in such sectors as waste disposal, power, water, transport, telecommunications and natural gas. Much of this activity has its origins in the deregulation policies in the United States during 1970s and in the privatization experiences of Chile, New Zealand, and the United Kingdom during the 1980s. These deregulation and privatization policies were driven by disenchantment with public sector performance, fiscal crises, and technological changes that have increased the scope for competition. Since 1984, eighty-six countries have privatized 547 infrastructure companies. At least 547 private Greenfield infrastructure projects are under way in some eighty-two countries. (So and Shin, 1995)

The World Bank's lending operations have supported this world wide private participation in infrastructure (PPI) movement. In 1988-94, the Bank provided funds for more than 500 infrastructure projects about a third of all bank operations in this period. Of these projects, ninety-two contained significant PPI components, including the privatization of public utilities, on lending to private sector operators, and franchising operations involving leases, concessions and management contracts. (Karasapan, 1995)

Privatization is also promoted as a way to investigate public budget deficits and attack the country's infrastructure crisis. Liddle (1995) identified that there are three basic ways in which the government can privatize infrastructure projects

- The government can contract one to a private company the operation and maintenance (O & M) of an existing project.
- The government can sell an existing facility to private company.
- The government can contract with a private firm to BOT a new project for an agreed on concession period, after which ownership would be transferred to the public sector.

Liddle (1995) also identified the following as the benefits of infrastructure privatization:

- Improved efficiency and innovation as private firms are more efficient; they can deliver the project at a lower cost. Private firms are more innovative in the selection design and operation phases of a project or service.
- Increased investment and projects, and lower public deficits; the private sector can increase investment and create more projects and can raise money for the government, thus lowering budget deficits.
- Gains in selection and design phase; the private sector can design, construct and perhaps operate the project regardless of ownership. It also has access to the international capital markets and can issue its own debt at competitive interest rates.
- Gains in operation and maintenance phase; gains from privatization in the operation and maintenance phase of infrastructure projects can come from both innovation and cost efficiencies.

3.0 Methodology

3.1 General

The possibility of private sector participation (PSP) in the rehabilitation of irrigation projects depends on the financial viability of that investment. However, the decision to permit PSP by the GOSL will depend on the economic feasibility of that project. This section will describe the analysis framework for economic feasibility and financial feasibility applicable to the rehabilitation of irrigation projects.

3.2 Analysis framework

The development of the two part theoretical framework as shown in Figure 1 is based on principles of engineering economics. The framework explores the viability of PSP in the rehabilitation of irrigation schemes. First part uses principles of economic feasibility to ensure that the rehabilitation of an irrigation scheme is worthwhile from viewpoint of the economy. Second part uses principles of financial feasibility to decide on the viability of PSP.

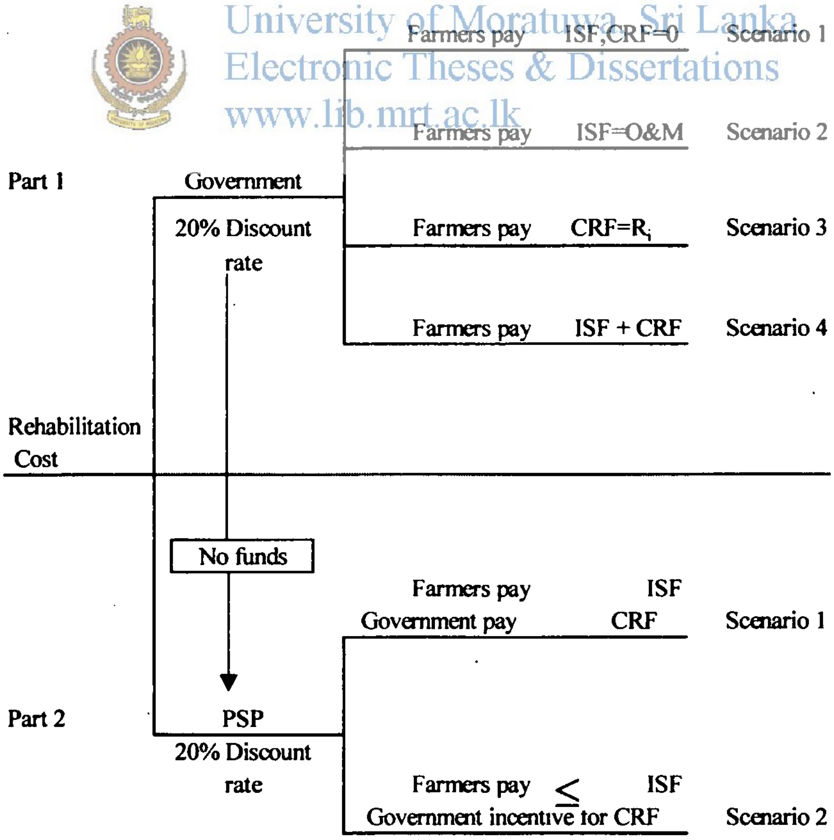


Figure 1. Analysis framework to recover ISF & CRF

The analysis based on the first part of the framework looks at four scenarios from an economic viewpoint. First, the GOSL should take the decision to implement the project considering the forecast economic benefits. The recovery of O&M costs as ISF from beneficiaries is the second scenario. The third explores the recovery of invested capital for rehabilitation as CRF. The recovery of both ISF and CRF from the beneficiaries is the forth scenario. Even if full cost recovery is possible from an economic viewpoint, the lack of funds for investment in feasible projects forces the GOSL to look for funds from Private Sector.

The analysis based on the second part of the framework also looks at two scenarios from the financial viewpoint. The first looks at the recovery O&M costs as ISF from the beneficiaries and the invested capital as CRF form the government. The ISF for the analysis in the part 1 is adopted for the analysis in the part 2 of the framework assuming feasibility of recovery of ISF from beneficiaries. In the second, innovative financial strategies that GOSL can adopt to promote PSP in the rehabilitation of irrigation projects as Government incentives are suggested.

The logic of this development is that GOSL can obtain the economic benefits of rehabilitating viable irrigation systems without using its scarce capital. Instead, with PSP, GOSL gets to convert capital expenditure into annual recurrent expenditure. Since the beneficiaries have to bear the O&M costs as ISF, it would create a sense of ownership of the rehabilitated asset.

3.3 Financial Viability

The project is evaluated from the view point of the investor. It is a tool that provides the investors with the information required to decide whether to undertake an investment. Hence, the objective of the financial analysis is to determine, analyse and interpret all financial consequences that may be relevant to and significant for investment and financing decisions. The financial feasibility of infrastructure projects is typically carried out at market prices prevailing at the time of analysis. This analysis considers the estimated actual costs and the forecasted financial benefits in terms of prevailing market prices.

In the project area where the rehabilitation is planned, there already exists the agricultural production, production cost and O&M cost data. The cost item, which is newly introduced, is the rehabilitation cost. The rehabilitation cost includes those required for improvements of head works, main systems, and sub systems and for other institutional developments, which will develop farmer attitudes, knowledge on the agriculture. The reduction of O &M cost is expected in this study as some of the O & M problems will not arise after rehabilitation programme.

The economic life of the project has to be determined for the purpose of evaluation. A number of economic and physical forces limit the economic life of any project. Physical depreciation, obsolescence, changing requirements for project services, time discount, allowances for risk and uncertainty may limit the present value of project services. The economic life of a project is determined as the point in time at which the effect of the foregoing factors cause the cost of continuing the project to exceed the additional benefits to be expected from continuation. As so used, the economic life is generally less then the estimated physical life. The economic life of these projects is assumed as 30 years (McCarthy and Perry, 1989).

3.4 Project costs

3.4.1 Construction cost

Project cost includes the actual construction cost for the rehabilitation of the irrigation facilities that bring about the increase of the agricultural production. In implementing major rehabilitation projects, the irrigation and farmer requirements are identified in detail by conducting different surveys. Once the rehabilitation needs are identified, the procedure of preparation of detail drawings and estimates are commenced. The project cost can be finalized only after this procedure. However, this takes a considerable time and cannot be applied to finalise the project costs for this study. The methodology adopted to estimate the base cost is by using sample estimates prepared for the selected areas representing the entire scheme. (ex. head works, main channel, distributory channels etc.)

3.4.2 Production cost

The present production cost of farmers to cultivate one acre lot was calculated from the information collected from the farmers, Agricultural Department officers, Cooperative Societies, Project Managers and published data during the surveys for different crops. The details of inputs such as labour, fertilizer, weedicide and pesticide costs, and applying quantities for cultivation of crops per acre were collected and production cost for the analysis estimated based on these information. The actual production costs to achieve forecast targets of yield were estimated based on the costs of cultivation of sample lots of seed paddy and recommended types and proportions by Agriculture Department for the crops for the selected areas.

It was found that the majority of farmers are not using correct agricultural techniques to obtain higher yield from the crops. The farmer awareness should be developed on irrigated agriculture, methodologies which will increase productivity and profitability under proper guidance and assistance. There are recommended crops, fertilizer, seed varieties, and pest control methods for different areas after analyzing soil properties, climatic conditions, topography etc. These recommendations should be followed by farmers to increase productivity.

3.4.3 Operation and Maintenance Cost

Although the operation and maintenance cost is listed as a cost item, it is actually a benefit for this study as the forecasted O&M cost is less than the present O &M cost. This was estimated based on the typical O&M cost per acre per annum for the gravity irrigation works which was based on the survey carried out for 16 selected schemes at one per range in year 1981 updated for the prices of year 2000 (1st quarter), (see Annex A).

Once the major rehabilitation works are done, there will be less regular O & M works and it was assumed for the analysis that O &M cost could be reduced to half of the requirement before rehabilitation. However, there may be possibilities of further reduction of forecast O&M cost after rehabilitation compared to the maintenance works carried out from the given funds at present.

3.5 Project Benefits

3.5.1 Revenue from Production

The recorded yield and the market prices of the dry seeds during the seasons for the last five years were collected from the records of farmers, Cooperative Societies and from the statistics division of District Secretary's office, Badulla. The present yield and the price represent the mean values of them. The revenue from production after rehabilitation is the forecast yield multiplied by the present market prices of yield.

Traditionally, most of the farmers cultivate paddy, even though it has low profitability in most of the irrigation schemes in the country. This culture has to be changed to face challenges in water saving, improving productivity and profitability. Therefore, the farmers should be encouraged to cultivate crops aiming the above factors. The cropping pattern has to be changed by introducing OFCC which are more profitable as well as efficient in saving water. The cultivation of paddy should be limited to areas which are more favorable for paddy and remaining areas should be cultivated with OFCC. It was found that yield of paddy, OFCC are relatively low, and they can be increased with improved water management, new agricultural techniques, proper seasonal planning etc.

3.5.2 Irrigation Service Fees (ISF) and Cost Recovery Fees (CRF)

These are suggested in line with the cost recovery principle of the GOSL in maintaining these irrigation systems. It is proposed to recover regular O & M costs as ISF and the cost of capital investments of the rehabilitation works as CRF in the study. The ISF and CRF can be either in monetary terms or collection of equivalent quantity of dry grains at the current market price of the year. The ISF and CRF in the analysis were done based on paddy for all crops. The ISF and CRF were reduced for the cultivators of OFCC with the intension of promoting them. The recovery of ISF or CRF or both may vary with the capital costs of rehabilitation, farmer revenue and costs, O&M costs and discount rate of investment.

This is clearly controversial. However, the research problem has identified that the lack of capital to rehabilitate irrigation works is not allowing them to provide optimum benefits. The present economic climate requires to consider the possible use of such financial instruments.

3.6 Financial Analysis

This analysis is based on cash flow techniques to compare and analyse the estimated revenues and costs. The net present value (NPV) of the irrigation scheme that needs to be rehabilitated is the basis for the decision. NPV analysis is most frequently used to determine the difference in present value of future money receipts and payments. The present value (PV) of cash flows over time is its value today, usually represented as time zero in a cash flow diagram. In other words, it is the time value obtained by discounting at a constant rate, generally called the Minimum Acceptable Rate of Return (MARR) separately for each year, the differences of all the annual cash outflows and inflows accruing through out the life of the project. Then, the fundamental relationship to determine the NPV of an alternative is given by,

$$NPV = PV(R) - PV(C) \qquad (1.0)$$

where PV(R) and PV(C) are the present values of revenues (benefits) and costs respectively.

The analysis is done to explore the financial feasibility of farmers and investors when the project is economically feasible. The project costs and benefits of the farmers before and after rehabilitation of the schemes are shown in cash flows in Figure 2 and Figure 3 respectively. The incremental costs and benefits of the farmers are shown in cash flow in Figure 4. The viability of PSP is analysed for the cash flows in Figure 5,6 and 7.

Net annual farmer income (before rehabilitation) = $I_i - X_i$

Net annual farmer income (after rehabilitation) = $L_i - Y_i - t_i$

Where I_i and L_i are revenues and X_i and Y_i are costs of productions. The t_i consists of ISF or CRF or both for different analysis.

The project is beneficial from the view point of farmers (beneficiaries) when the following condition is satisfied.

$$Li\text{-}Yi\text{-}ti > Ii\text{-}Xi \qquad (2.0)$$

or in incremental terms

$$\Delta Ii > \Delta Pi + ti$$

Based on the cash flow diagrams in Figures 5,6 and 7, the project to be financial feasible from the view point of investor, the following condition should be satisfied.

$$NPV = PV(ti) + PV(Si) - PV(O+m)i - PV(Ri) > 0 \qquad (3.0)$$

or

$$NPV = \sum_{i=1}^{30} \frac{ti}{(1+y)^i} + \sum_{i=1}^{30} \frac{Si}{(1+y)^i} - \sum_{i=1}^{30} \frac{(O+m)i}{(1+y)^i} - \sum_{i=1}^{3} \frac{Ri \prod_{j=0}^{i} (1+\Theta_J)}{(1+y)^i}$$

Where

ti - ISF or CRF or ISF&CRF

Ri - rehabilitation cost

y - discount rate of 20% is used as the minimum market rate for investment by Private Sector Investors

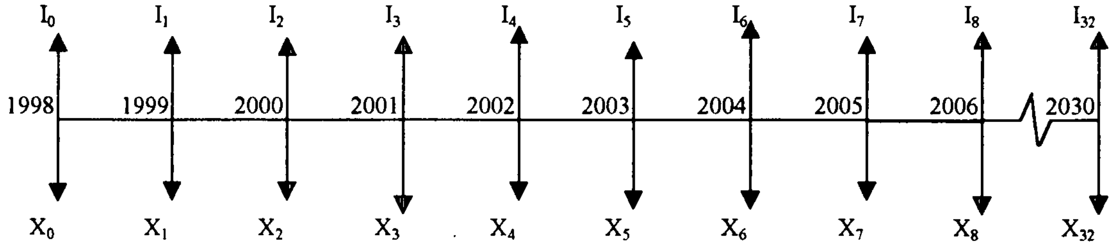
Si - Government Subsidy are all in financial terms

Θ_j - forecast escalation rate

CASH FLOW DIAGRAMS

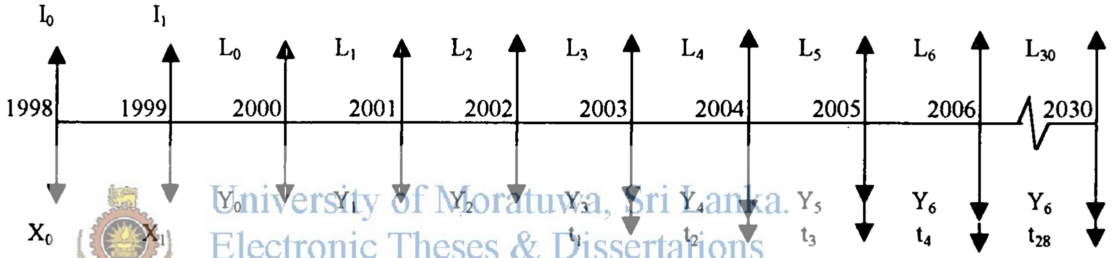
Point of view of Farmers

Figure 2 Before rehabilitation of project



Note : X_i - Production cost I_i - Farmer income

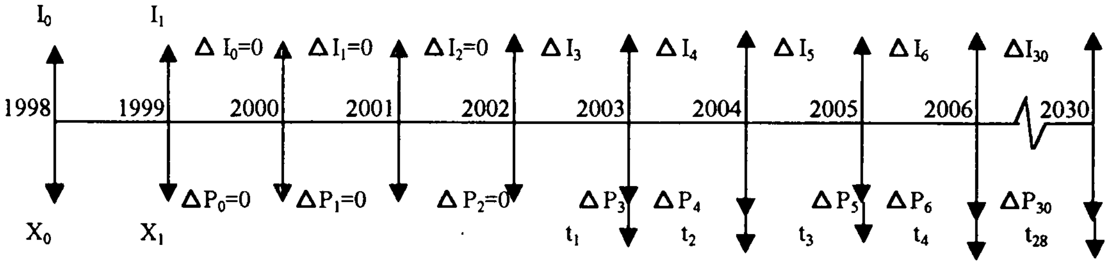
Figure 3 After rehabilitation of project



Note : $X_i \longrightarrow Y_i$ - Production cost $I_i \longrightarrow L_i$ - Farmer income

t_i - ISF & CRF

Figure 4 Incremental costs and benefits after rehabilitation of project

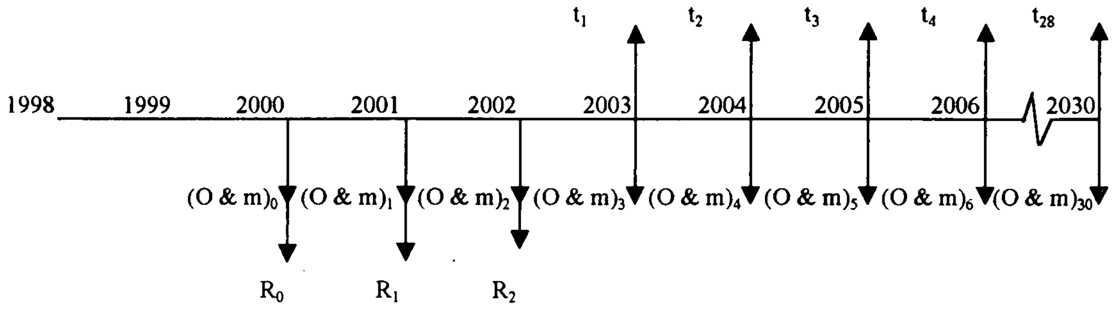


Note : $\Delta P_i \longrightarrow Y_i - X_i$ - Increase in production cost

$\Delta I_i \longrightarrow L_i - I_i$ - Increase in farmer revenue

CASH FLOW DIAGRAMS
Point of View of Investors

Figure 5 Farmers pay ISF and CRF



Note :

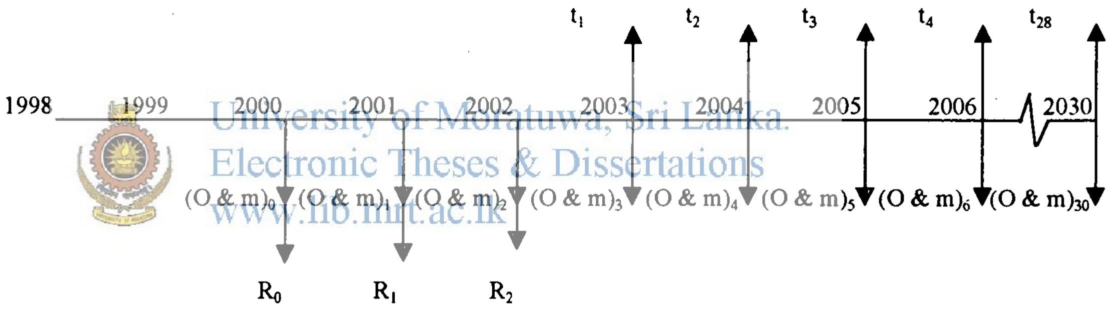
Costs

R$_i$ - Rehabilitation cost

Revenue

t$_i$ - ISF & CRF

Figure 6 Farmers pay ISF and Government pay CRF



Note :

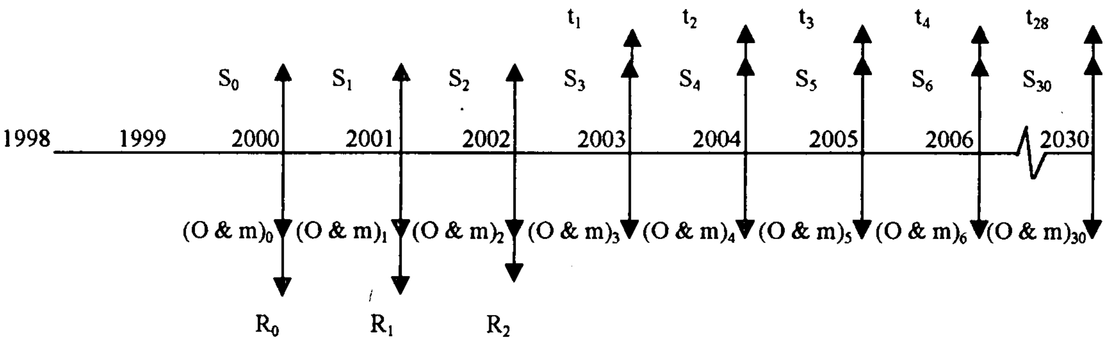
Costs

R$_i$ - Rehabilitation cost

Revenue

CRF$_i$ - ISF & CRF

Figure 7 Farmers pay ISF and CRF with government incentive



3.7 Economic Feasibility Analysis

The economic analysis looks at the rehabilitation of the project from the view point of the economy of the country. The difference between the financial analysis and economic analysis is that the market distortions in the financial analysis is corrected through shadow pricing in the tangible estimates and all intangible economic benefits and costs which are accepted by the Irrigation Department as practices of project implementation are included. An economic analysis is of the same as a financial analysis, except the case of an economic analysis, the benefits and costs are measured from the point of view of economy.

The financial feasibility analysis is carried out at the prevailing market prices of the goods and services in the relative year of the analysis. Taxes and subsidies (transfer payments), foreign exchange distortions, monopoly rents, and other externalities influence the market prices (Jenkins and Harberger, 1992). In a world without market failures or policy distortions, market prices would approximate to economic prices. Instead, market distortions cause market prices to diverge from economic prices.

Ideally, the prices of every input and out put should be adjusted so that economic prices can be approximated. Once the economic price is known, a conversion factor of the ratio of the economic price to the market price is used to facilitate this adjustment. Alternatively, the prices of goods, services can be converted to economic prices by using the conversion factors developed for the Department of National Planning by Curry and Lucking (1992).

The GOSL will benefit due to reduction in O&M costs after rehabilitation. The variations of O & M cost before and after rehabilitation of the scheme are shown in cash flows in Figure 8 and Figure 9 respectively. The implementation of the project by GOSL based on the economic NPV calculated in equation 4.0 for the incremental costs and benefits which are shown in cash flow diagram in Figure 10.

$$NPV = PV(\Delta Oi) + PV(\Delta Ji) + PV(ti) - PV(PV(\Delta Pi) - PV(Ri) > 0 \qquad (4.0)$$

or

$$NPV = \sum_{i=0}^{30} \frac{\Delta Oi}{(1+y)^i} + \sum_{i=0}^{30} \frac{\Delta Ii}{(1+y)^i} - \sum_{i=0}^{30} \frac{\Delta Pi}{(1+y)^i} - \sum_{i=1}^{3} \frac{R_i}{(1+y)^i}$$

Where

ΔOi - incremental reduction in O&M costs

ΔIi - incremental revenue from production

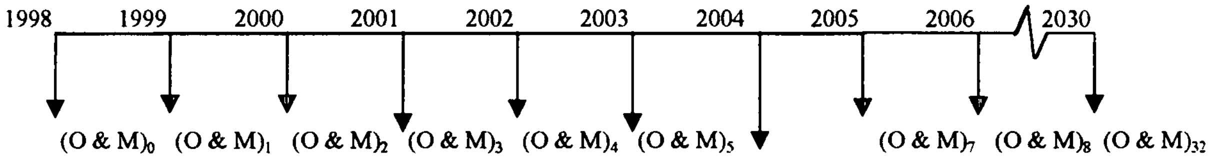
ΔPi - production cost

R_i - incremental rehabilitation cost

y - discount rate of 20% is used as the market rate as market distortions are corrected by shadow pricing

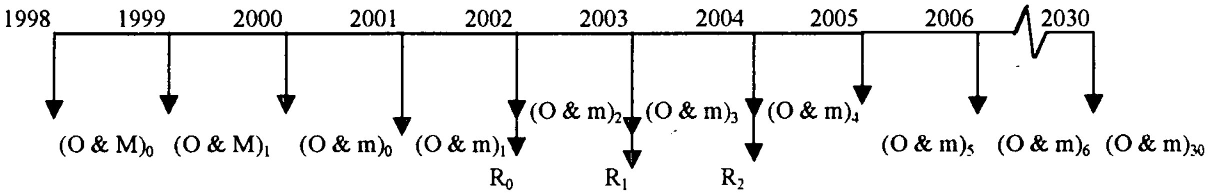
CASH FLOW DIAGRAMS
Point of View from National Economy

Figure 8 O&M costs of the GOSL before rehabilitation of project



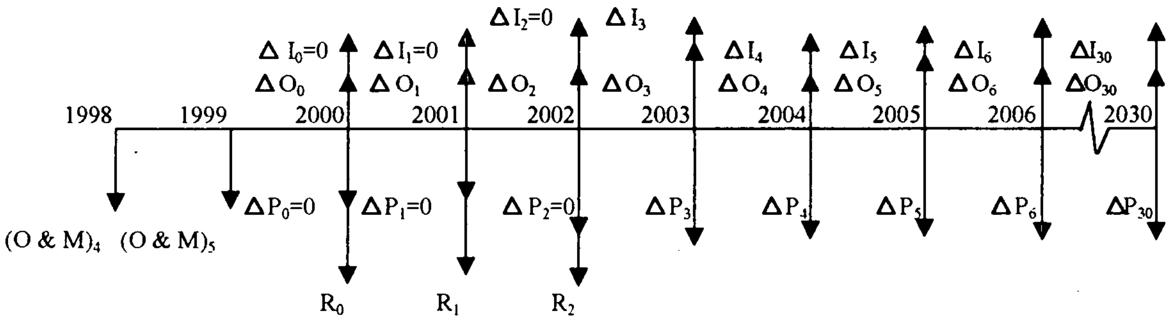
Note : $(O \& M)_i$ - Operation and Maintenance cost

Figure 9 O&M costs of the GOSL after rehabilitation of project



Note : $(O \& m)_i$ - Operation and Maintenance cost

Figure 10 Incremental costs and benefits for GOSL after rehabilitation of project



Note :

Costs

R_i - Rehabilitation cost
ΔP_i - Increase in production cost
$\Delta O_i \longrightarrow (O \& m)_i - (O \& M)_i$

Benefits

ΔO_i - Reduction in O & M cost
ΔI_i - Increase in farmer revenue

4.0 Data Collection

4.1 General

This chapter describes the methodology from which data were collected for the analysis of the rehabilitation of irrigation schemes. The study is based on the date collected from the following methods.

- Baseline surveys
- Walk through surveys
- Crop cutting surveys and
- Published information

4.2 Base line Surveys

This is the most important of all surveys in gathering information with respect to irrigation systems. The main objective of the survey is to identify the present status of engineering, socio economic, agriculture aspects and the level of performance of the scheme on future rehabilitation works and institutional development of the schemes. Similar surveys are conducted before and after rehabilitation works to compare the impact of rehabilitation. The survey is conducted by the different groups consisting of trained personnel, officers who are working in related fields and farmer representatives. The number of groups in each category will vary with the physical features and acreage of scheme, available resources and number of dates allocated for each survey.

The data were collected by interviewing the selected farmers, Heads of Schools, Grama Niladaris, Buddhist Monks, Government Officers in the each farmer organization area. The details were recorded at the site and were screened after collecting all the information to form a representative sample for the entire scheme.

4.3 Walk through Surveys

This is a field visit of the respective irrigation scheme to ascertain the immediate steps to be taken to improve the scheme from the present position. The physical rehabilitation works are planned and implemented based on the prioritized list of items of these surveys. This is vital to determine the rehabilitation cost of scheme.

4.4 Crop Cutting Surveys

The yield of irrigated lot is measured by crop cutting surveys just before harvesting. The yield of paddy is determined by harvesting a lot of 16'-6" x 16'-6" selected randomly. The yield of 1 acre or 1 hectare of the scheme or part of the scheme is based on the average of these results. The yield of paddy for this study was calculated based on recorded yield during last five years and from the details obtained from the baseline surveys. The yield of the OFCC were determined considering views of farmers and officers in Agriculture Department.

4.5 Published Information

The details of studies pertaining to different crops, recommendations of Department of Agriculture and Agrarian Service Department for these schemes were also collected from the textbooks, magazines and leaflets.

5.0 Case Studies

5.1 General

Two case studies of irrigation schemes in Badulla District requiring rehabilitation to demonstrate the framework developed in Chapter 3 using data collected as described in Chapter 4 to analyse the viability of PSP.

The two part theoretical framework shown by Figure 1 is the basis for recovery of ISF and CRF. The economic analysis considers four scenarios and financial analysis considers three scenarios. Both the economic analysis and the financial analysis are carried out at 20% discount rate. The argument being that after shadow pricing to remove the market distortions the economic analysis also could be at the same minimum rate as the financial analysis. However in reality an investor will need a rate above the minimum rate of 20% for their investments. As such estimated incentives by the government to attract PSP from the financial analysis is a minimum value. When the rehabilitation cost is provided by the GOSL, the viability of project is analysed from the national economic point of view considering the scenarios:

1. NPV>0 for the project at 20% discount rate; (the decision to be taken by the GOSL to implement the project)
2. farmers pay ISF=O&M at 20% discount rate; (the ISF is assumed as the maximum contribution of farmers' considering their acceptability)
3. farmers pay CRF at 20% discount rate; (minimum CRF to cover up rehabilitation cost) and
4. farmers pay ISF and CRF at the 20% discount rate (minimum ISF & CRF to cover up O&M and rehabilitation cost).

When the cost of the rehabilitation of project is provided by PSP, the financial viability of the project is analysed from the point of view of investors considering the scenarios:

1. farmers pay ISF and Government pay CRF at 20% discount rate (where ISF=O&M at 20% discount rate); and
2. farmers pay ≤ ISF and CRF as incentives of Government innovative financial strategies at 20% discount rate.

5.2 Case Study 1

5.2.1 General

Badulu Oya Irrigation Scheme

This scheme was built by constructing an anicut across Badulu Oya in 1956. It was designed to provide water to 1600 acres through 13 Km long main channel and 22 Km long field channels during Maha and Yala seasons. It has a catchment area of 114 Sq.miles covering Viyaluwa and Badulla electorates. The scheme was rehabilitated under Village Irrigation Rehabilitation Programme (VIRP) in 1983. The scheme plan of the Badulu Oya Scheme is shown in Figure 11.

The water management of the scheme is tedious due to deteriorated canal system during both seasons. There is an acute shortage of water during Yala Season causing frequent crop failures and to forces some areas specially at the tail ends of the canals to be abandoned. The rehabilitation works of the scheme under Irrigation Systems Rehabilitation Programme (ISRP) were commenced in year 2000.

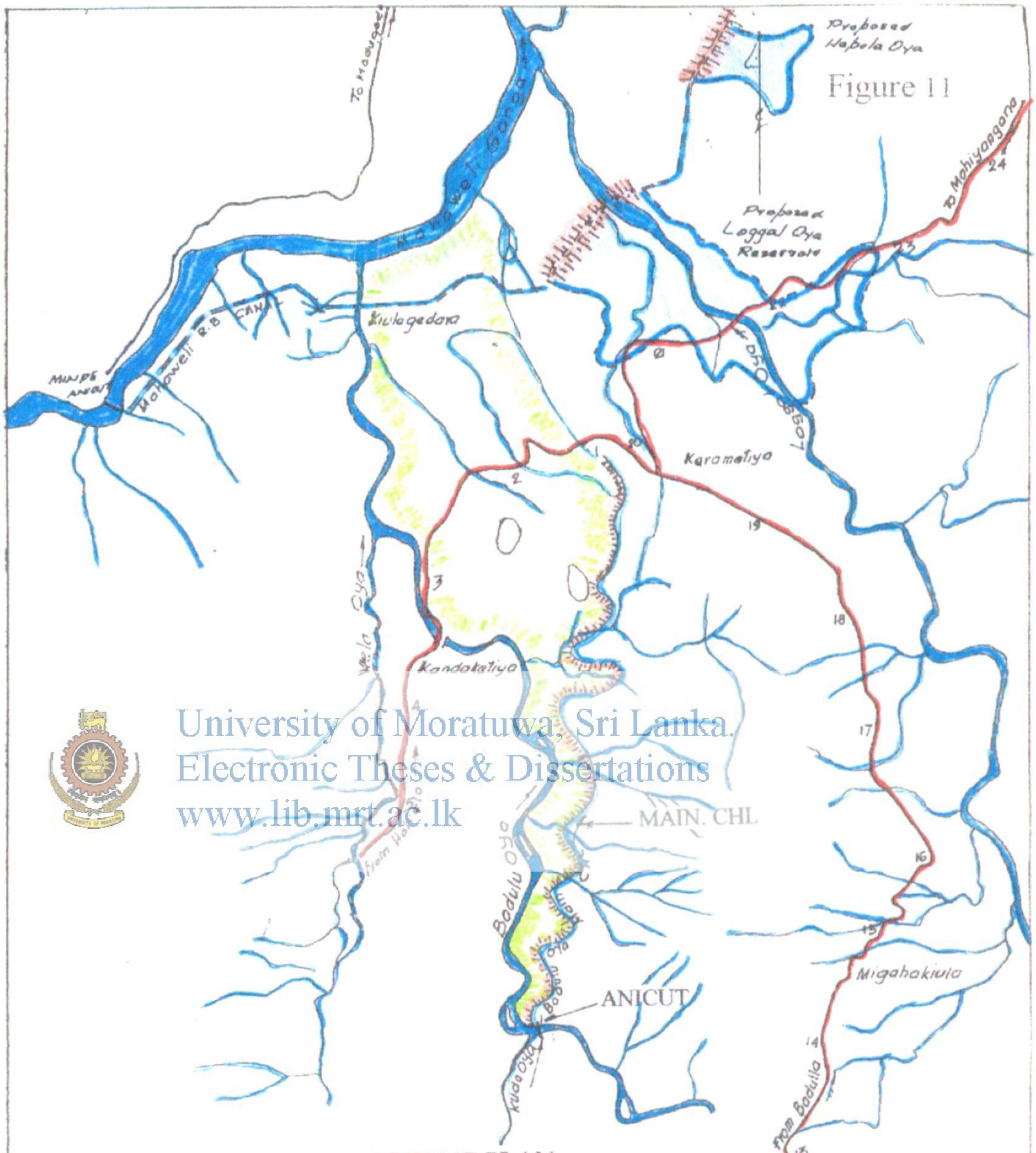
5.2.2 Data Collection

The details were collected as described in Chapter 4. The summaries of financial and economic costs and benefits due to increase in production of crops per acre are given in Table 1 to Table 6.

5.2.3 Financial and Economic Analysis

The financial and economic benefits due to increase in production as a result of the rehabilitation of Badulu Oya irrigation scheme are given in Table 7 to Table 11. The financial and economic benefits due to decrease in O & M costs after rehabilitation are given in Table 12. The financial and economic costs due to increase in production are given in Table 13 to Table 17. The total financial and economic costs and benefits due to increase in production are given in Tables 18 to Table 19 respectively.

The financial and economic analysis to analyse PSP or GOSL for funding for the rehabilitation of Badulu Oya Irrigation Scheme are given in Table 20(a) to Table 20(f) for the analysis framework in Figure 1. The analysis is in prices of 1st quarter in year 2000.



SCHEME PLAN

BADULU OYA ANICUT SCHEME

Coordinates	M/2 (7.00 x 4.28)
Catchment Area	114 Sq. Mls
Irrigable Area	1600 Acs
Anicut Type	Gravity
Length	217 Ft
Crest	573.0 MSL
Sluice	
Sill	568.0 MSL
Size	2 / 4 Ft x 4 Ft
Length of Main Channel	7 Mls and 500 Ft

5.2.4 Recovery of ISF and CRF

The recovery of ISF and CRF at 20% discount rate is feasible considering economic benefits of the project. The viability of the project depends on the farmers affordability and acceptability to these concepts. The lower the amount to be paid by the farmers higher will be the rate of acceptance. The recovery O&M cost as ISF was considered as the limit of acceptance. The financial analysis was too carried out restricting ISF to an equal amount of O&M. The ISF and CRF can both be reduced by introducing different financial strategies by the GOSL. The Table 21 shows the summary of ISF and CRF rates for the scenarios analysed.

5.2.5 Sensitivity Analysis

The viability of financial and economic analysis depends on estimated costs and forecast benefits which will vary with changes of agricultural productivity, price and expected rehabilitation cost. The impact on the project viability was studied by varying factors contributing to costs and benefits. The analysis was done for the scenario 1 of the part 1 of framework, the decision to be taken by GOSL to rehabilitate the irrigation schemes through PSP.

The economic NPV was calculated by varying the following above factors in the range –30% to 20% at 20% discount rate. The percentage variation Vs NPV is shown in Figure 12.

- Yield of paddy
- Price of paddy
- Yield of OFCC
- Price of OFCC
- Construction cost

Table 1. Financial and economic benefits and costs due to increase in production of paddy / acre - Maha season (Case Study 1 - Badulu Oya Irrigation Scheme)

Description	Convesion factor	Actual (1995-2000)				Economic value Rs.	Target year		Economic value Rs.	Remarks
		Unit	Quantity	Unit price Rs.	Amount Rs.		Quantity	Amount Rs.		
Gross income	0.697	Kg	1575	9.50	14962.50	10428.86	2520	23940.00	16686.18	Average yield at present 75 bu/ac and it can be increased to120 bu/ac
Production cost										after rehabilitation
Seed *	0.697	Bu	3	400.00	1200.00	836.40	3	1200.00	836.40	(1 bu = 21kg)
Fertilizer										Cultivation period - 4- 4 1/2 months
V1	0.650	Kg	25	18.00	450.00	292.50	-	-	-	Nursary Field
Urea	0.650	Kg	40	7.00	280.00	182.00	82	-	-	7.0 Kg 75.0 Kg
TDM	0.650	Kg	50	10.50	525.00	341.25	-	-	-	
TSP	0.650	Kg	-	19.50	-	-	35	682.50	443.63	10.0 Kg 25.0 Kg
MOP	0.650	Kg	-	12.50	-	-	18	225.00	146.25	3.0 Kg 15.0 Kg
Organic fertilizser	1.000	Ton	-	1000.00	-	-	2	2000.00	2000.00	Straw application
Weedicide	0.650	Item	Allow	Sum	1000.00	650.00	Allow	1000.00	650.00	Paddy varieties
										A.T 402, B.G 403, B.G 380
Pesticide	0.650	Item	Allow	Sum	1200.00	780.00	Allow	1200.00	780.00	B.G 379-2
Labour										
Family labour	0.785	days	15	100	1500.00	1177.50	15	1500.00	1177.50	
Hired labour	0.722	days	44	100	4400.00	3176.80	36	3600.00	2599.20	
Farm power										
Tillage	0.776	days	-	-	-		-	-		majority of farmers use tractors
Thrashing	0.776	days	1	750	750.00	582.00	1	750.00	582.00	
Animal										
Tillage	0.774	days	5	350	1750.00	1354.50	5	1750.00	1354.50	majority of farmers use cows and
Thrashing	0.744	days	-	-	-	-	-	-	-	buffaloes
Total cost		-	-	-	13055.00	9372.95	-	13907.50	10569.48	
Net income		-	-	-	1907.50	1055.91	-	10032.50	6116.71	
Increase in net income								8125.00		

* - Transplanting cultivation

Table 2. Financial and economic benefits and costs due to increase in production of paddy / acre - Yala season
(Case Study 1 - Badulu Oya Irrigation Scheme)

Description	Convesion factor	Actual (1995-2000)				Economic value Rs.	Target year		Economic value Rs.	Remarks
		Unit	Quantity	Unit price Rs.	Amount Rs.		Quantity	Amount Rs.		
Gross income	0.697	Kg	1470	9.50	13965.00	9733.61	2520	23940.00	16686.18	Average yield at present 70 bu/ac and it can be increased to120 bu/ac
Production cost										after rehabilitation
Seed *	0.697	Bu	3	400.00	1200.00	836.40	3	1200.00	836.40	(1 bu = 21kg)
Fertilizer										Cultivation period - 3- 3 1/2 months
V1	0.650	Kg	45	18.00	810.00	526.50	-	-	-	Nursary Field
Urea	0.650	Kg	50	7.00	350.00	227.50	62	434.00	282.10	7.0 kg 55.0 kg
TDM	0.650	Kg	40	10.50	420.00	273.00	-	-	-	
TSP	0.650	Kg	-	19.50	-	-	35	682.50	443.63	10.0 kg 25.0 kg
MOP	0.650	Kg	-	12.50	-	-	18	225.00	146.25	3.0 kg 15.0 kg
Organic fertilizser	1.000	Ton	-	1000.00	-	-	2	2000.00	2000.00	Straw application
Weedicide	0.650	Item	Allow	Sum	1200.00	780.00	Allow	1200.00	780.00	Paddy varieties
										B.G 357. B.G 352. B.G 350
Pesticide	0.650	Item	Allow	Sum	1200.00	780.00	Allow	1200.00	780.00	
Labour										
Family labour	0.785	days	15	100	1500.00	1177.50	15	1500.00	1177.50	
Hired labour	0.722	days	44	100	4400.00	3176.80	36	3600.00	2599.20	
Farm power										
Tillage	0.776	days	-	-	-		-	-		majority of farmers use tractors
Thrashing	0.776	days	1	750	750.00	582.00	1	750.00	582.00	
Animal										
Tillage	0.774	days	5	350	1750.00	1354.50	5	1750.00	1354.50	majority of farmers use cows and
Thrashing	0.744	days	-	-	-	-	-	-	-	buffaloes
Total cost		-	-	-	13580.00	9714.20	-	14541.50	10981.58	
Net income		-	-	-	385.00	19.41	-	9398.50	5704.61	
Increase in net income								9013.50		

* - Transplanting cultivation

Table 3. Financial and economic benefits and costs due to increase in production of green gram / acre - Yala season (Case Study 1 - Badulu Oya Irrigation Scheme)

Description	Convesion factor	Actual (1995-2000)				Economic value Rs.	Target year		Economic value Rs.	Remarks
		Unit	Quantity	Unit price Rs.	Amount Rs.		Quantity	Amount Rs.		
Gross income	0.723	Kg	400	40	16000.00	11568.00	675	27000.00	19521.00	M.I 5, Dharsha 77 Yield 1250-2100 kg/ha
Production cost										
Seed	0.723	Kg	8	75	600.00	433.80	12	900.00	650.70	Seed 30 kg/ha
Fertilizer										
V1	0.650	Kg	25	18.00	450.00	292.50	0	0.00	0.00	Basal Top dressing
TDM	0.650	Kg	0	10.50	0.00	0.00	0	0.00	0.00	
Urea	0.650	Kg	25	7.00	175.00	113.75	26	182.00	118.30	14 kg 12 kg
TSP	0.650	Kg	0	19.50	0.00	0.00	56	1092.00	709.80	56 kg
MOP	0.650	Kg	0	12.50	0.00	0.00	30	375.00	243.75	30 kg
Agreculture chemicals	0.650	Item	Allow	Sum	1500	975	Sum	1500	975	
Labour										
Family labour	0.785	days	15	150	2250.00	1766.25	15	2250.00	1766.25	
Hired labour	0.722	days	30	150	4500.00	3249.00	45	6750.00	4873.50	
Farm power										
Tillage	0.776	days	0	0	0.00	0.00	0	0.00	0.00	
Animal										
Tillage	0.774	days	2	350	700.00	541.80	2	700.00	541.80	majority of farmers use cows and
Total cost		-	-	-	10175.00	7372.10	-	13749.00	9879.10	buffaloes
Net income		-	-	-	5825.00	4195.90	-	13251.00	9641.90	
Increase in net income								7426.00		

Table 4. Financial and economic benefits and costs due to increase in production of maize / acre - Yala season (Case Study 1 - Badulu Oya Irrigation Scheme)

Description	Convesion factor	Actual (1995-2000) Unit	Quantity	Unit price Rs.	Amount Rs.	Economic value Rs.	Target year Quantity	Amount Rs.	Economic value Rs.	Remarks
Gross income	0.723	Kg	700	8.00	5600.00	4048.80	1400	11200.00	8097.60	Badra I Yield 4428-4500 kg/ha
Production cost										
Seed	0.723	Kg	8	30.00	240.00	173.52	5	900.00	650.70	(Imported seeds Rs.180/kg)
Fertilizer										Seed 16-20 Kg/Ha
V1	0.650	Kg	15	18.00	270.00	175.50	0	0.0	0.00	Basal Top dressing
TDM	0.650	Kg	0	10.50	0.00	0.00	0	0.00	0.00	
Urea	0.650	Kg	35	7.00	245.00	159.25	60	420.00	273.00	20 kg 40 kg
TSP	0.650	Kg	0	19.50	0.00	0.00	40	780.00	507.00	40 kg
MOP	0.650	Kg	0	12.50	0.00	0.00	20	250.00	162.50	20 kg
Agreculture chemicals	0.650	Item	Allow	400.00	0.00	0	Sum	600.00	390.00	
Labour										
Family labour	0.785	days	12	150	1800.00	1413.00	12	1800.00	1413.00	
Hired labour	0.722	days	20	150	3000.00	2166.00	30	4500.00	3249.00	
Farm power										
Tillage	0.776	days	0	0	0.00	0.00	0	0.00	0.00	
Animal										
Tillage	0.774	days	2	350	700.00	541.80	2	700.00	541.80	majority of farmers use cows and
Total cost		-	-	-	6255.00	4629.07	-	9950.00	7187.00	buffaloes
Net income		-	-	-	-655.00	-580.27	-	1250.00	910.60	
Increase in net income								1905.00		

Table 5. Financial and economic benefits and costs due to increase in production of soya bean / acre) - Yala season (Case Study 1 - Badulu Oya Irrigation Scheme)

Description	Convesion factor	Actual (1995-2000)				Economic value Rs.	Target year		Economic value Rs.	Remarks
		Unit	Quantity	Unit price Rs.	Amount Rs.		Quantity	Amount Rs.		
Gross income	0.723	Kg	600	25.00	15000.00	10845.00	1000	25000.00	18075.00	P.B 1 Yield 2500-3500 kg/ha
Production cost										
Seed	0.723	Kg	20	35.00	700.00	506.10	22	770.0	556.71	Seed 55 kg/ha
Fertilizer										
V1	0.650	Kg	0	18.00	0.00	0.00	0	0.0	0.00	Basal Top dressing
TDM	0.650	Kg	0	10.50	0.00	0.00	0	0.00	0.00	
Urea	0.650	Kg	35	7.00	245.00	159.25	60	420.00	273.00	20 kg 40 kg
TSP	0.650	Kg	0	19.50	0.00	0.00	60	1170.00	760.50	60 kg
MOP	0.650	Kg	30	12.50	375.00	243.75	30	375.00	243.75	30 kg
Agreculture chemicals	0.650	Item	Allow	Sum	1000.00	650.00	Sum`	1000.00	650.00	
Labour										
Family labour	0.785	days	10	125	1250.00	981.25	10	1250.00	981.25	
Hired labour	0.722	days	30	125	3750.00	2707.50	30	3750.00	2707.50	
Farm power										
Tillage	0.776	days	0	0	0.00	0.00	0	0.00	0.00	
Animal										
Tillage	0.774	days	1	350	350.00	270.90	1	350.00	270.90	majority of farmers use cows and
Total cost		-	-	-	7670.00	5518.75	-	9085.00	6443.61	buffaloes
Net income		-	-	-	7330.00	5326.25	-	15915.00	11631.39	
Increase in net income								8585.00		

Table 6. Financial and economic benefits and costs due to increase in production of Chilli / acre - Yala season (Case Study 1 - Badulu Oya Irrigation Scheme)

Description	Convesion factor	Actual (1995-2000)				Economic value Rs.	Target year		Economic value Rs.	Remarks
		Unit	Quantity	Unit price Rs.	Amount Rs.		Quantity	Amount Rs.		
Gross income	0.723	Kg	750	95.00	71250.00	51513.75	1000	95000.00	68685.00	Under Irrigation - Delhi Hot Yield 2500-3500 kg/ha
Production cost										
Seed	0.723	100 g	4	120.00	480.00	347.04	4	480.0	347.04	Seed 1 kg/ha
Fertilizer										Yield 2500-3500 kg/ha
V1	0.650	Kg	0	18.00	0.00	0.00	0	0.0	0.00	Basal Top dressing
TDM	0.650	Kg	0	10.50	0.00	0.00	0	0.00	0.00	
Urea	0.650	Kg	50	7.00	350.00	227.50	105	735.00	477.75	105 kg
TSP	0.650	Kg	0	19.50	0.00	0.00	40	780.00	507.00	40 kg
MOP	0.650	Kg	50	12.50	625.00	406.25	40	500.00	325.00	20 kg 20 kg
Agreculture chemicals	0.650	Item	Allow	Sum	2000.00	1300.00	Sum	3500.00	2275.00	
Labour										
Family labour	0.785	days	20	125	2500.00	1962.50	30	3750.00	2943.75	
Hired labour	0.722	days	30	125	3750.00	2707.50	50	6250.00	4512.50	
Farm power										
Tillage	0.776	days	0	0	0.00	0.00	0	0.00	0.00	
Animal										
Tillage	0.774	days	2	350	700.00	541.80	2	700.00	541.80	majority of farmers use cows and
Total cost		-	-	-	10405.00	7492.59	-	16695.00	11929.84	buffaloes
Net income		-	-	-	60845.00	44021.16	-	78305.00	56755.16	
Increase in net income								17460.00		

Table 7. Financial and economic benefits due to increase in production of paddy cultivation after rehabilitation (Case study 1 - Badulu Oya Irrigation Scheme)

Maha season

Command area = 1565.00 acres Before and after rehabilitation
Average yield = 75.00 bu/ac Before rehabilitation
120.00 bu/ac After rehabilitation

Yala Season

Command area = 1000.00 acres Before rehabilitation
1200.00 acres After rehabilitation
Average yield = 70.00 bu/ac Before rehabilitation
120.00 bu/ac After rehabilitation

Unit : Million Rs

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008-2030
Financial price									
Without project (A)	37.381	37.381	37.381	37.381	37.381	37.381	37.381	37.381	37.381
With project (B)	37.381	37.381	37.381	43.144	48.906	54.669	60.432	66.194	66.194
With - Without (B-A)	0.000	0.000	0.000	5.763	11.525	17.288	23.050	28.813	28.813
Economic price (Conversion factor) =			**0.697**						
Without project (C)	26.055	26.055	26.055	26.055	26.055	26.055	26.055	26.055	26.055
With project (D)	26.055	26.055	26.055	30.071	34.088	38.104	42.121	46.137	46.137
With - Without (D-C)	0.000	0.000	0.000	4.017	8.033	12.050	16.066	20.083	20.083

Assumed : Production will increase gradually after the construction period and it will reach maximum within 5 years time

Table 8. Financial and economic benefits due to increase in production of green gram cultivation after rehabilitation (Case study 1 - Badulu Oya Irrigation Scheme)

Maha season

Command area	=	10.00 acres	Before and after rehabilitation
Average yield	=	400.00 kg/ac	Before rehabilitation
		675.00 kg/ac	After rehabilitation

Yala Season

Command area	=	50.00 acres	Before rehabilitation
		100.00 acres	After rehabilitation
Average yield	=	400.00 kg/ac	Before rehabilitation
		675.00 kg/ac	After rehabilitation

Unit : Million Rs

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008-2030
Financial price									
Without project (A)	0.960	0.960	0.960	0.960	0.960	0.960	0.960	0.960	0.960
With project (B)	0.960	0.960	0.960	1.362	1.764	2.166	2.568	2.970	2.970
With - Without (B-A)	0.000	0.000	0.000	0.402	0.804	1.206	1.608	2.010	2.010
Economic price (Conversion factor) =			**0.723**						
Without project (C)	0.694	0.694	0.694	0.694	0.694	0.694	0.694	0.694	0.694
With project (D)	0.694	0.694	0.694	0.985	1.275	1.566	1.857	2.147	2.147
With - Without (D-C)	0.000	0.000	0.000	0.291	0.581	0.872	1.163	1.453	1.453

Assumed : Production will increase gradually after the construction period and it will reach maximum within 5 years time

Table 9. Financial and economic benefits due to increase in production of maize cultivation after rehabilittion (Case study 1 - Badulu Oya Irrigation Scheme)

Maha season

Command area	=	10.00 acres	Before and after rehabilitation
Average yield	=	700.00 kg/ac	Before rehabilitation
		1400.00 kg/ac	After rehabilitation

Yala Season

Command area	=	50.00 acres	Before rehabilitation
		100.00 acres	After rehabilitation
Average yield	=	700.00 kg/ac	Before rehabilitation
		1400.00 kg/ac	After rehabilitation

Unit : Million Rs

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008-2030
Financial price									
Without project (A)	0.336	0.336	0.336	0.336	0.336	0.336	0.336	0.336	0.336
With project (B)	0.336	0.336	0.336	1.568	2.800	4.032	5.264	6.496	6.496
With - Without (B-A)	0.000	0.000	0.000	1.232	2.464	3.696	4.928	6.160	6.160
Economic price (Conversion factor) =		**0.723**							
Without project (C)	0.243	0.243	0.243	0.243	0.243	0.243	0.243	0.243	0.243
With project (D)	0.243	0.243	0.243	1.134	2.024	2.915	3.806	4.697	4.697
With - Without (D-C)	0.000	0.000	0.000	0.891	1.781	2.672	3.563	4.454	4.454

Assumed : Production will increase gradually after the construction period and it will reach maximum within 5 years time

Table 10. Financial and economic benefits due to increase in production of soya bean cultivation after rehabilitation (Case study 1 - Badulu Oya Irrigation Scheme)

Maha season

Command area = 10.00 acres Before and after rehabilitation
Average yield = 600.00 kg/ac Before rehabilitation
1000.00 kg/ac After rehabilitation

Yala Season

Command area = 50.00 acres Before rehabilitation
100.00 acres After rehabilitation
Average yield = 600.00 kg/ac Before rehabilitation
1000.00 kg/ac After rehabilitation

Unit : Million Rs

Year	2000	2001	2002	2003	2004	2005	2006	2007	**2008-2030**
Financial price									
Without project (A)	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900
With project (B)	0.900	0.900	0.900	1.270	1.640	2.010	2.380	2.750	2.750
With - Without (B-A)	0.000	0.000	0.000	0.370	0.740	1.110	1.480	1.850	1.850
Economic price (Conversion factor) =			**0.723**						
Without project (C)	0.651	0.651	0.651	0.651	0.651	0.651	0.651	0.651	0.651
With project (D)	0.651	0.651	0.651	0.918	1.186	1.453	1.721	1.988	1.988
With - Without (D-C)	0.000	0.000	0.000	0.268	0.535	0.803	1.070	1.338	1.338

Assumed : Production will increase gradually after the construction period and it will reach maximum within 5 years time

Table 11. Financial and economic benefits due to increase in production of chilli cultivation after rehabilitation (Case study 1 - Badulu Oya Irrigation Scheme)

Maha season

Command area = 5.00 acres Before and after rehabilitation
Average yield = 750.00 kg/ac Before rehabilitation
1000.00 kg/ac After rehabilitation

Yala Season

Command area = 25.00 acres Before rehabilitation
100.00 acres After rehabilitation
Average yield = 750.00 kg/ac Before rehabilitation
1000.00 kg/ac After rehabilitation

Unit : Million Rs

Year	2000	2001	2002	2003	2004	2005	2006	2007	**2008-2030**
Financial price									
Without project (A)	2.138	2.138	2.138	2.138	2.138	2.138	2.138	2.138	2.138
With project (B)	2.138	2.138	2.138	3.705	5.273	6.840	8.408	9.975	9.975
With - Without (B-A)	0.000	0.000	0.000	1.568	3.135	4.703	6.270	7.838	7.838
Economic price (Conversion factor) =		**0.723**							
Without project (C)	1.545	1.545	1.545	1.545	1.545	1.545	1.545	1.545	1.545
With project (D)	1.545	1.545	1.545	2.679	3.812	4.945	6.079	7.212	7.212
With - Without (D-C)	0.000	0.000	0.000	1.133	2.267	3.400	4.533	5.667	5.667

Assumed : Production will increase gradually after the construction period and it will reach maximum within 5 years time

Table 12. Financial and economic benefits due to decrease in O & M costs after rehabilitaion (Case study 1 - Badulu Oya Irrigation Scheme)

Command area = 1600.00 acres

Financial

O & M expences = 900.00 Rs/ac Before rehabilitation
450.00 Rs/ac After rehabilitation

Economical

Production cost = 582.00 Rs/ac Before rehabilitation
291.00 Rs/ac After rehabilitation

Unit : Million Rs

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008-2030
Financial price									
Without project (A)	1.440	1.440	1.440	1.440	1.440	1.440	1.440	1.440	1.440
With project (B)	1.440	1.200	0.960	0.720	0.720	0.720	0.720	0.720	0.720
With - Without (B-A)	0.000	-0.240	-0.480	-0.720	-0.720	-0.720	-0.720	-0.720	-0.720
Economic value									
Without project (C)	0.931	0.931	0.931	0.931	0.931	0.931	0.931	0.931	0.931
With project (D)	0.931	0.776	0.621	0.466	0.466	0.466	0.466	0.466	0.466
With - Without (D-C)	0.000	-0.155	-0.310	-0.466	-0.466	-0.466	-0.466	-0.466	-0.466

Assumed : O & M cost will decrease gradually during the construction period and it will reach minimun after construction and remain constant thereafter.

Table 13. Financial and economic costs due to increase in production of paddy after rehabilitation (Case study 1 - Badulu Oya Irrigation Scheme)

Maha season

Command area =	1565.00 acres	Before and after rehabilitation	

Yala season

Command area =	1000.00 acres	Before rehabilitation	
	1200.00 acres	After rehabilitation	

Financial

Production cost =	13317.50 Rs/ac	Before rehabilitation	(Average of Yala Maha)
	14224.50 Rs/ac	After rehabilitation	

Economical

Production cost =	9543.58 Rs/ac	Before rehabilitation	(Average of Yala Maha)
	10775.53 Rs/ac	After rehabilitation	

Unit : Million Rs

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008-2030
Financial price									
Without project (A)	34.159	34.159	34.159	34.159	34.159	34.159	34.159	34.159	34.159
With project (B)	34.159	34.159	34.159	35.194	36.228	37.262	38.296	39.331	39.331
With - Without (B-A)	0.000	0.000	0.000	1.034	2.069	3.103	4.137	5.171	5.171
Economic value									
Without project (C)	24.479	24.479	24.479	24.479	24.479	24.479	24.479	24.479	24.479
With project (D)	24.479	24.479	24.479	25.542	26.605	27.668	28.731	29.794	29.794
With - Without (D-C)	0.000	0.000	0.000	1.063	2.126	3.189	4.252	5.315	5.315

Assumed : Production cost increase will start after three years and it will reach maximum within 5 years time

Table 14. Financial and economic costs due to increase in production of grean gram after rehabilitation (Case study 1 - Badulu Oya Irrigation Scheme)

Maha season

Command area =	10.00 acres	Before and after rehabilitation

Yala season

Command area =	50.00 acres	Before rehabilitation
	100.00 acres	After rehabilitation

Financial

Production cost =	10175.00 Rs/ac	Before rehabilitation
	13749.00 Rs/ac	After rehabilitation

Economical

Production cost =	7372.10 Rs/ac	Before rehabilitation
	9879.10 Rs/ac	After rehabilitation

Unit : Million Rs

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008-2030
Financial price									
Without project (A)	0.611	0.611	0.611	0.611	0.611	0.611	0.611	0.611	0.611
With project (B)	0.611	0.611	0.611	0.791	0.971	1.152	1.332	1.512	1.512
With - Without (B-A)	0.000	0.000	0.000	0.180	0.361	0.541	0.722	0.902	0.902
Economic value									
Without project (C)	0.442	0.442	0.442	0.442	0.442	0.442	0.442	0.442	0.442
With project (D)	0.442	0.442	0.442	0.571	0.700	0.829	0.958	1.087	1.087
With - Without (D-C)	0.000	0.000	0.000	0.129	0.258	0.387	0.516	0.644	0.644

Assumed : Production cost increase will start gradullay after the construction period and it will reach maximum within 5 years time

Table 15. Financial and economic costs due to increase in production of maize cultivation after rehabilitation (Case study 1 - Badulu Oya Irrigation Scheme)

Maha season

Command area =	10.00 acres	Before and after rehabilitation

Yala season

Command Area =	50.00 acres	Before rehabilitation
	100.00 acres	After rehabilitation

Financial

Production cost =	6255.00 Rs/ac	Before rehabilitation
	9950.00 Rs/ac	After rehabilitation

Economical

Production cost =	4629.07 Rs/ac	Before rehabilitation
	7187.00 Rs/ac	After rehabilitation

Unit : Million Rs

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008-2030
Financial price									
Without project (A)	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375
With project (B)	0.375	0.375	0.375	0.519	0.663	0.807	0.951	1.095	1.095
With - Without (B-A)	0.000	0.000	0.000	0.144	0.288	0.432	0.575	0.719	0.719
Economic Value									
Without project (C)	0.509	0.509	0.509	0.509	0.509	0.509	0.509	0.509	0.509
With project (D)	0.509	0.509	0.509	0.565	0.622	0.678	0.734	0.791	0.791
With - Without (D-C)	0.000	0.000	0.000	0.056	0.113	0.169	0.225	0.281	0.281

Assumed : Production cost increase will start gradullay after the construction period and it will reach maximum within 5 years time

Table 16. Financial and economic costs due to increase in production of soya bean cultivation after rehabilitation (Case study 1 - Badulu Oya Irrigation Scheme)

Maha season		
Command area =	10.00 acres	Before and after rehabilitation
Yala season		
Command Area =	50.00 acres	Before rehabilitation
	100.00 acres	After rehabilitation
Financial		
Production cost =	7670.00 Rs/ac	Before rehabilitation
	9085.00 Rs/ac	After rehabilitation
Economical		
Production cost =	5518.75 Rs/ac	Before rehabilitation
	6443.61 Rs/ac	After rehabilitation

Unit : Million Rs

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008-2030
Financial price									
Without project (A)	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460
With project (B)	0.460	0.460	0.460	0.568	0.676	0.784	0.892	0.999	0.999
With - Without (B-A)	0.000	0.000	0.000	0.108	0.216	0.323	0.431	0.539	0.539
Economic value									
Without project (C)	0.331	0.331	0.331	0.331	0.331	0.331	0.331	0.331	0.331
With project (D)	0.331	0.331	0.331	0.407	0.482	0.558	0.633	0.709	0.709
With - Without (D-C)	0.000	0.000	0.000	0.076	0.151	0.227	0.302	0.378	0.378

Assumed : Production cost increase will start gradullay after the construction period and it will reach maximum within 5 years time

Table 17. Financial and economic costs due to increase in production of chilli cultivation after rehabilitation (Case study 1 - Badulu Oya Irrigation Scheme)

Maha season

Command area = 5.00 acres Before and after rehabilitation

Yala season

Command area = 25.00 acres Before rehabilitation
100.00 acres After rehabilitation

Financial

Production cost = 10405.00 Rs/ac Before rehabilitation
16695.00 Rs/ac After rehabilitation

Economical

Production cost = 7492.59 Rs/ac Before rehabilitation
11929.84 Rs/ac After rehabilitation

Unit : Million Rs

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008-2030
Financial price									
Without project (A)	0.312	0.312	0.312	0.312	0.312	0.312	0.312	0.312	0.312
With project (B)	0.312	0.312	0.312	0.600	0.888	1.177	1.465	1.753	1.753
With - Without (B-A)	0.000	0.000	0.000	0.288	0.576	0.864	1.153	1.441	1.441
Economic value									
Without project (C)	0.225	0.225	0.225	0.225	0.225	0.225	0.225	0.225	0.225
With project (D)	0.225	0.225	0.225	0.430	0.636	0.841	1.047	1.253	1.253
With - Without (D-C)	0.000	0.000	0.000	0.206	0.411	0.617	0.822	1.028	1.028

Assumed : Production cost increase will start gradullay after the construction period and it will reach maximum within 5 years time

Table 18. Total financial and economic benefits due to increase in production after rehabilitation (Case study 1 - Badulu Oya Irrigation Scheme)

Unit : Million Rs

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008-2030
Paddy									
Financial (with - without)	0.000	0.000	0.000	5.763	11.525	17.288	23.050	28.813	28.813
Economic (with - without)	0.000	0.000	0.000	4.017	8.033	12.050	16.066	20.083	20.083
Green gram									
Financial (with - without)	0.000	0.000	0.000	0.402	0.804	1.206	1.608	2.010	2.010
Economic (with - without)	0.000	0.000	0.000	0.291	0.581	0.872	1.163	1.453	1.453
Maize									
Financial (with - without)	0.000	0.000	0.000	1.232	2.464	3.696	4.928	6.160	6.160
Economic (with - without)	0.000	0.000	0.000	0.891	1.781	2.672	3.563	4.454	4.454
Soya bean									
Financial (with - without)	0.000	0.000	0.000	0.370	0.740	1.110	1.480	1.850	1.850
Economic (with - without)	0.000	0.000	0.000	0.268	0.535	0.803	1.070	1.338	1.338
Chilli									
Financial (with - without)	0.000	0.000	0.000	1.568	3.135	4.703	6.270	7.838	7.838
Economic (with - without)	0.000	0.000	0.000	1.133	2.267	3.400	4.533	5.667	5.667
Total financial	0.000	0.000	0.000	9.334	18.668	28.002	37.336	46.670	46.670
Total economic	0.000	0.000	0.000	7.135	14.271	21.406	28.542	35.677	35.677

Table 19. Total financial and economic costs due to increase in production after rehabilitation (Case study 1 - Badulu Oya Irrigation Scheme)

Unit : Million Rs

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008-2030
Paddy									
Financial (with - without)	0.000	0.000	0.000	1.034	2.069	3.103	4.137	5.171	5.171
Economic (with - without)	0.000	0.000	0.000	1.063	2.126	3.189	4.252	5.315	5.315
Green gram									
Financial (with - without)	0.000	0.000	0.000	0.180	0.361	0.541	0.722	0.902	0.902
Economic (with - without)	0.000	0.000	0.000	0.129	0.258	0.387	0.516	0.644	0.644
Maize									
Financial (with - without)	0.000	0.000	0.000	0.144	0.288	0.432	0.575	0.719	0.719
Economic (with - without)	0.000	0.000	0.000	0.056	0.113	0.169	0.225	0.281	0.281
Soya bean									
Financial (with - without)	0.000	0.000	0.000	0.108	0.216	0.323	0.431	0.539	0.539
Economic (with - without)	0.000	0.000	0.000	0.076	0.151	0.227	0.302	0.378	0.378
Chilli									
Financial (with - without)	0.000	0.000	0.000	0.288	0.576	0.864	1.153	1.441	1.441
Economic (with - without)	0.000	0.000	0.000	0.206	0.411	0.617	0.822	1.028	1.028
Total financial	0.000	0.000	0.000	1.754	3.509	5.263	7.018	8.772	8.772
Total economic	0.000	0.000	0.000	1.529	3.059	4.588	6.117	7.646	7.646

Table. 20(a) Economical analysis for Badulu Oya Irrigation Scheme

Scenario 1						
Year	R_i	R_i	ΔP_i	ΔI_i	ΔO_i	NPV of Project
Economical analysis - Part 1						
		C.F				
Discount rate		*0.900*				*20%*
2000	15.000	13.500	0.000	0.000	0.000	-13.500
2001	20.000	18.000	0.000	0.000	0.155	-14.871
2002	20.000	18.000	0.000	0.000	0.310	-12.284
2003			1.529	7.135	0.466	3.514
2004			3.059	14.271	0.466	5.632
2005			4.588	21.406	0.466	6.946
2006			6.117	28.542	0.466	7.666
2007			7.646	35.677	0.466	7.953
2007=2029						
2030			7.646	35.677	0.466	0.120
						30.219

Table. 20(b) Economical analysis for Badulu Oya Irrigation Scheme

Scenario 2							
Year	R_i	ΔP_i	ΔI_i	ΔO_i	$(O \& m)_i$	Farmers pay ISF	NPV of $-(O \& m)_i$ + ISF
Economical analysis - Part 1							
Discount rate						*20%*	*20%*
2000	13.500	0.000	0.000	0.000	0.931	0.000	-0.931
2001	18.000	0.000	0.000	0.155	0.776	0.000	-0.647
2002	18.000	0.000	0.000	0.310	0.621	0.000	-0.431
2003		1.529	7.135	0.466	0.466	1.048	0.337
2004		3.059	14.271	0.466	0.466	1.048	0.281
2005		4.588	21.406	0.466	0.466	1.048	0.234
2006		6.117	28.542	0.466	0.466	1.048	0.195
2007		7.646	35.677	0.466	0.466	1.048	0.162
2007=2029							
2030		7.646	35.677	0.466	0.466	1.048	0.002
							0.000

Table. 20(c) Economical analysis for Badulu Oya Irrigation Scheme

Scenario 3							
Year	R_i	ΔP_i	ΔI_i	ΔO_i	$(O \& m)_i$	Farmers pay CRF	NPV of $-R_i$ + CRF
Economical analysis - Part 1							
Discount rate						*20%*	*20%*
2000	13.500	0.000	0.000	0.000	0.931	0.000	-13.500
2001	18.000	0.000	0.000	0.155	0.776	0.000	-15.000
2002	18.000	0.000	0.000	0.310	0.621	0.000	-12.500
2003		1.529	7.135	0.466	0.466	11.880	6.875
2004		3.059	14.271	0.466	0.466	11.880	5.729
2005		4.588	21.406	0.466	0.466	11.880	4.774
2006		6.117	28.542	0.466	0.466	11.880	3.979
2007		7.646	35.677	0.466	0.466	11.880	3.315
2007=2029							
2030		7.646	35.677	0.466	0.466	11.880	0.050
							0.000

Table. 20(d) Economical analysis for Badulu Oya Irrigation Scheme

Scenario 4							
Year	R_i	ΔP_i	ΔI_i	ΔO_i	$(O \& m)_i$	Farmers pay ISF	Farmers pay CRF
Economical analysis - Part 1							
Discount rate						*20%*	*20%*
2000	13.500	0.000	0.000	0.000	0.931	0.000	0.000
2001	18.000	0.000	0.000	0.155	0.776	0.000	0.000
2002	18.000	0.000	0.000	0.310	0.621	0.000	0.000
2003		1.529	7.135	0.466	0.466	1.048	11.880
2004		3.059	14.271	0.466	0.466	1.048	11.880
2005		4.588	21.406	0.466	0.466	1.048	11.880
2006		6.117	28.542	0.466	0.466	1.048	11.880
2007		7.646	35.677	0.466	0.466	1.048	11.880
2007=2029							
2030		7.646	35.677	0.466	0.466	1.048	11.880

Table. 20(e) Financial analysis for Badulu Oya Irrigation Scheme

Scenario 1					
Year	R_i	$(O \& m)_i$	Farmers pay ISF	Government pay CRF	NPV of Investor
Financial analysis - Part 2					
Discount rate			*CF=.697*	*20%*	*20%*
2000	13.500	1.440	0.000	0.000	-14.940
2001	18.000	1.200	0.000	0.000	-16.000
2002	18.000	0.960	0.000	0.000	-13.167
2003		0.720	1.503	11.997	7.396
2004		0.720	1.503	11.997	6.163
2005		0.720	1.503	11.997	5.136
2006		0.720	1.503	11.997	4.280
2007		0.720	1.503	11.997	3.567
2007=2029					
2030		0.720	1.503	11.997	0.054
					0.000

Table. 20(f) Financial analysis for Badulu Oya Irrigation Scheme

Scenario 2					
Year	R_i	$(O \& m)_i$	Farmers pay ISF	Minimum Government incentive	NPV of Investor
Financial analysis - Part 2					
Discount rate			*CF=.697*		*20%*
2000	13.500	1.440	0.000	3.034	-11.906
2001	18.000	1.200	0.000	3.034	-13.471
2002	18.000	0.960	0.000	3.034	-11.059
2003		0.720	1.503	3.034	2.209
2004		0.720	1.503	3.034	1.841
2005		0.720	1.503	3.034	1.534
2006		0.720	1.503	3.034	1.279
2007		0.720	1.503	3.034	1.065
2007=2029					
2030		0.720	1.503	3.034	0.016
					0.000

Where

R_i - Rehabilitation cost
ΔP_i - Increase in production cost
ΔO_i - Reduction in O & M cost
ΔI_i - Increase in farmer revenue
t_i - ISF & CRF
$(O \& m)_i$ - O&M cost after rehabilitation

- Return period 30 years

- Figures are given in Rs. M

Table 21: Summary of ISF & CRF for the Scenarios in Case Study 1
Badulu Oya Irrigation Scheme

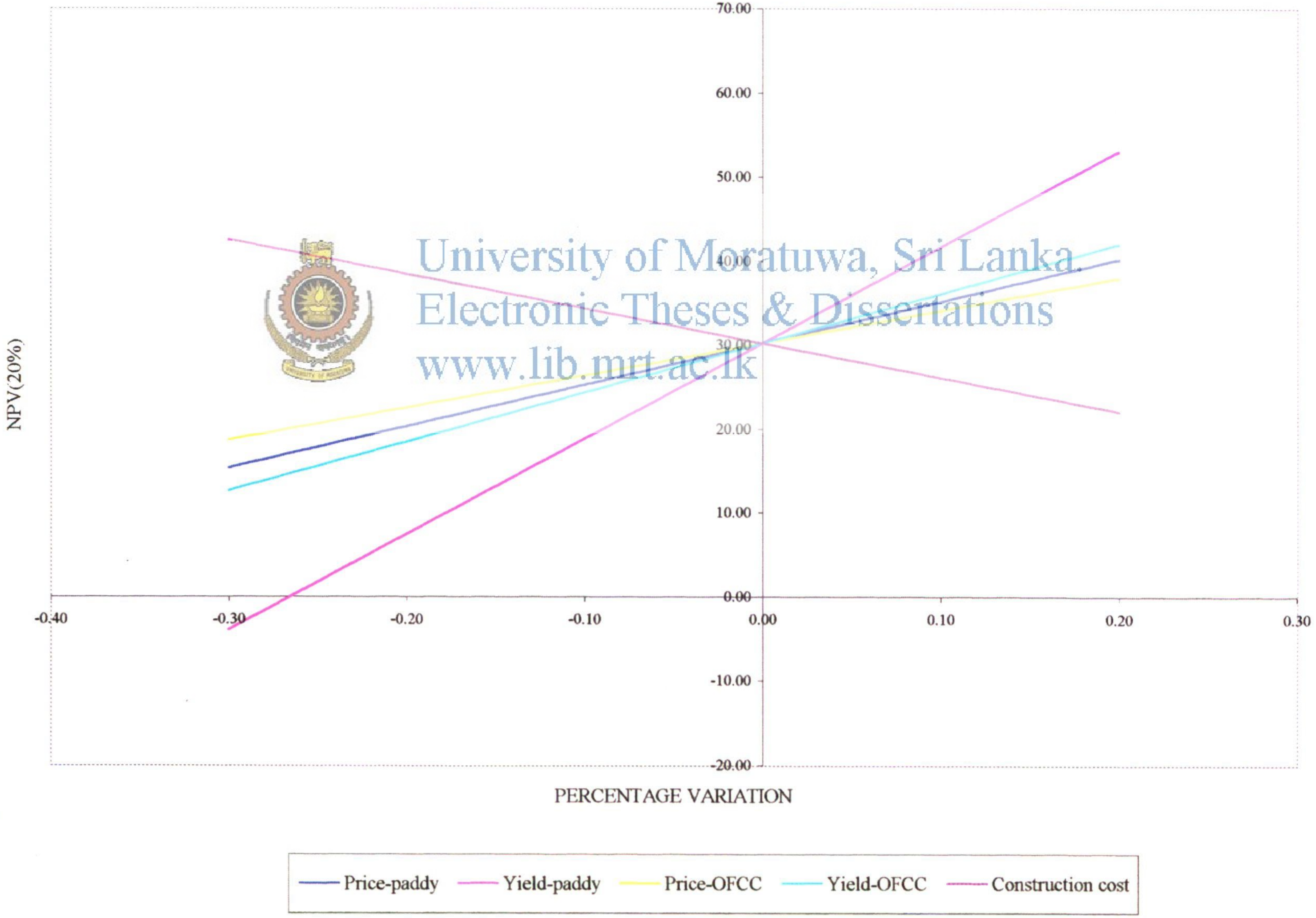
Cultivation : Paddy

Senario	Maha			Yala		
	ISF(bu/ac)	CRF(bu/ac)	Incentive	ISF(bu/ac)	CRF(bu/ac)	Incentive
Part 1						
Scenario 1	-	-	-	-	-	-
Scenario 2	1.58	-	-	1.97	-	-
Scenario 3	-	17.66	-	-	21.19	-
Scenario 4	1.58	17.66	-	1.97	21.19	-
Part 2						
Scenario 1	1.58	17.83	-	1.97	21.40	-
Scenario 2	1.58	-	*	1.97	-	*
Cultivation : OFCC						
	50%	90%		50%	85%	

* see Table 20(f)

Figure-12

SENSITIVITY ANALYSIS - BADULU OYA SCHEME



5.3 Case Study 2

5.3.1 General

Demodara Irrigation Scheme

This is a tank irrigation scheme constructed in 1983 in Mahiyangana electorate. It has the capacity of 1322 Acft at the full supply level and provides water to 380 Acs through 4 Km long main channel and 9 Km long distributory and field channels. The scheme plan of the Demodara irrigation scheme is shown in Figure 13.

The canal system of the scheme is not efficient due to percolation and seepage losses. So that the cultivations in Yala season is totally abandoned in some years causing lots of hardships to farmers, as the farming is only livelihood of majority of villagers. The some areas of the scheme were rehabilitated under Centenary Irrigation Rehabilitation Programme (CIADP) in year 1999 and rehabilitation works under Irrigation Systems Rehabilitation Programme (ISRP) were commenced in year 2000.

5.3.2 Data Collection

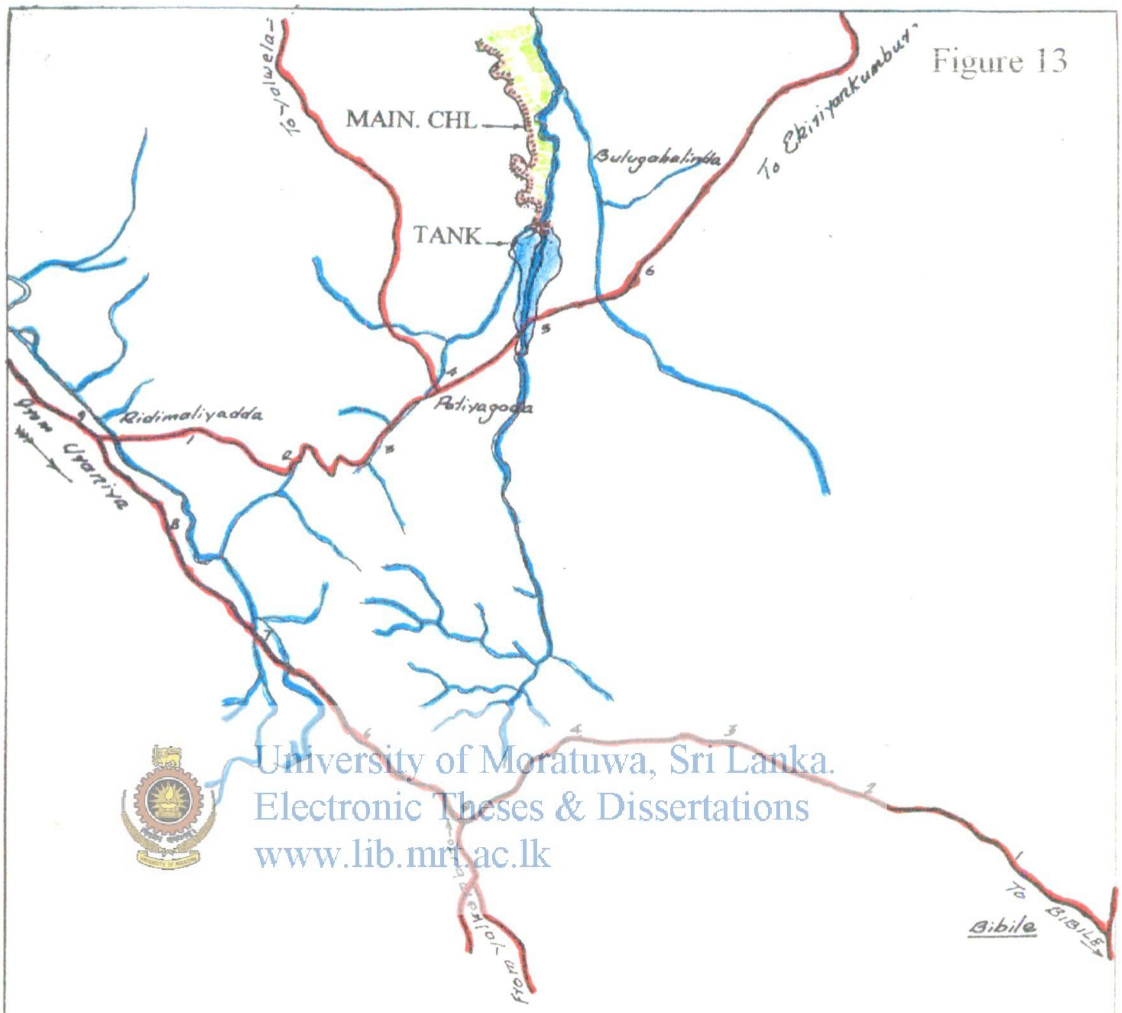
The details were collected as described in chapter 4.0. The financial and economic costs and benefits due to increase in production per acre are given in Table 22 to Table 25.

5.3.3 Financial and Economic Analysis

The financial and economic benefits due to increase in production as a result of the rehabilitation of Demodara irrigation scheme are given in Table 26 to Table 28. The financial and economic benefits due to decrease in O & M costs after rehabilitation are given in Table 29. The financial and economic costs due to increase in production are given in Table 30 to Table 32. The total costs and benefits due to increase in production are given in Tables 33 to Table 34 respectively.

The financial and economic analysis analyse PSP or GOSL for funding for the rehabilitation of Demodara irrigation scheme are given in Table 35(a) to Table 35(f) for the analysis framework in Figure 1. The analysis is in prices of 1st quarter in year 2000.

Figure 13



SCHEME PLAN

DEMODARA PERANI KANDIYA TANK SCHEME

Coordinates		J/23 (3.63 x 2.23)
Catchment Area		6.0 Sq. Mls
Irrigable Area		380 Acs
Capacity		1497 Ac.ft
F.S.L.		137.0 R.L
H.F.L.		141.0 R.L
B.T.L.		145.0 R.L
Length of Bund		3700 Ft
Spill	Type	Crest Orgee
	Length	200 Ft
Sluice	Type	Reinforced Concrete Tower
	Size	2 Ft 6 In Dia.
	Sill	116.0 R.L
Length of Main Channel		7 Mls and 500 Ft

5.3.4 Recovery of ISF and CRF

This was done as described in Clause 5.1.4. The summary of ISF and CRF rates for the scenarios analysed are shown in Table 36.

5.3.5 Sensitivity Analysis

This was done as described in Clause 5.1.4 for the same variables. The graphs of percentage variation Vs NPV are shown in Figure 14.

Table 22. Financial and economic benefits and costs due to increase in production of paddy / acre - Maha season (Case Study 2 - Demodara Irrigation Scheme)

Description	Convesion factor	Actual (1995-2000)				Economic value Rs.	Target year		Economic value Rs.	Remarks
		Unit	Quantity	Unit price Rs.	Amount Rs.		Quantity	Amount Rs.		
Gross income	0.697	Kg	1470	9.50	13965.00	9733.61	2625	24937.50	17381.44	Average yield at present 70 bu/ac and it can be increased to125
Production cost										bu/ac after rehabilitation
Seed *	0.697	Bu	3	400.00	1200.00	836.40	3	1200.00	836.40	(1 bu = 21kg)
Fertilizer										Cultivation period - 4 months
V1	0.650	Kg	50	18.00	900.00	585.00	-	-	-	Nursary Field
Urea	0.650	Kg	25	7.00	175.00	113.75	105	735.00	477.75	10.5 kg 94.5 kg
TDM	0.650	Kg	50	10.50	525.00	341.25	0	0.00	0.00	
TSP	0.650	Kg	-	19.50	-	-	35	682.50	443.63	35.0 kg
MOP	0.650	Kg	-	12.50	-	-	20	250.00	162.50	20.0 kg
Organic fertilizser	1.000	Ton	-	1000.00	-	-	2	2000.00	2000.00	Straw application
Weedicide	0.650	Item	Allow	Sum	1200.00	780.00	Allow	950.00	617.50	
Pesticide	0.650	Item	Allow	Sum	1200.00	780.00	Allow	750.00	487.50	
Labour										
Family labour	0.785	days	15	100	1500.00	1177.50	15	1500.00	1177.50	
Hired labour	0.722	days	44	100	4400.00	3176.80	36	3600.00	2599.20	
Farm power										
Tillage	0.776	days	-	-	-		-	-		majority of farmers use tractors
Thrashing	0.776	days	1	750	750.00	582.00	1	750.00	582.00	
Animal										
Tillage	0.774	days	5	350	1750.00	1354.50	5	1750.00	1354.50	majority of farmers use cows and
Thrashing	0.744	days	-	-	-	-	-	-	-	buffaloes
Total cost		-	-	-	13600.00	9727.20	-	14167.50	10738.48	
Net income		-	-	-	365.00	6.41	-	10770.00	6642.96	
Increase in net income								10405.00		

* - Transplanting cultivation

Table 23. Financial and economic benefits and costs due to increase in production of paddy / acre - Yala season (Case Study 2 - Demodara Irrigation Scheme)

Description	Convesion factor	Actual (1995-2000)				Economic value	Target year		Economic value	Remarks
		Unit	Quantity	Unit price Rs.	Amount Rs.	Rs.	Quantity	Amount Rs.	Rs.	
Gross income	0.697	Kg	1575	9.50	14962.50	10428.86	2625	24937.50	17381.44	Average yield at present 75 bu/ac and it can be increased upto130
Production cost										buac after rehabilitation
Seed *	0.697	Bu	3	400.00	1200.00	836.40	3	1200.00	836.40	(1 bu = 21kg)
Fertilizer										Cultivation period - 3.5 months
V1	0.650	Kg	50	18.00	900.00	585.00	0	0.00	0.00	Nursary Field
Urea	0.650	Kg	25	7.00	175.00	113.75	105	735.00	477.75	10.5 kg 94.5 kg
TDM	0.650	Kg	50	10.50	525.00	341.25	0	0.00	0.00	
TSP	0.650	Kg	0	19.50	0.00	0.00	35	682.50	443.63	35.0 kg
MOP	0.650	Kg	0	12.50	0.00	0.00	20	250.00	162.50	20.0 kg
Organic fertilizser	1.000	Ton	0	1000.00	0.00	0.00	2	2000.00	2000.00	
Weedicide	0.650	Item	Allow	Sum	1200.00	780.00	Allow	950.00	617.50	
Pesticide	0.650	Item	Allow	Sum	1200.00	780.00	Allow	750.00	487.50	
Labour										
Family labour	0.785	days	15	100	1500.00	1177.50	15	1500.00	1177.50	
Hired labour	0.722	days	44	100	4400.00	3176.80	36	3600.00	2599.20	
Farm power										
Tillage	0.776	days	0	0	0.00	0.00	0	0.00		majority of farmers use tractors
Thrashing	0.776	days	1	750	750.00	582.00	1	750.00	582.00	
Animal										
Tillage	0.774	days	5	350	1750.00	1354.50	5	1750.00	1354.50	majority of farmers use cows and
Thrashing	0.744	days	-	-	-	-	-	-	-	buffaloes
Total cost		-	-	-	13600.00	9727.20	-	14167.50	10738.48	
Net income		-	-	-	1362.50	701.66	-	10770.00	6642.96	
Increase in net income								9407.50		

* - Transplanting cultivation

Table 24. Financial and economic benefits and costs due to increase in production of green gram / acre - Yala season (Case Study 2 - Demodara Irrigation Scheme)

Description	Convesion factor	Actual (1995-2000)				Economic value Rs.	Target year		Economic value Rs.	Remarks	
		Unit	Quantity	Unit price Rs.	Amount Rs.		Quantity	Amount Rs.			
Gross income	0.723	Kg	325	40	13000.00	9399.00	700	28000.00	20244.00	M.I 5, Dharsha 77 Yield 1250-2100 kg/ha	
Production cost											
Seed	0.723	Kg	12	75	900.00	650.70	12	900.00	650.70	Seed 30 kg/ha	
Fertilizer										Basal	Top dressing
V1	0.650	Kg	25	18.00	450.00	292.50	0	0.00	0.00		
Urea	0.650	Kg	50	7.00	350.00	227.50	26	182.00	118.30	14 kg	12 kg
TSP	0.650	Kg	0	19.50	0.00	0.00	56	1092.00	709.80	56 kg	
MOP	0.650	Kg	0	12.50	0.00	0.00	30	375.00	243.75	30 kg	
Agreculture chemicals	0.650	Item	Allow	Sum	1000.00	650	Sum	1000.00	650		
Labour											
Family labour	0.785	days	25	125	3125.00	2453.13	25	3125.00	2453.13		
Hired labour	0.722	days	40	125	5000.00	3610.00	40	5000.00	3610.00		
Farm power											
Tillage	0.776	days	0	0	0.00	0.00	0	0.00	0.00		
Animal											
Tillage	0.774	days	2	350	700.00	541.80	2	700.00	541.80	majority of farmers use cows and buffaloes	
Total cost		-	-	-	11525.00	8425.63	-	12374.00	8977.48		
Net income		-	-	-	1475.00	973.38	-	15626.00	11266.53		
Increase in net income								14151.00			

Table 25. Financial and economic benefits and costs due to increase in production of maize / acre - Yala season (Case Study 2 - Demodara Irrigation Scheme)

Description	Convesion factor	Actual (1995-2000)				Economic value Rs.	Target year		Economic value Rs.	Remarks
		Unit	Quantity	Unit price Rs.	Amount Rs.		Quantity	Amount Rs.		
Gross income	0.723	Kg	650	8.00	5200.00	3759.60	1600	12800.00	9254.40	Badra1 Yield 4428-4500 kg/ha
Production cost										
Seed	0.723	Kg	8	30.00	240.00	173.52	5	900.00	650.70	(Imported seeds Rs.180/kg)
Fertilizer										Seed 16-20 kg/ha
V1	0.650	Kg	25	18.00	450.00	292.5	0	0.00	0.00	Basal Top dressing
TDM	0.650	Kg	0	10.50	0.00	0.00	0	0.00	0.00	
Urea	0.650	Kg	25	7.00	175.00	113.75	60	420.00	273.00	20 kg 40 kg
TSP	0.650	Kg	0	19.50	0.00	0.00	40	780.00	507.00	40 kg
MOP		Kg	0	12.50	0.00	0.00	20	250.00	0.00	20 kg
Agreculture chemicals	0.650	Item	Allow	400.00	0.00	0	Sum	600.00	390.00	
Labour										
Family labour	0.785	days	12	125	1500.00	1177.50	12	1500.00	1177.50	
Hired labour	0.722	days	25	125	3125.00	2256.25	25	3125.00	2256.25	
Farm power										
Tillage	0.776	days	0	0	0.00	0.00	0	0.00	0.00	
Animal										
Tillage	0.774	days	2	350	700.00	541.80	2	700.00	541.80	majority of farmers use
Total cost		-	-	-	6190.00	4555.32	-	8275.00	5796.25	
Net income		-	-	-	-990.00	-795.72	-	4525.00	3458.15	
Increase in net income								5515.00		

Table 26. Financial and economic benifits due to increase in production of paddy cultivation after rehabilitation (Case study 2 - Demodara Irrigation Scheme)

Maha season

Command area = 380.00 acres Before and after rehabilitation

Average yield = 70.00 bu/ac Before rehabilitation

125.00 bu/ac After rehabilitation

Yala season

Command area = 30.00 acres Before rehabilitation

30.00 acres After rehabilitation

Average yield = 75.00 bu/ac Before rehabilitation

125.00 bu/ac After rehabilitation

Unit : Million Rs

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008-2030
Financial price									
Without project (A)	5.756	5.756	5.756	5.756	5.756	5.756	5.756	5.756	5.756
With project (B)	5.756	5.756	5.756	6.649	7.543	8.437	9.331	10.224	10.224
With - Without (B-A)	0.000	0.000	0.000	0.894	1.788	2.681	3.575	4.469	4.469
Economic price (Conversion factor) =		**0.697**							
Without project (C)	4.012	4.012	4.012	4.012	4.012	4.012	4.012	4.012	4.012
With project (D)	4.012	4.012	4.012	4.635	5.258	5.880	6.503	7.126	7.126
With - Without (D-C)	0.000	0.000	0.000	0.623	1.246	1.869	2.492	3.115	3.115

Assumed : Production will increase gradually after the construction period and it will reach maximum within 5 years time

Table 27. Financial and economic benefits due to increase in production of green gram cultivation after rehabilitation (Case study 2 - Demodara Irrigation Scheme)

Maha season
Command area = 0.00 acres Before and After rehabilitation
Average yield = 325.00 kg/ac Before rehabilitation
700.00 kg/ac After rehabilitation

Yala season
Command area = 40.00 acres Before rehabilitation
120.00 acres After rehabilitation
Average yield = 325.00 kg/ac Before rehabilitation
700.00 kg/ac After rehabilitation

Unit : Million Rs

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008-2030
Financial price									
Without project (A)	0.520	0.520	0.520	0.520	0.520	0.520	0.520	0.520	0.520
With project (B)	0.520	0.520	0.520	1.088	1.656	2.224	2.792	3.360	3.360
With - Without (B-A)	0.000	0.000	0.000	0.568	1.136	1.704	2.272	2.840	2.840
Economic price (Conversion factor) =			**0.723**						
Without project (C)	0.376	0.376	0.376	0.376	0.376	0.376	0.376	0.376	0.376
With project (D)	0.376	0.376	0.376	0.787	1.197	1.608	2.019	2.429	2.429
With - Without (D-C)	0.000	0.000	0.000	0.411	0.821	1.232	1.643	2.053	2.053

Assumed : Production will increase gradually after the construction period and it will reach maximum within 5 years time

Table 28. Financial and economic benefits due to increase in production of maize cultivation after rehabilittion (Case study 2 - Demodara Irrigation Scheme)

Maha season

Command area	=	0.00 acres	Before and after rehabilitation
Average yield	=	650.00 kg/ac	Before rehabilitation
		1600.00 kg/ac	After rehabilitation

Yala season

Command area	=	20.00 acres	Before rehabilitation
		80.00 acres	After rehabilitation
Average yield	=	650.00 kg/ac	Before rehabilitation
		1600.00 kg/ac	After rehabilitation

Unit : Million Rs

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008-2030
Financial price									
Without project (A)	0.104	0.104	0.104	0.104	0.104	0.104	0.104	0.104	0.104
With project (B)	0.104	0.104	0.104	1.320	2.536	3.752	4.968	6.184	6.184
With - Without (B-A)	0.000	0.000	0.000	1.216	2.432	3.648	4.864	6.080	6.080
Economic price (Conversion factor) =			**0.723**						
Without project (C)	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075
With project (D)	0.075	0.075	0.075	0.954	1.834	2.713	3.592	4.471	4.471
With - Without (D-C)	0.000	0.000	0.000	0.879	1.758	2.638	3.517	4.396	4.396

Assumed : Production will increase gradually after the construction period and it will reach maximum within 5 years time

Table 29. Financial and economic benefits due to decrease in O & M costs after rehabilitaion (Case study 2 - Demodara Irrigation Scheme)

Command area = 380.00 acres

Financial

O & M expences =	900.00 Rs/ac	Before rehabilitation
	450.00 Rs/ac	After rehabilitation

Economical

Production cost =	582.00 Rs/ac	Before rehabilitation
	291.00 Rs/ac	After rehabilitation

Unit : Million Rs

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008-2030
Financial price									
Without project (A)	0.342	0.342	0.342	0.342	0.342	0.342	0.342	0.342	0.342
With project (B)	0.342	0.285	0.228	0.171	0.171	0.171	0.171	0.171	0.171
With - Without (B-A)	0.000	-0.057	-0.114	-0.171	-0.171	-0.171	-0.171	-0.171	-0.171
Economic value									
Without project (C)	0.221	0.221	0.221	0.221	0.221	0.221	0.221	0.221	0.221
With project (D)	0.221	0.184	0.147	0.111	0.111	0.111	0.111	0.111	0.111
With - Without (D-C)	0.000	-0.037	-0.074	-0.111	-0.111	-0.111	-0.111	-0.111	-0.111

Assumed : O & M cost will decrease gradually during the construction period and it will reach minimun after construction and remain constant thereafter.

Table 30. Financial and economic costs due to increase in production of paddy after rehabilitation (Case study 2 - Demodara Irrigation Scheme)

Maha season

Command area = 380.00 acres Before and after rehabilitation

Yala season

Command area = 30.00 acres Before rehabilitation

30.00 acres After rehabilitation

Financial

Production cost = 13600.00 Rs/ac Before rehabilitation (Average of Maha and Yala)

14167.50 Rs/ac After rehabilitation

Economical

Production cost = 9727.20 Rs/ac Before rehabilitation (Average of Maha and Yala)

10738.48 Rs/ac After rehabilitation

Unit : Million Rs

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008-2030
Financial price									
Without project (A)	5.576	5.576	5.576	5.576	5.576	5.576	5.576	5.576	5.576
With project (B)	5.576	5.576	5.576	5.623	5.669	5.716	5.762	5.809	5.809
With - Without (B-A)	0.000	0.000	0.000	0.047	0.093	0.140	0.186	0.233	0.233
Economic value									
Without project (C)	3.988	3.988	3.988	3.988	3.988	3.988	3.988	3.988	3.988
With project (D)	3.988	3.988	3.988	4.071	4.154	4.237	4.320	4.403	4.403
With - Without (D-C)	0.000	0.000	0.000	0.083	0.166	0.249	0.332	0.415	0.415

Assumed : Production cost increase will start gradullay after the construction period and it will reach maximum within 5 years time

Table 31. Financial and economic costs due to increase in production of grean gram after rehabilitation (Case study 2 - Demodara Irrigation Scheme)

Maha season
Command area = 0.00 acres Before and after rehabilitation
Yala season
Command area = 40.00 acres Before rehabilitation
120.00 acres After rehabilitation

Financial
Production cost = 11525.00 Rs/ac Before rehabilitation
12374.00 Rs/ac After rehabilitation

Economical
Production cost = 8425.63 Rs/ac Before rehabilitation
8977.48 Rs/ac After rehabilitation

Unit : Million Rs

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008-2030
Financial price									
Without project (A)	0.461	0.461	0.461	0.461	0.461	0.461	0.461	0.461	0.461
With project (B)	0.461	0.461	0.461	0.666	0.871	1.075	1.280	1.485	1.485
With - Without (B-A)	0.000	0.000	0.000	0.205	0.410	0.614	0.819	1.024	1.024
Economic value									
Without project (C)	0.337	0.337	0.337	0.337	0.337	0.337	0.337	0.337	0.337
With project (D)	0.337	0.337	0.337	0.485	0.633	0.781	0.929	1.077	1.077
With - Without (D-C)	0.000	0.000	0.000	0.148	0.296	0.444	0.592	0.740	0.740

Assumed : Production cost increase will start gradullay after the construction period and it will reach maximum within 5 years time

Table 32. Financial and economic costs due to increase in production of maize cultivation after rehabilitation (Case study 2 - Demodara Irrigation Scheme)

Maha season
Command area = 0.00 acres Before and after rehabilitation
Yala season
Command area = 20.00 acres Before rehabilitation
80.00 acres After rehabilitation

Financial
Production cost = 6190.00 Rs/ac Before rehabilitation
8275.00 Rs/ac After rehabilitation

Economical
Production cost = 4555.32 Rs/ac Before rehabilitation
5796.25 Rs/ac After rehabilitation

Unit : Million Rs

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008-2030
Financial price									
Without project (A)	0.124	0.124	0.124	0.124	0.124	0.124	0.124	0.124	0.124
With project (B)	0.124	0.124	0.124	0.231	0.339	0.447	0.554	0.662	0.662
With - Without (B-A)	0.000	0.000	0.000	0.108	0.215	0.323	0.431	0.538	0.538
Economic value									
Without project (C)	0.364	0.364	0.364	0.364	0.364	0.364	0.364	0.364	0.364
With project (D)	0.364	0.364	0.364	0.384	0.404	0.424	0.444	0.464	0.464
With - Without (D-C)	0.000	0.000	0.000	0.020	0.040	0.060	0.079	0.099	0.099

Assumed : Production cost increase will start gradullay after the construction period and it will reach maximum within 5 years time

Table 33. Total financial and economic benefits due to increase in production after rehabilitation (Case study 2 - Demodara Irrigation Scheme)

Unit : Million Rs

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008-2030
Paddy									
Financial									
(with - without)	0.000	0.000	0.000	0.894	1.788	2.681	3.575	4.469	4.469
Economic									
(with - without)	0.000	0.000	0.000	0.623	1.246	1.869	2.492	3.115	3.115
Green gram									
Financial									
(with - without)	0.000	0.000	0.000	0.568	1.136	1.704	2.272	2.840	2.840
Economic									
(with - without)	0.000	0.000	0.000	0.411	0.821	1.232	1.643	2.053	2.053
Maize									
Financial									
(with - without)	0.000	0.000	0.000	1.216	2.432	3.648	4.864	6.080	6.080
Economic									
(with - without)	0.000	0.000	0.000	0.879	1.758	2.638	3.517	4.396	4.396
Total financial	0.000	0.000	0.000	2.678	5.356	8.033	10.711	13.389	13.389
Total economic	0.000	0.000	0.000	1.913	3.826	5.738	7.651	9.564	9.564

Table 34. Total financial and economic costs due to increase in production after rehabilitation (Case study 2 - Demodara Irrigation Scheme)

Unit : Million Rs

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008-2030
Paddy									
Financial (with - without)	0.000	0.000	0.000	0.047	0.093	0.140	0.186	0.233	0.233
Economic (with - without)	0.000	0.000	0.000	0.083	0.166	0.249	0.332	0.415	0.415
Green gram									
Financial (with - without)	0.000	0.000	0.000	0.205	0.410	0.614	0.819	1.024	1.024
Economic (with - without)	0.000	0.000	0.000	0.148	0.296	0.444	0.592	0.740	0.740
Maize									
Financial (with - without)	0.000	0.000	0.000	0.108	0.215	0.323	0.431	0.538	0.538
Economic (with - without)	0.000	0.000	0.000	0.020	0.040	0.060	0.079	0.099	0.099
Total financial	0.000	0.000	0.000	0.359	0.718	1.077	1.436	1.795	1.795
Total economic	0.000	0.000	0.000	0.251	0.502	0.753	1.003	1.254	1.254

Table 35(a) Economic Analysis for Demodara Irrigation Scheme

Scenario 1						
Year	R_i	R_i	ΔP_i	ΔI_i	ΔO_i	NPV of Project
Economical analysis - Part 1						
		C.F				
Discount rate		***0.900***				***20%***
2000	4.000	3.600	0.000	0.000	0.000	-3.600
2001	4.000	3.600	0.000	0.000	0.037	-2.969
2002	3.000	2.700	0.000	0.000	0.074	-1.824
2003			0.251	1.526	0.111	0.802
2004			0.502	3.052	0.111	1.283
2005			0.753	4.577	0.111	1.582
2006			1.003	6.103	0.111	1.745
2007			1.254	7.629	0.111	1.810
2007=2029						
2030			1.254	7.629	0.111	0.027
						7.742

Table 35(e) Financial Analysis for Demodara Irrigation Scheme

Scenario 1					
Year	R_i	$(O \& m)_i$	Farmers pay ISF	Government pay CRF	NPV of Investor
Financial analysis - Part 2					
Discount rate			***CF=.697***	***20%***	***20%***
2000	3.600	0.342	0.000	0.000	-3.942
2001	3.600	0.285	0.000	0.000	-3.238
2002	2.700	0.228	0.000	0.000	-2.033
2003		0.171	0.357	2.483	1.545
2004		0.171	0.357	2.483	1.287
2005		0.171	0.357	2.483	1.073
2006		0.171	0.357	2.483	0.894
2007		0.171	0.357	2.483	0.745
2007=2029					
2030		0.171	0.357	2.483	0.011
					0.000

Table 35(b) Economic Analysis for Demodara Irrigation Scheme

Scenario 2							
Year	R_i	ΔP_i	ΔI_i	ΔO_i	$(O \& m)_i$	t_i	NPV of
Economical analysis - Part 1						Far. Pay ISF	$-(O \& m)_i$ + ISF
Discount rate						*20%*	*20%*
2000	3.600	0.000	0.000	0.000	0.221	0.000	-0.221
2001	3.600	0.000	0.000	0.037	0.184	0.000	-0.154
2002	2.700	0.000	0.000	0.074	0.147	0.000	-0.102
2003		0.251	1.526	0.111	0.111	0.249	0.080
2004		0.502	3.052	0.111	0.111	0.249	0.067
2005		0.753	4.577	0.111	0.111	0.249	0.056
2006		1.003	6.103	0.111	0.111	0.249	0.046
2007		1.254	7.629	0.111	0.111	0.249	0.039
2007=2029							
2030		1.254	7.629	0.111	0.111	0.249	0.001
							0.000

Table 35(f) Financial Analysis for Demodara Irrigation Scheme

Scenario 2					
Year	R_i	$(O \& m)_i$	Farmers pay ISF	Minimum Government incentive	NPV of Investor
Financial analysis - Part 2					
Discount rate			***CF=.697***		***20%***
2000	3.600	0.342	0.000	1.458	-2.484
2001	3.600	0.285	0.000	1.458	-2.022
2002	2.700	0.228	0.000	1.458	-1.021
2003		0.171	0.357	1.458	0.952
2004		0.171	0.357	1.458	0.793
2005		0.171	0.357	1.458	0.661
2006		0.171	0.357	1.458	0.551
2007		0.171	0.357	1.458	0.459
2007=2029					
2030		0.171	0.357	1.458	0.007
					0.000

Table 35(c) Economic Analysis for Demodara Irrigation Scheme

Scenario 3							
Year	R_i	ΔP_i	ΔI_i	ΔO_i	$(O \& m)_i$	t_i	NPV of
Economical analysis - Part 1						Far. Pay CRF	$-R_i$ + CRF
Discount rate						*20%*	*20%*
2000	3.600	0.000	0.000	0.000	0.221	0.000	-3.600
2001	3.600	0.000	0.000	0.037	0.184	0.000	-3.000
2002	2.700	0.000	0.000	0.074	0.147	0.000	-1.875
2003		0.251	1.526	0.111	0.111	2.456	1.421
2004		0.502	3.052	0.111	0.111	2.456	1.184
2005		0.753	4.577	0.111	0.111	2.456	0.987
2006		1.003	6.103	0.111	0.111	2.456	0.822
2007		1.254	7.629	0.111	0.111	2.456	0.685
2007=2029							
2030		1.254	7.629	0.111	0.111	2.456	0.010
							0.000

Where

R_i - Rehabilitation cost

ΔP_i - Increase in production cost

ΔO_i - Reduction in O & M cost

ΔI_i - Increase in farmer revenue

t_i - ISF & CRF

$(O \& m)_i$ - O&M cost after rehabilitation

- Return period 30 years

- Figures are given in Rs. M

Table 35(d) Economic Analysis for Demodara Irrigation Scheme

Scenario 4							
Year	R_i	ΔP_i	ΔI_i	ΔO_i	$(O \& m)_i$	t_i	t_i
Economical analysis - Part 1						Far. Pay ISF	Far. Pay CRF
Discount rate						*20%*	*20%*
2000	3.600	0.000	0.000	0.000	0.221	0.000	0.000
2001	3.600	0.000	0.000	0.037	0.184	0.000	0.000
2002	2.700	0.000	0.000	0.074	0.147	0.000	0.000
2003		0.251	1.526	0.111	0.111	0.249	2.456
2004		0.502	3.052	0.111	0.111	0.249	2.456
2005		0.753	4.577	0.111	0.111	0.249	2.456
2006		1.003	6.103	0.111	0.111	0.249	2.456
2007		1.254	7.629	0.111	0.111	0.249	2.456
2007=2029							
2030		1.254	7.629	0.111	0.111	0.249	2.456

Table 36: Summary of ISF & CRF for the Scenarios in Case Study 2
Demodara Irrigation Scheme

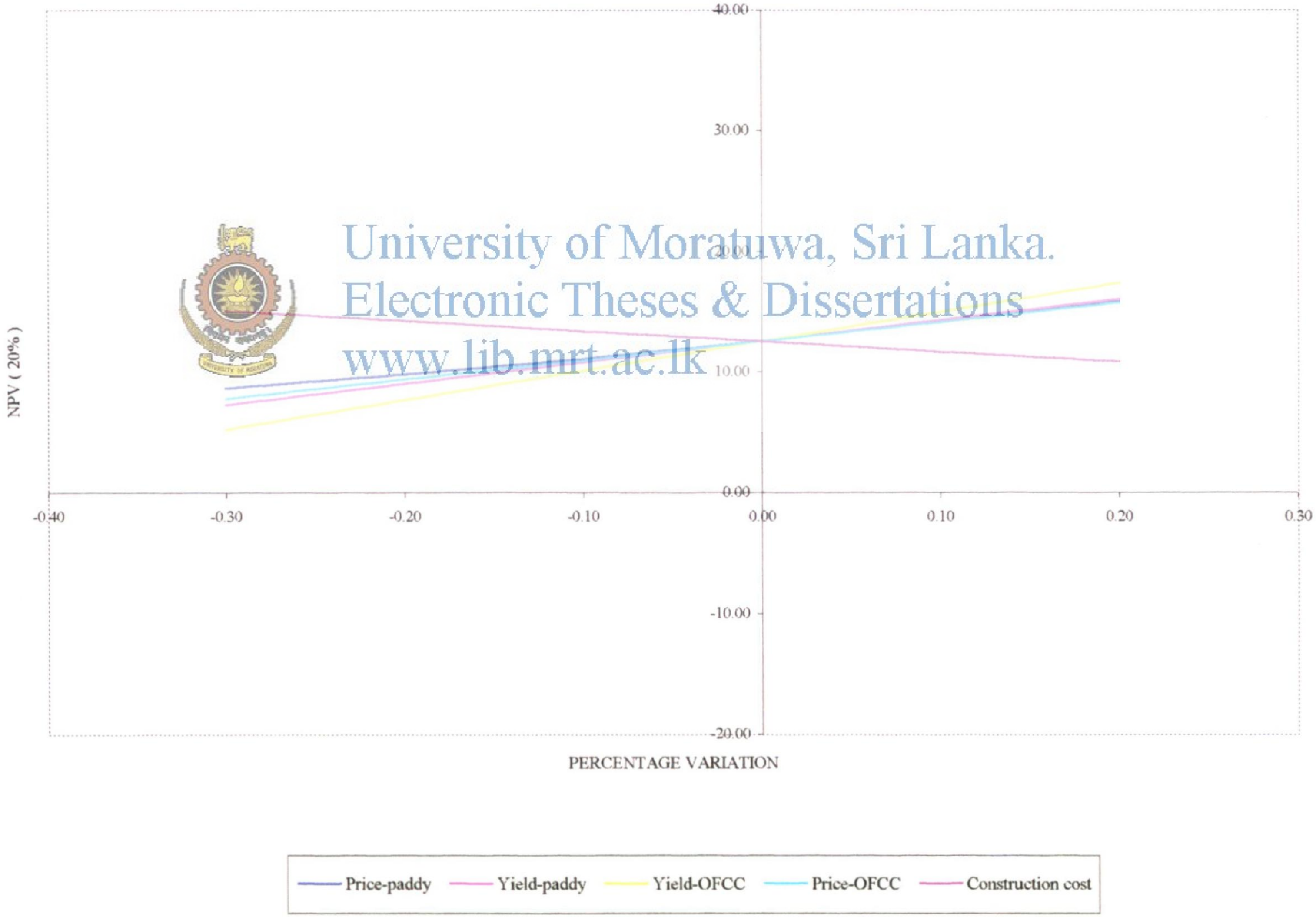
Cultivation : Paddy

Senario	Maha			Yala		
	ISF(bu/ac)	CRF(bu/ac)	Incentive	ISF(bu/ac)	CRF(bu/ac)	Incentive
Part 1						
Scenario 1	-	-	-	-	-	-
Scenario 2	2.11	-	-	2.47	-	-
Scenario 3	-	19.85	-	-	19.85	-
Scenario 4	2.11	19.85	-	2.47	19.85	-
Part 2						
Scenario 1	2.11	20.08	-	2.47	24.09	-
Scenario 2	2.11	-	*	2.47	-	*
Cultivation : OFCC						
	50%	90%		50%	85%	

* see Table 35(f)

Figure -14

SENSITIVITY ANALYSIS - DEMODARA SCHEME



5.4 Discussion

The rehabilitation of irrigation schemes through PSP is possible if the recovery of ISF and CRF comes from increased benefits of farmers. GOSL will obtain economic benefits and farmers and investors will also obtain financial benefits from the savings of losses due to deterioration of the systems. The PSP is possible as long as recovery of investors capital is possible from innovative financial strategies such as payments of recurrent nature or providing other assets that may enable to Private Sector to have positive cash flows. Even though the farmers benefit due to rehabilitation, the farmers contribution to pay for the benefits depend on their willingness to pay and but not the perceived affordability of government officials. Therefore, these are difficult and controversial decisions to be made against the tradition.

Since the most of the benefits come from increased production and therefore a systematic process is required to regularize agricultural activities and maintain the uniformity in agricultural patterns in large scale irrigation systems. The farmers cannot invest money for agriculture due to low income. They are to be supported either financially or material wise at the beginning of season on condition of recovery after harvesting. The organizations such as cooperative societies can promote farmers ensuring a better market prices for their products by purchasing yield to stabilise price fluctuations and increasing farmers confidence in selling their products. For these things, there should be unwavering government policies on agriculture and the less political influence to avoid frequent changes in policies.

The present trend of the farmers is to cultivate paddy in most areas of the irrigation schemes in both seasons. Since there is a water deficit during Yala season due to less rainfall, cultivation of more OFCC, which need less water and are more profitable compared to paddy should be promoted. The extend of cultivation of OFCC should be increased whereas extend of cultivation of paddy should be limited those areas favorable for paddy. The farmer education on agricultural activities such as low consumption of water, cultivation of OFCC, and introduction of new agricultural techniques should be developed to improve productivity and profitability.

It was assumed that the farmers acceptability of payment is limited to ISF to cover up O&M costs. However, in theory farmers can afford to contribute ISF and CRF according to analysis framework. The

Table 20(b) and Table 35(b) consist of minimum ISF at the 20% discount rate, which has been used for the analysis of other scenarios estimating farmers' acceptability. The Table 20(e) and Table 35(e) show the CRF requirement at 20% discount rate needed while maintaining minimum ISF in the economic analysis. The Table 20(f) and Table 35(f) depict the incentives from the government to promote PSP. The ISF and CRF can be adjusted depending on government innovative financial strategies that are offered to attract and enhance the efficiencies of PSP.

These ISF and CRF used for the analysis are based on the judgments on costs and benefits before and after rehabilitation. The ISF could be reduced depending on the requirement after rehabilitation. The recovery of ISF is essential as it would create the sense of ownership of the rehabilitated asset.

The options such as introducing of ISF as a low rate and thereafter gradually increasing with time would be advisory until the farmers are familiar with the concept. The incidents when the forecasts cost and benefits diverge should be studied with alternative cash flow arrangements to provide concessions for the farmers. The concessions of the government to the farmers in the events such as cultivation failure, flood, drought etc could be strategies to promote farmers and to build up trust between farmers and the investors.

5.5 Limitations of the study

The most of the details collected in these schemes depend on the decisions taken based on the views of farmers and generalization for these details to represent the entire scheme. It is true that that there is a significant difference in the performance of the schemes and variations in agricultural practices of the farmers in some areas compared to other areas. The accuracy of these overviews can cause variations of statistics in the analysis of costs and benefits. However, these variations will not alter the main findings of the study.

The analysis was done by assuming fifty present reduction in O&M costs after rehabilitation. However, this amount may be too high compared to the allocated prorate per acre for O&M at present. Therefore, there is a possibility of reducing ISF given in Tables 21 and Table 36.

6.0 Conclusions and Recommendations

6.1 Conclusions

The objectives of this research were to explore the viability of PSP and the use of ISF and CRF in the rehabilitating of existing irrigation schemes in Sri Lanka. The study expects to collect ISF from the beneficiaries as a way of releasing financial burden on the government / investor in rehabilitating irrigation facilities. The followings are the main conclusions of the study.

1. The rehabilitation of irrigation schemes brings high economical benefits, even though the recovery of full capital cost of the investment from beneficiaries seems to be practically difficult.
2. The case studies highlight the possibility of recovering ISF from the beneficiaries.
3. The GOSL can reap the economic benefits of rehabilitating irrigation systems without using its scarce capital with PSP. Then the GOSL gets to convert capital expenditure into annual recurrent expenditures as net subsidies for PSP in the rehabilitation of the irrigation schemes. The ISF is the minimum recoverable from beneficiaries (i.e. the farmers)

6.2 Recommendations

The following recommendations are made with regard to studies carried out on rehabilitation of existing irrigation schemes.

1. The further studies on the possibility of recovery of CRF and ISF should be made by selecting more schemes, which are having different performances from other areas.
2. The awareness programmes, training programmes and workshops should be conducted with aiming to educate the farmers in modern agricultural systems and discard wrong concepts on agricultural activities.
3. The strict control of cropping calendar, supervision of farmer activities, introduction of technological expertise, provision of irrigation facilities should be incorporated to increase productivity.

4. The steps should be taken to keep up the targets such as type of cultivation, extend of cultivation and yield as variations may cause the failure of project.
5. The possibility of individual farmer to take his own decisions, which affects the functions of the schemes should be minimized.
6. Since the study is based on several forecasts and also there are possibilities of occurrence of other disasters which affect the viability of projects. Therefore, precautions should be taken to overcome them.
7. It is difficult to find literature on PSP in rehabilitation of irrigation projects and the details and practices of them in other countries. The literature review should be extended to collect information from the other countries.

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Appendix A

CALCULATION OF OPERATION AND MAINTENANCE COST (O & M) - BANDARAWELA RANGE

(TYPICAL O & M COSTS PER ACRE PER ANNUM FOR GRAVITY IRRIGATION WORKS - YEAR 2000 PRICES)
BASED ON ANALYSIS OF 1981 PERFORMANCE ON 16 SELECTED SCHEMES AT ONE PER RANGE

Description	Unit	Qty	Man Power		Unit Rate	Amount	Labour in man day		Conversion	Economic
			Out put/day	Daily Wage	(Rs.)	(Rs.)	Regular	Casual	Factor	Value
A. LABOUR										
1. TO Attendents including + 10% to cover head works	Ac	1	1.39 (500ac/360)	220.00 a	158.40	158.40	0.72	-	0.785	
2. Weeding	Sqr	20.00	25.00	200.00 b	8.00	160.00	0.80	-	0.785	125.60
3. Removal of Salvenia	Sqr	2.00	12.00	200.00	16.67	33.33	-	0.17	0.722	24.07
4. Desilting	Cu	0.50	0.50	200.00	400.00	200.00	-	1.00	0.722	144.40
5. Filling scours	md	0.15	1.00	200.00	200.00	30.00	0.15	-	0.785	23.55
6. Repairs to structures	md	0.10	1.00	500.00 c	500.00	50.00	0.10	-	0.785	39.25
7. Spreading gravel	Sqr	0.20	10.00	200.00	20.00	4.00	0.02	-	0.785	3.14
Total for A						635.73	1.79	1.17		360.01
B. SUPERVISION										
Work Supervisor	Ac	1.00	6.94 (2500ac/360)	200.00	28.80	28.80	-	-	0.785	22.61
Total for B						28.80				22.61
C. DRIVERS AND OPERATORS										
1. Drivers of jeeps, lorries, trippers @ 4% of labour cost in A	Ac	1.00	-	-	25.43	25.43	-	-	0.785	19.96
2. Operators of farm tractors @ 2% of Labour Cost in A	Ac	1.00	-	-	12.71	12.71	-	-	0.785	9.98
Total for C						38.14				29.94
D. TRAVELLING & COMNINED ALLOWANCE										
1. Work Supervisor - 3600 mls m/c @ Rs. 2/= + 72 days @ Rs. 230/-	Ac	1.00	6.94 (2500ac/360)	66.00	9.50	9.50	-	-	0.814	7.74
2. TO Attendant - Bicycle allowance @ Rs. 40/= per month	Ac	1.00	1.39 (5000ac/360)	1.33	0.96	0.96	-	-	0.814	0.78
Total for D						10.46				8.52
E. FUELS & REPAIRS TO VEHICLES										
1. Fuel for jeeps, lorries, trippers and farm tractors	Gl	0.25	-	-	89.89	22.47	-	-	0.650	14.61
2. Repairs to vehicles @ 50% of fuel cost	Ac	1.00	-	-	11.24	11.24	-	-	0.776	8.72
3. Overtime for Drivers and Operators @ 5% of item 1	Ac	1.00	-	-	1.12	1.12	-	-	0.785	0.88
Total for E						34.83				24.21

Description	Unit	Qty	Man Power		Unit Rate	Amount	Labour in man day		Conversion	Economic
			Out put/day	Daily Wage	(Rs.)	(Rs.)	Regular	Casual	Factor	Value
F. PURCHASE OF MATERIALS AND TOOLS										
1. Cement	Bg	0.10	-	-	315.00	31.50	-	-	0.746	23.50
2. Sand	Cu	0.01	-	-	400.00	2.00	-	-	1.000	2.00
3. Metal	Cu	0.01	-	-	2990.00	14.95	-	-	0.717	10.72
4. Rubble	Cu	0.01	-	-	2447.00	12.24	-	-	1.000	12.24
5. Gravel	Cu	0.05	-	-	500.00	25.00	-	-	1.000	25.00
6. Paints	Gl	0.01	-	-	1419.00	7.10	-	-	0.650	4.61
7. Gunnybags	Bag	0.15	-	-	30.00	4.50	-	-	1.000	4.50
8. Cane baskets	No	0.05	-	-	15.00	0.75	-	-	1.000	0.75
9. Miscellaneous materials @ 5% of items 1 to 8	Ac	1.00	-	-	5.17	5.17	-	-	1.000	5.17
10. For replacement of tools @ 5% of items 1 to 8	Ac	1.00	-	-	5.47	5.47	-	-	1.000	5.47
Total for F						108.67				**93.95**
G. PHYSICAL CONTINGENCY										
at 5% of items A to F Base cost for O & M per ac per annum	Ac	1.00	-	-	-	42.83	-	-	1.000	42.83
Total A to G						899.47				**582.07**

H. ADMINISTRATION AND OVERHEADS

Description	Annual Salary in Rs.	No.	Range Amount Rs.	No.	Division Amount Rs.	Conversion Factor	Economic Range Amount	Economic Division Amount
Deputy Director of Irrigation	200,000.00	1	200,000.00	-	-	0.785	157000.00	-
Chief Irrigation Engineer	160,000.00	1	160,000.00	-	-	0.785	125600.00	-
Irrigation Engineer	111,000.00	1	111,000.00	1	111,000.00	0.785	87135.00	87,135.00
Administrative officer	95,000.00	1	95,000.00	-	-	0.785	74575.00	-
Accountant	125,000.00	1	125,000.00	-	-	0.785	98125.00	-
Chief Clerk	80,000.00	1	80,000.00	1	80,000.00	0.785	62800.00	62,800.00
Clerks and Typists	75,000.00	12	900,000.00	7	525,000.00	0.785	706500.00	412,125.00
Minor Employees	60,000.00	5	300,000.00	3	180,000.00	0.785	235500.00	141,300.00
Drawing office assistant	98,000.00	1	98,000.00	-	-	0.785	76930.00	-
Draughtmen	75,000.00	5	375,000.00	2	150,000.00	0.785	294375.00	117,750.00
Divisional Assistant	100,000.00	-	-	1	100,000.00	0.785	-	78,500.00
Total			2,444,000.00		1,146,000.00		1918540.00	899610.00

Note : The administration costs tabulated on the left hand side are apportioned equally for " Investigation, Design and Construction " and " Operation and Maintenance " respectively.

Description	Unit	Quantity	Out Put per annum	Annual Cost in Rs.	Unit Rate in Rs.	Amount in Rs.	Conversion Factor	Economic Value
1. Technical Assistants	Ac	1.00	5000	72,000.00	14.40	14.40	0.785	11.30
2. Administration & OH of Range Office	Ac	1.00	40000	1,222,000.00	30.55	30.55	0.785	23.98
3. Administration & OH of Divisional Office	Ac	1.00	12000	573,000.00	47.75	47.75	0.785	37.48
4. Travelling, CA, O/T and repairs @ 20% of items 1 to 3	Ac	1.00	-	-	18.54	18.54	0.814	15.09
5. Physical Contingency @ 5% of items 1 to 4 Administration and OH cost for O & M per ac per annum	Ac	1.00	-	-	5.56	5.56	0.785	4.37
Total O & M Cost per Ac per Annum						116.80		92.23

I. INSPECTION OF VEHICLES AND EQUIPMENT

3 Jeeps, 1 Lorry and 5 Farm Trailers are required for O & M for 15,000 Acs.

Assumed deprication period is 5 years

Average Investment Cost (AIC) = 0.6 Capital Cost

Insurance is 1% of AIC

Depriciation per annum is as below:-

	3 Jeeps	1 Lorry	5 T/Trailers
Fixed Cost	1,080,000.00	300,000.00	700,000.00
Insurance	45,000.00	15,000.00	60,000.00
OH at 10%	112,500.00	31,500.00	76,000.00
	1,237,500.00	346,500.00	836,000.00

Description	Unit	Quantity	Out Put per annum	Annual Cost in Rs.	Unit Rate in Rs.	Amount in Rs.	Conversion Factor	Economic Value
1. Depriciation cost of jeeps	Ac.	1.00	-	-	82.50	82.50	0.776	64.020
2. Depriciation cost of lorry	Ac.	1.00	-	-	23.10	23.10	0.776	17.926
3. Depriciation cost of tractor trailers	Ac.	1.00	-	-	55.73	55.73	0.776	43.249
4. Depriciation cost of miscellaneous items @ 5% of item 1 to 3			-	-	8.07	8.07	0.776	6.260
5. Contingengy at 5% of 1 to 3 Depriciation Cost for O & M per ac. Per annum Total O & M Cost per Ac. Per annum	Ac.	1.00			8.07	8.07 177.47	0.776	6.260 137.71

a. Semi skilled wage	Rs. 220.00	b. Unskillled wage	Rs. 200.00
c. Skilled wage + Unskilled wage	Rs. 500.00		

Total allocation requirement for O &M Rs. 1193.74
Economic Value Rs. 812.01

When H & I are excluded 75% of total O&M cost
72% of total O&M cost