PRIVATE SECTOR PARTICIPATION IN THE REHABILITATION OF IRRIGATION PROJECTS

by

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Abstract

This paper describes the development of a two part theoretical framework based on principles of engineering economics to explore the viability of private sector participation (PSP) in the rehabilitation of irrigation schemes and its application to two case studies developed from major irrigation schemes which are now taken up under the Irrigation Systems Rehabilitation Programme (ISRP) in the Badulla District. The first part uses principles of economic feasibility to ensure that the rehabilitation of an irrigation scheme is worthwhile from the viewpoint of the Government of Sri Lanka (GOSL), while the second part uses principles of financial feasibility to decide on the viability of PSP. The logic of this development is that the GOSL can obtain the economic benefits of rehabilitating an irrigation system 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 operation and maintenance costs as Irrigation Service Fee (ISF), it would create a sense of ownership of the rehabilitated asset. Even though in theory PSP seems to be the panacea for all ills, these case studies demonstrate that in reality it will not happen unless the GOSL and all public sector institutions involved in water management realise that in future it is investments by PSP that will help to reverse the deterioration of existing irrigation schemes. As such, every encouragement and facility should be extended for PSP.

1.0 Introduction

The Government of Sri Lanka (GOSL) has spent and is spending a considerable amount of money for development of the irrigation sector. However, this amount is still comparatively small in relation to that which is actually required. Hence, priority is given in general for Operation and Maintenance (O&M) works of the existing schemes and less priority to developing new irrigation schemes and the rehabilitation of existing irrigation schemes unless foreign funds are available. There is a tendency to even neglect the O&M function in the allocation of the limited funds available which has resulted in progressive deterioration of the existing irrigation schemes.

Since allocation of sufficient funds from traditional sources for proper maintenance is shrinking and the resulting deterioration of irrigation systems requiring rehabilitation is the main problem, other options such as private sector participation (PSP) in the rehabilitation of irrigation systems should be explored to find necessary funds. Clearly, this is a controversial consideration given the fact that historically the responsibility for funding irrigation systems has been with the GOSL.

The objectives of this paper are therefore to: (1) explore the viability of PSP in the rehabilitation of irrigation schemes; (2) explore the use of Irrigation Services Fees (ISF) to cover O&M costs and Cost Recovery Fees (CRF) to recover invested capital in the rehabilitation from beneficiaries during the operation period; and (3) develop case studies from irrigation schemes to analyse the PSP.

2.0 Private Sector Participation in Infrastructure Projects

Developing countries need to embark on extensive infrastructure provision in order to achieve and sustain economic growth. In order to achieve these objectives, developing countries face two major constraints: unavailability of indigenous technological expertise and

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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 the 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 that 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) states that more than half the utilities in developing countries have low rates of return and that several have incurred losses. Inevitably, therefore, sooner than anticipated, the reliability of the facilities is jeopardized. 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 an economy's faltering productivity, profitability and private sector capital formation.

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 for 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 and bilateral or multilateral donor funds. These sources are constrained and not adequately available to meet the requirements with the fast changing economic conditions in the world. Budget deficits are increasing in most developing countries and they are challenged to find other options such as PSP (Lammie 1988, Beidleman et al. 1990, Aschauer, 1991, McCarthy and Tiong, 1991; Karasapan, 1995; Dias and Ioannou, 1996; Shen et al., 1996; Liddle, 1997; and Ranasinghe, 1999).

To overcome these constraints alternative forms of project developments through PSP such as build, operate and transfer (BOT) and build, operate and own (BOO) projects are being adopted in most developing countries. This decision is based on expected cost saving from improved efficiency and innovation of the private sector (Liddle, 1997) and because such projects would be off the balance sheet. The recent project financing pattern in most developing countries in South and South East Asia have taken the form of BOT (Tam, 1995). Since the massive capital requirements for infrastructure projects cannot be found by the public sector through the traditional sources of funding, the GOSL too has focused attention on PSP (Daily News, 1995) through BOO/BOT contractual arrangements.

Liddle (1997) identified the following as the benefits of infrastructure privatisation:

- 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 the 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 Theoretical Framework

3.1 General

The possibility of 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 development of a two part theoretical framework based on principles of engineering economics to explore the viability of PSP in the rehabilitation of irrigation schemes. The first part uses principles of economic feasibility to ensure that the rehabilitation of an irrigation scheme is worthwhile from the viewpoint of the economy. The second part uses principles of financial feasibility to decide on the viability of PSP.

3.2 Financial Feasibility Analysis

In the financial feasibility analysis the project is evaluated from the viewpoint of the investor. It is a tool that provides the investors with the information required to decide whether to undertake an investment. Hence, the objectives of the financial analysis are 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, data for agricultural production, production cost and O&M costs. The cost item that is newly introduced, is the rehabilitation cost. The reduction in O&M cost is assumed in the analysis as most of the causes for frequent O&M problems can be controlled during a major 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. For example, physical depreciation, obsolescence, changing requirements for project services, time discount, and allowance for risk and uncertainty may limit the present value of project services. Therefore, the economic life of a project is determined as the point at which the effect of the foregoing factors causes the cost of continuing the project to exceed the additional benefits to be expected from the continuation. Hence, the economic life is generally less than the estimated physical life. Generally, the economic life of these projects may be assumed as 30 years (McCarthy and Perry, 1989).

The analysis criterion from the investor's point of view is based on the recovery of investors capital. The scenarios of recovery of Irrigation Services Fees (ISF) and Cost Recovery Fees (CRF) should be explored to promote investors in rehabilitation of irrigation projects. The analysis estimates costs and benefits at market prices for the cash flow analysis.

3.3 Economic Feasibility Analysis

The economic analysis looks at the rehabilitation of the project from the viewpoint of the economy of the country. The difference between the financial analysis and economic analysis is that the market distortions in the financial analysis are 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 nature as a financial analysis, except in the case of the economic analysis, benefits and costs are measured from the point of view of the 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. 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 (Jenkins and Harberger, 1992).

Ideally, the prices of every input and output 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 and services can be converted to economic prices by using the conversion factors developed for the Department of National Planning by Curry and Lucking (1992).

Since the criterion for project viability is the economic net present value (NPV), which is the difference between present value of all economic costs and economic benefits during the return period, the first part of the framework looks at four scenarios from an economic viewpoint.

3.4 Framework

The two part theoretical framework shown in Figure 1 is the basis for recovery of Irrigation Services Fees (ISF) and Cost Recovery Fees (CRF). The economic analysis considers four scenarios and financial analysis considers two scenarios. Both economic and financial analyses 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 GOSL to attract PSP from the financial analysis is a minimum value.

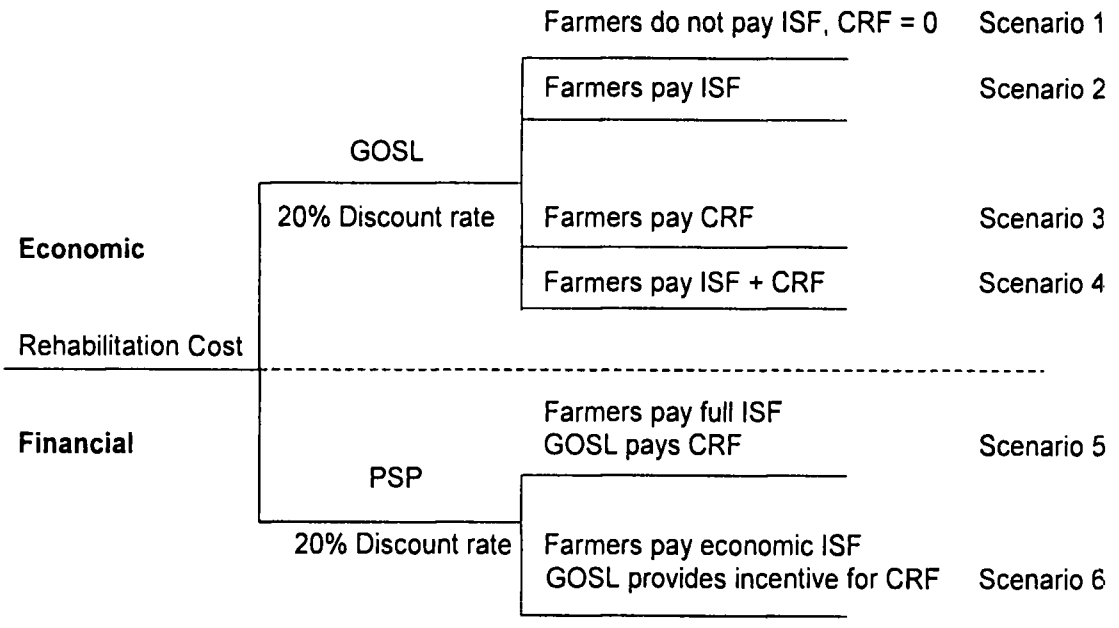

Figure 1. Analysis framework to recover ISF and CRF

When the rehabilitation cost is provided by the GOSL, the viability of a project is analysed from the national economic point of view from the following scenarios:

Scenario 1: NPV>0 for the project at 20% discount rate. (Decision to be taken by the GOSL to implement the project considering the forecasted economic benefits).

Scenario 2: Farmers pay ISF=O&M cost at 20% discount rate; (ISF is assumed as the maximum contribution from farmers)

Scenario 3: Farmers pay CRF at 20% discount rate; (minimum CRF to cover rehabilitation cost to recover invested capital for rehabilitation) and

Scenario 4: Farmers pay ISF and CRF at the 20% discount rate (minimum ISF and CRF to cover up O&M and rehabilitation cost).

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 the Private Sector. 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 following scenarios:

Scenario 5: Farmers pay ISF and GOSL pays CRF at 20% discount rate (where ISF=O&M cost at 20% discount rate. Recovery of full O&M costs as ISF from the beneficiaries and the invested capital as CRF from the GOSL); and

Scenario 6: Farmers pay ISF estimated from the economic analysis and GOSL provides incentives equivalent to CRF at 20% discount rate. (Innovative financial strategies that GOSL can offer to promote PSP in rehabilitation of irrigation projects as incentives are explored).

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.

4.0 Case Studies

4.1 General

Two case studies of irrigation schemes in Badulla District requiring rehabilitation are utilized to demonstrate the framework developed in the third section to analyse the viability of PSP.

4.2 Case Study 1 - Badulu Oya Irrigation Scheme

The anicut constructed across Badulu Oya in 1956 diverts the water for irrigation of 1600 acres in the Kandakatiya area through a right bank canal system of 18 km long main channel and 22 km long field channels during the Maha and Yala seasons. It has a catchment area of 114 sq.miles covering the Viyaluwa and Badulla electorates. The water management of the scheme is tedious due to the deteriorated canal system and the

drastic drop in water level in the Badulu Oya during both seasons. There is an acute shortage of water during Yala Season causing frequent crop failures and farmers are forced to abandon vast areas of irrigated land especially at the tail ends of the canals. The scheme was rehabilitated under Village Irrigation Rehabilitation Programme (VIRP) in 1983.

This scheme was selected again for rehabilitation under Irrigation Systems Rehabilitation Programme (ISRP) and rehabilitation works commenced in 2000. The rehabilitation works are to be completed by the end of year 2002. The costs and benefits before and after rehabilitation were estimated based on the details collected from baseline surveys, agricultural officers, statistics of Agricultural Department (DOA, 1986; 1997; 1998; FOA, 1985), farmers etc. The details of land use and yields of crops in the schemes are given in Table 1.

Description	Before rehabilitation		After rehabilitation	
	Maha	Yala	Maha	Yala
Acreage –Paddy (acres)	1565	1000	1565	1200
Yield (bu/acre)	75	120	70	120
Acreage –Green gram (acres)	10	50	10	100
Yield (kg/acre)	400	400	675	675
Acreage –Maize (acres)	10	50	10	100
Yield (kg/acre)	700	700	1400	1400
Acreage –Soya bean (acres)	10	50	10	100
Yield (kg/acre)	600	600	1000	1000
Acreage –Chilli (acres)	5	25	5	100
Yield (kg/acre)	750	750	1000	1000

Table 1. Acreages and yields before and after rehabilitation

Economic and Financial Analysis

The analysis was done for the scenarios in the framework of Figure 1 assuming 50% reduction in actual O&M cost due to less O&M work after rehabilitation and 10% reduction in rehabilitation cost due to the efficiencies of PSP (Liddle, 1997). It was assumed that the targeted productivity would be achieved after five years from completion of rehabilitation.

The details of the financial and economic analysis, which show the minimum contributions of the beneficiaries for the different scenarios, are shown in Tables 2 to Table 7 for Badulu Oya Irrigation Scheme. The ISF and CRF can be either monetary terms or collection of equivalent quantity of dry grains at the current market price of the year. The recovery of ISF or CRF or both may vary with the capital costs of rehabilitation (Ri), reduction in O&M costs (_Oi), farmer production costs (_Pi) and revenue from production (_Ii), O&M costs ((O&M)i) and discount rate of the investment.

Year	R_i	P_i	O_i	I_i	NPV of Project
2000	13.500	0.000	0.000	0.000	-13.500
2001	18.000	0.000	0.078	0.000	-15.065
2002	18.000	0.000	0.155	0.000	-12.608
2003		1.529	0.233	7.135	3.110
2004		3.059	0.233	14.271	5.295
2005		4.588	0.233	21.406	6.665
2006		6.117	0.233	25.542	7.432
2007		7.646	0.233	35.677	7.758
2007=2030					
2030		7.646	0.233	35.677	0.117
					27.291

Table 2. Scenario 1 for Badulu Oya Irrigation scheme

Year	R_i	P_i	O_i	I_i	$(O\&M)_i$	Farmers pay ISF	NPV of $(-(O\&M)_i + ISF)$
2000	13.500	0.000	0.000	0.000	0.233	0.000	-0.233
2001	18.000	0.000	0.078	0.000	0.310	0.000	-0.259
2002	18.000	0.000	0.155	0.000	0.388	0.000	-0.269
2003		1.529	0.233	7.135	0.466	0.686	0.128
2004		3.059	0.233	14.271	0.466	0.686	0.106
2005		4.588	0.233	21.406	0.466	0.686	0.089
2006		6.117	0.233	28.542	0.466	0.686	0.074
2007		7.646	0.233	35.677	0.466	0.686	0.062
2007=2030							
2030		7.646	0.233	35.677	0.466	0.686	0.001
						NPV of $-(O\&M)_i$ +ISF = 0	

Table 3. Scenario 2 for Badulu Oya Irrigation scheme

Year	R_i	P_i	O_i	I_i	$(O\&M)_i$	Farmers pay CRF	NPV of $(-R_i +$ CRF)
2000	13.500	0.000	0.000	0.000	0.233	0.000	-13.500
2001	18.000	0.000	0.078	0.000	0.310	0.000	-15.000
2002	18.000	0.000	0.155	0.000	0.388	0.000	-12.500
2003		1.529	0.233	7.135	0.466	11.880	6.875
2004		3.059	0.233	14.271	0.466	11.880	5.729
2005		4.588	0.233	21.406	0.466	11.880	4.774
2006		6.117	0.233	28.542	0.466	11.880	3.979
2007		7.646	0.233	35.677	0.466	11.880	3.315
2007=2030							
2030		7.646	0.233	35.677	0.466	11.880	0.050
						NPV of $-Ri$ + CRF = 0	

Table 4. Scenario 3 for Badulu Oya Irrigation scheme

Year	R_i	P_i	O_i	I_i	$(O\&M)_i$	Farmers pay ISF	Farmers pay CRF @ 20%
2000	13.500	0.000	0.000	0.000	0.233	0.000	0.000
2001	18.000	0.000	0.078	0.000	0.310	0.000	0.000
2002	18.000	0.000	0.155	0.000	0.388	0.000	0.000
2003		1.529	0.233	7.135	0.466	0.686	11.800
2004		3.059	0.233	14.271	0.466	0.686	11.800
2005		4.588	0.233	21.406	0.466	0.686	11.800
2006		6.117	0.233	28.542	0.466	0.686	11.800
2007		7.646	0.233	35.677	0.466	0.686	11.800
2007=2030							
2030		7.646	0.233	35.677	0.466	0.686	11.800

Table 5. Scenario 4 for Badulu Oya Irrigation scheme

Year	R_i	$(O\&M)_i$	Farmers pay ISF	Government pay CRF	NPV of Investor
2000	13.500	0.400	0.000	0.000	-13.900
2001	18.000	0.507	0.000	0.000	-15.422
2002	18.000	0.613	0.000	0.000	-12.926
2003		0.720	1.082	11.880	7.084
2004		0.720	1.082	11.880	5.904
2005		0.720	1.082	11.880	4.920
2006		0.720	1.082	11.880	4.100
2007		0.720	1.082	11.880	3.416
2007=2030					
2030		0.720	1.082	11.880	0.052
					0.0

Table 6. Scenario 5 for Badulu Oya Irrigation scheme

Year	R_i	$(O\&M)_i$	Farmers pay ISF	Minimum Government Incentive	NPV of Investor
2000	13.500	0.400	0.000	0.000	-13.900
2001	18.000	0.507	0.000	0.000	-15.422
2002	18.000	0.613	0.000	0.000	-12.926
2003		0.720	0.686	12.276	7.084
2004		0.720	0.686	12.276	5.904
2005		0.720	0.686	12.276	4.920
2006		0.720	0.686	12.276	4.100
2007		0.720	0.686	12.276	3.416
2007=2030					
2030		0.720	0.686	12.276	0.052
					0.0

Table 7. Scenario 6 for Badulu Oya Irrigation scheme

Table 8 shows the summary of minimum contributions of farmers for ISF and CRF in quantities of paddy (bushels/acre) for the Badulu Oya irrigation scheme.

	Maha		Yala	
Scenario	ISF (bu/ac)	CRF (bu/ac)	ISF (bu/ac)	CRF (bu/ac)
Economic				
Scenario 1	-	-	-	-
Scenario 2	1.38	-	1.61	-
Scenario 3	-	19.85	-	23.82
Scenario 4	1.38	19.85	1.61	23.82
Financial				
Scenario 5	2.18	19.85	2.55	23.82
Scenario 6	1.38	20.61	1.61	24.74

Table 8. Summary of ISF and CRF for Scenarios in the Badulu Oya irrigation scheme.

4.3 Case Study 2 - Demodara Irrigation Scheme

This is a tank irrigation scheme constructed in 1983 in the 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 canal system of the scheme is not efficient due to percolation and seepage losses. Hence, cultivations in Yala season were totally abandoned in some years causing lots of hardships to farmers, as farming is the only livelihood of the majority of villagers. The same areas of the scheme were rehabilitated under Centenary Irrigation Rehabilitation Programme (CIADP) in the year 1999 and rehabilitation works under Irrigation Systems Rehabilitation Programme (ISRP) commenced in 2000. The costs and benefits before and after rehabilitation are estimated based on the details collected from baseline surveys, agricultural officers, statistics of Agricultural Department (DOA, 1986; 1997; 1998; FOA, 1985), farmers etc.. The details of pattern of land use and yields of crops in the schemes are given in Table 9.

Description	Before rehabilitation		After rehabilitation	
	Maha	Yala	Maha	Yala
Acreage –Paddy (acres)	380	30	380	30
Yield (bu/acre)	75	125	75	125
Acreage –Green gram (acres)	0	40	0	120
Yield (kg/acre)	325	325	700	700
Acreage –Maize (acres)	10	50	10	100
Yield (kg/acre)	20	20	80	80
Acreage –Soya bean (acres)	625	625	1600	1600

Table 9. Acreages and yields before and after Rehabilitation

Economic and Financial Analysis

Similar to the previous Case Study in section 4.2, the analysis was done for the same criterion. The details of the economic and financial analysis, which show the minimum contributions of the beneficiaries for the different scenarios are shown in Table 10 to Table 15 for the Demodara Irrigation Schemes.

Year	R_i	P_i	O_i	I_i	NPV of Project
2000	3.600	0.000	0.000	0.000	-3.545
2001	3.600	0.000	0.018	0.000	-2.939
2002	2.700	0.000	0.037	0.000	-1.811
2003		0.251	0.055	1.913	1.026
2004		0.502	0.055	3.826	1.656
2005		0.753	0.055	5.738	2.048
2006		1.003	0.055	7.651	2.263
2007		1.254	0.055	9.564	2.350
2007=2030					
2030		1.254	0.055	9.564	0.035
					12.622

Table 10. Scenario 1 for Demodara Irrigation scheme

Year	R_i	P_i	O_i	I_i	$(O\&M)_i$	Farmers pay ISF	NPV of $(-(O\&M)_i + ISF)$
2000	3.600	0.000	0.000	0.000	0.000	0.000	-0.055
2001	3.600	0.000	0.018	0.000	0.000	0.000	-0.061
2002	2.700	0.000	0.037	0.000	0.000	0.000	-0.064
2003		0.251	0.055	1.913	0.111	0.163	0.030
2004		0.502	0.055	3.826	0.111	0.163	0.025
2005		0.753	0.055	5.738	0.111	0.163	0.021
2006		1.003	0.055	7.651	0.111	0.163	0.018
2007		1.254	0.055	9.564	0.111	0.163	0.015
2007=2030							
2030		1.254	0.055	9.564	0.111	0.163	0.000
						NPV of $-(O\&M)_i + ISF = 0$	

Table 11. Scenario 2 for Demodara Irrigation scheme

Year	R_i	P_i	O_i	I_i	$(O\&M)_i$	Farmers pay ISF	NPV of $(-(O\&M)_i + ISF)$
2000	3.600	0.000	0.000	0.000	0.055	0.000	-3.600
2001	3.600	0.000	0.018	0.000	0.074	0.000	-3.000
2002	2.700	0.000	0.037	0.000	0.092	0.000	-1.875
2003		0.251	0.055	1.913	0.111	2.456	1.421
2004		0.502	0.055	3.826	0.111	2.456	1.184
2005		0.753	0.055	5.738	0.111	2.456	0.987
2006		1.003	0.055	7.651	0.111	2.456	0.822
2007		1.254	0.055	9.564	0.111	2.456	0.685
2007=2030							
2030		1.254	0.055	9.564	0.111	2.456	0.010
						NPV of $-R_i + CRF = 0$	

Table 12. Scenario 3 for Demodara Irrigation scheme

Year	R_i	P_i	O_i	I_i	$(O\&M)_i$	Farmers pay ISF	Farmers pay CRF @ 20%
2000	3.600	0.000	0.000	0.000	0.055	0.000	0.000
2001	3.600	0.000	0.018	0.000	0.074	0.000	0.000
2002	2.700	0.000	0.037	0.000	0.092	0.000	0.000
2003		0.251	0.055	1.913	0.111	0.163	2.456
2004		0.502	0.055	3.826	0.111	0.163	2.456
2005		0.753	0.055	5.738	0.111	0.163	2.456
2006		1.003	0.055	7.651	0.111	0.163	2.456
2007		1.254	0.055	9.564	0.111	0.163	2.456
2007=2030							
2030		1.254	0.055	9.564	0.111	0.163	2.456

Table 13. Scenario 4 for Demodara Irrigation scheme

Year	R_i	$(O\&M)_i$	Farmers pay ISF 20%	Government pay CRF	NPV of Investor
2000	3.600	0.095	0.000	0.000	-3.695
2001	3.600	0.120	0.000	0.000	-3.100
2002	2.700	0.146	0.000	0.000	-1.976
2003		0.171	0.257	2.456	1.471
2004		0.171	0.257	2.456	1.226
2005		0.171	0.257	2.456	1.021
2006		0.171	0.257	2.456	0.851
2007		0.171	0.257	2.456	0.706
2007=2030					
2030		0.171	0.257	2.456	0.011
					0.0

Table 14. Scenario 5 for Demodara Irrigation scheme

Year	R_t	$(O\&M)_t$	Farmers pay ISF	Minimum Government Incentive	NPV of Investor
2000	3.600	0.095	0.000	0.000	-3.695
2001	3.600	0.120	0.000	0.000	-3.100
2002	2.700	0.146	0.000	0.000	-1.976
2003		0.171	0.163	2.550	1.471
2004		0.171	0.163	2.550	1.226
2005		0.171	0.163	2.550	1.021
2006		0.171	0.163	2.550	0.851
2007		0.171	0.163	2.550	0.709
2007=2030					
2030		0.171	0.163	2.550	0.011
					0.0

Table 15. Scenario 6 for Demodara Irrigation scheme

Table 16 shows the summary of minimum contributions of farmers for ISF and CRF in quantities of paddy (bushels/acre) for the Demodara irrigation scheme.

	Maha		Yala	
Scenario	ISF (bu/ac)	CRF (bu/ac)	ISF (bu/ac)	CRF (bu/ac)
Economic				
Scenario 1	-	-	-	-
Scenario 2	1.03	-	1.29	-
Scenario 3	-	17.66	-	21.19
Scenario 4	1.03	17.66	1.29	21.19
Financial				
Scenario 1	1.63	17.66	2.03	21.19
Scenario 2	1.03	19.75	1.29	21.89

Table 16. Summary of ISF and CRF for the Demodara Irrigation scheme

4.4 Limitations of the Study

Most of the details collected for the case studies are based on the views of farmers and officers involved in various sectors for activities of the irrigation schemes. Some of the available information such as yield, use of fertilizer, etc., represents certain areas of the schemes and have been generalized to represent the entire scheme. It is true that there can be significant differences 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 assumptions can cause variations in the data for the analysis. However, these variations will not make significant changes to the results given in Table 8 and Table 16.

The analysis was done by assuming a 50% reduction in the O&M costs after rehabilitation of the irrigation schemes. However, this amount may be too high compared to the allocated prorata per acre for O&M cost at present. Therefore, there is a possibility of reducing ISF given in Tables 8 and 16. The error of the assumption however is on the conservative side.

5.0 Discussion

The concept of rehabilitation of irrigation schemes through PSP should be understood as the recovery of ISF and CRF from increased benefits to farmers by reversing the financial losses due to deterioration. Therefore, GOSL will benefit from the economic viewpoint while the farmers and investors will benefit from a financial viewpoint. The PSP is only possible if the recovery of investors' capital is ensured by adopting innovative financial strategies such as payments of recurrent costs, subsidies or allocating other assets, which can be converted into positive cash flows.

For this, incorporation of other agencies such as Departments of Forest, Agriculture, Road Authority, etc, is essential in national planning to achieve integrated development by harnessing the benefits of PSP. Even though the farmers benefit due to rehabilitation, the farmers' contribution will depend on their perceived affordability and not necessarily on their willingness to pay. Therefore, fixing of ISF and CRF contributions from the beneficiaries is difficult and controversial decisions need to be made against tradition.

The present trend of the farmers is to cultivate paddy in most areas of the irrigation schemes during both seasons. Unfortunately, cultivation of paddy is not always successful and large scale cultivation failures have occurred due to water shortages aggravating the grievances of farmers. The cultivation of other crops, which need less water and are more profitable compared to paddy, should be promoted in water deficient areas and especially during the Yala season.

The different varieties of crops suitable for the season should be introduced after a proper study to maximise the income of farmers. There is a clear indication that the set back of farmers in Sri Lanka compared to other developed nations is due to the lack of useful education and technological expertise in the farming community (Water Vision 2025). Farmer education on agricultural activities such as low consumption of water, cultivation of other crops and introduction of new agricultural techniques should be developed to improve their productivity and profitability.

The ISF could be the starting point of contribution by farmers for O&M cost of the irrigation schemes. The analyses in the previous section show that farmers can make significant contributions to cover up ISF. The Table 3 and Table 11 show the minimum ISF at the 20% discount rate, for the two irrigation schemes developed

as case studies. Table 6 and Table 14 show ISF and CRF at the 20% discount rate, which give higher ISF values compared to Table 3 and Table 11. Alternatively, Table 7 and Table 15 show the CRF requirement when maintaining minimum ISF as shown by Table 3 and Table 11 at 20% discount rate. In practice ISF could be reduced depending on requirement after rehabilitation. However, the possibility of recovery ISF is high, which will also build up the sense of ownership of the rehabilitated asset.

The options such as introduction of ISF at a low rate and gradual increase with time would be advisory until the farmers are familiar with the concept. The incidents when the forecasts cost and benefits are diverged should be studied with alternative cash flow arrangements to provide concessions for the farmers. The concessions by the government to farmers during cultivation failure, flood, drought etc would be strategies to promote farmer equity and to build up trust between farmers and investors.

Ultimately most of the benefits come from increased production and possibly higher selling prices of the products. Therefore a systematic process is required to regularize agricultural activities aiming to increase productivity. There are many cases where farmers are not able to invest money for agriculture due to low income from low selling prices and low productivity. These situations should be minimised by supporting farmers either financially or materially at the beginning of season on condition of recovery after harvesting. The organizations both public and private can ensure farmers better market prices for farm products by purchasing output at reasonable prices to reduce price fluctuations and ensuring farmers' confidence in selling their products. Consistent government policies on agriculture and less political influence to avoid frequent changes in policies are needed.

6.0 Conclusions

The objectives of this paper were to explore the viability of private sector participation and the use of Irrigation Services Fees (ISF) and Cost Recovery Fees (CRF) in rehabilitating existing irrigation schemes in Sri Lanka. The study analysed the collection of ISF and if possible CRF from the beneficiaries, as means of reducing the financial burden on the GOSL rehabilitate irrigation facilities.

It was clear that the rehabilitation of irrigation schemes could bring high economic benefits, even though the recovery of full capital cost from beneficiaries is practically difficult. The case studies estimated actual contributions needed from beneficiaries to recover O&M costs and invested capital for the rehabilitation. Therefore, GOSL should package innovative financial strategies to attract PSP while ensuring recovery of ISF as minimum contribution from beneficiaries. Thus, GOSL can reap the economic benefits of rehabilitated irrigation systems without using its scarce capital. Instead with PSP, GOSL gets to convert capital expenditure into annual recurrent expenditure. In other words, the rehabilitation of irrigation schemes through PSP becomes an "off balance sheet" activity for the GOSL.

Even though in theory PSP seems to be the panacea for all ills, the case studies demonstrate that in reality it will not happen, unless the GOSL and all public sector institutions involved in integrated water management realise that in future it is investments by PSP that will help to reverse the deterioration of existing irrigation schemes. As such, every encouragement and facility should be extended for PSP.

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References

Aschauer, D.A (1991), Infrastructure: America's third deficit, *Challenge*, Vol. 34, 39-45.

Bazin, M.L (1986), Project management in progress, tools and strategies for the '90s', *The Manageability of the Development Process*, Elservier Science Ltd, Netherlands, pp. 167-180.

Beidleman, C.R., Fletcher, D., and Veshosky, D. (1990), On allocating risk: the essence of project finance, *Sloan Management Review*, 31(Spring), pp. 47-55.

Curry, S. and Lucking, R. (1992), *Shadow Prices for Sri Lanka*, National Planning Department, Sri Lanka, April 1992.

Daily News (1995), President's Policy Statement, 7 January 1995, 12 & 15.

Dias, A.J and Ioannou, P.G (1996), Company and Project Evaluation Model for Privately Promoted Infrastructure Projects, *Journal of Construction Engineering and Management*, Vol. 121, 404-414.

DOA (1986), *Techno Guide Line*, Publication of Department of Agriculture, 1986.

DOA, (1997), *Diseases of Paddy Cultivation*, Publication of Department of Agriculture, 1997.

DOA(1998), *Recommended fertilizer for paddy cultivation*, Publication of Department of Agriculture, 1998.

Feasibility Report on the rehabilitation of tank irrigation project, March 1986, Japan International Corporation Agency (JICA).

FOA (1985), *Socio Economic data of selected village irrigation schemes in Sri Lanka*, Working Paper No 3, Department of Agricultural Economics and Extension, Faculty of Agriculture, University of Peradeniya, October 1985.

Jenkins,GP and Harberger, AC (1992), *Cost-Benefit Analysis of Investment Decisions*, Harvard Institute for International Development, Cambridge, USA.

Karasapan, O (1995), The World Bank Contribution to private Participation in Infrastructure, World Bank Group, pp 109-112.

Lammie, J.L. (1988), Lending opportunities in privatization, *Journal of Commercial Bank Lending*, Vol. 71(1), pp. 4-12.

Liddle, B.T (1997), Privatization Decision and Civil Engineering Projects, *Journal of Management in Engineering*, ASCE, Vol. 13, No.3, pp. 73-78.

McCarthy, S.C and Perry J.G (1989), BOT contracts for water supply, *Conference Proceedings, World Water 89*, Thomas Telford, London, pp. 215-220.

McCarthy, S.C and Tiong, R.L.K (1991), Financial and contractual aspects of build - operate - transfer projects", *International Journal of Project Management*, Vol. 9 (4), pp. 222-227.

Plamer, C.F (1986), Introduction of special public works projects to Sudan, *International Journal of Project Management*, Index to Vol 4.

Quartey, E.L.J (1996), Development projects though build-operate schemes : their role and place in developing countries, *International Journal of Project Management*, Vol.14(1), No.1, pp. 47-52, 1996.

Ranasinghe, M. (1999), Private sector participation in infrastructure projects: A methodology to analyze viability of BOT, *Construction Management and Economics*, E&FN Spon, U.K., Vol. 17, No. 3, pp. 613-623.

Shen, L, Lee, R.K.H, and Zhang, Z (1996), Application of BOT System for Infrastructure Projects in China, *Journal of Construction Engineering and Management*, Vol. 121, pp. 319-323.

Tam, C.M (1995), Features of power industries in Southeast Asia, *International Journal of Project Management*, Vol. 13. No.5. pp. 303-311, 1995.

Water Vision 2025 (2002), *Vision to Action*, Lanka Jalani, Sri Lanka National Water Partnership, July 2002.