47

RECOVERY OF ABANDONED PADDY LANDS: A CASE STUDY FROM NORTH WESTERN PROVINCE

by

Malik Ranasinghe

Abstract

Large extents of paddy lands are abandoned in the North Western Province (NWP). Low productivity of paddy lands and lack of water at the correct times seem to be the obvious reasons. However, the regulatory requirement that only paddy can be cultivated in paddy lands and economics of paddy cultivation is as or more important reasons for abandoning large extents of paddy lands. The paper describes as a case study, the engineering that was carried out to recover approximately five hectares of abandoned paddy lands to those on which Teak trees can be planted including the actual experiences and behaviour of the engineered project; and the feasibility analysis of planting Teak trees. Based on the case study, the paper highlights a process to recover abandoned paddy lands by providing proper drainage, which can then be used for other agricultural purposes. The planting of Teak trees in abandoned paddy lands in the NWP is technically and financially viable, and economically and environmentally feasible.

1.0 Introduction

Large extents of paddy lands are abandoned in the Western Province and North Western Province (NWP) of Sri Lanka. Even though low productivity of paddy lands and lack of water at the correct times seem to be the obvious reasons, the regulatory requirement to plant only paddy (section 62 of the Agrarian Services Act No. 58 of 1979), and economics of paddy cultivation is as or more important reasons for abandoning large extents of paddy lands. In the present market conditions, unless one can harvest at least 75 bushels of paddy per acre it is not economical to cultivate paddy in the NWP.

With availability of opportunities for employment and alternatives available for secondary or even tertiary employment for those employed in the suburban areas of NWP, motivation to cultivate paddy lands that are not productive is lacking (Abeynayake and Ajith Kumara, 1992). Therefore, the objectives of this paper are to analyse and describe as a case study,

1. engineering that is needed to recover abandoned paddy lands to those on which for example Teak trees could be planted; and
2. the financial, economic and environmental analysis of a pilot project to plant Teak trees in approximately five hectares to determine feasibility of recovering abandoned paddy lands.

2.0 Case Study

The case study presented in this section describes:

1. engineering that is needed to convert abandoned paddy lands to those on which Teak trees can be planted;
2. actual experiences and behaviour of the engineered project; and
3. financial, economic and extended benefit cost analyses of planting Teak trees in approximately five hectares of abandoned paddy lands.

2.1 Pilot Project

The abandoned paddy lands, which are being recovered under the pilot project are located in Yogiyana, in the Dankotuwa Divisional Secretary Area of the Puttlam District in the North Western Province (NWP). The extent of the paddy lands is approximately twelve and quarter acres or five hectares as shown in Fig. 1. These paddy lands have been abandoned for over fifteen years. When recovered it is possible to plant approximately 7000 Teak trees in this extent of land.

Eng. (Prof.) Malik Ranasinghe, BSc Eng(Hons), MASC, PhD, MIE(SL), Dean Faculty of Engineering, University of Moratuwa.

Except for the main canal, which drains the water from the Singakkuliya tank and two natural springs (Bulanas) upstream to Maha Oya, all of the other canals within the paddy lands were filled due to neglect over a long period from abandoning of the paddy lands. Secondly, because the outlet culverts were not laid at the correct level there was silting in the canals. Since drainage is not properly facilitated there is significant water logging during the rains. Even though the new Agrarian Development Act No. 46 of 2000 permits the use of paddy lands for agricultural purposes, unless proper drainage is provided, despite the new Act, paddy lands may remain abandoned.

2.2 Engineering

As in most paddy lands in this area, slope for drainage is marginal with level difference between entry (99.68 m) and exit (99.31 m) of water to these paddy lands being 0.37 m or little over one foot as shown in Fig. 1. After establishing levels, it was evident that if the outlet culverts are laid at the correct levels the water entering the paddy field can be drained out. However, as this will not be a quick process due to the marginal drainage slope, paddy fields can remain waterlogged for long periods due to heavy rains that can be experienced in this area. This is not conducive for planting Teak or for any other agricultural purpose.

The drainage is enabled, by rehabilitating the old canals and creating a new canal network within the paddy field. This canal network had to have the ability to retain most of the water within the paddy lands while draining only the excess water through the outlet culverts. As a result, canal system as shown in Fig. 1 was established in the abandoned paddy field. The canals shown in double line are the old canals while those indicated by the single line are the new canals. All canals are 12 feet wide with average depths ranging from 3 to 4 feet depending on the location of the canal.

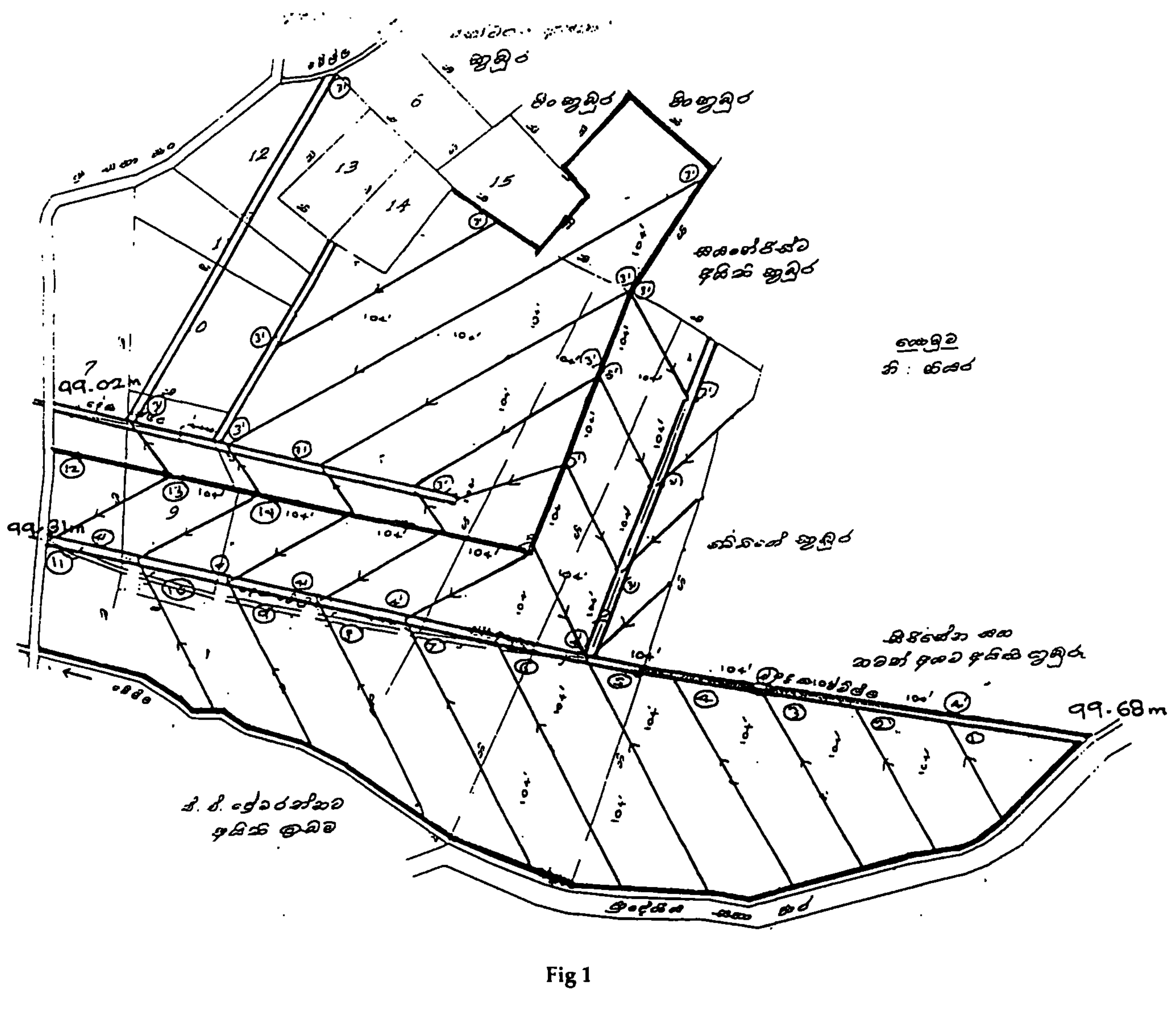

Fig 1

The canals were excavated along the diagonals of squares of 104 feet by 104 feet or quarter acre size blocks. The soil that was excavated to layout the designed canal system was levelled in the paddy fields to raise it to the level of the ridges. Even though the level was not raised more than 9 inches to a foot, by relaying the outlet culverts precisely, we have managed to drain out the excess water at the earlier level of the paddy fields. In other words, the maximum water level is always 9 inches to a foot below the level of the planting ground. Hence the reason for 12 feet canals.

As a result it is now possible to retain significant amount of water within the paddy field and at the same time haul out sufficient soil to raise the level of the paddy fields to that of their ridges. The heavy rains in September/October/November 2000 and 2001 showed that the canals are behaving as predicted. Since no soil was brought into the paddy field or any soil taken out after excavation of the canals, no laws are broken in providing for drainage through a canal system within the paddy lands. Significantly, approval of the Land Reclamation and Development Corporation for this project was only if such system of canals was laid within the paddy field.

2.3 Analysis

Feasibility analyses relevant to this pilot project, namely, financial, economic and environmental, which is sometimes called extended benefit-cost, are presented in this section.

Financial Analysis

The starting point is the financial analysis where the project is analysed from the viewpoint of the investor. This analysis is based on the, actual costs that were incurred, forecasts based on prevailing prices and expenditure, and forecasts of harvesting and prices for firewood and timber from the literature of commercial Teak growers and market information.

There were five main items of costs.

1. The cost to purchase the five hectares of land including the legal, survey and approval costs (Rs. 384,000);
2. The cost to rehabilitate old canals and establish a new canal system to provide for sufficient drainage (Rs. 405,000);
3. The cost to prepare the land for planting (Rs. 225,000);
4. The cost to purchase Teak plants and for the planting itself (Rs. 90,000); and
5. The estimated cost of annual maintenance of the canals (Rs. 10,000) and periodic maintenance of the wire fences (Rs. 30,000 once in four years up to year 12), and the annual cost of fertilising (Rs. 15,000).

There are two items of revenue.

1. The revenue from the sale of pruned branches to the tile industry as firewood from year 8 onwards. The pruning of branches is recommended to ensure that the tree will grow straight. At present tile industry purchases a cubic yard of Teak firewood at Rs. 200.
2. The revenue from the sale of Teak trees in 20 years time. At present a 20 year old tree is valued approximately at Rs. 15,000 (Help Green, 2000). As the base case it is assumed that 40% of the trees planted (approximately 2700) can be harvested in 20 years.

This revenue estimate is compatible with the data given in the Forestry Department leaflet on Teak planting. In that leaflet it is estimated that the average volume of timber harvested from one hectare is 270 m^3 (165-375 m^3). Help Green (2000) states that the price of Teak timber is Rs. 30,000 per m^3 in 2000 prices. For five hectares it works out to Rs. 40.5 million as revenue from timber. This is same as the revenue from 2700 trees valued at Rs. 15,000 (Help Green, 2000). While the assumption of 40% of trees to be harvested in 20 years is slightly higher than that by the Forestry Department leaflet, Kotagama (1997) has shown that the yield from privately managed Teak plantations tend to be higher than that of state managed plantations.

When it is assumed that the Teak trees will be harvested in the 21st year and all revenue will be realised by the end of the 22nd year, the financial internal rate of return (FIRR) of the pilot project is 19.4% (see Table 1 for the analysis). Kotagama (1997) estimated the FIRR at 18.4%, using yield data per hectare of plantation based on Management Plans prepared by the Forest Department. He assumed the prices of timber equal to 1.26 times Stumpage Value and costs for material and labour based on Forest Department data used in the Stumpage Value Assessment Study by Herath (1994). Similar to this analysis prices and costs were considered in constant term excluding the effect of inflation. Since the present analysis is based on actual costs incurred in 2000 and revenue forecasted from more recent price information on timber, this analysis can be considered to be compatible with the study by Kotagama (1997).

Year	Land & Legal	Costs Canals	Plants & Planting	Land Prepare	Revenue Firewood	Trees	Net C F	DR = 0.194 NPV = -0.7
2000	384,000	405,000	90,000	225,000	-	-	-1,104,000	-924792
2001	-	10,000	15,000	-	-	-	-25,000	-17542
2002	-	10,000	15,000	-	-	-	-25,000	-14695
2003	-	10,000	15,000	-	-	-	-25,000	-12310
2004	-	10,000	15,000	30,000	-	-	-55,000	-22685
2005	-	10,000	15,000	-	-	-	-25,000	-8638
2006	-	10,000	15,000	-	-	-	-25,000	-7235
2007	-	10,000	15,000	-	-	-	-25,000	-6061
2008	-	10,000	15,000	30,000	200,000	-	145,000	29447
2009	-	10,000	15,000	-	200,000	-	175,000	29771
2010	-	10,000	15,000	-	200,000	-	175,000	24938
2011	-	10,000	15,000	-	200,000	-	175,000	20890
2012	-	10,000	15,000	30,000	200,000	-	145,000	14499
2013	-	10,000	15,000	-	200,000	-	175,000	14659
2014	-	10,000	15,000	-	200,000	-	175,000	12279
2015	-	10,000	15,000	-	200,000	-	175,000	10286
2016	-	10,000	15,000	-	200,000	-	175,000	8616
2017	-	10,000	15,000	-	200,000	-	175,000	7218
2018	-	10,000	15,000	-	200,000	-	175,000	6046
2019	-	10,000	15,000	-	200,000	-	175,000	5065
2020	-	10,000	15,000	-	200,000	-	175,000	4242
2021	-	10,000	15,000	-	200,000	-	175,000	3554
2022	-	-	-	-	-	40,500,000	40,500,000	822448

Table 1. Finacial Feasibility of the Teak Plantation in 2000 prices

Economic Analysis

The objective of economic analysis is to determine whether the implementation of a project will improve the economic welfare of the country (Jenkins and Harberger, 1992). Since economic analysis evaluates direct benefits and costs of the project from the economy's perspective, the approval and implementation of a project by the public sector is based primarily on its economic feasibility.

An economic analysis is of the same nature as a financial analysis, except benefits and costs of the project are measured from the point of view of the economy (Jenkins and Harberger, 1992). Instead of relying solely on cash flow techniques to measure revenue (benefits) and costs as in the case of the financial analysis, economic analysis requires the project to be assessed with respect to the impact it has on the efficiency of the economy as a whole.

The key issue in the economic analysis of the pilot project is the opportunity cost of paddy lands. Since Agrarian Services Act No. 58 of 1979 does not permit any activity but cultivation of paddy or food crops or fodder in between, and the intent of the Agrarian Development Act No. 46 of 2000 is still open for interpretation, it is reasonable to assume that at present the only legally permitted activity on paddy lands is paddy cultivation. Then, **opportunity cost of abandoned paddy lands is zero** because of the prevailing laws and regulations of the country.

Year	Opp	Canals	Costs			Benefits		Net Benefits	DR = 0.208
			Plants	Planting	Land	Firewood	Trees		NPV = 0.6
CFs		1.115		0.785	0.785	0.787	0.841		
2000	-	451575	30000	47100	176625		-	-705,300	-583893
2001	-	11150	-	11775	0		-	-22,925	-15712
2002	-	11150	-	11775	0		-	-22,925	-13007
2003	-	11150	-	11775	0		-	-22,925	-10768
2004	-	11150	-	11775	23550		-	-46,475	-18072
2005	-	11150	-	11775	0		-	-22,925	-7380
2006	-	11150	-	11775	0		-	-22,925	-6110
2007	-	11150	-	11775	0		-	-22,925	-5058
2008	-	11150	-	11775	23550	157400	-	110,925	20261
2009	-	11150	-	11775	0	157400	-	134,475	20334
2010	-	11150	-	11775	0	157400	-	134,475	16834
2011	-	11150	-	11775	0	157400	-	134,475	13936
2012	-	11150	-	11775	23550	157400	-	110,925	9517
2013	-	11150	-	11775	0	157400	-	134,475	9551
2014	-	11150	-	11775	0	157400	-	134,475	7907
2015	-	11150	-	11775	0	157400	-	134,475	6546
2016	-	11150	-	11775	0	157400	-	134,475	5419
2017	-	11150	-	11775	0	157400	-	134,475	4486
2018	-	11150	-	11775	0	157400	-	134,475	3714
2019	-	11150	-	11775	0	157400	-	134,475	3075
2020	-	11150	-	11775	0	157400	-	134,475	2546
2021	-	11150	-	11775	0	157400	-	134,475	2107
2022	-	-	-	-	0	-	34060500	34,060,500	533765

Table 2. Economic Feasibility of the Teak Plantation in 2000 prices

The market prices used in the financial analysis for the respective costs and revenues have to be adjusted to reflect the opportunity cost (or shadow price). Then, cost to society of the project is measured in terms of forgone marginal products of inputs, had they been used in the next best alternative (Jenkins and Harberger, 1992). The respective costs and revenues were adjusted for the economic analysis using the conversion factors (CFs) suggested by Curry and Lucking (1992) for projects in Sri Lanka. The CFs used are:

* 0.785 for Scarce Labour for land preparation and planting costs;
* 1.115 for Infrastructure for the canal construction costs;
* 0.787 for Firewood; and
* 0.841 for Forestry for the revenue from timber

The economic IRR of the pilot project based on the above conversion factors and assumption on the opportunity cost of land is 20.8% (see Table 2). Even if it is assumed that minimum acceptable economic discount rate is 20%, as the project is commercially oriented, planting Teak in abandoned paddy fields is economically feasible.

Extended Benefit Cost Analysis

Till recent, little attention was paid to immediate and long-term environmental impacts of projects (Dixon et al., 1988; Pearce and Warford, 1993; Munasinghe, 1993; Panayotou, 1993; Pearce et al., 1994; Winpenny, 1996; Ranasinghe, 1996; 1997; Rutherford et al., 1998). At present, many indirect costs are included in the economic analyses by means of environmental and/or non-market valuation (Panayotou, 1993). This process is called the extended benefit cost analysis. In other words, valuations of critical impacts as environmental benefits and costs are incorporated to the economic analysis to carry out the extended benefit cost analysis.

Abandoning large extents of paddy land due to the prevailing laws and regulations and the economics of the permitted activities creates a hidden social cost. This becomes more acute when there is a demand for that land for alternative activities like housing. As a result owners are tempted to engage in unauthorised activities such as refilling of paddy lands. The direct economic costs of regulation are captured by considering the opportunity cost of land as zero in the economic analysis. However, the additional social cost of not being able to use the land for an alternate economic activity despite the demand for it is not captured.

Generally, paddy lands are on drainage paths. When paddy lands are abandoned over long periods without maintaining the canal system for proper drainage, they tend to become waterlogged. This may create marshes and its own eco-systems. Famous Muthurajawela paddy lands are a classic example. One must understand that abandoned paddy lands were man made lands used for economic agricultural purposes. The recovery of paddy lands by providing efficient drainage returns the land to their original purpose.

On the other hand there are no major environmental costs in growing Teak trees. A significant environmental benefit that accrues to society as a result of growing trees is the sequestration of CO_2 by the Teak plantation (Abayasiri, 2000). In addition the paddy lands, which require large amounts of water to grow paddy, can be utilised for other agricultural purposes requiring less amounts of water after recovery.

The USEPA (1990) estimated an average CO_2 sequestration rate of 1.81-2.26 tons per acre per year. This value is likely to be conservative as the growth rates in tropical forests of Sri Lanka are likely to be faster than in the temperate forests of the United States. Abayasiri (2000) estimated the "Mean Annual Carbon Storage (MACS)" in tons of carbon per hectare per year (tC/ha/yr) as a result of CO_2 sequestration according to different age classes of Teak trees. For example, according to Abayasiri (2000), MACS for age classes between 1-10, 11-20, 21-30, 31-40, and 41-50 years are respectively 1.1, 64.7 322.2, 466.4 and 52.2 tC/ha/yr.

For estimation purposes we can assume an average sequestration rate of 2 tons of CO_2 per acre per annum based on the USEPA (1990) study. Then, the annual sequestration by the Teak trees in 5 hectares is approximately 25 tons of CO_2. Alternatively, we can assume MACS values estimated by Abayasiri (2000) as they are for Teak plantations in Sri Lanka. Then MACS by Teak trees in 5 hectares for age classes between 1-10 years and 11-20 years are respectively 5.5 and 323.5 tC/yr.

In a landmark study Ottinger et al., (1990), estimated the damage cost at US$ 15 per emitted ton of CO_2 in 1990 prices. Meier and Munasinghe (1994) suggested the use of the same value for Sri Lanka. Assuming an annual inflation rate of 3% of the US$, the environmental benefit of a sequestrated ton of CO_2 is approximately US$ 20 in 2000 prices. Assuming an exchange rate of Rs. 80 for 1 US$, the annual environmental benefit is approximately Rs. 1600 for a sequestrated ton of CO_2 in 2000 prices. The annual environmental benefit as a result of sequestration of CO_2 by the 5 hectare Teak plantation is Rs. 8,800 during the first ten years and Rs. 517,600 for the next ten years in 2000 prices.

Then, the extended benefit cost analysis of the pilot project shows an extended IRR of 23% (see Table 3 for the analysis). This analysis clearly shows that planting Teak trees in abandoned paddy lands is economically and environmentally feasible option. In addition, there are a number of other local environmental benefits that have not been quantified. For example, as the engineered canals in the paddy fields will retain water for longer periods, the drying up of the water wells in the area will be slower. The Teak trees will reduce the heat reflected to the houses adjoining the abandoned paddy fields and generally make the environment cooler during dry seasons. The estimated environmental benefit is therefore only a lower bound.

3.0 Conclusions

The objectives of this paper were to analyse the engineering that is needed to recover abandoned paddy lands to those on which for example Teak trees could be planted, and conduct feasibility analysis of a pilot project to plant Teak trees to determine the feasibility of recovering abandoned paddy lands.

A system of 12 foot canals with average depths ranging from 3 to 4 feet (depending on the location of the canal) was designed to provide drainage when the level difference is little over a foot between the entry and exit of water to the paddy lands. As a result it is now possible to retain significant amount of water within the paddy field and at the same time haul out sufficient soil to raise the level of the paddy fields to that of the ridges. The recovery of abandoned paddy fields for the use of agricultural purposes as permitted by the new Agrarian Development Act No. 46 of 2000 requires the involvement of engineers to ensure that the canal system to facilitate drainage is properly laid out.

Year	Opp	Canals	Costs Plants	Planting	Land	Firewood	Benefits Trees	Environt	Net Benefits	DR = 0.23 NPV = 3.3
CFs		1.115		0.785	0.785	0.787	0.841			
2000	-	451575	30000	47100	176625		-	-	-705,300	-573369
2001	-	11150	-	11775	-		-	-	-22,925	-15151
2002	-	11150	-	11775	-		-	8,800	-14,125	-7589
2003	-	11150	-	11775	-		-	8,800	-14,125	-6169
2004	-	11150	-	11775	23550		-	8,800	-37,675	-13377
2005	-	11150	-	11775	-		-	8,800	-14,125	-4077
2006	-	11150	-	11775	-		-	8,800	-14,125	-3314
2007	-	11150	-	11775	-		-	8,800	-14,125	-2694
2008	-	11150	-	11775	23550	157400	-	8,800	119,725	18566
2009	-	11150	-	11775	-	157400	-	8,800	143,275	18062
2010	-	11150	-	11775	-	157400	-	8,800	143,275	14684
2011	-	11150	-	11775	-	157400	-	8,800	143,275	11937
2012	-	11150	-	11775	23550	157400	-	517,600	628,525	42570
2013	-	11150	-	11775	-	157400	-	517,600	652,075	35904
2014	-	11150	-	11775	-	157400	-	517,600	652,075	29188
2015	-	11150	-	11775	-	157400	-	517,600	652,075	23728
2016	-	11150	-	11775	-	157400	-	517,600	652,075	19290
2017	-	11150	-	11775	-	157400	-	517,600	652,075	15681
2018	-	11150	-	11775	-	157400	-	517,600	652,075	12748
2019	-	11150	-	11775	-	157400	-	517,600	652,075	10363
2020	-	11150	-	11775	-	157400	-	517,600	652,075	8425
2021	-	11150	-	11775	-	157400	-	517,600	652,075	6849
2022	-	-	-	-	-	-	34060500		34,060,500	357748

Table 3. Extended Benefit Cost of the Teak Plantation in 2000 prices

As the financial IRR of the pilot project is 19.4%, planting Teak trees is an activity that can be encouraged amongst farmers/owners of abandoned paddy lands in the NWP. The economic IRR was estimated at 20.8% while the extended IRR was 23%. Since it is economically and environmentally feasible, planting Teak trees in recovered paddy fields is an activity that can be encouraged. Transferring land from high water consuming agriculture like paddy to low water consuming agriculture is a significant shift in areas where paddy cultivation is not economical and water is scarce.

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