ECONOMIC ANALYSIS OF MULTIPURPOSE AGROFORESTRY PLANTATION IN ABANDONED TEA LANDS IN MID COUNTRY OF SRI LANKA

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ABSTRACT

A particular multipurpose cropping model was established at Delpitiya of Gampola, Sri Lanka in November 1979 in one hectare of absolutely eroded abondoned tea land on experiemtal basis. This study was carried out to assess the performance of this cropping model during 2004-2011. Soil loss was measured by installing physical soil erosion measuring units. Technical purpose of multipurpose cropping model was estimated to identify the potential increase in productivity of marginal tea lands which have been becoming serious environmental, social and ecological hazards in mid country of Sri Lanka. The system urged to compare and analyze with and without project benefits. The results showed that soil loss on multipurpose cropping model came down to only 2 tons after its 8th year. But soil loss without project (old seedling tea field) went upto 61 tons per hectare at its 8th year. There was almost 31 times less erosion than without projects. The model shows higher values of cost benefit ratio (12.92), net present value (Rs. 1582976.33) and internal rate of return (40.20%) to confirm economic viability of the system.

KEYWORDS: Cropping patterns; marginal land; cost benefit analysis; Sri Lanka.

INTRODUCTION

When commercial tea plantations was started with British planters in the country, well planned soil conservations methods or erosion mitigation technologies were not followed due to priorities of hasty profit making. Existing line planting of seedling tea plants instead of contour planting is one reason for soil erosion acceleration. Also wider spacing between up and down planting rows (1.2m x 0.9m) is another reason for soil deterioration. The history of plantations industry in Sri Lanka reveals that tea industry was

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started by clearing of virgin forest/untouched lands and Patna lands. Before tea and coffee plantations in Sri Lanka these virgin forest and Patna area seemed to be rich with biodiversity, virgin soils and ecosystems. It is assumed that ecosystem and biodiversity were disturbed with the start of plantations industry as well as deterioration of virgin soil was another ecological problem identified. The degradation of virgin soil declined physical, chemical, biological and social values with the exposure of forest soil for commercial plantations. It was a reason to increase extent of marginal lands in plantations sector later on.

In addition, planters from British period have failed to undertake proper infilling programmes on annual requirements. Some manual weed controlling systems such as usage of scrapers also were responsible for accelerated soil erosion and time of replanting of old seedlings on fields top soil loss is substantially high. With passage of time these factors resulted in marginalization of tea lands in Sri Lanka.

Some policy failures also can be identified as a major factor to marginalized tea lands. When the lands clearing was undertaken prior to nationalization of plantations sector in Sri Lanka, there was no any proper national environment or forestry acts/policies or action plans pertaining to land clearing or environmental conservation. Hence, tea lands marginalization problem is unexpectedly raised. It has developed gradually due to mismanagement of plantations sector alongwith number of reasons before and after nationalization including unplanned establishment of tea without sufficient environmental attention by British planters and local planters.

Land degradation has been a major issue in tea estates of Sri Lanka compared to rubber and coconut plantations. Nearly 80 percent of the land is old seedlings plantations which are often poorly managed. Large tracts of these old seedling tea plantations have been either neglected or left fallow. It is estimated that about 30 percent of entire tea land is marginal or uneconomical (40% of this is totally abandoned). Long steeps and poor management practices are responsible for severe soil erosion on tea lands (7).

Early plantations industry was under the management of British planters and there were no other parties in the industry with entitlement for plantations. However, tea industry of Sri Lanka today depends on three parties management system namely government tea estate, large scale private plantations and small holders.

This research concerned with large scale plantations where more marginal lands can be seen and considered as immediate rehabilitation and management required. Marginal tea lands of the large scale tea plantations (special reference to the Regional Plantations Companies in Sri Lanka-RPCs) have four types of marginal lands on the definition of Dharmasena (3).

Gampola tea growing region is one of controversial regions in environment management of the country and is rested in Kandy district of central hills of the country. It is proved that more abandoned lands in the Kandy district are observed in Gampola region compared with other tea growing areas of the district. Elevation of the region is 700-1300 m. This section is recognized as moderate rainfall sites of Sri Lanka. Though the region receives average annual rainfall of 2000-3500 mm (6), yet selected sites for studies are belonged to intermediate zones or mid grown plantations in tea land classifications. Humidity of the region is 80-85 percent and widely spreading soils are red yellow podzolic (RYP).

The present study was conducted to assess the performance of multipurpose cropping model established at Delpitiya of Gampola, Sri Lanka to improve abandoned tea lands.

MATERIALS AND METHODS

This study was conducted during the year 2004-2011. Two types of methods i.e. economic approach and ecological approach were used to analyze existing condition of marginal lands and benefits of the agroforestry model for abandoned tea lands in Sri Lanka. For economic analysis, discounting measures like cost benefit ratio (CBR), net present value (NPV) and internal rate of return (IRR) were used as analytical tools. Under ecological approach, three soil erosion measuring units were installed to cover one hectare of abandoned tea lands closed to the model and three soil erosion measuring units installed to cover one hectare of model under similar geological condition.

RESULTS AND DISCUSSION

Considering both economic and social benefits, multipurpose cropping model was establised at Delpitiya of Gampola-Sri Lanka in November 1979 in one hactare of eroded marginal tea land. After pegmarking entire area at 8'x8'(feet) of all planting points at spacing of 40' x 40' (feet) were dug to size of 80cm cubes pits for large size canopy crops, while pits of 40 cm cube were

dug for all other planting points. The pits for san ramon coffee were dug at 4'x4' apart between every two rows of pepper (2).

Banana and papaw started to give crop from second year while pepper and jak started to yield from 3rd year onward. There are 13 crops under this project and total number of plants are 3662 with different planting distance. Planting distances of different crops and layouts of model are given below (Table, Fig. 1).

Table. Planting distance of different crops.

Crop	Spacing (feet)*	Crop	Spacing (feet)*
Pepper	8x8	Coffee(Robusta)	8x8
Pepper(Catimor)	4x8	Cocunut	40x40
Aricunet	8x8	Banana	8x8
Lime	8x8	Nutmeg	40x40
Clove	40x40	Jak	40x40
Bread fruit	40x40	Avacado	40x40
Mango	40x40		

*One foot = 30.48 centimeters or 0.3048 meter.

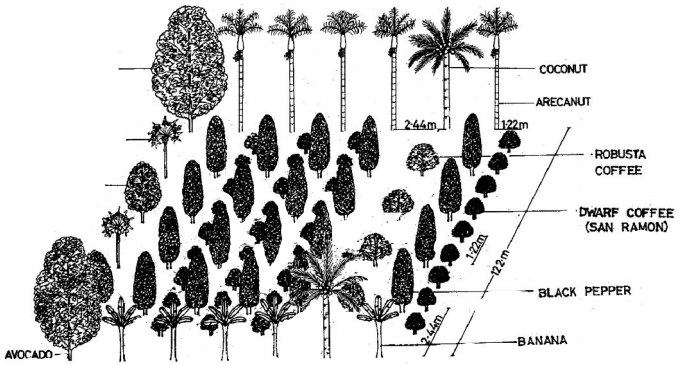

Fig. 1. Schematic diagram of the canopy architecture of a high intensity multi-species crop model.

Prevention of soil erosion with and without agroforestry (adjoining zero productive fields to model)

Soil loss was analyzed from the year 2004 to 2011 by installing physical soil erosion measuring units. This system urges us to compare and analyze the project viability. From Fig. 2 it can be seen that without the project system,

initial soil loss was 21 tons per hectare in 2004. Soil losses before starting organic agroforestry system in 2004 was 42 tons per hectare of eroded and abandoned tea field. The results give authentic picture regarding with and without project benefits of agroforestry models.

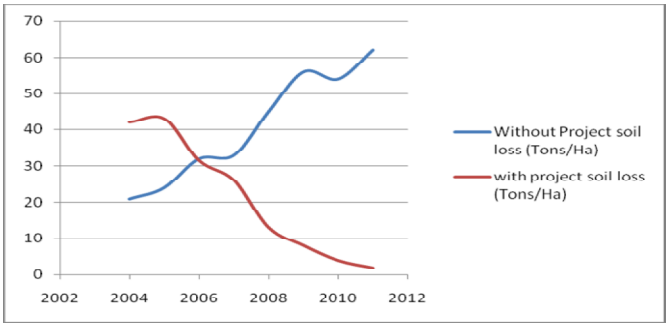

Fig.2. Soil loss comparison with and without projects.

Cost benefits ratio

CBR was derived from present worth of the benefit stream divided by present worth of cost stream. CBR is not commonly used in developing countries due to fact of price fluctuation and/or economic instability. Discounted cash flow measures of net present value and internal rate of return had become well known and were being widely used for private investment.

$$\text{Cost benefits ratio} = \frac{\text{Present value of benefits}}{\text{Present value of cost}}$$

$$CBR \frac{\sum_{t=1}^{n} \frac{B_n}{(1+i)^t}}{\sum_{t=1}^{n} \frac{C_n}{(1+i)t}}$$

B_n .benefits in each year
C_n. cost in each year
t- Number of years
i. Interest rate

Cost benefits (interest) ratio @ 10 %
1715734.2÷132757.87 = 12.92

CBR was occupied for the agroforestry project using reliable data. The project life was considered as 18 years. Present value of costs and benefits of the project were Rs 128632.87 and Rs.1715734.2, respectively. Thus CBR of project was 12.92. According to CBR ratio, the project is extremely successful.

Net present value

The difference between the present value of cash inflows and the present value of cash outflows is known as NPV. It is used in capital budgeting to analyze the profitability of a project. NPV analysis is sensitive to the reliability of future cash inflows of an investment or project. The formula for NPV is as,

$$NPV = \sum_{t=1}^{n} \frac{B_t}{(1+i)t} - \sum_{t=1}^{n} \frac{Ct}{(1+i)t}$$

B_t – benefits in each year
C_t - cost in each year
t- Number of years
I-interest rate

Though any project with positive NPV could be considered for implementation, yet large NPV is better. NPV calculated for the project was Rs.1582976.33 and thus the project is extremely acceptable on NPV tool.

Net present value = present value of benefits - present value of cost.

NPV @ 10 % = 1715734.20 – 132757.87 = 1582976.33

NPV @ 10 % of agro forestry project is Rs. 1582976.33

Internal rate of return

IRR is another way of using the discounted cash flow procedure for measuring worth of a project. It is to find discount rate which makes the NPV of cash flow equal to zero. This discount rate is termed as IRR and in a sense represents the average earnings capacity of capital invested in the project over the project life.

$$IRR = L_1 + D_{r1} * P_{w1} / A_{d1}$$

L_1- Lower discount rate
D_{r1}- Difference between the discount rates
P_{w1}- Present worth of cash flow at lower discount rate
A_{d1}- Absolute difference between present worth of the
cash flow at two discount rates (*Two discounted rates used for this analysis were 40% and 50%)*

IRR = 40 +10*(1028.45/49606.9)
= 40 + 10 (0.020)
= 40 + 0.20
= 40.20%

IRR is more significant discounting measure. The project had 40.20 percent percent of IRR value, which is higher than opportunity cost of capital. So, the project can be accepted according to IRR economic tool.

CONCLUSION AND RECOMMENDATIONS

The study concludes that according to discounting techniques, CBR, NPV and IRR are acceptable rates. Further, positive attitudes by all types of responders was found towards the agroforestry system and they preferred agro-forestry system as a soil conservation method rather than traditional method. Even a company invests for an agroforestry project by 40 percent of an interest rate, it will give profits after 8 years because the project has strong IRR value.

Soil loss due to project has been reduced to 2.1 tons from 42 tons when it is in its 8^{th} year. Also we can easily see, that soil loss of agroforestry project was maximum at starting point and after well establishment of the project it declined. Soil loss in non-project area is constantly increasing with increasing rate. An agroforestry system wherever it practices, will contribute to control soil erosion but magnitude may be fluctuated according to agroclimatic conditions. However, soil loss of old seedling tea fields has been increasing at increasing rate and it has reached to 62 tons per hectare when it is in its 8^{th} year. It proves that well managed and defined multipurpose cropping system will give enormous ecological benefits to the environment, provided species selection is undertaken very carefully according to the environment and geological condition.

For a sustainable and environment friendly culture, collaborative practices are required in view of past and present scientific researches and to formulate the appropriate agroforestry practices suitable for this region. Both organic farming and well maintained agroforestry models give environmental, economic and social benefits. This type of system is emphasized alongwith varied environmental factors for improving marginal/abandoned tea lands of the region.

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