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Multipurpose cropping model to improve economic and ecological viability in abandoned tea lands in mid country of Sri Lanka

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ABSTRACT

This particular multipurpose cropping model has been established at Delpitiya of Gampola-Sri Lanka in November 1979 in one hactare of absolutely eroded abondoned tea land on experiemtal basis. This study was carried out during 2004-2010; soil loss was measured by installing physical soil erosion measuring units. Technical purpose of multipurpose cropping model was estimated in order to identify the potential increase in productivity of marginal tea lands where have been becoming serious environmental, social and ecological hazards in mid country of Sri Lanka. This system urges us to compare and analyze with and with out project benefits. Total soil loss on degraded marginal tea lands has been recorded 174.28 for 7 years. But total soil loss of with agroforestry has been come down to 11.51 tons/ha with in tested period of 7 years. This is almost 15.2 times less erosion than with out projects and average annual soil loss has been reported as 24.8 and 1.64 tons/ha/year marginal lands and agroforestry, respectively. The model showed higher CBR, NPV and IRR values to confirm economic viability of the system.

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Key Words : Soil erosion, Economic viability, Agroforestry, Tea plantations

INTRODUCTION

When British planters started commercial tea plantations in the country, well planned soil conservations methods or erosion mitigation technologies were not followed due to priorities of hasty profits making. Ex. line plantings of seedling tea plants instead to contour plantings is one reason for soil erosion accelerated. Wider spacing between up and down planting rows (1.2m *0.9m) is another reason for soil deterioration. The history of plantations industry in Sri Lanka reveals that the tea industry has been 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 would be rich with biodiversity, virgin soils and eco systems. It is assumed that ecosystem and bio diversity were disturbed with the starting of plantations industry as well as deterioration of virgin soil was another ecological problem identified. The results of degradation of virgin soil have been declined physical, chemical, biological and social values with the exposure of forest soil for commercial plantations. It was one reason to increase extent of marginal lands in plantations sector later on.

In additions to these reasons, planters from British period to present have been failed to under take proper infilling programs on annual requirements. Some manual weeding controlling systems such as usage of scrapers also was responsible for accelerated soil erosion and time of replanting of old seedling fields top soil loss is substantially high. With the time being those factors have been resulted for marginalization of tea lands in Sri Lanka as removal of top soils and its' fertility.

Some policy failures also can be identified as a major factor to be marginalized tea lands. Ex: when the lands clearing under taken prior to nationalization of plantations sector in Sri Lanka, there was not a proper national environment and forestry acts / policies or actions plans pertaining to the land clearing or environmental conservation. Hence, tea lands marginalization problem is not unexpectedly risen one. It has been developed gradually due to mismanagement of the plantations sector due to no of reasons before and after nationalization and also unplanned establishment of tea with out sufficient environmental attention by British planters and local planters.

Land degradations have been a major issue in tea estates of Sri Lanka compared to rubber and coconut plantations. Nearly about 80 per cent of the land is old seedling tea which is often poorly managed. Large tracts of these old seedling tea plantations have been either neglected or left fallow. It is estimated that about 30 per cent of the entire tea land is marginal or uneconomic (40% of this is totally abandoned). Long steeps and poor management practices are responsible for severe soil erosion on tea lands (Sivapanal, 1993).

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

As this research concerned with large scale plantations where can be seen more marginal lands and consider 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, 2008). Marginal tea land where has been giving low / negligible yields or zero yields per hectare due to environment or/ and management limitation.

Gampola tea growing region one of controversial region in environment management of the country, is rested in Kandy district of the 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 where boarded to Kandy district. Elevation of the region is 700m-1300m. This section is recognized as moderate rainfall recorded sites of Sri Lanka. Even though the region receives average annual rainfall 2000m-3500mm (Punniyawardana, 2008) selected sites for studies are belonged to intermediate zones or mid grown plantations in tea land classifications. Humidity of the region is 80-85 per cent and widely spreading soils are red yellow podzolic (RYP).

RESEARCH METHODOLOGY

Two types of methods have been used to analyze existing condition of marginal lands and benefits of the agroforestry model

- Economic approach
- Ecological approach

Economic analysis:

Discounting measures were used as analytical tools

— CBR -Cost benefits ratios
— NPV- Net present value
— IRR - Internal rate of return

Ecological approach:

Installed 2 soil erosion measuring units to cover one hectare of abandoned tea lands closed to the model and 02 soil erosion measuring units to cover one hectare of the model under similar geological condition. Experimental plots were designed on the way experiment carried out by Jinze (1981). He designed soil erosion sedimentation plot for $60m^2$ to $200m^2$. Even though, this particular experiment was based on sedimentation plots introduced by Jinze, size of sedimentation plot was standardized for $100m^2$ in the area with a regular shape and sedimentation pit was 3m x 1.5m x 2m. Entire sedimentation plot were completely covered by using high gage galvanize sheets for ensuring run off water not to over flowing or going out from the plot, runoff water from sedimentation plot were collected in the sedimentation pits which were well covered using white durable polytheen.

RESEARCH FINDINGS AND ANALYSIS

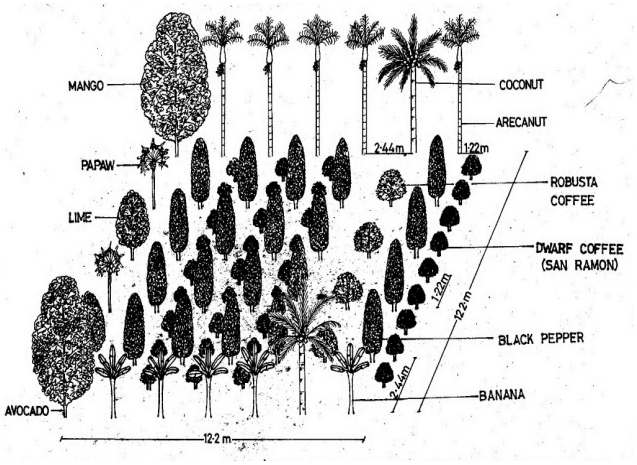
Considering both economic and social benefits multipurposes cropping model was establised at Delpitiya of Gampola-Sri Lanka in November 1979 in one hactare of eroded marginal tea land. After pegmarking entire area at 8'x8' all the planting points at specing of 40'x40' were dug to the size of 80cm cubes pits for large size canopy crops, while pits of 40cm cube were dug for all the other planting points. The pits for san ramon coffee were dug at 4'x4' apart in between every two rows pepper.

Banana and papaw has started to give crop from secound year while pepper,jak started for yielding from 3rd year onwards. There were 13 crops under this project and recored total number of plants were 3662 with different planting distance. Planting distanc of different crops and layouts of the model are shown (Fig. 1).

It has been examined during 2004-2010; soil loss was analyzed by installing physical soil erosion measuring units. This system urges us to compare and analyze the project viability. As follows graphs, it can be seen where, as without project system total soil loss was 174.28 tons/ha in over 7 years. Total soil losses of agroforestry was recorded 11.51 tons/ha. The land has been totally changed in positive way and soil loss has been came down rapidly and soil building capacity is very high due to green manure production of the agroforestry system. Following graphs (Fig. 2, 3 and 4) give real picture about with and without project benefits of the agro forestry models. It explains soil loss tons/ha/yr with an agro forestry project and with out a project (Adjoining eroded tea field).

Benefits cost ratio-CBR:

This is the ratio obtained when the present worth of the benefit stream is divided by the present worth of cost stream. The cost benefit ratio is not commonly used in developing countries; this is because the value of the ratio will change depending on where the netting out in the



Crop	Spacing	Crop	Spacing
Perrer	8x8	Coffee (Robusta)	8x8
Pepper (Catimor)	4x8	Coconut	40x40
Arecanut	8x8	Banana	8x8
Lime	8x8	Nutmeg	40x40
Clove	40x40	Jak	40x40
Bread fruit	40x40	Avacado	40x40
Mango	40x40		

Fig. 1: Layout of the field

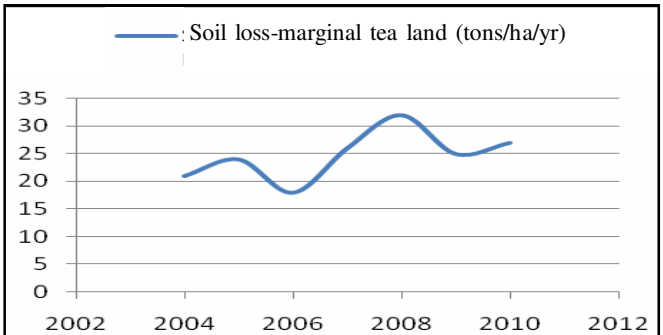


Fig. 2: Soil loss-marginal tea land (2004-2010)

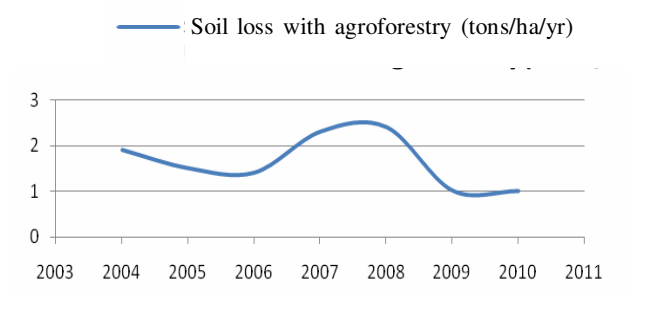


Fig. 3: Soil losses with soil loss with agroforestry (2004-2010)

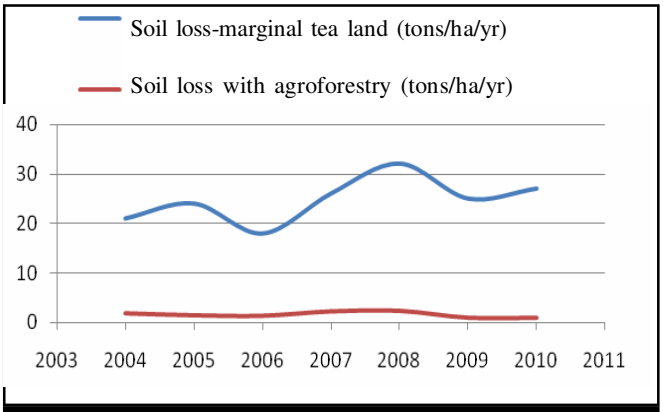


Fig. 4: Soil loss comparion with projects and without projects (2004-2010)

cost benefits stream occurs. By the time discounted measure of project worth began to be applied in developing countries.

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

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

where,

B_n - benefits in each year

C_n - cost in each year

t- Number of years

i- Interest rate

Cost benefits ratio @ 10 %

1715734.2/ 132757.87 = 12.92

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

Net present value –NPV:

The formal selection criterion for NPV measure of projects with a positive NPV, when discounted that the opportunity cost of capital, net present value is the difference between discounted total benefits and discounted total costs of the project this could be calculated as

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

where,

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, large NPV better for the project in, the NPV calculated for the project was Rs. 1582976.33 and thus the project is extremely accepted on net present value 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):

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

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

where,
IRR- Internal rate of return
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 the present worth of the cash flow at the 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 has 40.20 of IRR value, which is higher than the opportunity cost of capital. So, the project can be accepted according to IRR economic tool.

Conclusion:

It was analyzed CBR, NPV and IRR according to these discounting techniques both CBR and NPV and IRR are acceptable rate. Further it was found that positive attitudes toward the agro forestry system by all type of responders and they prefer agroforestry system as a soil conservation method rather than traditional methods. Even a company invests for an agro forestry project by 40 per cent of an interest rate. It will made profits after 8 years, because the project is having strong IRR value.

Average soil loss of with project has been reduced to 1.64 tons/ha/yr from 24.89 tons/ha/yr of marginal land. This explicates how annual loss has been down of agroforestry systems and soil loss of marginal eroded lands is fluctuating between 18 and 32.07 tons over 7 years. As well as we can easily see, an agro forestry system wherever it practices, contributes to control soil erosion but, magnitude may be fluctuated according to agro climatic conditions. But soil loss of old seedling tea field has been fluctuating on high rate and increasing by increasing rate. It proves well managed and defined multipurpose cropping system will give enormous ecological benefits to the environment short term as well as long term. But species selection should be under taken very carefully according to the environment and geological condition. For a sustainable and environment friendly culture, collaborative practices are required from past and present scientific researches and formulated the appropriate agro forestry practices suitable for this region. Both organic farming and well maintained agro forestry models is always environmental sound, economic viable and social acceptable. This type of system is emphasized along with the varied environmental factors for improving marginal/abandoned lands of the region. As mid country marginal tea land extent is recorded as 42000 ha, well managed agroforestry/mix cropping systems will be remedy for the issue of land degradation of mid country in Sri Lanka.

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