Tropical Agricultural Research Vol. 20: 409 - 413 (2008)
Short communication

Potential of Dendro-Thermal Energy Use in Organic Tea Industry: An Extended Benefit Cost Analysis

V.M.B.A. Priyantha[1] and S.Thiruchelvam[2]

Postgraduate Institute of Agriculture
University of Peradeniya
Peradeniya, Sri Lanka

ABSTRACT. *Dendro thermal energy has been emerged as an alternative energy source for fossil fuel in the past decade. The environmental and economic benefits of using Dendro thermal energy in organic tea production have not been investigated in Sri Lanka. In this context this study assesses the economic viability of Dendro thermal energy for curing of tea in the organic tea industry in Sri Lanka. The data was collected from an organic tea producing factory and 33 randomly selected fuel wood suppliers in Haputale and Haldummulla divisional secretariat divisions in the Badulla District in 2008. The extended benefit cost analysis and Likert scaling method were employed as main analytical tools.*

The transfer of diesel energy to Dendro thermal energy leads to the reduction of cost from Rs. 38.60/kg to Rs. 7.45/kg of made tea and increased the factory net income by Rs. 7,548,000.00 from 240,000 kg of made tea per annum. About 47% of biomass was obtained from registered suppliers of the company through contractors. Most of the farmers who supply feedstock to the plant had a high perception in continuing supply due to additional net income of Rs. 17,812/ha for 35 man days spent on fuel wood production and supply. The Benefit Cost Ratio for Dendro and diesel were 2.65 and 1.46 respectively. Further, the study showed that the appropriate institutional arrangements for fuel wood suppliers are important for sustainable supply of fuel wood. Incremental benefits from environment will encourage the other factories to follow the use of Dendro thermal energy.

INTRODUCTION

The global energy crisis is profoundly affecting the developing countries, which contain three quarters of the world population. Development of renewable energy sources has become a national priority in Sri Lanka for energy security. The importance of a policy to facilitate dendro thermal power generation using biomass for sustainability and decentralization has emerged (Ranasingha, 2006). Experiences of Asian countries show that a biomass energy plantation projects are not appropriate for achieving the social objective of

[1] Norway Development Fund, Kandy.

[2] Department of Agricultural Economics and Business Management, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka.

poverty alleviation, since the people who are targeted are typically not market oriented and they do not have access to land to grow food or cash crops with quick return (Ranasinghe *et al*, 2007**)**. Some factors that increasingly work against biomass production are the higher cost of land caused by increased population pressure of land for food, other purposes and the price of oil, which is still declining in real terms. Hence supply of biomass fuels should be based on byproducts of agro products and multiple use trees and other trees intercropped with other crops for conservation purposes and soil enrichment purposes (FAO, 2000). However, the present oil prices are zooming up. Since Sri Lanka introduced organic tea to the world market in early 1990's, it is gaining popularity, especially as a health beverage. While hundred of thousands farmers in the developing countries practice organic agriculture, the potential gain in organic tea production is in a dilemma of how to overcome this problem of mainly being non attractive to the local suppliers of biomass as a renewable energy. According to IAFN (2007) usage of fossil fuel must be limited up to 40% in energy usage in tea estate which are certified under Forest Garden Product Inspection Service (FGPIS). Hence supply of biomass fuels should be based on byproducts of agro products and multiple use trees and other trees intercropped with other crops for conservation purposes and soil enrichment purposes**.**

Against this background, this study was designed to assess the economic viability of Dendro thermal energy for curing of tea in organic tea production to generate much needed foreign exchange for the country. The specific objectives of the study were to carry out an extended benefit cost analysis; evaluate the supply base and storage facilities of raw materials for a Dendro thermal energy plant and to find out the positive factors contributing to organically certified cultivation for feasibility of establishing a dendro power unit in tea factories of Sri Lanka.

METHODS

The overall guiding null hypothesis was that there is no sustainability and profitability in establishing a Dendro thermal power generation unit in organic tea production in Sri Lanka.

The study was carried out in Badulla District, including Haputale and Haldummulla divisional secretariat divisions. Thotatagala tea factory and other organic certified factories were purposively selected for economic investigation. Thotatagala tea estate belongs to Green Filed Bio Plantation Pvt Ltd which has been certified as organic tea plantation since 1996 by many international certification bodies. Thus Thotatagala tea factory was considered as an excellent candidate for economic investigation for organic tea production.

From the two divisional secretariat divisions, 11 organically certified tea small holder farmers, 12 organically certified spices farmers and 10 organic spices farmers were randomly selected. Thus, the fuel wood suppliers were restricted to 33 farmers. Data on biomass production, labour use, cost and returns in fuel wood supply, soil and water conservation, soil erosion, biodiversity, micro climatic change etc., were collected during June and July in 2008 by using a pre-tested interview schedule. In addition to that data was collected from 4 *Gliricidia* collectors those who collect *Gliricidia* from farmers and supply to the tea factory. Secondary data on the cost and return of using diesel and Dendro thermal energy in curing tea, supply problems with regard to fuel wood etc., were obtained from the

Thotatagala tea factory and other organic certified factories. Supply base from Thotatagala estate and other organically certified farms were also analyzed.

Extended benefit cost analysis was carried out to evaluate the eco-friendly nature and economic viability of Dendro thermal energy use in drying tea. Benefit transfer method was employed to value the environmental losses avoided such as deforestation, biodiversity losses, vulnerability of landslides, soil erosion and soil fertility losses. Gunatillake and Thiruchelvam (2003) employed extended benefit cost analysis for incorporating environmental cost and benefits in the evaluation of small scale hydropower projects in Sri Lanka. The calculation of the environmental valuation in this study was adopted from the above study. Sensitivity analysis was carried out at 6, 10, 12 and 18% discount rates. Cost increase by 10 and 20% were also tested. In transferring market price into economic price, shadow price and conversion factors such as labour 0.92, energy 0.92 and material cost 0.88 were used. In order to investigate the problems faced by fuel wood suppliers a *Likert*-scale with ranking the problems was employed. The suppliers were asked to give a score to each constraint based on their experience in fuel wood supply in their rotational harvesting pattern adopted in meeting the fuel demand. Further the farmers' perception on contribution of *Gliricidia* in fulfilling the international organic standards was estimated by using ranking method.

RESULTS AND DISCUSSION

Economic analysis showed that the requirement of Dendro fuel for the drying of one kg of tea was 0.8 kg of Dendro fuel and the cost of drying using Dendro fuel was 7.45/kg of tea. The cost of drying with diesel was Rs 38.60/kg. The cost of Dendro fuel was Rs 6.00/ kg. Hence annual saving from usage of dendro fuel was Rs 7,548,000 for the company having the capacity of 240,000 kg of made tea. Annual Dendro fuel requirement for Dendro power plant was 300,000 kg and out of which potential company owned farms' supply base was 160,000 kg which was 53% of the requirement Dendro fuel. Hence 140,000 kg have to be supplied from outside the company owned farms. Production of Dendro fuel in organically certified tea gardens and spice gardens under company out grower system was 1,050,000 kg which was over 4.5 times of the requirement. In addition to that 320,000 kg green manure and 19,200 kg wood ash were produced from dendo fuel within company owned farms as by products which will be a support to fertility management of organically certified lands. Both financial and socio-economic analyses show validity of the supplying fuel wood on an environmentally friendly basis. About 90 % of the farming population owns sufficient mixed spice gardens and tea gardens with *Gliricidia* plants for the supply of Dendro fuel and the storage of Dendro fuel are made possible by the arrangements made by the factories.

A farmer earned Rs 17,812.00 from fuel wood supply in addition to his primary income from farming. This income was obtained from spending 35 working days annually to prepare Dendro fuel. Further, farmers became convinced of other major advantages, such as reduced soil erosion, moisture conservation, and retention of soil fertility and productivity. Although these advantages have not been measured by the farmers, they are clearly visible when comparing their fields with those practicing inorganic or conventional farming. Soil fertility improvement to *Gliricidia* supplier from pepper growers was found that it can replace 50% required fertility for pepper cultivation that is saving of 700 kg of fertilizer per 0.4 ha. Thus pepper cultivators can supply the total requirement of *Gliricidia.* Replacement

cost of fertilizer revealed that Rs 20,000.00/ha could be saved from *Gliricidia* inter cropping. *Likert* scaling analysis revealed that most farmers' perception was high in continuing supply of fuel wood. In this regard farmers' degree of satisfaction in getting required labour supply, drying, storing and transport of sticks, price received for fuel wood, contractual arrangement were analysed. Accordingly it was found that organizing better contractual arrangements with large groups would meet the fuel wood demand. Improved technology in cutting of fire wood, reduction in labor cost, providing storage facilities and systemizing of supplying of Dendro fuel need to be developed.

Financial cost and benefits were 3.82 and 2.24 for Dendro energy and fossil fuel energy respectively. These values at 6% discount rate in the economic analysis were 2.65 and 1.46 for dendro energy and fossil fuel respectively. The results of sensitivity analysis revealed that the relative less sensitivity to the benefits and cost changes. The effect was less in the long run. This was mainly due to more environmental benefits gained from the biomass production and use of fuel wood in curing tea. These incremental benefits from environment give many promises for the other factories to follow the use of Dendro thermal energy with the better institutional arrangement with the suppliers. When cost increased by 20% fossil fuel energy use become non economical while Dendro energy use continue to be above BCR of 2.4.

Table 1 Potential production base and supply of *Gliricida* stick company owned & received from out growers of mixed spice garden & tea

Source of *Gliricidia*	Amount kg/year for Dendro dryer	% of total requirement for Dendro dryer	% of Actual supply
Annual requirement for dryer	300,000	100	
1 Total from company owned lands	160000	53	62
2 Small scale organic tea farmers	92500	31	-
3 Koswattha estate	60000	20	20
4 Organic Mixed spices farmers	1050000	450	18
Total potential production	1522500	507	100

Table 2: Result of extended benefit cost analysis for Dendro plant and diesel plant for a five year production period

Items	Discount rates			
	6%	10%	12%	18%
Dendro plant				
NPV Rs. Mil	234	223.23	218.5	205.5
EBCR	2.652	2.651	2.6517	2.6514
Diesel plant				
NPV Rs. Mil	103.6	94.9	91.23	80.8
EBCR	1.467	1.4647	1.4647	1.4645

CONCLUSIONS

The study revealed that the annual economical gain of using dendro power for tea dry was Rs 7,548,000 with other social and environmental benefits. The economic analysis results showed that the Dendro thermal had an overall benefit. Sensitivity analysis suggests that no uncertainties exist in transferring fossil fuel to dendro thermal energy use in organic tea curing. Most farmers who supply bio mass had positive perception on continued supply. Since land size of each farm is limited, organizing contract farming with large groups is important to meet the fuel wood demand these results also show that there is a good level of increase in soil conservation and soil fertility by conserving bio diversity with the Dendro thermal fuel wood supply. Immediate economic benefits and the protection of soil and water can go hand in hand especially when enhanced by collective action.

ACKNOWLEDGMENTS

The authors wish to acknowledge the cooperation extended by Thotatagala Tea Factory, Green Field Bio Plantation Limited, other organically certified spice farmers and tea small holders in Haputtale and Haldummulla Divisional Secretariat areas for their support in providing data.

REFERENCES

FAO (2000). Options for Dendro power in Asia. Report on the export consultation regional wood energy development program in Asia GCP/RAS/154/net 1-18.

Gunathillake, P.M.P.C. and Thiruchelvam, S. (2003). An evaluation of small-scale hydropower development project in Sri Lanka: A case study in Sripadagama. Trop. Agric. Res. 15: 288-298.

IAFN. (2007). Forest Gardens Products Standards. International Analogy Forestry Network

Ranasingha, D.M.S.H.K. (2006). Asia socio economic study on the dendro power project at Kumalgamuwa Walapane Asia Proecp Program

Ranasingha, D.M.S.H.K., Vanniarachi, A, Jayarartne, T. and Amarasena, S. (2007). Potential and socio-economics of using dendro energy in Sri Lanka – a case study of the Dendro plant in Kumalgamuwa, Walapane. Proc. Int. Forestry and Envir. Sympo. 2007, Univ. Sri Jayawardenapura, Sri Lanka 53.