

**GROWTH, YIELD, CARBON FIXATION AND
ECONOMICS OF RUBBER CULTIVATION
IN SRI LANKA**

BY

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DECLARATION

The work described in this thesis was carried out by me under the supervision of Dr. (Mrs) U.A.D.P. Gunawardena of the University of Sri Jayewardenepura and Dr. V.H.L. Rodrigo of the Rubber Research Institute of Sri Lanka and a report on this has not been submitted in whole or in part to any university or any institution for another Degree/Diploma.

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SUPERVISORS' CERTIFICATION

We certify that this thesis meets the required standard for the Degree of Doctor of Philosophy.

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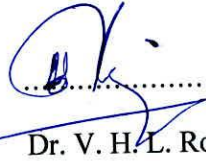
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“DEDICATED TO THE MEMORY OF ONE I LOST”

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ABBREVIATIONS

ADSL	-	Agriculture Department of Sri Lanka
AGBM	-	Aboveground Biomass
AGR	-	Absolute Growth Rate
ANRPC	-	Association of Natural Rubber Producing Countries
BCR	-	Benefit Cost Ratio
BGBM	-	Belowground Biomass
BI	-	Renewed bark of base panel of the rubber tree
BM	-	Biomass
BO	-	Virgin bark of base panel of the rubber tree
BCA	-	Benefit Cost Analysis
CDM	-	Clean Development Mechanism
CER	-	Certified Emission Reduction
CIF	-	Cost Insurance and Freight
COP	-	Cost of Production
D	-	Diameter
DNA	-	Designated National Authority
DOE	-	Designated Operational Entity
DS	-	Divisional Secretaries
EAD	-	Export Agriculture Department
EB	-	Executive Board
ERP	-	Eppawala Rock Phosphate

ERU	-	Emission Reduction Units
ET	-	Emission Trading
FD	-	Forest Department
G-77	-	Group of 77
GDP	-	Gross Domestic Production
GHG	-	Greenhouse Gas
GoSL	-	Government of Sri Lanka
H	-	Height
HWP	-	Harvested Wood Products
IRR	-	Internal Rate of Return
IZ	-	Intermediate Zone
JI	-	Joint Implementation
LULUCF	-	Land Use Land Use Change and Forestry
MC	-	Marginal Cost
MDF	-	Medium Density Fibre Board
MENR	-	Ministry of Environment and Natural Resources
MOP	-	Muriate of Potash
MPAHA	-	Ministry of Public Administration and Home Affairs
MPI	-	Ministry of Plantation Industries
NPV	-	Net Present Value
NTFP	-	Non Timber Forest Products
PAC	-	Policy Analysis Circle
PDD	-	Project Design Document
PIN	-	Project Idea Note

RDDSL	-	Rubber Development Department of Sri Lanka
RDO	-	Rubber Development Officer
RGR	-	Relative Growth Rate
RP	-	Rock Phosphate
RPC	-	Regional Plantation Company
RRISL	-	Rubber Research Institute of Sri Lanka
RSS	-	Ribbed Smoked Sheets
SOC	-	Social Opportunity Cost
STFIC	-	Special Task Force Intercropping
STPR	-	Social Time Preference Rate
TBM	-	Total Biomass
TEV	-	Total Economic Value
TPD	-	Tapping Panel Dryness
TRISL	-	Tea Research Institute of Sri Lanka
TSHDA	-	Tea Small Holders Development Authority
TSR	-	Technically Specified Rubber
UNFCCC	-	United Nations Frame Work Convention on Climate Change
WTA	-	Willingness to Accept
WTP	-	Willingness to Pay
WZ	-	Wet Zone
YAP	-	Years after Planting
YPH	-	Yield per Hectare

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Growth, yield, carbon fixation and economics of rubber cultivation in Sri Lanka

Enoka Shiromalee Munasinghe

ABSTRACT

Being an industrial crop, rubber (*Hevea brasiliensis* Muell. Arg.) is exclusively cultivated for income generation though some associated crops in rubber based intercropping systems could partly be used for subsistence. As for any venture, direct and indirect investments made by different stakeholders to promote rubber cultivation in the country are to be justified in financial and economic terms. Obviously, spatial and temporal variability of rubber cultivation with respect to plant growth and yield, management conditions, market flows and stakeholders' perceptions is to be accounted in these financial and economic assessments. Such studies to date have been confined to the general condition prevailed in the plantation sector of Sri Lanka. Therefore, the present study was aimed to assess the financial and economic viability of the rubber cultivation considering its growth in two major agroecological zones: Wet and Intermediate zones, and the potential benefits received from latex, timber/firewood and carbon credits in CDM market under the average management conditions with both sole and intercropping. Further, the study was met to identify the key factors underpinning the profitability of some rubber based intercrops in smallholdings.

Ontogenetic variations of tree growth and yield of rubber were quantified through *in situ* assessments of related parameters and, simple models were derived to explain timber volume, biomass and carbon content in the rubber tree based on easily measurable growth

indicators such as tree diameter and total height. This information together with market rates/economic values for cost and revenue components of rubber cultivation and three major intercrops: banana, tea and pineapple, is used for financial and economic assessments. The present status of rubber based intercropping systems in the country was assessed through an island wide survey and then, key socio economic factors underpinning the profitability of above mentioned intercrops were identified.

On average, a rubber tree in Wet zone was capable of producing 0.73 m³ of total timber and 0.58 m³ of sawn timber log volumes, 668 kg of biomass and fixing 274 kg of carbon in 30 years. Corresponding values per hectare were 208 m³, 166 m³, 191 MT and 79 MT, respectively. The resultant values in Intermediate zone were *ca.* 16% less than those in the Wet zone. As per the guidelines given for forestry based CDM projects, new planting of rubber in Intermediate zone has a potential of trading its CO₂ fixed within the trees. Rubber cultivation only for latex and timber was financially viable (at farmer level) with NPV of Rs.1.66 million, IRR of 22% and BCR of 1.44. According to economic analyses, rubber cultivations were more viable at national level than the farmer level with NPV of Rs.3.9 million, IRR of 34% and BCR of 2.32. Inclusion of carbon values and intercrops increased the financial/economic viability by *ca.* 6% and *ca.* 60%, respectively. Potential for reducing the rotational age of rubber cultivation was also assessed. Profitability of both banana and tea intercropping with rubber was governed by the cropping intensity and the total land extent of respective crop. Further, type of employment and educational level of the farmer influenced the profitability of banana whilst scarcity of labour was a determinant of the profitability of tea. Measures to be taken for effective adoption of rubber based intercrops and building up CDM projects are proposed.