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Carbon footprint of rubber/sugarcane intercropping system in Sri Lanka: a case study

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Abstract

The global climate has been changing with the elevated CO_2 in the atmosphere; hence identification of effective measures to mitigate or combat the adverse effects of climate change is at uttermost importance. The goal of Government of Sri Lanka (GoSL) for planting 40,000 ha of rubber (*Hevea brasiliensis* Muell. Arg.) in the Uva province may partly address this issue sequestering the key greenhouse gas (GHG), CO2. Farmers in the area usually practice intercropping sugarcane (*Saccharum officinarum*) under immature rubber plants for extra income during the initial period of rubber cultivation. In the process of valuing rubber cultivation in mitigating the climate change effect, information on net greenhouse gas (GHG) emission from rubber/sugarcane intercropping system is required. Being scanty of such knowledge, this study was aimed to estimate the carbon footprint in the cultivation of rubber/sugarcane intercropping system in Sri Lanka.GHG emissions from the cultivation of rubber and sugarcane were calculated using the information available in the smallholdings having rubber/sugarcane intercropping in Monaragala district (IL2). GHG emission resulting from raw rubber processing, i.e. Ribbed Smoked Sheets (RSS) and Crepe Rubber (CR), was assessed using the data available in Kumarawatta Estate, Monaragala and Dartonfield Estate, Agalawatta, respectively. Also, GHG emission resulting from processing refined sugar was gathered from Palwatta Sugar Industries (Ltd), Monaragala. Carbon sequestration capacities of both crops were adopted from previous studies. Guidelines of Intergovernmental Panel on Climate Change (IPCC) were used in the estimation of carbon footprint. GHG emission in the process of cultivating rubber for its lifespan (30 years) was 65.15 CO2-eq ton/ha. When sugarcane was cultivated in rubber lands for four year period as a rubber/sugarcane intercropping system, GHG emission increased only by 9.72 CO2-eq ton/ha. Processing of RSS throughout the lifespan was responsible for additional 93.49 CO2-eq ton/ha emission whilst that for processing CR was limited to 50.14 CO2-eq ton/ha. Processing of refined sugar during four year intercropping period was accountable only for 0.62 CO2-eq ton/ha emission. In conclusion, carbon footprint (Net GHG emission) of cultivating rubber/sugarcane intercrop to produce CR and refined sugar was -1537.02 CO2-eq ton/ha/30yr whilst that for RSS and refined sugar was -1493.73 CO2-eq ton/ha/30yr. Increase in carbon footprint by intercropping sugarcane was only ca. 0.5% over mono cropping rubber. Potential application of this information in developing carbon trading projects is discussed.

Keywords: Carbon footprint; rubber; sugarcane; intercropping

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1. Introduction

Changing global climate due to enhanced greenhouse effect has been identified as one of the critical issues. To address this detrimental issue, Intergovernmental Panel on Climate Change (IPCC) has introduced key mechanisms which have been internationally recognized. First one is to mitigate climate change through reduction of emission of greenhouse gasses (GHG) and increasing the greenhouse gas absorption sinks to reduce their accumulation in the atmosphere. The second is adaptation for building capacity to adjust ecological, social and economical changes resulted due to climatic impacts[1,2]. Aligning with the global community, Government of Sri Lanka (GoSL) has developed a strategic climate plan based on different thrust areas. Industrial sector has been identified as one of the most important sectors influencing climate change.

Tree plantations such as rubber (*Hevea brasiliensis* Muell. Arg.) helps mitigate the climate change by sequestering atmospheric CO_2, thus considered to be carbon negative. As one of the major plantation crops in Sri Lanka, rubber plantation covers 131,000 ha and provides 152,000 MT of rubber[3]. Previous studies show that rubber plantations are capable of sequestering 1,660 MT of CO_2 per hectare[4] with ultimate fixing of 290 MT of CO_2 per hectare[5] during its 30-year economic life cycle.

Under the development goals of GoSL, 40,000 ha of new planting programme of rubber in the Uva province has been launched which would complement to combat the adverse effects of climate change providing GHG absorption sink. Sugarcane (*Saccharum officinarum*) is a common crop in this area, hence farmers prefer to cultivate sugarcane with rubber under intercropping system in order to obtain an extra income during the initial period of rubber cultivation[6,7]. Furthermore, intercropping ameliorates crop microclimate for improved growth of rubber[8,9]. Harvests of both crops are to be processed into different forms for marketing, thus several activities are involved in these processes of emitting CO2. Despite the knowledge on carbon fixing in crops, no information is available on the emission in the whole process. Any attempt for developing carbon trading projects on mitigation option of climate change requires information on net emission of GHG (carbon footprint). In this backdrop, the present study was aimed to estimate the carbon footprint of rubber/sugarcane intercropping system through activity base analyses.

2. Methodology

The data were mainly collected in Monaragala district which is located in the Intermediate Zone 2 (IL2) of Sri Lanka where rubber/sugarcane intercropping holdings are mostly available. Collection of agronomic data was carried out in four sites situated in Kumbukkana Gramasewa division of Monaragala district. Information on processing of sugarcane was collected from the processing unit of Palwatta Sugar Industries (Ltd) in Monaragala district. The information on rubber was collected from rubber processing units at Kumarawatta Estate, Moneragala and Dartonfield Estate, Agalawatta.

GHGs (CO_2 and CH_4 and N_2O) emissions from agronomic practices of rubber and sugarcane cultivation and processing into raw rubber and refined sugar were assessed and then used with data on carbon sequestration, for rubber[4] and for sugarcane[10] for the calculation of carbon footprint. Under the agronomic practices of rubber and sugarcane cultivation, land preparation, transportation of planting materials, transportation and application of fertilizers were considered. Transportation of field latex to the factory, machinery usage in rubber processing and drying were the key activities occupied in raw rubber processing, i.e. crepe rubber (CR) and Ribbed Smoked Sheets (RSS). Similarly, transportation of cane yield to the factory, machinery usage for milling, boiling and drying were the main steps practiced in processing of refined sugar. Emission of GHGs due to fuel combustion involved in above activities was taken into account. In addition, process related emissions at refinery stage of fuel were taken into account. Emission through the electricity usage in factories was counted on the basis of emission values available for electricity generation. The application of nitrogen fertilizer for both crops was quantified and emissions due to