Carbon Sequestration Potential of Tea Plantations in Sri Lanka

by

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Introduction and Focus

•Environmental issues – Climate Change (CC) becoming increasingly important.

•Concentrations of CO_2 and other greenhouse gasses (GHGs) increase.

Carbon sequestration:

•Comparatively a new idea

•Refers to capture and storage of CO_2 that would otherwise reside in the atmosphere for a long period of time (Anon, 2009)

•The provision of long term store of carbon in:

- Terrestrial biosphere
- Underground
- Oceans

•CO_2 concentration in atmosphere → reduced or slowed down

(Dharmaparakrama, 2006)

Types of C Sequestration:

1. Geologic Sequestration: underground in rock formations
2. Ocean Sequestration: Largest potential sink
   a. Solubility
   b. Biological
   c. Man made

3. Terrestrial Sequestration

   a. Biosphere
   b. Soil

Significant opportunity to reduce CO_2 and obtain additional benefits

Current Trend

- Information on carbon sequestration → already generated for
  - several land use types
  - ecosystems
- Such experiments continue
  - to gain more attention
  - &
  - high priorities among the other topics

due to the urge of the global trend

Estimated C Sequestration abilities of plants

Vegetation type	C sequestration ability (MT of C $ha^{-1}yr^{-1}$)	Reference
Rubber plantations	7.69	Tillekeratne, 2007
Shaded Coffee plantations	5.3	http://www.coffeehabitat.com, 2008
Smallholder Agroforestry Systems	1.5 - 3.5	http://www.coffeehabitat.com, 2008
Grevillea robusta	2.09	Niranjana & Viswanath, 2005
Tectona grandis	1.1 - 466.4	Abayasiri & Ranasinghe, 2000
Mesic Savannas	2.8	Williams *et. al.*, 2004

Tea

- One of the main plantation crops
  - 1% GDP
  - 326.3 million kilograms of made tea
    (Central Bank, 2012)
- Tea plantations:
  - Cover 3.4% of total land area
  - 18.5% of agricultural lands
  - provide livelihoods to over one million
    (Central Bank, 2010)

Tea plant community

- Resemble natural forests:
  - Tea plants
  - Shade trees
  - Wind belts, weeds etc

Biological CO_2 scrubbers

- Contribution of these species to store atmospheric CO_2 :
  Great importance to mitigate global climate change
- Very little reliable information on C sequestration of tea and these tree species

The magnitude of the C sequestration depends on:

- Plant physiological characteristics
  - rate of growth,
  - growth stage,
  - age etc.
- Environmental parameters
  - availability of soil moisture and nutrients,
  - temperature (both atmospheric as well as soil),
  - solar radiation,
  - rainfall
- Managerial aspects
  - planting density,
  - coppicing and pollarding etc

- Preliminary investigations showed a positive C balance in Sri Lankan tea industry (De Costa *et. al*., 2008).

Worthwhile to investigate the C sequestration capacity
&
Generate the baseline data

Marketing of Sri Lankan Tea As
"Environmentally- Friendly Product"

Objectives

- To assess the C sequestration potential of Sri Lankan tea plantations

&

- To develop "baseline data"

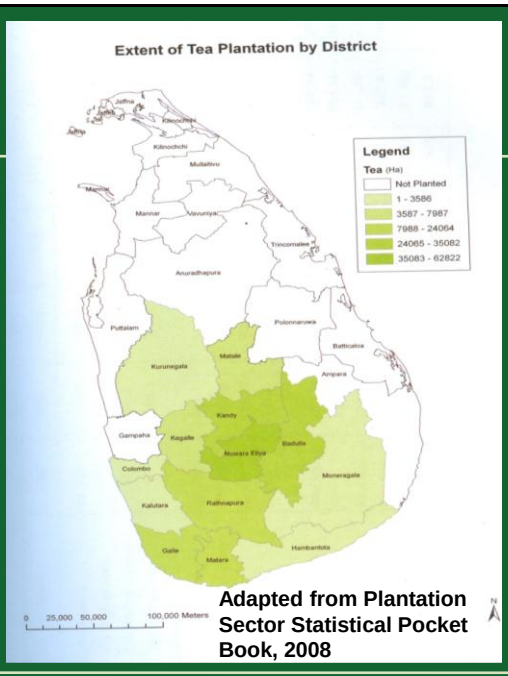
Methodology

➢ Site selection

A representative sample :

➢ tea growing region
- LC
- MC
- UC
- Uva

➢ Genotype
- Seedling
- VP

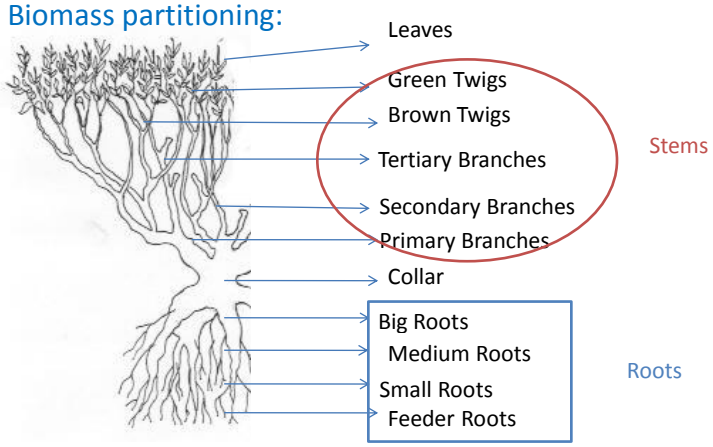


Adapted from Plantation Sector Statistical Pocket Book, 2008

a. Determination of biomass and carbon content in tea

Destructive sampling: Uprooting the whole tea bush
Initial and final measurements

Biomass partitioning:



Biomass content: Oven dry method
($85^{o}C$ → constant weight)

Organic carbon content: Walkley - Black method

b. Biomass and carbon content in shade trees

Allometric equations using CBH

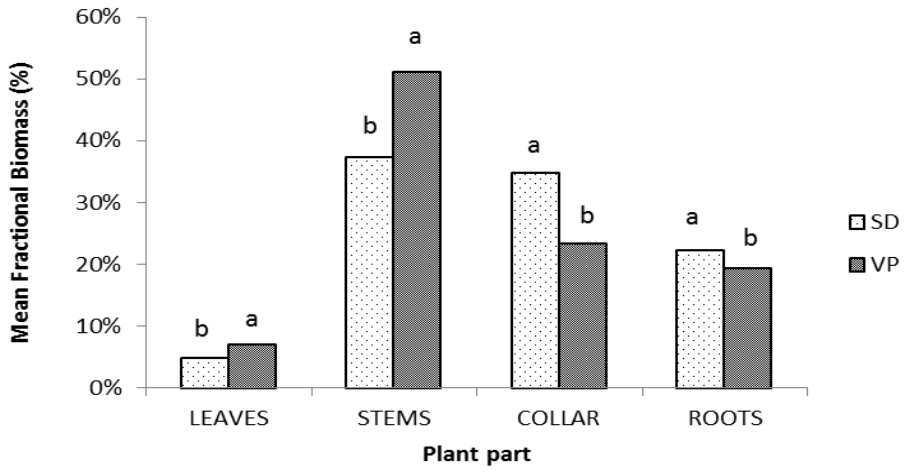
Data Analysis:
SAS v9

Calculation of C sequestration potential

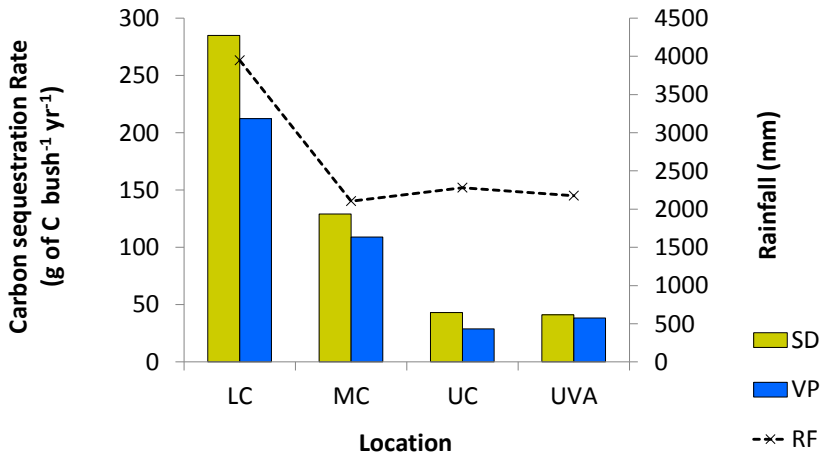
Plant Type	Age (yrs)	Management
Camellia sinensis	30	Recommended practices
Grevillea robusta	30	
Albizia moluccana	12	
Gliricidia sepium	20	
Erythrina lithosperma	20	

Results

1. Variation of fractional biomass distribution in tea plants among different composite parts in seedling and VP tea



2. Comparison of C sequestration potential of Seedling and VP tea



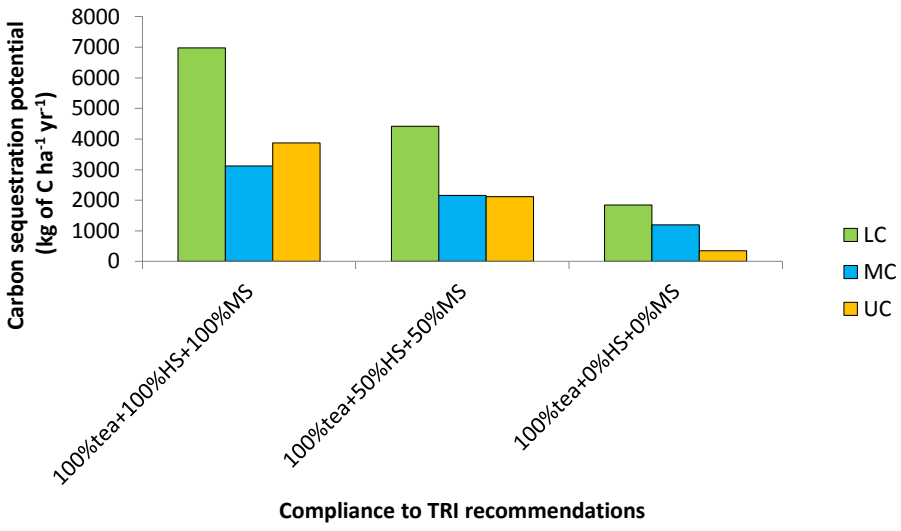
3. Comparison of carbon sequestration potential of tea lands in different regions without shade trees

Location	Type of tea	Bush densities (# of bushes/ha)	Adjusted C gain Rate (g/bush/year)	C sequestration (kg/ha/year)
LC	SD	8000	213.6	1708.8
LC	VP	12500	159.3	1991.3
MC	SD	8000	96.9	775.2
MC	VP	12500	81.6	1020.0
UC	SD	8000	32.4	259.2
UC	VP	12500	21.6	270.0
UVA	SD	8000	30.9	247.2
UVA	VP	12500	28.8	360.0

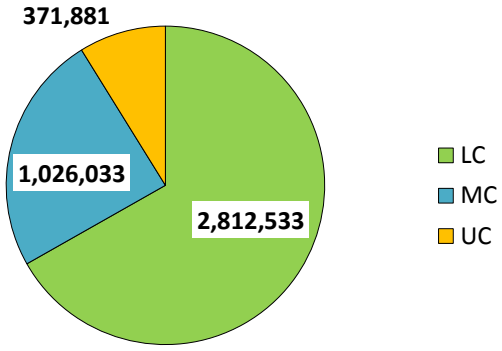
4. Variation of C sequestration potential of different types of shade trees

Plant Type	Age (yrs)	C sequestration potential (kg of C ha^{-1} yr^{-1})		
		LC	MC	UC
Grevillea robusta	30	557	426	1488
Albizia moluccana	12	3467	-	-
Gliricidia sepium	20	1978	2174	
Erythrina lithosperma	20	-	-	592

5. Variation of C sequestration potential of tea lands according to the compliance of TRI recommendations



6. Comparison of CO_2 sequestration potential of tea lands in different tea growing elevations



Carbon sequestration potential in metric tonnes per year
(1 tonne of C = 3.67tonnes of CO_2 equivalents)

Conclusions

C Sequestration potential

- Seedling tea > VP tea
- Substantially increase with
  the compliance of TRI recommendations →
  incorporation of shade trees,
  proper spacing,
  better management etc
- Varies in million MT/yr of CO_2 equivalents as→

LC	>	MC	>	UC
2.81		1.03		0.37

Although tea plants accumulate less biomass carbon than the other C3 crops,

based on their

management,

the extent of cultivation

&

the duration of the availability in the field,

the C sequestration ability of tea plantations

→considerable importance.

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