ASSESSMENT OF CARBON STOCK AND FLORISTIC DIVERSITY IN COFFEE BASED AGROFORESTRY SYSTEMS IN CENTRAL WESTERN GHATS OF KODAGU IN INDIA

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Abstract: The accumulation of shade tree biomass was 141.81 t/ha in native trees under evergreen as well as under moist deciduous vegetation 134 t/ha. Lowest biomass of 78.47 t/ha was noticed in exotic plantations under evergreen vegetation type. It was highest in native plantations of evergreen type 70.90 t/ha followed by native plantations under moist deciduous vegetation type 61 t/ha. It was least in case of exotic plantations 39.23 t/ha under evergreen conditions. And the total number of tree species found under evergreen vegetation was 94, which was much higher as compared to 61 species found under moist deciduous vegetation.

Keywords: Agroforestry system, Biodiversity, Carbon sequestration, Biosphere

INTRODUCTION

Global warming is a constant building up process contributed by burning of fossil fuels like coal, oil and natural gas, in which carbon has been stored for millions of years, with accelerated land clearance for industrialization and developmental activities. This has been resulted in the release of large amounts of greenhouse gasses (GHG's) in to the atmosphere. This has affected the biosphere, by altering the fine natural balance of the ecosystem. Due to this anthropogenic activates the atmospheric concentration of carbon dioxide has increased from 280 368 ppm for the period 1000 to 1780 (31± 4% increase) (IPCC, 2002).

Forests plays a critical role in global carbon cycle by offering a potential source to capture and hold carbon, thus providing a major sink for carbon and offers an important climate change mitigation option (Saxena *et al.*, 2003). It is estimated that as much as 90 per cent of the world's terrestrial carbon is stored in forests (Houghton, 1996b). These forests account for 3.6 billion hectares, or 28 per cent of the land area.

Agroforestry systems can potentially play an important role in the battle to mitigate climate change, both by sequestering carbon in living biomass, soil and wood products, and by helping reduce to pressure on nearby forests, thereby reducing the emission of greenhouse gases from deforestation (Albrecht and Kandji 2003). Present study was conducted to assess the carbon sequestration abilities in present in standing trees of coffee plantation and to assess the species diversity existing in coffee plantation of Kodagu.

MATERIAL AND METHOD

Kodagu district, located in Central Western Ghats (Western Ghats is chain of mountains 1600 Km long and 5-150 Km wide along the west cost of India). Kodagu district, situated mainly on the eastern slopes of the mountain range, extends between 11º 56' – 12º 52' N and 75º 22' – 76º 11' E (Pascal, and Meher, 1986). The landscape is mostly shaped by agriculture land, essentially coffee estates, which cover 29 per cent of the total area of the district (Ramakrishan, 1996)

The study was carried out in the coffee plantations distributed in the Cauvery watershed area under two vegetation types namely Evergreen and Moist deciduous type. These two vegetation types receive distinctly high and low rainfall. Further, in these two major vegetation types, coffee plantations are having the shade trees of different types of native tree species and the plantations with *Grevillea robusta* as one of the dominant tree were selected for the study. Coffee plantations with only native tree species are termed as native plantation and plantations with Grevillea *robusta* is considered as Exotic plantations Along the Cauvery watershed area 28 different villages were selected and of which 14 under the evergreen vegetation type and another 14 villages under the moist deciduous vegetation type. Altogether there were 56 plantations in that 52 plantations are robusta plantations and only four plantations are arabica plantations where were studied in both the areas of vegetation type (Fig-1&2).

To assess the amount of carbon sequestered in the vegetation non-destructive method of biomass estimation was followed. Sampling was carried out by laying out two 20 X 20m square plots, one in the outer periphery and other in the centre of the grove. Height of the entire tree species above 30 cm girth at breast height, were measured and identified using the field key of (Pascal and Ramesh 1987).Girth was measured using the girth tape and the height using Haglof's Electronic clinometer. The growing stock was estimated using the girth and height. Growing stock was multiplied with Expansion Ratio (1.40) to obtain total volume (Ajay Kumar and Singh, 2003).

Total volume was multiplied with Conversion Ratio (0.5) to obtain total above ground biomass. Biomass was converted into carbon by multiplying with 0.5 as per Mac Dicken (1997). Species diversity was calculated using Shannon's species diversity index. Shannon's index of diversity is the measure of the average degree of uncertainty of predicting to what species individuals chosen at random from a collection of 'S' species, 'N' individuals will belong. This average uncertainty increases and as the distribution of individuals among the species become even. Thus, H' =0 when the species are represented by the same number of individuals.

RESULT AND DISCUSSION

It was found that the average height of native trees under evergreen vegetation type was less (10.63 m) compared to exotic plantation (11.26 m). However the differences were not significant. Under, the moist deciduous vegetation type the height of native trees was found to be more (12.12 m) but was not significantly different over exotic trees (11.18 m). The girth at breast height (GBH) of the trees under evergreen vegetation varied significantly between native and exotic plantation. The girth was highest (78.65 cm) in native plantations compared to the exotic plantations. In moist deciduous vegetation girth of the trees did not show much of difference (Table.1). If the girth is compared between the trees of exotic plantation between evergreen and moist deciduous vegetation type, it was more under moist deciduous condition (70.73 cm), while the trends were opposite in case of native plantations.

The biomass accumulation was found to be highest (141.81 t/ha) in native trees under evergreen as well as under moist deciduous vegetation (134 t/ha). In case of exotic plantation biomass accumulation was significantly low under both evergreen as well as under moist deciduous conditions. Lowest biomass of 78.47 t/ha was noticed in exotic plantations under evergreen vegetation type. The carbon content of the above ground biomass of the standing shade trees of the coffee plantations showed similar trend as that of standing trees above ground biomass. It was found to be more in native trees both under evergreen as well as moist deciduous vegetation types. It was highest in native plantations of evergreen type (70.90 t/ha) followed by native plantations under moist deciduous vegetation type (61 t/ha). It was least in case of exotic plantations (39.23 t/ha) under evergreen conditions (Table 2).

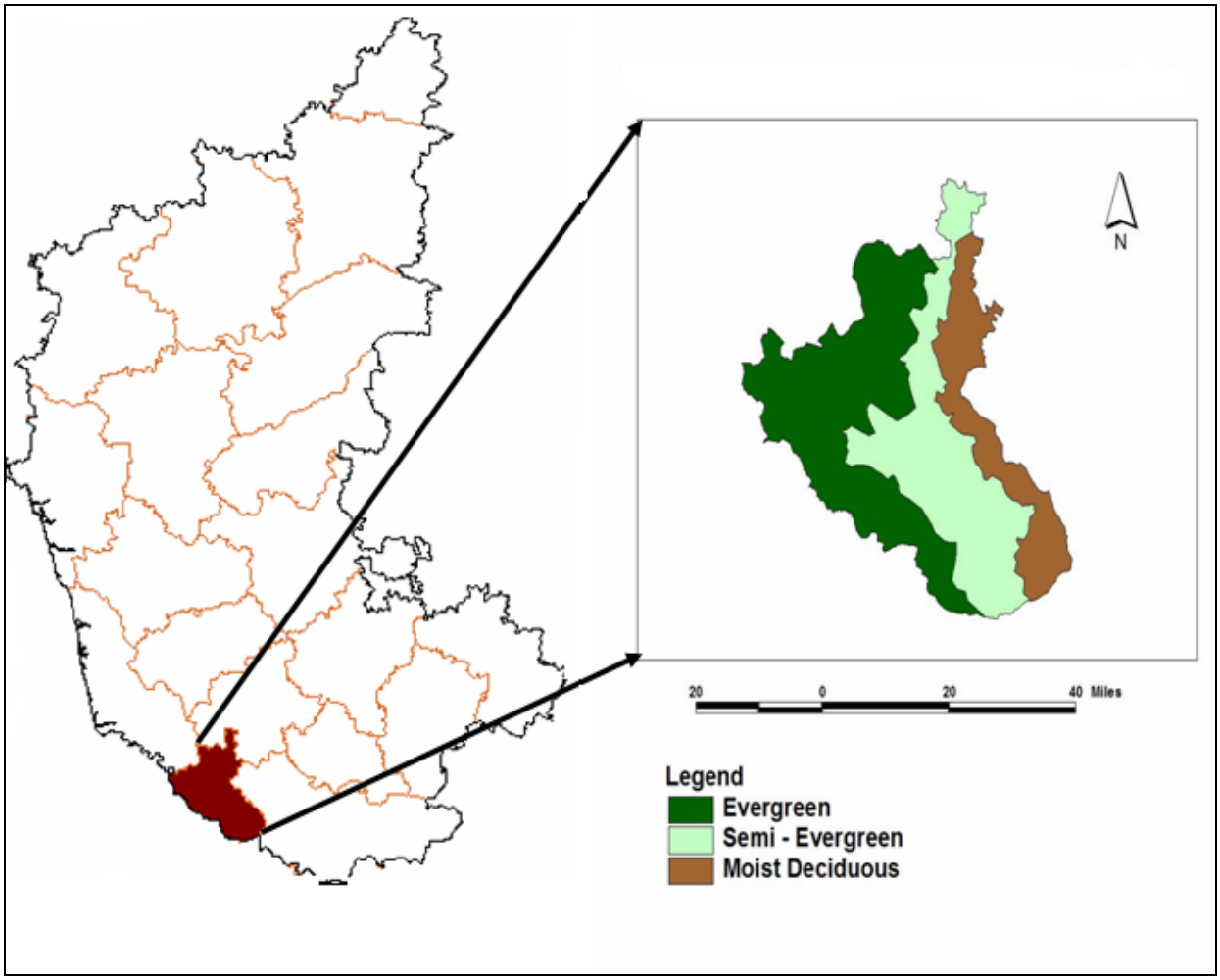

Fig 1: The different vegetation pattern in Kodagu district

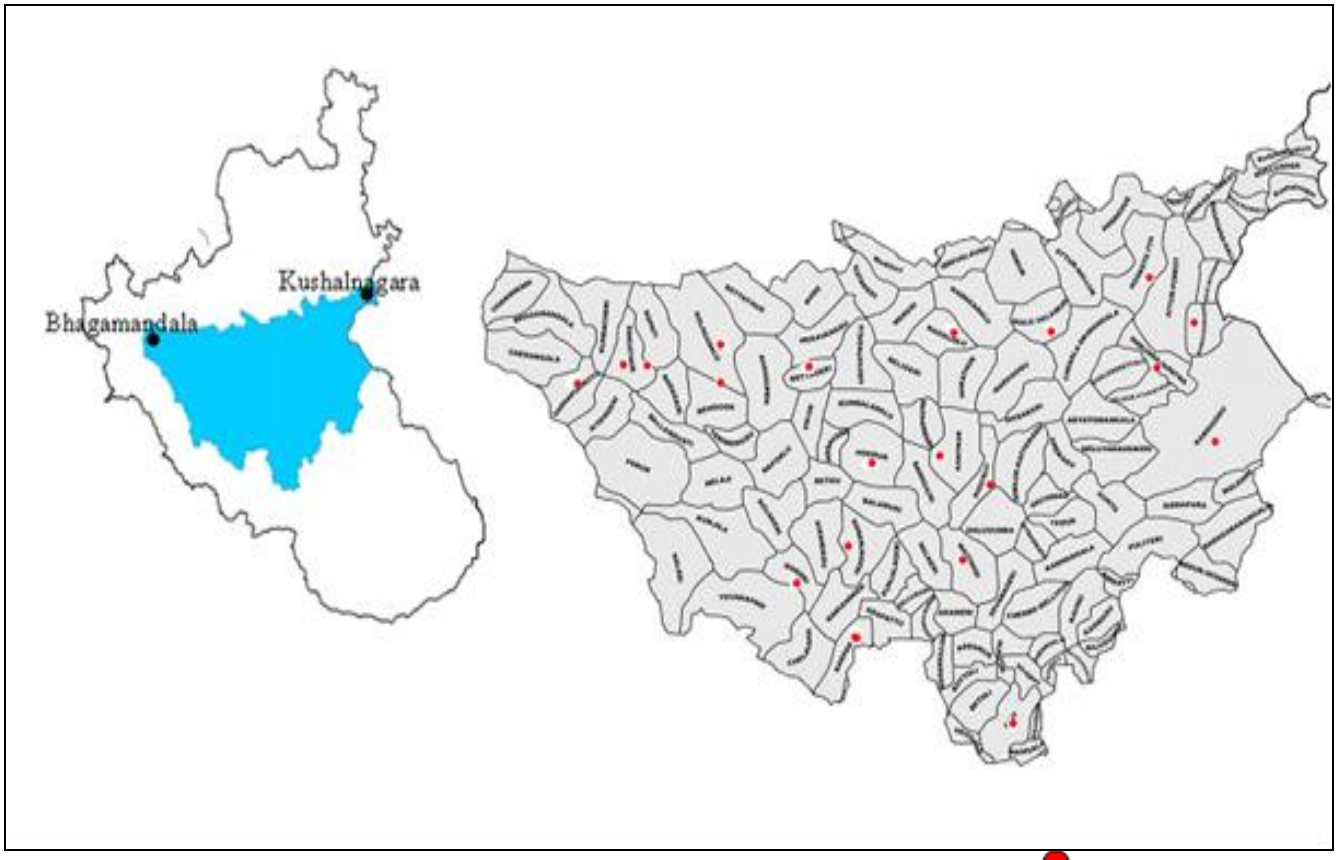

Fig 2: Study area of Cauvery watershed area in Kodagu district of Karnataka

The species composition of evergreen and moist deciduous vegetation types seems to vary considerably (Table 3). The total number of species found under evergreen vegetation was found 94, which was much higher compared to 61 species found under moist deciduous vegetation. The species diversity measured in terms of Shannon diversity index was found to be highest under evergreen vegetation (3.74) compare to moist deciduous vegetation (3.25). The carbon sequestration occurring in the shade trees of coffee based agro forestry system under Indian condition is quite substantial when compared to a similar system in Costa Rica (Anon, 2005). Coffee plantations are well protected ecosystem, it has lot of potential to store carbon and help in not only mitigation of the climate change but also help in conservation of biodiversity.

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