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RESEARCH PAPER

Carbon sequestration potential of different species in dry deciduous forests of Haliyal taluk

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Abstract: The study was conducted to assess the carbon sequestration potential of dry deciduous forests of Haliyal taluk, Uttar Kannada district, Karnataka, during the year 2019-2022. The carbon content of trees was estimated by laying sample plots in the study area *i.e.* through Point Centered Quarter (PCQ) technique. The results indicated that the total carbon contents of all the sampled trees in dry deciduous forests of Haliyal taluk was 789.235 tons. Among the different tree species found in the study area, *Tectona grandis* was found to have major share in carbon sequestration by 333.698 tons, followed by *Careya arborea* (67.124 tons) and *Lagerstroemia lanceolata* (48.81 tons). The other species like *Terminalia paniculata, Terminalia tomentosa, Xyliaxylocarpa, Dalbergia latifolia, Strychnosnux-vomica, C. timorentis* and *Anogeissus latifolia* also have considerable amount of contribution towards carbon sequestration with 48.232 tons, 45.145 tons, 43.769 tons, 37.717 tons, 20.835 tons, 19.335 tons, 17.592 tons of carbon respectively are in the top ten species having the potential to sequester carbon in dry deciduous forests of Halyal taluk. The periodic assessment and protection of these forest species is necessary since these dry deciduous forests are in high risk of degradation and deforestation by natural and anthropogenic factors resulting in release of carbon into the atmosphere and acting as carbon source.

Key words: Carbon, Dry deciduous, Forest, Sequestration, Species

Introduction

India is a tropical country with 329 mha of total geographical area, about 21.71% of which is represented by forest cover (ISFR, 2021). Land-use and land-cover change (LUCC) are an important contributor to emissions of direct and indirect greenhouse gases to the atmosphere (Jain *et al.,* 2013). The tropical zones have shown an increased accumulation of atmospheric CO_2 to >400 ppm in 2015 (Betts *et al*., 2016) and this accumulation is projected to exceed 500 ppm by 2050 (Cai *et al*., 2014).

Forests absorb one-twelfth of the total earth's atmospheric CO_2 stock, most of which is stored as woody biomass (Pandey *et al.,* 2019). Since the mid-1900s, many objectives of global climate change research have shifted to reducing terrestrial carbon sources and enhancing sinks as a means of combating future climate change under carbon dioxide (CO_2) enrichment (Kumar *et al*., 2017).

Computation of the landscape level and carbon storage facilitates the understanding of biogeochemical cycle, carbon dynamic (source/sink) and regional carbon cycle (Weiskittel *et al*., 2015). Hence, the present study was undertaken to assess the carbon sequestration potential of dry deciduous forests of Haliyal taluk, Uttar Kannada district, Karnataka during the year 2019-2022.

Material and methods

The study was carried out in Haliyal taluk having dry deciduous forest type in Uttar Kannada district of Karnataka. The study area is having total geographical area 38,724 hectare with 26,332.32 hectare of forest area. The study area is shown in fig 1.

The tree volume was estimated by Point Centered Quarter (PCQ) technique. The PCQs within the grids were laid according to the topography. In flat area, PCQ is put diagonally to the grid and in slopes, it is put along the slope. In PCQ technique of forest survey, transect of 100 m was laid in forests. At every 20 m, a point is marked and that site is divided into four quarters. In each of quarter, the distance is measured from the point/ stake to the nearest tree of e"30 cm. Only one tree of e"30 cm diameter was measured in a quarter and parameters like species, girth (m) and height (m) were taken. Such points were laid at every 20 m and thus at the end of 100 m, five points were recorded with 20 trees. The tree height was measured using Ravi altimeter and girth of tree using measuring tape.

A non-destructive method was used to estimate tree biomass. The volume estimations was done by using species specific volume equations published by Forest Survey of India (FSI, 2006). For the species where species specific equations were not available, the regional volume equation, $V= 0.16948-10.63682D^2H$ was used. The tree biomass was then calculated by multiplying the volume with wood density values and

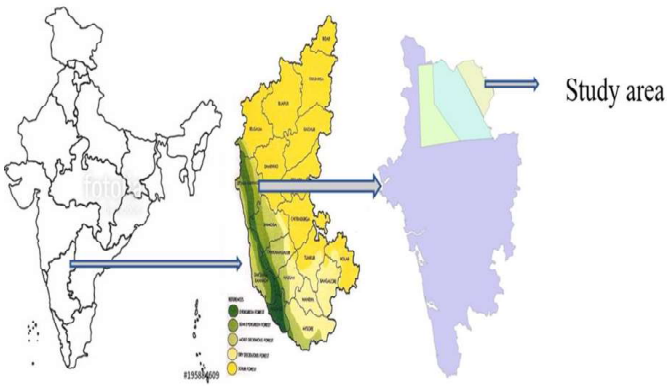

Figure 1. Study area

Biomass expansion factor (BEF- default value of 3.4) (Devagiri *et al*., 2013) of species, obtained by Forest Research Institute (FRI, 1996). In the present study, 47% of the biomass was taken as the carbon content.

IPCC (2007) suggest that below-ground-biomass is close to 27% of the total above ground biomass and indicate majority of the underground biomass of the forest is contained in the heavy roots generally defined as those exceeding 2 mm in diameter. In the present study, below-ground-biomass (BGB) was obtained by multiplying AGB with 0.27 *i.e.* root to shoot ratio.

BGB (tons) = AGB(tons) x 0.27

Hence, total tree biomass density is the sum of above ground biomass and below ground biomass.

Total Biomass (tons)=AGB + BGB

As suggested by IPCC (2007), the carbon content was calculated by the following formula;

Carbon content (tons)= 0.47(Carbon fraction) x Sum of carbon content of trees (tons)

Total carbon content (tC)= Carbon content of the sampled area x Total forest area.

Results and discussion

The results indicated that in the dry deciduous forests of Haliyal taluk, 1,300 hectares of forest was sampled by PCQ method. The mean area per plant was found to be 15.45 m^2 and 647.46 trees per hectare above 10 cm of girth were observed. In

Table 1. Contribution of different species towards carbon sequestration in dry deciduous forests of Haliyal taluk.

Tree Species	Total Volume	Specific gravity	AGB (tons)	BGR (tons)	Total tree Biomass (tons)	Carbon content trees of a species (tons)
Tectona grandis	298.958	0.55	559.052	150.944	709.996	333.698
Careya arborea	52.919	0.63	112.454	30.363	142.816	67.124
Lagerstroemia lanceolata	47.719	0.50	81.772	22.078	103.850	48.810
Terminalia paniculata	36.339	0.65	80.804	21.817	102.621	48.232
Terminalia tomentosa	30.473	0.73	75.633	20.421	96.054	45.145
Xyliaxylocarpa	31.716	0.68	73.328	19.798	93.126	43.769
Dalbergia latifolia	23.231	0.80	63.188	17.061	80.249	37.717
Strychnosnux-vomica	11.937	0.86	34.905	9.424	44.329	20.835
C. timorentis	13.610	0.70	32.392	8.746	41.138	19.335
Anogeissus latifolia	16.670	0.52	29.473	7.958	37.430	17.592
Buchananialanzan	10.840	0.78	28.748	7.762	36.510	17.159
Acacia auriculiformis	11.317	0.72	27.782	7.501	35.283	16.583
Butea monosperma	11.761	0.56	22.393	6.046	28.439	13.366
Randia dumetorum	6.862	0.76	17.731	4.787	22.518	10.584
Peltophorum pterocarpum	4.534	0.80	12.394	3.346	15.741	7.398
Pterocarpus marsupium	5.272	0.67	12.026	3.247	15.274	7.179
Sesbania grandiflora	6.355	0.51	11.019	2.975	13.994	6.577
Cordia diaddotoma	4.509	0.59	9.044	2.442	11.486	5.399
Careya arborea	2.818	0.60	5.749	1.552	7.301	3.432
Canthium dicocum	3.647	0.42	5.208	1.406	6.614	3.109
Grewia teliaefolia	2.081	0.68	4.810	1.299	6.109	2.871
Ziziphus rugosa	1.516	0.85	4.380	1.183	5.563	2.615
Pongamia pinnata	1.354	0.64	2.946	0.795	3.741	1.758
Cassia species	1.294	0.48	2.111	0.570	2.682	1.260
Morinda pubescens	0.643	0.80	1.749	0.472	2.221	1.044
Madhuca indica	0.914	0.50	1.567	0.423	1.990	0.935
Diospyros melanoxylon	0.656	0.68	1.516	0.409	1.926	0.905
Semicarpus species	0.606	0.64	1.319	0.356	1.675	0.787
Bauhinia racemosa	0.674	0.55	1.260	0.340	1.600	0.752
Carissa carandas	0.540	0.68	1.248	0.337	1.586	0.745
Adina cordifolia	0.478	0.52	0.845	0.228	1.073	0.504
Lannea coromandelica	0.492	0.50	0.831	0.224	1.055	0.496
Holigarna arnottiana	0.485	0.41	0.681	0.184	0.865	0.407
Dillenia pentagyna	0.285	0.55	0.532	0.144	0.676	0.318
Mitragyna parvifolia	0.204	0.56	0.388	0.105	0.492	0.231
Ceiba pentandra	0.165	0.45	0.252	0.068	0.321	0.151
Dysoxymum melanoxylon	0.135	0.50	0.230	0.062	0.291	0.137
Cassia fistula	0.090	0.71	0.217	0.059	0.276	0.130
Terminalia bellirica	0.079	0.63	0.169	0.046	0.214	0.101
Mallotus philippensis	0.038	0.60	0.078	0.021	0.099	0.047
	644.215					789.235

the total sampled area, 40 different species were found. The average height of trees in the study area was 10.56 meters and average girth was 0.84 meters. The average basal area of trees was found to be 7.09 square meters and average volume per tree was 0.733 cubic meters. The total carbon content of trees was determined, and the results indicated that the total carbon contents of all the sampled trees in dry deciduous forests of Haliyal taluk was 789.235 tons.

Among the different tree species found in the study area, *Tectona grandis* was found to have major share in carbon sequestration (333.698 tons) followed by *Careya arborea* (67.124 tons) and *Lagerstroemia lanceolata* (48.81 tons) (Table 1). The other species like *Terminalia paniculata, Terminalia tomentosa, Xyliaxylocarpa, Dalbergia latifolia, Strychnosnux-vomica, C. timorentis and Anogeissus latifolia* also have considerable amount of contribution towards carbon sequestration with 48.232 tons, 45.145 tons, 43.769 tons, 37.717 tons, 20.835 tons, 19.335 tons, 17.592 tons of carbon respectively and are the top ten species having the potential to sequester carbon in dry deciduous forests of Haliyal taluk (Table 1).

Since the estimation of carbon was done by considering 47 % of total biomass, sequestration potential of carbon from these forests depends upon the type of forests, age and size classes of trees.

Conclusion

The tree species in dry deciduous forests had their respective share of contribution in sequestering carbon. Among the different tree species found in the study area, *Tectona grandis* was found to have major share in carbon sequestration followed by *Careya arborea* and *Lagerstroemia lanceolata*. The other species like *Terminalia paniculata, Terminalia tomentosa, Xyliaxylocarpa, Dalbergia latifolia, Strychnosnux-vomica, C. timorentis and Anogeissus latifolia* also have considerable amount of contribution towards carbon sequestration. The periodic assessment and protection of these forest species is necessary since these dry deciduous forests are in high risk of degradation and deforestation by natural and anthropogenic factors resulting in release of carbon into the atmosphere and acting as carbon source.

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