

Carbon Sequestration potential and status of *Peltophorum pterocarpum* (DC.) K. Heyne

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ABSTRACT

In the present investigation aboveground and belowground carbon sequestration potential of *Peltophorum pterocarpum* from nine sectors of Aurangabad city was measured. Total standing biomass of *Peltophorum pterocarpum* in 2847 hectares of Aurangabad are 79.29tha^{-1} . The sequestered carbon stalk in aboveground and belowground standing biomass of *Peltophorum pterocarpum* were 45.17tha^{-1} and 11.74t.ha^{-1} respectively, while total sequestered carbon of *Peltophorum pterocarpum* in 2847 hectares area were 56.92tha^{-1} . The average carbon sequestration and carbon dioxide of *Peltophorum pterocarpum* intake is 39.65tha^{-1} and 149.50tCO_2 in Aurangabad. The highest carbon sequestered percentage in *Peltophorum pterocarpum* at sector 7th it is 20% and lowest at sector 1st it is 1%, while in sector 7th (19%), sector 8th (15%), sector 4th and 9th (10% each), sector 5th (9%), in sectors 2nd and 3rd (8% each).

Key words: Aboveground carbon, *Peltophorum pterocarpum*, belowground carbon, carbon stock, carbon sequestration potential, climate change.

INTRODUCTION

As more photosynthesis occurs, more CO_2 is converted into biomass, reducing carbon in the atmosphere and sequestering it in plant tissue above and below ground (Gorte, 2009; IPCC, 2003) resulting in growth of different parts (Chavan and Rasal, 2010). In the global carbon cycle biomass is an important building block, significantly carbon sequestration and is used to help quantify pools and changes of Green House Gases from the terrestrial biosphere to the atmosphere associated with land-use and land cover changes (Cairns *et al*, 2003; IPCC, 2001). Biomass production in different forms plays important role in carbon sequestration in trees. Above-ground biomass, below-ground biomass, dead wood, litter, and soil organic matter are the major carbon pools in any ecosystem (FAO, 2005; IPCC, 2003; IPCC, 2006). The increasing carbon emission is of major concerns for entire world as well addressed in Kyoto protocol (Chavan, and Rasal, 2010; Ravindranath *et al*, 1997). Carbon sequestration in growing forests is known to be a cost-effective option for mitigation of global warming and global climatic change. India is sequestering more than 116 million tones of CO_2 per year which is equal to 32 millions of carbon sequestration, contributes to reduce atmospheric carbon of the globe (SFR, 2009; Jasmin and Birundha, 2011).

Estimates of carbon stocks and stock changes in tree biomass (above and belowground) are necessary for reporting to the United Nations

Framework Convention on Climate Change (UNFCCC) and will be required for Kyoto Protocol reporting (Green *et al*, 2007; Almgir and Al-Amin, 2007). The objective of this paper is to estimate sequestered carbon of *Peltophorum pterocarpum* from Aurangabad.

MATERIALS AND METHODS

Study area

The study is located in the state of Maharashtra, in India. Aurangabad is located at the latitude $19^{\circ}53'47''\text{N}$ and longitude $75^{\circ}23'54''\text{E}$. The average day temperature ranges from 27.7°C to 38.0°C while it falls from 26.9°C to 20.0°C during night.

The average annual rainfall in Aurangabad city and adjoining area is 725.8mm ($28.57''$). Relative humidity is extremely low in this region for major part of the year which ranges between 35 to 50%, while it is highest (85%) during monsoon (ESRAM, 2009; 2010). The total land portion underforest cover is about 557km^2 which is only 7.6% area of total land area in Aurangabad (SFR, 2009). The total 28.47sq.km area of Aurangabad city is selected for the carbon sequestration study. The total 2847 hectares of study area from Aurangabad was selected for the carbon sequestration study. The fig.1 shows the 9 sectors from Aurangabad city as sampling locations for *Peltophorum pterocarpum* trees studied. The samples were collected from *Peltophorum pterocarpum* tree from each sampling plot from the study region.

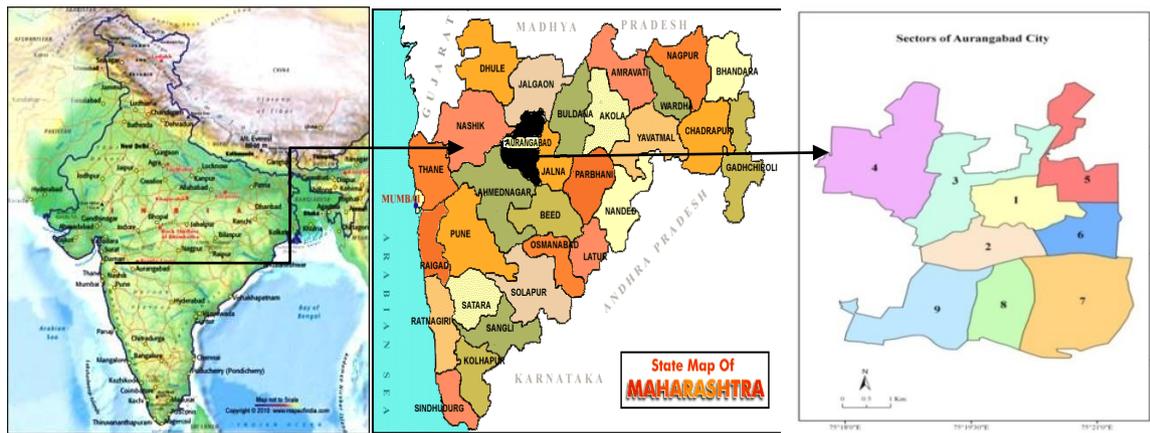


Fig. 1: Map indicates the location of study area. (<http://www.mapsofIndia.com>, Source: <http://bhuvan-noeda.nrs.gov.in>)

Biophysical measurements

The height and diameter at breast height (DBH) are two main biophysical measurements which measured for each tree sample. The height of *Peltophorum pterocarpum* tree were measured by Theodolite instrument follow the procedure given (Chavan and Rasal, 2010; 2011). The tree diameter was measured at breast height (DBH) by using diameter measure tape.

Estimation of Aboveground biomass

Above-ground biomass includes all living biomass above the soil. The aboveground biomass (AGB) has been calculated by multiplying volume of biomass and wood density (Brown, 1997; Ravindranath and Ostwald, 2008). The volume was calculated based on diameter and height. The wood density value for the *Peltophorum pterocarpum* species obtained from web (www.worldagroforestry.org).

$$\text{AGB (g)} = \text{Volume of biomass (cm}^3\text{)} \times \text{wood density (g/cm}^3\text{)}$$

The biomass of all samples *Peltophorum pterocarpum* trees in the all the sample plots (t) was calculated and extrapolating it for total area for tons per hectare (tha^{-1}).

Estimation of Belowground biomass

The Below Ground Biomass (BGB) includes all biomass includes all biomass of live roots

excluding fine roots having <2mm diameter (Chavan and Rasal, 2011; 2012c). Biomass estimation equations for tree roots are relatively uncommon in the literature. The belowground biomass (BGB) has been calculated by multiplying above-ground biomass taking 0.26 as the root to shoot ratio (Cairns *et al*, 1997; Ravindranath and Ostwald, 2008).

$$\text{Belowground biomass (tha}^{-1}\text{)} = 0.26 \times \text{above-ground biomass (tha}^{-1}\text{)}$$

RESULT AND DISCUSSION

Biomass estimation

The estimation of the aboveground and belowground biomass in the selected tree species was performed by estimating carbon percentage and by measuring the tree height, DBH and wood density. The carbon concentration of different tree parts was rarely measured directly, but generally assumed to be 50% of the dry weight on the basis of literature (Chavan and Rasal, 2011; Jana *et al*, 2009) as the content of carbon in woody biomass in any component of forest on average is around 50% of

dry matter (Paladinic *et al*, 2009; Chavan and Rasal, 2011; 2012a; 2012b).

The standing biomass stalks in *Peltophorum pterocarpum* trees in Aurangabad are shown in Table 1 and fig.3. It was observed that in sector 6th the *Peltophorum pterocarpum* tree containing highest aboveground biomass, belowground biomass and total standing biomass (12.30 tha^{-1} , 3.20 tha^{-1} and 15.49 tha^{-1}) followed in sector 7th (12.06 tha^{-1} , 3.14 tha^{-1} and 15.20 tha^{-1}), sector 8th (9.15 tha^{-1} , 2.38 tha^{-1} and 11.53 tha^{-1}),

sector 4th(6.53 tha⁻¹, 1.70 tha⁻¹ and 8.23 tha⁻¹), sector 9th(6.10 tha⁻¹, 1.59 tha⁻¹ and 7.69 tha⁻¹), sector 5th(5.67 tha⁻¹, 1.47 tha⁻¹ and 7.15 tha⁻¹), sector 2nd(5.22 tha⁻¹, 1.36 tha⁻¹ and 6.58 tha⁻¹), sector 3rd(5.03 tha⁻¹, 1.31 tha⁻¹ and 6.33 tha⁻¹) and lowest at sector 1st(0.86 tha⁻¹, 0.22 tha⁻¹ and 1.09 tha⁻¹)

respectively. The standing aboveground biomass and belowground biomass of *Peltophorum pterocarpum* were 62.93tha⁻¹ and 16.36tha⁻¹ respectively, while total standing biomass of *Peltophorum pterocarpum* in 2847 hectares area was 79.29tha⁻¹.

Table 1: The sector wise aboveground biomass (AGB), belowground biomass (BGB) and total biomass (TB) of *Peltophorum pterocarpum* in Aurangabad

Sectors	Tree count	AGB t/ha	BGB t/ha	TB t/ha
1	48	0.86	0.22	1.09
2	291	5.22	1.36	6.58
3	280	5.03	1.31	6.33
4	364	6.53	1.70	8.23
5	316	5.67	1.47	7.15
6	685	12.30	3.20	15.49
7	672	12.06	3.14	15.20
8	510	9.15	2.38	11.53
9	340	6.10	1.59	7.69
	3506	62.93	16.36	79.29

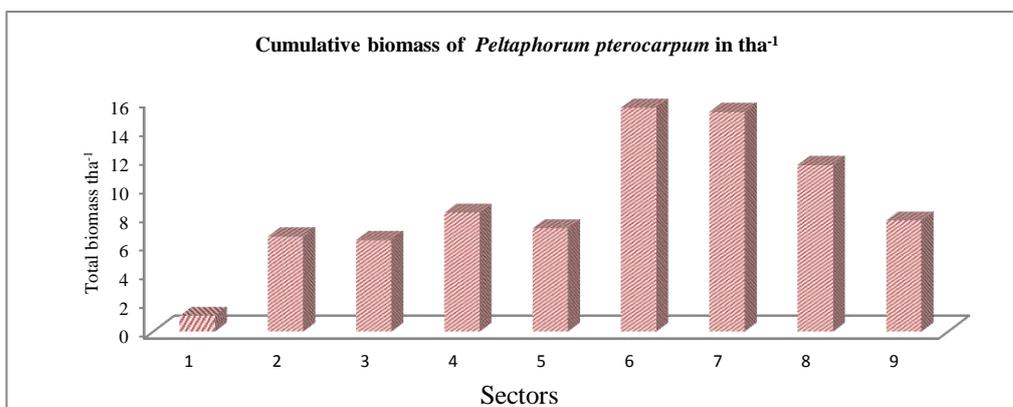


Fig.3: Cumulative total biomass (tha⁻¹) of *Peltophorum pterocarpum* from 9 sectors of Aurangabad

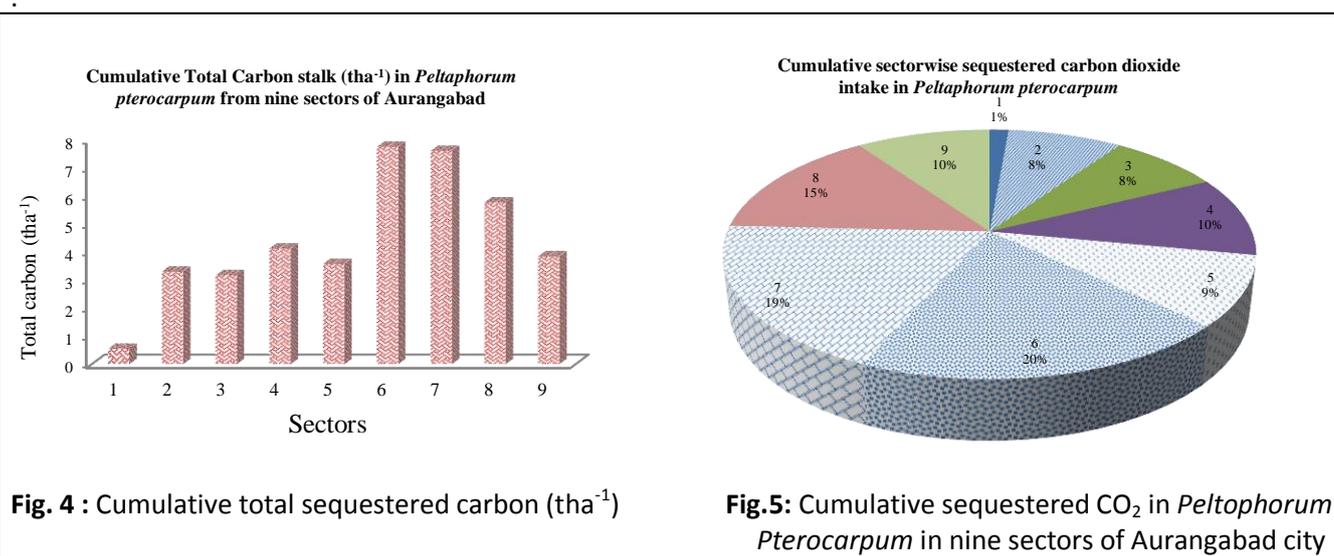


Fig. 4 : Cumulative total sequestered carbon (tha⁻¹)

Fig.5: Cumulative sequestered CO₂ in *Peltophorum Pterocarpum* in nine sectors of Aurangabad city

Carbon stock estimation

The sequestered carbon stalks in *Peltophorum pterocarpum* trees in Aurangabad is shown in Table 2, fig.4. It was observed that in sector no. 6 the *Peltophorum pterocarpum* tree containing highest carbon stalk in aboveground, belowground and total carbon sequestered (6.15 tha^{-1} , 1.60 tha^{-1} and 7.75 tha^{-1}) followed in sector no. 7 (6.03 tha^{-1} , 1.57 tha^{-1} and 7.60 tha^{-1}), sector no. 8 (4.58 tha^{-1} , 1.19 tha^{-1} and 5.77 tha^{-1}), sector no. 4 (3.27 tha^{-1} , 0.85 tha^{-1} and 4.12 tha^{-1}), sector no. 9 (3.05 tha^{-1} , 0.79 tha^{-1} and 3.84 tha^{-1}), sector no. 5 (2.84 tha^{-1} , 0.74 tha^{-1} and 3.57 tha^{-1}), sector no. 2 (2.61 tha^{-1} , 0.68 tha^{-1} and 3.29 tha^{-1}), sector no. 3 (2.51 tha^{-1} , 0.65 tha^{-1} and 3.17 tha^{-1}) and lowest at sector no. 1 (0.43 tha^{-1} , 0.11 tha^{-1} and 0.54 tha^{-1}) respectively. The sequestered carbon stalk in aboveground and belowground standing biomass of *Peltophorum pterocarpum* were 31.46 tha^{-1} and 8.18 tha^{-1} respectively, while total standing biomass of *Peltophorum pterocarpum* in 2847 hectares area was 39.65 tha^{-1} . The average carbon sequestration and carbon dioxide of *Peltophorum pterocarpum* intake is 39.65 tha^{-1} and 149.50 tCO_2 in Aurangabad.

The carbon sequestration is multiplied by factor of 3.67 to get the carbon dioxide (CO₂) because 1 ton carbon is equal to 3.67 tones of CO₂ (C=12 and O =16; CO₂= 12+16+16=44, 44/12=3.67) (Kumar *et al.*, 2009; Jasmin and Birundha, 2011; Jindal *et al.*, 2007). The Above Ground Carbon (AGC), Below Ground Carbon (BGC) and Mean Organic Carbon (MOC) in *Azadirachta indica* 1.91, 0.26, 2.08 t/tree respectively in the university campus of Aurangabad (Chavan and Rasal, 2010), The total of aboveground biomass and belowground biomass

together as sequestered carbon stalk per hectare as estimated from university campus of Aurangabad for *Mangifera indica* it was $30.6 \text{ Kg C ha}^{-1}$ (Chavan and Rasal, 2011). The total aboveground biomass carbon stock per hectare as estimated for *Shorea robusta*, *Albizia lebbek*, *Tectonagrandis* and *Artocarpus integrifolia* were 5.22 tCha^{-1} , 6.26 tCha^{-1} , 7.97 tCha^{-1} and 7.28 tCha^{-1} respectively in selected forest stands (Jana, *et al.*, 2009). The average carbon sequestration and carbon dioxide of *Eucalyptus ssp.* intake is 320.67 tha^{-1} and 1176.85 tCO_2 in 2847 hectares of area at Aurangabad city.

From the fig.5 it is revealed that cumulative percentage of carbon dioxide intake (tCO₂) in *Peltophorum pterocarpum* in nine sectors of Aurangabad city the highest sequestered carbon dioxide in sector 6th (20%) followed by sector 7th (19%), sector 8th (15%), sector 4th and 9th (10% each), sector 5th (9%), in sectors 2nd and 3rd (8% each), and lowest in sector 1st (1%).

CONCLUSION

Total standing biomass of *Peltophorum pterocarpum* in 2847 hectares of Aurangabad are 79.29 tha^{-1} . The sequestered si stalk in aboveground and belowground standing biomass of *Peltophorum pterocarpum* were 31.46 tha^{-1} and 8.18 tha^{-1} respectively, while total standing biomass of *Peltophorum pterocarpum* in 2847 hectares area was 39.65 tha^{-1} . The average carbon sequestration and carbon dioxide of *Peltophorum pterocarpum* intake is 39.65 tha^{-1} and 149.50 tCO_2 in Aurangabad. The CO₂ intake percentage in *Peltophorum pterocarpum* shows highest (20%) at 6th sector, while lowest (1%) at 1st sector.

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