Carbon Sequestration Potential of Selected Tree Species in the Campus of Shuats

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Abstract— This study is oriented towards investigating the above ground biomass, below ground biomass and carbon sequestration potential of few important multipurpose tree species viz., Alstonia scholaris, Anthocephalus cadamba, Delonix regia, Emblica officinalis, Mimusops elengi, Moringa oleifera and Peltophorum pterocarpum by non-destructive method. Total above ground biomass was highest for Anthocephalus cadamba 5.925 ton tree^{-1}. The maximum below ground biomass of 0.888 ton tree^{-1} was observed for Anthocephalus cadamba. Maximum fixed carbon was recorded for Delonix regia 55.6% and the minimum was recorded for Moringa oleifera 31.56%. It was observed that the amount of carbon sequestration was highest for Anthocephalus cadamba sequestrating 215.14 t C tree^{-1} and the minimum carbon sequestration was recorded for Delonix regia sequestrating 16.84t C tree^{-1}. The trees which were examined are important multipurpose tree species and are significant components of Agro forestry and plantation forestry in the study region.

Key words: Above Ground Biomass, Below Ground Biomass, Carbon Sequestration, Fixed Carbon, Climate Change

I. INTRODUCTION

Forest ecosystems are deemed to be an important factor in climate change because they can be both sources and sinks of atmospheric CO2. They can assimilate CO2 via photosynthesis and store carbon in biomass and in soil (Trexler and Haugen, 1994; Brown et al., 1996; Watson et al., 2000). Plantations or naturally regenerated trees can protect watersheds against droughts, flash floods or landslides thought to be more prevalent due to climate change. Sustainable forestry practices can increase the ability of forests to sequester atmospheric carbon, while simultaneously enhancing other ecosystem services, such as improved soil and water quality. Carbon sequestration is also a good indicator of the health and functioning of ecosystems. Forests may help local communities to cope with climate change in a numerous ways (Robledo and Forner, 2005).

As more photosynthesis occurs, more CO2 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, significant 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 CO2 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).

II. MATERIALS AND METHODS

The experiment was conducted in the university campus, Sam Higginbottom University of Agriculture Technology and Sciences, Allahabad. The elevation above sea level is 98m at 25˚28' N latitude and 81˚55' E longitude. The study was undertaken in 6-10 year old MPT's. Three trees of each species were selected and three samples of 10x3x2 cm were collected from each tree. The species selected were Alstonia scholaris, Anthocephalus cadamba, Delonix regia, Emblica officinalis, Mimusops elengi, Moringa oleifera and Peltophorum pterocarpum

A. Biophysical Measurements

The height and diameter at breast height (DBH) are the two main biophysical measurements which were measured for each tree sample. The tree height was determined with the help of RAVI ALTIMETER in meters. Diameter at breast height was measured in centimeters using vernier caliper.

Above-ground biomass includes all living biomass above the soil. The aboveground biomass (AGB) has been calculated by multiplying volume with specific gravity. The volume was calculated based on diameter and height. Specific gravity was calculated by the ratio of oven dry weight and green volume of the pieces of wood samples.

Aboveground biomass (t tree^{-1}) = Volume of tree (m^3) x specific gravity (g cm^3)

The Below Ground Biomass (BGB) includes all biomass. The belowground biomass (BGB) accounts for about 15% of the total tree biomass.

Belowground biomass (t tree^{-1}) = AGB X (15/100)

Fixed carbon mainly contributes to carbon storage. It was calculated as:

Fixed carbon (%) = 100 – Ash content – Moisture content. (Ganeshaiah et.al., 2003).

Total carbon sequestration was estimated as the product of total above ground biomass and fixed carbon.

Total carbon sequestration (t C tree^{-1}) = Total Biomass x Fixed carbon (%). (Jana et.al., 2009).

III. RESULTS AND DISCUSSION

A. Biomass estimation

The standing biomass of the selected tree species are shown in table 1 and fig.1. It was observed that Anthocephalus cadamba had the highest aboveground biomass, belowground biomass and total standing biomass 0f 6.813 t ha^{-1} followed by Alstonia scholaris 4.418 t ha^{-1}, Mimusops elengi 4.093t ha^{-1}), Peltophorum pterocarpum 0.591 t ha^{-1}, Emblica officinalis 0.561t ha^{-1}, Delonix regia 0.321t ha^{-1}) and lowest for Moringa oleifera 2.258 t ha^{-1}.

Serial no.	Species	AGB (t tree^{-1})	BGB (t tree^{-1})	TB (t ha^{-1})
1	Alstonia scholaris	3.842	0.576	4.418
2	Anthocephalus cadamba	5.925	0.888	6.813
3	Delonix regia	0.279	0.042	0.321
4	Emblica officinalis	0.488	0.073	0.561
5	Mimusops elengi	3.560	0.533	4.093
6	Moringa oleifera	1.964	0.294	2.258
7	Peltophorum pterocarpum	0.514	0.077	0.591

Table 1: Aboveground biomass (AGB), belowground biomass (BGB) and Total biomass (TB) of the selected tree species.

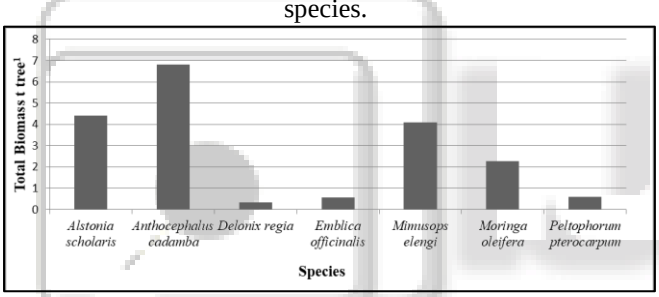

Fig 1: Total biomass of the different tree species

B. Fixed carbon estimation

From figure 2., it was observed that the maximum fixed carbon was recorded for Delonix regia 55.6% followed by Mimusops elengi 51.01%, Peltophorum pterocarpum 44.42%, Alstonia scholaris 42.99%, Emblica officinalis 41.63%, Anthocephalus cadamba 33.05% and the minimum was recorded for Moringa oleifera 31.56%.

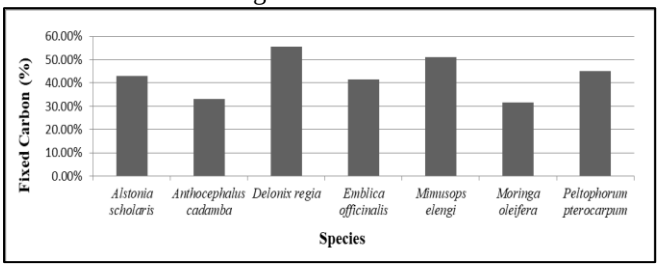

Fig. 2: Fixed carbon of the different tree species selected.

C. Carbon Sequestration (t C/tree)

The sequestered carbon in the selected tree species are shown in fig.3. it was observed that the amount of carbon sequestration was highest for Anthocephalus cadamba sequestering 215.14 t C tree^{-1} followed by Mimusops elengi sequestering 208.82 t C tree^{-1}, Alstonia scholaris 190.36 t C tree^{-1}, Moringa oleifera 71.26 t C tree^{-1}, Peltophorum pterocarpum 26.66 t C tree^{-1}, Emblica officinalis 23.53 t C tree^{-1} and the minimum carbon sequestration was recorded for Delonix regia 16.84 t C tree^{-1}.

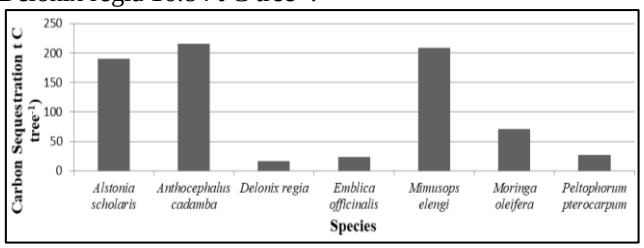

Fig. 3: Carbon sequestration of the different tree species.

IV. CONCLUSION

From the above study, the maximum total biomass was found for Anthocephalus cadamba 6.813 tons sequestering 215.14 tons of carbon followed by Alstonia scholaris 4.418tons sequestering 190.36 tons of carbon. The species Delonix regia had the lowest carbon sequestration potential i.e. 16.84 tons. Delonix regia had the maximum fixed carbon of 55.6% followed by Mimusops elengi with 51.01%. Moringa oleifera had the minimum fixed carbon of 31.56%. The research can be useful for estimating carbon sequestration potential of the tree species in Allahabad city for assessing the contribution in carbon sequestration by the tree species.

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