International Journal of Geology, Earth & Environmental Sciences ISSN: 2277-2081 (Online)
An Open Access, Online International Journal Available at http://www.cibtech.org/jgee.htm
2016 Vol. 6 (2) May-August, pp. 97-100/Tripathi
Research Article

EVALUATING CARBON SEQUESTRATION POTENTIAL OF SOME NATIVE TREE SPECIES GROWING NATURALLY IN THE TARAI REGION OF KUMAON HIMALAYA

***Mayank Tripathi**
Ecophysiology Laboratory, Department of Plant Biology, Kumaon University, Almora Campus, Almora, Uttrakhand, India
**Author for Correspondence*

ABSTRACT
Carbon sequestration potential of some native tree species growing in Tarai region of Kumaon, Uttrakhand were evaluated by non- destructive method. The carbon sequestration potential of a tree depends upon its biomass. Biomass can be estimated using tree variables like Diameter at Breast Height (DBH), Height (H), Wood Density (WD) or DBH alone. In the present investigation DBH was used as the only independent variable to calculate the aboveground biomass. Analysis showed that trees with thick girth and slow growing nature store more carbon in comparison to other species. Investigation revealed that native species such as *Adina cordifolia, Shorea robusta, Terminalia arjuna* and *Bombax ceiba* should be planted more and more for maximum carbon storage. IVI showed strong correlation with mean tree carbon stocks.

Keywords**:** *Carbon Sequestration, Native Tree Species, Tarai, above Ground Biomass, Diameter at Breast Height, Important Value Index*

INTRODUCTION
Rapid urbanization coupled with deforestation has severely hit the Tarai belt, at the foothills of Kumaon Himalaya. The local biodiversity has been disturbed with lot of *Popular deltoides*, *Eucalyptus sp.*, *Tectona grandis* and *Dalbergia sissoo* plantations coming up in the past few decades which has gradually replaced the native species of this region. The native species has been mostly restricted to natural forests and urbanization pressure always poses a serious threat to this region as well. In the present scenario, anthropogenic climate change is a global threat and accumulation of carbon in the ecosystem is a big worry.

Carbon management through forests is considered as an effective way to mitigate CO_2 from the atmosphere. Thus, evaluating carbon offsetting abilities of trees is the need of the hour. The accumulation of CO_2 and other greenhouse gases in the atmosphere is expected to cause observable climatic changes in the coming century. Approximately 22% of the annual CO_2 emission results from human activities such as deforestation (Jina *et al*., 2008). The carbon sequestration capacity of tree species depends upon its age, height, girth, size, biomass accumulation rates, canopy diameter wood density (Rathore *et al*., 2013) and rotation lengths (Baral *et al.*, 2004).

Long lived, slow- growing and high density hardwood trees store more carbon than short- lived, low-density and fast growing trees. Forest species vary significantly in their carbon sequestration potential hence, knowledge of the sequestration capacity of individual tree species is essential. The present paper aims to study the carbon sequestration potential of some native tree species growing in tarai region, at the foot hills of Kumaon Himalaya. The author firmly believes that the native species should be conserved and propagated to improve the local biodiversity of the region on one hand and to utilize such trees for carbon management on the other.

MATERIALS AND METHODS
Study Area
The study site included tarai area around Lalkuan in the district Nainital and Pantnagar, in district Udhamsingh Nagar. Geographically, the area is located approximately between 28° 41’ -29° 05’ N

latitude and 79° 18'-79° 31' E longitude with altitude ranging from 200- 256m amsl. The area comprises of somewhat tropical and sub tropical vegetation dominated by woody species. The site enjoys typical monsoon climate with rich humidity during July to mid September. Nearly 70% of the annual rainfall is monsoonal during July-September.

A typical tarai region at the foothills of Kumaon Himalaya is water- logged alluvial plain with gentle South- East slope, deep and fertile, moist, loamy soil forming marshy land free from boulders and gravels (Lodhiyal *et al*., 2001).

Methods

Some native tree species growing in natural forest were considered for carbon sequestration study. Random sampling was done at two sites i.e. Lalkuan and Pantnagar using 1 ha plots. For convenience, 1 ha plots were further divided into (25), 20×20 m (0.04 ha) plots for each site. Thus, a total of 50 (0.04 ha) plots were studied from 2 ha land.

A total of 1068 individuals consisting of 10 species were studied. DBH was used as the only independent variable to estimate the above ground biomass. Literature revealed that tree DBH showed positive correlation with aboveground biomass (Clark *et al*., 2001; Mani *et al*., 2009; Sahu *et al*., 2016). Initially, circumference at breast height (cbh) was measured using measuring tape which was later converted to corresponding DBH values.

The biomass (above and below ground) and carbon were measured by non destructive methods i.e. without harming the tree. The equation by (Brown *et al*, 1989) was used for above ground biomass estimation.

The equation (R^2=0.88 for natural forest) can effectively be used for above ground biomass estimation of trees growing in tropical, sub- tropical climate.

$$\mathbf{Y= 38.4908- 11.7883*D + 1.1926D^2}$$

Where Y is the aboveground biomass in Kg and D is the Diameter at Breast Height in cm

The aboveground stem wood biomass was then expanded to total above ground biomass of tree including leaves, twigs, branches, bole and bark using biomass expansion factor (BEF).

i.e. **Total Aboveground Biomass = AGB × BEF**

The Mean BEF value of 1.5 was used for this study as prescribed by Brown *et al*., (1992). Below ground biomass (BGB) was calculated by using simple default value of 25% of the above ground biomass for hardwood trees (IPCC, 2006). Total Biomass (TB) was measured as sum of above and below ground biomass (Sheikh *et al*., 2011). Carbon was considered as 50% of its biomass (Pearson *et al*., 2005).

Density, frequency and abundance of individual tree species were calculated using the formula given by Curtis *et al*., (1950).

Important Value Index (IVI) was calculated by adding relative frequency, relative density and relative dominance (Relative Total Basal Area) as prescribed by Dombois *et al*., (1974). All the parameters were later mathematically correlated with mean carbon stocks of trees.

RESULTS AND DISCUSSION

The data related to carbon sequestered by trees were assessed from the tarai area of Kumaon in both aboveground and beloground plant parts is presented in (Figure- 1a). Among the ten random species selected *A.cordifolia*, *S. robusta*, *T. arjuna* and *B. ceiba* showed good potential to maintain carbon stocks. IVI is a measure of how dominant a specie is in a given forest area. IVI Vs Mean Carbon stocks (MCSs) showed positive correlation with R^2 value of 0.9098 (Figure 1b). The R^2 value is close to +1 which indicates the better the line fits the data.

The next best correlation was found between Density Vs MCSs with the R^2 value of 0.6647 (Figure 1d). Frequency and abundance does not correlate well with mean carbon stocks of different tree species. Thus, IVI is an important indicator to predict the carbon sequestration potential of different tree species. In a natural forest where variety of species grow and survives in a common environment, those with high IVI values will possibly sequester more carbon through photosynthesis at a given instant in comparison to other species.

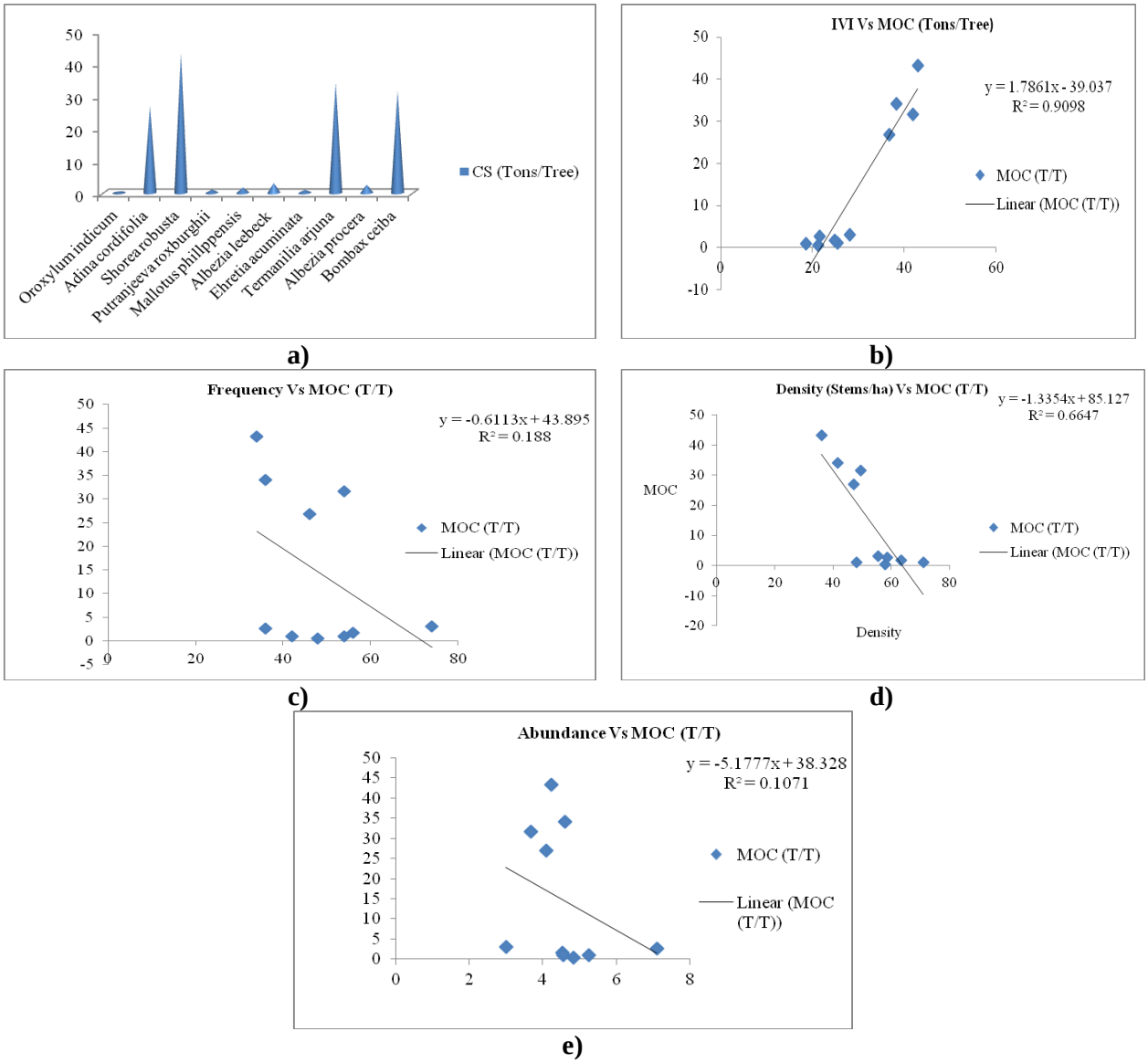

Figure 1(a): Carbon Sequesteration Potential of Different Tree Species; (b-e): Correlation between Mean Organic Cabon and Different Structural Components within a Forest

Table 1: Mean Organic Carbon Stocks (Tons/Tree) of Different Tree Species along with IVI Values

Scientific Name	Av DBH (cm)	MAGOC (T/T)	MBGOC (T/T)	MOC (T/T)	IVI
Oroxylum indicum	25	0.37	0.09	0.46	21.31
Adina cordifolia	160	21.51	5.38	26.89	36.76
Shorea robusta	201.6	34.6	8.65	43.25	42.99
Putranjeeva roxburghii	35.03	0.82	0.2	1.02	25.43
Mallotus phillppensis	43.5	1.34	0.33	1.67	24.92
Albezia leebeck	57	2.43	0.61	3.04	28.15
Ehretia acuminata	34	0.76	0.19	0.95	18.57
Terminalia arjuna	179.5	27.26	6.82	34.08	38.4
Albezia procera	52.8	2.06	0.51	2.57	21.5
Bombax ceiba	173	25.27	6.32	31.59	42

Conclusion

Tarai region at the foothills of Kumaon Himalaya is currently facing urbanization pressure which is severly affecting its local biodiversity as well. The native tree species are being ignored and are replaced by plantations as mentioned above. People and State government should be encouraged to plant more an more native species to strengthen the local biodiversity. Moreover,such tree species should also be utilized for carbon storage and management. Four species were found to be suitable for the aforsaid purpose. There slow groing nature and high wood density allow them to accumulate more carbon in the long run in comparison to fast growing species thus helping to strengthen the ecosystem services.

ACKNOWLEDGEMENT

The author would like to thank the Head of the Department of Plant Biology, Kumaon University, Almora Campus, Almora for allowing him to do the following assingment. The author would also like to thank the technical team for collecting the field data.

REFERENCES

Baral A and Guha GS (2004). Tree for carbon sequestration or fossil fuel substitution: the issue of cost VS carbon benefit. *Biomass and Bioenergy* **27** 41-55.

Brown S and Lugo AE (1992). Aboveground biomass estimates for tropical moist forests of theBrazalian Amazon. *Jaterciercia* **17**(1) 8-18.

Brown S, Gillespie A and Lugo A (1989). Biomass estimation methods for tropical forests with applications to forest inventory data. *Forest Science* **35** 881- 902.

Clark DA, Brown S, Kicklighter D, Chambers JQ, Thomlinson JR and Ni J (2001). Measuring Net Primary Production in Forests: Concepts and Field Methods. *Ecological Applications* **11** 356- 370.

Curtis JT and McIntosh RP (1950). The interrelations of certain analytic and synthetic phytosociological characters. *Ecology* **31** 434- 455.

IPCC (2006). *Guidelines for National Greenhouse Gas Inventories*, edited by S. Eggelston, L. Bevendia, K. Miwa, T. Nagra and K.Tanabe, Published by (The Institute for Global Environmental Studies for the IPCC, Kanagawa, Japan) ISBN 4-88788- 032- 4.

Jina BS, Sah P, Bhatt MD and Rawat YS (2008). Estimating carbon sequestration rates and total carbon stockpile in degraded sites of oak and pine forests of Kumaun central Himalaya. *Ecoprint* **15** 75-81.

Lodhiyal LS and Lodhiyal N (2001). Plant Diversity, productivity and nutrient cycling of short lived species under popular plantations in Tarai region of central Himalaya. *Indian Journal of Tropical Biodiversity* **9**(1-4) 8-17.

Mani S and Parthasarathy N (2009). Tree population and aboveground biomass changes in two disturbed tropical dry evergreen forests of peninsular India. *Tropical Ecology* **50**(2) 249- 258.

Mueller-Dombois D and Ellenberg H (1974). *Aims and Methods of Vegetation Ecology*, (John Wiley and Sons, Inc, New York, USA).

Pearson TRH, Brown S and Ravindranath NH (2005). Integrating carbon benefits estimates into GEF Projects. *Capacity Development and Adaptation Group Guidelines* 1-56.

Rathore A and Jasari YT (2013). Urban green patches as carbon sink: Gujarat University Campus, Ahmedabad, India. *Indian Journal of Fundamental and Applied Life Sciences* **3**(1) 208-213.

Sahu SC, Suresh HS and Ravindranath NH (2016). Forest structure, composition and aboveground biomass of Tree Community in tropical dry forests of Eastern Ghats, India. *Notulae Scientia Biologicae* **8**(1) 125- 133.

Sheikh MA, Kumar M, Bussman R and Wand TNP (2011). Carbon Balance and Management, doi, 1186-1750.