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Full Length Article

Carbon sequestration potential of tree species in the environment of North Maharashtra University Campus, Jalgaon (MS) India

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ABSTRACT

In the present investigation aboveground biomass and belowground biomass carbon sequestration potential of selected tree species of North Maharashtra University campus in Jalgaon city was measured. Total standing biomass of selected tree species was in 8000 m^2 hectares. The total of 462 numbers of 10 trees species present in selected area of North Maharashtra University Jalgaon. Total biomass and carbon sequestrated in the tree species have been estimated using non-destructive method. The aboveground and belowground organic carbon (tones/tree) and total organic carbon of each species were calculated. The calculated total organic carbon has been compared with allometric model. *Moringa olifera* species was found to be dominant sequestrated 15.775 tons of carbon and having 14 trees followed by *Azadirachta indica* 12.272tones. The species *Eucalyptus citriodora* has lowest carbon sequestration potential i.e. 1.814tones.

Key words: aboveground, belowground, organic carbon, carbon sequestration, total organic carbon, total biomass.

INTRODUCTION

Carbon is held in different natural stocks in the environment. Natural stocks are oceans, fossil fuel deposits, terrestrial system and atmosphere. In the terrestrial ecosystem, carbon is sequestered in rocks and sediments, wetlands and forests, and in the soils of forestland, grasslands and agricultural land. Carbon sequestration phenomenon is the extraction of the atmospheric carbon dioxide and its storage in terrestrial ecosystems for a very long period of time. Plants store carbon for as long as they live, in terms of the live biomass. Once they die, the biomass becomes a part of the food chain and enters the soil as soil carbon. If the biomass is incinerated, the carbon is re-emitted into atmosphere.

Most terrestrial carbon storage is in tree trunks, branches, foliage, and roots which is often called biomass. Terrestrial vegetation and soil represents important sources and sinks of atmospheric carbon (Watson et al., 2000), with land use change accounting for 24% of net annual anthropogenic emission of GHGs to the atmosphere (Prentice et al., 2001). Trees act as a sink for CO_2 by fixing carbon during photosynthesis and storing excess carbon as biomass.

Trees are carbon reservoir on earth. In nature, forest ecosystem act as a reservoir of carbon. They store huge quantities of carbon and regulate the carbon cycle by exchange of CO from the atmosphere. Forest ecosystem is one of the most important carbon sinks of the terrestrial ecosystem. Plant uptakes the carbon dioxide by the process of photosynthesis and stores the carbon in the plant tissues. Forest ecosystem plays important role in the global carbon cycle by sequestering a substantial amount of carbon dioxide from the atmosphere (Vashum and Jay Kumar, 2012).

Carbon sequestration is a mechanism for the removal of carbon from the atmosphere by storing it in the biosphere (Chavan and Rasal, 2012). In the global carbon cycle biomass is an important building block, significally 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). 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 this paper, the estimation of the biomass and carbon sequestration rates for the selected trees species carried out with diameter and breast height in North Maharashtra University Campus. We investigate the extent to which a university can rely on carbon sequestration by tree species located in NMU campus (Haghparast H, *et al*.. 2013, Chavan and Rasal, 2010).

MATERIALS AND METHODS

Study Area

The study is located in the state of Maharashtra, in India. Jalgaon city lies between 75° 31' 36.39" to 75° 36' 5.30"E Longitude and 20° 58' 22.40" to 21°01'26.35"N Latitude. The average rainfall of the city is 700-750 mm which categories it as semi-arid region. Temperature extends from 10° to 46° C. The total area of university campus was related and studied in present investigation.North Maharashtra University campus is 652 acre of land in which many plant species present. The land used for construction of various departments approximately in 100 acre.

Sampling Technique:

Quadrant method

The goal of the quadrate method is to estimate the population; the density of each species a given community. Population density is the number of individuals of each per unit area. Small square, called quadrates are randomly selected to avoid choosing unrepresentative sample.

Size of Quadrant: 40m * 40m

No. Quadrants: 5

Total Area Studied: 8000m^2

The following parameters were measured for estimating the above-ground biomass pool. The following parameters were measured for estimating the above-ground biomass pool.

Measurement of Height

To estimate biomass from selective tree species, it is not advisable to cut them. The biomass can be measured by mathematical models by measuring diameter at breast height (DBH) directly and the girth at DBH. Girth considered is the DBH (Chavan*et al.,* 2010).

Above Ground Biomass of Tree

AGB include all living biomass above the soil. The aboveground biomass (AGB) has been calculated by multiplying volume of biomass and wood density the volume was calculated based on diameter and height (Pandya*et al*., 2013).

The wood density value for the species obtained from web (www.worldagroforestry.org)

AGB (g) = volume of biomass (cm^3) *wood density (g/ cm^3)

Below Ground Biomass of Tree

The below ground biomass (BGB) include all biomass of live roots excluding find roots having,<2 mm diameter (Chavan and Rasal, 2011; 2012). 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 shoot ratio (Chavan and Rasal, 2011; Hangarge*et al.,* 2012).

BGB (g) = 0.26 X above ground biomass (ton).

Total Biomass

Total biomass is the sum of the above and below ground biomass. (Sheikh*et al.*. 2011).

Total Biomass (TB) = Above Ground Biomass + Below Ground Biomass

Carbon Estimation

Generally, for any plant species 50% of its biomass is considered as carbon (Pearson *et al.,* 2005) i.e.,

Carbon Storage = Biomass x 50% or Biomass/2

Many large trees planted in the areas on campus, and one for individual tree and small tree clusters scattered throughout campus. To calculate the amount of carbon stored and sequestered in the larger regions of NMU campus.

RESULTS AND DISCUSSION

The Field data of trees studied from the quadrate method are tabulated in Table 1 at revels that the *Tectona grandis* trees species are dominant in each quadrant having 244 trees and *Delonix regia* tree species having 13 trees less in number.

Table 1: Field data of trees studied from the quadrate method in NMU campus

Sr No.	Scientific name	Quadrant					Total
		1	2	3	4	5	
1	*Acacia nilotica*	8	10	2	4	8	32
2	*Albizia lebbek*	-	4	12	7	5	27
3	*Azadirachta indica*	2	8	15	10	15	50
4	*Butea monosperma*	3	1	8	2	2	15
5	*Dalbergia sisso*	4	3	2	2	12	22
6	*Delonix regia*	3	1	2	4	3	13
7	*Eucalyptus citriodora*	2	3	1	20	2	28
8	*Moringa olifera*	5	1	2	2	4	14
9	*Peltaforum pterocarpum*	4	5	3	4	1	17
10	*Tectona grandis*	80	14	100	25	25	244

Table 2: represents the standard wood densities of selected tree species, which others wood densities are consider as 0.6 g/cm^3 (Patwardhan *et al*).

Sr. No.	Vernacular name	Scientific name	Wood density g/cm^3
1	Subabhule	*Acacia nilotica*	0.6
2	Shirish	*Albizia lebbeck*	0.61
3	Neem	*Azadirachta indica*	0.69
4	Palas	*Butea monosperma*	0.48
5	Sissam	*Dalbergia sisso*	0.62
6	Gulmohar	*Delonix regia*	0.51
7	Nilgiri	*Eucalyptus citriodora*	0.51
8	Madhushevaga	*Moringa olifera*	0.39
9	Pilmohar	*Peltaforum pterocarpum*	0.62
10	Teak	*Tectona grandis*	0.55

Standard wood densities of tree species (www.worldagroforestry.Org)

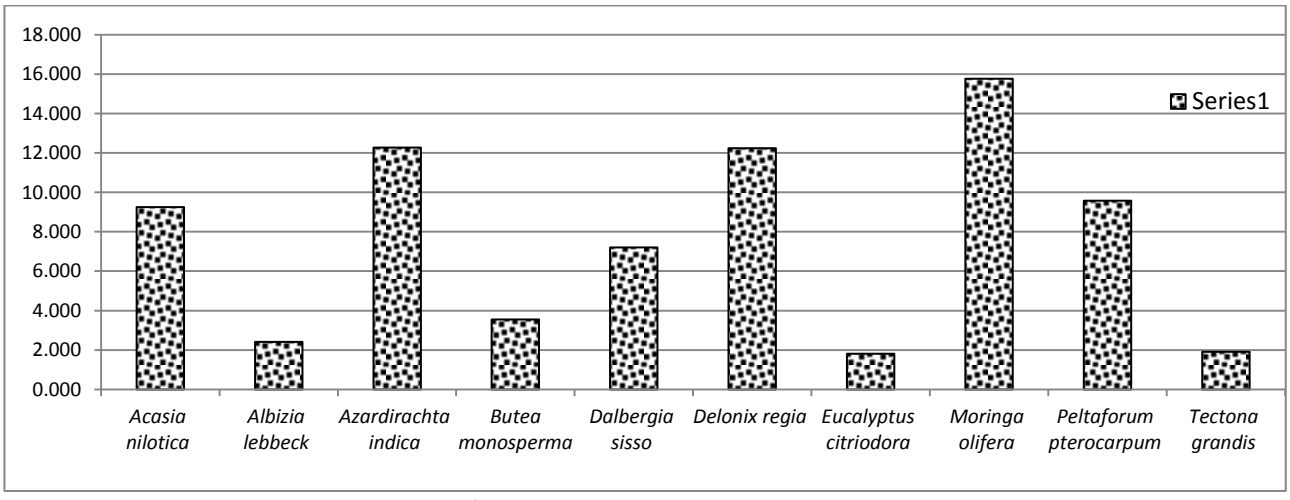

Fig.1 Total organic carbon of trees in t/tree

Table 3: List of Selected Tree Species and their Physiological Details in study area

Sr. No.	Vernacular name	Scientific name of tree	Number of tree	Average GBH (cm)	Average Height (meter)	Average organic carbon (t/ individual)			Organic carbon (ton/tree)
						AGB	BGB	TOTAL	
1	Subabhule	*Acasia nilotica*	32	19.1	12.84	0.367	0.095	0.462	9.248
2	Shirish	*Albizia lebbeck*	27	10.55	11	0.096	0.025	0.121	2.419
3	Neem	*Azardirachta indica*	50	22.29	12.51	0.487	0.127	0.614	12.272
4	Palas	*Butea monosperma*	15	12.73	11.11	0.141	0.037	0.178	3.553
5	Sissam	*Dalbergia sisso*	22	19.1	10	0.286	0.074	0.360	7.207
6	Gulmohar	*Delonix regia*	13	22.29	12	0.486	0.126	0.612	12.247
7	Nilgiri	*Eucalyptus citriodora*	28	9.55	10.12	0.072	0.019	0.091	1.814
8	Madhushevaga	*Moringa olifera*	14	25.47	12.31	0.626	0.163	0.789	15.775
9	Pilmohar	*Peltaforum pterocarpum*	17	19.1	13.27	0.38	0.099	0.479	9.576
10	Teak	*Tectona grandis*	244	9.55	10.73	0.076	0.020	0.096	1.915
Total trees			462	**Total carbon sequester**					76.028

Field data of trees from study area were tabulated in Table 3.it reveals that there are 10 species including 462 individuals have been recorded in North Maharashtra University. Selected 10 tree species and total number of trees each species present in NMU campus. It also indicates the average GBH in cm and average tree heights in meters. The mean above ground organic carbon (AGC) per tree (t/tree); mean of below ground organic carbon (BGC) per tree (t/tree); the total organic carbon of each species in tones and the total organic carbon sequestrated in 462 trees have been summarized. The organic carbon sequestrated in per species is shown for comparison purpose. The estimated organic carbon (biomass) has been compared with allometric model. *Tectona grandis* species are dominant in NMU campus having 244 trees and sequestrated 1.915 tons of carbon. The major carbon sequestrating species were *Moringa olifera* (15.775tons) followed by *Azardirachta indica (*12.272 tons), *Delonix regia* (12.247 tons), *Peltaforum pterocarpum* (9.576 tons), *Acasia nilotica* (9.248 tons) *Dalbergia siss*o (7.207 tons), *Butea monosperma* 3.553tons), *Albizia lebbeck (*2.419 tons). The *Eucalyptus citriodora has* lowest carbon sequestration potential (1.814 tons) and the second lowest carbon sequestrating species was *Tectona grandis* having carbon content (1.915 tons). Graphically Fig. 1 represents total organic carbon of trees in t/tree (Bohre *et al.,* 2012, Pandya *et al.,* 2013 and G Sandhya *et al.,* 2011).

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