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Assessment of biomass and carbon stocks in selected tree species in vindhyas series

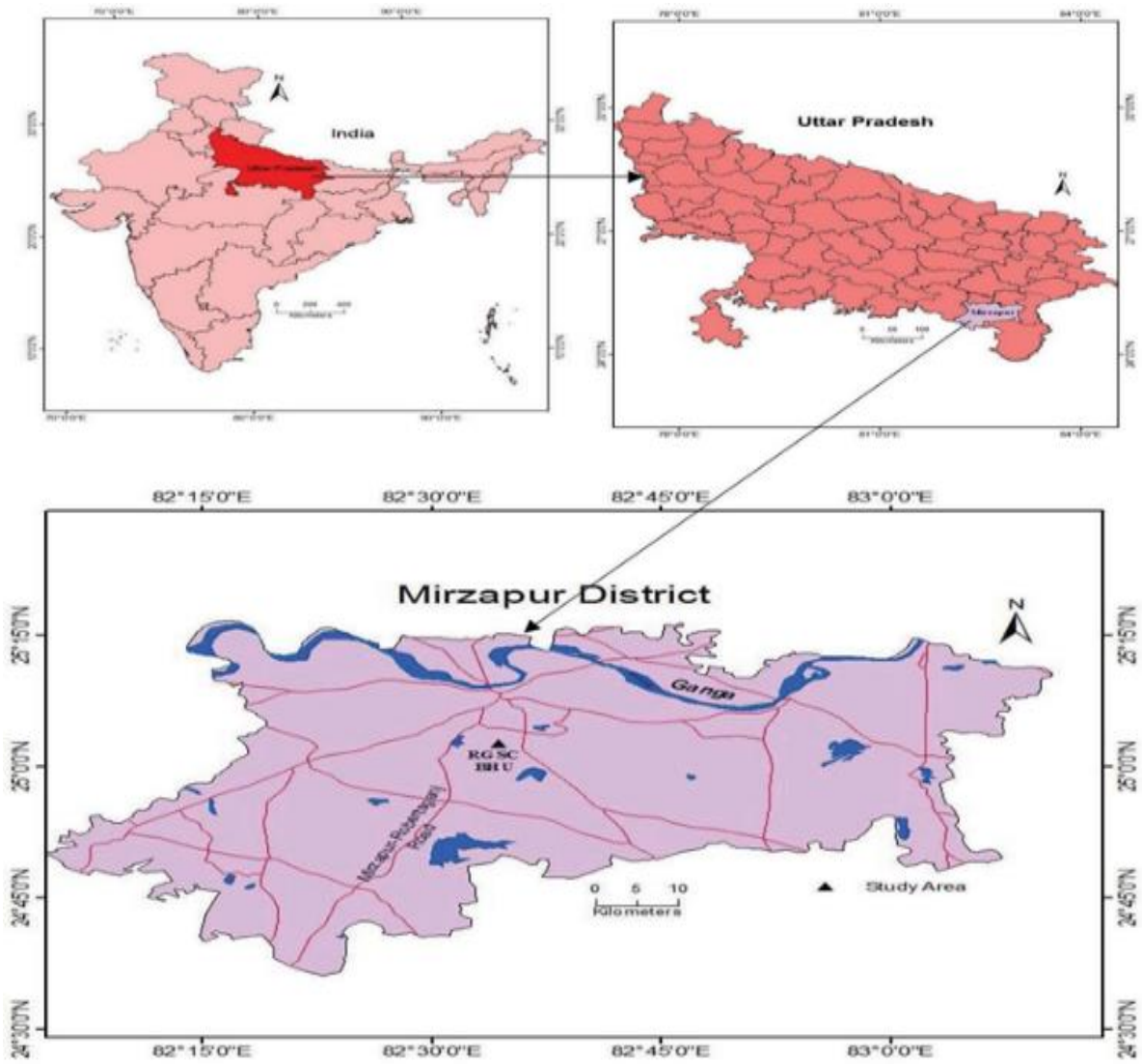
Namo Narayan Mishra and Biswarup Mehera

Abstract
It was observed that in sites no. 8 the *Dalbergia sissoo* tree containing highest aboveground biomass, belowground biomass and total standing biomass (2.254tha^{-1}, 0.586tha^{-1} and 2.672tha^{-1}) followed in sites no. 9 (2.121 tha^{-} 1, 0.551 tha^{-1} and 2.672tha^{-1}), sites no. 5 (2.013 tha^{-1}, 0.523 tha^{-1} and 2.536 tha^{-1}), sites no. 6 (1.857 tha^{-1}, 0.483 tha^{-1} and 2.340 tha^{-1}), sites no. 7 (1.825 tha^{-1},0.474 tha^{-1} and 2.30 tha^{-1}), sites no. 4 (0.788 tha^{-1}, 0.205 tha^{1} and 0.993 tha^{-1}), sites no. 3 (0.725 tha^{-1}, 0.188 tha^{-1} and 0.913 tha^{-1}), sites no. 2 (0.372 tha^{-1}, 0.097 tha^{-1} and 0.479tha^{-1}), and lowest at sites no. 1 (0.041tha^{-1}, 0.011 tha^{-1} and 0.052tha^{-1}) respectively. The standing aboveground biomass and belowground biomass of *Dalbergia sissoo* were 11.996tha^{-1} and 3.12tha^{-1} respectively, while total standing biomass of *Dalbergia sissoo* in 2847 hectares area was 15.114tha^{-1}.

Keywords: biomass estimation, allometric equation, tree height, wood density, specific gravity, carbon stocks.

Introduction
Plant plays an important role in an ecosystem. Biomass of plants strongly affects the structure and function of ecosystem. Trees plays vital role in mitigating the diverse effect of environmental carbon degradation and on reducing global warming. Trees promote sequestration of carbon into soil and biomass therefore, tree-based land use practice could be viable alternatives to store atmospheric carbon di oxide due to their cost effectiveness, high potential of carbon uptake and associated environmental as well as social benefits due to as forest maintain over 86% of the terrestrial carbon stock on earth during photosynthesis and storing excess carbon as biomass. An accurate estimate of forest carbon storages including natural forest plantation etc. separately for different trees land of various locality will be of great significant to the research on the productivity of terrestrial ecosystem. Carbon cycle and global warming determination of above ground biomass (AGB) is an important step in planning the protection and sustainable use of deciduous trees resources. Biomass determination can be in or direct way by cutting and weighing all the plants in sample areas. This requires considerable efforts and time. Destroys vegetation in these areas and in some situation is not desirable or may even be illegal. Therefore, allometric relationships for estimating (AGB) of deciduous trees from measurement of stem diameter at breast height (DBH) and tree height (H). Have been devised and reported by a no. by workers.

Experimental Site
Vindhya Range
Highest point Peak (Sadbhawna Shikhar/Kalumar Peak) Elevation 752 m (2,467 ft) Coordinates 23°28′0″N 79°44′25″E Coordinates: 23°28′0″N 79°44′25″E Different sources vary on the average elevation of the Vindhyas, depending on their definition of the range. MC Chaturvedi mentions the average elevation as 300 m. Pradeep Sharma states that the "general elevation" of the Vindhyas is 300–650 m, with the range rarely going over 700 m during its 1200 km extent.



Climate and Weather

Mirzapur falls in a belt of semi-arid to sub-humid climate. The normal period for the onset of monsoon in this region is the third week of June and it lasts up to the end of September or sometimes extends to the first week of October. Winter showers are often experienced in between the month of December to mid of February. However, March to May is generally dry. On an average, out of the total annual rainfall major fraction (75%) is received from June to September. The winter months are cool whereas summers are hot and dry. The coldest and hottest months are January and May, respectively. The temperature begins to rise from the month of February and reaches its maximum in May.

Rainfall (mm)

Total rainfall received during the tree growth period was 1049.34 mm. The maximum rainfall of 446.32 mm was recorded in February 2018 and minimum rainfall of 3.40 mm was recorded in February 2019

Temperature (°C)

The monthly mean maximum and minimum temperature, during the period of experiment, ranges from 19.94 ^{0}C to 36.75 ^{0}C and 10.51 ^{0}C to 27.34 ^{0}C, respectively. The maximum temperature 36.750C was recorded in the month of June, whereas the minimum temperature 10.51 ^{0}C was observed in the month of December.

Relative humidity (%)

The monthly maximum relative humidity of 90.20 to 94.68% in and monthly minimum relative humidity 55.36 to 72.81% in during the period of experimentation.

Methods and Materials

Above Ground Biomass (g) = volume of biomass (cm3) * wood density (g/ cm3)

AGB (Above ground biomass) includes the all living biomass above the soil.

AGB are calculates by multiplying volume to the green wood density of the tree species.

$$AGB=V\mathbf{x}D$$

Where, AGB= Above Ground Biomass, V= Volume of the tree in M^3 and D= Wood Density of species. Wood density is used from global wood density database. The standard average density of 0.6 g/cm^3 is applied wherever the density value is not available for tree species.

BGB (Below Ground Biomass) has been calculated by the multiplying the AGB by 0.26, as per factor prescribed by Hangarge *et al*.

$$BGB= AGB\mathbf{x}0.26$$

TB (Total Biomass) has calculated by the sum total of AGB and BGB.

$$Totalbiomass=AGB+BGB$$

Carbon Estimation

Generally, for any plant species 50% of its biomass is considered as carbon.

$$Carbon\ Storage = Biomass\ x\ 50\%\ or\ Biomass/2$$

Where, V= volume of the tree in m^3, r= radius of the trunk in m, h = Height of the tree. As very less taper was observe in trees, hence average volume was estimated by using above formula.In present study, we have calculated carbon with assumption, that any tree species contain 50% of its biomass.

$$Carbon\ storage = Biomass\ x\ 50\%$$

Carbon sequestration (CO_2e)

The elemental carbon removed from the atmosphere (CO_2) was then calculated as per procedure followed by Dury *et al.* (2002).

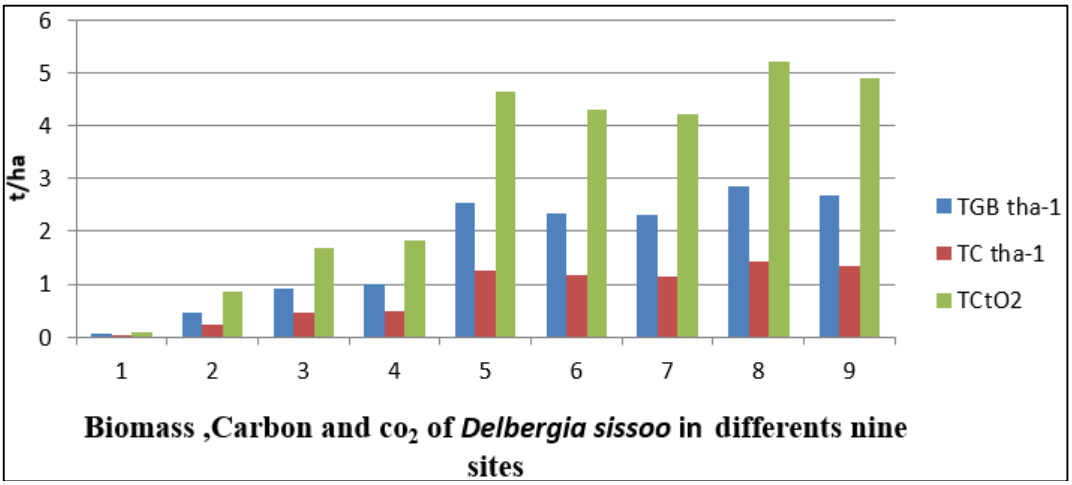
$$CO_2e = C_b \times 3.67$$

Result

Dalbergia sissoo is a common tree observed in all sites of vindhyas series. The density of tree is highest in sites 8. This counted 709 trees followed by 667 in sites 9. In all there are 3773 trees of *Dalbergia sissoo* are recorded in vindhyas series covering nine sites. The standing biomass stalks and carbon sequestered in *Dalbergia sissoo* trees in are shown in Table.

Table 1: Carbon sequestration in Dalbergia sissoo

Sites	Area in ha	Tree count	AGB tha^{-1}	BGB tha^{-1}	TGB tha^{-1}	AGC tha^{-1}	BGB tha^{-1}	TC tha^{-1}	$TCtO_2$
111 1	221	13	0.041	0.011	0.052	0.021	0.005	0.026	0.095
2	223	117	0.372	0.097	0.469	0.186	0.048	0.234	0.86
3	356	228	0.725	0.188	0.913	0.362	0.094	0.457	1.67
4	528	248	0.788	0.205	0.993	0.394	0.103	0.497	1.823
5	244	633	2.013	0.523	2.536	1.006	0.262	1.268	4.65
6	175	584	1.857	0.483	2.340	0.928	0.241	1.170	4.292
7	501	574	1.825	0.474	2.30	0.912	0.237	1.150	4.219
8	232	709	2.254	0.586	2.840	1.127	0.293	1.420	5.211
9	369	667	2.121	0.551	2.672	1.060	0.276	1.336	4.90
	2847	3773	11.996	3.119	15.114	5.998	1.559	7.56	27.73



Discussion

The standing biomass stalks in *Dalbergia sissoo* trees in are shown in Table. It was observed that in sites no. 8 the *Dalbergia sissoo* tree containing highest aboveground biomass, belowground biomass and total standing biomass (2.254tha^{-1}, 0.586tha^{-1} and 2.672tha^{-1}) followed in sites no. 9 (2.121 tha^{-} 1, 0.551 tha^{-1} and 2.672tha^{-1}), sites no. 5 (2.013 tha^{-1}, 0.523 tha^{-1} and 2.536 tha^{-1}),sites no. 6 (1.857 tha^{-1}, 0.483 tha^{-1} and 2.340 tha^{-1}), sites no. 7 (1.825 tha^{-1},0.474 tha^{-1} and 2.30 tha^{-1}), sites no. 4 (0.788 tha^{-1}, 0.205 tha^{1} and 0.993 tha^{-1}),sites no. 3 (0.725 tha^{-1}, 0.188 tha^{-1} and 0.913 tha^{-1}), sites no. 2 (0.372 tha^{-1},0.097 tha^{-1} and 0.479tha^{-1}), and lowest at sites no. 1 (0.041tha^{-1}, 0.011 tha^{-1} and 0.052tha^{-1}) respectively. The standing aboveground biomass and belowground biomass of *Dalbergia sissoo* were 11.996tha^{-1} and 3.12tha^{-1} respectively, while total standing biomass of *Dalbergia sissoo* in 2847 hectares area was 15.114tha^{-1}.

The *Dalbergia sissoo* tree containing highest carbon stalk in sites no. 8 the in aboveground, belowground and total carbon sequestered (1.127 tha^{-1}, 0.293 tha^{-1} and 1.42tha^{-1}) followed in sites no. 9 (1.06 tha^{-1}, 0.276 tha^{-1} and 1.336 tha^{-1}), sites no. 5 (1.006tha^{-1}, 0.262 tha^{-1} and 1.2681tha^{-1}), sites no.6 (0.928tha^{-1}, 0.241tha^{-1} and 1.147tha^{-1}), sites no. 7 (0.912tha^{-1}, 0.237 tha^{-1} and 1.15tha^{-1}), sites no. 4 (0.394tha^{-1}, 0.103 tha^{-1} and 0.497 tha^{-1}), sites no. 3 (0.362 tha^{-1}, 0.094tha^{1} and 0.457 tha^{-1}), sites no.2 (0.186 tha^{-1}, 0.048 tha^{-1} and 0.234tha^{-1}) and lowest at sites no. 1 (0.021 tha^{-1}, 0.005 tha^{-1} and 0.026tha^{-1}) respectively.

Conclusion

The sequestered carbon stalk in aboveground and belowground standing biomass of *Dalbergia sissoo* were 6.0 tha^{-1} and 1.56 tha^{-1} respectively, while total standing biomass of *Dalbergia sissoo* in 2847 hectares area was 7.56 tha^{-1}. The average carbon sequestration and carbon dioxide of *Dalbergia sissoo* intake is 7.56tha^{-1} and 27.735 tCO_2 in.

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