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Carbon Sequestration and Phyto-Diversity of tree species with special reference to Anusuiya beat of Chitrakoot Forest Range

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ABSTRACT

The increasing concentration of CO_2 and other GHGs in the atmosphere is now widely recognized as the leading cause of global warming. The continued increase in its concentration in the atmosphere is believed to be accelerated by human activities such as burning of fossil fuels and deforestation. Carbon sequestration can be defined as the removal of CO_2 from atmosphere into green plants where it can be stored indefinitely. Forests can be regarded as major sinks and most appropriate land management systems for mitigating atmospheric carbon dioxide. The carbon fixation / carbon concentration estimated in certain forest area indicated that there are certain tree species with high ability to fix atmospheric carbon dioxide into their biomass. The large variability in carbon fixation among the species exhibit variability in the capacity of conversion of atmospheric carbon dioxide load to organic carbon to be stored in plants biomass. In this paper an attempt has been made to study the Phyto-diversity (tree species) and CO_2 sequestration by selected forest area. The study site Anusuiya (Sedhaunhan) beat has area of 19.85 Km^2 consisting of 9 compartments. In this study 29 tree species were observed and total carbon sequestration was found 7159.88kg/year. The frequency and density of tree species was also calculated. The maximum density 13.33 was observed for *Lagerstroemia parviflora* followed by 13.22 *Diospyros melanoxylon* and minimum density 0 .11for *Cassia fistula, Catunaregum nilotica, Dalbergia sissoo, Haldinia cordifolia, and Schleichera oleosa.*

.**Key words –** Global warming, carbon fixation, Sequestration, Phyto- Diversity, Forest.

INTRODUCTION

Forest ecosystems play an important role in sequestering carbon from the atmosphere, which aids in lowering carbon footprints and regulating global warming and subsequent climatic changes. Carbon from the atmosphere is stored in above- and below-ground biomass. The native and undamaged forests increase the mean residence duration of carbon sinks with low re-emission (Lal et al. 2015).Global surface temperatures have increased by 0.88C since the late nineteenth century. . Earth's mean temperature is projected to increase by 1.5–5.88C during the twenty- first century (IPCC 2001).

Since 1975, the global temperature has risen at a pace of 0.158 ºC every decade. Aside from the 15-23 cm rise in sea level during the twentieth century (IPCC 2007), there have been major changes in ecosystems (Greene & Pershing 2007) and the frequency and intensity of wildfires (Westerling et al. 2006). These and other observable climate changes are allegedly driven by anthropogenic activities such as land-use change, deforestation, biomass burning, wetlands draining, soil cultivation, and fossil fuel combustion. As a result, the concentration of GHGs in the atmosphere is increasing day by day. Carbon sequestration implies transfer of atmospheric CO_2 into other long-lived global pools including oceanic, petrologic, biotic and geological strata to reduce the net rate of increase in atmospheric CO_2. Because of the importance of biodiversity in the provision of ecosystem services, extensive forest degradation is expected to have far-reaching consequences, such as diminished resistance to natural or anthropogenic disturbance. As such disturbance appears to be growing in frequency and intensity, decreases in biodiversity are anticipated to reduce forest tolerance to climate extremes and invasive species, as well as other disturbance variables, and to reduce overall ecosystem service provision. The objective of this paper was to study the Carbon sequestration by tree species selected study area along with frequency & density of tree species.

STUDY AREA: Satna district is located in between $23^0 58'$ to $25^0 12'$N and $80^0 21'$to $81^0 23'$ E in Madhya Pradesh. Satna district has 7502 km^2 geographical area with 2037 km^2 forest area. The total forested area is (27.15%) divided in to 10 forest ranges and 150 forest beats.. The study area Anusuiya (Sedhaunhan) Beat has 19.85 Km^2 area which consists 9 compartments. The vegetation of Satna forest is tropical dry deciduous type (Champion and Seth 1968). It is Vindhyan range of forest.

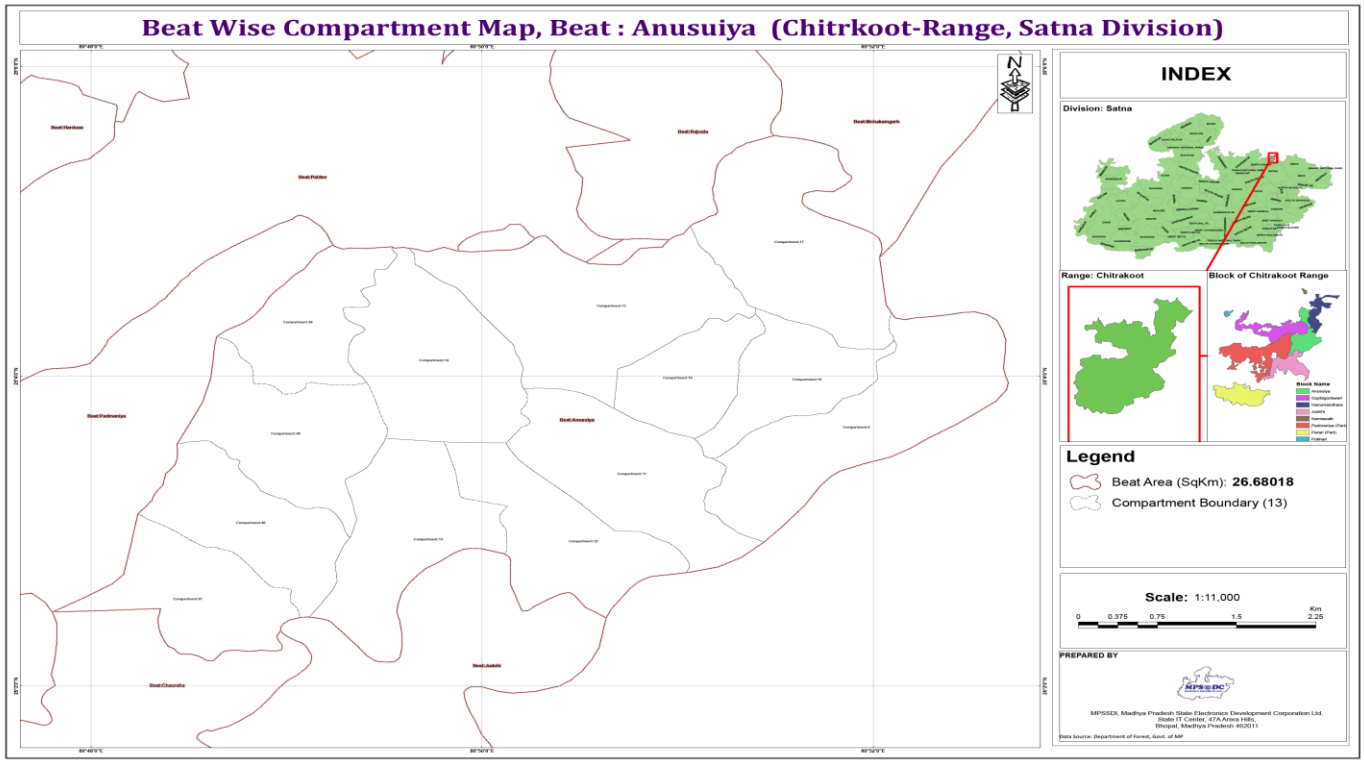


Fig: 1. Map showing study area

MATERIALS & METHODS

The field survey was conducted to collect the data. Stratified random sampling method was adopted for laying sampling plots within the forests. For the tree species analysis, 35 m × 35 m plots were randomly laid throughout the forests. The quadrates were studied and the tree species found were recorded. Canopy of trees within the plots were

recorded and the circumference at breast height (CBH) was measured at 1.37 m above the ground using a measuring tape. The DBH of the individual tree species was ascertained using the formula, DBH = CBH/π. For height measurement of tree, Nikon rangefinder Forestry Pro II was used. This was supplemented by the use of quadrates in areas of difficult terrains. The survey consisted of listing all free stationed trees of at least 11cm or above in diameter (CBH) in each study site. Tree species in this study were identified using the works of Hutchinson and Dalziel (1968-1972).

Biomass (Dry weight) - Estimated by using following formula-

Total (green) weight (W1) of the tree:

W1= 0.25D2H (If D<11) (Clark et al., 1986)
W1= 0.15D2H (If D>11) (Clark et al., 1986)

Dry Weight (W2) = W1×72.5% (Dewald et al., 2005)

Weight of Carbon (C1) = W2×50% (Birdsey, 1992)

Frequency & Density of the forest tree was calculated by following formula:-

$$\text{Frequency (\%)} = \frac{\text{Number quadrates in which species occurred}}{\text{Number of quadrates studied}} \times 100$$

$$\text{Density} = \frac{\text{Total number of plant of a species}}{\text{Number of quadrates studied}}$$

RESULT & DISCUSSION

Environmentalists are increasingly taking a comprehensive approach to the ever-decreasing tree cover and resulting decline in carbon sinks. This decrease in carbon sink has resulted in an increase in carbon emissions and, as a result, a rise in world temperatures. The quadrate approach was used to conduct the study in Anusuiya (Sedhaunhan) beat. The current study calculated carbon sequestration and frequency& density also. The obtained results are discussed below:

Carbon sequestered by Anusuiya (Sedhaunhan) beat Chitrakoot forest range – The total 29 tree species were found in Anusuiya (Sedhaunhan) Beat. Common name, Botanical name, Number of Tree, DBH, Height, and total sequestered CO_2 is given in table- 1. A total no. of 694 individuals trees were observed and evaluated from an area of 19.85 Km^2 using quadrates. Detail of individuals tree species i.e. no. of trees per individual, average DBH, mean height and carbon sequestration is given in table 1.The annual total CO_2 sequestration was found 7159.88 kg/year. Most prevalent tree species was *Lagerstroemia parviflora* in this beat. Maximum CO_2 sequestration was observed by *Schleichera oleosa* 27.78 (kg)/tree/years followed by *Tectona grandis* 26.42 CO_2 Kg /tree/year. Minimum CO_2 sequestration was observed for *Miliusa tomentosa* 1.02 (kg)/tree/years followed by *Catunaregum nilotica* 1.48 CO_2 Kg /tree/year. Total CO_2 sequestration was observed 7159.88 Kg/ year in Anusuiya (Sedhaunhan) beat of forest range Chitrakoot Satna Madhya Pradesh. Relation between DBH and CO_2 sequestration shown in Fig. 2

The frequency & density of various tree species observed in study area is given in table -2. The maximum frequency 100% was observed for *Anogeissus latifolia, Diospyros melanoxylon, Lagerstroemia parviflora* and *Wrightia tinctoria* followed by 88% by *Lannea coromandelica* and minimum frequency 11.11 was observed for *Cassia fistula,*

Cassine glauca, Catunaregum nilotica, Dalbergia sissoo, Grewia rothi, Haldinia cordifolia, Mallotus philippensis, Sapindus mukorossi, Schleichera oleosa, and Terminalia bellirica. The maximum density 13.33 was observed for *Lagerstroemia parviflora* followed by 13.22 *Diospyros melanoxylon* and minimum density 0 .11for *Cassia fistula, Catunaregum nilotica, Dalbergia sissoo, Haldinia cordifolia, and Schleichera oleosa.*

Table: -1. Integrated CO_2 sequestration in Anusuiya Beat

S. no.	Common Name	Botanical Name	Total No. of Tree	Average DBH (Inch)	Average Height of Trees (ft)	Sequestered CO_2/ tree /year (Kg)	Total Sequestered Co_2(kg)/year
1.	खैर	*Acacia catechu*	24	4.69	20.20	5.54	132.96
2.	बेल	*Aegle marmelos*	6	5.75	27.00	10.07	60.42
3.	धवा	*Anogeissus latifolia*	91	6.79	27.29	10.83	985.53
4.	सलई	*Boswellia serrata*	56	8.94	31.85	15.37	860.72
5.	तोरहा	*Bridelia retusa*	16	11.06	28.81	12.07	193.12
6.	अचार	*Buchanania lanzan*	16	8.37	29.68	12.63	202.08
7.	पलास	*Butea monosperma*	3	7.21	23.33	7.99	23.97
8.	किरवार	*Cassia fistula*	1	6.38	28.00	10.01	10.01
9	जमरासी	*Cassine glauca*	2	4.25	15.00	3.61	7.22
10	खरहर	*Catunaregum nilotica*	1	3.75	7.00	1.48	1.48
11	शीशम	*Dalbergia sissoo*	1	10.14	32.00	18.37	18.37
12	तेंदू	*Diospyros melanoxylon*	119	5.90	21.99	6.86	816.34
13	कटइया	*Flacourtia indica*	15	6.28	14.73	4.32	64.80
14	गंगेरुआ	*Grewia rothi*	4	4.72	9.00	2.40	9.60
15	हरदू	*Haldinia cordifolia*	1	4.72	9.00	2.40	2.40
16	सेझ	*Lagerstroemia parviflora*	120	4.88	35.00	9.66	1159.20
17	गुरजा	*Lannea coromandelica*	30	6.22	20.51	7.34	220.20
18	महुआ	*Madhuca indica*	46	8.96	27.03	13.51	621.46
19	सिन्दूरी	*Mallotus philippensis*	2	9.87	30.07	16.34	32.68
20	कारी	*Miliusa tomentosa*	11	2.25	8.00	1.02	11.22
21	कइमा	*Mitragyana parviflora*	2	5.83	20.81	7.11	14.22
22	आंवला	*Phyllanthus emblica*	20	5.07	16.50	4.73	94.60
23	विजयसार	*Pterocarpus marsupium*	3	8.83	27.25	11.71	35.13
24	रीठा	*Sapindus mukorossi*	5	3.13	17.33	3.07	15.35

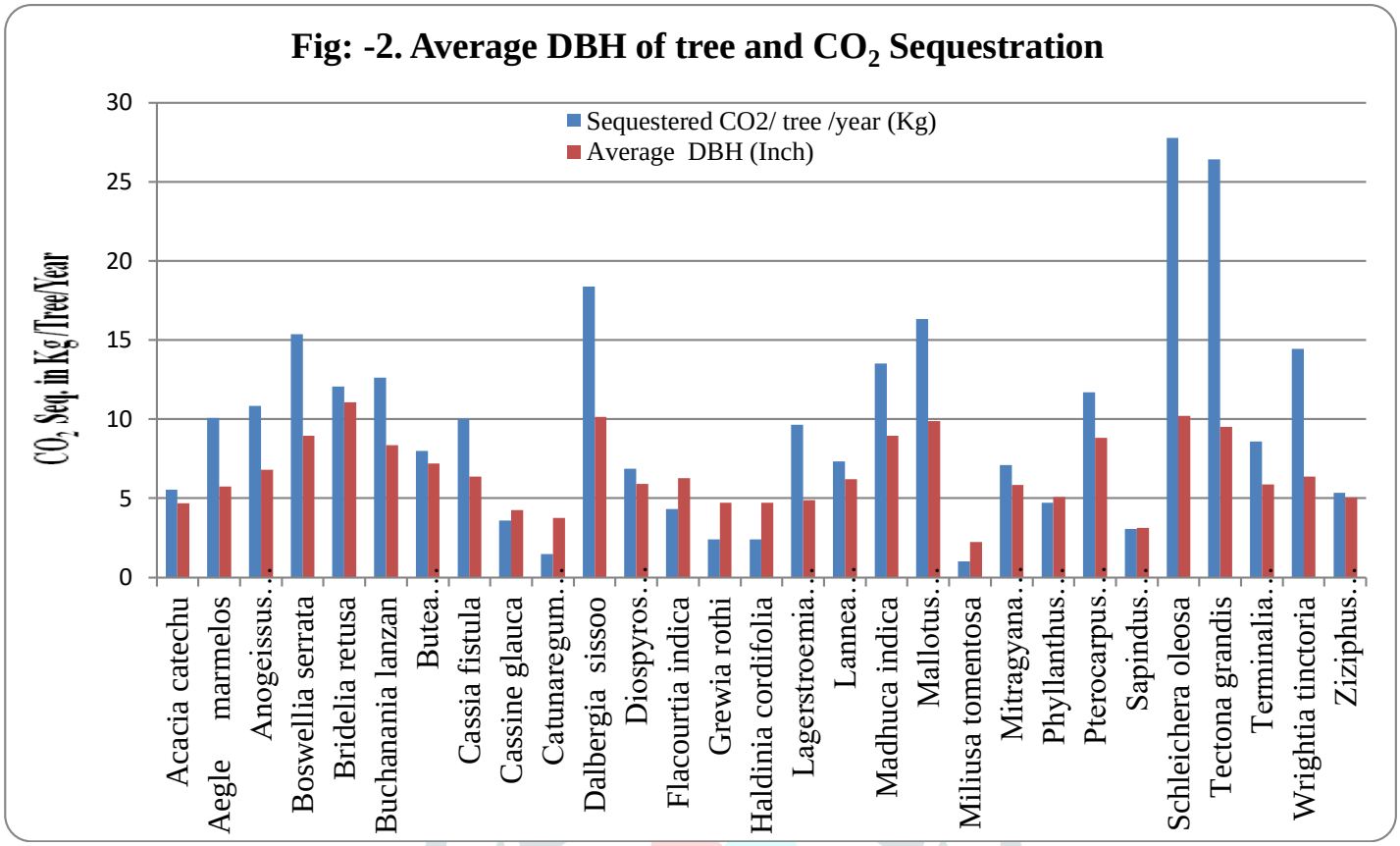
25	कोशम	*Schleichera oleosa*	1	10.22	48.00	27.78	27.78
26	सागौन	*Tectona grandis*	20	9.52	49.00	26.42	528.40
27	बहेरा	*Terminalia bellirica*	1	5.89	25.95	8.59	8.59
28	दूधी	*Wrightia tinctoria*	65	6.38	40.00	14.43	937.95
29	घोटहर	*Ziziphus xylopyrus*	12	5.05	17.39	5.34	64.08
						Total	7159.88

Table:-2. Frequency and Density of various tree species in Anusuiya forest beat

S. N0.	Common name	Name of tree species	Frequency (%)	Density
1	खैर	*Acacia catechu*	66.67	2.67
2	बेल	*Aegle marmelos*	33.33	0.66
3	धवा	*Anogeissus latifolia*	100	10.11
4	सलई	*Boswellia serrata*	44.44	6.22
5	तोरहा	*Bridelia retusa*	55.55	1.77
6	अचार	*Buchanania lanzan*	55.55	1.77
14	गंगेरुआ	*Grewia rothi*	11.11	0.44
15	हरदू	*Haldinia cordifolia*	11.11	0.11
16	सेझ	*Lagerstroemia parviflora*	100	13.33
17	गुरजा	*Lannea coromandelica*	88.88	3.33
18	महुआ	*Madhuca indica*	55.55	5.11
19	सिन्दूरी	*Mallotus philippensis*	11.11	0.22
20	कारी	*Miliusa tomentosa*	22.22	1.22
21	कइमा	*Mitragyana parviflora*	22.22	0.22

7	पलास	*Butea monosperma*	22.22	0.33
8	किरवार	*Cassia fistula*	11.11	0.11
9	जमरासी	*Cassine glauca*	11.11	0.22
10	खरहर	*Catunaregum nilotica*	11.11	0.11
11	शीशम	*Dalbergia sissoo*	11.11	0.11
12	तेंदू	*Diospyros melanoxylon*	100	13.22
13	कटइया	*Flacourtia indica*	44.44	1.66
22	आंवला	*Phyllanthus emblica*	66.66	2.22
23	विजयसार	*Pterocarpus marsupium*	22.22	0.33
24	रीठा	*Sapindus mukorossi*	11.11	0.55
25	कोशम	*Schleichera oleosa*	11.11	0.11
26	सागौन	*Tectona grandis*	22.22	2.22
27	बहेरा	*Terminalia bellirica*	11.11	0.11
28	दूधी	*Wrightia tinctoria*	100	7.22
29	घोटहर	*Ziziphus xylopyrus*	22.22	1.33

Fig: -2. Average DBH of tree and CO_2 Sequestration



CONCLUSION

The study area 694 trees belonging to 29 different species were observed. The study concluded that the overall CO_2 sequestration by trees was 7159.88 Kg/year. The maximum CO_2 was sequestered by *Schleichera oleosa* 27.78 kg/tree/years and minimum by *Miliusa tomentosa* 1.02 kg/tree/ year (Fig.-2). The maximum frequency 100% was observed for *Anogeissus latifolia, Diospyros melanoxylon, Lagerstroemia parviflora* and *Wrightia tinctoria* and minimum frequency 11.11 was observed for *Cassia fistula, Cassine glauca, Catunaregum nilotica, Dalbergia sissoo, Grewia rothi, Haldinia cordifolia, Mallotus philippensis, Sapindus mukorossi, Schleichera oleosa, and Terminalia bellirica.* The maximum density 13.33 was observed for *Lagerstroemia parviflora* and minimum density 0 .11for *Cassia fistula, Catunaregum nilotica, Dalbergia sissoo, Haldinia cordifolia, and Schleichera oleosa.* Carbon sequestration monitoring in the study area suggests that it is a valuable strategy for reducing excessive atmospheric CO_2 concentrations and hence contributes to the avoidance of global warming. To minimize a rise in temperature for the good of society, measures must be done to maintain the forest and avoid illegal cutting. This study may be helpful in the forest ecosystem management and CO_2 sequestration by tree and it can also be fruitful for the sustainability aspect which is good for humanitarian prospective. It will also give the idea of the dominant tree species of the region.

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