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Carbon stock estimation major tree species in Attarsumba range, Gandhinagar forest division, India

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ABSTRACT

The forests of the world are a big carbon sink. About two third of the globe's terrestrial carbon, is sequestrated in the standing forests, forest under kept plants, leaf and forest debris, and in forest soils (7).Attarsumba range has 23 villages. The total area of villages is 2,931.71 hectare, which covers about 26.02 % of total Gandhinagar Forest Division. Total number of species present in the range is 78.There is a major 10 dominated tree species selected for study. The maximum number of major trees species present in girth class 0-30 cm.The range is dominated by Acacia tortilis (Forsk) Hyne (2,41,040). It makes 41% of the total number of selected tree species (5,79,340). Carbon sequestration is the long term storage of carbon in oceans, soils, vegetation (especially forests), and geological formations (6). Carbon sequestration is the process of removing excess carbon dioxide (CO_2) from the atmosphere.The total carbon stock of the major trees species in Attarsumba range is 46,093.55 ton. Out of which range has maximum carbon stock in Acacia tortilis (Forsk) hyne (26,096.57 ton). It has 56% of the total carbon stock of major trees species in range. The species Cordia perrottetii Wt has lowest carbon sequestration potential i.e. 25.15 tonnes. The second lowest carbon sequestration potential species was Phoenix sylvestris (L) Roxb (86.43 tonnes).

Key words: Attarsumba Range, Carbon sequestration, Tree species

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INTRODUCTION

Carbon is found in all living organism and is the major building block for life on earth. Carbon exists in many forms, predominately as plant biomass, soil organic matter, and as the gas carbon dioxide (CO_2) in the atmosphere and dissolved in sea water (8). There is a perpetual cycle of carbon being sequestered on the earth and emitted back into the atmosphere. It is argued that the accelerating accumulation of greenhouse gases, particularly carbon dioxide (CO_2), in the atmosphere from human activities such as reducing amount of forest cover, increasing the amount and variety of chemicals released into the atmosphere, and intensive farming, is driving climate change. Some of these changes have decreased the capacity of the environment to support some life forms (1).Terrestrially, carbon is stored in vegetation and in the soil. Plants store carbon for as long as they live, in terms of live biomass. Once they die, the biomass becomes a part of the food chain and eventually enters the soil as a soil carbon. If the biomass is incinerated, the carbon is remitted into the atmosphere and is free to move in the carbon cycle (7).They sequestered CO_2 by fixing carbon during photosynthesis and storing excess carbon is biomass. Plant growth occurs through the process of photosynthesis, during which carbon is captured and stored in plant cells as the plant grows. Over time, branches, leaves and other materials fall to the ground, gradually losing their stored carbon back to the atmosphere

as they decompose. A portion of the carbon from this decomposing plant litter may sometimes be captured by organisms living in the soil, or through processes involving plant root systems (7).

MATERIALS AND METHODS

A) Study Area

This study was carried out in Atarsumba range, comes under Gandhinagar forest Division. According to the revised classification of forest type by Champion and Seth (1968), part of this forest falls under group 5-A Tropical Dry Deciduous Forests. The Range is occurred within the geoposition between $23^0$05' Latitude and $72^0$97'Longitude.The total area of villages is 2,931.71 hectare, which covers about 26.02 % of total Gandhinagar Forest Division.The climate of the tract is characterized by hot summer, cool winter, and general dryness except in the south - west monsoon months. The cold season from December to February is followed by the hot season from March to May. The period from June to September is the monsoon season followed by the post-monsoon period of October – November(5).

B) Methodology

For the estimation of carbon stock of major tree species, non-destructive method was used. The biomass of trees was estimated on the basis of GBH (Girth at Breast Height) and tree height.

1)Above Ground Biomass (AGB):

The AGB of trees includes the whole plant parts outside the soil. The random sampling method was used for sampling the above ground biomass. The GBHs of trees having diameter greater than 10 cm were measured directly by measuring tape and height of the trees were measured by using Haga's altimeter (2).

Allometric equations for biomass usually include information on trunk Diameter at breast height *DBH* (in m), total tree height *H* (in m), and wood density (in Kg/m^3). The unit of the AGB estimated from the allometric equation is the kilogram (Kg). AGB is calculated using the following formula:

AGB (Kg/tree) = Volume of tree (m^3) x Wood density (Kg/m^3)

$= \pi r^2 H$ (m^3) x Wood density (Kg/m^3)

$= \frac{(GBH)^2}{4\pi}$ x H x Wood density (Kg/m^3)

Where, r = radius of the tree (in m) = GBH/2π

H = Height of the tree (in m)

Radius of the tree is calculated from GBH of tree. The wood densities were obtained from the website – www.worldagroforestrycentre.org/sea/products/AFDbases/WD/ (2). Wherever the wood density of tree species was unavailable, the standard average value 0.6 gm/cm^3 were taken (7).

2)Below Ground Biomass (BGB):

The Below Ground Biomass (BGB) includes all biomass of live roots excluding fine roots having < 2 mm diameter. The BGB has been calculated by multiplying AGB by 0.26 factors as the root: shoot ratio. BGB is calculated by given following formula BGB (Kg/tree) or (ton/tree) = AGB (Kg/tree) or (ton/tree) x 0.26 (4).

3)Total Biomass:

Total biomass of trees was calculated by sum of AGB and BGB of trees. The Total Biomass of trees was calculated by following method (4).

Total Biomass (Kg/tree) or (ton/tree) = AGB + BGB

RESULTS AND DISCUSSION

Attarsumba range has 23 villages. The total area of villages is 2,931.71 hectare, which covers about 26.02 % of total Division. Total number of species present in the range is 78.There is major 10 dominated tree species selected for

study. From which the range is dominated by *Acacia tortilis* (Forsk) Hyne (2,41,040). It makes 41% of the total number of selected tree species (5,79,340). *Acacia Senegal* Willd (1,22,680), *Azadirachta indica* A Juss (61,520), *Holoptelia integrifolia* (Roxb) P (50,110) etc. are the other leading species in Attarsumba range. In higher girth class (above 150cm) are *Acacia tortiles* (Forsk) Hyne (1,320), *Acacia nilotica* (L) Dell (170), *Holoptelia integrifolia* L (120) and *Prosopis cineraria* (L) Druce (60). The maximum number of major trees species present in girth class 0-30 cm (2,79,710) and followed by girth class 31-60 cm (1,93,220), girth class 61-90 cm (84,060), girth class 91-120 cm (3,490), girth class 121-150 cm (1,670) and girth class above 150 cm (1,670) (Table-I).

Table-I: Girth Class wise total number of major trees species of Attarsumba range

Sr. No.	Scientific Name	Girth (in cm)						Total No. of Species
		0-30	31-60	61-90	91-120	121-150	> 150	
1.	*Acacia tortilis* (Forsk) hyne	83010	87020	55840	11660	2190	1320	241040
2.	*Acacia senegal* Willd	70080	44820	7590	190	-	-	122680
3.	*Azadirachta indica* A Juss	36220	20270	4510	470	50	-	61520
4.	*Holoptelia integrifolia* (Roxb) P	34540	10170	4110	980	190	120	50110
5.	*Stribulus asper* L	22840	13850	3660	1040	380	-	41770
6.	*Acacia nilotica* (L) Dell	9560	9790	5210	2330	550	170	27610
7.	*Wrightia tinctoria* R Br	12330	3460	1200	100	40	-	17130
8.	*Prosopis cineraria* (L) Druce	2460	3410	1760	420	90	60	8200
9.	*Cordia perrottetii* Wt	4380	410	100	-	-	-	4890
10.	*Phoenix sylvestris* (L) Roxb	4290	20	80	-	-	-	4390
	TOTAL	**279710**	**193220**	**84060**	**17190**	**3490**	**1670**	**579340**

> = Above, cm = Centimeter

The total carbon stock of the major trees species in Attarsumba range is 46,093.55 ton. Out of which range has maximum carbon stock in *Acacia tortilis* (Forsk) hyne (26,096.57 ton). It has 56% of the total carbon stock of major trees species in range. *Acacia nilotica* (L) Dell (4,457.39 ton), *Azadirachta indica* A Juss (3,981.44 ton), *Stribulus asper*L (3,575.79 ton), *Acacia senegal* Willd (3,420.51 ton), *Holoptelia integrifolia* (Roxb) P (2,200.27 ton), *Prosopis cineraria* (L) Druce (1,329.04 ton), *Wrightia tinctoria* R Br (920.96 ton), *Phoenix sylvestris* (L) Roxb (86.43 ton) and *Cordia perrottetii* Wt (25.15 ton) are the leading total carbon stock major tree species in Attarsumba range. The maximum of carbon stock present in girth class 61-90 cm (17,261.39 ton) which is followed by girth class 31-60 cm (11,190.51 ton), girth class 91-120 cm(8,350.28 ton), girth class 121-150 cm (3,365.04 ton), girth class above 150 cm (3,006 ton) & girth class 0-30 cm (2,920.33 ton) (Table-II).

Table-II: Girth Class wise total carbon stock of major trees species of Attarsumba range

Sr. No.	Scientific Name	Girth (in cm)						Total C stock (in ton)
		0-30	31-60	61-90	91-120	121-150	>150	
1.	*Acacia tortilis* (Forsk) Hyne	929.71	4916.63	10652.60	5231.94	1971.16	2394.53	26096.57
2.	*Acacia senegal* Willd	553.47	1828.48	981.87	56.69	-	-	3420.51
3.	*Azadirachta indica* A Juss	429.38	1584.15	1542.89	355.85	69.17	-	3981.44
4.	*Holoptelia integrifolia* (Roxb) P	277.21	456.09	757.91	394.26	137.36	177.44	2200.27
5.	*Stribulus asper*L	319.95	1038.34	1059.67	662.16	495.67	-	3575.79
6.	*Acacia nilotica* (L) Dell	119.05	752.7	1436.91	1325.4	533.02	290.31	4457.39
7.	*Wrightia tinctoria* R Br	181.64	303.54	321.24	63.85	50.69	-	920.96
8.	*Prosopis cineraria* (L) Druce	36.7	301.95	478.57	260.13	107.97	143.72	1329.04
9.	*Cordia perrottetii*Wt	13.27	6.77	5.11	-	-	-	25.15
10.	*Phoenix sylvestris*(L) Roxb	59.95	1.86	24.62	-	-	-	86.43
	Total	**2920.33**	**11190.51**	**17261.39**	**8350.28**	**3365.04**	**3006**	**46093.55**

C Stock = Carbon Stock, > = Above, cm = Centimeter

CONCLUSION

The carbon stock determined for major tree species in Attarsumba range shows that *Acacia tortilis* (Forsk) Hyne and *Azadirachta indica* A Juss have the maximum carbon sequestration potential while on the basis of the girth class, the capacity to absorb carbon is the highest in the girth class 31-60 cm. On the basis of this study we can calculate carbon stock for tree species by non-destructive method.To rescue the world from global warming and climate change, the sustainable management of forest with the objectives of carbon sequestration is mandatory. Before applying the approach of forest management, qualification of organic carbon in the different strata of forest is necessary and to quantify organic carbon sequestration potential of a forest accurate, easy and fast scientific method is required. The present study will unbolt a new arena in this aspect of forest management.

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