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CARBON SEQUESTRATION POTENTIAL, ITS CORRELATION WITH HEIGHT AND GIRTH OF SELECTED TREES IN THE GOLAPBAG CAMPUS, BURDWAN, WEST BENGAL (INDIA).

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ABSTRACT

The present work reveals the carbon sequestration potential of eight selected species of trees which predominate in the Golapbag campus of the University of Burdwan in the West Bengal state of India with an objective to find their utilitarian value in environmental optimization of the area and landscape designing for aesthetic rejuvenation. It was found that *Swietenia mahagoni* successively followed by *Albezia saman, Polyalthia longifolia, Drypetes roxburghii, Mangifera indica, Saraca asoca, Dolichandrone stipulata* and *Lagestroemia speciosa* are with high efficiency to sequester atmospheric CO_2. Further attempts to correlate these values with Height and Grith of the concerned species could reveal positive relationship except in case of *Swietenia mahagoni, Albezia saman* and *Mangifera indica* respectively. Thus it can be inferred that the tree species have mostly been judiciously used in composing the campus flora.

Key words: carbon sequestration potential, landscape designing, aesthetic rejuvenation.

One of the most important contemporary environmental issues is global warming from escalated atmospheric carbon dioxide. To build up adequate resilience to such an adversity, greening of landscapes with appropriate tree species has been the subject of concern of present day environmental scientists. In view of this the present work was taken up to study the CO_2 sequestration potential of some selected trees sustained in Golapbag Campus of Burdwan University. Carbon sequestration is the process through which CO_2 from the atmosphere is absorbed naturally through photosynthesis by the plants (Pandya et al, 2013) and store carbon for as long as they live, in terms of the live biomass. Once they die, then the biomass becomes a part of the food chain and enters in the soil as soil carbon. If the biomass is incinerated, the carbon is re-emitted in atmosphere in form of carbon dioxide. Carbon is held in different natural stocks such as are oceans, fossil fuel deposits, terrestrial system and atmosphere in the environment. In the terrestrial ecosystem, carbon is sequestered in rocks and sediments, wetlands and forests, and in the soils of forestland, grasslands and agricultural land.

Most terrestrial carbon storage site is tree trunks, branches, foliage, and roots which are often called biomass. Terrestrial vegetation as well as soil represents important sources and sinks of atmospheric carbon (Watson and Core, 2001), with laid use change accounting for 24% of net annual anthropogenic emission of GHGs to the atmosphere (prentice et al, 2001). Tropical deforestation is responsible for 20% of world's annual CO_2 emissions, though offset by uptake of atmospheric CO_2 by forests and agriculture. Carbon sequestration rates differ based on the species of tree, type of soil, regional climate, and topography and management practice. Carbon accumulation eventually reaches saturation point where additional sequestration is no longer possible (when trees reach maturity, or when the organic matter in soils builds back up to original levels before losses occurred) After saturation, the trees or agricultural practices still need to be sustained to maintain the accumulated carbon and prevent subsequent losses of carbon back to the atmosphere. 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_2 from the atmosphere. Forest ecosystem plays important role in the global carbon cycle by sequestering a substantial amount of carbon dioxide from the atmosphere (Vashum et al, 2012).

STUDY SITE

Golapbag or garden of rose, of Barddhaman, is a beautiful place being an attractive site for tourists, students, natural scientists and academicians.

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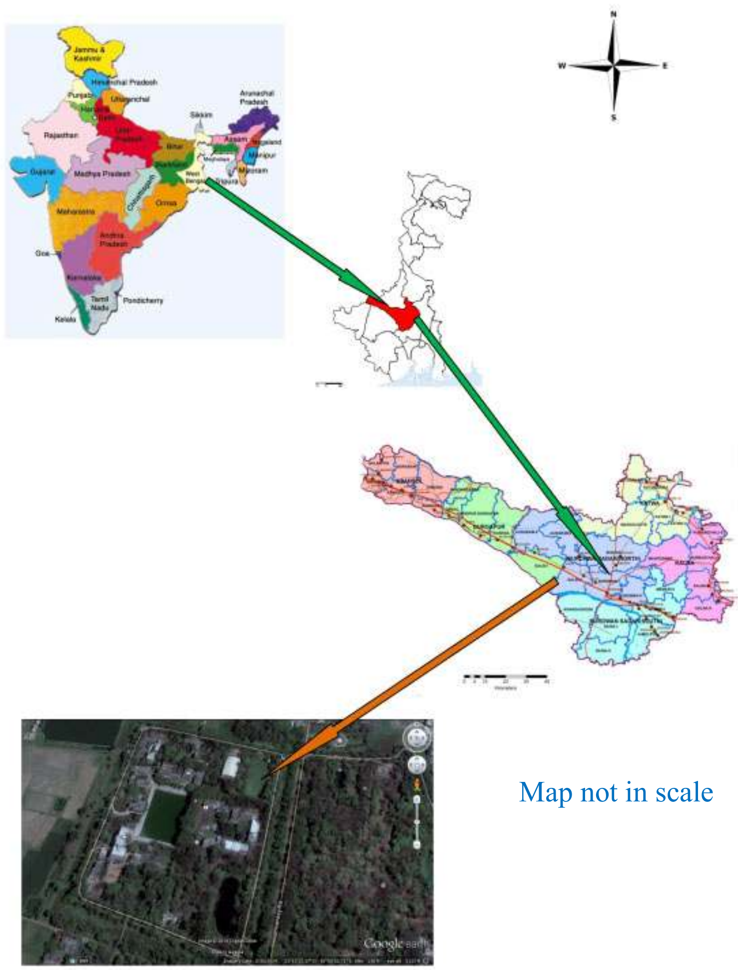
It was the botanical and zoological garden established by the king Bijoy Chand Mahatab in 1884 with advice from the then British experts in the subject. Famous botanist Sir J. D Hooker came there and listed 128 types of trees. At present there are numerous *Polyalthia longifolia, Swietenia mahagoni, Drypetes roxburghii, Saraca asoca, Albizia saman* and other trees in the garden.

Burdwan is the alternative name of the city, which remains in use since the British period. Barddhaman is located at 23.25°N and 87.85°E.It has an average elevation of 40 meters (131 ft). The city is situated 1100 km from New Delhi and a little less than 100 km north-west of Kolkata on the Grand Trunk Road (NH-2) and Eastern Railway.



Study site and its location in Burdwan District in West Bengal State, India

Map not in scale

METHODOLOGY

As many as eight species dominating the study site were selected the girth of each of which was measured conventionally at the breast height (GBH) i.e. near about 1.32m above ground surface. Tree diameter (D) was calculated by dividing π (22/7) by the actual marked girth of species (Bohre et al, 2012) i.e. GBH x 7/22. Biomass of the listed phanerophytes is calculated by simply applying of bio-statistics based allometric equations. Above ground Biomass i.e .AGB are measured by multiplying the bio-volume to the green wood density of tree species. Tree bio-volume (T_{BV}) value established by multiplication of diameter with height of phanerophytes to factor 0.4.

Bio-volume (T_{BV}) = 0.4 X D x H

AGB=Wood density x T_{BV}

Where; D is calculated from GBH, assuming the trunk to be cylindrical, H = Height in meter. Height is mesured with the help of the instrument Theodolite. Wood density is used from Global wood density database (Zanne et al, 2009). The standard average density of 0.6 gm/ cm is applied wherever the density value is not available for tree species. The belowground biomass has been calculated by multiplying the above ground biomass (AGB) by 0.26factors as the root: shoot ratio (Hangarge et al, 2012).

BGB =AGB x 0.26

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/ Carbon sequestrational potential = Biomass /2

Phanerophytes were classified on the basis of their height; as follows

Mega- phanerophytes:- Over 30 meter high

Meso- phanerophytes:-8-30 meter high

Micro- phanerophytes:-2-8 meter high

Nano- phanerophytes:- Under 2 meter

RESULTS AND DISCUSSION

Table 1: Tree characteristics having relevance to their carbon storage potential

Name of the plant	Plant No	GBH (in meter)	Diameter (in meter)	Height (in meter)	Types of phanerophytes	T_{BV} (meter^{3})	AGB in Kg	BGB (Kg)	TB (Kg)	Carbon Storage (Gram)
Polyalthia longifolia Sonn.	63	2.33	0.7413	11.9	Meso-phanerophytes	2.61574	1.56944	0.40805	1.97749	988.75
	55	2.17	0.6904	11.8		2.24979	1.34987	0.35097	1.70084	850.42
	38	2	0.6363	8.6		1.39277	0.83566	0.21727	1.05293	526.47
	10	2.55	0.8113	11.7		3.08038	1.84823	0.48054	2.32877	1164.39
	70	2.87	0.9131	20.1		6.70335	4.02201	1.04572	5.06773	2533.87
Lagestroemia speciosa (L.) Pers.	139	0.95	0.3022	4.3	Micro-phanerophytes	0.15708	0.09425	0.02451	0.11876	59.38
	151	1.58	0.5027	4.1		0.41443	0.24866	0.06465	0.31331	156.66
	157	1.07	0.3404	4		0.1854	0.11124	0.02892	0.14016	70.08
	173	1.45	0.4613	6.2		0.52774	0.31664	0.08233	0.39897	199.48
	195	1.38	0.4390	8		0.61672	0.37003	0.09621	0.46624	233.12
Saracca asoca (Roxb.) Wilde	159	1.02	0.3245	3.1	Micro-phanerophytes	0.13057	0.07834	0.02037	0.09871	49.36
	171	1.27	0.4040	6		0.39174	0.23504	0.06111	0.29615	148.08
	630	1.78	0.5663	7.8		1.00058	0.60035	0.15609	0.75644	378.22
	676	1.20	0.3818	9.5		0.55395	0.33237	0.08642	0.41879	209.39
	724	2.17	0.6904	9.3		1.77314	1.06388	0.27661	1.34049	670.24
Dolichandrone stipulata Benth. & Hook.f.	649	1.02	0.3245	8.1	Meso-phanerophytes	0.34117	0.2047	0.05322	0.25792	128.96
	639	0.77	0.245	7.9		0.18968	0.11381	0.02959	0.1434	7.17
	635	1.13	0.3595	12.4		0.64108	0.38465	0.10001	0.48466	242.33
	633	1.34	0.4263	12.2		0.88682	0.53209	0.13834	0.67043	335.21
	687	1.45	0.4613	9		0.76608	0.45965	0.11951	0.57916	289.58
Swietenia mahagoni (L.) Jacq.	652	4.10	1.3045	25.6	Meso-phanerophytes	17.4257	10.4554	2.7184	13.1738	6586.9
	643	4.50	1.4318	23.7		19.4345	11.6607	3.03178	14.6925	7346.23
	637	5.93	1.8868	18.3		26.0592	15.6355	4.06524	19.7008	9850.38

	674	4.00	1.2727	23.9		15.4851	9.29103	2.41567	11.7067	5853.35
	673	3.82	1.2154	24.5		14.4766	8.68594	2.25834	10.9443	5472.14
Mangifera indica L	657	1.49	0.4740	16.3	Meso-phanero phytes	1.46488	0.87893	0.22852	1.10745	553.73
	920	1.85	0.5886	8.1		1.1225	0.6735	0.17511	0.84861	42.43
	923	2.60	0.8272	19.6		5.36452	3.21871	0.83686	4.05557	202.779
	1139	1.95	0.6204	16.1		2.47876	1.48726	0.38669	1.87395	936.98
	1142	1.49	0.4740	12.2		1.09641	0.65785	0.17104	0.82889	414.45
Albizia saman F.Muell.	622	1.90	0.6045	12.2	Meso-phanero phytes	1.78327	1.06996	0.27819	1.34815	647.07
	621	2.85	0.9068	14.3		4.70356	2.82214	0.73376	3.5559	1777.95
	620	2.80	0.8909	14.1		4.47647	2.68588	0.69833	3.38421	1692.1
	740	2.25	0.7159	19.33		3.96265	2.37759	0.61817	2.99576	1497.88
	743	3.40	1.0818	19.35		9.05812	5.43487	1.41307	6.84794	3423.97
Drypetes roxburghii (Wall.) Hurus.	760	1.55	0.4931	18.2	Meso-phanero phytes	1.77013	1.06208	0.27614	1.33822	669.11
	765	0.94	0.2990	20.2		0.72235	0.43341	0.11269	0.5461	273.05
	763	2.79	0.8877	19.8		6.24096	3.74458	0.97359	4.71817	2359.08
	766	2.52	0.8018	20.1		5.16871	3.10123	0.80632	3.90755	1953.78
	800	1.40	0.4454	16.3		1.29341	0.77605	0.20177	0.97782	488.91

Table 2: Correlation between GBH and carbon sequestrational potential of different phanerophytes

Name of phanerophytes	Correlation coefficient values
Polyalthia longifolia	0.93960*
Lagestroemia speciosa	0.80101
Saraca asoca	0.9721**
Dolichandrone stipulata	0.94420*
Swietenia mahagoni	0.9881**
Mangifera indica	-0.2428
Albezia saman	0.93111*
Drypetes roxburghii	0.98695**

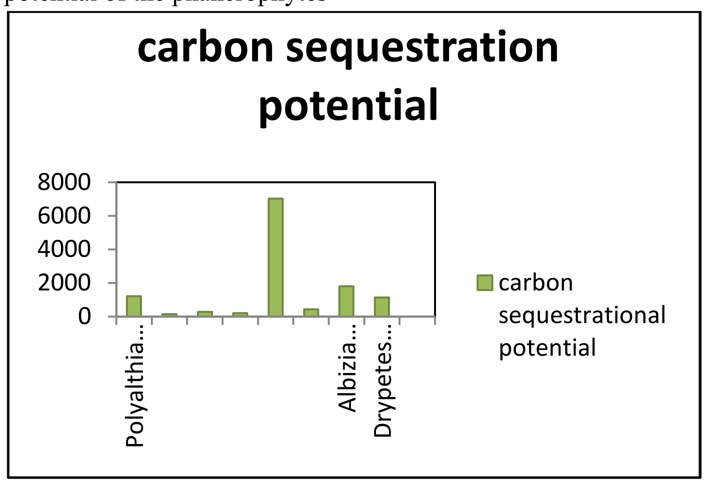
Table 3: Correlation between height and carbon sequestrational potential of different phanerophytes

Name of phanerophytes	Correlation coefficient values
Polyalthia longifolia	0.98658**
Lagestroemia speciosa	0.87447
Saraca asoca	0.70426
Dolichandrone stipulata	0.7239
Swietenia mahagoni	-0.8917*
Mangifera indica	0.3195
Albezia saman	-43.0453
Drypetes roxburghii	0.587009

* Significant at P 0.05

** Significant at both P 0.05 and P 0.01

Fig. 1: Graphical representation of carbon storage potential of the phanerophytes



We have measured the carbon sequestration potential of 40 individual phanerophytes belonging to eight different genera occurred in the Golapbag campus of Burdwan University. Out these eight genera six are mesophanerophytes and rest two are micro phanerophytes (Table 1) of among them *Swietenia mahagoni* has highest whereas *Lagestroemia speciosa* has lowest carbon sequestration potential from this we can conclude that *Swietenia mahagoni* can remove highest amount of CO_2 from the atmosphere (Fig. 1). All the phanerophytes except *Mangifera indica* shows positive correlation between

GBH and carbon storage potential, among them *Polyalthia longifolia, Dolichandrone stipulata, Albezia saman* and *Saraca asoca, Swietenia mahagoni, Drypetes roxburghii* possess the correlation coefficient values which is significant at P 0.05 and at both P 0.05 and P 0.01 respectively. If the GBH is increased then the carbon sequestration potential will be decresed in case of *Mangifera indica* but in the other species result will be the opposite (Table 2). Increasing height results in higher carbon sequestration potential but in *Swietenia mahagoni* and *Albezia saman* Shows negative correlation. *Polyalthia longifolia* possess positive correlation significant at both P 0.05 and P 0.01 whereas *Swietenia mahagoni* shows negative correlation significant at P 0.05 (Table 3).

CONCLUSION

From the findings of the present work it is clear that CO_2 sequestration potential varies from species to species, the best in the act being *Swietenia mahagoni* successively followed in order of merit by *Albezia saman, Polyalthia longifolia, Drypetes roxburghii, Mangifera indica, Saraca asoca, Dolichandrone stipulata* and *Lagestroemia speciosa.*

For landscape designing with tall trees having high sequestration potential the names of *Polyalthia longifolia* and *Lagestroemia speciosa* can be suggested and when with short trees, certainly *Swietenia mahagoni, Drypetes roxburghii, Saraca asoca* are suitable

While summing up it can be said that the present work can pave the pathway to aesthetic rejuvenation through landscape designing collaterally with environmental optimization through CO_2 sequestration with appropriate trees.

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