Estimation of Carbon Storage in the Tree Growth ofSt. Mary's College (Autonomous) Campus, Thoothukudi, Tamilnadu, India

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Abstract

The present study addresses carbon storage and sequestration by trees grown in**St. Mary's College (Autonomous)** campus, Thoothukudi. The aboveground biomass was calculated. The above ground biomass includes non-destructive sampling. The Non-destructive method includes the measurement of height of thetree and diameter of the tree.There were total 41 species including individuals recorded in St. Mary's college campus in Thoothukudi. **Table 1** showed the details of various tree species in different sites there. *Azadirachta indica* has sequestered 686454.5 lbs which is compared to other trees species from the study area. It is due to high DBH and height of the tree. At the same time AGB 430422.02 lbs, dry weight 374467.2 lbs and carbon 187233.6 lbs which is highest in the *Azadirachta indica* which has only 62 tree count. *Murraya koenigii* sequestered lowest CO_2 1006.61 lbs compared to other trees which is may be due to lowest DBH i.e. 104.25 meters. Total AGB 631.16lbs, total dry weight 549.118 and total carbon 274.55 lbs and total CO_2 sequestered is 10066.15 lbs.

Keywords : biomass, *Azadirachta indica*, *Murraya koenigii* , CO_2 sequestered

Introduction

Global emissions of carbon have been increasing for about 140 years since the beginning of the Industrial Revolution. Researchers at the University of East Anglia (UEA) have forecast a rise of 0.2% CO_2 for 2016, average 2.3% year-on-year increases in CO_2 output from fossil fuels until 2013. The rise in 2014 was 0.7%. Trees are capable of effective sequestration and storage of atmospheric carbon in above-ground and below-ground biomass by way of processes of photosynthesis and tree growth. Carbon is absorbed and assimilated by tree foliage and is stored as carbon-rich organic compounds such as cellulose and hemicelluloses, lignin, starch, lipid and waxes, mostly in secondary woody tissues in tree boles and in large roots, as well as in foliage, branches and roots. Establishing forest plantations on presently non-forested land provides an energy-conscious world with a clean, efficient means of absorbing some of the excess in atmospheric CO_2 . Such absorption offers a significant offset against continuing greenhouse gas emissions and may be combined with other benefits such as timber production, environmental protection, added biodiversity and land rehabilitation. Three major components (or sets of processes) together constitute net sequestration of carbon in forest trees:

1. Carbon uptake and assimilation, including immediate respiratory losses which detract from previously 'fixed' carbon in photosynthetic plant cells;

2. Carbon transport, allocation and partitioning of carbon for storage, structural and metabolic use in above-ground and below-ground parts of the tree; and

3 . Return of forest carbon to the atmosphere via oxidative pathways, notably via the food chain, biological decay and combustion of forest biomass and forest products.

The estimation of stem volume and tree biomass forms the part of non-destructive and allometric methods for the estimation of carbon storage. It is recommended for both sustainable planning of forest resources and for studies on the energy and nutrients flows in ecosystems (Henry,*et.al* ., 2011) taking an average of 1,000 trees per hectare, 73.326 lbs CO_2/tree/year In addition, the United Nations Framework convention on climate change and in particular the Kyoto Protocol recognize the importance of forest carbon sink and the need to monitor, preserve and enhance terrestrial carbon stocks, since changes in the forest carbon stock influence the atmospheric CO_2 concentration (Parry *et.al.*, 2006)

India being a tropical country, it has very high potential for tree growth and carbon sequestration. More than 116 million tons of CO_2 per year is sequestered contributing to reduce atmospheric carbon (Pearson,*et.al* .,2005). Urban forest (Wilcox,2012)includes trees in streets, gardens and parks provide ecosystem services such as removing air-borne pollutants (Nowak, D. J. *et al.*, 2002) reducing the urban heat island effect (Akbari, *et al.*, 2001) and counterbalancing carbon emissions through carbon storage and sequestration. In India, several studies have successfully shown the carbon storage potential for urban forests (Pandya *et.al* .,2013) and trees planted in the university campuses (Waran A and Patwardhan A, 2001; Hangarge. *et.al* 2012). The present study deals with the estimation of tree biomass, carbon storage and sequestration in the St. Mary's College (Autonomous), Thoothukudi, Tamil Nadu.

Methodology of sampling technique

Scale method was used to estimate the population of all the tree species. They were made site wise. All the species located on the campus was counted. The following parameters were measured to estimate biomass and carbon content.

The material was used to be photographed. By using the wooden scale to measure the length and their diameter.

Determine the total (green) weight of the tree (World agroforestry centre)

Based on World agroforestry the algorithm used to calculate the weightof a tree is:

W = Above-ground weight of the tree in pounds

D = Diameter of the trunk in inches

H = Height of the tree in feet

For trees with D < 11:

W = 0.25D2H

For trees with D >= 11:

W = 0.15D2H

The root system weighs about 20% as much as the above-ground weight of the tree.

Therefore, to determine the total green weight of the tree, multiplied the above-ground weight of the tree by 120%.

Determine the dry weight of the tree

This is based on an extension publication from the University of Nebraska. This publication has a table with average weights for one cord of wood for different temperate tree species. Taking all species in the table into account, the average tree is 72.5% dry matter and 27.5% moisture.

Therefore, to determine the dry weight of the tree, multiplied the weight of the tree by 72.5%.

Determine the weight of carbon in the tree

The average carbon content is generally 50% of the tree's total volume.5 Therefore, to determine the weight of carbon in the tree, multiply the dry weight of the tree by 50%.

Determine the weight of carbon dioxide sequestered in the tree

CO2 is composed of one molecule of Carbon and 2 molecules of Oxygen.

The atomic weight of Carbon is 12.001115.

The atomic weight of Oxygen is 15.9994.

The weight of CO2 is C+2*O=43.999915.

The ratio of CO2 to C is 43.999915/12.001115=3.6663.

Therefore, to determine the weight of carbon dioxide sequestered in the tree, multiplied the weight of carbon in the tree by 3.6663.

Determine the weight of CO_2 sequestered in the tree per year

Divided the weight of carbon dioxide sequestered in the tree by the age of the tree.

Result and discussion

Assessment of biomass provides information on the structure and functional attributes of trees. With approximately 50% of dry biomass comprises of carbon (Westlake, 1963, HGoldbrg *et al*. 1998; Schroeder 1992, Dixon 1994; Cannell.M., 1995; Richter *et al*. 1995), biomass assessments illustrate the amount of carbon that may be sequestered by trees, Biomass is an important indicator in carbon sequestration therefore estimating the biomass in trees is the first step in carbon accounting. Lu (2006) mentioned three approaches to biomass assessment. This method (non- destructive) can be used that predicts biomass given some easily measurable predictor variable, such as "tree diameter" and "height" can be used. Many studies were conducted to develop biomass equation that relates dry biomass of trees to its biophysical variables (e.g. diameter-at-breast height(dbh), tree height) (Brown, 1997; Ketterings *et.al*, 2001; Zhao *et.al*., 2010) and basal area .Therefore species specific equations using basal area(BA), height (H), diameter at breast height (DBH)and volumetric equations based on wood density of individual tree species and allometric based regression equations for the trees which does not have species specific biomass equations areused to calculate the biomass based on the available literature.

The study was conducted in St. Mary's college campus to estimate the above ground biomass, carbon dioxide sequestered, carbon from tree species.There were total 41 species including individuals recorded in St. Mary's college campus in Thoothukudi. **Table 1** showed the details of various tree species in different sites there. *Azadirachta indica* has sequestered 686454.5 lbs which is compared to other trees species from the study area. It is due to high DBH and height of the tree.At the same time AGB 430422.02 lbs, dry weight 374467.2 lbs and carbon 187233.6 lbs which is highest in the *Azadirachta indica* which has only 62 tree count. *Murraya koenigii* sequestered lowest CO_2 1006.61 lbs compared to other trees which is may be due to lowest DBH i.e. 104.25 meters. Total AGB 631.16lbs, total dry weight 549.118 and total carbon 274.55 lbs and total CO_2 sequestered is 10066.15 lbs.

Large healthy trees having the diameter more than 150 cm sequestered approximately 40 times more carbon as compared to the small healthy trees species which have the diameter less than 12.5 cm. Large also save nearly 1000 times maximum carbon than smaller trees (MacDicken K.G. 1997). In **Table 2 and Fig. 1 .** at the site St.Mary's college campus, *Azadirachta indica* (Meliaceae) shared maximum 32% of the total stand density while *Polyalthia longifolia* (Annonaceae), *Cocos nucifera* (Arecaceae), *Peltophorum pterocarpum* (Fabaceae) shared 20%, 12% and 7% respectively. From the samples of the trees taken, many have shown promising results. It terms of being a good carbon sink in an atmosphere from an ecological perspretive, it should act as a carbon resernour rather than source (Chavan B.L and G.B Rasal , 2010). Trees have a positive role to play in energy transfer and conservation between the building and surroundings and also this balance of conservation will result in reducing the atmosphere CO_2 to a large extent, as they will be stored in trees illustrated in **Fig.2 and 3**.

Trees also remove large amounts of air pollutants that consequently improve air quality. Few studies indicated that 600 trees in the tropics would fill one are, which could sequester up to 15 tonnes of CO_2 annually (Nowak,D.J., 2010)Few of the studies carried out in India are "Sequestered standing carbon stock in selective tree species of University campus at Aurangabad, Maharashtra, India (Chavan B.L and G.B Rasal, 2010) which showed the above ground biomass for trees as follows: *Ficusreligiosa* is 4.27, t/tree, *FicusBenghalensis* 3.89, t/tree, *Mangiferaindica*3.13, t/tree, *Delonixregia*2.12, t/tree, *Buteamonosperma* 2.10, t/tree, *Peltophorumpterocarpum* 2.01, t/tree, *Azadirachtaindica* 1.91, t/tree,*Pongamiapinnata* 1.57t/tree respectively, in a study carried out in and around Pune Carbon Sequestration Potential of Trees in 2002 (Warran and Patwardhan, 2005) showed the rate of carbon sequestered by the trees was 15,000 tons per year. In yet another study it was estimated that a 20-year-old Silver oak shade tree can sequester up to 41.8 Mg/ha of carbon (Niranjana K.S and Viswanath.S, 2005). The study emphasize that when the urban trees are young the standing carbon stock is not substantial, however, the growth of the trees represents a potential increase in biomass and hence carbon sequestration is dependent on the growth rate. The case of Kerwa urban forest area in Bhopal is another Indian case that supports several threatened and endangered plant, animal, and bird species. It also plays a critical role as a carbon sink with a total storage of about 19.5 thousand tonnes of aboveground carbon (Dwivedi*etal*. 2009)

Table 1. **Biophysical measurements and carbon estimation of trees found in study area**

Site	Tree name	No	Diameter (inches)	Height (feet)	green weight above ground (lbs)	Total green weight (lbs)	dry weight (lbs)	Carbon /tree (lbs)	CO_2 sequestered (lbs)	CO_2 sequestered per year (lbs)
site1(Enterance bank side right)	*Polyalthia longifolia.*	6	92.83	297.61	6912.21	8294.65	6013.62	3006.81	11023.87	330716.18
	Roystonea regia.	1	24.21	187.71	1136.54	1363.84	988.79	494.39	1812.59	18125.92
	Peltophorum pterocarpum.	1	217.97	158.43	8633.34	10360.01	7511.01	3755.50	13768.81	137688.10
site 2(SIB Bank)	*Tecoma stans.*	1	24.22	245.40	1485.79	1782.95	1292.64	646.32	2369.60	14217.62
	polyalthia longifolia .	2	96.87	259.38	6281.85	7538.22	5465.21	2732.60	10018.54	300556.30
	Adenanthera pavonina.	1	387.50	338.04	32747.56	39297.07	28490.38	14245.19	52227.13	1566814.00
site3 (Two wheelar shed)	*Azadirachta indica.*	1	605.47	263.75	39923.02	47907.62	34733.02	17366.51	63670.84	1910125.00
Site 4(fatima hall)	*Azadirachta indica .*	3	1550.00	605.05	234455.20	281346.30	203976.10	101988.00	373918.70	11217562.00
Site 5(Infront of dean office left)	*Caryota mitis.*	1	24.22	187.28	1133.89	1360.67	986.48	493.24	1808.37	7233.49
	Roystonea regia	5	24.22	171.98	1041.28	1249.54	905.92	452.96	1660.68	9964.09
Site 6(guesthouse opposite)	*Azadirachta indica .*	1	3487.49	351.15	306158.30	367390.00	266357.70	133178.90	488273.60	14648209.00
Site7 (Insite of dean office left)	*Polyalthia longifolia*	4	24.22	238.40	1443.46	1732.15	1255.81	627.90	2302.09	69062.59
	Adenanthera pavonina .	1	605.47	234.47	35491.14	42589.37	30877.29	15438.65	56602.71	1698081.00
	Araucaria aracana.	1	24.22	67.74	410.11	492.14	356.80	178.40	654.07	6540.66
Site 8(Insite of dean office right)	*Polyalthia longifolia*	3	24.22	239.72	1451.40	1741.68	1262.72	631.36	2314.75	69442.37
Site 9(Controll office shed II)	*Azadirachta indica .*	1	3487.49	460.40	401410.40	481692.50	349227.10	174613.50	640185.60	19205569.00
site 10(controll office opposite)	*Azadirachta indica .*	1	605.47	438.55	66381.94	79658.33	57752.29	28876.15	105868.60	3176058.00

Site 11(cycle shed II)	*Azadirachta indica .*	2	2421.87	525.95	318445.60	382134.80	277047.70	138523.80	507870.00	15236100.00
	Peltophorum pterocarpum .	2	871.87	351.15	76539.57	91847.48	66589.42	33294.71	122068.40	1220684.00
	Cocos nucifera.	3	96.87	263.75	6387.68	7665.22	5557.28	2778.64	10187.33	305620.00
Site 12(Enterance left)	*Polyalthia longifolia .*	3	217.97	370.82	20206.48	24247.77	17579.64	8789.82	32226.11	966783.30
	Cardia sebestena.	1	24.22	210.87	1276.77	1532.12	1110.79	555.39	2036.24	30543.61
Site 13(Zoology back site)	*Roystonea regia*	1	96.87	259.38	6281.85	7538.22	5465.21	2732.60	10018.54	100185.40
	Polyalthia longifolia .	9	387.50	373.00	36134.30	43361.16	31436.84	15718.42	57628.45	1728853.00
Site 14(MA history opposite)	*Ficus benghalensis.*	1	2421.87	316.19	191442.80	229731.30	166555.20	83277.60	305320.70	1526603.00
	Polyalthia longifolia	2	96.87	333.67	8081.05	9697.27	7030.52	3515.26	12887.99	386639.80
	Azadirachta indica	1	1550.00	201.26	77987.66	93585.19	67849.27	33924.63	124377.90	3731336.00
Site15(MA History back site)	*pongamia pinnata.*	1	1550.00	263.75	102203.10	122643.80	88916.72	44458.36	162997.70	814988.40
	polyalthia longifolia	3	387.50	313.13	30334.50	36401.40	26391.02	13195.51	48378.69	1451361.00
	Crataeva mangna	1	871.87	263.75	57489.13	68986.95	50015.54	25007.77	91685.99	2750580.00
Site 16(Botany garden)	*Caryota mitis*	1	387.50	220.05	21317.30	25580.76	18546.05	9273.03	33997.69	339976.90
	Cycas circinalis	1	217.97	128.28	6990.24	8388.29	6081.51	3040.76	11148.32	111483.20
	Vitex negundo.	1	96.87	165.43	4006.38	4807.65	3485.55	1742.78	6389.54	127790.70
	Mimusops elengi.	1	24.22	128.28	776.69	932.03	675.72	337.86	1238.70	12387.03
	Murraya koengii.	1	24.22	104.25	631.17	757.40	549.12	274.56	1006.62	10066.15
	Moringa oleifera	1	24.22	186.40	1128.60	1354.32	981.88	490.94	1799.93	8999.67
	Manilkara zapota.	1	387.50	189.46	18353.90	22024.68	15967.89	7983.95	29271.54	439073.10
	Tectona grandis.	1	24.22	235.35	1424.94	1709.93	1239.70	619.85	2272.55	45450.96
	Artabotrys hexapetalus.	1	217.97	228.79	12467.22	14960.67	10846.49	5423.24	19883.23	198832.30

	Atrocarpus communis.	1	96.87	276.86	6705.19	8046.23	5833.52	2916.76	10693.71	320811.30
	Murraya paniculata.	1	24.22	105.12	636.46	763.75	553.72	276.86	1015.05	20301.09
	Mangifera indica .	4	96.87	132.65	3212.61	3855.13	2794.97	1397.49	5123.60	153708.00
Site 17(Out side garden)	*Morinda tinctoria.*	1	871.87	230.54	50249.98	60299.97	43717.48	21858.74	80140.70	2404221.00
	Peltophorum pterocarpum	1	387.50	282.54	27371.10	32845.32	23812.86	11906.43	43652.54	436525.40
Site 18(Chemistry lab opposite)	*Polyalthia longifolia*	6	387.50	321.43	31138.84	37366.61	27090.79	13545.39	49661.48	1489844.00
site 19(auditorium step side)	*Polyalthia longifolia*	2	387.50	369.94	35837.94	43005.53	31179.01	15589.50	57155.80	1714674.00
Site20(physics front)	*Azadirachta indica .*	7	871.87	394.85	86064.78	103277.70	74876.36	37438.18	137259.60	4117788.00
	Peltophorum pterocarpum .	2	24.22	145.58	881.41	1057.69	766.83	383.41	1405.71	14057.07
Site21(library garden)	*Polyalthia longifolia*	1	24.22	176.35	1067.74	1281.29	928.94	464.47	1702.88	51086.34
	Licuala peltata	1	24.22	155.37	940.74	1128.89	818.44	409.22	1500.33	7501.64
	Azadirachta indica .	2	1961.71	351.15	172214.00	206656.80	149826.20	74913.08	274653.80	8239614.00
	Morinda tinctoria .	1	605.47	357.71	54144.69	64973.63	47105.88	23552.94	86352.14	2590564.00
Site22(soosaiapper garden)	*Cassia glauca.*	1	24.22	251.51	1522.84	1827.40	1324.87	662.43	2428.68	12143.40
	Delonix elata.	1	387.50	348.09	33721.25	40465.50	29337.48	14668.74	53780.01	1613400.00
	Callistemon citrinus	3	96.87	292.59	7086.20	8503.44	6164.99	3082.50	11301.36	339040.70
	Cycas circinalis	2	96.87	145.76	3530.12	4236.14	3071.20	1535.60	5629.98	168899.20
Site 23(NCC room)	*Azadirachta indica .*	1	387.50	501.92	48622.89	58347.47	42301.91	21150.96	77545.75	2326373.00
Site 24(canteen back side)	*Cocos nucifera .*	12	96.87	141.39	3424.28	4109.14	2979.13	1489.56	5461.18	163835.50
	Azadirachta indica .	5	387.50	204.76	19835.59	23802.71	17256.96	8628.48	31634.60	949038.00
Site 25(hostel side)	*Azadirachta indica .*	2	1550.00	401.84	155713.40	186856.00	135470.60	67735.32	248338.00	7450140.00
	Bougainvilla.	1	96.87	180.72	4376.80	5252.16	3807.82	1903.91	6980.30	34901.52
Site 26(Ethel harvey hostel)	*Peltophorum*	1	96.87	263.75	6387.68	7665.22	5557.28	2778.64	10187.33	61124.00

	pterocarpum .									
	Polyalthia longifolia .	1	387.50	317.50	30757.83	36909.40	26759.31	13379.66	49053.83	1471615.00
Site27(Self enterance)	*Peltophorum pterocarpum .*	1	605.47	544.74	82455.74	98946.89	71736.50	35868.25	131503.80	3945113.00
	Azadirachta indica .	3	605.47	394.85	59767.26	71720.71	51997.52	25998.76	95319.25	2859577.00
	Albizia lebbeck.	1	96.87	199.95	4842.48	5810.98	4212.96	2106.48	7722.98	231689.50
	Gliricidia sepium.	1	605.47	335.86	50837.36	61004.84	44228.51	22114.25	81077.49	2432325.00
Site29(back gate side)	*Azadirachta indica*	4	217.97	373.87	20373.17	24447.80	17724.66	8862.33	32491.96	974758.70
	Millingtonia hortensis.	1	1550.00	496.67	192459.50	230951.40	167439.80	83719.89	306942.20	9208267.00
	Delonix regia .	2	24.22	272.49	1649.84	1979.81	1435.36	717.68	2631.23	78936.87
Site30(juncelin hall)	*Azadirachta indica .*	4	96.87	231.41	5604.50	6725.40	4875.91	2437.96	8938.28	268148.40
	Cocos nucifera	3	24.22	255.01	1544.00	1852.80	1343.28	671.64	2462.44	73873.14
Site31(church side)	*Cocos nucifera .*	6	96.87	279.05	6758.11	8109.73	5879.55	2939.78	10778.10	323343.10
	Terminalia arjuna.	1	217.97	368.63	20087.41	24104.90	17476.05	8738.03	32036.22	320362.20
	Azadirachta indica .	3	1550.00	416.70	161471.30	193765.50	140480.00	70239.99	257520.90	7725627.00
	Thespesia populnea.	1	96.87	189.46	4588.48	5506.17	3991.97	1995.99	7317.89	36589.43
	Peltophorum pterocarpum .	1	96.87	198.20	4800.15	5760.18	4176.13	2088.06	7655.47	229664.00
	Azadirachta indica .		96.87	263.75	6387.68	7665.22	5557.28	2778.64	10187.33	305620.00
Site32(self staff room)	*Azadirachta indica .*	4	387.50	336.29	32578.20	39093.84	28343.04	14171.52	51957.04	1558711.00
Site32(BBA side)	*Azadirachta indica .*	6	217.97	220.05	11990.98	14389.18	10432.15	5216.08	19123.70	573711.10
Site33(self maths staff room)	*Azadirachta indica*	8	387.50	324.93	31477.51	37773.02	27385.44	13692.72	50201.61	502016.10
	Pongamia pinnata	1	24.22	220.05	1332.33	1598.80	1159.13	579.56	2124.86	21248.56

Site34(Maddona block side)	*Peltophorum pterocarpum*	3	24.22	285.60	1729.22	2075.06	1504.42	752.21	2757.82	27578.22
	Pongamia pinnata .	1	96.87	283.42	6863.94	8236.73	5971.63	2985.82	10946.89	109468.90
Site35(hostel mess side)	*Azadirachta indica .*	5	871.87	373.44	81397.43	97676.91	70815.76	35407.88	129815.90	3894477.00
	Leucaena leucocephala.	1	1550.00	403.59	156391.10	187669.40	136060.30	68030.14	249418.90	7482567.00
Site36(counselling room)	*Plumeria alba.*	1	96.87	239.72	5805.59	6966.70	5050.86	2525.43	9258.98	277769.50
	Polyalthia longifolia .	1	387.50	359.89	34864.25	41837.10	30331.90	15165.95	55602.92	1668088.00
	Azadirachta indica .	1	387.50	287.79	27879.10	33454.92	24254.82	12127.41	44462.72	1333882.00
	Cocos nucifera .	2	24.22	292.16	1768.90	2122.68	1538.95	769.47	2821.12	84633.57
	Albizia lebbeck.	1	24.22	307.45	1861.51	2233.81	1619.51	809.76	2968.81	29688.11
Site 37(ground enterance)	*Pongamia pinnata*	7	3487.49	335.86	292823.00	351387.60	254756.00	127378.00	467006.00	2335030.00
	Azadirachta indica	5	24.22	233.16	1411.71	1694.05	1228.19	614.09	2251.45	22514.49
	Peltophorum pterocarpum	3	387.50	307.45	29784.14	35740.97	25912.20	12956.10	47500.96	1425029.00
	Plumeria alba	1	217.97	220.05	11990.98	14389.18	10432.15	5216.08	19123.70	573711.10
	Terminalia catapa	1	871.87	373.44	81397.43	97676.91	70815.76	35407.88	129815.90	3894477.00
	Terminalia bellirica.	1	24.21	187.27	1133.88	1360.66	986.48	493.24	1808.37	54251.17
	Tamarindus indica	1	24.21	176.35	1067.74	1281.29	928.93	464.46	1702.87	51086.34

Table 2. Tree density of the study area

S.No.	Botanical name	Fam ily	Number
1.	*Polyalthia longifolia*. Sonn	Annonaceae	44
2.	*Roystonea regia* (Kunth) O.F.Cook	Arecaceae	7
3.	*Licuala peltata* Roxb.ex.Buch.Ham.	Arecaceae	1
4.	*Peltophorum pterocarpum* (DC.)K.Heyne	Fabaceae	15
5.	*Tecoma stans* (L)Juss.ex Kunth	Bignoniaceae	1
6.	*Adenanthera pavonina* L.	Fabaceae	2
7.	*Azadirachta indica* A. Juss	Meliaceae	70
8.	*Caryota mitis* L.	Arecaceae	2
9.	*Araucaria araucana* Juss	Araucariaceae	1
10.	*Cocos nucifera* L.	Arecaceae	26
11.	*Cardia sebestena* L.	Boraginaceae	1
12.	*Ficus benghalensis* L.	Moraceae	1
13.	*Pongamia pinnata* (L.)Pierre	Fabaceae	9
14.	*Crataeva mangna* (Lour.)DC.	Capparaceae	1
15.	*Cycas circinalis* L.	Cycadaceae	3
16.	*Vitex negundo* L.	Lamiaceae	1
17.	*Mimusops elengi* L.	Sapotaceae	1

18.	*Murraya koenigii* (L)Sprenge.	Rutaceae	1
19.	*Moringa oleifera* Lam.	Morringaceae	1
20.	*Manilkara zapota* (L) P.Royen	Sapotaceae	1
21.	*Tectona grandis* L.f.	Verbenaceae	1
22.	*Artabotrys hexapetalus* (L.f.)Bhandari.	Annonaceae	1
23.	*Murraya paniculata* (L.)Jack.	Rutaceae	1
24.	*Morinda tinctoria* Roxb.	Rubiaceae	2
25.	*Cassia glauca* L.	Leguminosae	1
26.	*Callistemon citrinus* R.Br.	Myrtaceae	3
27.	*Atrocarpus communis* J.R.Forster&G.Forster	Moraceae	1
28.	*Delonix elata* (L)Gamble	Fabaceae	1
29.	*Albizia lebbeck* (L).Benth	Fabaceae	2
30.	*Bougainvillae glabra* Choisy	Nyctaginaceae	1
31.	*Gliricidia sepium* Kunth.	Fabaceae	1
32.	*Millingtonia hortensis* L.f.	Bignoniaceae	1
33.	*Delonix regia* Boj(ex Hook) Raf	Fabaceae	2
34.	*Terminalia arjuna* (Roxb.)Wight&Arn.	Combretaceae	1
35.	*Thespesia populnea* (L)Sol.excorrea.	Malvaceae	1
36.	*Leucaena leucocephala* (Lam.) de wit.	Mimosea	1
37.	*Terminalia bellirica* (Gaertn.) Roxb.	Combretaceae	1

38.	*Tamarindus indica* L.	Fabaceae	1
39.	*Mangifera indica* L.	Anacardiaceae	4
40.	*Terminalia catappa* L.	Combretaceae	1
41.	*Plumeria alba* L.	Apocynaceae	2
Total			219

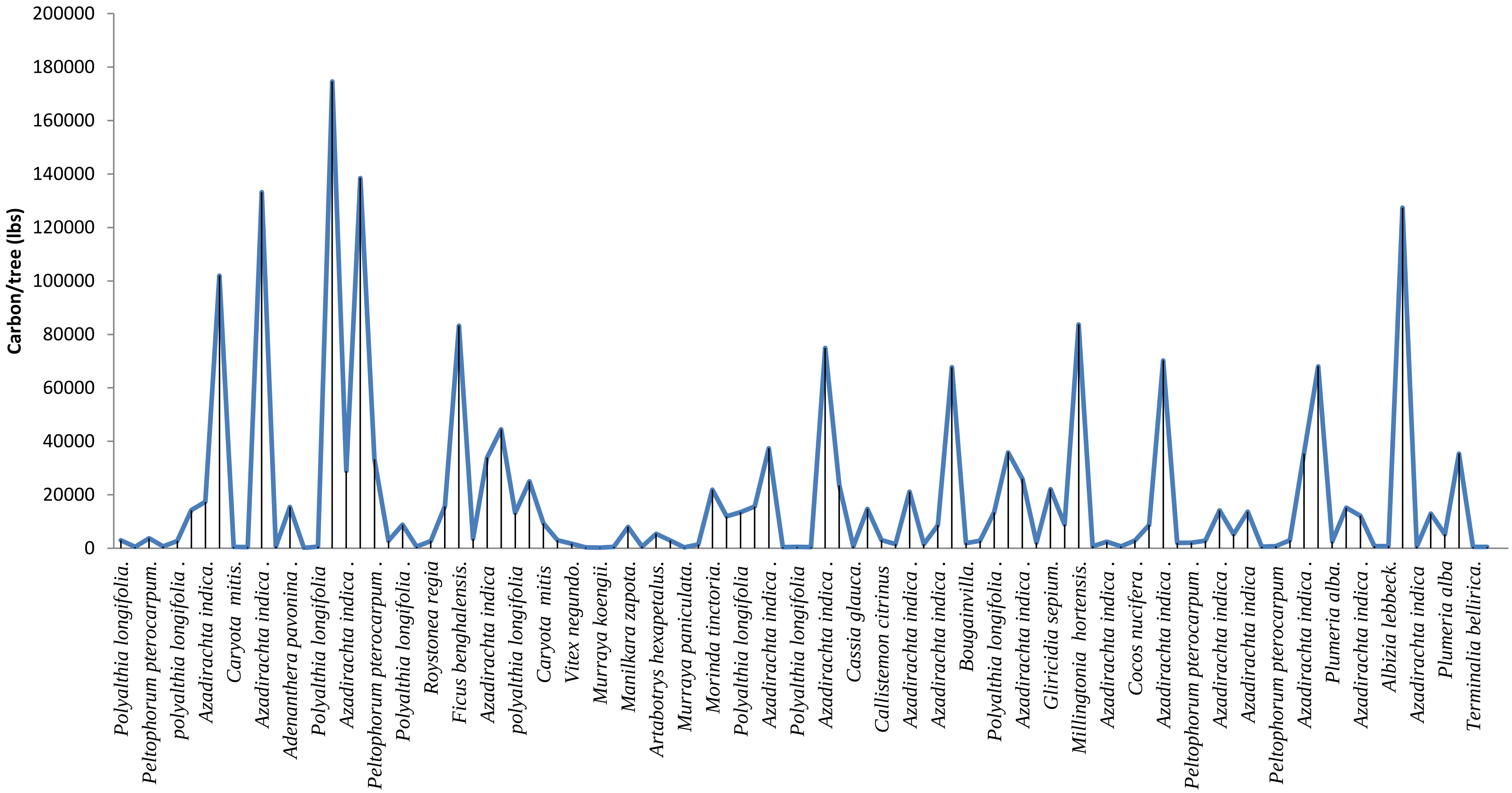

Fig. 2. Amount of carbon of trees species found in study area

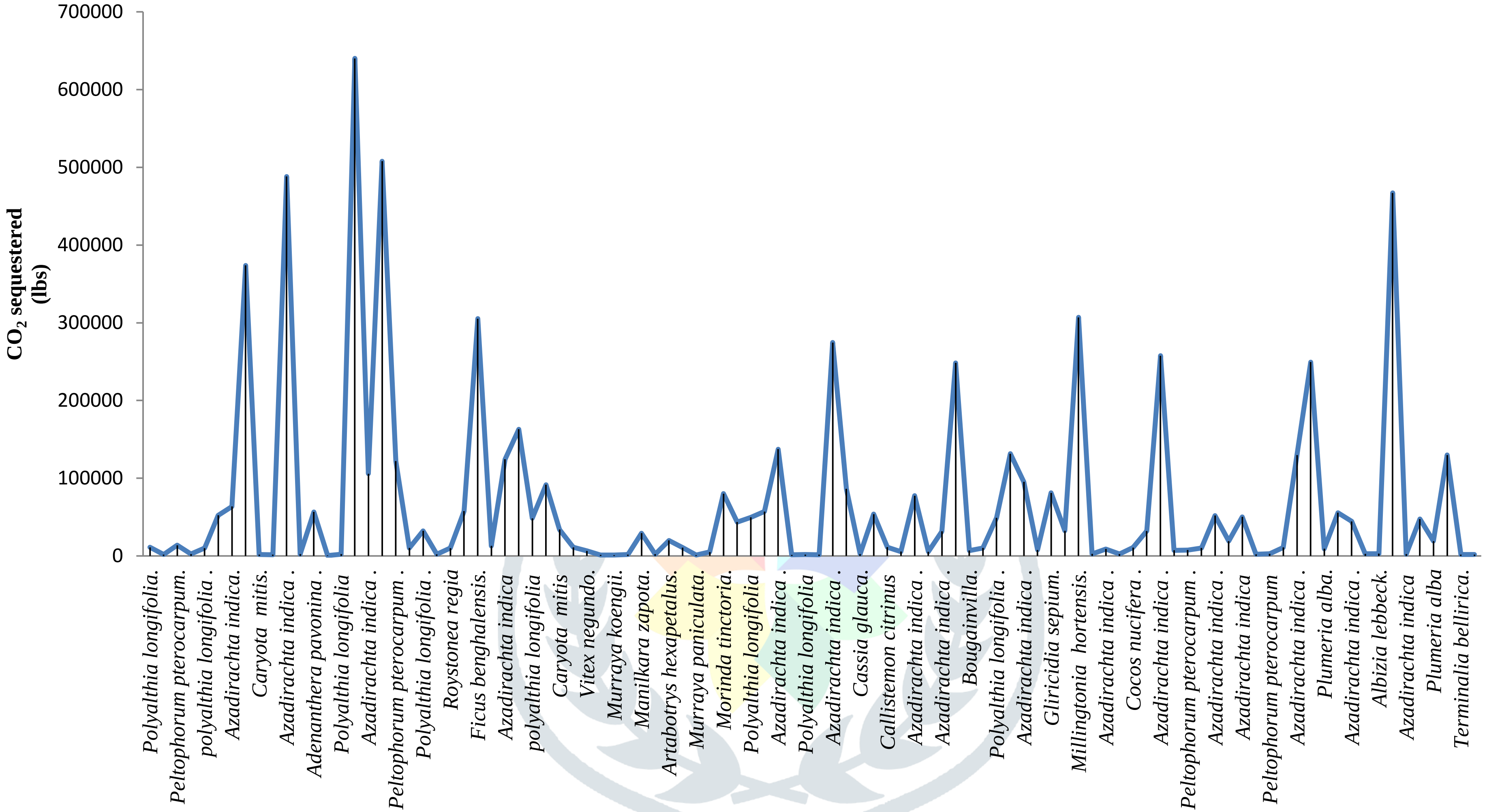

Fig. 3. Carbon stock sequestered by the tree species enumerated from the study area

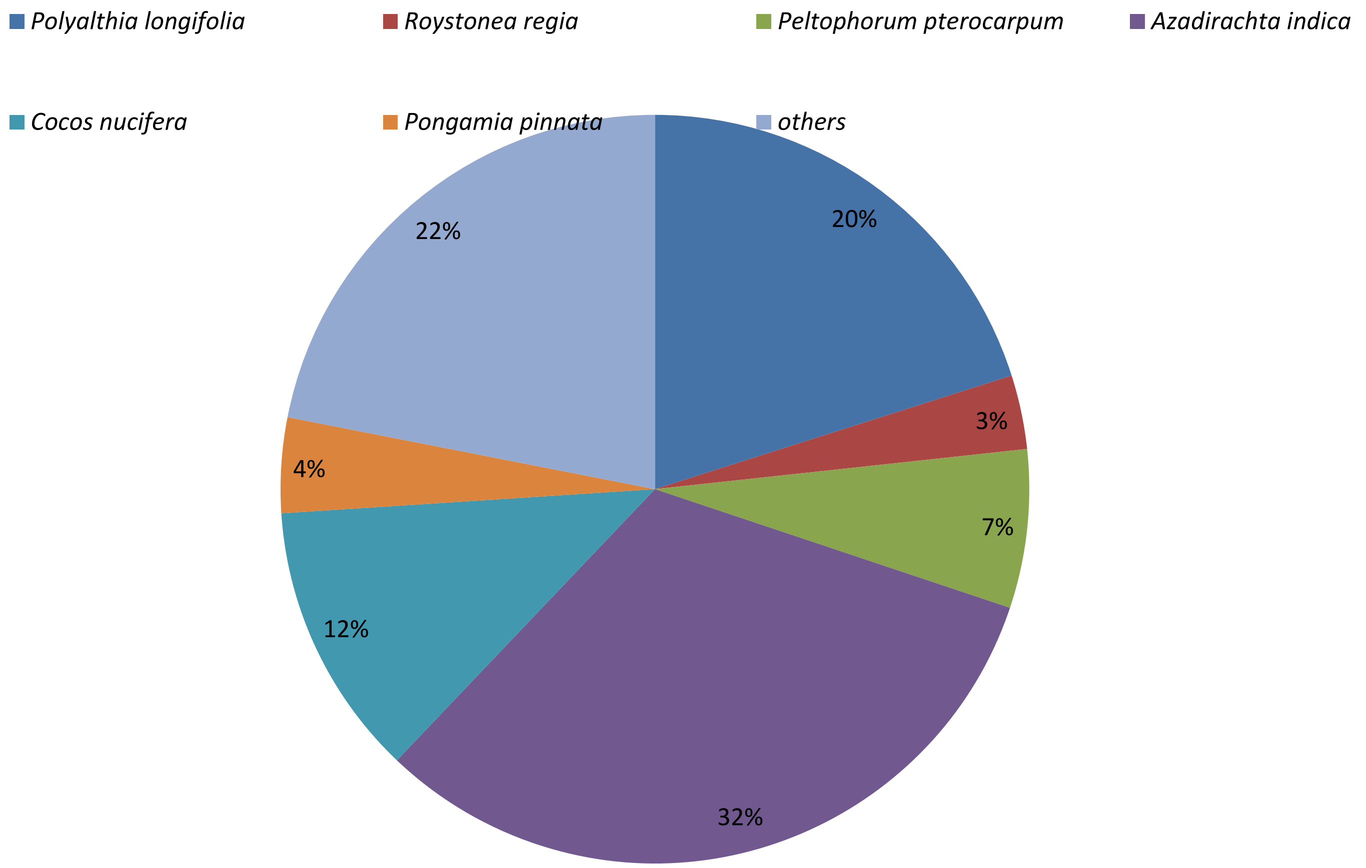

Fig. 1. Percentage of representation of dominant trees in the study area

Summary and conclusion

Trees play crucial roles in reduction of the atmospheric carbon dioxide levels. In thepresent research work calculation of AGB, Total green weight, dry weight, carbon and carbon dioxide sequestration potential rate often tree species was done by nondestructive method. Scales and measuring tapes were used to measure the biophysical characters. Wood densities were obtained from the World Agroforestry Centre for the measurement of carbon sequestered by trees. Carbon stock was determined for 219tree species inside the St. Mary's College campus of Thoothukudi city. The dominant trees in the campus are *Polyalthia longifolia*, *Azadirachtaindica* and *Cocosnucifera*. Results showed that *Azadirachtaindica* has the better carbon sequestration potential rate which sequestered 686454.5 lbs of CO_2 whereas *Murraya koenigii* has the least sequestration rate which sequestered 1006.61 lbs of CO_2 as compared to other species. More field measurements are needed in urban regions to help improve carbon accounting and other functions of urban forest ecosystems. Before applying the approach of urban tree management, quantification of organic carbon in the urban region by nondestructive method will be helpful.

To rescue the world from global warming and climatic change, the sustainable management of trees with the objectives of carbon sequestration is mandatory. The present study will unbolt a new arena in the aspect of trees management in colleges and also in different parts of the world. Thoothukudi city is one of the ever-burgeoning cities of India. Destruction of more than 100 years old trees for broadening of roads, construction of new buildings are evident. This adds to the glowing global warming in the city,institutions like St. Mary's college harbouring tree plantations are the "GREEN LUNGS" of the city.

References

Akbari, H., Pomerantz, M., & Taha, H., 2001 "*Cool surfaces and shade trees to reduce energy use and improve air quality in urban areas," Journal of Solar Energy,* 70(3), pp. 295-310.

Brown, S. and Lugo.A.E, 1997. *The storage and production of organic matter in tropical forests and their role in the global carbon cycle*. Biotropica 14: 161-187.

Cannell, M. 1995. *Forest and the Global Carbon Cycle in the Past, Present and Future*. European Forest Institute Report No: 2, Finland.

Chavan B.L and G.B Rasal, 2010. Sequestered standing carbon stock in selective tree species grown in University campus at Aurangabad, Maharashtra, India. *International Journal of Engineering Science and Technology Vol. 2(7), 3003-3007.*

Dixon, R.K., Brown, S., Houghton, R.A., Solomon, A.M., Trexler, M.C. and Wisniewski, J., 1994. *Carbon poolsand flux of global forest ecosystems*. Science263, pp. 185–190.

Dwivedi, P., C. S. Rathore and Y. Dubey. 2009. *Ecological benefits of urban forestry:* Bhopal, India. Applied Geography 29(2): 194-200.

Hangarge L. M., D. K. Kulkarni, V. B. Gaikwad, D. M. Mahajan and Nisha Chaudhari,2012, *"Carbon Sequestration potential of tree species in Somjaichi Rai (Sacred grove) at Nandghur village, in Bhor region of Pune District, Maharashtra State, India,"* Annals of Biological Research, 3(7), pp. 3426-3429.

Henry, M., Picard, N., Trotta, C., Manlay, R. J., Valentini, R., Bernoux, M., & Saint-André, L, 2011. *"Estimating Tree Biomass of Sub-Saharan African Forests: A Review of Available Allometric Equations",* Silva Fennica, 45(3B), 477-569.

HGoldbrg, Philip; Zhong-Ying chen; O'Connor, William; Walters , Richard; Ziock ans 1998*." CO2 Mineral Sequestration Studies in US" (PDF).*National Energy Technology Laboratory . Retrived 2009.

Ketterings Q.M., Coe R., Noordwijk M.V., Ambagau Y., Palm C.A., 2001. *"Reducing uncertainty in the use of allometric biomass equations for predicting above-ground tree biomass in mixed secondary forests*, " Forest Ecology and Management, 146, pp. 199–209.

MacDicken, K.G., 1997, *A guide to monitoring carbon storage in forestry and agro forestry projects USA, Winrock International Institute for Agricultural development*, pp 19-99.

Niranjana K.S and Viswanath.S. 2005. APANews - *The Asia-Pacific Agroforestry Newsletter*.

Nowak DJ, Crane DE 2002. *Carbon storage and sequestration by urban trees in the USA.* Environ Pollut 116(3):381–389.

Nowak, D.J. 2010. Urban biodiversity and climate change. In: Muller, N., Werner, P., Kelcey, J.G. (Eds.), *Urban Biodiversity and Design. Wiley-Blackwell Publishing,* Hoboken, NJ, pp. 101-117.

Pandya I. Y, Salvi H, Chahar O and Vaghela N, 2013. "*Quantitative Analysis on Carbon Storage of 25 Valuable Tree Species of Gujarat, Incredible India,"* Indian J.Sci.Res., 4(1), pp. 137-141.

Parry M. L., O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., "*Climate Change 2006: Impacts, Adaptation and Vulnerability", Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, Cambridge, UK, 982pp

Pearson TRH, Brown S., and Ravindranath N. H.,"*Integrating carbon benefits estimates into GEFProjects*",pp.1-56,2005.Pollution116:381-389,

Richter , D.D., D. Markewitz, J.K. Dunsomb, C.G. Wells, A. Stuanes, H.L. Allen, B. Ureego, K. Harrison & G.Bonani. 1995. Carbon cycling in a loblobby pine forest: Implication for the missing carbon sink and for the concept of soil. pp. 223-251. *Carbon Forms and Function inForest Soils*.

Schroeder, P. 1992. *Carbon storage potential of shortrotation tropical tree plantations. Forest EcologyandManagement* .

Waran A and Patwardhan A, 2001. "*Urban carbon burden of Pune City : A case study from India," Masters thesis* submitted to University of Pune .

Warran. A and Patwardhan. A, 2005, Carbon sequestration potential in and around Pune city; RANWA, C-26/1; Ketan Heights, Kothrud, Pune, 411038, India.

Westlake, D.F. 1963. *Comparisons of plant productivity*. Biol. Rev. 38:385-425.

Wilcox, M. C., 2012. *Auckland's Remarkable Urban Forest* . ,Epsom, Auckland 1344, New Zealand: Auckland Botanical Society Inc.

Zhao M, Escobedo F, Staudhammer, 2010. *Spatial patterns of a subtropical, coastal urban forest: implications for land tenure, hurricanes and invasives. Urban For Urban Green*. doi: 10.10.