Department of Botany,

St Xavier's College (Autonomous), Mumbai

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CERTIFICATE

This is to certify that the project on 'Carbon sequestration by urban trees in Dadar Parsee colony, Dadar (East)' has been successfully completed by Ms. Ena Taukir Ahmed Shaikh of Botany M.Sc. Part II, UIDNo 188318 during the academic year 2019-20

Project Guide

Head, Dept of Botany

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ST. XAVIER'S COLLEGE
(AUTONOMOUS)
MUMBAI - 400 001.

<u>DISSERTATION</u>

CARBON SEQUESTRATION BY URBAN TREES IN DADAR PARSEE COLONY, DADAR (EAST).

SUBMITTED BY

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M.Sc. Part – II (SEM 10) BOTANY

UID No. – 188318

(ANGIOSPERM TAXONOMY AND PHYTOCHEMISTRY)

UNDER THE GUIDANCE

OF

MR. SAIF Y. KHAN

DEPARTMENT OF BOTANY

ST. XAVIER'S COLLEGE (AUTONOMOUS)

2019-2020

ST. XAVIER'S COLLEGE, MUMBAI

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This is to certify that Ms. ENA TAUKIR AHMED SHAIKH, student of M.Sc. Part- II Semester X Botany (Angiosperm Taxonomy and Phytochemistry), St. Xavier's College (Autonomous) with UID No. 188318 has completed her research project on "**CARBON SEQUESTRATION BY URBAN TREES IN DADAR PARSEE COLONY, DADAR (EAST)"** in the academic year 2019-2020

Mr. Saif Khan	External Examiner	Mr. Alok Gude
Project guide		Head of Department.

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INDEX

CARBON SEQUESTRATION BY URBAN TREES IN DADAR PARSEE COLONY, DADAR (EAST)

Abstract :

The effect of greenhouse gases is hazardous. Carbon dioxide is one of the major greenhouse gas emission, resulting mainly from vehicular combustion and other urban developmental activities.Trees in urban areas act as a carbon sink by sequestering carbon during the process of photosynthesis. The girth of trees was taken into consideration for the measurement of standing biomass and carbon content which was estimated by the non destructive method. Our own findings suggest that 506.17 tons/hectare carbon is sequestered by 452 trees planted alongside roads in the Dadar Parsee colony, Mumbai. Species distribution and girth size are important parameters in determining the amount of stored carbon, which can be helpful in the urban planning for reducing the amount of carbon content in the atmosphere.

Key words : Carbon sequestration, Climate change, Carbon storage, Urban planning

Introduction:

Trees in cities and parks not only beautify the area but when planted alongside roads, the standing stock acts as carbon sink which absorbs carbon dioxide mainly from vehicular exhausts and thus helps in reducing air pollution by improving the air quality. As trees grow and their biomass increases, they absorb carbon from the atmosphere and store it in the plant tissues (Mathews *et al*., 2000). Park ecosystems in urban areas offers open spaces with high tree densities having a significant impact on the air quality for local residents (Nowak *et al.,* 2010). Tree canopies provide a cooling effect on microclimate directly by shading the ground surface and indirectly by transpiration (Scott *et al*.; 1999).

Air pollution has negative impact on human health and has damaging effects on plant tissues particularly foliage, which impair its ability of photosynthesis and predisposing them to further damage by insects and disease[1]. It is therefore important to implement a proper urban forest management policies, tree selection, and a success of urban tree planting programs.

The above relevant fact has brought need of evaluating the green cover in urban ecosystems. In this context, the present study was undertaken in the Dadar Parsee Colony, in midtown South Mumbai. The area lies between 19.0203°N to 72.8538°E in the F North ward of Brihanmumbai Municipal Corporation. The trees planted alongside roads and in Five Gardens are included under study.

Literature Review

- Carbon storage and sequestration by urban trees in the United States was quantified to assess magnitude and the role of urban forests in relation to climate change in a research paper submitted by David J Novak, Eric J Greenfield and Elizabeth lapoint

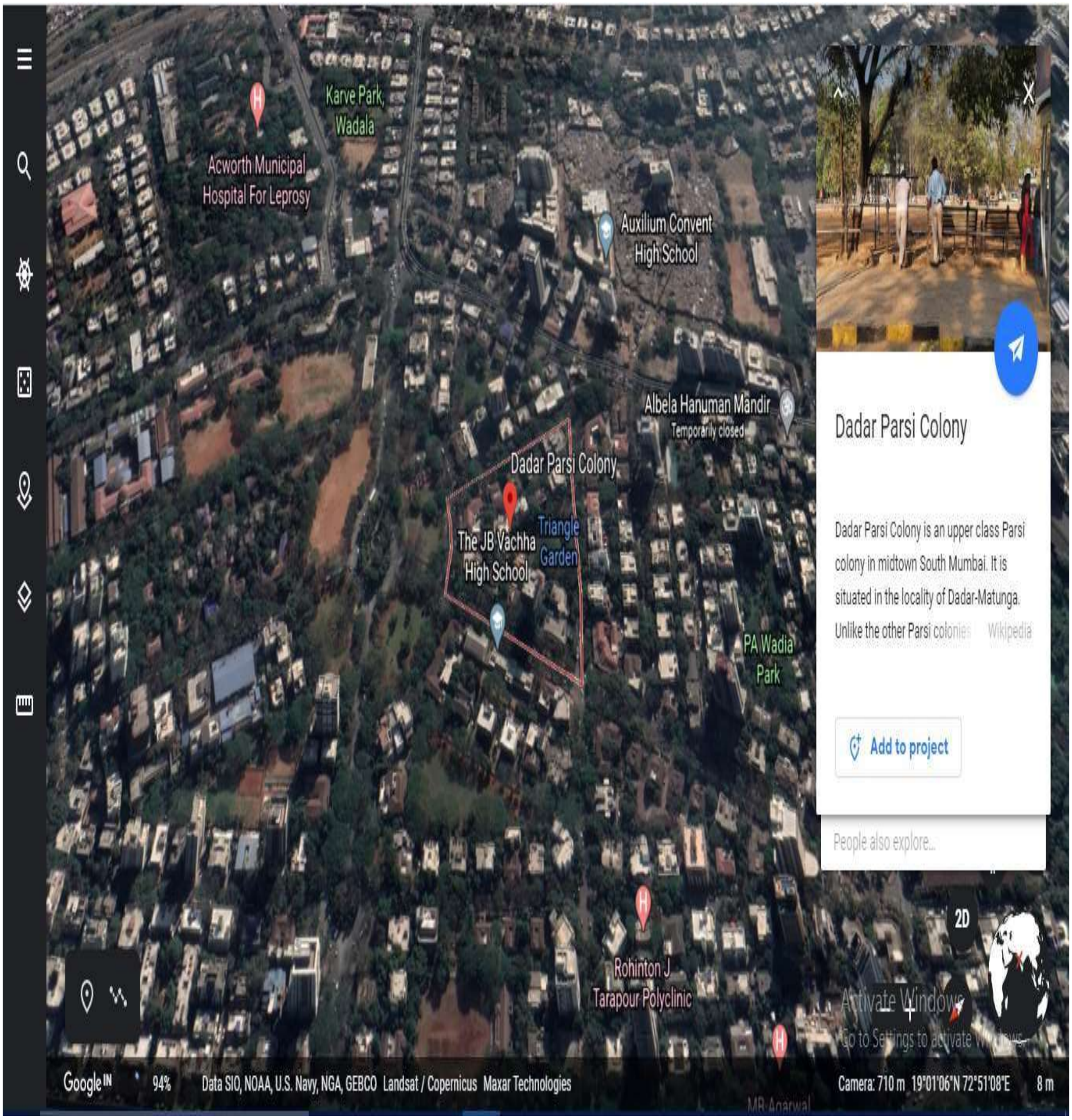
- Urban forests can play an important role in mitigating the impacts of climate change by atmospheric carbon dioxide. Quantification of carbon storage and sequestration by urban forests is critical for the assessment of the actual and potential role of urban forests in reducing atmospheric carbon dioxide. Their paper provides a case study of the quantification of carbon storage and sequestration by urban forests submitted by Changfu Liu, Xioma Li.

- Meenakshi Kaul, G M J Mohren and V K Dadhwa in their paper accounted for mitigation of carbon dioxide emission in a long term.

- Murari Lal and Roma Singh in their study described about the forest cover has potential to absorb carbon and emphasized on increasing the area of tree plantation in order to expect forest to continue to act as a carbon sink in the future

- G Sandhya Kiran and Shah Kinnary in their study covered the trees planted alongside roads in the Vadodora city of Gujarat, they found out the amount of carbon stored by the trees and comparing it with the total CO_2 emitted from the vehicular exhaust. The paper also highlights the idea of urban tree management and the importance of tree plantation on roadsides could be an effective method of offsetting carbon dioxide from human sources

- B. L. Chavan and G. B. Rasal studied the total carbon sequestered in trees on the campus of Dr. B. A. M. University, Aurangabad. The tree height and girth are taken into consideration for the measurement of biomass and carbon content which was determined by Allometric model, the study revealed that Allometric model based on a theoretical model can be successfully used to determine the tree biomass by the non destructive method.



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Acworth Municipal Hospital For Leprosy
Auxilium Convent High School
Albela Hanuman Mandir
Temporarily closed
Dadar Parsi Colony
The JB Vachha High School
Triangle Garden
PA Wadia Park
Rohinton J Tarapour Polyclinic
Dadar Parsi Colony
Dadar Parsi Colony is an upper class Parsi colony in midtown South Mumbai. It is situated in the locality of Dadar-Matunga. Unlike the other Parsi colonies Wikipedia
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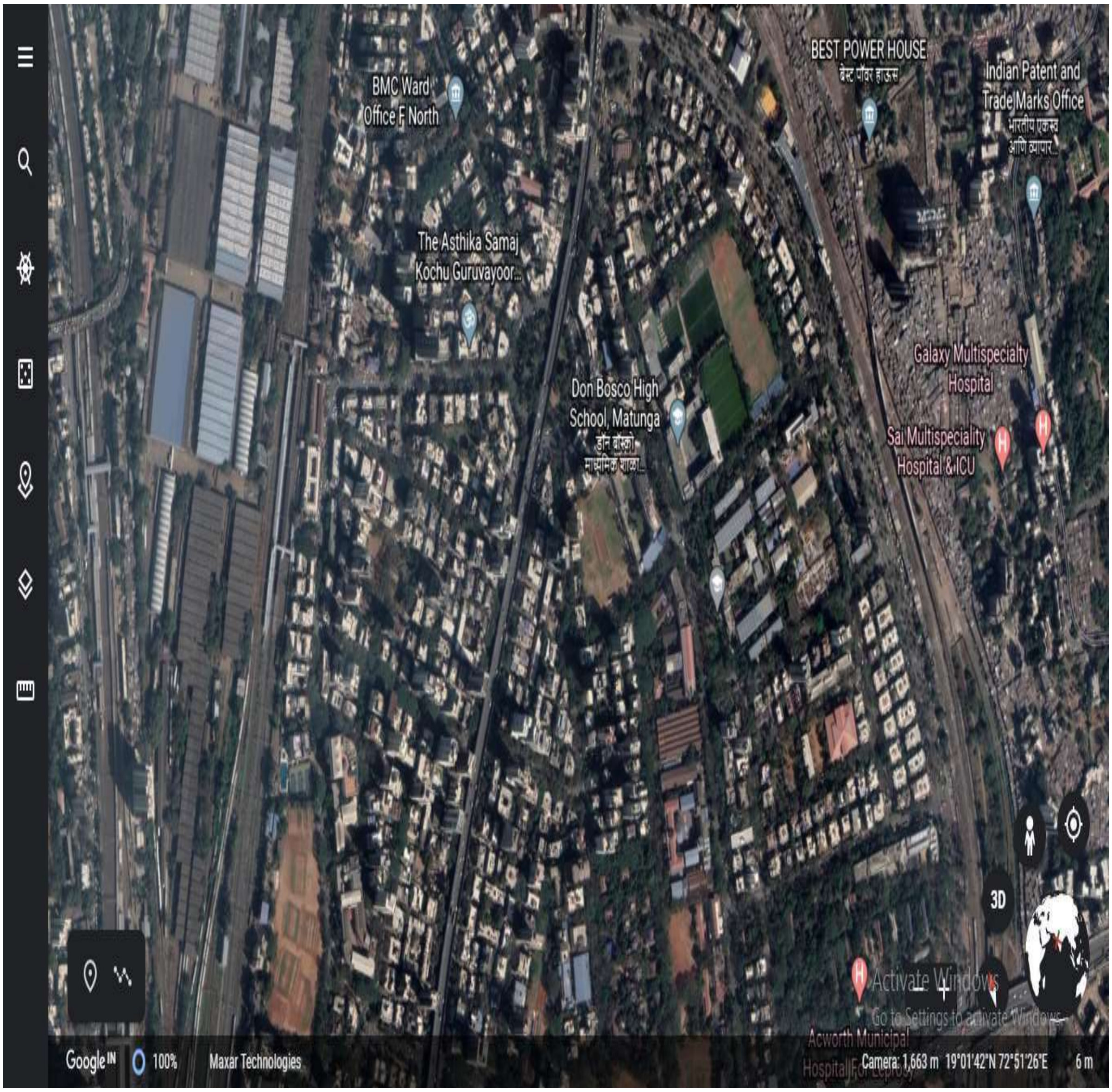

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AIM AND HYPOTHESIS :

- To provide a scientific communication to mitigate climate change due to high CO_2 emissions
- To examine the carbon content absorbed by trees
- To identify trees taxonomically in order to determine the potential of trees for carbon uptake
- To highlight the importance of urban forest planning, tree selection and tree plantation programs to mitigate the hazardous effect of greenhouse gases.
- To highlight the need of reducing carbon footprint in order to combat climate change.

Materials and Method :

1. The area of study was selected
2. Taxonomic Identification of trees was done by taking significant morphological characters into consideration.
3. The measurement of the amount of carbon has been carried out and this was based on the amount of standing woody biomass of trees on the roadsides of the area under study
4. The measurements of Girth breast height GBH (cm) and Basal Area (m^2) for different trees were taken (Yadava and Supriya, 2006)
5. Based on these values Standing Woody Biomass SWB (T/ha) (Abraham *et al*., 2005) and Carbon sequestration rate of trees (T/ha) (Negi *et al*., 2003) were calculated.
6. Based on the carbon sequestration values of these trees, species of trees having higher capability of carbon sequestration were determined.

Different equation used were

1. Basal Area (m2) = $(GBH/2\pi)^2 * \pi$

2. Standing Woody Biomass (ton/ha) = -1.689+8.32*BA

3.Carbon Sequestration= 0.46*SWB

OBSERVATION TABLE :

1. Checklist of trees at Mancherji Joshi Road

Sr.no	Scientific name of trees	Family	No. of trees	Carbon Sequestration T/ha
1	*Albizia julibrissin*	Fabaceae	3	1.136
2	*Melia azedarach*	Meliaceae	4	16.44
3	*Sterculia fetida*	Sterculiaceae	8	5.729
4	*Sterculia alata*	Sterculiaceae	2	5.614
5	*Tamarindus indica*	Caesalpiniaceae	1	2.500
6	*Ficus sycomorous*	Moraceae	1	5.407
7	*Adenanthera pavonia*	Fabaceae	1	3.333
8	*Delonix regia*	Fabaceae	1	4.657
9	*Leucaena leucophala*	Fabaceae	1	0.111
10	*Putranjiva roxburghii*	Putranjivaceae	2	1.266
11	*Peltophorum pterocarpum*	Fabaceae	37	7.07

12	*Swietenia macrophylla*	Meliaceae	2	2.621
		TOTAL :	63	55.88

2. Checklist of trees at Jaame Jamshed Marg

Sr. no	Scientific Name of Trees	Family	Total no. Of trees	Carbon Sequestration (T/ha)
1	*Peltophorum pterocarpum*	Fabaceae	31	4.822
2	*Thespesia populnea*	Malvaceae	3	3.841
3	*Couroupita guianensis*	Lecythidaceae	1	10.736
4	*Senna siamea*	Fabaceae	1	2.440
5	*Polyalthia longifolia*	Annonaceae	19	4.024
6	*Adenanthera pavonia*	Fabaceae	2	6.558
7	*Sterculia fetida*	Sterculiaceae	6	3.984
8	*Artocarpous heterophyllus*	Moraceae	2	0.724
9	*Phoenix sylvestris*	Arecaceae	2	1.843
10	*Fernandoa adenophylla*	Bignoniaceae	1	1.383
11	*Putranjiva roxburgii*	Putranjivaceae	1	3.505
		TOTAL :	69	43.86

3. Checklist of trees at A. B Homavazir Road

Sr. No	Scientific Name of trees	Family	No. of Trees	Carbon Sequestration (T/ha)
1	*Peltophorum pterocarpum*	Fabaceae	1	2.070
2	*Kigelia africana*	Bignoniaceae	8	8.150
3	*Millingtonia hortensis*	Bignoniaceae	1	2.890
4	*Azadirachta indica*	Meliaceae	1	0.750
5	*Ficus hispida*	Moraceae	1	0.647
6	*Thespesia populnea*	Malvaceae	2	0.672
		TOTAL :	14	15.179

4. Checklist of trees at Khareghat Road.

Sr. no	Scientific Names of trees	Family	No. of Trees	Carbon Sequestration (T/ha)
1	*Peltophorum pterocarpum*	Fabaceae	16	4.859
2	*Senna siamea*	Fabaceae	1	0.862
3	*Terminalia catappa*	Combretaceae	1	0.622
4	*Kleinhovia hospita*	Malvaceae	15	5.570
		TOTAL:	33	11.913

5. Checklist of trees at Parsee Colony Road Number 4.

Sr. no	Scientific Names of trees	Family	No. of Trees	Carbon Sequestration (T/ha)
1	*Samanea saman*	Mimosaceae	1	23.30
2	*Peltophorum pterocarpum*	Fabaceae	10	3.831
3	*Neolamarkia cadamba*	Rubiaceae	1	1.456
4	*Albizia lebbeck*	Mimosaceae	1	3.221
5	*Thespesia populnea*	Malvaceae	1	2.026
6	*Spathodea campanulata*	Bignoniaceae	1	1.571
7	*Tamarindus indica*	Caesalpiniaceae	1	7.330
		TOTAL :	15	42.735

6. Checklist of trees at Dinshaw Master Road.

Sr. no	Scientific Names of trees	Family	No. of Trees	Carbon Sequestration (T/ha)
1	*Senna siamea*	Fabaceae	20	4.660
2	*Peltophorum pterocarpum*	Fabaceae	11	7.08
3	*Cassia fistula*	Fabaceae	3	4.96
4	*Thespesia populnea*	Malvaceae	1	10.55
5	*Sterculia fetida*	Sterculiaceae	1	3.16
		TOTAL :	36	30.410

7. Checklist of trees at Lady Jehangir Road.

Sr. no	Scientific Names of trees	Family	No. of Trees	Carbon Sequestration (T/ha)
1	*Putranjiva roxburghii*	Putranjivaceae	6	4.150
2	*Peltophorum pterocarpum*	Fabaceae	11	4.006
3	*Delonix regia*	Fabaceae	12	4.593
4	*Saraca asoca*	Fabaceae	1	0.950
5	*Sterculia fetida*	Sterculiaceae	1	4.428
6	*Robinia pseudoacacia*	Fabaceae	1	10.55
7	*Senna siamea*	Fabaceae	1	4.046
		TOTAL :	33	32.723

8. Checklist of trees at Rustom Tirandaz Park.

Sr. no	Scientific Names of trees	Family	No. of Trees	Carbon Sequestration (T/ha)
1	*Delonix regia*	Fabaceae	5	5.661
2	*Roystonea regia*	Arecaceae	1	4.046
3	*Samanea saman*	Mimosaceae	2	11.798
4	*Kigelia africana*	Bignoniaceae	1	1.297
5	*Livinstona chinensis*	Arecaceae	1	4.693
		TOTAL :	10	27.49

9. Checklist of trees at Five Garden no. 1

Sr. no	Scientific Names of trees	Family	No. of Trees	Carbon Sequestration (T/ha)
1	*Putranjiva roxburghii*	Putranjivaceae	4	2.589
2	*Peltophorum pterocarpum*	Fabaceae	8	2.633
3	*Sterculia fetida*	Sterculiaceae	6	2.801
4	*Kigelia africana*	Bignoniaceae	2	2.115
5	*Thespesia populnea*	Malvaceae	4	2.690
6	*Roystonea regia*	Arecaceae	2	1.408
7	*Azadirachta indica*	Meliaceae	3	1.370
		TOTAL :	29	16.976

10. Checklist of trees at Five Garden no. 2

Sr. no	Scientific Names of trees	Family	No. of Trees	Carbon Sequestration (T/ha)
1	*Senna siamea*	Fabaceae	1	3.651
2	*Cocos nucifera*	Arecaceae	6	2.694
3	*Peltophorum pterocarpum*	Fabaceae	8	2.364
4	*Samanea saman*	Mimosaceae	5	17.169
5	*Polyalthia longifolia*	Annonaceae	2	1.833
6	*Artocarpous heterophyllus*	Moraceae	2	2.923
7	*Syzygium cumini*	Mytraceae	3	1.596
8	*Putranjiva roxburghii*	Putranjivaceae	1	4.046
9	*Ficus elastica*	Moraceae	1	1.107
10	*Sterculia fetida*	Serculiaceae	1	1.729
11	*Araucaria columnaris*	Araucariaceae	1	0.672
12	*Ficus religiosa*	Moraceae	1	26.87
		TOTAL :	32	70.70

11. Checklist of trees at Five Garden no. 3

Sr. no	Scientific Names of trees	Family	No. of Trees	Carbon Sequestration (T/ha)
1	*Senna siamea*	Fabaceae	5	2.25
2	*Peltophorum pterocarpum*	Fabaceae	10	3.675
3	*Tamarindus indica*	Fabaceae	8	1.907
4	*Ficus religiosa*	Moraceae	2	4.36
5	*Ceiba pentandra*	Malvaceae	1	5.139
6	*Sterculia fetida*	Sterculiaceae	6	2.264
7	*Polyalthia longifolia*	Annonaceae	9	0.570
8	*Thevetia cascabela*	Apocynaceae	1	0.622
9	*Lagerstroemia speciosa*	Lythraceae	4	1.610
10	*Crataeva religiosa*	Capparidaceae	1	0.670
11	*Ficus altissima*	Moraceae	2	12.66
12	*Ficus benghalensis*	Moraceae	1	31.03
13	*Thespesia populnea*	Malvaceae	4	2.690
14	*Aegle marmelos*	Rutaceae	1	0.647
15	*Tabebuia rosea*	Bignoniaceae	1	2.792
16	*Ficus racemosa*	Moraceae	2	0.805

17	*Samanea saman*	Mimosaceae	3	14.28
18	*Putranjiva roxburghii*	Putranjivaceae	3	2.491
		TOTAL :	64	90.662

12. Checklist of trees at Five Garden no 4.

Sr. no	Scientific Names of trees	Family	No. of Trees	Carbon Sequestration (T/ha)
1	*Sterculia fetida*	Sterculiaceae	3	1.370
2	*Samanea saman*	Mimosaceae	4	6.610
3	*Diospyros malabarica*	Eebenaceae	2	13.33
4	*Tabebuia rosea*	Bignoniaceae	1	11.673
5	*Cassia fistula*	Fabaceae	3	1.137
6	*Senna siamea*	Fabaceae	1	4.04
7	*Polyalthia longifolia*	Annonaceae	3	1.252
8	*Ziziphus jujuba*	Rhamnaceae	1	2.252
		TOTAL :	18	41.664

13. Checklist of trees at Five Garden no. 5

Sr. no	Scientific Names of trees	Family	No. of Trees	Carbon Sequestration (T/ha)
1	*Tabebuia rosea*	Bignoniaceae	9	1.880
2	*Putranjiva roxburghii*	Putranjivaceae	3	2.299
3	*Polyalthia longifolia*	Annonaceae	11	1.343
4	*Artocarpus heterophylus*	Moraceae	1	0.672
5	*Pithecellobium dulce*	Fabaceae	1	1.043
6	*Casuarina equisetifolia*	Casuarinaceae	1	0.740
7	*Roystonea regia*	Arecaceae	8	5.05
8	*Ficus religiosa*	Moraceae	1	12.121
9	*Mangifera indica*	Anacardiaceae	1	1.130
		TOTAL :	36	25.978

RESULTS AND DISCUSSION

Trees sequester atmospheric carbon through their growth process and conserve energy in urban areas, is one of the effective method to combat increasing levels of atmospheric carbon (David J Nowak 1993).Besides directly storing carbon, urban trees also reduce carbon dioxide emissions particularly, from the vehicular exhausts by cooling ambient air and allowing residents to minimize annual heating and cooling (Nowak *et al.,* 1991). In the past few years with increasing urban developmental activities, there has been an increase in the levels of atmospheric carbon dioxide. (Parikh *et al.*, 1994) reported that Carbon emissions are much higher in urban, consumerist societies than rural, and biomass dependent landscapes. Nowak, 2002 has brought out that Carbon sequestration is not only related to the increased proportion of large and healthy trees in the population. It is therefore significant to understand how much carbon can be stored and sequestered by the roadside trees and park ecosystems in residential areas. This paper addresses this concern at multiple scales by estimating that some tree species sequester more carbon than others, roads with similar number of species shows variation in the amount of carbon sequestrated (Table 1) and the importance of tree species selection for urban tree plantation programs to combat climate change.

Air quality crisis in cities is mainly due to vehicular emissions (Ghose *et al.,* 2004).The trees planted on the roadsides of study area attributes its carbon source from such vehicular emissions. The contribution of emission of each type when taken into consideration shows that the present tree population in the Dadar Parsee Colony contributes only 0.12% annually in reducing carbon pollution due to vehicles of the entire Mumbai City (Table 2)

Table 1: Total CO_2 sequestered from the park and roadsides of Dadar Parsee Colony, Dadar East, Mumbai

Sr. no	Name of Road	Total Number of trees	Total CO_2 Sequestered (ton/hectares)
1	Mancherji Joshi Road	63	55.88
2	Jame Jamshedji Road	69	43.86
3	A B Homavazir Road	14	15.179
4	Khareghat Road	33	11.913
5	Parsee Colony Road No. 4	15	42.735
6	Dinshaw Master Road	36	30.410
7	Lady Jehangir Road	33	32.723
8	Rustom Tirandaz Park	10	27.49
9	Five Garden No. 1	29	16.976
10	Five Garden No. 2	32	70.7
11	Five Garden No. 3	64	90.662
12	Five Garden No. 4	18	41.664
13	Five Garden No. 5	36	25.978
		Total : 452	Total : 506.17

Table 2 : Emission Load For Mumbai City. (NEERI Air Quality Assessement, Emission Inventory & Source Apportionment Studies: Mumbai)

	CO (tons/year)
VEHICLES	
2 Wheelers	3303.2
Taxies	778.6
Total	4081.8

It is important to reduce carbon pollution by increasing tree plantations in urban areas to maintain carbon cycle. Since Mumbai is one of the densely populated city, effective tree plantation programs are needed to increase green cover in the available area. Maintaining park ecosystem by wise selection of trees in such cases if done precisely, i.e by looking at the development of their girth size, ability to resist pollution and potential to sequester carbon can be planted for environmental and health benefits. According to the present study, the tree species recommended to be planted on roadsides are Neem (*Azadirachta indica*), Indian laburnum (*Cassia fistula, C. siamea*), Gulmohar (*Delonix regia*), Monkey pod tree (*Samanea saman*), Sacred fig (*Ficus religiosa*), Banyan (*Ficus benghalensis*), Malabar ebony (*Diospyros malabarica*) has shown higher carbon sequestration rates and are more suitable for urban environment.

CONCLUSIONS

Urban areas are densely populated and therefore have higher levels of pollutions. As demonstrated in this study, Trees planted on roadsides and in the park will continue to curb the carbon pollution and improve air quality in this region. It is significant to maintain parks and plant more healthy trees on the roadsides in urban areas to maximize the amount of carbon sequestration, thus mitigating the harmful effects of greenhouse gases.

FUTURE PROSPECTS OF THE STUDY

1. The area of study can be increased in order to survey the type and number of trees and their ability to sequester carbon.
2. Tree plantation programs can be implemented with species having greater potential to improve air quality on the roadsides to mitigate the hazardous effects of air pollution
3. More studies has to be done to study emission sources and air quality of a particular area and accordingly implement measure to curb its harmful consequences
4. It is important to raise awareness of air pollution and a financial app that reduces the carbon footprint of consumers, a number of developmental programs to be focused on climate change mitigation, including the reduction of emissions from energy consumption. These initiatives can contribute to achieve the Sustainable Development Goals.
5. The aim of improving inner-city air quality can be achieved by raising the profile of alternative energy solutions and increasing the uptake of electric vehicles in urban areas.

REFERENCES

1. Oswalt, M. & Clatterbuck, K.(2005).Impact of Air pollution on the Urban Forests. UT Extension,(pp. 1-5). Retreived from https://extension.tennessee.edu
2. Nowak, D. J. (1993). Atmospheric Carbon Reduction by Urban Trees. Journal of Environmental Management, 37(3), 207-217. doi:10.1006/jema.1993.1017
3. Ghose, M. K., Paul, R., & Banerjee, S. (2004). Assessment of the impacts of vehicular emissions on urban air quality and its management in Indian context: The case of Kolkata (Calcutta). Environmental Science & Policy, 7(4), 345-351. doi:10.1016/j.envsci.2004.05.004
4. Negi, J.D.S., Manhas, R.K., Chauhan, P.S. (2003), Carbon allocation in different components of some tree species of India: A New Approach for Carbon Estimation. Current Science. 85 (11):1528-1531
5. D.J. Nowak, and R.A.Rowntree (Eds). Chicago's Urban Forest Ecosystem: Results of the Chicago Urban Forest Climate Project, General Technical Report NE-186. USDA Forest Service, Northeastern Forest Experiment Station, Radnor, PA
6. Nowak. D., Crane. N. (2002), Carbon storage and sequestration by urban trees in the USA. Environmental Pollution. 116:381–389.

7. Scott, K.I., J.R. Simpson, and E.G. McPherson. 1999. Effects of tree cover on parking lot microclimate and vehicle emissions. J.Arboric. 25:129–142
8. Wallace, J., et.al. (2009) Mobile monitoring of air pollution in cities: the case of Hamilton, Ontario,Canada. Journal of Environmental Monitoring. 11: 998–1003.
9. Yadava, P.S. and Supriya Devi, L. (2006), In Floristic diversity assessment and vegetation analysis of tropical semi evergreen forest of Manipur, north east India. Tropical Ecology. 47(1):89-95.

10. Liu, C., & Li, X. (2012). Carbon storage and sequestration by urban forests in Shenyang, China. Urban Forestry & Urban Greening, 11(2), 121-128. doi: 10.1016/j.ufug.2011.03.002
11. Kaul, M., Mohren, G., & Dadhwal, V. (2010). Carbon storage and sequestration potential of selected tree species in India. Mitigation And Adaptation Strategies For Global Change, 15(5), 489-510. doi: 10.1007/s11027-010-9230-5
12. Lal, M., & Singh, R. (2000). Environmental Monitoring And Assessment, 60(3), 315-327. https://doi.org/10.1023/a:1006139418804
13. Chavan, Balbhim & Rasal, Ganesh. (2010). Sequestered standing carbon stock in selective tree species grown in

University campus at Aurangabad, Maharashtra, India. International Journal of Engineering Science and Technology. 2.

14. Sandhya, G & Garge, Sandhya & Kinnary, Shah. (2011). Carbon sequestration by urban trees on roadsides of Vadodara city. International Journal of Engineering Science and Technology. 3.

15. Jyoti Parikh, Economic and Political Weekly Vol. 29, No. 45/46 (Nov. 5-12, 1994), pp. 2940-2943

16. Ghose, M., Paul, R., & Banerjee, S. (2004). Assessment of the impacts of vehicular emissions on urban air quality and its management in Indian context: the case of Kolkata (Calcutta). Environmental Science & Policy, 7(4), 345-351. doi: 10.1016/j.envsci.2004.05.004

17. Air Quality Assessment, Emissions Inventory and Source Apportionment Studies : Mumbai. (2010). Retrieved 16 May 2020, from http://ecmpcb.in

18. "Dadar Parsi Colony to stay 'exclusive'". The Times of India. 24 December 2009. Retrieved 14 May 2020.