A COMPARATIVE STUDY ON CARBON STORAGE OF VARIOUS TREE SPECIES FOUND IN SURAT CITY

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ABSTRACT: *Worldwide, we are losing many valuable trees each year due to climate change, population, industrialization. Since carbon sequestration is an emerging topic which involves carbon capture and the long term storage of atmospheric carbon which helps in mitigation of increasing emission of carbon into the atmosphere, as trees are the best carbon sinks to use CO_2 by the process of photosynthesis. The present study was done on various locations of Surat city to estimate the amount of carbon stock in various plants species. In this study a total 16 tree species were taken in the study area and were compared for their carbon storage. Total biomass and carbon stored in various tree species were estimated using a non-destructive method. The diameter and tree height was measured by GBH meter and laser range finder to calculate carbon storage. The maximum carbon stock was present at Girth Breast Height (GBH) i.e 200-300 cm forFicus benghalensis and Pithecellobium dulce. These plant species showed maximum carbon sequestration in the study area.*

Key Words: *Carbon Sequestration, Surat, Total biomass, Tree species, Carbon stock, Girth Breast Height.*

I. INTRODUCTION

Trees and green plants are performing important ecological function in reducing the atmospheric pollution. Trees stores huge quantity of atmospheric carbon and regulate the carbon cycle, hence more the number of trees more will be the carbon absorbed by them and at same time trees also helps to avoid climate change and global warming. By means of Carbon cycle trees convert atmospheric CO_2 to carbohydrates by the process of photosynthesis and the carbohydrate which is formed by the process of photosynthesisis used by the plants to produce oxygen in the atmosphere. When these trees die or are burnt, the carbon stored in them is released back in to the atmosphere. This natural cycle of carbon is maintained and controlled by a dynamic balance between biological and inorganic process of earth.

Carbon sequestration is the phenomena of extraction of atmospheric CO_2 and its storage in oceans, soils and vegetation for a very long period of time in the form of live biomass, which in turn are an important part of the food chain and this carbon enters the soil as soil carbon which than finally enters into the atmosphere upon burning of fossil fuels and decomposition.

Biomass production plays an important role in carbon storage of trees. Biomass is the total amount of aboveground living organic matter in trees including leaves, shrubs, branches and bar and below ground biomass includes live roots, fine roots, soil organic matter in the form of carbon. The above ground biomass of the trees is the largest carbon pool and is directly affected by the deforestation and degradation activity. As the tree grows and their biomass increases, they absorb carbon from the atmosphere and stores in the plant tissues in the form of carbon.

Carbon sequestration is the long lived pools of carbon. There are five carbon pools of terrestrial ecosystem including biomass, namely the above-ground biomass, below-ground biomass, wood debris, the dead mass of animals and organic matter. These are an important part of an overall carbon management to help reduce global CO_2 emissions.The carbon cycle plays an important role on the Earth's environment, preventing CO_2 in to the atmosphere from getting too high or too low. If CO_2 levels are too high, global warming could occur. If CO_2 levels are too low, global cooling could occur.

II. AIMS AND OBJECTIVES

To identify some frequently occurring roadside tree species of Surat city which can store more atmospheric carbon and can be suggested in various re-plantation projects in the city. The present study also counts the density of selected plants in the study area.

III. MATERIALS AND METHOD

Geographical Location of Study Area

Surat from Gujarat state was selected for the study purpose. It is located at 21.1700^0 N Latitude to 72.8300^0 N longitude. It is the eighth largest city and ninth largest urban agglomeration in India. It lies near the mouth of the Tapi river at the Gulf of Khambhat. The total geographical area of the city is 4,418 km^2. Its population in urban area is 79.74% and 20.26% in rural area. The population growth rate is 42.24%. The average annual rainfall is 1192 mm and temperature is 27.2^{0}C. The summer are quite hot with temperature ranging from 37.78^{0}C to 44.44^{0}C. The overall climate of the city is pleasant.

Fig.-1 Location of Study area Surat city, Gujarat

Estimation of biomass carbon

For the estimation of total biomass and carbon storage, a total of 16 roadside tree species were selectedin the study area. These tree species were *Mangifera indica*(Mango), *Ficus benghalensis* (Banyan), *Polyalthia longifolia*(Ashoka), *Thuja occidentalis* (White ceder), *Manilkara zapota* (Chikoo), *Delonix regia* (Royal Poinciana), *Cocos nucifera* (Coconut), *Phoenix dactylifera* (Palm), *Syzygium samarangens* (Jamaun), *Eucalyptus oblique*, *Cordia dichotoma* (Glue berry), *Aegle marmelos* (Bili or Bhel), *Azadirachta indica* (Neem), *Pithcellobium dulce* (Monkeypod), *Ficus religiosa* (Peepal), *Terminalia catappa* (Indian almond). These plants were selected along the roadside with conditions in the study area through random sampling and their density was counted in the study area.

Fig.-2 *Polyalthia longifolia*

Fig.-3*Ficus benghalensis*

Measurement of Tree Height and Girth at Breast Height (GBH)

The height of tree was measured by using Hypsometer having make and model as Nikon Forestry Pro and girth of the tree was measured at the Girth Breast Height (GBH) using measuring tape. The amount of carbon stored in various tree species was carried out using non-destructive method using equations - the total volume, total biomass, percentage of carbon stored of the various tree species was calculated. The selection of tree species in the study was done randomly along the roadside.

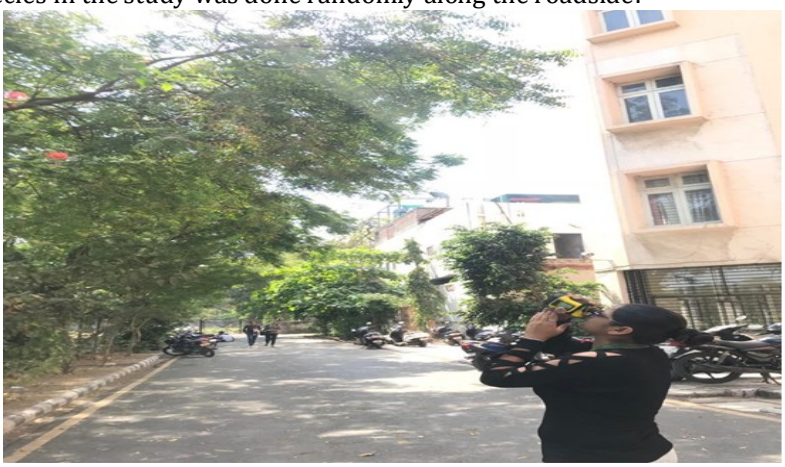

Fig.-4 Recording of Tree Height with Hypsometer

Estimation of Above Ground Biomass (AGB)

Estimation of AGB includes all living biomass above the soil level. The AGB of the tree was measured by calculating the volume of tree and wood density. The proposed biomass equation is based on the relationship between wood density and volume of the selected tree species.Volume was calculated by measuring diameter at breast height to the above-ground biomass. The wood density was obtained from the World Agroforestry Database for the selected tree species, whose standard average value was 0.6 gm/cm^3. Radius of the tree was calculated from GBH of tree species.

AGB (g/tree) = volume of tree (cm^3) × wood density (g/cm^3)

= π r^2 H (cm^3) × wood density (g/cm^3)

= (GBH)^2 / 4π × H × wood density (g/cm^3)

Where,

r = radius of the tree (cm) = GBH/2π

H=Height of the tree (m)

Estimation of Below Ground Biomass (BGB)

It includes all biomass below the soil importantly live roots and fine roots. The BGB was calculated by multiplying AGB by 0.26 factor as root: shoot ratio. BGB is calculated by following formula,

BGB (ton/tree) = AGB (ton/tree) × 0.26

Estimation of Total Biomass (TB)

Total biomass was determined by sum of both AGB and BGB of tree species. The total biomass of tree was calculated using following formula,

Total Biomass (ton/tree) = AGB + BGB

Estimation of Carbon stock

For any plant species 50% of biomass is considered as carbon stock. The carbon storage of tree was calculated using following formula,

Carbon stock = Biomass / 2

IV. RESULTS AND DISCUSSION

TABLE NO. 1: Estimation of GBH size, Total biomass and Carbon stock of selected tree species.

Sr. No.	Tree species	Total No. Count (Density)	GBH Size (cm)	Total Biomass (ton)	Carbon Store (ton)
1	*Magnifera indica*	25	80-150	17,519.216	8,759.608
2	***Ficus benghalensis***	**28**	**200-300**	**50,609.937**	**25,304.968**
3	*Manilkara zapota*	20	100-150	21,336.655	10,668.327

4	*Thuja occidentalis*	08	70-110	9,600.6101	4,800.305
5	*Phoenix dactylifera*	07	90-150	18,053.894	9,026.947
6	*Cocos nucifera*	20	80-120	12,445.252	6,222.626
7	*Delonix regia*	30	100-150	16,998.331	8494.1655
8	*Pithecellobium dulce*	17	200-300	36,056.866	18,028.433
9	*Ficus religiosa*	15	60-120	7,865.7707	3,932.8853
10	*Azadirachta indica*	27	90-120	14,711.904	7,355.9522
11	*Terminalia catappa*	10	60-100	1,843.4176	921.70882
12	*Syzygium samarangense*	18	80-100	11,402.598	5,701.2993
13	*Eucalyptus oblique*	25	80-120	12,445.252	6,222.6263
14	*Polyalthia longifolia*	30	50-100	5,195.5430	2,597.7715
15	*Aegle marmelos*	07	60-100	6,293.387	3,146.6935
16	***Cordia dichotoma***	**05**	**60-120**	**2,754.590**	**1,377.29525**

Table 1: The maximum biomass found was in *Ficus benghalrnsis* about 50,609.937 ton, the carbon stock about 25,304.968 ton and GBH size was the 200-300 cm. The minimum biomass found was in *Cordia dichotoma* about 2,754.590 ton, the carbon stock is about 1,377.29525 ton and GBH size was the 60-120 cm, hence they have minimum carbon sequestration capacity for atmospheric carbon dioxide. The maximum height was found in *Ficus beghalensis, Magnifera indica* and *Cocos nucifera* about 7 – 15 m and GBH size was maximum found in*Ficus beghalensis*, *Pithecellobium dulce* 200-300 cm, hence they having higher biomass and carbon stock than others, Also theyhave high carbon sequestration capacity for reducing atmosphere carbon dioxide.

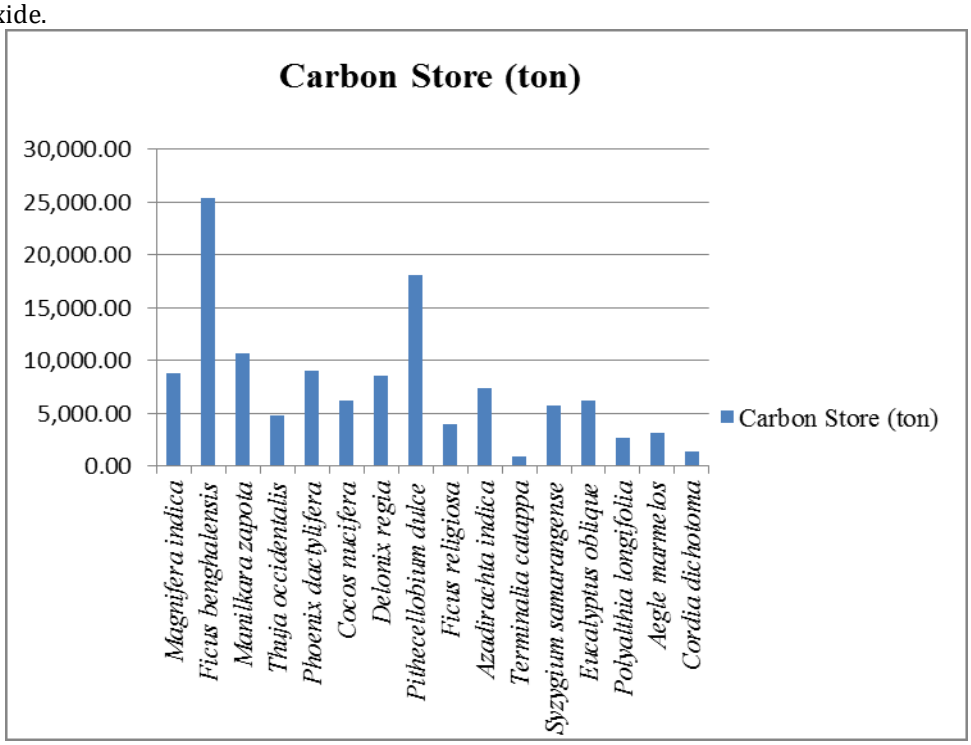

Fig.-5 Carbon storageof tree species

V. CONCLUSION

Carbon sequestration plays a major role in reducing the greenhouse gas emissions. The tree plantations in urban areas plays an important role in carbon capture and carbon sequestration. The carbon storage capacity increase as the age of tree increases. Hence, it can be concluded that older tree having higher carbon content than younger trees. Althoughthere have been various studies on the estimation of biomass of trees and carbon stock, but there is still further need to develop methods to quantify the estimates of biomass of all trees components and carbon stocks. The analysis of carbon sequestration of tree species in Surat city suggested that tree girth size of 200-300 cm has maximum capacity to store atmospheric carbon. From this study it can be said that as the diameter of tree species increase its biomass and carbon storage capacity also increase, hence the carbon sequestration capacity of a tree species directly depends on the tree

height, age, biomass, diameter and wood specific density and it is suggested that plantation of *Ficus benghalrnsis*and*Pithecellobium dulce*tree species should be done as they have high carbon dioxide and maintains natural heritage of state.

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