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CARBON SEQUESTRATION BY TREES

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ABSTRACT

Trees from the urban regions currently store carbon, which can be released into the atmosphere after the death of the tree, and capture carbon as they grow. A major challenge is the lack of correct and spatially explicit estimates of tree carbon storage, over the entire urbanized area. The study was carried out on the agronomy Experimental Farm, Annamalai University, to know the Carbon sequestration from the identified fourteen tree species. Assessment of the carbon sequestration of urban trees was carried out through the biomass estimation and quantification, for the estimation of total CO2 sequestration DBH and height measured. Wood densities were obtained from the world agro forestry centre. It is found that, highest carbon sequestration is rain tree (*Albiziasaman*) is 427.00 kg, followed by coconut (*Cocos nucifera*), which is 420.54 kg. It is found that, total Carbon sequestered by the selected area is 2081.00 kg. Carbon sequestration is a way to mitigate the accumulation of greenhouse gases released in the atmosphere, by the burning of fossil fuels and other anthropogenic activities.

KEYWORDS: Trees, Carbon Sequestration, Annamalai University

INTRODUCTION

Developmental activities and increased transportation activities are increasing the concentration of air pollutants as greenhouse gases, especially CO2 (Chavan and Rasal, 2010). These are leading to increased atmospheric temperature, through the trapping of certain wavelengths of heat radiation in the atmosphere. The increasing carbon emission is of major concerns, and addressed in the Kyoto Protocol (Ravindranath et al., 1997). Natural forests, forest plantations, Agro forestry practices and some other agricultural activities, act as a sink for carbon dioxide (CO2), through photosynthesis and store carbon as biomass (Benites et al., 1999; David and Crane, 2002; Thangata and Hildebran, 2012). They reduce the amount of CO2 in the atmosphere, and provide benefit to the global climate (Kort and Turnock, 1999).

Forests are a critical component of the global carbon cycle, storing over 80% of global terrestrial aboveground carbon (Dixon et al., 1994). Forests play a significant role in the global carbon cycle, through dynamic exchange of CO2 in the atmosphere. The management of such terrestrial forest carbon stocks can deliver a significant component, to the international climate change abatement strategies (Read et al. 2009). Forest ecosystems play a leading role in global terrestrial carbon cycle, owing to their huge carbon pool and high productivity (Schlesinger et al., 1997). Several studies so far suggested that, forest action can cost effectively and provide roughly 30% of the total global effort needed in all sectors, to meet climate mitigation strategies (Webb, 1992). With an increasing concern for global climate changes, resulting from more and more anthropogenic greenhouse gas, protecting carbon stocks in the existing forests and getting the new carbon stocks through afforestation and reforestation, have become the important measures to enhance the carbon sequestration capacity in the terrestrial ecosystems and mitigate the increasing carbon dioxide concentration in the atmosphere (Lal, 2005). The global forest plantation was 187 million ha in 2005, about 1.4% of the total world available land area.

On this planted area 36% were located in the tropics and 64% in the non-tropical regions. The tropical forest plantation area was more than double from 1995 to 2005, and on an average, the growth rate of tropical forest plantations was 8.6% per year (FAO, 2006; Arias et al., 2011). Plantation forests are important sources of timber, that alleviate the pressure on native forests, for commercial forest products and are viewed as an effective means of short-term carbon sequestration (Turner et al., 1999; Silver et al., 2000; Curlevski et al., 2010). Growing trees in urban areas can be a potential contributor, in reducing the concentration of CO2 in the atmosphere by its accumulation therefore, in the form of biomass (Chavan and Rasal, 2010).

Biomass is an essential aspect of studies of the carbon cycle (Cairns et al., 2003; Ketterings et al., 2001). There are two methods to calculate forest biomass, one is direct method and the other is an indirect method (Salazar et al., 2010). Direct methods, also known as destructive methods, involves of felling trees to determine biomass (Parresol, 1999; Salazar et al., 2010). Indirect means of estimation of stand biomass are based on allometric equations, using measurable parameters. The use of circumference or girth at breast height alone (expressing the basal area) for above ground biomass estimation, is common to many studies that showed that diameter at breast height (DBH) is one of the universally used predictors, because it shows a high correlation with all tree biomass components and easy to obtain accurately (Razakamanarivo et al., 2012; Antonio et al., 2007; Heinz et al., 2002; Zianis, 2008).

Most of the research works revealed that, AGB is strongly correlated with tree diameter (Brown, 1997; Brown and Lugo, 1984; Clark et al., 2001). Also, it is accepted that, simple model with only diameter as input is a good estimator of the above ground biomass (Brown, 1997; Nelson et al., 1999; Clark et al., 2001; Djomoa et al., 2010).

Hence, in the present study, we took the trees on agronomy farm in Annamalai Nagar and measure the width of the different tree species, by taking the average (at breast height). Thereby, we are able to find the carbon sequestered by trees in our farm area.

Based on the above evidence, the study was planned with the following objectives.

- To identify various tree species available at the Experimental Farm.
- To measure the diameter at the breast height and identify the type of wood.
- To analyze the co_2 sequestered from the existing tree species.

MATERIALS AND METHODS

The study on carbon sequestration was conducted in our experimental farm during 18.12.2016 to 15.4.2017. Field experiments were conducted at the experimental farm, Department of Agronomy, Annamalai University, Annamalai Nagar. The experimental sites are geographically situated at $11^0$24' North latitude and $79^0$44' East longitudes and at an altitude of +5.79 m, above mean sea level. The weather data of the experimental site were moderately warm with hot summer months. While the maximum temperature varied between 27.9^0C to 39.2^0C and minimum temperature ranging from 20.2^0C to 28.5^0C. The high relative humidity of 95% (during October) and low of 76% (during May), with a mean of 71% were recorded. Total rainfall of Annamalai Nagar is 1086.3 mm with a distribution of 784.1 mm during the northeast monsoon, 271.3 mm during southwest monsoon, 9.2 mm during winter period, and 21.7 mm during the hot summer period, spreading over 43 rainy days. The mean hour of bright sunshine per day is 6.7.

Materials Required

- Trees
- Ruler
- Measuring tape
- Calculator
- Pocket note

METHODOLOGY

- Identify the tree species on the Experimental Farm.
- Count the number of trees that has been identified.
- Categorize the identified tree species into softwood and hardwood.
- Measure the breast height of the tree (DBH) by using a ruler and measuring tape.
- Identify the age of the tree.

(Some of the identified tree species are neem, coconut, pungam, teak copper shield etc.,)

Calculate the amount of Co_2 sequestered in a tree/year by using the following steps

- Determine the height of the tree.
- Determine the age of the tree.
- Determine the weight of the carbon dioxide sequestrated in the tree.
- Determine the weight of the carbon dioxide sequestrated in the tree per year.

The weight of the carbon sequestrated in the tree can be calculated by using following aspects

Trees can be classified based on 2 aspects

Type of Wood

- Hardwood
- Softwood

Generally, Carbon sequestered in hardwood is high when compared to softwood.

Speed of Growth

- Fast growing
- Moderate growing
- Slow growing

Carbon sequestrated in fast growing tree is comparatively higher than moderate and slow growing tree.

Survival Factor

Survival factor can be calculated by the number of trees surviving at the end of the reporting year. It is necessary to account mortality, for a fraction of trees planted inevitably die in each year. The ideal method for determining the number of trees surviving is to conduct a census of the tree planted.

Annual Sequestration Rate

The annual carbon sequestration rate is the amount of carbon table given for trees in urban and suburban.

Carbon Sequestered Per Year in Agronomy Experimental Farm

It can be calculated by multiplying the number of trees surviving and annual sequestration rate.

Calculation Model of Carbon Sequestration

The amount of carbon sequestrated in NEEM (*Azadiractaindica*)

Name of the tree: NEEM

Type of the tree: HARDWOOD

Age of the tree: 20 YEARS

Survival factor: 0.73

Number of trees: 21

Annual sequestration rate (kg/tree): 16.72

Carbon sequestration (kg/tree) =Number of surviving trees * Annual Sequestration Rate

=21*16.72

=351.12kg/tree

RESULTS

The amounts of carbon sequestered by various tree species are given below.

Table 1

S. No	Name of The Tree	Type of The Tree	Age of The Tree	No. of Surviving Trees	Survival Factor	Annual Carbon Sequestration (Kg/Tree)	Carbon Sequestered in Kg
1	Coconut	S	25	58	0.73	07.63	420.54
2	Rain Tree	H	50	14	0.65	30.50	427.00
3	Pungam	S	20	05	0.69	18.60	93.00
4	Neem	H	20	21	0.73	16.72	351.12
5	Silk Cotton	S	37	02	0.63	21.40	42.80
6	Beef Wood Tree	H	40	04	0.79	42.36	42.80
7	Golden Shower	S	40	01	0.42	10.63	169.44
8	Vaadham	S	10	01	0.58	04.90	10.63
9	False Ashoka	S	40	05	0.77	23.50	04.90
10	May Flower	S	40	06	0.71	10.63	63.78
11	Eucalyptus	H	30	05	0.76	29.25	149.75
12	Copper Shield	H	40	18	0.68	10.60	191.34
13	Teak	H	10	01	0.80	02.50	02.50
14	Tulip	H	20	03	0.64	04.90	14.70
Total							2081kgs

S= SOFTWOOD, H= HARDWOOD

Total kilograms of carbon sequestrated = 2081 kg

Total carbon dioxide (Co_2) sequestrated =TOTAL * 3.663 (Ratio of Co_2 to C)

= 2081 * 3.663

=7622.703kgs

Total carbon dioxide sequestrated in tonnes = 7622.703/1000

=7.622 tonnes

- The highest amount of carbon sequestration is Rain tree (*Albiziasaman*) = 427.00 kg. It is high because of its biomass, hardwood and age.
- The lowest amount of carbon sequestration is teak (*Tectonagrandis*) = 0.2.50 kg.

CONCLUSIONS

Carbon sequestration is broad and an important subject. It is essential in the effort, to circumvent the effects of climate change. Carbon capture and storage is one of the most effective and discussed methods of solving this issue. However, there is no single solution to this problem. We cannot pump carbon underground forever. In order to reverse the effects of climate change, carbon capture and storage must be coupled with forward thinking methods of generating clean energy, so that there is no more carbon being released into the atmosphere. Furthermore, cleaner methods of farming, reforestation and afforestation are effective methods of restoring natural methods of sequestration that existed before humans tampered with the environment.

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