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Green patches as carbon reservoir: A case study from Dhruba Chand Halder College, West Bengal

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Abstract

In the context of Climate change, greenhouse gas mitigation is one of the major concerns of the present era. Carbon sequestration by green plants is one of the most important processes for the reduction of carbon dioxide emission. Trees are the major sinks for atmospheric carbon. In the present study we evaluated the stored carbon in the dominant trees of Dhruba Chand Halder College (formerly Dakshin Barasat College) campus through the assessment of Above Ground Stem Biomass (AGSB) and Above Ground Stem Carbon (AGSC) of each species. AGSB ranged from 0.631 tonnes (*Delonix regia*) to 21.343 tonnes (*Swietenia macrophylla*) and AGSC ranged from 0.291 tonnes (*Delonix regia*) to 10.437 tonnes (*Swietenia macrophylla*) during study period. The assessment of the carbon dioxide equivalent for the species reveals considerable potential of the trees in off-setting atmospheric carbon dioxide.

Keywords: Climate change, Carbon sequestration, Above Ground Stem Biomass, Above Ground Stem Carbon, CO_2-equivalent.

Introduction

Global warming is the most dreaded problem of this millennium which just represents one aspect of climate change. It is caused mostly by increasing concentrations of greenhouse gases (carbon dioxide, methane, nitrous oxide and others) in the atmosphere resulting to changes in climate pattern such as rising of temperature, sea level *etc*. Over the last century, global temperatures have risen by 0.7°C (Eliasch, 2008). The concentration of atmospheric carbon dioxide has increased from 278 ppm in the pre-industrial era (1970) to 379 ppm in 2005 with an average increase of 1.9 ppm per year (IPCC, 2007). Thus it is necessary to control their rise of carbon dioxide at least at local scale to retard the adverse impact of climate change by limiting anthropogenic emissions of greenhouse gases. The trees act as a major sink of carbon dioxide. The green trees have high potential of trapping atmospheric carbon dioxide through photosynthesis

and sequester the carbon in the plant tissues as biomass by separation from the oxygen atoms which results in their growth (Matthews *et al*., 2000; Nowak and Crane, 2002). Therefore growing trees can be a potential contributor in reducing the concentration of carbon dioxide in atmosphere by accumulation in the form of biomass (Chavan and Rasal, 2010). Biomass has been widely used for carbon cycle studies because it is an important indicator of vegetation growth and dynamic (Yan *et al*., 2013). Carbon is a valued product in the global market and so the estimation of the amount of stored carbon in growing trees and harvested wood is also important (McKinley *et al*., 2011). The carbon sequestration capacity of a tree species depends upon its age, height, girth size, biomass accumulation capacity, canopy diameter and most important wood specific density (Rathore and Jasrai, 2013).

On this background, the primary objective of the present study was to establish a dataset of the stored carbon in dominant trees of Dhruba Chand Halder College campus located in the South 24 Parganas district of West Bengal. The CO_2-equivalent of each species has also been estimated to assess the role of the selected trees in offsetting CO_2. The work was undertaken by the college authority not only to document the magnitude of stored carbon in the dominant trees, but also to aware the student community about the mitigation process.

Materials and Methods

Study site

The present study was conducted in the campus of Dhruba Chand Halder College (22°13'51.9"N; 88°27'19.6"E), formerly known as Dakshin Barasat College. It was established in 1965, a co-educational Government aided College, affiliated to the University of Calcutta. This college campus is located near Dakshin Barasat Railway Station in Sealdah-Lakshmikantapur-Kakdwip-Namkhana section under Jaynagar-1 Block in South 24 Parganas district of West Bengal. We selected 10 dominant tree species in the area based on the relative abundance of the trees during June, 2016 (Figure 1).

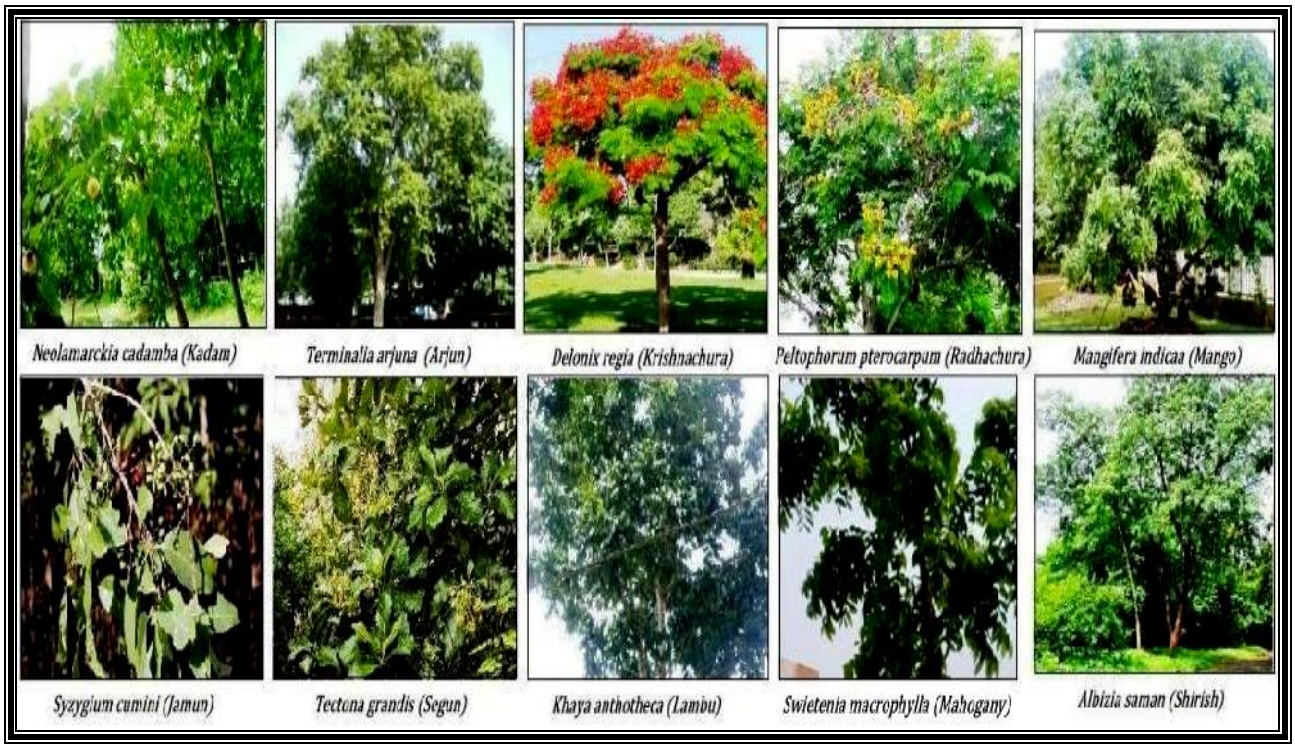

Figure 1. Dominant trees in Dhruba Chand Halder College campus

Above Ground Stem Biomass (AGSB) estimation

The stem biomass for each tree species was estimated using non-destructive method in which the Diameter at the Breast Height (DBH) was measured after assessing the circumference with a measuring tape and height with laser beam (BOSCH DLE 70 Professional model). Form factor was determined with Spiegel relascope as per the method outlined by Koul and Panwar (2008). The stem volume (V) was then calculated using the expression $FH\Pi r^2$, where F is the form factor, r is the radius of the tree derived from its DBH and H is the height of the target tree. Specific gravity (G) of the wood was estimated taking the stem cores, which was further converted into stem biomass (B_S) as per the expression $B_S = GV$.

Above Ground Stem Carbon (AGSC) and CO_2-equivalent estimation

The fresh sample of stem from selected trees of individual species was collected and oven dried at 70°C, randomly mixed and ground to pass through a 0.5 mm screen. The carbon content (in %) was finally analyzed for each species through a *Vario MACRO elementar* CHN analyzer. This value was converted to stored carbon (known as Above Ground Stem Carbon or AGSC) per species (in tonnes) considering the AGSB of each species and its population (as estimated by quadrate method; quadrate dimension = 10 cm X 10 cm). Finally the total stored carbon per species (10 No. of species) is converted to CO_2-equivalent by multiplying with a factor of 3.67.

Results

The AGSB and AGSC values of the selected dominant trees species in the College campus are presented in Figure 2. The values of CO_2-equivalent of these species are depicted in Figure 3.

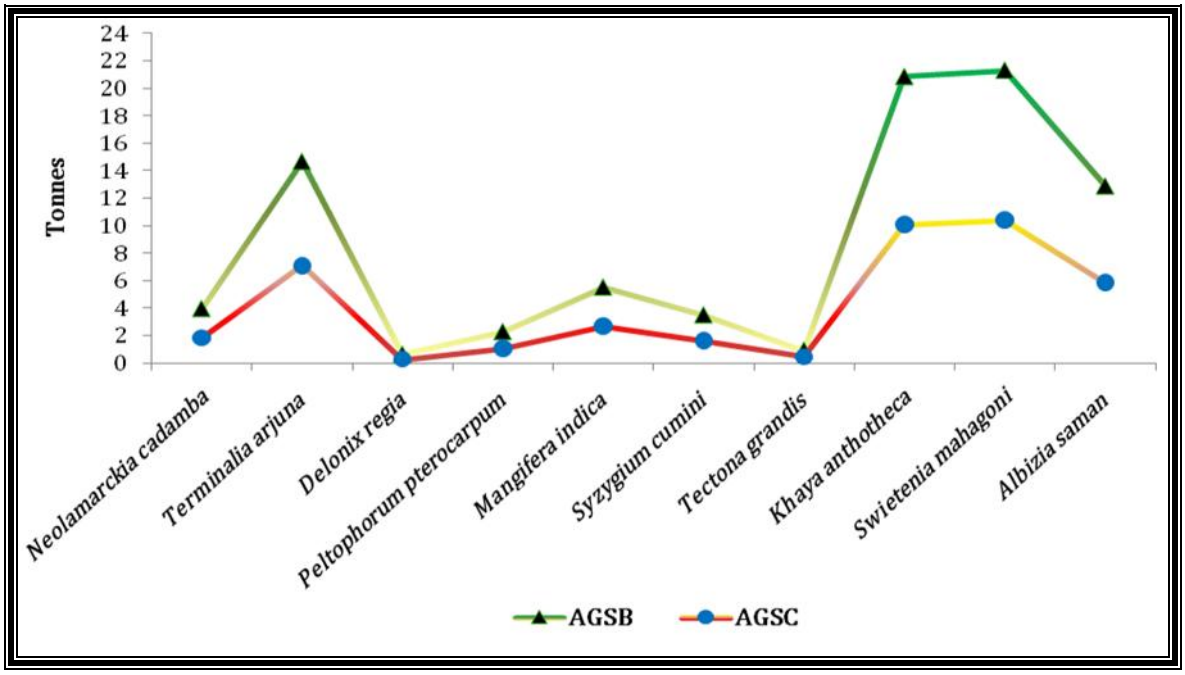

Figure 2. AGSB and AGSC (in tonnes) of dominant trees in Dhruba Chand Halder College campus

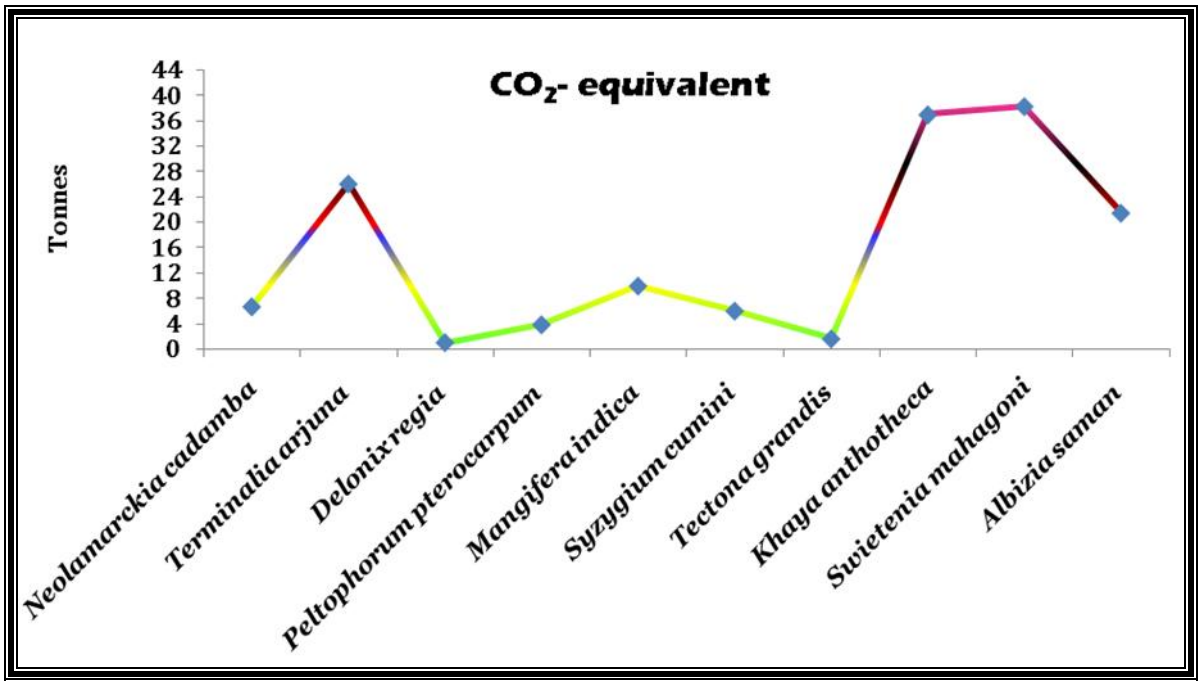

Figure 3. CO_2-equivalent of the trees in Dhruba Chand Halder College campus

The AGSB of the dominant trees species in the study site is in the order *Swietenia macrophylla* > *Khaya anthotheca* > *Terminalia arjuna* > *Albizia saman* > *Mangifera indica* > *Neolamarckia cadamba* > *Syzygium cumini* > *Peltophorum pterocarpum* > *Tectona grandis* > *Delonix regia*.

Similarly the AGSC follows the sequence of *Swietenia macrophylla* > *Khaya anthotheca* > *Terminalia arjuna* > *Albizia saman* > *Mangifera indica* > *Neolamarckia cadamba* > *Syzygium cumini* > *Peltophorum pterocarpum* > *Tectona grandis* > *Delonix regia*.

Discussion

The recent thrust on global warming phenomenon has generated considerable interest in the carbon storing ability of trees. The carbon sequestration is a function of biomass production capacity which in turn depends upon interaction between edaphic, climatic, topographic factors of an area (Mitra and Zaman, 2014; Mitra and Zaman, 2015). The carbon dioxide equivalent values obtained from the present study confirm the potentiality of the species to store carbon provided optimum growth of the species is maintained through proper soil management. It is also suggested that in the afforestation programme of the college, thrust should be given to plant *Swietenia macrophylla*, *Khaya anthotheca*, *Terminalia arjuna* and *Albizia saman* as these four species are better suited on the background matrix of the prevalent edaphic factors. Such study has great relevance in combating carbon dioxide rise at the local level particularly as the selected study site is adjacent to the highly urbanized city of Kolkata, where a large chunk of the green patches has been destroyed to build high rise building, shopping malls and various amusement centers. It is suggested that all these units (like high rise building, shopping malls and various amusement centers etc.) must consider the plantation of these species as a part of their Corporate Social Responsibility (CSR). This can be a low cost eco-friendly approach to upgrade the air quality.

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