

## ASSESSMENT OF GREEN URBAN PARKS WITH REGARDS TO CARBON SEQUESTRATION POTENTIAL

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### ABSTRACT

The paper discusses about Carbon Sequestration potential of an urban park. Urban parks, gardens and vegetation around the city are considered as lungs of the cities. Urban parks can reduce atmospheric CO<sub>2</sub> directly and indirectly. Trees, through their growth process, act as sink for atmospheric carbon. Therefore, growing can be a potential contributor in reducing the concentration of CO<sub>2</sub> in atmosphere by its accumulation in the form of biomass. Therefore, this study is going to focus on carbon pool, specifically in terms of live aboveground biomass of urban park vegetation. Green plants also have a positive impact on moods, can promote health, and relieve stress (Ulrich, 1984). The parks also provide a wide variety of ecological services and amenities to communities, also contribute significantly to human health and environmental quality. Trees have high potential for carbon storage and are often emphasized for carbon offset projects, as required by UNFCCC, to which India is a signatory.

**Key words:** Carbon Sequestration, Carbon Sequestration methods and techniques, Carbon storage, Atmospheric carbon.

### 1. INTRODUCTION

Climate change is one of major environmental concerns of 21st century. Climate change has been defined by the Intergovernmental Panel on Climate Change (IPCC) as any change in climate over time, whether due to natural variability or as a result of human activity (IPCC, 2007). Climate change is primarily driven by the high concentration of greenhouse gases which are mainly emitted by anthropogenic actions (Jones et al., 2023). For decades, humans have been burning fossil fuels to produce energy and have been cutting down forests at unprecedented rates to free up land for urban development and agricultural land. These activities release large amounts of greenhouse gases into the atmosphere, which trap heat and cause global temperatures to rise. The atmosphere is warming, and if current trends continue, scientists expect that by 2050, the earth would have warmed by an average of 1.5 to 4.5 degrees Celsius. Carbon dioxide, which has existed in the atmosphere for about 200 years due to its peculiar properties, is responsible for more than 55 percent of current global warming caused by GHGs created by human activities. Its concentration has risen by more than 30% since pre-industrial times (around 1750). We must minimise greenhouse gas (GHG) emissions or increase the ability of carbon sinks to absorb more and more GHGs from the atmosphere in order to offset this accelerated climate change and to reduce significant future climatic changes.

Tree plantations in urban areas are seen as an important nature-based solution for addressing the environmental crises of biodiversity loss and global climate change. They provide precious ecosystem services such as shade, erosion control, nitrogen fixation, pollution control, carbon (C) sequestration, micro-climate regulation and ornamental value (Chiesura, 2004). Carbon sequestration is the removal of the air carbon dioxide and its storage in terrestrial ecosystems for a much-extended period of time. Plants, through their growing period, act as sink for atmospheric carbon. Therefore, growing vegetation in metropolitan areas can be a potential contributor in decreasing the concentration of CO<sub>2</sub> in atmosphere by its accumulation in the form of biomass. As trees grow and their biomass expands, they extract carbon from the air and store it in the plant tissues (Mathews et al., 2000).

### 2. STUDY AREA

The present study was conducted to assess the carbon sequestration potential of Maharaja Hari Singh park of Jammu, J&K UT. Jammu is one of the fast developing cities in north India and is the winter capital of the UT of Jammu and Kashmir. Jammu city is located on the banks of the river Tawi and lies between 32° 38' and 32° 48' North latitude and 74° 47' and 74° 52' East longitude. The old city is situated on a hillock and the north-eastern parts of the city are sloping up towards the hills. It is surrounded by the Shivalik range to the north, east, and southeast and by the Trikuta Range surrounds to the northwest. Jammu city is a focal point for the pilgrims going to Vaishno Devi and Kashmir valley. Known as the city of temples renowned for its ancient temples and shrines, Jammu is the most visited place in the union territory. All the routes leading to Kashmir, Poonch, Doda and Ladakh start from Jammu city.

The recently developed Maharaja Hari Singh park is located on the northern bank of river Tawi. The area of park is around 2 ha (2.17 ha). Evergreen tree fondly planted at various locations in City of temples stands planted in the park.

### 3. METHODOLOGY

The methods, steps, techniques and formulae based calculations done to find out the carbon sequestration potential are described below:

A total of 10 sample plots of 10m x 10m size were randomly selected for recording the data by laying quadrants. The quantitative analysis of live tree biomass, carbon content and CO<sub>2</sub> sequestered by different tree species were thoroughly worked out and described below by using the following methodology. The plants having girth of more than or equal to 30 cm were considered as trees and inventoried and their circumference at breast height (cbh in cm) i.e. 1.37m from the ground surface was measured and recorded using the methodology described by Ravindranath and Ostwald (2008). The diameter at breast height (dbh) was obtained by dividing the cbh with the value of pie (3.14). The volume of each tree was calculated by using the allometric equations developed by FSI (1996) for various tree species of Indian Himalaya presented in Table 3.1. A general volume equation was used for tree species for which the volume equations were not available. The computation of growing stock was undertaken by sorting out the data collected, according to plot wise and species wise, and analysed using MS Excel.

**Table 3.1:** Various volume equations used for estimation of above ground biomass.

| S.No | Species                    | Volume equation                               |
|------|----------------------------|---|
| 1.   | Acacia sps                 | $V=0.0418535-0.183567\sqrt{D}+3.787825D^2$    |
| 2.   | Albizia lebbeck L.         | $V=0.07389+4.47501D^2$                        |
| 3.   | Anthocephalus cadamba L.   | $V=-0.0189+0.0005073 D^2$                     |
| 4.   | Bauhinia variegata L.      | $V =-0.04262+6.09491 D^2$                     |
| 5.   | Bombax ceibaL.             | $V =-0.032-0.619+7.208 D^2$                   |
| 6.   | Dalbergia sisoo Roxb.      | $V =-0.013703+3.943499 D^2$                   |
| 7.   | Grevillea robusta A. Cunn. | $V=-0.44075+7.49221D-36.09962D^2+71.91238D^3$ |
| 8.   | Lagerstroemia speciosa L.  | $V=0.11740-1.58941D+9.76464D^2$               |
| 9.   | Melia azedarach L.         | $V=-0.03510+5.32981D^2$                       |
| 10.  | Michelia champaca L.       | $V=-0.11391+1.06784D+5.36178D^2$              |
| 11.  | Pinus roxburgii Sarg.      | $V=0.276739-3.068630D+12.409920D^2$           |
| 12.  | Tectona grandis L.         | $V=0.8847-1.46936D+11.98979D^2+1.970560D^3$   |
| 13.  | Terminalia arjuna Roxb.    | $V=0.50603-6.64203D+25.23882D^2-9.919797D^3$  |
| 14.  | Terminalia bellirica Roxb. | $V=0.26454-3.05249D+12.35740D^2$              |
| 15.  | General equation           | $V =0.03316+0.77262D-0.50833D^2+11.50107D^3$  |

V= Under bark volume (m<sup>3</sup>)

D= Diameter at breast height (m)

**Equation used for calculating various parameters:**

- Aboveground Biomass (g)** = Volume (cm<sup>3</sup>) x wood density (g/cm<sup>3</sup>) x BEF
- Belowground Biomass (t/ha)** = Aboveground Biomass(t/ha) x 0.275
- Total Biomass (t/ha)** = Aboveground Biomass (t/ha) + Belowground Biomass (t/ha)
- Carbon Content (carbon stock)=** Total Biomass (t/ha) x 0.47
- Carbon Sequestered (t/ha)** = Carbon Content x 3.667

### 4. OBSERVATIONS

**Table 4.1:** Biomass carbon stock and CO<sub>2</sub> sequestered by live trees in the site

| S.No | Name of species    | Above ground biomass (in t/ha) | Below ground biomass (in t/ha) | Total biomass density (in t/ha) | carbon stock (in t/ha) | Carbon sequestered (in t/ha) |
|------|--------------------|--------------------------------|--------------------------------|---------------------------------|------------------------|------------------------------|
| 1.   | Syzygium cumini    | 0.0184                         | 0.005                          | 0.024                           | 0.011                  | 0.04                         |
| 2.   | Alstonia scholaris | 0.003                          | 0.001                          | 0.004                           | 0.002                  | 0.007                        |

|       |                                 |        |       |       |       |       |
|-------|---------------------------------|--------|-------|-------|-------|-------|
| 3.    | <i>Pterospermum acerifolium</i> | 0.0575 | 0.016 | 0.073 | 0.034 | 0.126 |
| 4.    | <i>Ficus benjamin</i>           | 0.006  | 0.002 | 0.008 | 0.004 | 0.014 |
| 5.    | <i>Bauhinia variegata</i>       | 0.011  | 0.003 | 0.014 | 0.006 | 0.024 |
| 6.    | <i>Anthocephalus cadamba</i>    | 0.354  | 0.097 | 0.451 | 0.212 | 0.778 |
| 7.    | <i>Roystonea regia</i>          | 0.163  | 0.045 | 0.208 | 0.098 | 0.36  |
| 8.    | <i>Michelia champaca</i>        | 0.014  | 0.004 | 0.018 | 0.009 | 0.031 |
| 9.    | <i>Cycas revolute</i>           | 0.038  | 0.011 | 0.049 | 0.023 | 0.084 |
| 10.   | <i>Plantanus orientalis</i>     | 0.007  | 0.002 | 0.009 | 0.004 | 0.015 |
| 11.   | <i>Polyalthia longifolia</i>    | 0.007  | 0.002 | 0.009 | 0.004 | 0.016 |
| TOTAL |                                 | 0.6789 | 0.188 | 0.867 | 0.407 | 1.495 |

\*Values have been recorded at 3<sup>rd</sup> or 4<sup>th</sup> place after the decimal.

## 5. RESULT & DISCUSSION

Biomass assessment is essential in understanding the productivity of an ecosystem. Biomass carbon stock and CO<sub>2</sub> sequestered by live tree vegetation has been presented in Table 4.1.

**Biomass:** Species wise maximum total biomass value of 0.451t/ha has been recorded for *Anthocephalus cadamba* followed by *Roystonea regia* (0.208 t/ha), while minimum value of 0.004 t/ha of total biomass has been exhibited by *Alstonia scholaris*. The value for above ground biomass for different species ranges from maximum of 0.354 t/ha in *Anthocephalus cadamba* followed by *Roystonea regia* (0.163 t/ha), while the minimum value was exhibited by *Alstonia scholaris* ( Table 4.1)

Similarly, for below ground carbon biomass, maximum value of 0.097 t/ha was exhibited by *Anthocephalus cadamba* followed by *Roystonea regia* (0.045 t/ha), while minimum value was exhibited by *Alstonia scholaris* (Table 4.1)

**Carbon dioxide sequestered:** Maximum CO<sub>2</sub> sequestered has been recorded for *Anthocephalus cadamba* (0.778t/ha) and minimum value of CO<sub>2</sub> sequestered (0.007 t/ha) was found in *Alstonia scholaris* (Table 4.1).

Total biomass stock within the study area has been recorded to be 0.867t/ha. Above ground contributes nearly 78.3% while below ground contributes 21.68 % respectively.

The total CO<sub>2</sub> sequestered was calculated by multiplying the area of the park (2.17 ha approximately) with the total carbon calculated for that park (1.495 t/ha). The total CO<sub>2</sub> sequestered by the park is 3.244 tonnes at any given time.

## 6. CONCLUSION

Urban parks store large quantities of carbon and allow its exchange with the atmosphere through photosynthesis and respiration. However carbon stored is strongly affected by vegetation type, composition, density, climate etc. Therefore, carbon inventory of various sectors is necessary to know the periodic changes in carbon stocks of biomass. The study suggests that urban parks contribute considerably from biomass carbon stock to carbon sequestration as well as oxygen production. Thus proper long term planning along with scientific management will increase the vegetation type and in turn enhance the carbon sequestration potential of urban parks. International cooperation and actions are necessary to tackle climate change, as climate change is a global problem that requires global solutions. This includes strengthening existing international agreements, such as the Paris Climate Accord, and developing new initiatives and policies to reduce greenhouse gas emissions.

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