

CHAPTER 1

INTRODUCTION

1.1 Background

Urbanisation is taking place at a rapid rate. Land use is gradually being changed to meet the increasing requirement of rising population. This is causing environmental stress and problems. Forest plays crucial role in mitigation of such problems. They enhance city's physical environment and landscape, control environmental pollution, clean the air by providing life sustaining oxygen and absorb carbon dioxide and filter particulate matter from the air, conserve soil and moisture, acts as moderator of climate and provides space for recreational needs of the people.

Climate Change is internationally widely discussed subject. The effects of the climate change have been observed across the globe. Emission of Green House Gases (GHGs) has increased manifold. Carbon dioxide (CO₂) is a major contributor to built up of Green House Gases in the atmosphere. Time and again India has shown its commitment towards global efforts to contain GHGs emission. One of the eight missions under National Action Plan on Climate Change(NAPCC) is the National Mission for Green India with an aim to enhance ecosystem services including carbon sink. Forest happens to be one of the most effective carbon sink and so as part of strategy green cover of a city needs not only to be kept intact but also to be strengthened further by creating man made forest by taking up regular plantation activity. Also it needs to be a prudent mix of such

species in the plantation which meet the challenges and requirement of the growing cities and enhance the ecosystem services such as carbon sequestration.

The population density of Delhi and its districts and their growth rate has become alarmingly high. Increase in population has resulted in increase in GHGs emissions. Effort has been made to sustain the green cover of Delhi. Time to time new plantations have been made which will play long lasting role of carbon sink.

1.2 Statement of the Problem

About 31.6% of the country population (i.e. approx. 37 Cr) resides in the Urban Area. It is expected to reach 40 % by 2026. Due to this trend of growth of the urban population, it may also be the centre of environmental degradation. Population growth and high density in cities can adversely impact natural and environmental resources (Town and Country Planning Organisation, 2014).

Population density of Delhi and its districts and their growth rate has become alarmingly high. This has resulted in tremendous pressure on the natural resources including the green cover of Delhi. Increase in population has resulted in increase in GHGs emissions due to higher consumption of energy, growing vehicular traffic etc. Delhi is one of the most polluted city of the world. Reduction of Carbon dioxide CO₂ content in atmosphere is possible only in two ways. One way through emission cut. The other way is to increase the amount of carbon sequestered by terrestrial ecosystem such as forests. Forest sequesters and store more carbon than any other terrestrial ecosystem and are an important natural brake on climate change.

In last one decade Delhi has become one of the most polluted city in the world and uncontrolled carbon emissions is posing serious questions to the developmental activities in this part of the country. In Delhi multipronged action has been taken for adding to the greenery.

Urban Forestry in Delhi: As per ISFR 2017 published in 2018, the total area under forest and tree cover in Delhi is 20.59 % of its geographical area whereas in respect of whole country it is 21.54%. The national goal for the forest and tree cover as per the National Forest Policy, 1988 is 1/3rd of the total area. Delhi being a megacity and densely populated, to further increase the green cover a sustained and multipronged action is required because difficulty of availability of land for carrying out plantation is also there. Different category of forest such as ridge forest, protected area, protected forest as well as green plantations such as city forests, road side and central verge plantations have been developed. DDA has developed Yamuna Biodiversity Park and Aravali Biodiversity Park. There are more than 18000 parks and gardens in NCT of Delhi and hence to coordinate their management a society namely Delhi Parks and Gardens Society under the state government has been registered. Vacant lands such as along river Yamuna and gram sabha lands are identified and trees are planted. So there is difficulty of availability of land for plantation and despite the same a sustained effort has been made to protect and strengthen it further. On the legislation side, there is an act known as Delhi Preservation of Tree Act,1994 which is a deterrent for any one to remove any tree from any land including private. One can remove tree only with the permission of the tree officer designated in accordance with the provisions of the DPTA,94 and the Rules made thereunder. As per the provision of the act and its rule, the agency/individual getting

permission is ordered to make compensatory plantation in lieu of felled tree and even asked to deposit a prescribed amount. In view of the above it is important to have an idea of the role played by the young plantations of Delhi in sequestering carbon from the atmosphere so that city develops its own potential to mitigate its atmospheric built up of Carbon.

1.3 Objective

The cities need to be made able to mitigate its own environmental impacts through various strategic initiatives. One of such strategy is to protect, improve and expand its green cover. The present study aims to ascertain the role of young plantation in carbon sequestration and relative potential of the species. Such study should be useful in integrating Urban Forestry in the Urban Planning to address the climate change issues.

1.4 Justification

India stands third in the world map in carbon emission after China and USA (Statista, 2017). Climate Change is one of the most discussed global issue and implication of which is not confined to the boundary of any individual country. Its effect is visible in many ways. India is also witnessing some of the adversities due to rise in temperature due to high built up of the GHGs in the atmosphere such as receding Himalayan glacier which is source of many of the perennial river of the north India, rising sea level and increase in surface temperature (MoEF&CC, 2008). Initiatives are being taken by the countries to join their hands together through meetings, conventions and agreements to contain the global warming to a desired level through proper intervention. Global level

initiatives had been initiated after Rio summit in 1992. United Nations Framework Convention on Climate Change (UNFCCC) has been ratified by 197 countries. India is one of the signatory of United Nations Framework Convention on Climate Change (UNFCCC) and committed towards the global efforts to contain the emission of Global House Gases (GHGs). Emission of GHGs is to be reduced so that the average temperature rise is within 2⁰C above the pre-industrial level and it was emphasized in the Paris agreement in 2015 that member countries should make voluntary national commitment to reduce their own emissions. Every year, a Conference of Parties (COP) brings together all the countries that have ratified the convention. Intergovernmental Panel on Climate Change (IPCC) was created in November, 1988 by United Nations which is the most authoritative scientific effort to understand and address changes in the earth climate.

Forest is a natural as well as effective system of carbon sequestration. The pace of urbanisation and growing population pressure on the cities including Delhi, consequent rise in vehicular traffic, rise in the electricity consumption has caused uncontrolled high built up of the GHGs in the atmosphere and alarming level of air pollution. Green cover of Delhi is over stressed due to pressure of growing population. The built up area is on increase and so the green cover of the city is under threat unless they are protected well. Considering the ecosystem services including carbon sequestration extended by forest and urban green, continuous efforts have been made to strengthen the existing green cover of Delhi by carrying out new plantation and maintain it despite pressure of rising population and requirement of development. In view of the above estimating the carbon

sequestration by decade old young plantation will be of immense help. This will also help in furthering the cause of full-fledged integration of urban forestry in urban planning.

1.5 Research Questions

- (i) What is the amount of Carbon sequestered by the young plantation created at Hindon Cut in Delhi about a decade back?
- (ii) What is the average carbon sequestered by the species planted at Hindon Cut?

1.6 Limitation

- To collect the field data for the research question, demarcation and measurements are to be carried out in the said plantation which requires time, manpower for accuracy. Due to the time constraint and the limited manpower and other resources it is proposed to limit the field work to plantation at only one place at Hindon Cut created about a decade back in 2007-08.
- The main focus of the present study is to ascertain the role of young plantation in sequestering carbon and also a comparative study among different species in doing so. Since all the species preferred for plantation in Delhi may not be present in the plantation under study, this study will be limited to that extent.
- Effect of the spacing, soil condition have not been factored into the study.
- The study has been limited to study of the carbon sequestered by the various species using an empirical relation uniformly which has been used in the study by Tripathy and Joshi (2015).

1.7 Research Methodology

- It is proposed to carry out quantitative research. After survey of the plantation area and its boundary, the plots for enumeration purpose will be demarcated. Primary data in the form of Girth of the tree at Breast Height (GBH) shall be measured and collected from each plots for each individual tree within the plot.
- Data of all the individual tree having $GBH \geq 25$ cm ($DBH \geq 8$ cm) shall be collected.
- Diameter at Breast Height (DBH) shall be calculated from Girth of the tree at Breast Height (GBH) using the formula $Girth = \pi \times Diameter$.
- Data so collected shall be segregated in species wise information.
- Average DBH for each of the species taken together from all the plots shall be calculated.
- Total Biomass shall be calculated for all the enumerated tree species seperately using the empirical relation $AGB = 34.4703 - 8.0671 D + 0.6589 D^2$; $BGB = 15\%$ of AGB ; $TB = AGB + BG$ where AGB is Above Ground Biomass, BGB is Below Ground Biomass, TB is Total Biomass and D is the Average DBH for the particular species. The estimation of AGB, BGB, TB and carbon sequestered by each species i.e. 50% of the TB shall be made using above empirical relation which has been used by Tripathy and Joshi (2015) in their study.

- The plantation block contains large no of trees. A lot of time and resources in the form of manpower for assistance shall be required. As there is limited and less time available, it is practically difficult to measure the GBH of each individual tree of the plantation. So, randomly some plot within the plantation area of size 20mX20m or 10mX10m or combination of the same shall be selected for the total enumeration.
- Selection of the no of plot for enumeration depends on the time and resources available for carrying out the measurement of all the trees inside the selected plot. So considering constraints it is proposed to select no of plots randomly such that the total area sum of all the randomly selected plots is atleast 10% of the total area of the plantation.
- Total carbon sequestered by the trees of all the species within the enumerated shall be found out by summing up the carbon sequestered by each species and then the total carbon sequestered by the whole plantation shall be computed by multiplying for the factor for the whole area. This will enable to answer the research question and give the carbon sequestered by the decade old young plantation at Hindon Cut plantation and its species.
- The above computation shall also give the information in respect of the each species. A comparative picture can be obtained among the various species and the carbon sequestered.

- The complete exercise for collection of primary data shall be by non destructive method without felling of any tree in process. The rationale for the use of the empirical relation for the assessment of carbon sequestration using the value of DBH is there in the reference by Tripathy and Joshi (2015).

1.8 Chapterisation Scheme

Chapter 1 of the study discusses briefly about urbanisation and increase of the population, built up of the Green House Gases in the air, global concern and international efforts over climate change, role of the forest as a carbon sink. Delhi is one of the most populated. Its green cover is playing significant role in preventing the situation from further deterioration. The green cover of Delhi is under constant threat but due to a sustained effort for its protection and strengthening by creating new plantations the city has managed to keep it intact. The present study aims at determining the role of the young plantation in sequestering carbon. Also the study aims at determining the relative potential of the various species in sequestering carbon from the atmosphere. Objective, rational, research questions, research methodology adopted for the present study, limitation has been discussed in this chapter.

Chapter 2 which is on the literature review, has touched upon the references and studies relating NAPCC, SAPCC of Delhi, National Forest Policy, adverse impact of urbanization on the green cover, role of forest in carbon sequestration, forest of Delhi and strategy to protect and strengthen it, international efforts, Urban Green Guidelines 2014 of MoUD, Ecosystem Services. The impact of urbanization is there on the climate and green cover. Built up area is on increase and so there is pressure on the green cover which

require protection and strengthening. India is committed to the global efforts in reduction of carbon emission. The green cover is playing its role in mitigation of the GHGs from the atmosphere. So in this context the present study aims to ascertain the role played by the young plantations been created in Delhi about a decade back in carbon sequestration and in a way helping into the global efforts and India's commitment on carbon reduction from the atmosphere.

As discussed in chapter 1, the Hindon Cut plantation of East Delhi has been selected for the estimation of carbon sequestered by it and also by the species present over there. This plantation was created about a decade back in 2007-08. The plantation is close to NH-24 on its northern side and it is close to the densely populated neighbouring area. In Chapter-3, it shall be discussed about the steps and action taken for survey, plot selection, no of the plot selected, size of the plots, location of the plots, plot wise trees with GBH. Total 35 no. of plots of size 20mX20m were selected in the plantation for the enumeration purposes.

Chapter 4 is on the result and discussion. In this chapter the data so collected in Chapter 3 has been processed and segregated species wise. The mean DBH of the individual species has been calculated taking the enumerated trees of the species from all the plots together. Thereafter using the empirical relation between DBH and AGB, the AGB has been ascertained for all the species and subsequently using the relation between AGB and BGB the BGB and TB has been calculated. Further, using Total Biomass (TB) data carbon sequestered by each species in the total enumerated plot area has been calculated.

The Chapter 5 discusses about the trend of urbanization, ecosystem services of forest. Since the present study relates to urban green of Delhi, a comprehensive picture of the forest of Delhi has been presented in the chapter. Population of Delhi has increased manifold in recent years. This trend has very adverse impact on the green cover. A sustained effort has been made to protect the existing green cover applying the provisions of various acts and in parallel new plantations have been created in due course of time which plays important role in carbon sequestration.

In Chapter 6 the discussion has been made on the climate change and international efforts to mitigate the presence of GHGs in the air so as to keep the global warming in check. Climate change is a global issue and it is not confined within the national boundaries. Therefore the nations are to exhibit individual as well as collective responsibility to deal with the situation. This chapter highlights the global efforts made to bring the countries on one platform to deal with the issue of climate change. In this direction several concerted efforts has been made through summits, conventions and agreements. Climate Change is one of the 17 SDGs of UN. India has also made commitment toward global efforts on climate change and hence the present study is in line with the global concerns and the efforts.

Finally, in Chapter 7, based on the study conducted on the plantation, information gathered, results of the study, an effort has been made to draw conclusion from the findings on carbon sequestered by the trees of the plantation and recommendations has been made.