Forest Department
Government of NCT of Delhi

सत्यमेव जयते

Report On

"Monitoring and Evaluation of the Works Carried out by Delhi Forest Department under CAMPA Schemes"

Submitted to:
Delhi Forest Department




Submitted by:
Silviculture and Forest Management Division
ICFRE-Forest Research Institute
(October 2024)

Foreword

Delhi Forest Department assigned the task of monitoring and evaluation of plantation activities under Compensatory Afforestation Fund Management and Planning Authority (CAMPA) in four divisions of Delhi to Forest Research Institute (FRI), Dehradun. Delhi has total Forest Cover of

195.44 sq. km which is 13.18 % of the State's geographical area. In terms of forest canopy density classes, the State has 6.72 sq. km under Very Dense Forest (VDF), 56.60 sq. km under Moderately Dense Forest (MDF) and 131.68 sq. km under Open Forest (OF) India State of Forest Report, 2021. The main forest types of NCT of Delhi are the Type Group 5 (Tropical Dry Deciduous Forests) and Type Group 6 (Tropical Thorn Forests). Around 67.35 % of the total forest cover comes under plantation/ TOF and 32.65 % constitute the natural forest, which covers 57.67 sq. km of Delhi's forests. The major tree species in the forests are Dalbergia sissoo, Acacia nilotica, Terminalia arjuna, Syzygium cumini, Melia azadirach, Holoptelea integrifolia, Pongamia pinnata, Tamarix diocia, Bombax ceiba, Butea monosperma, Ficus benghalensis, Ficus religiosa, Pterospermum acerifolium and Zizyphus spp. etc.

Although, the land availability for the plantation in Delhi is very limited but Forest department is undertaking plantations on all types of vacant lands viz, road sides, Yamuna pusta, ridges and on village lands. Compensatory Afforestation Fund Management and Planning Authority (CAMPA) is meant to promote afforestation and regeneration activities as a way of compensating for forest land diverted to non-forest uses. The Compensatory Afforestation Fund Act, 2016 mandates carrying out qualitative and quantitative supervision, monitoring and evaluation of the works being implemented from amounts available in the CAMPA Fund. Monitoring and evaluation is also necessary as it provides evidence that objectives of the project are achieved and if alternative approaches need to be considered to improve effectiveness.

Hence, the Delhi Government entrusted the Forest Research Institute (FRI), Dehradun to take up the monitoring and evaluation of works being carried out by the Delhi Forest Department under CAMPA upto 2020-21. . Recommendations and observations of different sites in the report could be useful in maintenance and management of plantations.

I believe that the present report would be useful to the forest department.

Dr. Renu Singh, IFS
Director ICFRE-FRI

Preface

Delhi, the National Capital Territory (NCT) of India, has a geographical area of 1,483 sq. km, which is 0.05 % of the geographical area of the country. The landscape of Delhi can geographically be divided into three major regions viz the low-lying Yamuna flood plains, the Aravalli ridge and the great Gangetic plains that cover most part of the city. The altitude of the Delhi ranges from 180 m to 316 m above the mean sea level. The population of NCT of Delhi is increasing at a very faster rate. The toxic levels of air pollution in and around Delhi are creating threats to the lives of the residents. Adding to the severity, the changing weather conditions have locked the pollutants in the air and made the situation worse especially in winter season.

The Aravalli mountain range provides the major forests in Delhi. The ridges of Delhi are the fragmented parts of Aravalli which comprises of five fragmented zones namely, Northern Ridge, Central Ridge, South Central Ridge, Southern Ridge and Nanakpura South Central Ridge. The forests on the ridge provide ecosystem services to the population of Delhi and are the foundation of biodiversity.

“Monitoring and evaluation of the works were carried out by Delhi Forest department under CAMPA Schemes for 2021-2022 in four forest divisions of Delhi. Forest department of Delhi undertook massive plantations on all vacant and degraded areas on gram sabha lands, along the roads, ridge areas, river banks, railway lines etc. During auditing of plantations by Forest Research Institute, the monitoring was carried out on different aspects of plantations on the basis of format designed by Ministry of Environment, Forests and Climate Change, Govt. of India.

Richa Misra, IFS
Head, Silviculture & Forest Management Division
ICFRE-FRI

Executive Summary

The State of Forest Report, 2021 has reported that Delhi has total Forest Cover of 195.44 sq. km which is 13.18 % of the State's geographical area. The primary aim of Delhi Forest Department is to maintain 2/3rd of the area under such forest cover in order to prevent erosion and land degradation and to ensure stability of the fragile eco-system keeping in view of massive industrialization, urbanization and vehicular pollution. Vegetation of Delhi is typical Northern Tropical Thorn Forest Type (Champion and Seth 1968). Among trees Acacias such as A. nilotica, A. leucophloea, A. catechu, A. modesta are commonly found. Butea monosperma, Cassia fistula, Salvadora persica. Anogeissus latifolia with abundance of Prosopis juliflora form the major vegetation of the area.

CAMPA aims to compensate the loss of ecosystem and forest land due to diversion of forests for non-forest use through compensatory afforestation, restoration of degraded forest, improvement of wildlife habitats, enrichment of biodiversity, etc.. The task of plantation is enormous and it requires proper monitoring and evaluation so as to successfully achieve the objectives of the project. Monitoring and evaluation will help the policy planers for correct decision making and future management. It is a process that involves on- going and routine collection of information used to assess the efficient use of resources and the extent to which the programme has achieved its objectives in terms of outputs (programme activities) and outcomes and impact (whether the expected benefits to the target population were reached). Monitoring and evaluation of the project is done to know status and the impact of the plantations. Hence, the Government of NCT, Delhi entrusted the Forest Research Institute (FRI), Dehradun to take up the auditing of CAMPA plantations 2011-12, 2012-13, 2014-15 to 2020- 21 in four forest divisions of Delhi Forest Department.

For carrying out monitoring of plantations, all the plantation sites, and 10 percent of the plantation area was sampled for the survey. Moreover,, all sites were surveyed for area verification with GPS. Survival percentage of the plantations was ranging from 86.48 % to 93.61

% in the state. The maximum survival of plants was observed in Anand Vihar range of Central Delhi forest division (93.61 %) and the minimum was found in Rithala STP of North Delhi Forest Division (86.48 %). The growth of plants is found to be satisfactory.

During the monitoring of plantations somewhere serious and specific symptoms of damages by insects and pests have been recorded. Most of the site requires proper fencing for protection of the plantation from cattle and wild animals. The cultural operations like singling, weeding, pruning, watering, soil working etc. could not have been taken up in most of the plantations properly as per the prescriptions. The growth of plants would have improved if the plantations

might have been protected from wild and stray animals and cultural operations could have been carried out timely. The major species planted in the years were Terminalia arjuna, Dalbergia sissoo, Albizia lebbeck, Morus alba, Bauhinia variegata, Acacia catechu, Acacia nilotica, Albizia procera, Terminalia arjuna, Terminalia bellirica, Ficus virens, Syzygium cumini, Ficus benghalensis etc. It is imperative that sites of the plantations and species should be

selected keeping in view of ecology of sites and biotic factors. Protection and maintenance period should be varied for the different sites as per the site conditions.

It is encouraging that this plantation programme has proved the importance of the potent capacities of different species in ameliorating degraded sites and Yamuna bank sites which were hitherto left fallow. This result would definitely persuade others to think for the bioremediation of large tracts adversely affected due to inflow of industrial polluted water and sewerage in Delhi. The presence of varieties of other local species and an array of visiting avifauna ensures a lasting hope for bringing back the natural renewability of the unutilized land in addition to enhancing the green canopy over the area. The plantation will improve forest biomass and sequesters carbon from the environment and thereby will help in mitigation of climate change.

The Division wise overall performance of the average weighted survival of different sites in four forest divisions of Delhi is given below. The field survey was carried out in October 2022.

Division wise status of survival percentage of CAMPA plantations

S. No.	Forest Division	Name of the Site	Year of creation	Area (ha)	Survival Percentage
1.	Central Division	NH-24, adjacent Yamuna Bank metro station near PWD office	2019-2020	1.81	93.61 %
2.	Central Division	NH-24, Near PWD office	2020-2021	10	89.73 %
3.	Central Division	NH-24 between CWG village and Yamuna Bank Metro Station	2020-2021	35.73	90.05 %
4.	Central Division	Shastri Park- Near Metro Station	2015-2016	8.354	93.59 %
5.	North Division	Rithala Sewage treatment Plant/ DSC Pump House	2015-2016	0.28	86.48 %
6.	South Division	Asola Bhatti	2011-12	100	88 %
7.	Central Division	Bela Farm (Near Shastri Park))	2016-2017	19.9	Inaccessible due to flood.
	Grand Total			176.074	

Project Implementation Team

Project Coordinators

Dr. Renu Singh, IFS; Director, ICFRE FRI, Dehraddun

Sh. C.D. Singh, IFS, Principal Chief Conservator of Forest, Govt. of NCT Delhi

Smt. Richa Mishra; IFS, Head, Silviculture & Forest Management Division, ICFRE-FRI

Mr. Vijay Ratre; IFS, AS (G), Silviculture & Forest Management Division, ICFRE-FRI

Principal Investigator

Mr. Mohit Husain, Scientist-C, ICFRE-FRI, Dehradun

Report Preparation Team

Mr. Mohit Husain, Scientist-C, ICFRE-FRI, Dehradun

Sh. Vedpal Singh; Scientist-D, ICFRE-FRI, Dehradun

Team Members from Delhi Forest Department

Dr. Surabhi Rai, IFS, Conservator of Forest,Govt. of NCT Delhi

Sh. Amit Anand, IFS, DCF, Govt. of NCT Delhi

CHAPTER 1

Introduction

Introduction

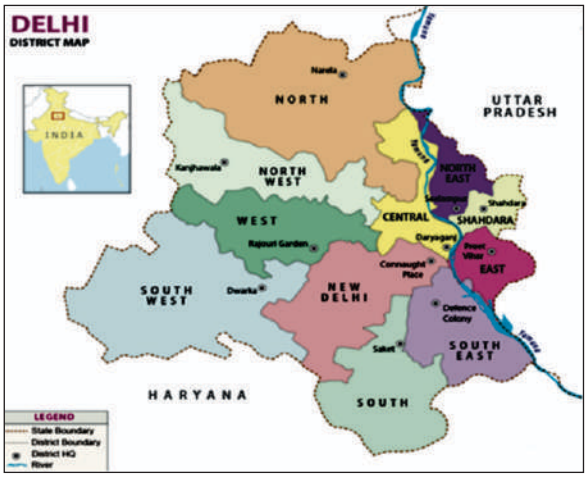
Delhi, officially the National Capital Territory (NCT) of Delhi, is a city and a union territory of India containing New Delhi, the capital of India. NCT of Delhi stretches along the western bank of the river Yamuna between 28o 22' and 28o 54' North latitude and 76o 48' and 77o 23' East longitude. It is surrounded on the south-east by Thar Desert, on the north-east by the Indo- Gangetic plains and in the south by the Aravalli. Due to its location, the NCT of Delhi, which is

58.3 km in length and 48 km in width, has a diversity of physiographic features as well as vegetation. The NCT covers an area of 1,484 sq. km (FSI 2021). It is one of the greenest metros in the country. The city has experienced tremendous growth in the recent times, with increasing developmental activities.

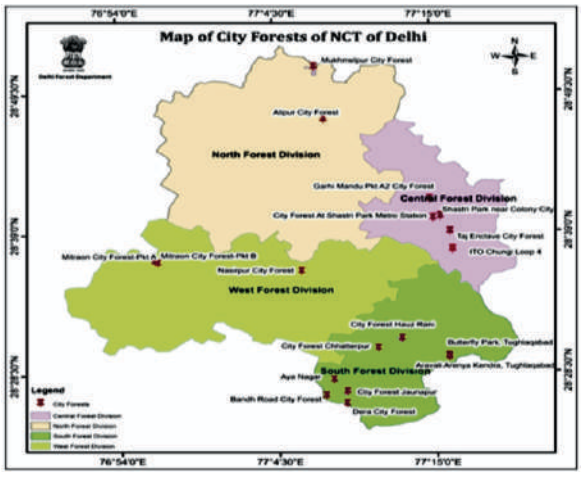
The plantations under CAMPA in the state of Delhi have been created as part of Compensatory Afforestation against projects for which forest land has been diverted for non-forestry purposes.. Compensatory Afforestation under CAMPA was carried out in Delhi in the year 2011-12 over an area of 100 ha degraded forest land against diversion of wherein about 40.67 ha of forest land was diverted for various developmental projects after prior approval of the MoEF&CC, GoI . In the years 2015-16 and 2016-17, Compensatory Afforestation (CA) was undertaken over an area of about 28 ha against diversion of 27.32 ha forest land for construction of Metro stations by DMRC.

The task of plantation scheme is enormous; it requires proper monitoring and evaluation of all the works so as to successfully achieve the objective. Monitoring and evaluation will help the policy planners for decision making and future management. Delhi Forest Department has entrusted FRI, Dehradun for carrying out third party monitoring and evaluation of CA plantations under CAMPA.

In addition to this, the Forest department under the Government of Delhi supervises and monitors various activities such as distribution of seedlings to public, government departments and institutions, plantations on gram sabha lands, along the roads, ridge area, railways lines etc.



Map of Delhi



Map of divisions of city forest of NCT Delhi

1.1 FOREST SCENARIO

Forests are the storehouse of Biodiversity. They play a vital role in the protection and improvement, foster a wide variety of fauna apart from giving life saving oxygen, acting as a sink for the greenhouse gases, and play a vital role in Soil and Moisture Conservation and ground water recharge. To maintain ecological balance and to ensure environmental stability, it is essential to propagate, protect and preserve our valuable forest resources.

Forest Types of Delhi: As per the Champion and Seth (1968) classification of forest types of India, the forests in Delhi belong to the Type Group 5 (Tropical dry deciduous forest) and Type Group 6 (Tropical thorn forests). Around 112.28 sq. km (57.36 % of the total area) comes under TOF/plantation (FSI, 2021).

Table 1.1: Details of forest resources.

S. No.	Forest types	Area (sq. km)	Forest type (%)
1.	5B/C2 Northern dry mixed deciduous forest	20.51	10.48
2.	6B/C2 Ravine thorn forest	62.95	32.16
	Sub Total	**83.46**	**42.64**
3.	TOF/Plantation	112.28	57.36
	Total (Forest cover and Scrub)	**195.74**	**100.00**

Forest cover of NCT Delhi

Forest cover of NCT Delhi is classified into very dense forest, medium dense forest, open forest and scrub forest. Distribution of above classes is given below:

Table 1.2: Details of forest cover

Class	Area (sq. km)	% Total geographic area (GA)
Very Dense Forest (VDF)	6.72	0.45
Medium Dense Forest (MDF)	56.60	3.82
Open Forest (OF)	131.68	8.88
Total	**195.00**	**13.15**
Scrub	**0.38**	**0.03**

(Source-India State of Forest Report. 2021)

Table 1.3: Details of growing stock.

S. No.	Growing Stock (GS)	2021 Assessment (million cubic meters)
1.	Growing Stock in recorded forest area	0.51
2.	Growing Stock in TOF	1.75

(Source-India State of Forest Report. 2021)

Table 1.4: Diameter class distribution of top five tree species inside recorded forest area in Delhi.

S. No.	Species	Diameter Class (cm)		
		10-30	30-60	>60
1.	Prosopis juliflora	475	25	6
2.	Acacia lenticularis	172	8	0
3.	Azadirachta indica	45	18	0
4.	Holoptelea integrifolia	33	4	0
5.	Ficus virens	6	8	0

Source-India State of Forest Report 2021

Table 1.5: List of species planted under CAMPA schemes by Delhi forest department.

S. No.	Scientific Name	Common Name	Family
1.	*Acer species*	Maple	Sapindaceae
2.	*Aegle marmelos*	Beal	Rutaceae
3.	*Albizia lebbeck*	Siris	Fabaceae
4.	*Anthocephalus cadamba*	Kadamba	Rubiaceae
5.	*Artocarpus heterophyllus*	Jack fruit	Moraceae
6.	*Azadirachta indica*	Neem	Meliaceae
7.	*Bauhinia variegata*	Kachnar	Fabaceae
8.	*Bombax ceiba*	Semal	Malvaceae
9.	*Butea monosperma*	Palash	Fabaceae
10.	*Cordia myxa*	Lasoda	Boraginaceae
11.	*Cassia fistula*	Amaltas	Fabaceae
12.	*Cassia siamea*	Kassod	Fabaceae
13.	*Ceiba pentandra*	Kapop	Malvaceae
14.	*Dalbergia sissoo*	Shisham	Fabaceae
15.	*Emblica officinalis*	Amla	Phyllanthaceae
16.	*Ficus benghalensis*	Bargad	Moraceae
17.	*Ficus recemosa*	Gular	Moraceae
18.	*Ficus religiosa*	Peepal	Moraceae
19.	*Ficus virens*	Pilkhan	Moraceae
20.	*Helicteres isora*	Marod phali	Malvaceae
21.	*Jacaranda mimosifolia*	Jacaranda	Bignoniaceae
22.	*Mimusops elengi*	Maulsari	Sapotaceae
23.	*Mitragyna parvifolia*	Kaim	Rubiaceae
24.	*Morus alba*	Shahtoot	Moraceae
25.	*Pithecellobium dulce*	Jungle jalebi	Fabaceae
26.	*Pongamia pinnata*	Karanj	Fabaceae
27.	*Psidium guajava*	Amrood	Myrtaceae
28.	*Schleichera oleosa*	Kusum	Sapindaceae
29.	*Syzygium cumini*	Jamun	Myrtaceae
30.	*Terminalia arjuna*	Arjun	Combretaceae
31.	*Terminalia bellirica*	Bahera	Combretaceae
32.	*Ziziphus mauritiana*	Ber	Rhamnaceae

CHAPTER 2

Monitoring and Evaluation

Monitoring and Evaluation

2.1 Study Sites

The monitoring and evaluation works of plantation works of plantations under NCT Delhi CAMPA was carried out by Forest Research Institute, Dehradun during the period from 2011-12, 2012-13, 2014-15 to 2020-21.The plantation work under NCT Delhi CAMPA schemes and its components Compensatory Afforestation (CA) and Net Present Value (NPV) was carried out in three Forest Divisions namely North, South and Central.

Total seven plantation sites were monitored by adopting random sampling method with total plantation area of 176.074 ha. Division wise details of the sites selected and area covered for monitoring of the plantations under NCT Delhi CAMPA is provided in below Table-2.1

Table 2.1: Details of the sites covered.

S. No.	Name of Division	Year of creation	Scheme	Name of the Site	Area (ha)	Survival Percentage
1.	Central Division	2019-2020	Delhi CAMPA	NH-24, adjacent Yamuna Bank metro station near PWD office	1.81	93.61 %
2.	Central Division	2020-2021	Delhi CAMPA	NH-24, near PWD office	10	89.73 %
3.	Central Division	2020-2021	Delhi CAMPA	NH-24, between CWG Village and Yamuna Bank metro station	35.73	90.05 %
4.	Central Division	2015-2016	Delhi CAMPA	Shastri Park-Near metro station	8.354	93.59 %
5.	North Division	2015-2016	Delhi CAMPA	Rithala Sewage treatment Plant/ DSC Pump House	0.28	86.48 %
6.	South Division	2011-2012	Delhi CAMPA	Asola Bhatti	100	88 %
7.	Central Division	2016-2017	Delhi CAMPA	Bela Farm (Near Shastri Park)	19.9	Inaccessible due to flood
	Grand Total				**176.074**	

2.2. Evaluation and Process

2.2.1 Methodology

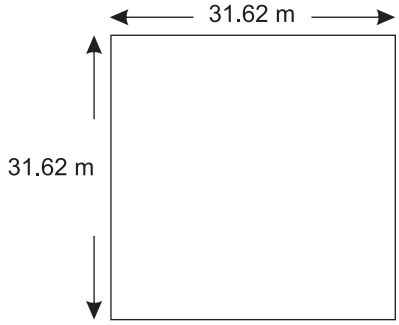
Monitoring and evaluation works under CAMPA were carried out by selecting sample plots (area 0.1 ha = 31.62 m × 31.62 m) in each plantation's area considered as a unit. Moreover, the size of plots and category of plantations were also taken into consideration for

representation of all units. The random sampling strategy was adopted for the selection of sample plots in all plantation areas. The selected plantation sites were traversed and plantation area verified by recording the Global Positioning System (GPS) locations. Entire plantation was assessed for small area (< 0.5 ha) but in bigger area it required sampling of 10% of the total area of each forest for data collection. In each patch up to size of 5 ha, 5 sample plot of 0.1 ha were laid, in patch of 5-10 ha 5-10 plots of 0.1 ha were laid, in case of patch with area 10-15 ha, 10-15 sample plots 0.1 ha, and for 15-20 ha size patch a total of 15-20 sample plots 0.1 ha were laid randomly for monitoring.

Plantation area size (ha)	Number of sample plots	Area covered by each sample plot (ha)	Sampling Intensity (%)	Total covered area (ha)
Less than 05	05	0.1	10	0.5
05-10	05-10	0.1	10	0.5-1.0
10-15	10-15	0.1	10	1.0 1.5
15-20	15-20	0.1	10	1.5 -2.0

Note: **Complete enumeration will be done for a site having area less than 1.0 ha.**

The physiography, ground patterns, habitations and relief as well as vegetation type of the sites were duly considered for organization of study zones.



Layout of sample plot (area 0.1 ha = 31.62 m × 31.62 m)for enumeration

2.2.2 Indicators for Monitoring and Evaluation

For the monitoring and evaluation of the plantations under the project an indicator framework was developed in consultation with the Delhi Forest Department. These indicators were simple, measurable yardsticks for assessing the plantations in terms of their effectiveness, relevance, sustain ability. Also these indicators were finalized in concordance with the needs for output, outcome and impacts of the scheme in the plantation sites with respect to bio-diversity conservation. By using these indicators, the information pertaining to various parameters such as plantation scheme, species selection, plantation methodology and health of plantations, survival rate and other was generated during the field sampling in the sampled plantation patches.

The major indicators for data collection are provided below:
- Plantation scheme and its components
- Choice of species in the sites
- Selection of the planting site
- Planting methods size of the pits/trenches including earth work done
- Spacing of the pits
- Time of planting
- Health of the plants
- Cultural operations (hoeing, weeding, soil working etc.)
- Protection status of the plantation
- Management of plantations (causality replacement, watering, pruning, thinning etc.)
- Growth and survival of plants.

2.2.3 Collection of field data

The primary and secondary data were collected for raised plantation sites. The primary data was collected from the sites with help of the officials of forest departments and secondary data collected from the various records as well as from the forest officers of the respective forest divisions. The primary data were recorded in the prepared questionnaire. Some data was also collected from field observation in selected sites.

The data collected for plantation work was carried out under Delhi CAMPA and its components viz., NPV and CA during the period from 14 October 2022 to 22 October 2022. The parameters used for assessing the plantation work were choice of species with respect to the requirement of sites, local communities need about the species, readiness of planting such as cleaning and preparation of sites, advance pitting for proper weathering, temporary arrangement for storage of seedlings and arrangement for irrigation before planting, soil working and weeding immediately after planting and causality replacement of plant if required. In addition to above the ecological aspects such as soil and water conservation activities undertaken under the scheme in different plantations sites were also observed to understand their impact at these sites. Efforts were also made to understand the socio-economic issues in terms of fuel and fodder supply and improvement in water table by interacting with local people. Biodiversity aspect of the plantation activity was also recorded by conducting vegetation analysis in plantation sites and presence of wild fauna during the survey. The data for the monitoring and evaluation of the plantation sites was collected by experts from Silviculture and Forest Management Division. The collected data was compiled, tabulated and then analyzed for the preparation of final report.

2.2.4 Compilation and analysis of field data

The field data collected from Silviculture and Forest Management Division team were compiled and tabulated. The field data of each site was compiled range/site wise. The survival of plants was calculated by using data on number of plants of each species planted from the plantation's journal to the actual number of plants observed in the fields. The average height and diameter of each species is also compiled for observation of growth of plants.

CHAPTER 3

Forest Division-Wise Monitoring Evaluation

Forest Division-Wise Monitoring Evaluation

The Delhi Forest Department has four territorial divisions namely; Central, North, South and West. Monitoring and evaluation of CA plantations undertaken under CAMPA in Central, North and South forest division was carried out. The details are as follow.

I. Central Forest Division

The monitoring and evaluation of the plantations raised under Delhi CAMPA and its components for the year 2021-2022 were carried out by the team of Forest Research Institute, Dehradun in October, 2022.

Site 1: NH-24, adjacent Yamuna Bank metro station near PWD Office (1.81 ha)

Field Observations

1) It was observed that the site was infested with the weed which requires intensive weeding and soil working for the better growth of the plantation.

2) The plantation was damaged by the wild and domestic animals namely neelgai, buffaloes, cow etc. Effective fencing is required in the site for protection of plants from these animals.

3) Well maintained plantation journal is available at department and they keep posted up-to-date information on it.

4) As per the statement of field staff, Senior Forest Officers (DFO, CF and CCF) visited the planting site but record of field visit by the officers was not maintained in the plantation journal.

5) Mixed species namely Dalbergia sissoo, Ficus racemosa, Syzygium cumini, Cassia fistula, Terminalia bellirica, Terminalia arjuna, Albizia lebbeck, Azadirachta indica, Emblica oficinalis, Ficus religiosa, Neolamarckia cadamba, Aegle marmelos and Morus alba were planted on the site and the planted species was found suitable for the site.

6) Growth characteristics like diameter and height of the planted plants was found well.

7) Planting was done in pits with pit size of 60 cm x 60 cm and plant to plant distance of 3m x 3m was observed at the site. Line to line gap is also 3 meter.

8) Average height of plants is ranging from 1.67 meter to 5.3 meter.

9) The total area of the plantation site was 1.81 ha as verified by GPS.

10) As per sampling procedure site were selected randomly for data collection. GPS coordinates of each sample plot (area equivalent to 0.1 ha) were recorded and presented in the Appendix-I. The plantation was done in patches. The data collection, field observations, survival of the plantation of selected site in all forest range are given below:-

Table 3.1: Yamuna Bank (near P.W.D. Office) sample site under Delhi CAMPA.

S. No.	Name of Forest Division	Name of Site	Area (ha)	Year of Plantation	Survival percentage	Component
1.	Central Division	NH-24, adjacent Yamuna Bank metro station near PWD office	1.81	2019-2020	93.61%	Delhi CAMPA

Plantation Growth Observation

The average survival of 93.61 % was observed at Yamuna bank (near P.W.D. Office) site of Anand vihar forest range. The maximum height (5.3 m) was recorded for Ficus virens followed by *Ficus religiosa* (4 m) and minimum height (1.67 m) was recorded for Syzygium cumini and Dalbergia sissoo (2.5 m). The maximum diameter (113 mm) was recorded for Ficus virens followed by *Terminalia bellirica* (107.66 mm) and minimum diameter (28.62 mm) for Syzygium cumini and Emblica officinalis (53.5 mm).

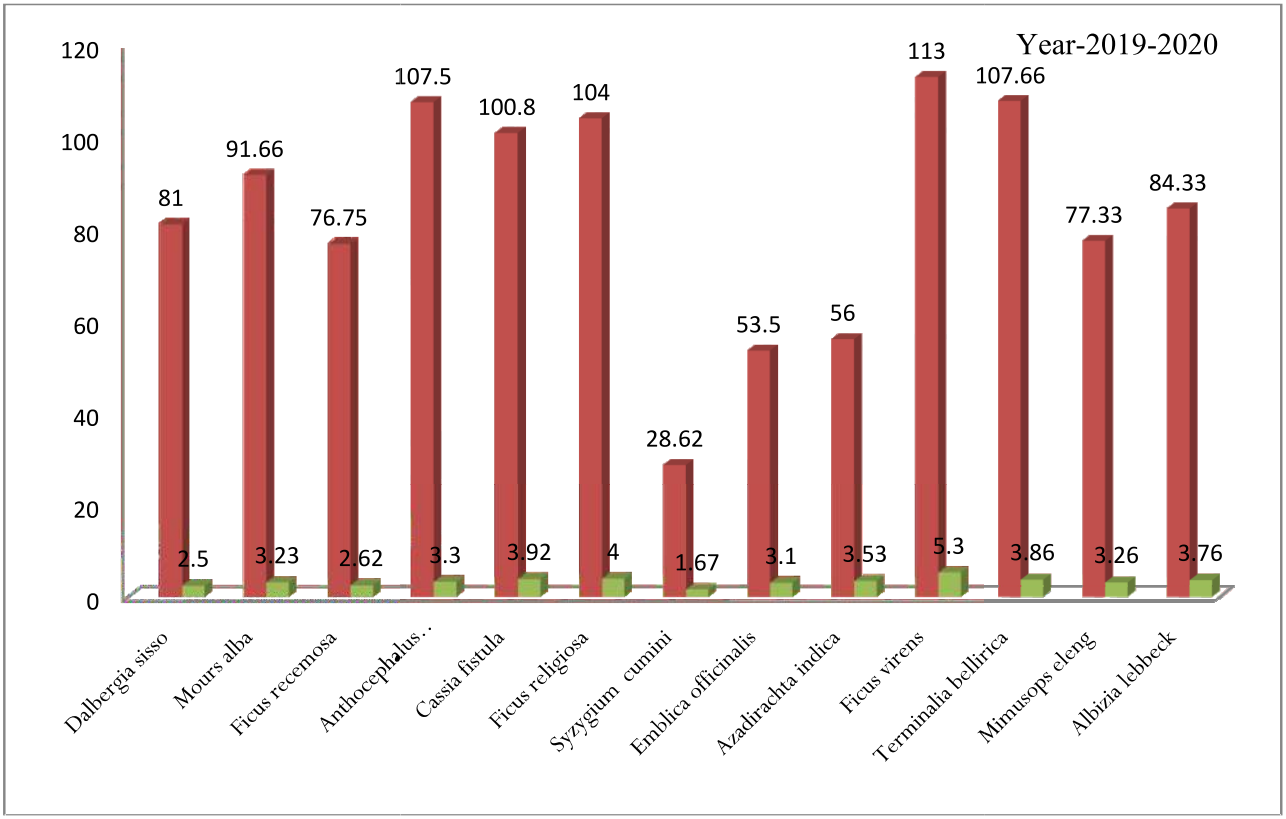


Figure 3.1: Plantation growth under Delhi CAMPA in Yamuna Bank (near P.W.D. Office).

Plantation at Yamuna Bank (near P.W.D. Office)

Insect attack on plantation

Measurement of collar diameter

View of plantation site

Field Observations

1) Mixed species namely Dalbergia sissoo, Ficus racemosa, Ficus infectoria, Syzygium, cumini, Ficus racemosa, Cassia fistula, Terminalia arjuna, Azadirachta indica, Emblica officinalis, Ficus religiosa, Neolamarckia cadamba and Morus alba were planted on the site and the planted species was found suitable for the site.
2) Average height of plants is ranging from 1.15 to 11.6 meter.
3) Watcher was engaged on the site for care of plants.
4) Fencing was not done in the planting area, which requires effective fencing for protection of plants from wild and domestic animals like neelgai, buffaloes and cow. It was observed at the site that the plants were damaged by these wild animals as well as domestic animals.
5) Plantation journal is available of planting site and up-to-date record/information posted in the journal.
6) As per the statement of field staff, Senior Forest Officers (DFO, CF and CCF) visited the planting site but record of field visit by the officers was not available.
7) Plants perform well at the site in terms of growth.
8) Planting was done in pits; pit size 60 cm x 60 cm and plant to plant distance 3 m x 3 m are maintained. Line to line gap is also 3 meter.
9) Total area of plantations was 10.0 ha as verified by the GPS.
10) As per sampling procedure site were selected randomly for data collection. GPS coordinates of each sample plot (area equivalent to 0.1 ha) were recorded and presented in the Appendix-I. The plantation was done in patches. The data collection, field observations, survival of the plantation of selected site in all forest range are given below:-

Table 3.2: Yamuna bank (near P.W.D. Office) sample site under Delhi CAMPA.

S. No.	Name of Forest Division	Name of Site	Area (ha)	Year of Plantation	Survival percentage	Component
1.	Central Division	Yamuna bank (near P.W.D. Office)	10.0	2020-2021	89.73%	Delhi CAMPA

Plantation Growth Observation

The average survival of 89.73 % was observed at Yamuna bank (near P.W.D. Office) site of Anand vihar forest range. The maximum height (11.6 m) was recorded for Pongamia pinnata followed by Azadirachta indica with height of 5.8 m and the minimum height of 1.15 m was recorded for Butea monosperma and Psidium guajava (1.76 m).The maximum diameter of 103 mm was recorded for Ficus virens followed by Ficus benghalensis with 99 mm diameter and minimum diameter (35 mm) for both Butea monosperma and Emblica officinalis.

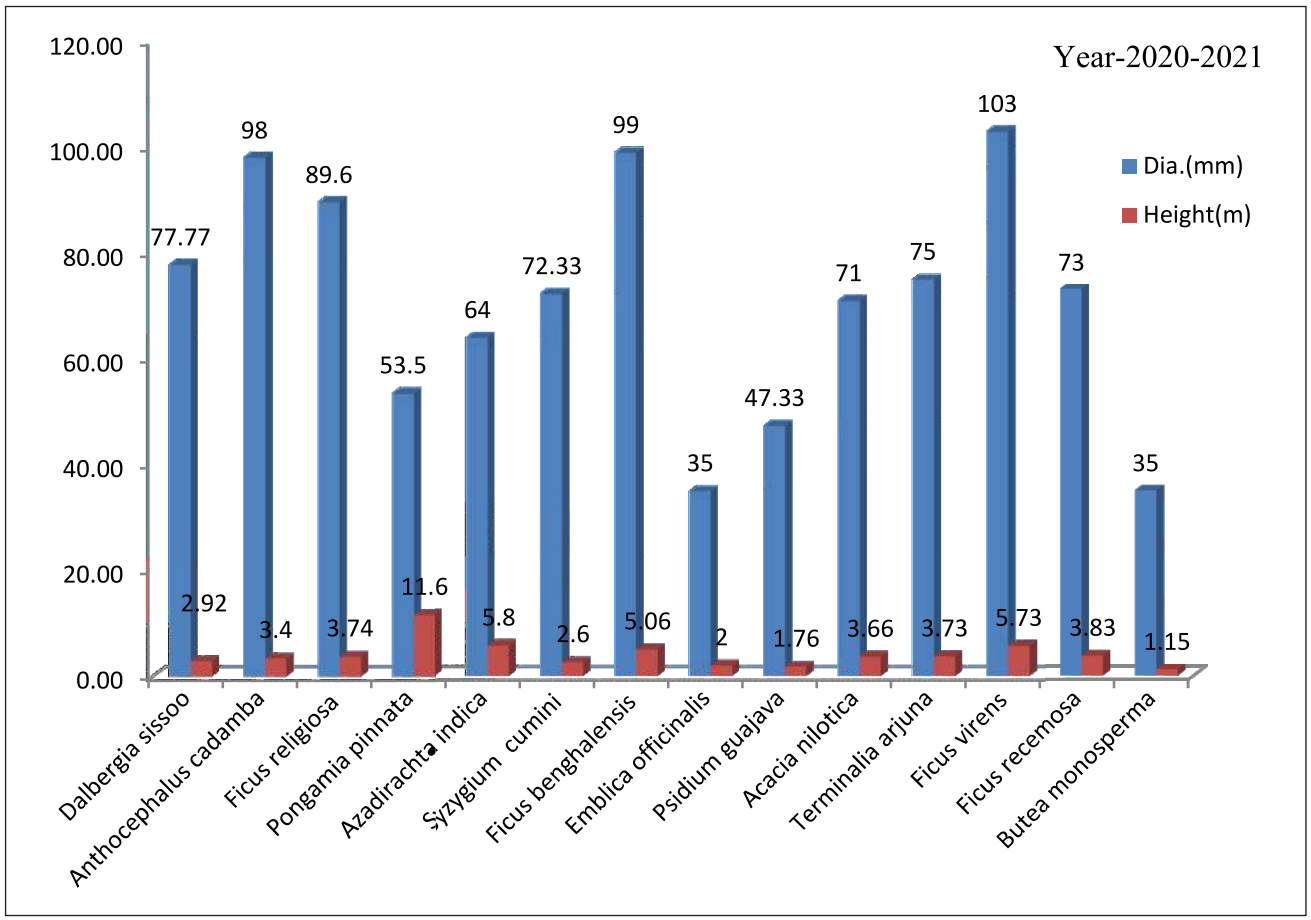


Figure 3.2: Plantation growth under Delhi CAMPA in Yamuna bank (near P.W.D. Office.)

Laying out sample plot at plantation site

View of plantation site

Sign Board at plantation site

Plant damaged by cattle

Site 3: Yamuna bank metro station
Field Observations

1) Mixed species namely (Dalbergia sissoo, Ficus racemosa, Ficus infectoria, Ficus benghalensis, Syzygium cumini, Ficus racemosa, Aegle marmelos, Acacia catechu Bombax ceiba, Cassia fistula, Psidium guajava, Terminalia arjuna, Azadirachta indica, Emblica officinalis, Ficus religiosa, Neolamarckia cadamba and Morus alba) were planted on the site and the planted species was found suitable for the site.
2) Average height of plants is ranging from 1.85 meter to 5.33 meter.
3) The plantation was damaged by the wild and domestic animals namely neelgai, buffaloes, cow etc. Effective fencing is requiredin the site for protection of plants from these animals.
4) Well maintained plantation journal is available at department and they keep posted up-to-date information on it.
5) As per the statement of field staff, Senior Forest Officers (DFO, CF and CCF) visited the planting site but record of field visit by the officers was not maintained in the plantation journal.
6) Growth characteristics like diameter and height of the planted plants was found well.
7) Planting was done in pits with pit size of 60 cm x 60 cm and plant to plant distance of 3 m x 3 m was observed at the site. Line to line gap is also 3 meter. Watcher was engaged on the site for care of plants.
8) The area of plantations was 35.73 ha as verified by GPS.
9) As per sampling procedure site were selected randomly for data collection. GPS coordinates of each sample plot (area equivalent to 0.1 ha) were recorded and presented in the Appendix-I.

The plantation was done in patches. The data collection, field observations, survival of the plantation of selected site in all forest range are given below:-

Table 3.3: Yamuna bank (near P.W.D. Office) sample site under Delhi CAMPA.

S. No.	Name of Forest Division	Name of Site	Area (ha)	Year of Plantation	Survival percentage	Component
1.	Central Division	NH-24 Between CWG village & Yamuna Bank Metro Station	35.73	2020-2021	90.05%	Delhi CAMPA

Plantation Growth Observation

The average survival 90.05 percentage of the plants were found at Yamuna bank metro station site of Anand Vihar forest range. The maximum height (5.3 m) was recorded for Mitragyna parvifolia followed by Anthocephalus cadamba and Ficus recemosa (5.1 m) and minimum height (1.7 m) was recorded for Cordia myxa and Ficus benghalensis (1.8 m).The maximum diameter (144.33 mm) was recorded for Anthocephalus cadamba followed by Mitragyna parvifolia (141.66 mm) and minimum diameter (28 mm) for Cordia myxa and Terminalia arjuna (38.75 mm).

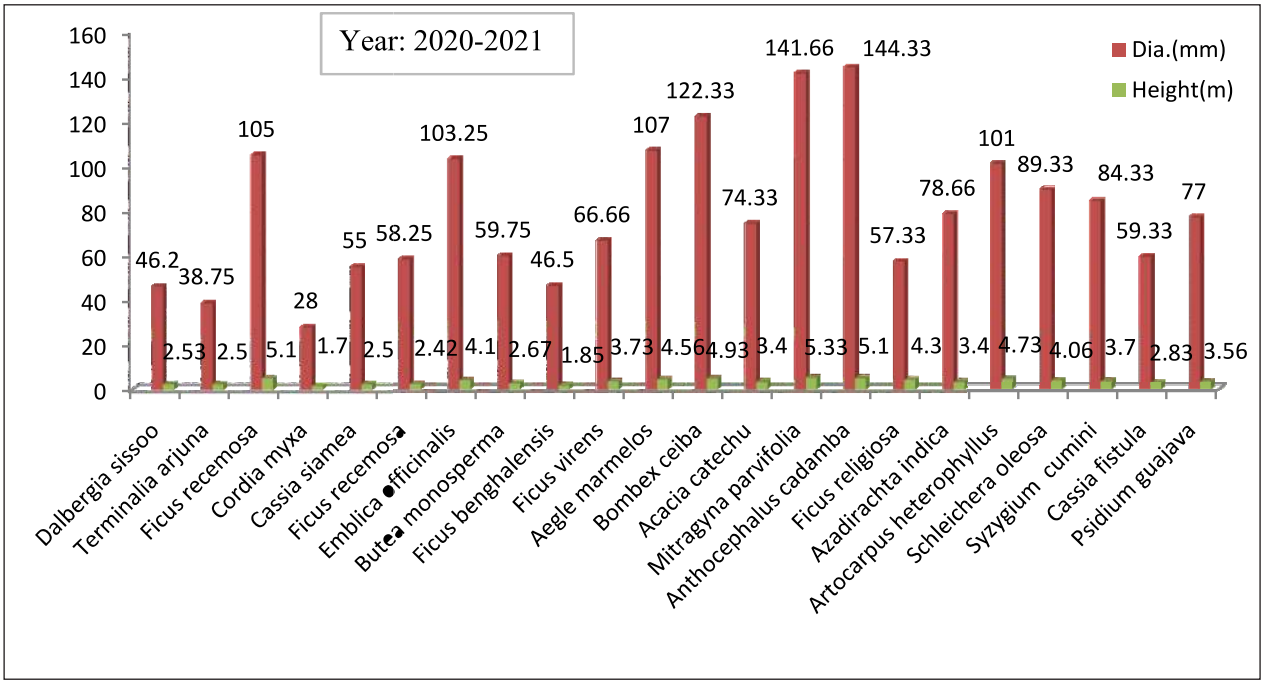


Figure 3.3: Plantation growth under Delhi CAMPA schemes in Yamuna bank metro station.

Plantation at Yamuna Bank Metro Station

Sign Board at plantation site

Plantation View

Laying out sample plot at plantation site

Site 4: Shastri Park-Near Metro Station

Field Observations

1) Average height of plants is ranging from 2 meter to 8 meter.
2) Barbed wire fencing with cemented pole done on the site which is effective to control the wild animals as well as pet animals.
3) Plantation Journal was not available for this site.
4) It was observed that the site was infested with the weed which requires intensive weeding and soil working for the better growth of the plantation.
5) Mixed species namely Dalbergia sissoo, Ficus racemosa, Syzygium cumini, Cassia fistula, Terminalia belerica, Terminalia arjuna, Albizia lebbeck, Azadirachta indica, Emblica officinalis, Ficus religiosa, Neolamarckia cadamba, Aegle marmelos and Morus alba were planted on the site and the planted species was found suitable for the site.
6) Growth characteristics like diameter and height of the planted plants was found well.
7) Planting was done in pits with pit size of 60 cm x 60 cm and plant to plant distance of 3 m x 3m was observed at the site. Line to line gap is also 3 meter.
8) The total area of the plantations site was 8.354 ha as verified by GPS.
9) As per sampling procedure site were selected randomly for data collection. GPS coordinates of each sample plot (area equivalent to 0.1 ha.) were recorded and presented in the Appendix-I. The plantation was done in patches. The data collection, field observations, survival of the plantation of selected site in all forest range are given below:-

Table 3.4: Shastri Park-Near Metro Station sample site under Delhi CAMPA.

S. No.	Name of Forest Division	Name of Site	Area (ha)	Year of Plantation	Survival percentage	Component
1.	Central Division	Shastri Park- Near Metro Station	8.354	2015-2016	93.59%	Delhi CAMPA

Plantation Growth Observation

The average survival 93.59 percentage of the plants were found at Shastri park-near metro station site of Shastri park forest range. The maximum height (8 m) was recorded for Ceiba pentandra followed by Bombex ceiba and Delonix regia (7 m) and minimum height (2 m) was recorded for Acer species and Terminalia arjuna (2.5 m). The maximum diameter (207 mm) was recorded for Ceiba pentandra followed by Helicteres isora (165 mm) and minimum diameter (55 mm) for Terminalia arjuna and Acer species (84 mm).

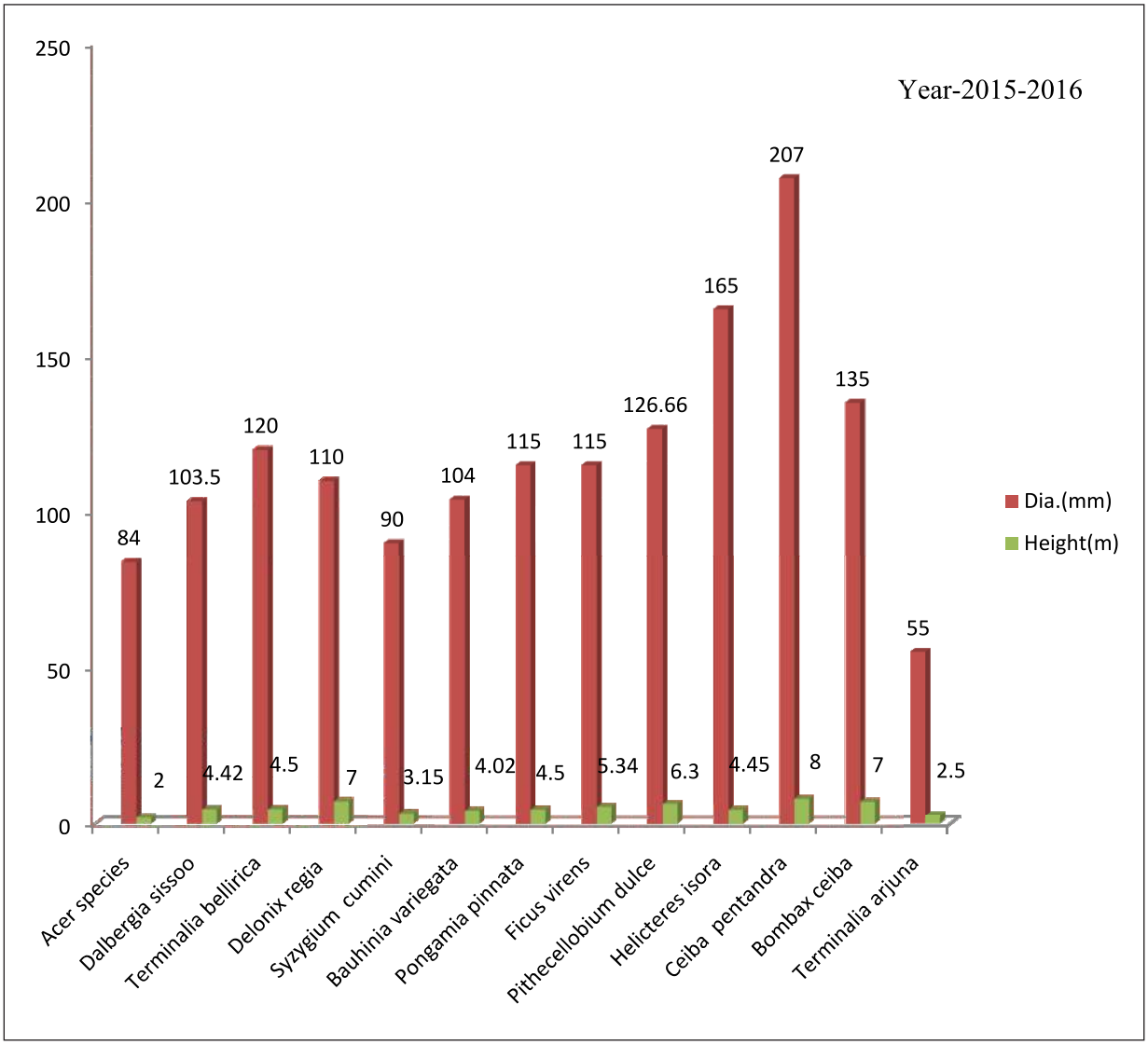


Figure 3.4: Plantation growth under Delhi CAMPA in Shastri park near metro station.

Plantation at Shastri park-near metro station

Measurement of collar diameter

Insect attack on plantation

FRI inspection team with forest officers

Site 5: North Forest Division, Nangloi sewage treatment plant/ DSC pump house

Field Observations

1. It was observed that the site was infested with the weed which requires intensive weeding and soil working for the better growth of the plantation.
2. Average height of plants is ranging from 7.35 meter to 11 meter.
3. Termite infection observed on the site, anti termite treatment requires on the site.
4. Mixed species namely Dalbergia sissoo, Delonix regia, Ficus benghalensis, Ficus infectoria, Ficus religiosa, Syzygium cumini, Terminalia arjuna, Azadirachta indica, Cassia fistula and Cordia myxa were planted on the site and the planted species was found suitable for the site.
5. Plantation journal is not available of planting site.
6. As per the statement of field staff, Senior Forest Officers (DFO, CF and CCF) visited the planting site but record of field visit by the officers was not available.
7. Growth characteristic of the like diameter and height of the planted plants was found well.
8. Planting was done in pits with pit size of 60 cm x 60 cm and plant to plant distance of 3 m x 3 m was observed at the site. Line to line gap is also 3 meter.
9. The total area of the plantations site was 0.28 ha as verified by GPS.
10. As per sampling procedure site were selected randomly for data collection. GPS coordinates of each sample plot (area equivalent to 0.1 ha) were recorded and presented in the Appendix-I. The plantation was done in patches. The data collection, field observations, survival of the plantation of selected site in all forest range are given below:-

Table 3.5: Nangloi sewage treatment plant/ DSC pump house sample site under Delhi CAMPA.

S. No.	Name of Forest Division	Name of Site	Area (ha)	Year of Plantation	Survival percentage	Component
1.	North Division	Rithala Sewage treatment Plant/DSC Pump House	0.28	2015-2016	86.48%	Delhi CAMPA

Plantation Growth Observation

The average survival 86.48 percentage of the plants were found at Nangloi sewage treatment plant/ DSC pump house in Nangloi forest range. The maximum height (11 m) was recorded for Prosopis juliflora followed by Delonix regia (9.65 m) and minimum height (6.7 m) was recorded for Azadirachta indica and Ficus benghalensis (7.35 m). The maximum diameter (299 mm) was recorded for Prosopis juliflora followed by Ficus religiosa (234 mm) and minimum diameter (136 mm) for Terminalia arjuna and Ficus benghalensis (157.5 mm).

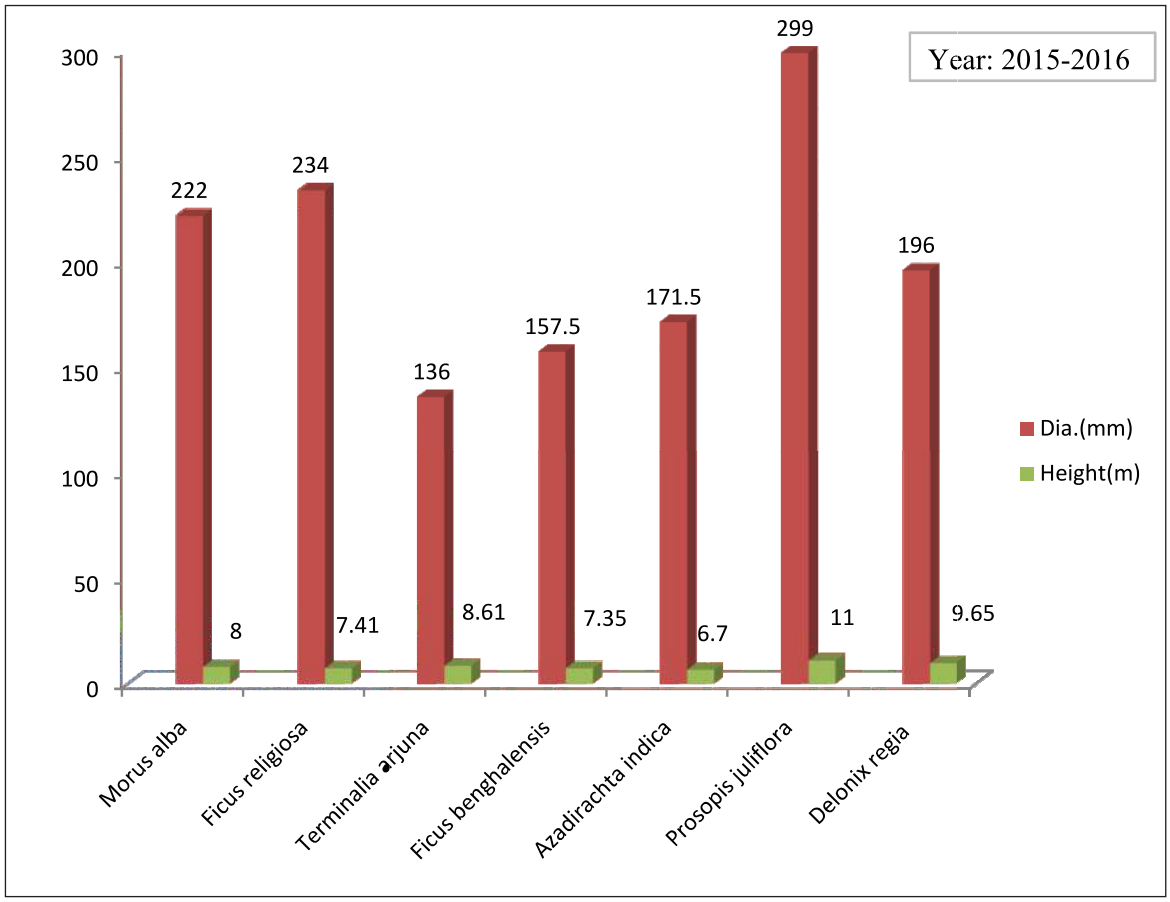


Figure 3.5: Plantation growth under Delhi CAMPA in Nangloi sewage treatment plant/ DSC pump house.

Sign Board at plantation site

Termite attack on tree

Plantation at Nangloi Sewage treatment Plant/ DSC Pump House

Dead plant

Site 6: South Delhi Forest Division, AsolaBhatti

Field Observations

1) Mixed species namely; Acacia nilotica, Acacia catechu, Acacia leucophloea, Holoptelia integrifolia, Dalbergia sissoo, Bamboo species ,Tectona grandis, Melia dubia, Pithecellobium dulce, Pongamia pinnata, Cassia fistula, Syzygium cumini, Neolamarckia cadamba and Morus alba were planted on the site and the planted species was found suitable for the site.
2) Average height of plants is ranging from 2.5 meter to 6 meter.
3) Termite infection found in some plants on the site, anti termite treatment require in some plants on the site.
4) It was observed that the site was infested with the weed which requires intensive weeding and soil working for the better growth of the plantation.
4) Browsing are found on the site by wild animals as well as pet animals.
5) Pruning and thinning are required in some plants.
6) Plantation journal is not available of planting site.
7) As per the statement of field staff, Senior Forest Officers (DFO, CF and CCF) visited the planting site but record of field visit by the officers was not maintained in the plantation journal.
8) Growth characteristics like diameter and height of the planted plants was found well.
9) Planting was done in pits with pit size of 60 cm x 60 cm and plant to plant distance of 3 m x 3m was observed at the site. Line to line gap is also 3 meter.
10) The total area of the plantations site was 100 ha as verified by GPS.
11) As per sampling procedure site were selected randomly for data collection. GPS coordinates of each sample plot (area equivalent to 0.1 ha) were recorded and presented in the Appendix-I. The plantation was done in patches. The data collection, field observations, survival of the plantation of selected site in all forest range are given below:-

Table 3.6: Asola Bhatti sample site under Delhi CAMPA.

S. No.	Name of Forest Division	Name of Site	Area (ha)	Year of Plantation	Survival percentage	Component
1.	South Division	Asola Bhatti	100	2011-12	88%	Delhi CAMPA

Plantation Growth Observation

The average survival 88 percentage of the plants were found at Asola Bhatti forest range. The maximum height (6 m) was recorded for Anthocephalus cadamba followed by Acacia leucophloea (5.66 m) and minimum height (2.5 m) was recorded for Dalbergia sissoo and Pithecellobium dulce (3 m). The maximum diameter (223 mm) was recorded for Anthocephalus cadamba and Prosopis juliflora (85 mm) and minimum diameter (45 mm) for Pithecellobium dulce and Dalbergia sissoo (65 mm).

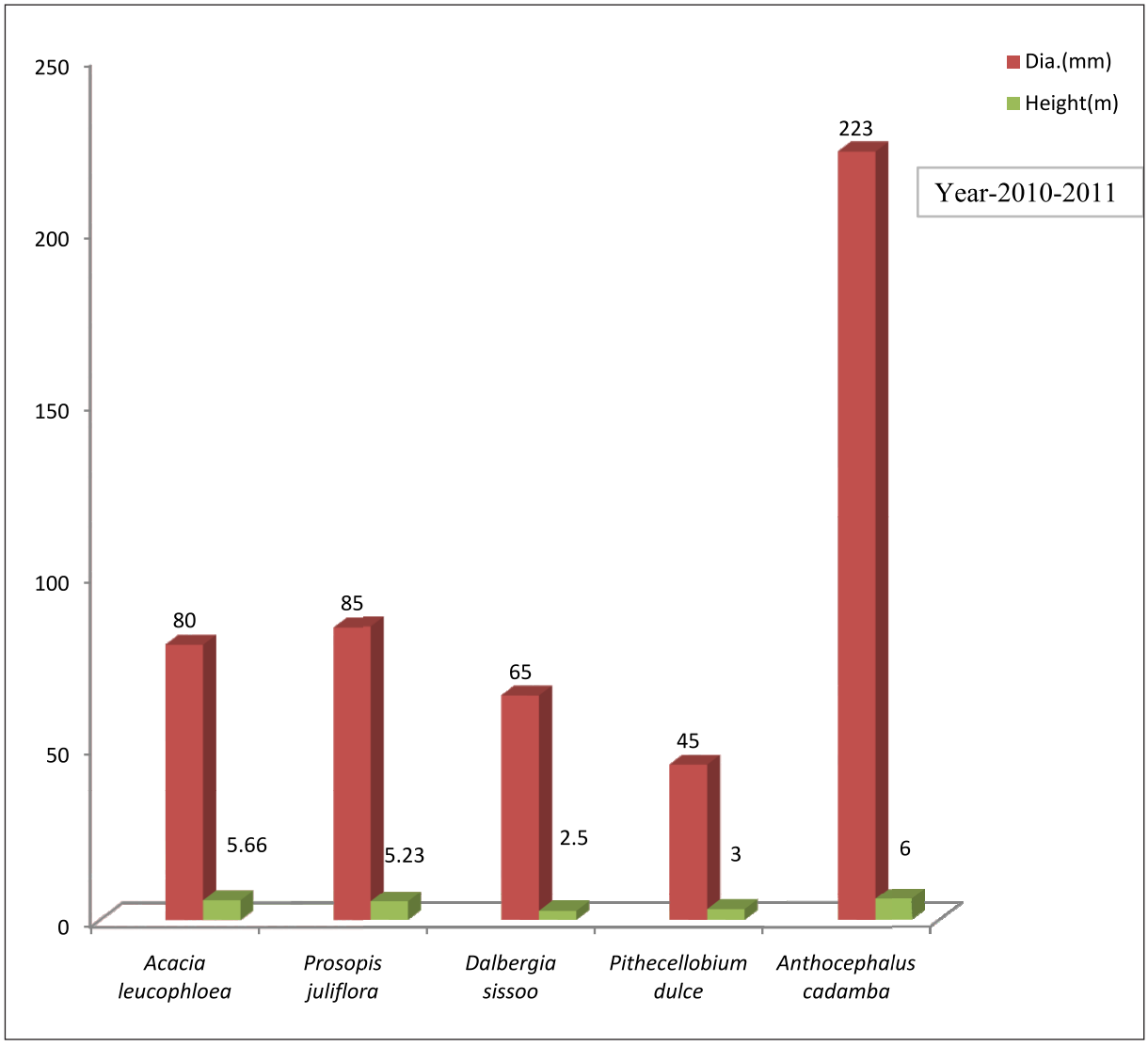
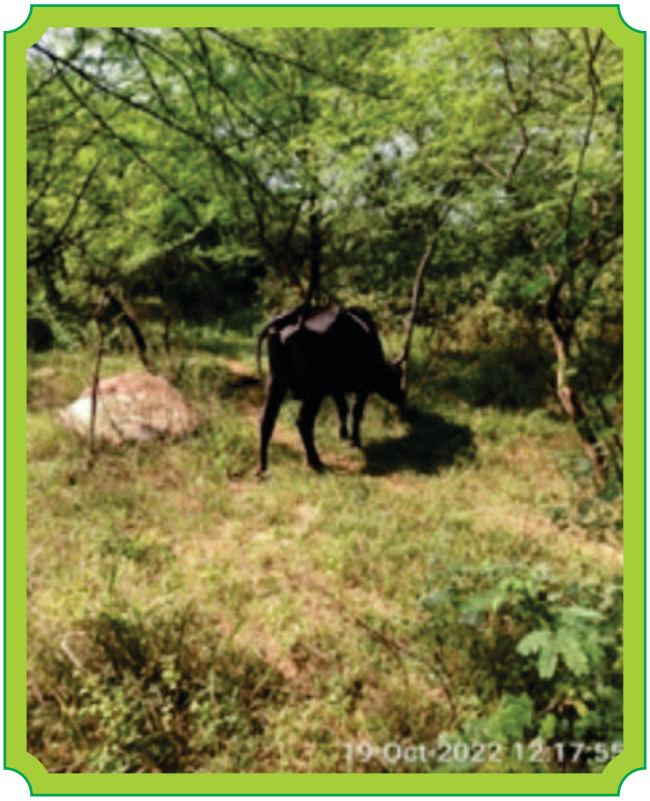


Figure 3.6: Plantation growth under Delhi CAMPA in AsolaBhatti.

Laying out sample plot at plantation site



Cattle grazing on plantation site

Field data collection by FRI team

Plantation view of Asola Bhatti site

Site 7: Shastri Park (near Bela Farm)

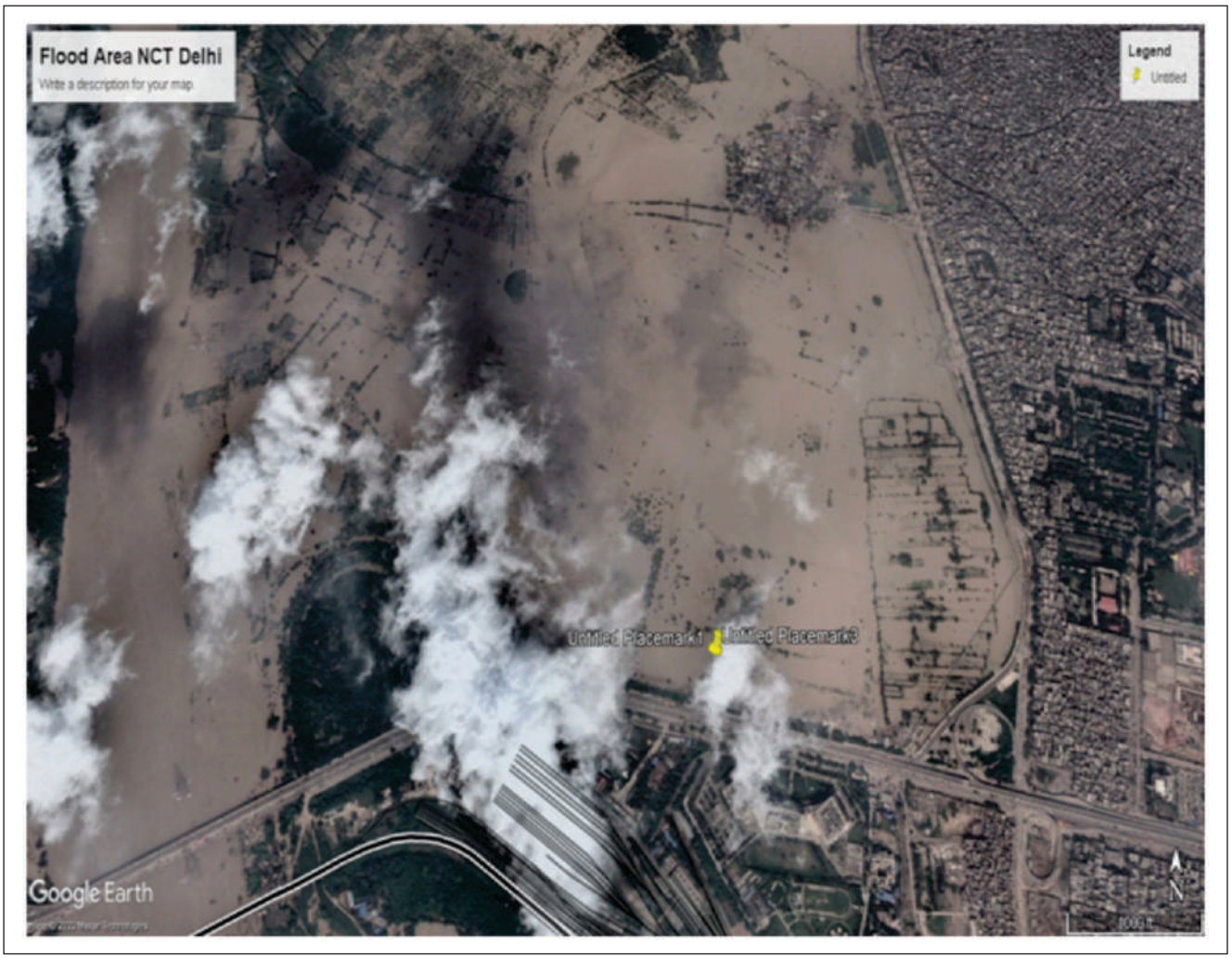
As the site was inaccessible due to flood so we can't comment on this particular site.

Water logging condition due to Yamuna

Photographs of flood affected area

Photographs of flood affected area

Photographs of flood affected area



Flood area in plantation site

CHAPTER 4

Lesson Learned and Recommendations

Lesson Learned and Recommendations

From the available evidence, the monitoring of the plantations conducted by FRI, Dehradun concluded that the scheme viz., CAMPA has been successfully able to promote afforestation and regeneration activities as a way of compensating for loss of green cover due to forest land diverted for non-forest uses.. The project activities will result in positive environment impacts and will also result in enhancing biological richness.

4.1 Lesson learned

The monitoring and evaluation of plantations highlighted following lessons, which may require follow-up action to enhance future outcomes and outputs:-

1. Plantation record maintenance: The present analysis found that records of some of the plantations sites were not available with the department. This is a serious problem with respect to monitoring and future implementation of the activities. Only numbers of plants, name of the sites and GIS maps were shown.

2. Protection of plantations: The field data indicate that at many sites the plants were found damaged due to wild animals and stray cattle. The fencing was not found in many plantation sites while fencing is mandatory in every new plantation site. The protection measures like effective fencing need to be enhanced in providing protection to the newly planted samplings. The plants raised on the bank of river Yamuna are also prone to damage by flood during rainy season. Effective protection measures like Soil Moisture Conservation (SMC) works and creation of grass ways at the river bank for the protection of these plants form damage caused by the flood.

3. Soil and water conservation: It was also found that soil and water conservation measures were feeble considering the fact that such measures were not adopted in majority of the sites. The soil and water conservation measures are important for enhancing the productivity of the land, recharge water table and improve the water regime in the plantation sites. In the long run, such measures play significant role in improving the survival rate of plantations by improving the productivity and by increasing soil moisture content. It would be prudent, if the soil and water conservation component is compulsorily included in the plantation programmes and annual work plans.

4. GIS and remote sensing: It was observed that the GIS based planning has not been adopted for taking up plantation and soil and water conservation activities in sites selected for plantation. With the simple and easy to use GIS based technology, it becomes very easy to map all plantation patches for further review, monitoring and assessment on regular basis.

5.2. Recommendations

Although the findings of the plantation monitoring presents an encouraging picture, however there are several steps which are suggested be taken up to enhance the outcomes and outputs of the plantation activity in future.

1. Site specific Annual Plan of Operations (APO) for the plantation: It is imperative to conduct site suitability analysis of the sites well in advance before taking up plantation activities. The

advance plantations works should be started after observation of suitability of sites for the plantations. The parameters such as soil characteristics, species suitability, topographic and locality factors should be considered under such assessments prior to plantation planning in a site. It was observed that some sites are not suitable for plantations as people throw garbage in plantation's area and stray cattle menace was also seen. Officials at field level should keep good liaison with people to protect the plantation from grazing or other such biotic pressures.

2. Use of Remote Sensing and GIS: The degraded lands affected by various land degradation drivers such as salinity, erosion, alkalinity, and water logging in the state should be mapped. Such degraded lands can be reclaimed and rehabilitated by taking up appropriate plantation activities. The GIS and remote sensing techniques are considered to be very helpful in providing more realistic and measurable data.

3. Adoption of Suitable Silvicultural Practices: Evidences from the field surveys and data analysis suggests that the plantation forestry is likely to be sustainable in terms of wood yield in most of the sites provided good practices are maintained. Adoption of improvised silvicultural techniques and plantation of native species may further enhance crop productivity. Since, silvicultural practices and species selection are geared to increase the speed of tree growth and shortening rotation periods which is imperative to achieve the goals and targets stated in the State Forest Policy. Fast grown trees like Bakain (Melia dubia) need to be pruned as those trees produced 2-3 leaders from the ground level. Singling will improve growth of trees. Plant to plant spacing of 3 m x 3 m should strictly be followed. Thinning in plantation should be carried out to maintain proper spacing of plants. Weeds like Parthenium, Lantana, Cannabis and Bathu (Chenopodium) and mesquite trees have assumed alarming proportions at many sites. These should preferably be removed before flowering, or before seed formation starts in these weeds. The mesquite can gradually be removed by shortening of crown and checking regeneration. The regeneration of native species should be encouraged and protected if natural regeneration is coming up in the forests. Areas with natural regeneration should be selected and only assisted natural regeneration (ANR) activities should be carried.

4. Research needs: Rapid assessment of biological richness in the plantation sites need to understand the impact of plantation on biodiversity. The climate change mitigation aspect of the plantations should also need to be assessed as per the area of plantations.

5. Plantation of medicinal and aromatic plants: It is imperative to cultivate medicinal and aromatic plants considering their conservation importance and its economic benefits for the local communities.

6. Plantation of multi purposes tree species (MPTS): The MPTS plantations will be of significant importance in meeting the local needs and for providing alternative livelihood options for the forest dependent communities. The MPTS plantations will also result in enhancing the local's economic conditions.

7. Avoid plantation with exotics: It is observed that few exotic species like, Acacia

auriculiformis, A. leucophloea, Callistemon viminalis etc. have been planted. The exotic species should be avoided as they are not fit for enhancement of biodiversity. Mixture of native species should be given preference so as to increase biodiversity and ecosystem services. (May be rechecked as plantation of exotic species is not undertaken).

8. Proper plantation inventory maintenance: Proper inventory of plantation activities are essential on all plantation sites to track issues, pitfall and for course correction for enhancing outcomes.

9. Capacity building and training of field staff involved in plantation activities: The field staff needs to be trained with respect to the latest plantation techniques and in forest fire control. Their capacity need to be enhanced on latest advancements in the field of plantation forestry. Training can be provided at Forest Research Institute, Dehradun in afforestation techniques and forest fire management to front line staff to increase their capacity for conducting field works in more efficient way. The training should be a part of afforestation activities.

10. Location specific plantations in consultation with the stakeholder: There is a need to have stakeholders' consultation before selecting the plantation species so as to meet the local people's desire and needs.

11. Adoption of best practices on land reclamation and restoration: The best practices developed elsewhere with similar geographic conditions should be adopted for plantation activities and for enhancing soil moisture regime in the state.

12. Enhancement of natural regeneration: Assisted Natural Regeneration (ANR) operations should be carried out where regeneration of species is not a problem. Natural regeneration is generally observed in Neem, Beri (Ziziphus mauritania), Mulberry, Babul, Khajoors (Date palm), Shisham and Burma drek.

Appendix-I

1. Geo-Coordinates of Central Forest Division

i. Anand Vihar range

Site No.1: Yamuna bank (near P.W.D. Office) 2019-2020, 1.81 ha. (site name as above)

Plot No.	Latitude	Longitude
	North	East
1.	28° 36 9.38"	77° 16' 13.71"
2.	28° 36' 08.01"	77° 16' 10.91"

ii. Anand Vihar range

Site No. 2: Yamuna bank (near P.W.D. Office) 2020-2021, 10.0 ha. (site name as above)

Plot No.	Latitude	Longitude
	North	East
1.	28° 35' 02.90"	77° 16' 08.28"
2.	28° 36' 02.64"	77° 16' 09.70"
3.	28° 35' 59.54"	77° 16' 06.25"
4.	28° 35' 56.98"	77° 16' 09.05"
5.	28° 35' 55.72"	77° 16' 04.10"
6.	28° 35' 58.69"	77° 16' 03.62"
7.	28° 36' 00.87"	77° 15' 59.23"
8.	28° 35' 58.25"	77° 16' 08.09"
9.	28°36' 01.72"	77°16' 11.89"
10.	28°35 '55.27"	77°16' 06.51"

iii. Anand Vihar range

Site No. 3: Yamuna bank metro station, 2020-2021, 35.73 ha. (site name as above)

Plot No.	Latitude	Longitude
	North	East
1.	28° 37' 25.72"	77° 16' 18.88"
2.	28° 37' 18.20"	77° 16' 21.64"
3.	28° 37' 13.09"	77° 16' 24.50"
4.	28° 37' 09.97"	77° 16' 16.06"
5.	28° 37' 06.61"	77°16' 06.21"
6.	28° 37' 16.78"	77° 16' 06.49"
7.	28° 37' 21.17"	77° 16' 17.54"
8.	28° 37' 19.69"	77° 16' 13.75"
9.	28° 37' 13.05"	77° 16' 03.15"
10.	28°37' 19.21"	77°16 '13.67"
11.	28°37'09.57"	77°16' 22.00"
12.	28°37'18.51"	77°16' 9.69"
13.	28°37'7.71"	77°16' 13.84"
14.	28°37'13.24"	77°16' 10.35"
15.	28°37'15.53"	77°15' 55.76"
16.	28°37'11.86"	77°15' 55.65"
17.	28°37'12.14"	77°15' 49.14"
18.	28°37'4.79"	77°16' 15.04"
19.	28°37'7.61"	77°16' 0.23"
20.	28°37'8.52"	77°15' 50.49"

iv. Shastri park range

Site No. 4: Shastri park-near metro station, 2015-2016, 8.354 ha. (site name as above)

Plot No.	Latitude	Longitude
	North	East
1.	28° 40' 00.62"	77° 16' 08.28"
2.	28° 40' 03.41"	77°14' 55.49"
3.	28° 40' 04.24"	77°14' 49.97"
4.	28° 40' 00.69"	77°14' 59.65"
5.	28° 43' 52.67"	77° 06' 03.91'
6.	28° 40' 03.41"	77°14' 55.49"
7.	28°41' 04.06"	77°15' 22.77"
8.	28°39' 47.22"	77°15' 44.63"

2. Geo-Coordinates of North Forest Division
i. Nangloi range

Site No. 5: Nangloi sewage treatment plant/ DSC pump house, 2015-2016, 0.28 ha. (site name as above)

Plot No.	Latitude	Longitude
	North	East
1.	28° 43' 52. 67"	77° 06' 03.91"
2.	28° 36' 08.01"	77° 16' 10.91"

3. Geo-Coordinates of South Forest Division

i. Asola Bhatti range

Plot No.	Latitude	Longitude
	North	East
1.	28° 27' 19. 44"	77° 13' 50.32"
2.	28° 27' 06 .50"	77° 13' 41.26"
3.	28° 26' 56.99"	77° 13' 40.12"
4.	28° 26' 45.10"	77° 13' 37.61"
5.	28° 26' 33.76"	77° 13' 35.08"
6.	28° 26' 26.34"	77° 13' 53.55"
7.	28° 26' 28.79"	77 13' 48.30"
8.	28° 26' 24.45"	77 13' 51.80"
9.	28° 26' 21.33"	77 13' 37.66"
10.	28° 26' 23.47"	77° 13' 51.85"
11.	28° 26' 23.55"	77° 13' 46.36"
12.	28° 26' 23.47"	77° 13' 51.85"
13.	28° 26' 38.56"	77° 14' 00.41"
14.	28° 26' 38.16"	77° 14' 14.05"
15.	28° 26' 41.73"	77° 14' 29.69"
16.	28° 26' 31.90"	77° 14' 00.23"
17.	28° 26' 58.80"	77° 14' 37.96"
18.	28° 26' 55.70"	77° 14' 23.54"
19.	28°25 '36.09"	77°14 '50.75"
20.	28°27' 27.03"	77°12' 18.04"

3. Geo-Coordinates of Central Forest Division
i. Shastri park range

Site No. 7: Near Bela Farm, 2016-2017, 19.9 ha. (site name as above)
This site was inaccessible due to flood.

Plot No.	Latitude	Longitude
	North	East
1.	28° 40' 29. 31"	77° 14' 55.08''
2.	28° 40' 29. 46"	77° 14' 55.10''

Appendix-II

Format for Data Collection

Field form for Monitoring & Evaluation of Plantations under Delhi CAMPA

1.	**General**			
	Name of Forest Circle			
	Name of Forest Division			
	Name of Forest Range			
	Name of Forest Beat			
	Name of Plantation Site			
2.	**GPS Location of the Sample Plots**			
	Plot No.	Latitude (in Degree Minute Second)	Longitude (in Degree Minute Second)	
	1.			
	2.			
	3.			
	4.			
	5.			
	6.			
	7.			
	8.			
	9.			
	10.			
3.	**Observation of area of plantation as per GPS (ha)**			
4.	**Type of Forest Plantation (Tick √)**			
	i. Degraded Forest		ii. Enrichment Planting	
	iii. Assisted Natural Regeneration		iv. Saline/Alkaline	
	v. SMC		vi Others	
5.	**Technique of planting (Tick √)**			

	i) Pit Planting		ii) Ridge Planting	
	iii) Auger Hole Planting		iv) Trench-cum-Pit	

			Planting	
	v) Others			
6.	**Area of Forest Plantation as per plantation journal (ha)**			
7.	**Species planted on site**			
	1.		3.	
	2.		4.	
8.	**Species planted as per plantation journal/record**			
	1.		3.	
	2.		4.	
9.	**Suitability of species to sites**			
10.	**Fencing and Protection works**			
	i) Type of Fencing Used (Tick √)	Stone wall fencing		Barbed wire
		Electric Fencing		Live fencing
		Trench Fencing		Social Fencing
		Others		No Fencing
	ii) Effectiveness of fencing			
	iii) Forest Fire Protection measures			
	iv) Engagement of watchman /policing			
11.	**Suitability of selected plantation area with respect to objectives**			
	Criteria	Indicator		

	i) Terrain ii) Soil wealth iii) Grazing intensity iv) Forest Fire incidences v) Human Interference vi) Intensity of wind vii) Irrigation facility	
12.	**Assessment of work as seen in the field**	
	Criteria	Indicator

	i) Spacing of plants ii) Size of pit iii) Trench-Ridge iv) Terracing v) Soil working vi) Hoeing vii) Weeding					
13.	**Species composition**	i) Mixed		ii) Monoculture		
14.	**Age, Height and Survival percentage of the plants (species wise)**					
	S.N.	Species	Age (years)	Height (m)	Survival %	
	1.					
	2.					
	3.					
	4.					
	5.					
15.	**Soil and moisture conservation works (Tick √)**					
	i) Stony Check dams		ii) Walls			
	iii) Crate wire check dams		iv) Local check dams			
	v) Others					
	Effectiveness of soil and moisture conservation works					
16.	**Health of the plants**					

	Criteria	Indicator
	i) Good/Bad ii) Insect attack iii) Disease attack iv) Water stress v) Lodging of plants vi) Plant competition vii) Browsing viii) Lopping ix) Illegal felling	

17.	**Increase in availability of biomass**	
	Criteria	Indicator
	i) Fuel wood ii) Fodder iii) Small timber iv) NTFPs v) Carbon sequestration	
18.	**Maintenance of records**	
	Criteria	Indicator
	i) Availability of plantation journals ii) Posting of up to date information and survey sketch map of plantation iii) Records of visits of officers like DFOs, CFs or CCFs etc. iv) Records of officers	
19.	**Suggestion for improvement from evaluating agency**	
	Criteria	Indicator

	i) Improvement in plantation ii) Protection iii) Record maintenance iv) Reasons for modification/ discontinuation of project.	
20.	Name and signature of the Forest Officials present during the visit	
21.	Name and signature of the field evaluators	

Silviculture and Forest Management Division
ICFRE-Forest Research Institute,
Dehradun 2024