GOVERNMENT OF NCT OF DELHI
DEPARTMENT OF FORESTS & WILDLIFE
A-BLOCK, 2ND FLOOR, VIKAS BHAWAN, IP ESTATE, NEW DELHI-110002

F.No. 15/CAMPA/F&WL/Misc/2024-25/ 1530-34 **Date:** 05/05/25

To,

The Chief Executive Officer,
National CAMPA,MoEF&CC
Room No.A-232, 2nd Floor, Agni Wing
Indira Paryavaran Bhawan, Jor Bagh
New Delhi-110003

Sub: Request for providing Monitoring Mechanism adopted for Monitoring & Evaluation of CAMPA activities by various States/UTs- reg.
Ref: Letter No. NA-1/14/2023-NA dated 27.02.2025 of NCAMPA

Sir,

Kind reference is invited towards NCAMPA letter NA-1/14/2023-NA dated 27.02.2025 on the subject cited above vide which the NCAMPA has requested to provide the Monitoring Mechanism adopted for Monitoring and Evaluation of CAMPA works. In this regard, it is to inform that CAMPA plantations are regularly monitored by the territorial DCFs/Officers of the Department and periodic visits are carried out to the CA plantation sites to ensure good survival and maintenance.

Also, it is to mention that third party monitoring and Evaluation of CAMPA plantations was carried out by AFC India Ltd for the duration 2011-12 to 2012-13 and also by FRI for the duration of 2011-12 to 2020-21 (a copy of the final report is enclosed). The third party monitoring and evaluation of CAMPA plantations for the period 2021-22 to 2023-24 is being carried out by FRI. In addition to this, a dedicated website has been developed by the Department for Delhi CAMPA which contains all the details including photographs regarding CA plantations & other activities carried out under CAMPA. The website is regularly updated by the Department (https://campa.eforest.delhi.gov.in/)

This is for your kind information.

Encl.A/A

Yours faithfully,

05/5/25

(Dr. P. Viswakannan)
Chief Conservator of Forests (Admn.)

Copy to:

1. APCCF/HoD, Department of Forests and Wildlife, GNCTD.
2. CF, Department of Forests and Wildlife, GNCTD.
3. CF (HQ), Department of Forests and Wildlife, GNCTD.
4. DCF (W/S/N/C), Department of Forests and Wildlife, GNCTD.

Third Party Monitoring & Evaluation of CAMPA Plantations				
S.No.	**Plantation year**	**Conducted by**	**Average Survival Rate**	**Remarks**
1	2011-12 to 2012-13	AFC India Ltd	90.65%	
2	2011-12 to 2020-21	Forest Research Insititute, Dehradun	90.24%	
3	2021-22 to 2023-24	Forest Research Insititute, Dehradun	Under process	

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	2020-2021	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

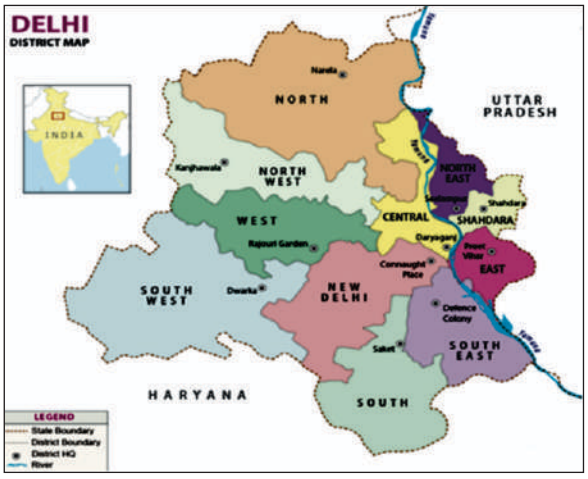
Delhi, officially the National Capital Territory (NCT) of Delhi, is a city and a union territory of India containing New Delhi, the capital of India. NCT of Delhi stretches along the western bank of the river Yamuna between 28o 22' and 28o 54' North latitude and 76o 48' and 77o 23' East longitude. It 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.

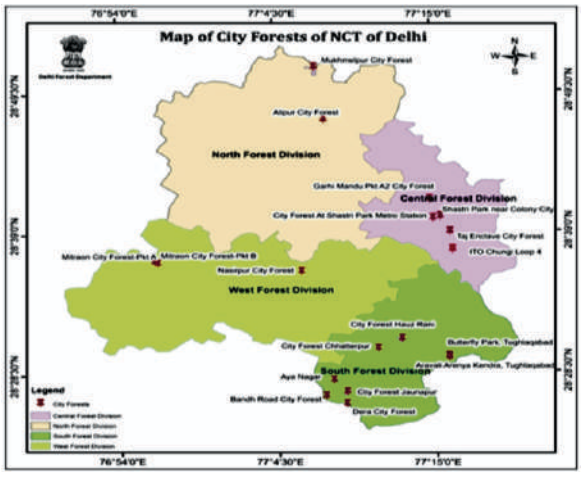
The plantations under CAMPA in the state of Delhi have been created as part of Compensatory Afforestation against projects for which forest land has been diverted for non-forestry purposes.. Compensatory Afforestation under CAMPA was carried out in Delhi in the year 2011-12 over an area of 100 ha degraded 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	2020-2021	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

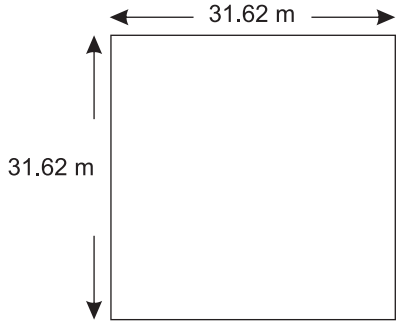
Monitoring and evaluation works under CAMPA were carried out by selecting sample plots (area 0.1 ha = 31.62 m × 31.62 m) in each plantation's area considered as a unit. Moreover, the size of plots and category of plantations were also taken into consideration for

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:-

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.

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

Insect attack on plantation

Measurement of collar diameter

View of plantation site

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	2020-2021	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).

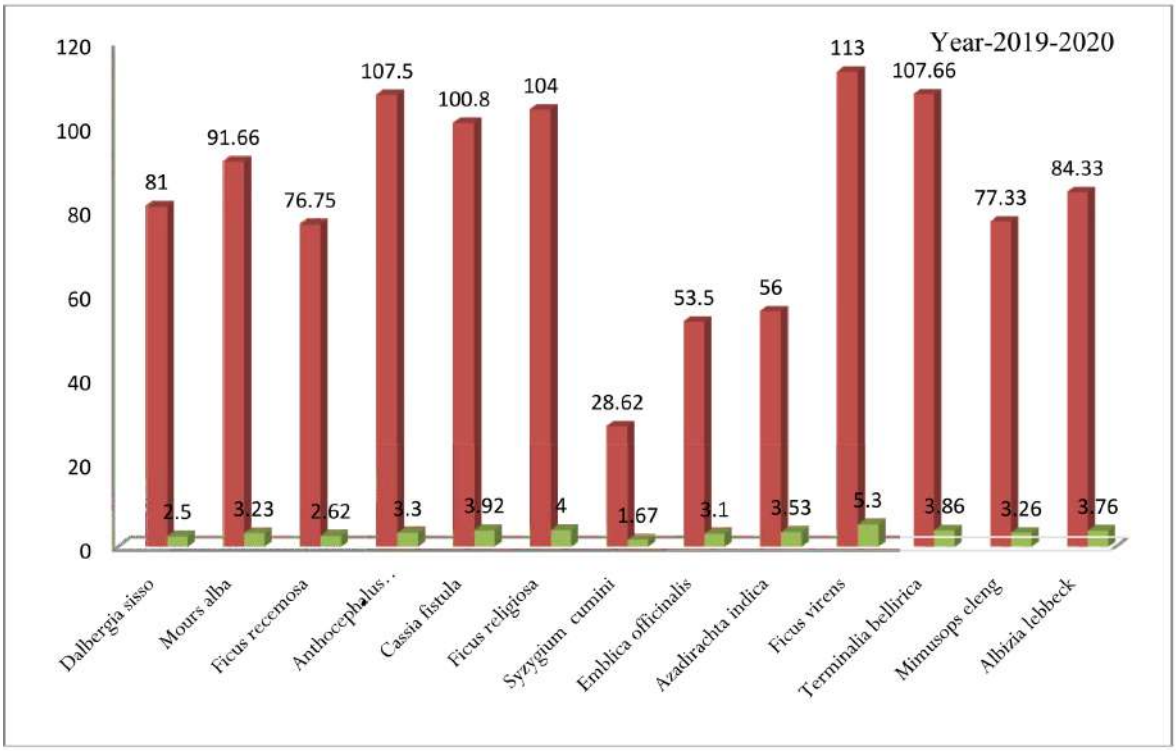


Figure 3.1: Plantation growth under Delhi CAMPA in Yamuna Bank (near P.W.D. Office).

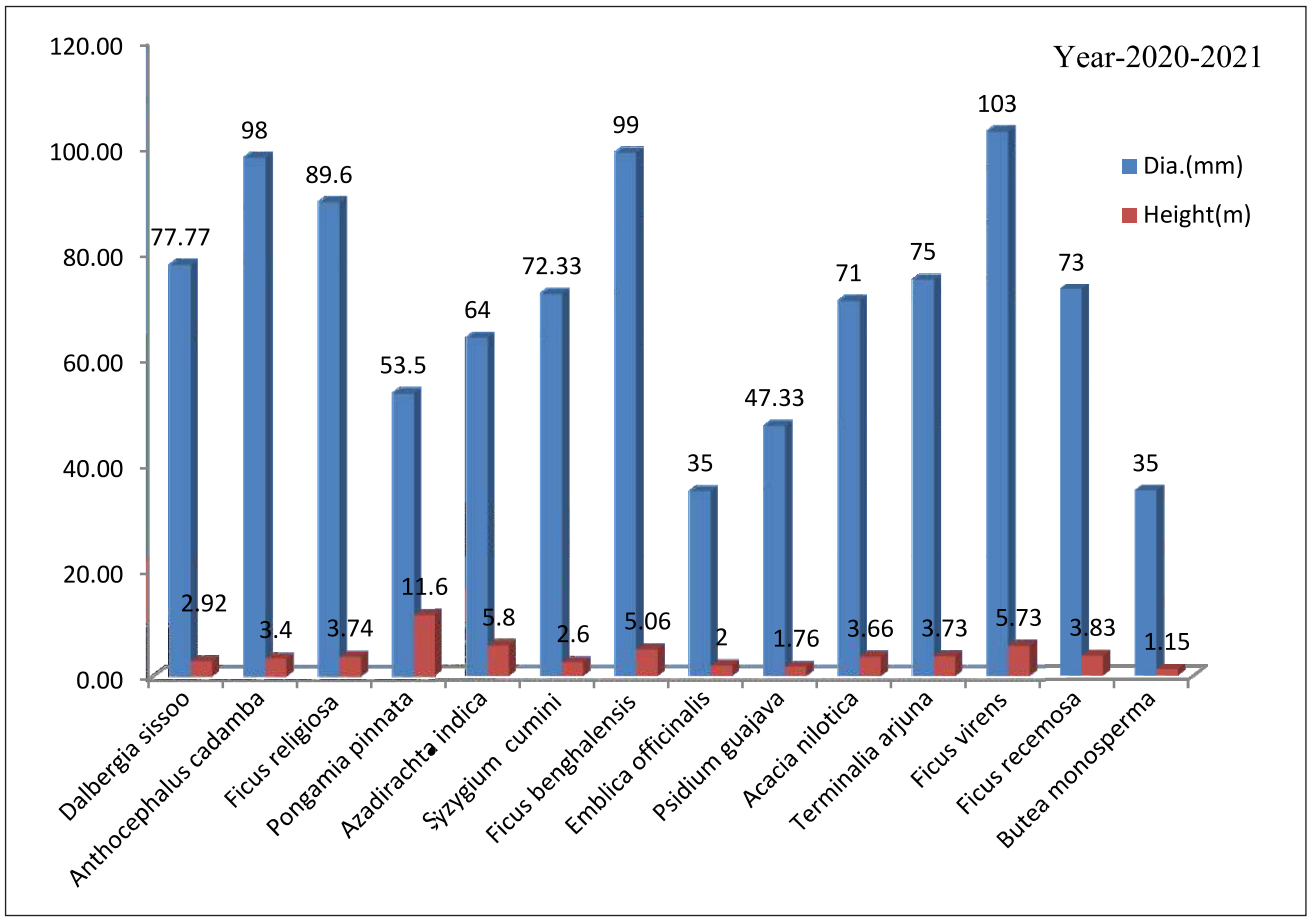


Figure 3.2: Plantation growth under Delhi CAMPA in Yamuna bank (near P.W.D. Office.)

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).

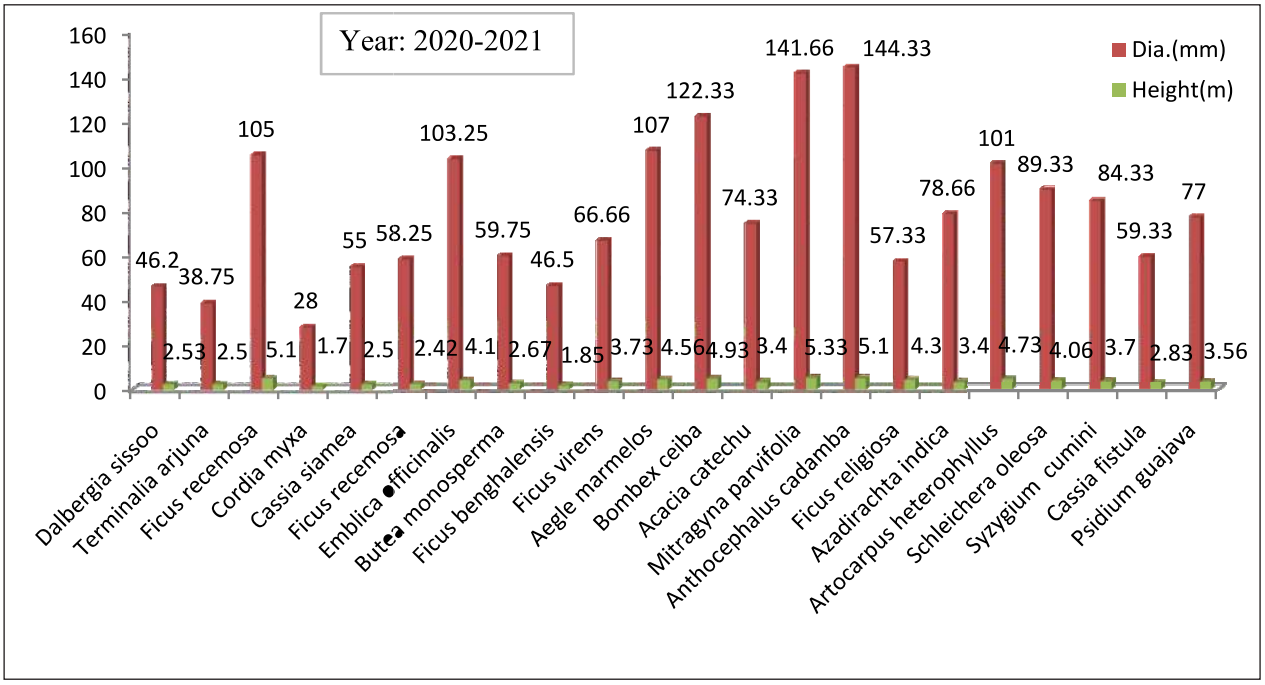


Figure 3.3: Plantation growth under Delhi CAMPA schemes in Yamuna bank metro station.

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).

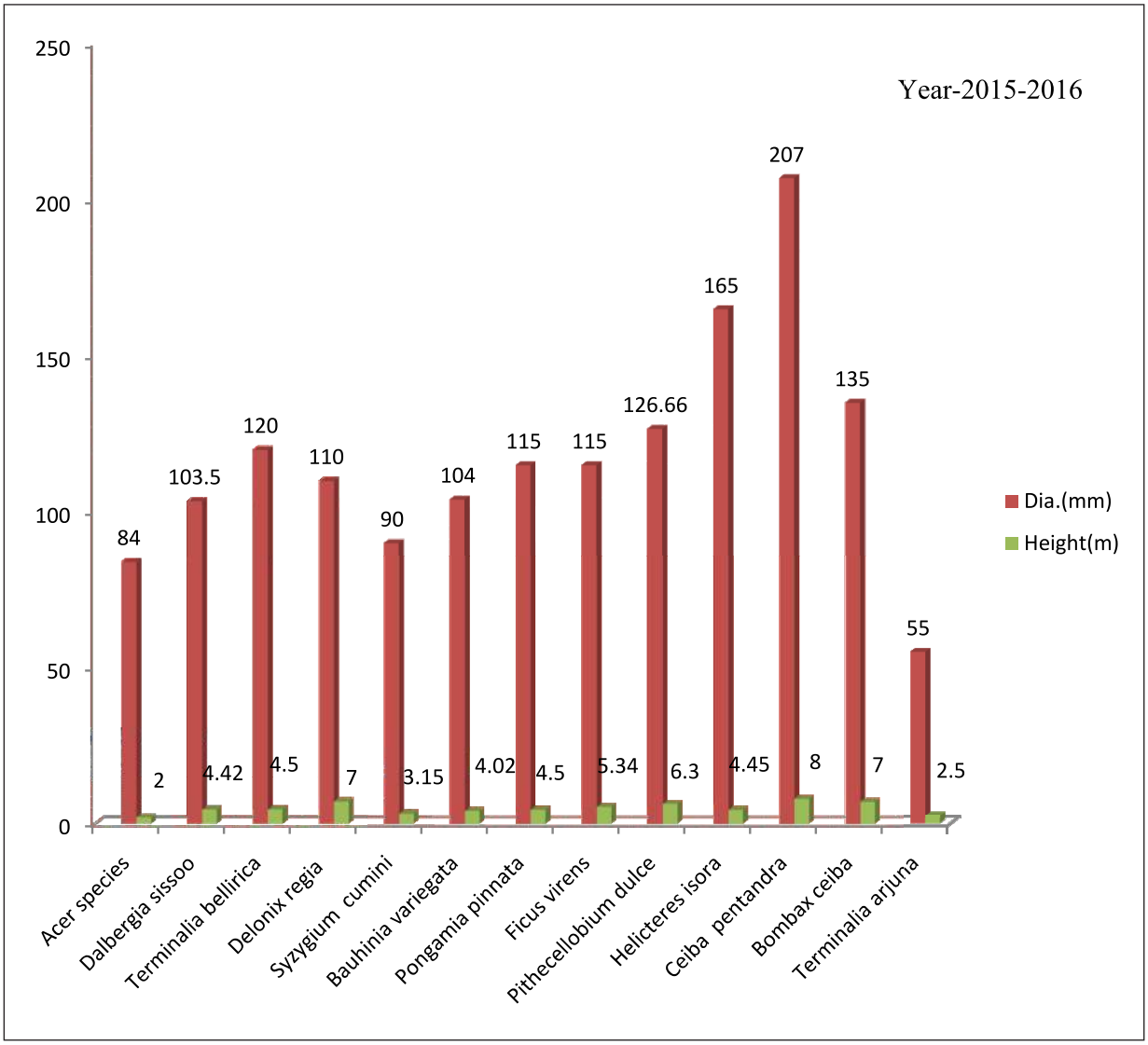


Figure 3.4: Plantation growth under Delhi CAMPA in Shastri park near metro station.

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).

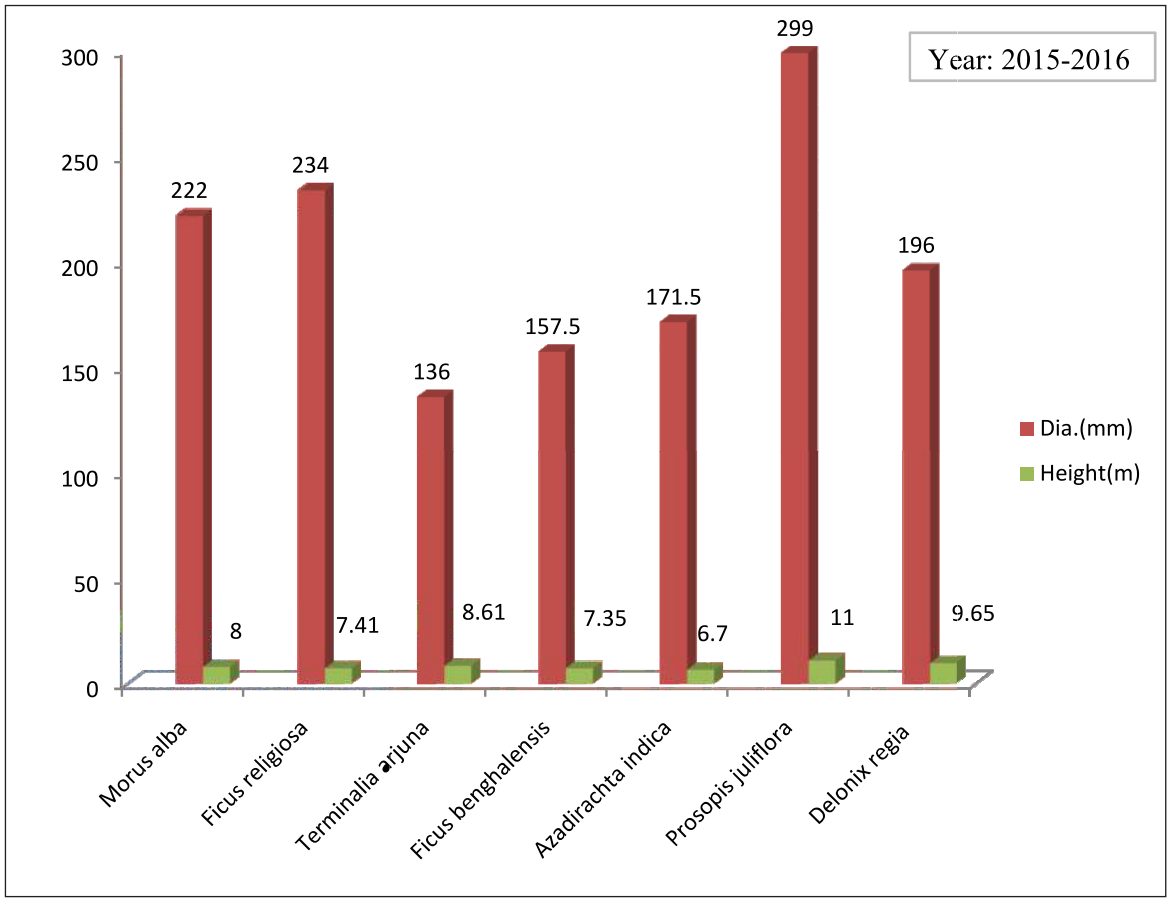


Figure 3.5: Plantation growth under Delhi CAMPA in Nangloi sewage treatment plant/ DSC pump house.

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).

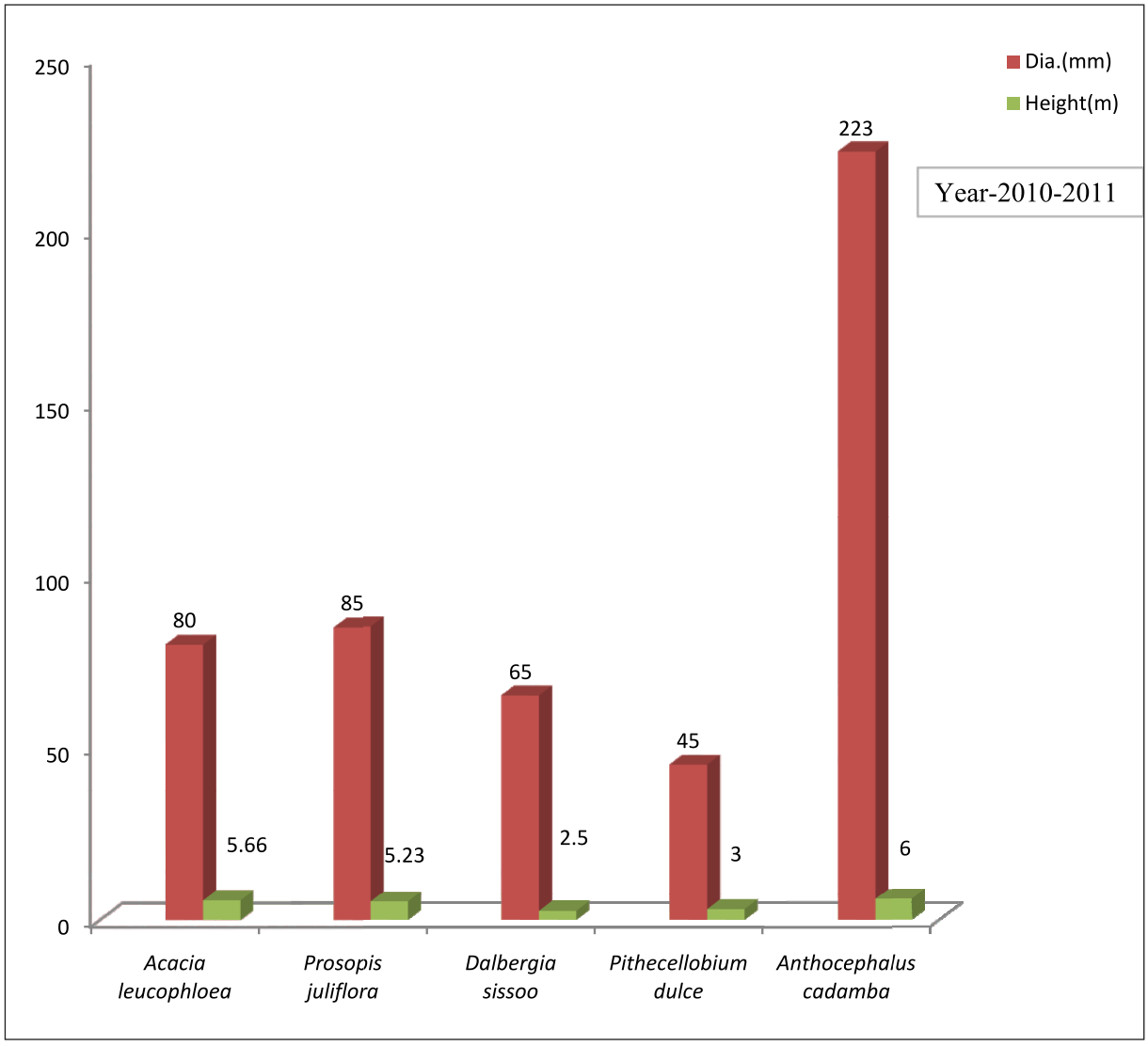
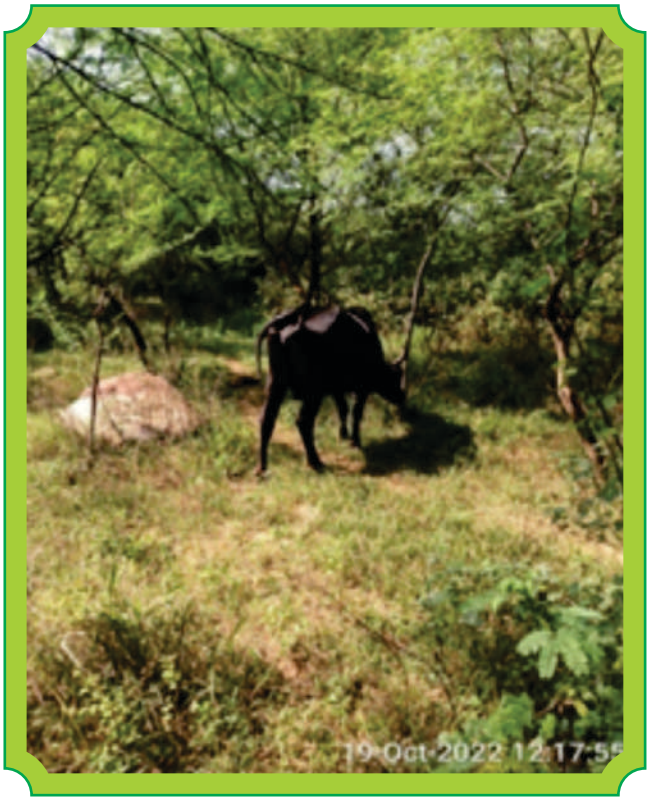


Figure 3.6: Plantation growth under Delhi CAMPA in AsolaBhatti.

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)

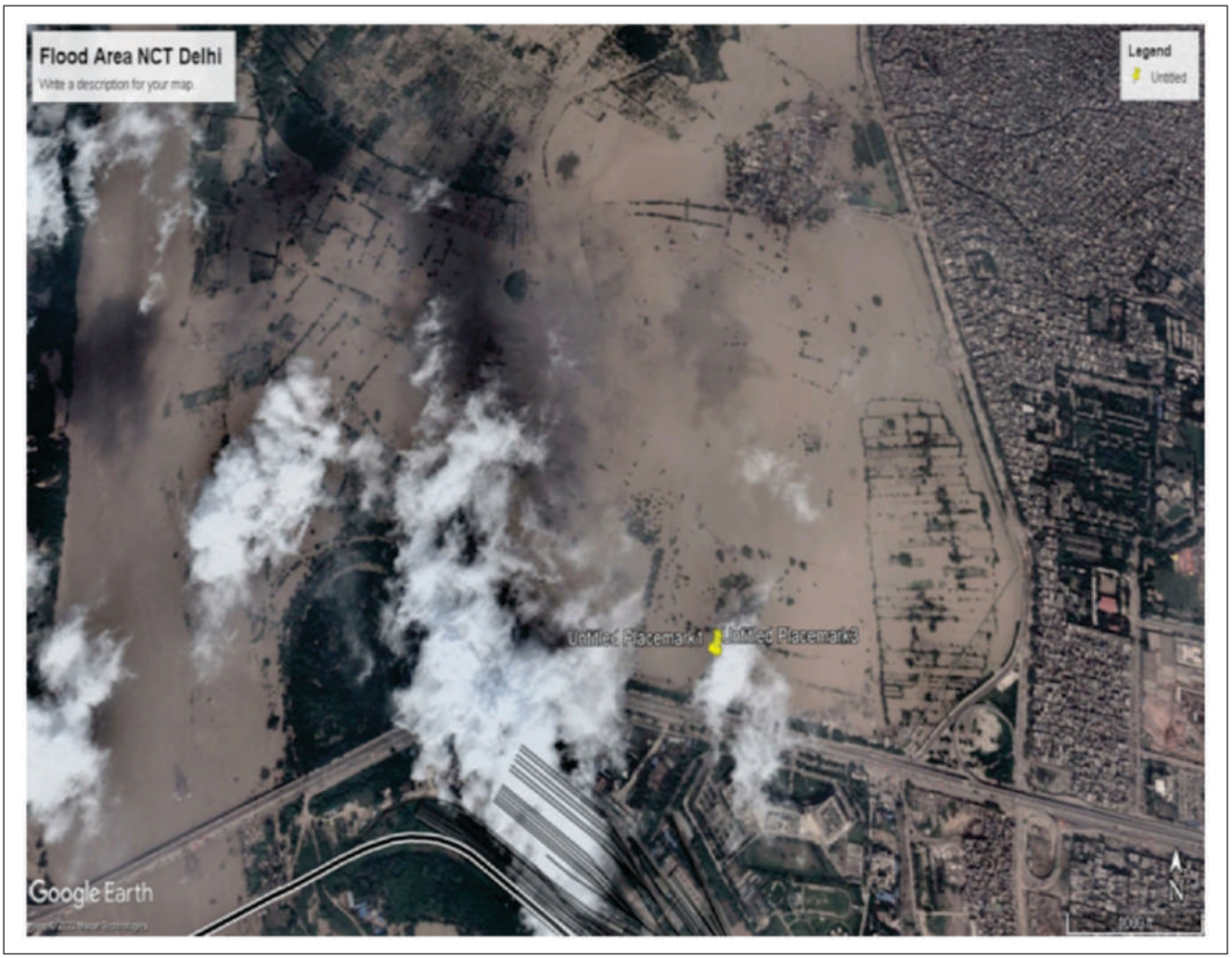
As the site was inaccessible due to flood so we can't comment on this particular site.

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

Report

MONITORING & EVALUATION OF CAMPA WORKS CARRIED OUT DURING 2011-12 & 2012-13 BY DEPARTMENT OF FORESTS & WILDLIFE, GOVT. OF NCT OF DELHI

Under Delhi CAMPA

Submitted to

Chief Conservator of Forest
Delhi Forest Department
New Delhi

AFC INDIA LIMITED

Northern Regional Office: B1/9, IIIrd floor, Community Centre
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Contents

Executive Summary		i-ii
Chapter-1	Background	1-5
Chapter-2	Quantitative Analysis	6-9
Chapter-3	Qualitative Analysis	10-21
Chapter-4	Conclusions	22-23
Chapter-5	Recommendations	24

Executive Summary

Asola Bhatti Wildlife Sanctuary, with a geographical area of 2782 ha, is located in South Delhi district of Delhi State of India. Though, the community land of villages Asola, Shapur & Maidangari (4707 Acre) was notified during 1986 & land of Bhatti (2167 Acre) was notified in 1991 for this Wildlife Sanctuary but the encroachments and illegal mining could not be controlled.

132 INF BN (TA) ECO-RAJPUT was raised as a Eco-Task Force (ETF) in the year 2000 for controlling the encroachments and illegal mining and eco-restoration of Asola Bhatti Wildlife Sanctuary.

For eco-restoration, two schemes (State scheme and CAMPA scheme) are being implemented by the ETF in the Asola Bhatti Wildlife Sanctuary. The State scheme is being implemented w.e.f 2001-02 and the CAMPA scheme w.e.f 2011-12. The Delhi Forest Department is providing funds and technical assistance to the ETF for the implementation of these schemes.

Ministry of Environment and Forests (MoEF), Govt. of India had issued guidelines on 2nd July 2009 for establishing Compensatory Afforestation Fund Management and Planning Authority (CAMPA) in the States/UTs and putting in place a funding mechanism for enhancing forest and tree cover and conservation and management of wildlife by utilising funds received towards Compensatory Afforestation (CA), Net Present Value (NPV), etc., currently available with the Adhoc CAMPA. Accordingly, the CAMPA was established in the Delhi State.

In CAMPA scheme, the ETF has planted 254,592 plants of 59 species of fruit, shady, ornamental, timber and medicinal value during 2011-12 and 2012-13 against the target of 200,000 plants fixed by the Delhi Forest Department resulting in 127% achievement. Further, ETF has achieved 100% target of soil and moisture conservation (SMC) works fixed by the Forest Department.

Third Party Evaluation of CAMPA works of the year 2011-12 and 2012-13 was done by the AFC India Limited, New Delhi, during January and February 2015. For this, 100% counting of pits dug up for planting and the surviving plants in the pits were done and general observations of height and growth of plantations were taken. Technical aspects of SMC works were evaluated and general observations of encroachments and illegal mining were made.

The results of evaluation were as given below:

1. *The ETF has achieved the main objective of controlling the illegal mining and encroachment as no fresh mining/encroachment was observed in the Asola Bhatti Wildlife Sanctuary.*

2. *The achievement of plantation was 125% against the target of 200,000 plants fixed by the Forest Department.*

   The survival of plantation was very good (89.71%).

   Though, 59 species of fruit, shady, ornamental, timber and medicinal value were planted but the maximum growth was of Shisham (Dalbergia sissoo), Bamboo

(Bamboo species), Pahari Papri (Holoptelia integrefolia), Neem (Azadirachta indica) and Kikar (Acacia nilotica).

Irrigation system installed has helped a lot in the survival and growth of plantations.

3. *The achievement of SMC works was 100% against the target fixed by the Forest Department.*

   Though, the SMC works were serving their purpose up to some extent but these works need technical improvements. .

For further improvement in Asola Bhatti Wildlife Sanctuary, it is recommended that:

i. *Presence of Eco-Task Force in the Asola Bhatti Wildlife Sanctuary should be continued.*

ii. *Map of Asola Bhatti Wildlife Sanctuary showing all the roads, paths, ETF office and posts, Forest office, lake, monkey feeding points, etc. and the habitations on its boundary along with geo-references should be prepared.*

   Year wise locations of all the sites of works carried out should be marked on the map.

   This map should be updated every year.

   Geo-reference of all the sites of works should be mentioned in the annual reports.

iii. *Irrigation system should be extended in all the young plantations.*

iv. *Services must be taken of an expert in soil and moisture conservation works.*

v. *Tree groves of Neem (Azadirachta indica), Bar (Ficus benegalensis), Pipal (Ficus religiosa) and Gular (Ficus racemosa) should be raised on mounds encircled with deep trench.*

ABBREVIATIONS

APO	Annual Plan of Operations
CA	Compensatory Afforestation
CAMPA	Compensatory Afforestation Fund Management & Planning Authority
DCF	Deputy Conservator of Forests
ETF	Ecological/Eco Task Force
FCA	Forest (Conservation) Act
JJ	*Jhugi-Jhopdi*
GNCTD	Government of National Territory of Delhi
MoEF	Ministry of Environment & Forests
NPV	Net Present Value
PCA	Penal Compensatory Afforestation
SMC	Soil & Moisture Conservation
TA	Territorial Army
UT	Union Territory
WLS	Wildlife Sanctuary

INTRODUCTION

Ministry of Environment and Forests (MoEF), Govt. of India had issued guidelines on 2nd July 2009 for establishing Compensatory Afforestation Fund Management and Planning Authority (CAMPA) in the States/UTs and putting in place a funding mechanism for enhancing forest and tree cover; conservation and management of wildlife by utilising funds deposited in the form of Net Present Value and Compensatory Afforestation/Penal CA on account of diversion of forest land for non-forestry purposes under FCA 1980 and to utilize the money in phased manner to carry out CA and other forestry works. The money is being released to State/UT Governments yearly for raising Compensatory Afforestation and other forestry related works under CAMPA. CAMPA - Delhi was established in the Delhi State vide notification No. F.1/CF/FCA/07-08/Part-II/ 3517-3540 dated 05.10.2009.

It is mandatory for States to carry out monitoring of CAMPA works by third party. Therefore, the work of monitoring and evaluation was awarded by Forest & Wildlife Department, Government of National Territory of Delhi (GNCTD) to Agriculture Finance Corporation for the works carried out under CAMPA during the year 2011-12 and the year 2012-13 (Annexure-A) assigning following scope of work:

1.1 Scope of Work:

Initially AFCIL proposed to take twenty percent sample area of year 2011-12 & 2012-13 for the detailed M&E task. But at the time of issuing work order the Chief Conservator of Forests has directed to the AFCIL to cover hundred per cent plantation area of both the years instead of twenty percent sampling. Accordingly the AFCIL has been covered the entire plantation areas and assess the survival percentage through counting of each plants planted during 2011-12 & 2012-13 under CAMPA.

Under the M&E the focus was mainly on assessing the survival of plants planted in two different years. Besides quantitative assessment of the plantation the key personal of study team were interacted with the field functionaries through Participatory Approach and shared the technical lacuna immediatlely whenever come across during the enumeration of plants.

1.2 Background:

An area of 42.0225 ha of forest/deemed forest land has been diverted for non-forestry purposes under FCA for various developmental works in the State of Delhi till the Year 2012-13. The total Compensatory Afforestation/Penal CA to be carried out was 87.84 ha. Total amount realized against cost of Compensatory Afforestation, Penal Compensatory Afforestation and Net Present Value is **Rs. 3467.978 lakhs (Annexure-I)** and deposited under Adhoc CAMPA. As per CAMPA guidelines, Compensatory Afforestation had to be carried out on double the forest area diverted. The total CA/PCA to be carried out was 87.84 ha but the Department has carried out plantation of over 200 ha on degraded forest land in Asola Wildlife Sanctuary against 87.84 ha. First Annual Action Plan under CAMPA –Delhi was approved in the year 2011-12. Proposal for carrying out Compensatory Afforestation over 100 ha of degraded forest land in Asola Wildlife Sanctuary was approved under first Action Plan during the year 2011-12. Compensatory Afforestation over 100 ha has been carried out in Asola Wildlife Sanctuary as per approved Action Plan under CAMPA during the year 2011-12. Since, there was availability of degraded forest land in Asola Wildlife Sanctuary and enough funds were available under Delhi CAMPA, therefore, it was proposed to carry out afforestation on additional 100 ha in Asola Wildlife Sanctuary to increase the forest cover in the State and also to enhance facilities for wildlife by carrying out enrichment plantation and soil moisture conservation works. The proposal for carrying out afforestation on additional 100 ha under CAMPA was approved during the Annual Action Plan of the year 2012-13 along with other allied works. An area of 200 ha has been afforested against the target of 87.84 ha under Delhi-CAMPA along with allied works related to soil conservation and wildlife management.

1.3 Site Selection for CA:

Earlier, it was proposed to carry out CA on degraded forest land in Ayanagar in South Forest Division but later it was decided to carry out CA in Asola WLS considering the availability of degraded forest area as well as to create suitable habitat for wild animals in Delhi.

1.4 Institutional Mechanism for Inplementation of CAMPA

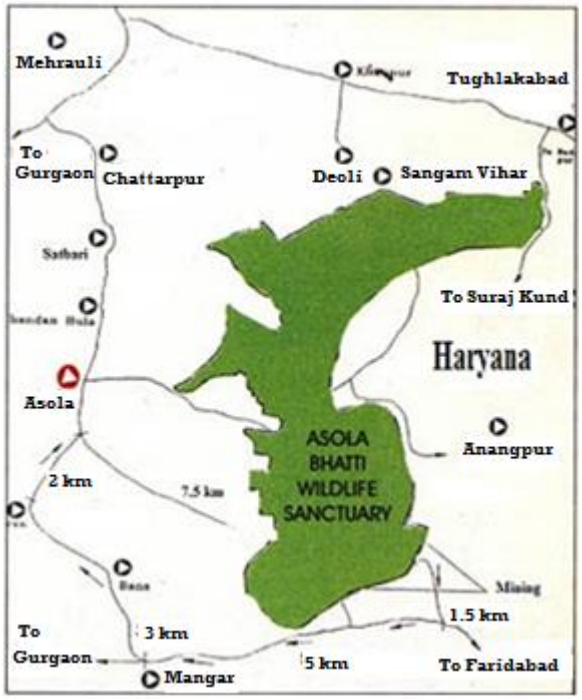
It was observed in the Executive Meeting that there was acute shortage of trained forestry personnel and infrastructure in the Department of Forests & Wildlife, GNCTD. The project of

eco-restoration of Bhatti Mines was being implemented well by Eco Task force since October 2000 which is adjacent to Asola WLS, having similar edapho-climatic conditions and vegetation, extremely vulnerable to biotic iinterference because of its proximity to human habitations like Sanjay Nagar Slum & *Jhugi Jhopadi*. Therefore, it was proposed and decided to implement CAMPA jointly through ETF and DCF (South).

1.5 Asola Bhatti Wildlife Sanctuary

Southern Ridge had been put to various landuse practices from times immoral like mining, garzing and illicit felling of trees. The active mining of quartzite, commonly known as 'Badarpur' had heavily seared and severly degraded the Southern ridge. The area also used to act as cattle/goat grazing site by local villagers, severly affecting the vegetation of the region. To safeguard the potential biological values and ecological functions by providing sufficient protection, and to put a check on any further degradation of the improverished land, the mining activity was stopped and Asola and Bhatti areas were notified as Wildlife Sactuary.

In order to preserve the sanctity of the area, 2679.26 acres of land was carved out from the community land of three villages viz. Asola, Sahurpur and Maidan Garhi and notified as Asola Wildlife Sanctuary under Wildlife (Protection) Act 1972 vide notification No. F.3(116)/CWLW/84/897-906 Dated 09.10.1986. After imposing of ban on the mining of Badarpur by Hon'ble Supreme Court, and in the larger interest of protection of ecology of the area, 2166.28 acres of village Bhatti was notified as sanctuary vide notification No. F.2(19)/DCF/90-91/1382-91 dated 15.04.1991 as Asola Bhatti Wildlife Sanctuary (4845.57 acres).



Location map of Asola Bhatti Wildlife Sanctuary

The Asola Bhatti Wildlife Sanctuary is located on the Southern Ridge of Delhi in South Forest Division of GNCTD. This Ridge is the northern terminal part of Aravalli Hills, one of the oldest Mountain Systems of the world. The epic remains of natural Dhok (*Anogeissus pendula*) Forests of Aravalli Hills are some of the attractions of this sanctuary.

Epic Remains of natural Dhok Forests

1.6 History of establishment of ETF

Though, the community land of villages Asola, Shapur & Maidangari was notified during 1986 and the land of Bhatti village was notified in 1991 as Wildlife Sanctuary but the encroachments and illegal mining could not be controlled. The mining was for the stone and red and golden Badarpur sand that are always in hot demand. The red Badarpur sand and stone are used for building and construction activities and the valuable golden sand found in deeper layers of mining pits is used for the manufacturing of glass.

To check the illegal mining and encroachment on the forest land in Bhatti area, a unit of TA viz. 132 INF BN ((TA) Eco-Rajput was established in the year 2000, commonly called as ETF.

This ETF in Delhi was raised in the year 2000 for achieving the following objectives in the Asola Bhatti Wildlife Sanctuary:

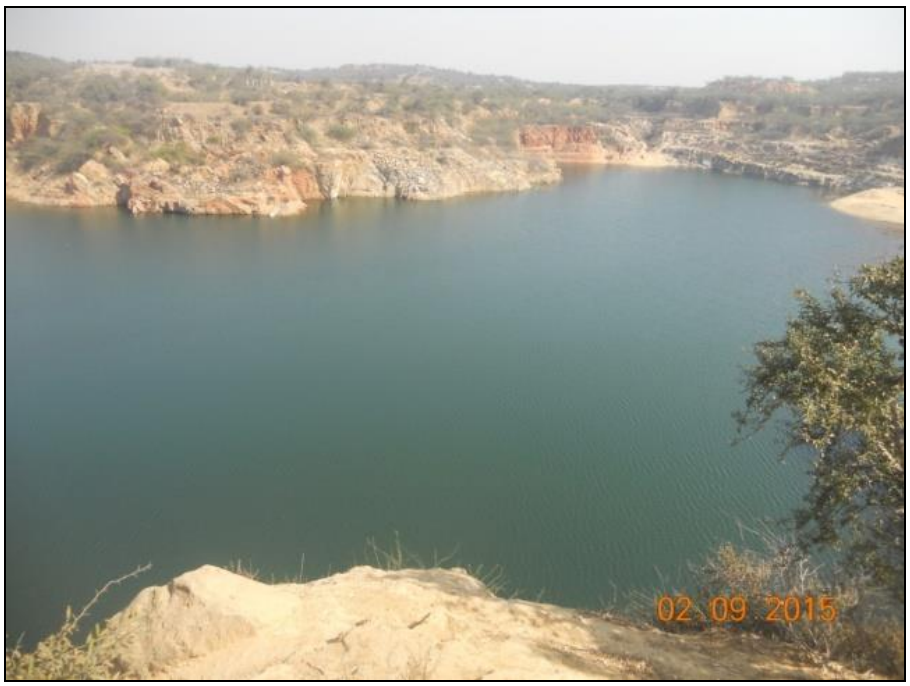
i. To remove encroachments.

ii. To stop illegal mining.

iii. To restore the ecology of the area.

The project of eco-restoration of Bhatti Mines was being implemented well by Eco Task force since October 2000 which is adjacent to Asola WLS, having similar edapho-climatic conditions and vegetation, extremely vulnerable to biotic iinterference because of its proximity to human habitations like Sanjay Nagar Slum & JJ. Therefore, it was proposed and decided to implement CAMPA jointly through ETF and DCF (South).

There are a number of abandoned large-open-deep mining pits in the ground all over the sanctuary and some of the pits are turned into lakes.



Mining Pit converted into a deep Lake

Deep & Dry Mining Pit

Two schemes (State scheme and CAMPA scheme) are being implemented by the ETF in the Asola Bhatti Wildlife Sanctuary. The State scheme is being implemented mainly in Bhatti and Mandi area, whereas the CAMPA scheme in Asola area.

The State scheme is being implemented by the ETF w.e.f 2001-02 and the CAMPA scheme w.e.f 2011-12. ETF has taken assistance of South Forest Division for the implementation of CAMPA scheme in Asola Bhati area.

The Delhi Forest Department is providing funds to the ETF for the implementation of these schemes.

An area of 42.80 ha of forest/deemed forest land was diverted for non-forestry purposes under various developmental works in the State of Delhi up to 31-3-2013. Total amount realized against the cost of CA, Penal CA and NPV was Rs.3467.97 lakh and it was deposited in the account of Adhoc CAMPA. Against 42.80 ha, the CA was to be carried out on 87.46 ha of degraded forest land.

First Annual Action Plan under CAMPA Delhi was approved in the year 2011-12 for carrying out CA on 100 ha of land by planting 100,000 plants in the Asola Bhatti Wildlife Sanctuary and this target was successfully achieved during the year 2011-12.

Since enough funds as well as degraded forest land were available, the Second Annual Action Plan under CAMPA Delhi was approved in the year 2012-13 for carrying out CA on another 100 ha of land by planting 100,000 plants in the Asola Bhatti Wildlife Sanctuary and this target was also successfully achieved during the year 2012-13.

Therefore, during the years 2011-12 and 2012-13, a target of 200 ha was achieved by planting 200,000 plants in the Asola Bhatti Wildlife Sanctuary against the target of 87.46 ha resulting in 229% achievement.

Presently, maintenance of plantations of the years 2011-12 and 2012-13 is in progress.

1.5 Third Party Monitoring and Evaluation (M&E)

The present third party M&E report pertains to the works carried out by the ETF in the Asola Bhatti Wildlife Sanctuary during the years 2011-12 and 2012-13 under the CAMPA scheme.

Chapter-2

Quantitative Evaluation

2.1 CA

As per approved annual plan, the plantations were raised during the years 2011-12 and 2012-13 under CAMPA scheme in the Asola Bhatti Wildlife Sanctuary by the Eco-Task Force (ETF) under the supervision of Delhi Forest Department.

2.1.2 Achievement of Physical Targets

Since the area was tough with less soil depth and lack of soil moisture, it was planned to plant 30% extra plants in first year so that atleast one lakh saplings will survive finally. Annual closure reports (showing fixed and achieved physical targets) for the years 2011-12 and 2012-13 of CAMPA scheme were obtained from the Eco-Task Force (ETF) and analyzed and the results of analysis were as given in table- 2.1.

Table- 2.1: Physical targets of plantation

Year	Target	Achievement
2011-12	100000 saplings	137600 saplings
2012-13	100000 saplings	116992 saplings
Total	**200000 saplings**	**254592 saplings**

Against the above said target the year wise and pocket wise numbers of plants planted are given below.

2.1.3 Achievement of Physical Targets

The number of plants planted in different pockets during year 2011-12 and 2012-13 are as given in Table- 2.2.

Table- 2.2: Achievement of targets of plantation achieved

Sr. No.	Year	Pocket	No. of Plants Planted
1	2011-12	A	15,871
		B	25,499
		C	27,106
		D	16,819
		E	11,726
		F	18,438
		G	22,141
		Sub-total	**137,600**
2	2012-13	A	37,165
		B	43,596
		C	13,165
		D	23,066
		Sub-total	**116,992**
Total			**254,592**

It is evident from Table-2.2 that:

i. 137,600 plants were planted during 2011-12 against the total fixed target of 100,000 plants resulting in a higher achievement of 37600 plants.

ii. 116,992 plants were planted during 2012-13 against the total fixed target of 100,000 plants resulting in a higher achievement of 16,992 plants.

iii. Thus, 254,592 plants were planted during 2011-12 and 2012-13 against the total fixed target of 200,000 plants resulting in a higher achievement of 54592 plants.

iv. Further, 254,592 plants were planted during 2011-12 and 2012-13 against the target of 200,000 plants fixed by the Forest Department resulting in 127% achievement.

2.1.4 Species Planted

The details of the species planted in each pocket during the year 2011-12 is given in Table-2.3.

Table- 2.3: Pocket wise species planted during 2011-12

Sr. No.	Name of Species		Pocket wise number of plants planted							
	Local/ English	Botanical	A	B	C	D	E	F	G	Total
1	Ailanthus/ Maha Neem	*Ailanthus excelsa*				200			532	732
2	Akash Neem	*Millingtonia hortensis*							35	35
3	Alstonia	*Alstonia scholaris*		8					8	16
4	Amaltas	*Cassia fistula*	165	165	833	260	70	913	160	2566
5	Amla	*Emblica officinalis*	165	320	195	130	8	50	125	993
6	Amrood	*Psidium guava*	15	30		4				49
7	Arjun	*Terminalia arjuna*	90	385		207	17		15	714
8	Bahera	*Terminalia bellerica*	300							300
9	Bakain	*Melia azadirachta*	100	130		110	9	12	22	383
10	Bans	*Bamboo species*	10	3007		200	250	1200	2450	7117
11	Bargad/Bar / Bari (Desi)	*Ficus benegalensis*	90	471	8	12	4	8	10	603
12	Bel Pattar	*Aegle marmelos*	50	90					70	210
13	Beri	*Zizyphus mauritiana*			880	583	1000	1010	292	3765
14	Boganvillea	*Boganvillea*	40							40
15	Bottel Brush	*Callistemon viminalis*							10	10
16	Cassia siamea	*Cassia siamea*	805			88		38	60	991
17	Dhak	*Butea monosperma*						15		15
18	Gullar	*Ficus racemosa*	200	55			2	5		262
19	Gulmohar	*Delonix regia*		40						40
20	Imli	*Tamarindus indica*	50	140		450			140	780
21	Jamun	*Syzygium cumini*	150	130		3	38		45	366
22	Jand/	*Prosopis cineraria*	90	520	180	1220	245	1430		3685

Sr. No.	Name of Species		Pocket wise number of plants planted							
	Local/ English	Botanical	A	B	C	D	E	F	G	Total
	Khezari									
23	Jangle jalebi	*Phithocelbium duice*	760	635	430	400	24	125		2374
24	Kachnar	*Bahunia variegata*		10		213				223
25	Karonda	*Carissa karonda*						10		10
26	*Kigelia*	*Kigelia pinnata*	30	3						33
27	Khair	*Acacia catechu*		30				2		32
28	Khairi	*Acacia senegal*	24	975	3100	228	350	1780	200	6657
29	Kikar	*Acacia nilotica*	3840	6515	5515	4150	4960	6875	4181	36036
30	Lagerstroemia	*Lagerstroemia speciosa*				10				10
31	Lasura	*Cordia dichotoma*	17	3		5		10	42	77
32	Mahogany	Swietenia mahagoni	7							7
33	Maror phalli	*Bigonia species*	70							70
34	Neem	*Azadirachta indica*	20	425	60	100	6	8	35	654
35	Papri	*Pongamia pinnata*	500	200		1231	11		55	1997
36	Pahari Papri	*Holoptelia integrefolia*		2550	1340	450	35	926	3625	8926
37	Pilkhan	*Ficus infectoria*	10	52	15	10	3	12	16	118
38	Pipal	*Ficus religiosa*	25	21	7	12	5	9	10	89
39	Ronj	*Acacia leucophloea*	760	1085	11505	1750	1825	1720	2550	21195
40	Mulberry	*Morus alba*	8	217	10	5				240
41	Teak	*Tectona grandis*		4						4
42	Semal	*Bombax ceiba*	30	10						40
43	Shisham	*Dalbergia sissoo*	7150	6333	3020	4788	2864	2255	7270	33680
44	Siris	*Albizia lebbeck*	300	940	8			25	178	1451
45	Sohanjana	*Moringa oleifera*							5	5
Total			**15871**	**25499**	**27106**	**16819**	**11726**	**18438**	**22141**	**137600**

It is evident from table-2.3 that during 2011-12:

i. Total 137,600 plants of 45 species of fruit, shady, ornamental, timber and medicinal value were planted.

ii. Maximum numbers of plants planted were of Kikar (36036) followed by Shisham (33680) and Ronj (21195).

The details of species planted in each pocket during the year 2012-13 is given in Table-2.4.

Table- 2.4: Pocket wise species planted during 2012-13

Sr. No.	Name of Species		Pocket wise number of plants planted				
	Local/ English	Botanical	A	B	C	D	Total
1	Ailanthus/Maha Neem	*Ailanthus excelsa*		800	7		807
2	Akash Neem	*Millingtonia hortensis*			25		25
3	Alstonia	*Alstonia scholaris*		10	2		12
4	Am/ Mango	*Mangifera indica*		20	8		28
5	Amaltas	*Cassia fistula*	350	600	50	250	1250
6	Amla	*Emblica officinalis*	150	350	35		535
7	Anar	*Punica grantum*				2	2
8	Anjeer	*Ficus carica*		15			15
9	Arjun	*Terminalia arjuna*	200	150	65		415
10	Bahera	*Terminalia bellerica*		185	5		190
11	Bakain	*Melia azadirachta*		50	60	10	120
12	Bans	*Bamboo species*	2000	3000	100	2000	7100
13	Bar/Bargad//Bari (Desi)	*Ficus benghalensis*	5	20	5	7	37
14	Bel Pattar	*Aegle marmelos*		125	25		150
15	Beri	*Zizyphus mauritiana*	150	350	125	1678	2303
16	Bottel Brush	*Callistemon viminalis*		50	50		100
17	Cassia siamea	*Cassia siamea*		100	150		250
18	Dhak	*Butea monosperma*	20	70	10		100
19	Gullar	*Ficus racemosa*		170	248		418
20	Harad	*Terminalia chebula*		65			65
21	Imli	*Tamarindus indica*		110	170		280
22	Jakrinda	*Jacaranda mimosifolia*		5	2		7
23	Jamun	*Syzygium cumini*	10	760	256		1026
24	Jand /Khezari	*Prosopis cineraria*				300	300
25	Jangle jalebi	*Phithocelbium duice*	340	300	125		765
26	Kachnar	*Bahunia variegata*			65		65
27	Kadam	*Anthocephallus chenensis*		18	5		23
28	Katahal	*Artocarpus heterophyllus*			2		2
29	Kanak Champa	*Pterospermum acerifolium*		20	3		23
30	Khairi	*Acacia senegal*	6400	1000	40	2610	10050
31	Kikar	*Acacia nilotica*	13200	10720	3890	5010	32820
32	Khazoor	*Phoenix dactylifera*		10			10
33	Kusam	*Schleichera oleosa*		25			25
34	Lagerstroemia	*Lagerstroemia speciosa*		10	5		15
35	Lesua/ Lasura	*Cordia dichotoma*		25	38		63

Sr. No.	Name of Species		Pocket wise number of plants planted				
	Local/ English	Botanical	A	B	C	D	Total
36	Mahuwa	*Madhuca indica*		10	4		14
37	Millingtonia	*Millingtoniaspp*		15			15
38	Neem	*Azadirachta indica*	125	85	125	15	350
39	Papri /Karanj	*Pongamia pinnata*			15		15
40	Pahari Papri	*Holoptelia integrefolia*	1261	8600	3356	1125	14342
41	Pilkhan	*Ficus infectoria*	5	10	5		20
42	Pipal	*Ficus religiosa*	7	15	5	6	33
43	Ritha	*Sapindus mukorossi*		25	5		30
44	Ronj	*Acacia leucophloea*	11120	11050	5	6535	28710
45	Sahtoot/Toot/ Mulberry	*Morus alba*			256		256
46	Sagwan/ Teak	*Tectona grandis*		165			165
47	Semal	*Bombax ceiba*		20	9		29
48	Shisham	*Dalbergia sissoo*	1560	4200	3780	2520	12060
49	Siris	*Albizia lebbeck*	250	235	20		505
50	Sohanjana/ Drum sticks	*Moringa oleifera*		5			5
51	Subabul	*Leucaena leucocephala*				1000	1000
Total			**37153**	**43568**	**13156**	**23068**	**116945**

It is evident from Table-2.4 that during 2012-13:

i. Total 116,945 plants of 51 species of fruit, shady, ornamental, timber and medicinal value were planted.

ii. Maximum number of plants planted were of Kikar (32,820) followed by Ronj (28,710), Pahari Papri (14,342), Shisham (12,060) and Khairi (10,050).

Finally, it emerged from Table-2.3 and Table-2.4 that:

i. Total 254,545 plants of 59 species of fruit, shady, ornamental, timber and medicinal value were planted during the years 2011-12 and 2012-13 under CAMPA scheme in the Asola Bhatti Wildlife Sanctuary.

ii. Maximum number of plants planted were of Kikar (68,856) followed by Ronj (49,905), Shisham (45,740), Pahari Papri (23,268) and Khairi (16,707).

2.2 Soil and Moisture Conservation Works

2.2.1 Achievement of Physical Targets

Annual closure reports (showing fixed and achieved physical targets) for the years 2011-12 and 2012-13 of CAMPA scheme were obtained from the Eco-Task Force (ETF) and analyzed and the results of analysis were as given in Table- 2.5.

Table- 2.5: Soil and Moisture Conservation Works

Sr. No.	Name of work	Unit	Target	Achievement
Year 2011-12				
	Construction of Water Bodies	No.	0	3
	Improvement in the existing Water Bodies	No.	2	4
	Construction of Check Dams	No.	3	3
Year 2012-13				
	Trenching	RM	0	6623
	Construction of small *Kuccha* Water Bodies in mining pits	No.	0	4
	Construction of Check Dams	No.	0	2

It is evident from above Table- 2.5 that:

i. The targets of soil and moisture conservation works have been achieved by 100%.

ii. Target of 6623 rm trench, 4 *Kuccha* Water Bodies and 2 Check Dams have been achieved over and above the fixed target.

Chapter-3

Qualitative Evaluation

3.1 CA

In Asola Bhatti Wildlife Sanctuary, plantations were raised during the years 2011-12 and 2012-13 under CAMPA Scheme by the Eco-Task Force (ETF) under the technical supervision of Delhi Forest Department.

The plantations were raised in 7 Pockets (A to G) during 2011-12 and in 4 Pockets (A to D) during 2012-13.

Evaluation of plantations was done during January and February 2015 and the results of evaluation were as given below:

3.1.1 Earth Work

Earth work was carried out with JCB machine at a spacing of 3m x 3m. Though, the earth work was very good but the alignment of pits was not proper since it was a gap plantation in WLS.

3.1.2 No. of Pits dug up

The counting of pit was carried out 100% of dug up pits in all the pockets and 249,665 pits were found on the spot against 254,545 pits reported resulting in a shortfall of 4,888 pits. This minor difference of 1.9% pits might be due to human error in counting of pits in the forest area.

The dug up pits (249,665) found on the spot resulted in:

i. Achievement of 125% against the target of 200,000 pits fixed by the Forest Department under CAMPA.

Year wise and pocket wise details of dug up pits reported and found on the spot were as given in Table-3.1

Counting of pits and surviving plants in 2012-13 plantation of 13000 wali Pocket

3.1.3 No. of Surviving Plants

The counting of surviving plants was done in all the pockets to the extent of 100% and 223,974 plants were found on the spot in the 249,665 dug up pits resulting in 89.71% survival, which was very good. Although the target of plantation was 200000 saplings under CAMPA and at site the saplings found were 223974. Therefore, the survival of saplings can be said more 100%.

The plants planted in the trenches dug up under soil and moisture conservation were not counted for evaluation.

Similarly, the surviving plants of seed sowing of different tree species on the dug up soil of pits were not counted for the purpose of evaluation.

Year wise and pocket wise details of number of surviving plants in the dug up pits were as given in Table-3.1

Table-3.1: Year wise and pocket wise details of plantations

Sr. No.	Pocket	Number of Pits		Number of Surviving Plants	Survival %	Av. Height (m)
		Reported	On the spot			
Year 2011-12						
1	A	15,871	17,216	16,078	93.39	1.75
2	B	25,499	26,821	25,256	94.17	2.00
3	C	27,106	23,956	21,141	88.25	1.20

4	D	16,819	17,111	16,027	93.66	1.50
5	E	11,726	11,264	10,216	90.70	1.00
6	F	18,438	17,402	15,268	87.74	0.70
7	G	22,141	21,614	20,028	92.66	1.00
Sub-total		**137,600**	**135,384**	**124,014**	**91.60**	**-**
Year 2012-13						
1	A (Khajur wala & Kabul wali Post)	37,165	38,552	33,130	85.94	1.00
2	B (Khajur wala, Neem wali & 20000 wali Post)	43,596	41,586	34,622	83.25	1.10
3	C (13000 Wali Pocket)	13,165	14,510	13,633	93.96	1.20
4	D (Water Tank Wali Pocket)	23,066	19,633	18,575	94.61	1.30
Sub-total		116,992	114,281	99,960	87.47	-
Total		**254,592**	**249,665**	**223,974**	**89.71**	**-**

3.1.5 Growth of Plants

Growth of plants was very good in the pockets with ensured irrigation wheras the growth in other pockets where irrigation facilities are far from, the growth was satisfactory.

Though, 59 species of fruit, shady, ornamental, timber and medicinal value were planted but the maximum growth was of Shisham (*Dalbergia sissoo*), Bamboo (*Bamboo species*), Pahari Papri (*Holoptelia integrefolia)*, Bakayan (Melia a*zadirach)* and Kikar (*Acacia nilotica*).

Shisham Plantation of year 2011-12 in Pocket A

Bamboo Plantation of year 2011-12 in Pocket B

Neem Plantation of year 2011-12 in Pocket B

Kikar Plantation of year 2011-12 in Pocket C

3.1.6 Irrigation System

Irrigation system installed as per approved Plan under CAMPA which has helped a lot in the survival and growth of plantations. It is a unique model in itself and may be replicated at other places. The water stored in mining pits has been successfully utilized for providing irrigation to plantations as well as to wildlife in the sanctuary. It included:

3.1.6.1 Installation of Submersible Pump on the Lake

Irrigation system installed at the lake for irrigation of plantation

3.1.6.2 Installation of Generator for running the Submersible Pump

Generator Set for running the Water lifting system

3.1.6.3 Installation of underground Tanks for Storage and Distribution of Water

Underground tanks for the storage and distribution of irrigation water

3.1.6.4 Installation of Pipes for further Distribution of Water

Pipe line for the distribution of irrigation water

3.1.7 Protection

Protection of land of Asola Bhatti Wildlife Sanctuary against the illegal mining and encroachment and the eco-restoration of the area was the main objective of handing over the area to the ETF and the ETF has achieved this objective up to a great extent. The protection measures taken included:

3.1.7.1 Construction of Posts where ETF staff remains on duty round the clock

ETF Post in Tauwala area

3.1.7.2 Construction of Roads and Path for patrolling

One of the Roads in Asola Bhatti Wildlife Sanctuary

3.1.7.3 Barbed wire Fencing strengthened with locally available biomass and contour trenching for protection of plantations against wildlife

Barbed wire Fencing strengthened with locally available biomass

3.2 Soil and Moisture Conservation (SMC) Works

3.2.1 Contour Trenches

Contour trenches dug up were playing their vital role in the soil and moisture conservation. The survival and growth of plants of planted in the trenches was very good due to availability of adequate moisture and silt. These plants were not counted for evaluation.

SMC Work (Bamboo Plantation in Trench) of 2012-13 in Asola-II

3.2.2 Water Bodies

Water bodies have been constructed in Asola Bhatti Wildlife Sanctuary for the soil and moisture conservation, recharging of sub-soil and for providing drinking water to the wild animals during the pinch period (April to June).

Though, the water bodies were playing their role in soil and moisture conservation and recharging of sub-soil but these were not providing drinking water to the wild animals during the pinch period.

Further, it would have been better if the services of some SMC expert were taken to avoid the following shortcomings:

i. Small catchment area of water body leading to less collection of water in the pondage area of water body.

ii. Porous bed of the water body leading to quick absorption of water in sub-soil.

iii. Absence of adequate intake channels.

iv. Non-strengthening of embankments.

v. Use of mechanical machinery for digging the water body.

SMC Work (Inlet of water pond)

SMC Work (Pondage area of water pond)

3.2.3 Check Dams

Earthen check dams have been constructed in Asola Bhatti Wildlife Sanctuary for the soil and moisture conservation.

Though the check dams were playing their role in SMC but it would have been better if the services of some SMC expert were taken to avoid the following shortcomings:

i. Non-compaction of soil.

ii. Non-removal of stones.

iii. Improper side slopes.

iv. Non-dressing and non-compaction of side slopes.

v. Non-planting of grass tuffs on the outer side slope.

vi. Ignorance about the concept of core wall and wing walls.

vii. Less top width.

The above shortcomings may lead to breakage of check dam in case of heavy rains.

Earthen Check Dam

Conclusions

1. Eco-Task Force (ETF) has achieved the main objective of controlling the illegal mining and encroachment as no fresh mining/encroachment was observed in the Asola Bhatti Wildlife Sanctuary.

2. The achievement of CA was 125% against the target of 200,000 plants fixed by the Forest Department under CAMPA.

3. The survival of plantation was very good (89.71%).

4. Though, 59 species of fruit, shady, ornamental, timber and medicinal value were planted but the maximum growth was of Shisham (*Dalbergia sissoo*), Bamboo (*Bamboo species*), Pahari Papri (*Holoptelia integrefolia)*, Bakayan (*Melia* a*zadirach)* and Kikar (*Acacia nilotica*).

5. Irrigation system installed has helped a lot in the survival and growth of plantations.

6. The achievement of soil and moisture conservation works was 100% against the target fixed by the Forest Department.

7. Though, the soil and moisture conservation works were serving their purpose up to some extent but these works need technical improvements.

8. The pug marks of female panther were seen during enumeration of plantation by our core team members were a clear indication of improved habitat for the wildlife in Asola Bhatti Wildlife Sanctuary. It is a great achievement of the efforts of Delhi Forest Department.

Chapter-5

Recommendations

1. Presence of Eco-Task Force in the Asola Bhatti Wildlife Sanctuary should be continued some more time.

2. Map of Asola Bhatti Wildlife Sanctuary showing all the roads, paths, ETF office and posts, Forest office, lake, monkey feeding points, etc. and the habitations on its boundary along with geo-references should be prepared.

   Year wise locations of all the sites of works carried out should be marked on the map.

   This map should be updated every year

3. Geo-reference of all the sites of works should be mentioned in the annual reports.

4. Irrigation system should be extended in all the young plantations.

5. Services must be taken of an expert in soil and moisture conservation works.

6. Tree groves of Neem (*Azadirachta indica)*, Bad (*Ficus benegalensis),* Pipal (*Ficus religiosa)*, Gular (*Ficus racemosa)* and other fruit species should be raised on mounds encircled with deep trench and number of these species should increase in future for habitat improved because this WLS is also being used for sifting of monkeys from habitations.

ANNEXURE-I

List of FCA cases approved by MoEF, GOI and details of CA/Penal CA/NPV realized upto the Year 2012-13

Sr. No.	Name of the project under FCA	Area diverted (Ha)	Date of final clearance accorded by Ministry	CA area Proposed	NPV realized Rs. in Lakh	Cost of CA (Rs. in Lakh)	Cost of Penal CA	Total of CA/PCA/NPV (Rs. in Lakh)
1.	Diversion of 0.38 ha of forest land for construction of diaphragm wall of underground railway line	0.38	No.91235/2001ROC/1770-71 Dated 27.11.2002	0.38	3.50	-	-	3.50
2.	Diversion of 1.0869 ha of forest land for Upgradation of Talkatora Stadium of NDMC	1.0869	No.9DLB001/2008/CHA/748-52 Dated 22.01.2008	2.2	10.00	61.07	-	71.07
3.	Diversion of 1.134 ha of forest land for construction of Bridge over Neela Hauz of PWD	1.134	No.9DLB949/2007/CHA/747 Dated 22.01.2008	2.3	10.43	63.23	-	73.66
4.	Diversion of 5.56 ha of forest land for construction of Qutub Minar-Gurgaon Corridor of DMRC	5.56	No.9DLB663/2007/CHA/2763 Dated 31.03.2008	11.20	51.15	344.86	-	396.01
5.	Diversion of 2.84 ha of forest land for upgradation of S. P. mukherji Swimming pool Complex of CPWD	2.84	No.9DLB116/2008/CHA/2682 Dated 03.04.2008	3.23	13.71	104.27	-	117.98
6.	Diversion of 6.89 ha of forest land for construction of Airport Express Link of DMRC	6.89	No.9DLB117/2008/CHA/4760-66 Dated 03.06.2008	8.84	63.39	271.07	-	334.46
7.	Diversion of 3.1916 ha of forest land for upgradation/re-construction of Dr. Karni Singh Shooting Range, Tughalkabad	3.1916	No.9DLB610/2008/CHA/11010 Dated 22.12.2008	6.4	29.36	227.58	-	256.94
8.	Diversion of 4.2 ha of deemed forest land for construction of depot at Ghitorani for Qutub Minar-Gurgaon Corridor of MRTS Project of DMRC	4.20	No.9DLB488/2008/CHA/363 Dated 16.01.2009 and No.9DLB488/2008/CHA/970 Dated 17.02.2009	8.4 (CA) + 8.4 (PCA)	38.64	261.15	245.15	544.94
9.	Diversion of 0.94 ha of forest land for construction of 45 m R/w Master Plan road from T-Junction of Mahrauli-Mahipalpur Road and Nelson Mandela road towards southern side from RD o mtr to Rd 1000 mtr for Commonwealth Games	0.94	No.9DLB184/2010/CHA/Dated 27.04.2010	4.89	8.648	140.00	-	148.648
10.	Diversion of 2.80 ha of forest land comprising of 2.2527 ha of deemed forest and 0.5473 ha of PRF for upgradation of NH-236 between Andheria More to Delhi-Haryana Border by NHAI	2.80	No.9DLB636/2010/CHA/820 Dated 24.01.2011	5.60	25.76	191.41	-	217.17
11.	Diversion of 13.00 ha of deemed forest land at Garhi Mandhu for construction of Signature Bridge over river Yamuna by DTDC	13.00	No.9DLB241/2011/CHA/8581Dated 21.10.2011	26.00	111.60	1192.00	-	1303.60
	Total	**42.0225**		**87.84**	**366.188**	**2856.64**	**245.15**	**3467.978**

Abbreviations: CA-Compensatory Afforestation; PCA-Penal CA; NPV- Net Present Value