

**A report**  
**on**  
**Monitoring and Evaluation of Plantations raised under**  
**Compensatory Afforestation Scheme of CAMPA- Chandigarh**

***SUBMITTED BY***



**FOREST RESEARCH INSTITUTE**  
**(Indian Council of Forestry Research & Education)**  
**P.O. NEW FOREST, DEHRADUN**  
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## Foreword

Chandigarh Forest & wildlife Department assigned the task of monitoring and evaluation of plantation activities under Compensatory Afforestation Fund Management and Planning Authority (CAMPA) to Forest Research Institute (FRI), Dehradun. Chandigarh has total Forest Cover of 22.88 sq. km which is 22.07% of the State's geographical area. In terms of forest canopy density classes, the State has 1.36 sq. km under Very Dense Forest (VDF), 13.51 sq. km under Moderately Dense Forest (MDF) and 8.01 sq. km under Open Forest (OF). The main forest types of Chandigarh are the Type Group 5B/C2 (Northern dry mixed deciduous Forest) and Type Group 5/DS1 (Dry deciduous scrub). Around 53.68 % of the total forest cover comes under plantation/ TOF. 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*, *Artocarpus heterophyllus*, *Bauhinia variegata*, *Cassia fistula*, *Delonix regia*, *Acacia catechu*, *Helicteres isora*, *Kgelia africana* and *Zizyphus spp.* etc.

Although, the land availability for the plantation in Chandigarh is very limited but Forest department is undertaking plantations on all types of vacant lands viz, road sides, parks ridges and on village lands. Scheme such as 'CAMPA' is implemented which aims to enhance green cover, mitigation of pollution, green lungs and rehabilitation of degraded lands of the Union Territory ( Chandigarh). Timely monitoring and evaluation is necessary for the long term viability of such plantations under this mega scheme. Monitoring and evaluation is also necessary as it provides the evidence that the investments into the project are worthwhile or alternative approaches need to be considered to improve effectiveness.

Hence, the Chandigarh Forest & Wildlife Department entrusted the Forest Research Institute (FRI), Dehradun to take up the monitoring and evaluation of works being carried out by the Chandigarh Forest Department under CAMPA scheme for the year 2022-2023. 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

## Preface

Chandigarh, the Union Territory (UN) of India, has a geographical area of 114 sq. km, Chandigarh had a forest spread in an area of 33.3515sq km in the year 2006-07 of which 30.686 sq.kms is reserved forest. There are two ranges viz., the Chandigarh Forest Range and the Nepali Forest Range. The Department of Environment and Forests established in 1966 has the objectives of creating a green belt around the city and to carry out soil conservation of Sukana Lake Catchments area. The Union Territory of Chandigarh is located in the foothills of the Shivalik hill ranges in the north, which form a part of the fragile Himalayan ecosystem. It is occupied by Kandi (Bhabhar) in the north east and Sirowal (Tarai) and alluvial plains in the remaining part. The subsurface formation comprises of beds of boulders, pebbles, gravel, sand, silt, clays and some kankar. The area is drained by two seasonal rivulets viz. Sukhna Choe in the east and Patiala-Ki-Rao Choe in the west. The central part forms a surface water divide and has two minor streams. The stream passing through the central part is called N-Choe and the other is Choe Nala which initiates at Sector 29.

The population of Chandigarh (UT) is increasing at a very faster rate. The toxic levels of air pollution in and around Chandigarh are creating threats to the lives of the residents. Chandigarh falls under Koeppen's CWG category i.e. it has cold dry winter, hot summer and sub tropical monsoon. Evaporation usually exceeds precipitation and the weather is generally dry.

Tree plantation and landscaping has been an integral part of the city's Master Plan. Twenty six different types of flowering and 22 species of evergreen trees (Sing et. Al., 1998) have been planted along the roads, in parking areas, shopping complexes, residential areas and in the city parks, to ameliorate the harsh climate of the region, especially the hot and scorching summers.

Forest & Wildlife Department of Chandigarh 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.

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**1. Introduction**

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The Union Territory (UT) of Chandigarh is a planned city which is divided into 56 Sectors and is mainly dominated with urban land use. Chandigarh is a city, district and union territory in India that serves as the joint capital of the two neighboring states of Punjab and Haryana. Chandigarh is bordered by the state of Punjab to the west and the south, and by the state of Haryana to the east. It constitutes the bulk of the Chandigarh Capital Region or Greater Chandigarh, which also includes the adjacent satellite cities of Panchkula and Mohali. It is located 260 km north of New Delhi and 229 km southeast of Amritsar. The city, lying in the northern plains, includes a vast area of flat, fertile land. Its northeast covers sections of Bhabar, while the remainder of its terrain is part of the Terai. Chandigarh is located by the foothills of the Shivalik Range of the Himalayas in northwest India. It covers an area of approximately 114 sq. km. The geographic coordinates of Chandigarh lies in between 30° 39' and 30° 49' in the North latitude and 75° 41' and 75° 51' in the East longitude (FSI 2021). It has an average elevation of 321 m.

**Wildlife and Biodiversity:**

Most of Chandigarh is covered by dense *Ficus benghalensis* and *Eucalyptus* Spp. Ashoka, Cassia, Mulberry and other trees flourish in the forested ecosystem. The city is surrounded by forests that sustain many animal and plant species. Deer, Sambars, Barking deer, Parrots, Woodpeckers and Peacocks inhabit the protected forests. Sukhna Lake hosts a variety of ducks and Geese and attracts migratory birds from parts of Siberia and Japan in the winter season. The Parrot Bird Sanctuary, Chandigarh provides a home to a large number of parrots. Sukhna Wildlife Sanctuary was declared a wildlife sanctuary in 1998. Chandigarh has beautiful roadside linear plantations, especially in the older sectors. Chandigarh is one of the greenest cities of the country. Urban forestry is the thrust area for the UT Forest Department which regularly undertakes plantation activities for increasing the forest and tree cover. The UT Department of Forest & Wildlife, Chandigarh, has started a novel initiative 'Forest department at your doorsteps', which is a scheme for free distribution of plants/saplings to general public without any formal application. To increase green cover in Chandigarh, "Annual Greening Chandigarh Action Plan" is being prepared.

In Union Territory of Chandigarh, the forest land has been diverted for various site specific non-forestry purposes and as mandated under the Forest Conservation Act, 1980, the department has carried out Compensatory Afforestation. The task of plantation under Compensatory Afforestation scheme of CAMPA 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. The Chandigarh Forest Department has entrusted FRI, Dehradun for carrying out third party monitoring and evaluation of various schemes of CAMPA.

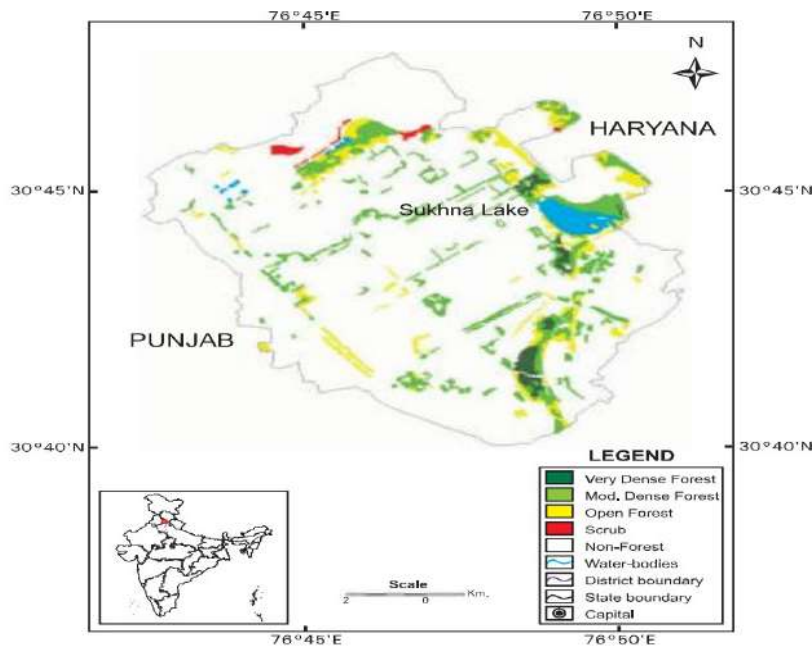
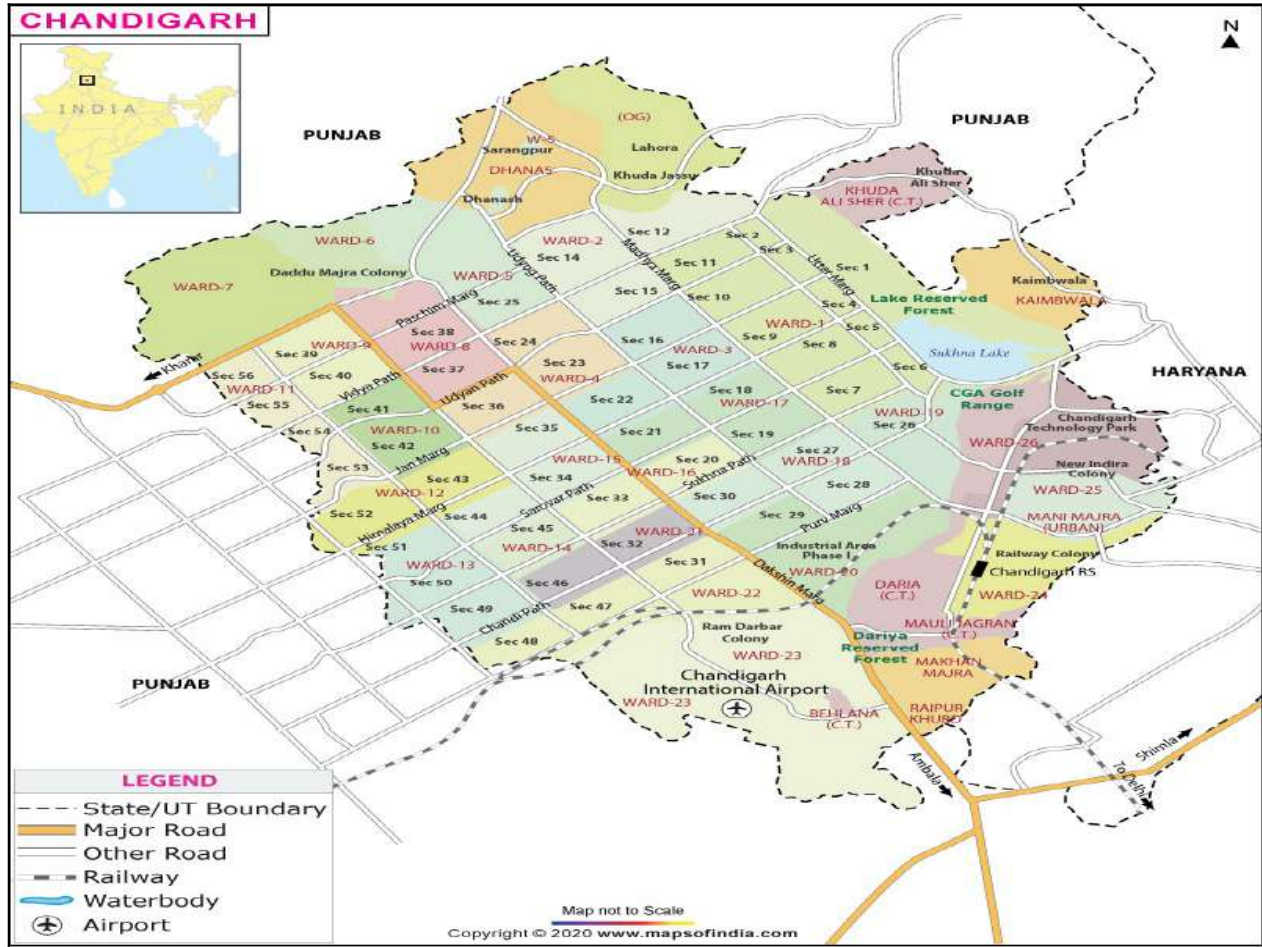


Fig.2. Forest Cover Map of Chandigarh.

Fig.1. Chandigarh City Map

## 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, playing 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 Chandigarh

As per the Champion and Seth Classification of Forest Types of India (1968), the forests of Chandigarh belong to one Forest Type Group i.e. Tropical Dry Deciduous Forest, which is further divided into two Forest Types. Around 11.88 sq. km (53.68 % of the total area) comes under TOF/plantation (FSI, 2021).

**Table 1.1: Details of forest resources.**

S. No.	Forest type	Area (sq km)	Forest type (%)
1.	5B/C2 Northern dry mixed deciduous forest	10.20	46.09
2.	5/DS1 Dry deciduous scrub	0.05	0.23
<b>Sub Total</b>		<b>10.25</b>	<b>46.32</b>
3.	TOF/Plantation	11.88	53.68
<b>Total (Forest cover and Scrub)</b>		<b>22.23</b>	<b>100.00</b>

Source-India State of Forest Report 2021

**Table 1.2: Land use pattern in Chandigarh.**

S. No.	Land use types	Areas (in '000 ha)	Percentage
1.	Geographical area	11	
2.	Reporting area for land utilization	7	100.0
3.	Forests	0	0.00
4.	Not available for land cultivation	5	71.42
5.	Permanent pastures and other grazing lands	-	-
6.	Land under misc. tree crops and groves	0	0.00
7.	Culturable wasteland	-	-
8.	Fallow land other than current fallows	1	14.29
9.	Current fallows	0	0.00

10.	Net area sown	1	14.29
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Source-India State of Forest Report 2021

### Forest cover of Chandigarh

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

**Table 1.3: Details of forest cover.**

Class	Area (sq. km)	%Total geographic area (GA)
Very Dense Forest (VDF)	1.36	1.09
Medium Dense Forest (MDF)	13.51	11.85
Open Forest (OF)	8.01	7.03
<b>Total</b>	<b>22.88</b>	<b>20.07</b>
Scrub	0.38	0.33

Source-India State of Forest Report 2021

**Table 1.4: District-wise forest cover in Chandigarh.**

District	Geo-graphical area	2021 Assessment			Total	%GA	Scrub
		VDF	MDF	OF			
Chandigarh	114	1.36	13.51	8.01	22.88	20.07	0.38
<b>Grand Total</b>	<b>114</b>	<b>1.36</b>	<b>13.51</b>	<b>8.01</b>	<b>22.88</b>	<b>20.07</b>	<b>0.38</b>

Source-India State of Forest Report 2021

**Table 1.5: Forest Cover Inside and Outside Recorded Forest Area (or Green Wash).**

Forest Cover Inside the Recorded Forest Area				Forest Cover Outside the Recorded Forest Area			
VDF	MDF	OF	Total	VDF	MDF	OF	Total
<b>1.28</b>	5.08	2.34	<b>8.70</b>	0.08	8.43	5.67	<b>14.18</b>
14.71%	58.39%	26.90%		0.56%	59.45%	39.99%	

Source-India State of Forest Report 2021



**Table 1.6: Altitude-wise forest cover in Chandigarh.**

(in sq. km)

Altitude Zone (m)	Geographical area	VDF	MDF	OF	Total	Scrub
0-500	114	1.36	13.51	8.01	22.88	0.38
Total	<b>114</b>	<b>1.36</b>	<b>13.51</b>	<b>8.01</b>	<b>22.88</b>	<b>0.38</b>

Source-India State of Forest Report 2021

**Table 1.7: Forest cover in different slope classes in Chandigarh**

(in sq. km)

Slope (in degrees)	Geographical area	VDF	MDF	OF	Total	Scrub
0-5	109	1.30	12.59	7.52	21.41	0.36
5-10	5	0.06	0.92	0.49	1.47	0.02
<b>Total</b>	<b>114</b>	<b>1.36</b>	<b>13.51</b>	<b>8.01</b>	<b>22.88</b>	<b>0.38</b>

Source-India State of Forest Report 2021

**Growing stock in forest of Chandigarh.****Table 1.8: Growing stock in the recorded forest area (RFA) in Chandigarh is given below:**

(in m cum)

S. No.	Growing Stock	2021 Assessment	% of country's GS
1.	Growing Stock recorded forest area	0.21	0.00
2.	Growing Stock in TOF	0.29	0.02

Source-India State of Forest Report 2021

**Table 1.9: Diameter-class distribution of top five tree species inside RFA in Chandigarh.**

(in '000)

S. No.	Species	Diameter class (cm)		
		10-30	30-60	>60
1.	<i>Acacia catechu</i>	202	7	0
2.	<i>Leucaena leucocephala</i>	196	9	0
3.	<i>Dalbergia sissoo</i>	96	14	0
4.	<i>Melia azadirachta</i>	64	11	0
5.	<i>Eucalyptus spp.</i>	16	5	0

Source-India State of Forest Report 2021

## Dominant tree species in Trees Outside Forests (TOF)

**Table 1.10: Top five tree species in numbers in Trees Outside Forests (TOF) in Chandigarh in rural and urban areas are given below:**

Top five tree species in rural area			Top five tree species in urban area	
S. No.	Species	Relative Abundance (%)	Species	Relative Abundance (%)
1.	<i>Eucalyptus</i> spp.	38.16	<i>Mangifera indica</i>	12.32
2.	<i>Mangifera indica</i>	12.52	<i>Polyalthia longifolia</i>	7.13
3.	<i>Prosopis juliflora</i>	8.17	<i>Morus</i> spp.	6.28
4.	<i>Morus</i> spp.	7.47	<i>Alstonia scholaris</i>	4.18
5.	<i>Dalbergia sissoo</i>	4.89	<i>Melia azadirachta</i>	3.64

Source-India State of Forest Report 2021

## Carbon stock in forest

The total carbon stock of forest in the Union Territory including the TOF patches which are more than 1.0 ha. in size is 0.18 million tones. It is 0.002% of total forest carbon of the country. Pool wise carbon in Chandigarh is given in the following table.

**Table 1.11: Forest carbon in Chandigarh in different pools.**

S. No.	Carbon Pools	Forest Carbon
1.	Above ground biomass	47
2.	Below ground biomass	15
3.	Dead wood	1
4.	Litter	3
5.	SOC	117
<b>Total</b>		<b>180</b>

Source-India State of Forest Report 2021

## Major Non-timber forest product species

Major NTFP species are assessed from forest inventory data are presented in the below table:

**Table 1.12: Major NTFP species in Chandigarh.**

S. No.	Species	Plant Type	Relative Abundance (%)
1.	<i>Phyllanthus emblica</i>	Tree	43.45
2.	<i>Mulberry</i>	Tree	32.14
3.	<i>Ficus virens</i>	Tree	5.52
4.	<i>Syzygium cumini</i>	Tree	4.83
5.	<i>Ziziphus mauritiana</i>	Tree	4.14

Source-India State of Forest Report 2021

**Table 1.13: List of species planted under CAMPA scheme by Chandigarh forest department.**

S. No.	Scientific Name	Common Name	Family
1.	<i>Acacia catechu</i>	Khair	Fabaceae
2.	<i>Aegle marmelos</i>	Beal	Rutaceae
3.	<i>Albizia lebbeck</i>	Siris	Fabaceae
4.	<i>Anthocephalus cadamba</i>	Kadamba	Rubiaceae
5.	<i>Artocarpus heterophyllus</i>	Jack Fruit	Moraceae
6.	<i>Azadirachta indica</i>	Neem	Meliaceae
7.	<i>Bauhinia variegata</i>	Kachnar	Fabaceae
8.	<i>Butea frondosa</i>	Palash	Fabaceae
9.	<i>Cascabela thevetia</i>	Kaner	Apocynaceae
10.	<i>Cassia fistula</i>	Amaltas	Fabaceae
11.	<i>Chukrasia tabularis</i>	Kaner	Meliaceae
12.	<i>Citrus limon</i>	Limon	Rutaceae
13.	<i>Clitoria ternatea</i>	Butterfly Pea	Fabaceae
14.	<i>Cordia dichotoma</i>	Lasoda	Boraginaceae

15.	<i>Dalbergia sissoo</i>	Shisham	Fabaceae
16.	<i>Delonix regia</i>	Gulmohar	Fabaceae
17.	<i>Drypetes roxburghii</i>	Indian Amulet Tree	Putranjivaceae
18.	<i>Emblica officinalis</i>	Amla	Phyllanthaceae
19.	<i>Ficus benghalensis</i>	Bargad	Moraceae
20.	<i>Ficus glomerata</i>	Gular	Moraceae
21.	<i>Ficus infectoria</i>	Pilkhan	Moraceae
22.	<i>Ficus religiosa</i>	Peepal	Moraceae
23.	<i>Ficus virens</i>	Pilkhan	Moraceae
24.	<i>Grevillea robusta</i>	Silver oak	Proteaceae
25.	<i>Grewia asiatica</i>	Phalsa	Malvaceae
26.	<i>Helicteres isora</i>	Marod Phali	Malvaceae
27.	<i>Holoptelea intergrifolia</i>	Indian Elm	Ulmaceae
28.	<i>Jacaranda mimosifolia</i>	Jacaranda	Bignoniaceae
29.	<i>Kigelia africana</i>	Sausage Tree	Bignoniaceae
30.	<i>Kigelia pinnata</i>	Sausage Tree	Bignoniaceae
31.	<i>Koelreuteria apiculata</i>	Golden Rain Tree	Sapindaceae
32.	<i>Lagerstroemia spp.</i>	Crape Myrtle	Lythraceae
33.	<i>Mangifera indica</i>	Aam	Anacardiaceae
34.	<i>Melia azedarach</i>	Bakain	Meliaceae
35.	<i>Millettia pinnata</i>	Indian Beech Tree	Fabaceae
36.	<i>Mimusops elengi</i>	Maulsari	Sapotaceae
37.	<i>Moringa oleifera</i>	Drumstick Tree	Moringaceae
38.	<i>Morus alba</i>	Shahtoot	Moraceae
39.	<i>Murraya koenigii</i>	Curry Leaf Tree	Rutaceae
40.	<i>Nerium indicum</i>	Olender	Apocynaceae
43.	<i>Phyllanthus emblica</i>	Indian Gooseberry	Eurphobiaceae

44.	<i>Pithecellobium dulce</i>	Jungle Jalebi Tree	Fabaceae
45.	<i>Pongamia pinnata</i>	Karanj	Fabaceae
46.	<i>Populus nigra</i>	Lombardy Poplar	Salicaceae
47.	<i>Psidium guajava</i>	Amrrod	Myrtaceae
48.	<i>Pterospermum acerifolium</i>	Kanak Champa	Sterculiaceae
49.	<i>Punica granatum</i>	Pomegranate	Lythraceae
50.	<i>Putranjiva roxburghii</i>	Putranjiva	Putranjivaceae
51.	<i>Sapindus mukorossi</i>	Ritha	Sapindaceae
52.	<i>Schleichera trijuga</i>	Kusum Tree	Sapindaceae
53.	<i>Senegalia catechu</i>	Black Catechu	Fabaceae
54.	<i>Swietenia mahogany</i>	Mahogany	Meliaceae
55.	<i>Syzygium cumini</i>	Jamun	Myrtaceae
56.	<i>Tamarindus indica</i>	Imali	Fabaceae
57.	<i>Tectona grandis</i>	Teak	Verbenaceae
58.	<i>Terminalia arjuna</i>	Arjun	Combretaceae
59.	<i>Terminalia bellirica</i>	Bahera	Combretaceae
60.	<i>Thuja compacta</i>	Morpankhi	Cupressaceae
61.	<i>Thuja occidentalis</i>	Northern White Cedar	Cupressaceae
62.	<i>Toona ciliata</i>	Toon Tree	Meliaceae
63.	<i>Vachellia nilotica</i>	Babool	Fabaceae

## 2. Monitoring and Evaluation

### 2.1 Study Sites

The monitoring and evaluation works of plantation works of plantations under Chandigarh CAMPA was carried out by Forest Research Institute, Dehradun during the period from 2014-15, 2015-16, 2016-17, 2017-18, 2018-19, 2019-20 and 2020-21. The plantation work under Chandigarh CAMPA schemes and its components CA (Compensatory Afforestation) and NPV (Net Present Value) was carried out in Chandigarh Forest Division.

Total twenty-seven plantation sites were monitored by adopting random sampling method with total plantation area of 100 ha approx. Division wise details of the sites selected and area covered for monitoring of the plantations under Chandigarh CAMPA is provided in below Table-2.1.

**Table 2.1: Details of the sites covered.**

S. No.	Name of the Range	Name of the Site	Year	Total No. of Plants	Area (ha)	Survival Percentage
1.	Chandigarh	Lake Beat	2015-2016	400	0.4	91.25 %
2.	Chandigarh	Patiala ki Rao Beat	2015-2016	1000	1.0	93.80 %
3.	Chandigarh	Patiala ki Rao Beat	2015-2016	675	0.675	92.59 %
4.	Chandigarh	Khuda Ali Sher Beat	2015-2016	4500	4.5	91.66 %
5.	Chandigarh	Patiala ki Rao Beat	2015-2016	1700	1.70	84.11 %
6.	Nepali	Manimajra Beat	2020-2021	60	0.06	96.66 %
7.	Nepali	Makhenmajra Beat Daria Road	2015-2016	21	0.021	100.00 %
8.	Nepali	Village-Behlana	2020-2021	140	0.14	93.57 %
9.	Nepali	Manimajra Beat	2020-2021	144	0.144	95.13 %
10.	Nepali	Hallomajra Beat,	2015-	8000	8.00	81.22 %

		Manimajra Block	2016			
11.	Chandigarh	Patiala ki Rao Beat	2015-2016	4200	4.2	82.85 %
12.	Nepali	Ghareri Beat, Ghareri Block	2015-2016	6000	6.00	80.83 %
13.	Chandigarh	Barotiwala Beat	2016-2017	6000	6.00	82.58 %
14.	Nepali	Lower Nepali Beat	2016-2017	6000	6.00	81.00 %
15.	Chandigarh	Kansal Beat, Kansal Block	2017-2018	5000 (2500+2500)	5[2.5 (A Plot) +2.5 (B Plot)]	85.10 %
16.	Nepali	Manimajra Beat, Manimajra Block	2017-2018	5000	5.00	80.72 %
17.	Chandigarh	Kansal Beat	2018-2019	4820	4.82	88.19 %
18.	Nepali	Lower Nepali Beat	2018-2019	4000	4.00	81.35 %
19.	Chandigarh	Khuda Ali Sher Beat, Kansal Block	2019-2020	6000	6.00	87.36 %
20.	Nepali	Piplanwali Beat, Nathewala Block	2019-2020	4500	4.5	84.71 %
21.	Chandigarh	Lake Beat	2020-2021	7780	7.78	91.06 %
22.	Nepali	Manimajra Beat, Manimajra Block	2020-2021	6220	6.22	84.02 %
Additional Plantation Sites which is not mentioned in the list provided by Chandigarh Forest Department						
23.	Chandigarh	Patiala ki Rao Beat	2014-2015	536	0.536	84.32 %
24.	Nepali	Hallomajra Beat	2021-2022	740	0.74	94.32 %
25.	Nepali	Mani Majra, Near FRH	2021-22	50	0.05	96.00 %

	<b>Grand Total</b>	<b>78.486</b>
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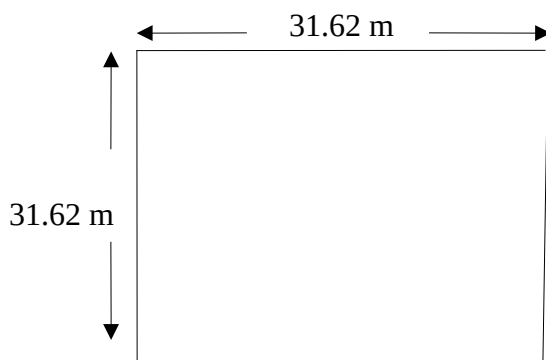
## 2.2. Evaluation and Process

### 2.2.1 Methodology

Monitoring and evaluation works under various schemes 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 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 of 0.1 ha, and for 15-20 ha size patch a total of 15-20 sample plots of 0.1 ha were laid randomly for monitoring.

<b>Plantation area size (ha)</b>	<b>Number of sample plots</b>	<b>Area covered by each sample plot (ha)</b>	<b>Sampling Intensity (%)</b>	<b>Total covered area (ha)</b>
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
<b>Note: Complete enumeration will be done for a site having area less than 1.0 ha.</b>				

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





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## **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 Chandigarh Forest Department. These indicators were simple, measurable yardsticks for assessing the plantations in terms of their effectiveness, relevance, sustainability. 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 biodiversity 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 were 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 were also collected from field observation in selected sites.

The data were collected for plantation work carried out under Chandigarh CAMPA and its components viz., NPV and CA during the period from 14 September 2022 to 22 September 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-III

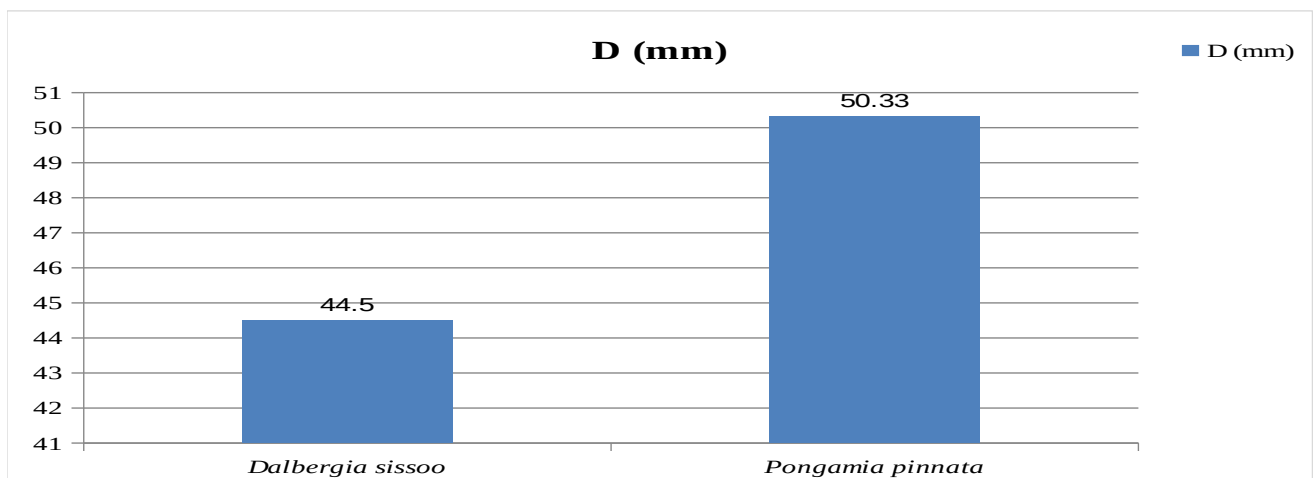
### 3. Forest Division-Wise Monitoring Evaluation

Union Territory Chandigarh has only one forest division that is Chandigarh forest division. Chandigarh forest division has two forest ranges namely; Chandigarh and Nepali. Monitoring and evaluation work under CAMPA scheme is done in UT Chandigarh division. The details are as follow.

#### Site 1: Lake beat, Chandigarh range

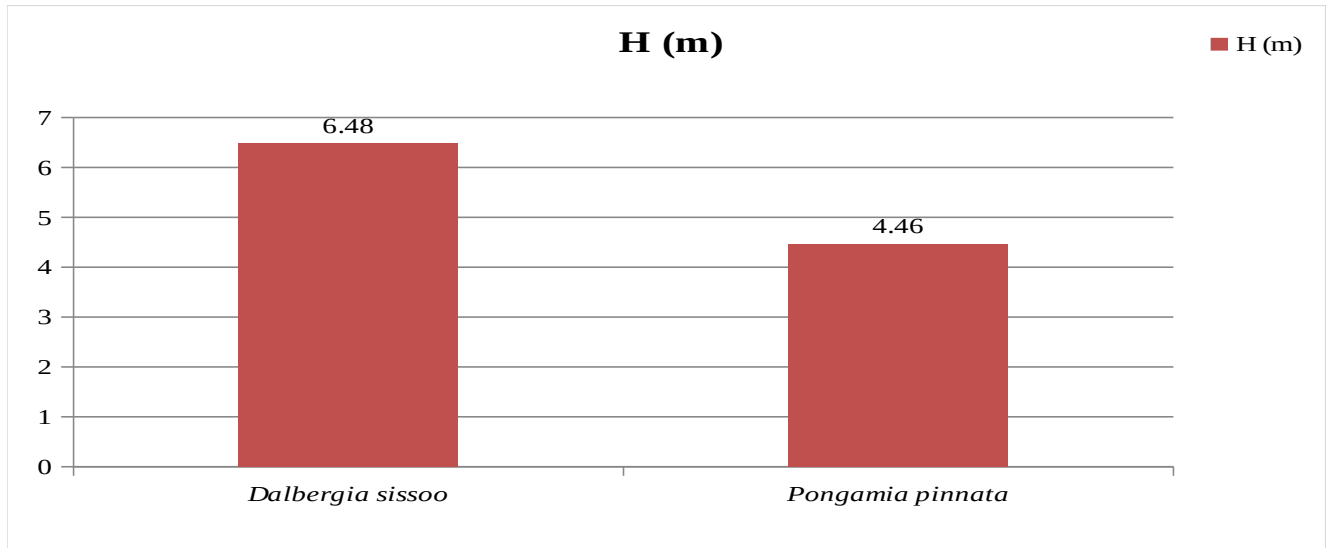
##### Plantation Growth Observation

The average survival of 91.25 % was observed in plantation site at Lake beat, in Chandigarh range. The maximum diameter (50.33 mm) was recorded for *Pongamia pinnata* and minimum diameter (44.5 mm) for *Dalbergia sissoo*.



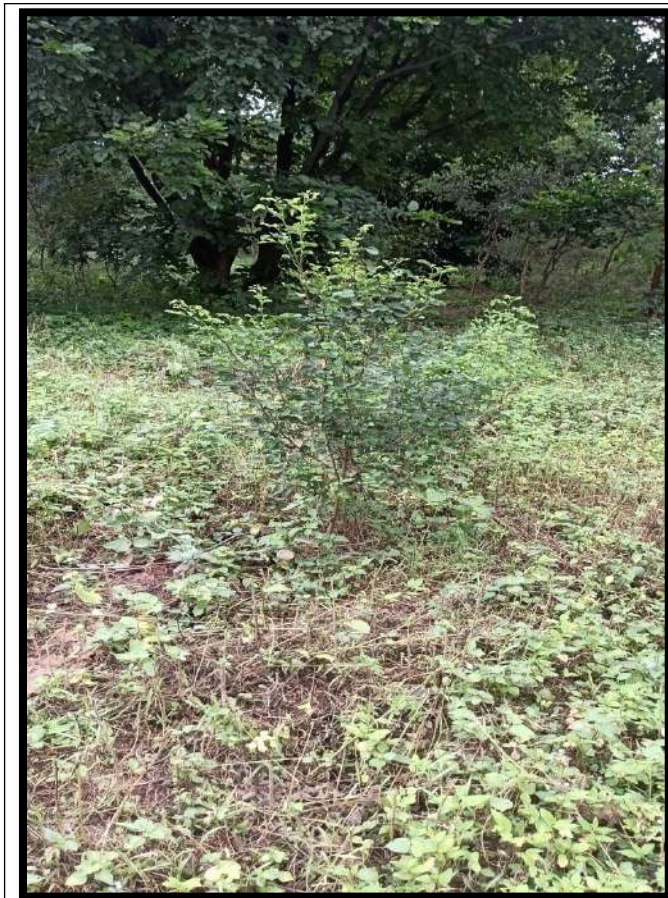
**Figure 3.1: Plantation diameter growth under Chandigarh CAMPA in, Lake Beat, Chandigarh range.**

The maximum height (6.48 m) was recorded for *Dalbergia sissoo* and minimum height (4.46 m) was recorded for *Pongamia pinnata*.



**Figure 3.2: Plantation height growth under Chandigarh CAMPA in, Lake Beat, Chandigarh range.**





**Site 2: Patiala ki Rao beat, Chandigarh range**

**Plantation Growth Observation**

The average survival of 93.80 % was observed in plantation site at Patiala ki Rao beat, in Chandigarh range. The maximum diameter (309 mm) was recorded for *Melia azedarach* followed by *Populus nigra* (137.33 mm) and minimum diameter (37 mm) for *Pithecellobium dulce* and *Pongamia pinnat* (45 mm).

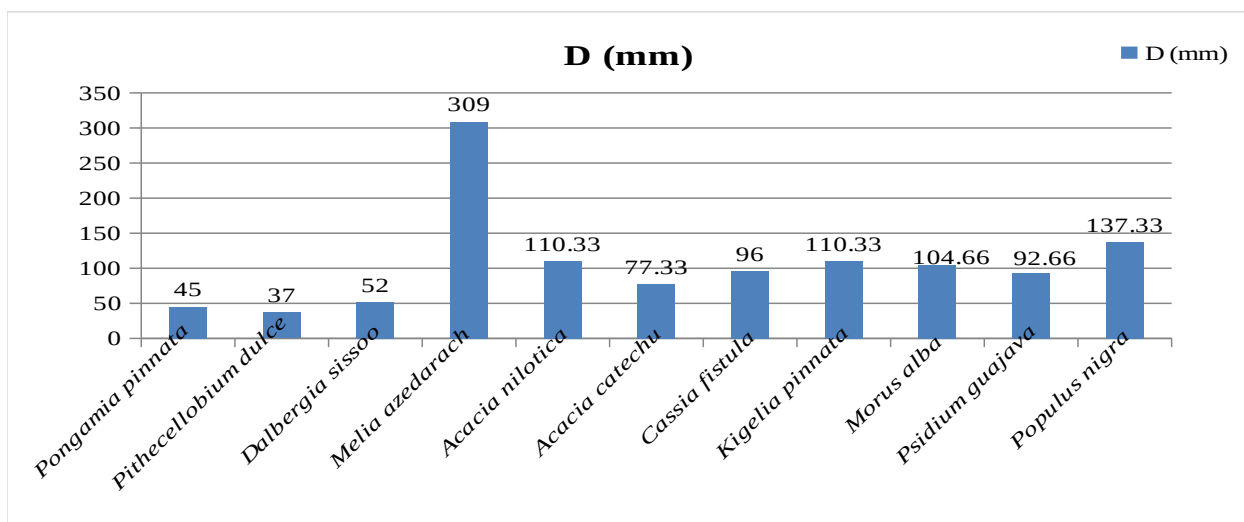


Figure 3.3: Plantation diameter growth under Chandigarh CAMPA in Patiala ki Rao beat, Chandigarh range.

The maximum height (5.56 m) was recorded for *Populus nigra* followed by (4.88 m) for *Melia azedarach* and minimum height (2.84 m) was recorded for *Pongamia pinnata* and *Acacia catechu* (3.26 m).

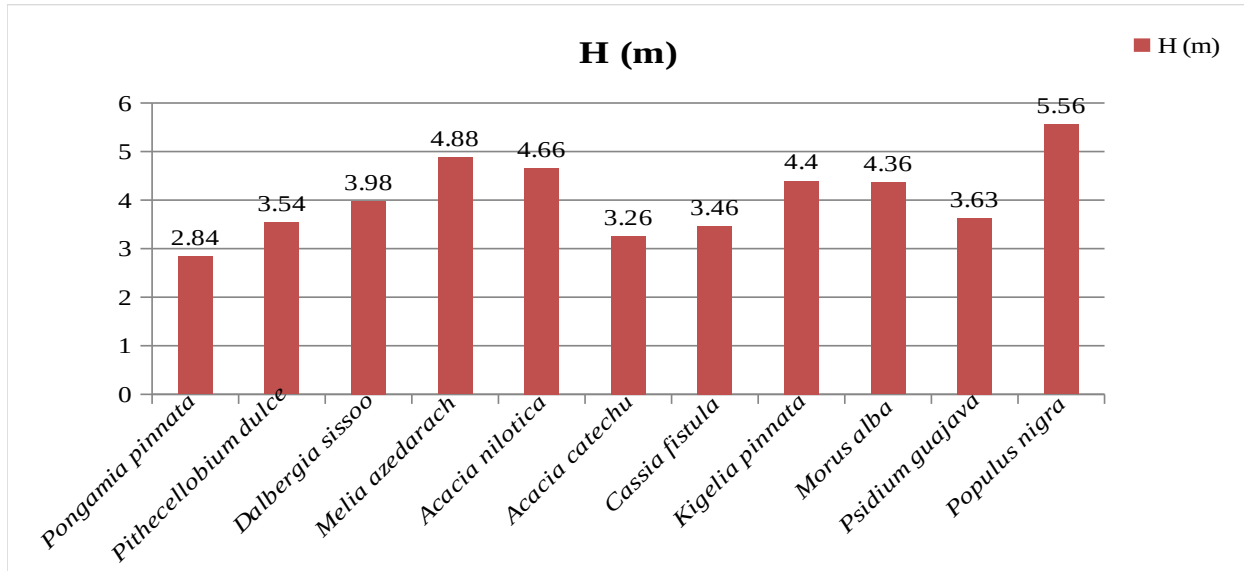
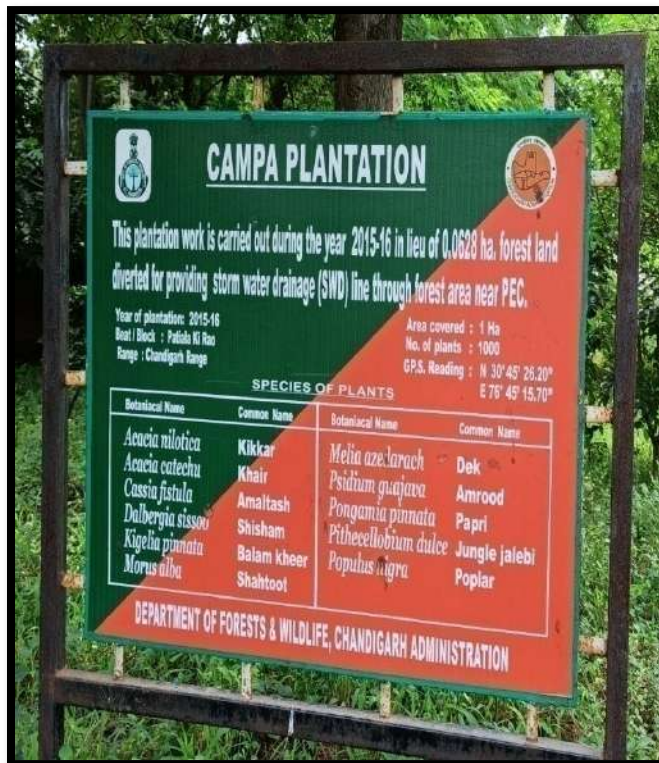


Figure 3.4: Plantation height growth under Chandigarh CAMPA in, Patiala ki Rao beat, Chandigarh range.





### **Site 3: Patiala ki Rao beat, Chandigarh range**

#### **Plantation Growth Observation**

The average survival of 92.59 % was observed in plantation site at Patiala ki Rao beat, in Chandigarh range. The maximum diameter (90 mm) was recorded for *Morus alba* followed by *Melia azedarach* (75.33 mm) and minimum diameter (10.66 mm) for *Syzygium cumini* and *Tamarindus indica* (11 mm).

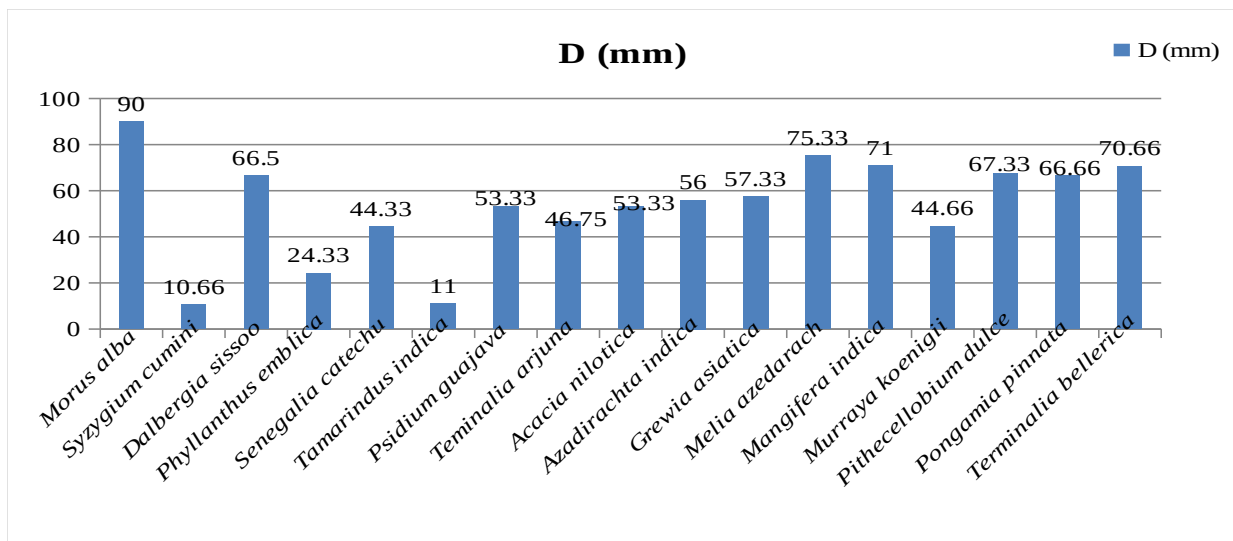


Figure 3.5: Plantation diameter growth under Chandigarh CAMPA in, Patiala ki Rao beat, Chandigarh range.

The maximum height (4.43 m) was recorded for *Melia azedarach* followed by (4.3 m) for *Grewia asiatica* and minimum height (0.83 m) was recorded for *Tamarindus indica* and *Syzygium cumini* (1.21 m).

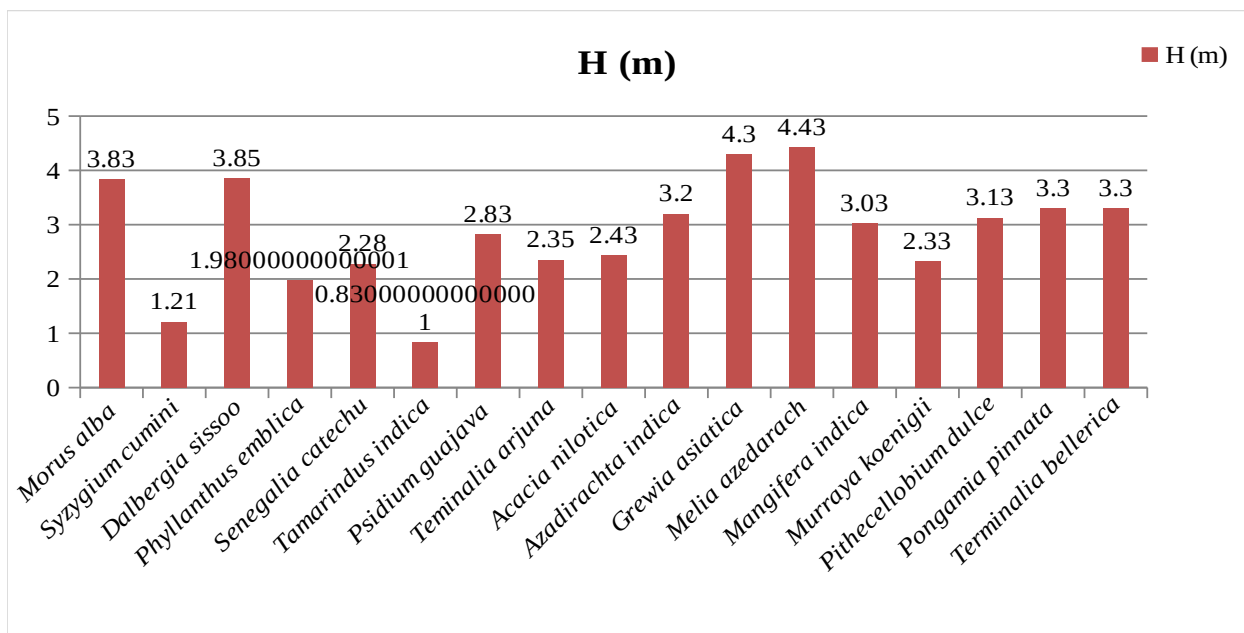
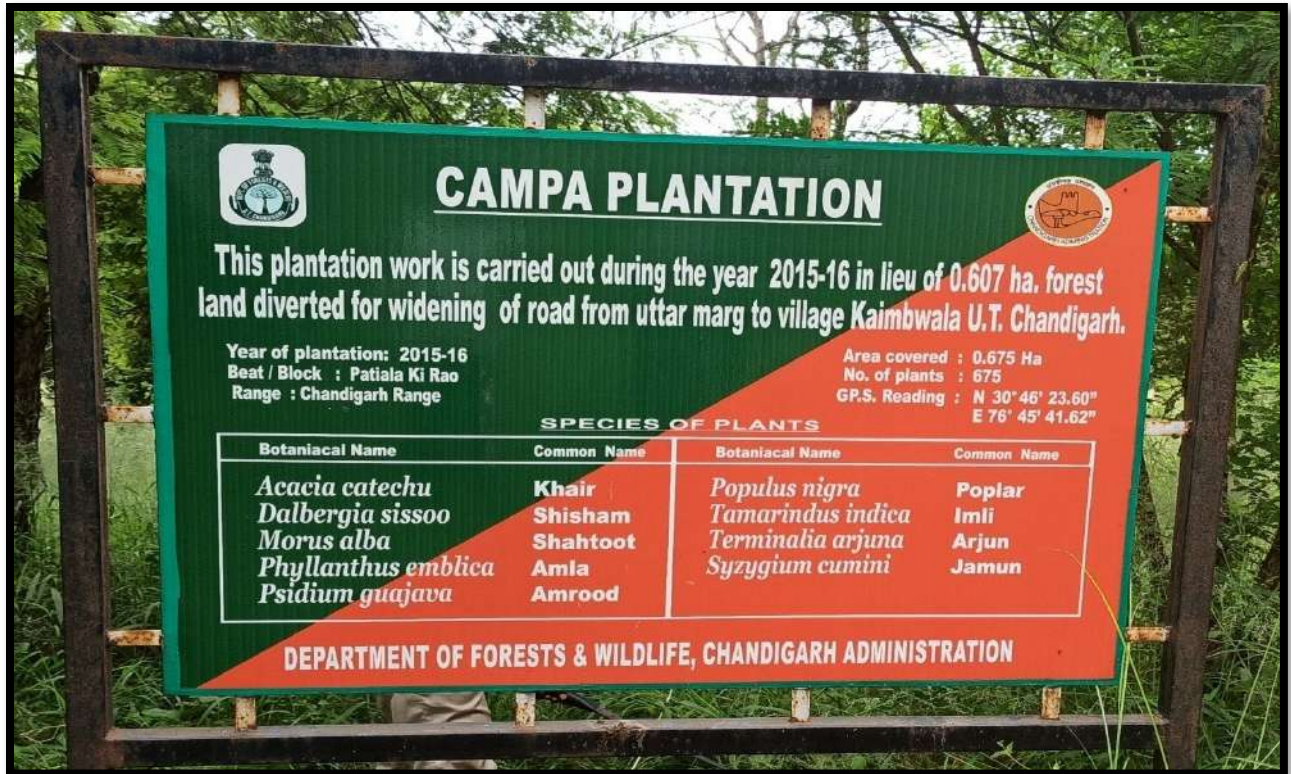


Figure 3.6: Plantation height growth under Chandigarh CAMPA in, Patiala ki Rao beat, Chandigarh range.





#### Site 4: Khuda Ali Sher beat, Chandigarh range

#### Plantation Growth Observation

The average survival of 91.66 % was observed in plantation site at Khuda Ali Sher beat, in Chandigarh range. The maximum diameter (59.33 mm) was recorded for *Acacia nilotica* followed by *Butea frondosa* (57 mm) and minimum diameter (29 mm) for *Pongamia pinnata* and *Murraya koenigii* (39 mm).

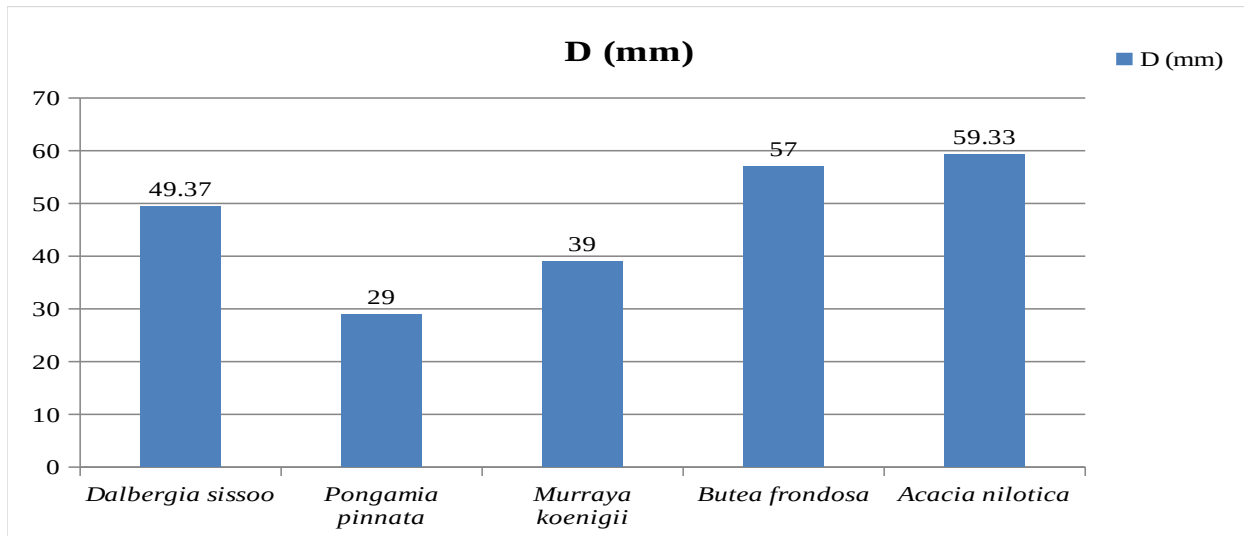


Figure 3.7: Plantation diameter growth under Chandigarh CAMPA in, Khuda Ali Sher beat, Chandigarh range.

The maximum height (3.24 m) was recorded for *Dalbergia sissoo* followed by (3.06 m) for *Butea frondosa* and minimum height (1.84 m) was recorded for *Pongamia pinnata* and *Murraya koenigii* (2 m).

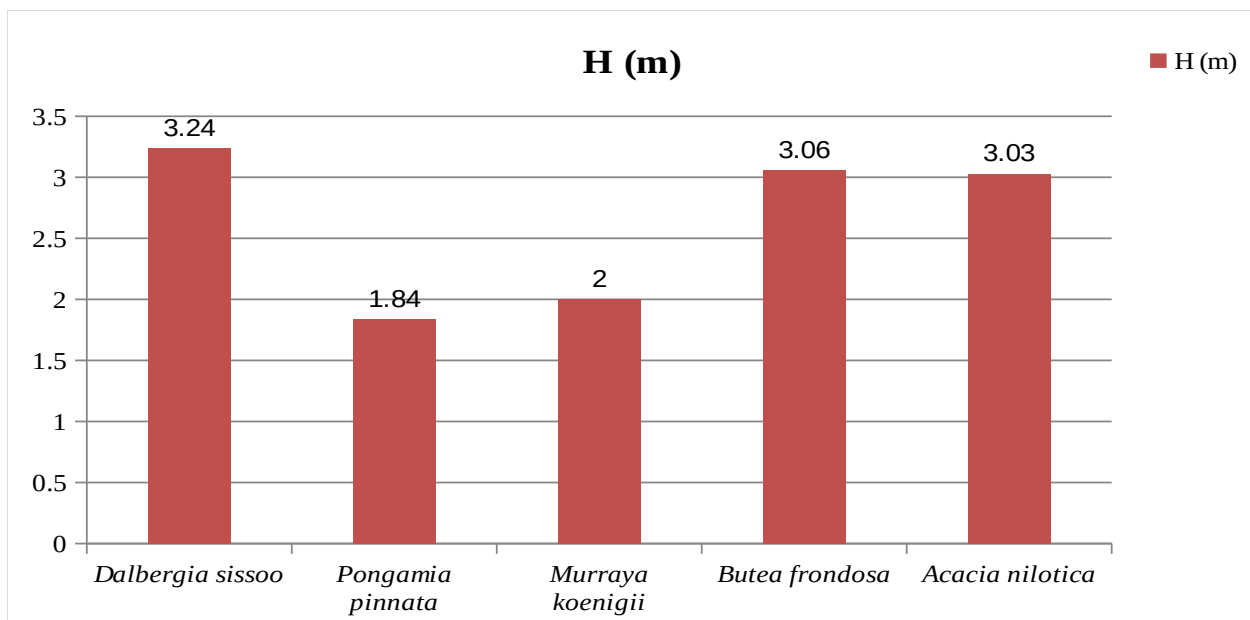


Figure 3.8: Plantation height growth under Chandigarh CAMPA in, Khuda Ali Sher beat, Chandigarh range.



**CAMPA PLANTATION**

This plantation is the part of plantation work done in lieu of 39.862 ha forest land diverted for the construction of various buildings of Post Graduate Institute of Medical Education & Research (PGIMER). Native plants of Shivalik Hills alongwith fruit bearing plants has been planted to conserve the local flora and to improve the habitat for the wildlife.

- Year of Plantation : 2015-16
- Beat / Block : Khuda Ali Sher Beat, Kansal Block
- Range : Chandigarh Range
- Area Covered : 4.5 Ha.
- No. of Plants : 4500 Nos.
- G.P.S. Reading : 30° 46' 23.53" N  
076° 49' 58.50" E

**SPECIES OF PLANTS**

Botanical Name	Common Name	Botanical Name	Common Name
<i>Acacia nilotica</i>	Kikar	<i>Murraya koenigii</i>	Curry Patta
<i>Butea frondosa</i>	Dhaak	<i>Pongamia pinnata</i>	Papri
<i>Dalbergia sissoo</i>	Shisham		

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## Site 5: Patiala ki Rao beat, Chandigarh range

### Plantation Growth Observation

The average survival of 84.11 % was observed in plantation site at Patiala ki Rao beat, in Chandigarh range. The maximum diameter (61.33 mm) was recorded for *Psidium guajava* followed by *Populus nigra* (57 mm) and minimum diameter (13.66 mm) for *Punica granatum* and *Tectona grandis* (32.33 mm).

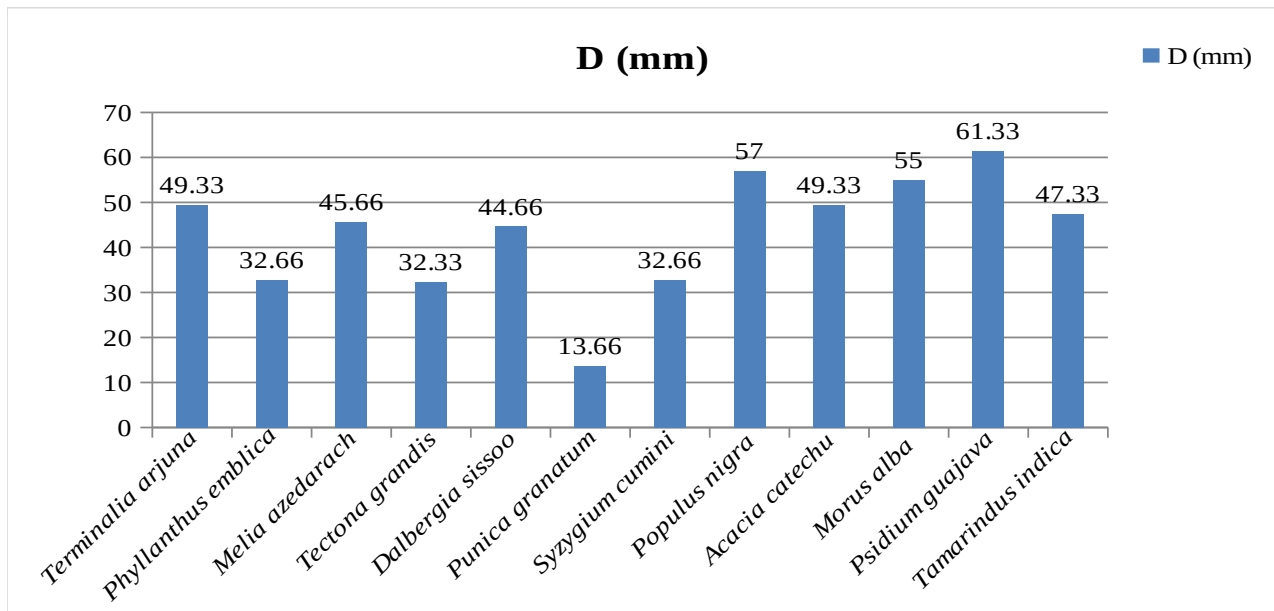


Figure 3.9: Plantation diameter growth under Chandigarh CAMPA in, Patiala ki Rao beat, Chandigarh range.

The maximum height (4.47 m) was recorded for *Melia azedarach* followed by (3.9 m) for *Populus nigra* and minimum height (1.46 m) was recorded for *Punica granatum* and *Tamarindus indica* (2.46 m).

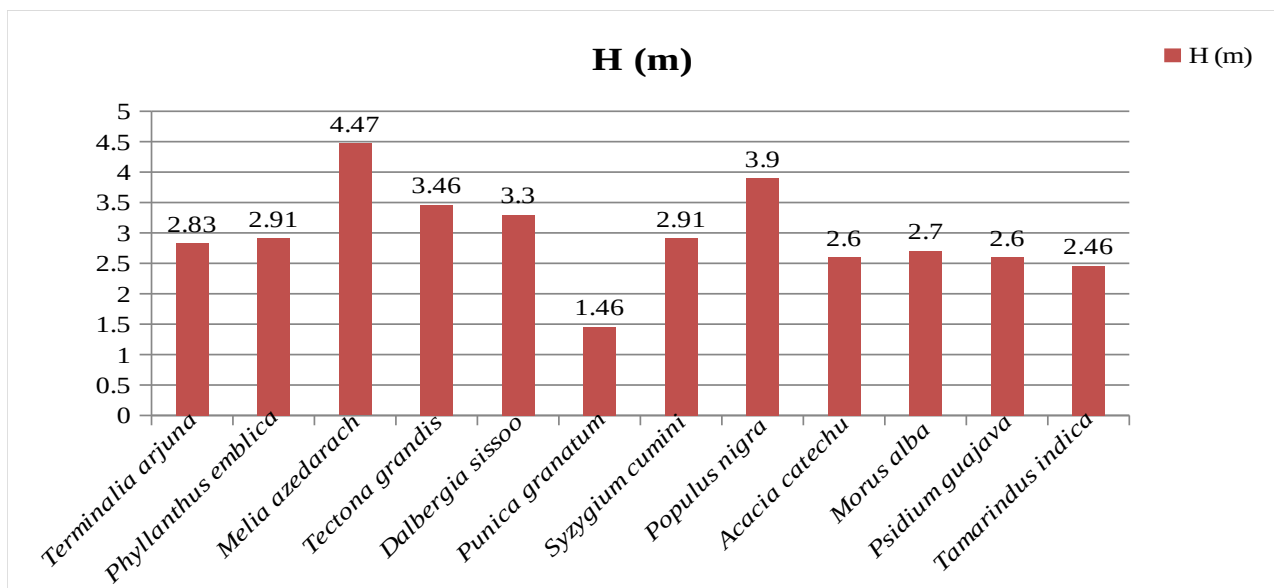


Figure 3.10: Plantation height growth under Chandigarh CAMPA in, Patiala ki Rao beat, Chandigarh range.

**CAMPA PLANTATION**

This plantation is the part of plantation work done in lieu of 39.862 ha forest land diverted for the construction of various buildings of Post Graduate Institute of Medical Education & Research (PGIMER). Native plants of this region along with fruit bearing plants have been planted to conserve the local flora and to improve the wildlife habitat.

Area covered : 1.70 Ha.  
 No. of plants : 1700  
 GPS Reading : N 30° 46' 05.50"  
 E 76° 49' 46.30"

Year of plantation: 2015-16  
 Beat : Patiala Ki Rao  
 Range : Chandigarh Range

**SPECIES OF PLANTS**

Botanical Name	Common Name	Botanical Name	Common Name
<i>Acacia nilotica</i>	Kikkar	<i>Phyllanthus emblica</i>	Amla
<i>Azadirachta indica</i>	Neem	<i>Pithecellobium dulce</i>	Jungle jalebi
<i>Dalbergia sissoo</i>	Shisham	<i>Psidium guajava</i>	Amrood
<i>Grewia asiatica</i>	Phalsa	<i>Pongamia pinnata</i>	Papri
<i>Morus alba</i>	Shahtoot	<i>Syzygium cumini</i>	Jamun
<i>Melia azedarach</i>	Dek	<i>Terminalia bellirica</i>	Bahera
<i>Mangifera indica</i>	Aam	<i>Terminalia arjuna</i>	Arjun
<i>Murraya koenigii</i>	Curry patta	<i>Tamarindus indica</i>	Imli

DEPARTMENT OF FORESTS & WILDLIFE, CHANDIGARH ADMINISTRATION



## Site 6: Manimajra beat, Nepali range

### Plantation Growth Observation

The average survival of 96.66 % was observed in plantation site at Manimajra beat, in Nepali range. The maximum diameter (114 mm) was recorded for *Grevillea robusta* followed by *Koelreuteria apiculata* (89 mm) and minimum diameter (63.33 mm) for *Dalbergia sissoo* and *Pongamia pinnata* (82 mm).

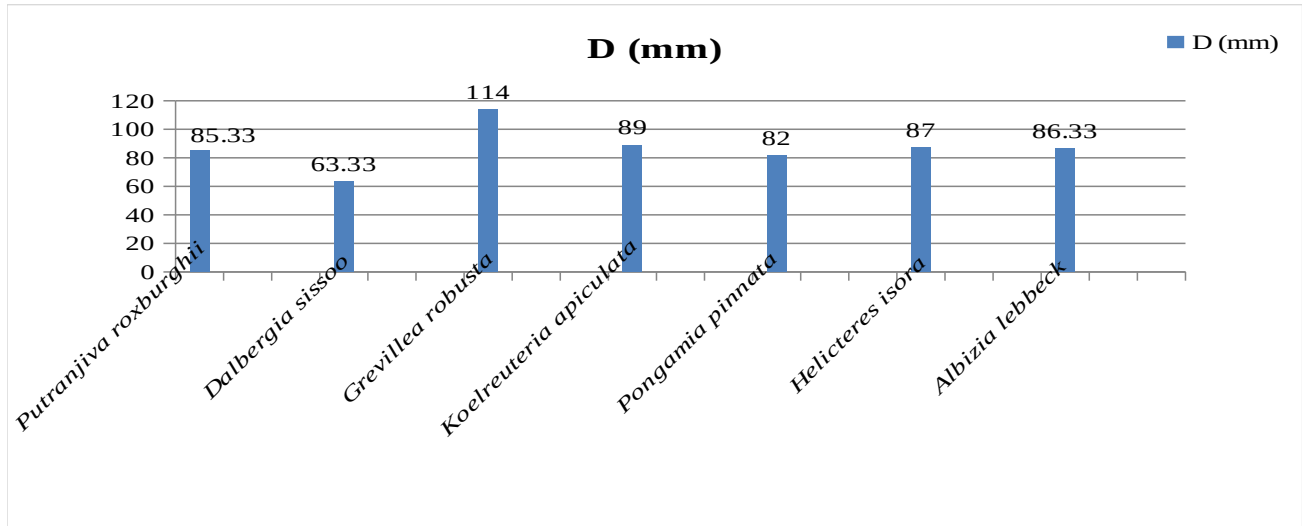


Figure 3.11: Plantation diameter growth under Chandigarh CAMPA in, Manimajra beat, in Nepali range.

The maximum height (19.66 m) was recorded for *Grevillea robusta* followed by (4.5 m) for *Albizia lebeck* and minimum height (2.83 m) was recorded for *Helicteres isora* and *Dalbergia sissoo* (3.8 m).

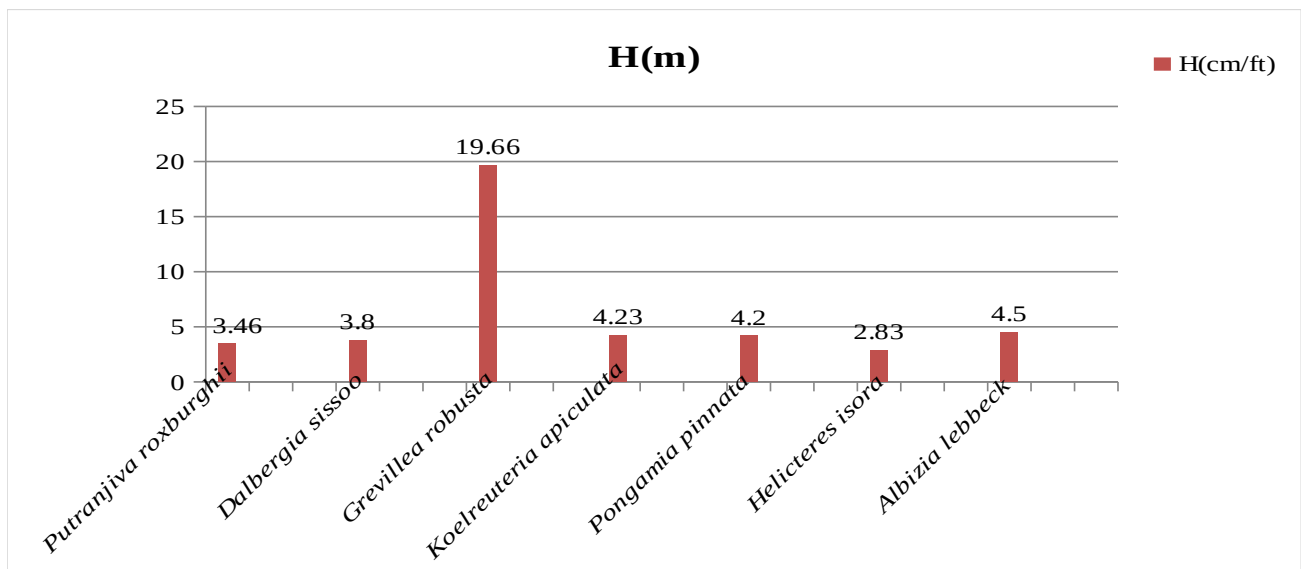


Figure 3.12: Plantation height growth under Chandigarh CAMPA in, Manimajra beat, in Nepali range.



## Site 7: Hallomajra beat, Nepali range

### Plantation Growth Observation

The average survival of 100 % was observed in plantation site at Hallomajra beat, in Nepali range. In this plantation site, *Pongamia pinnata* was dominant species. The diameter recorded for *Pongamia pinnata* was 87.28 mm.

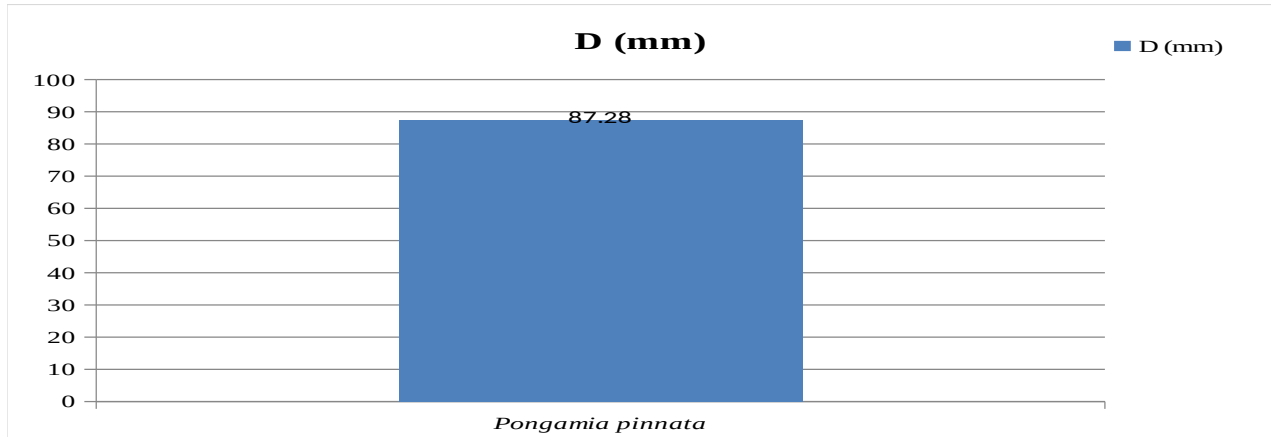


Figure 3.13: Plantation diameter growth under Chandigarh CAMPA in, Hallomajra beat, Nepali range.

The height (4.06 m) was recorded for *Pongamia pinnata*.

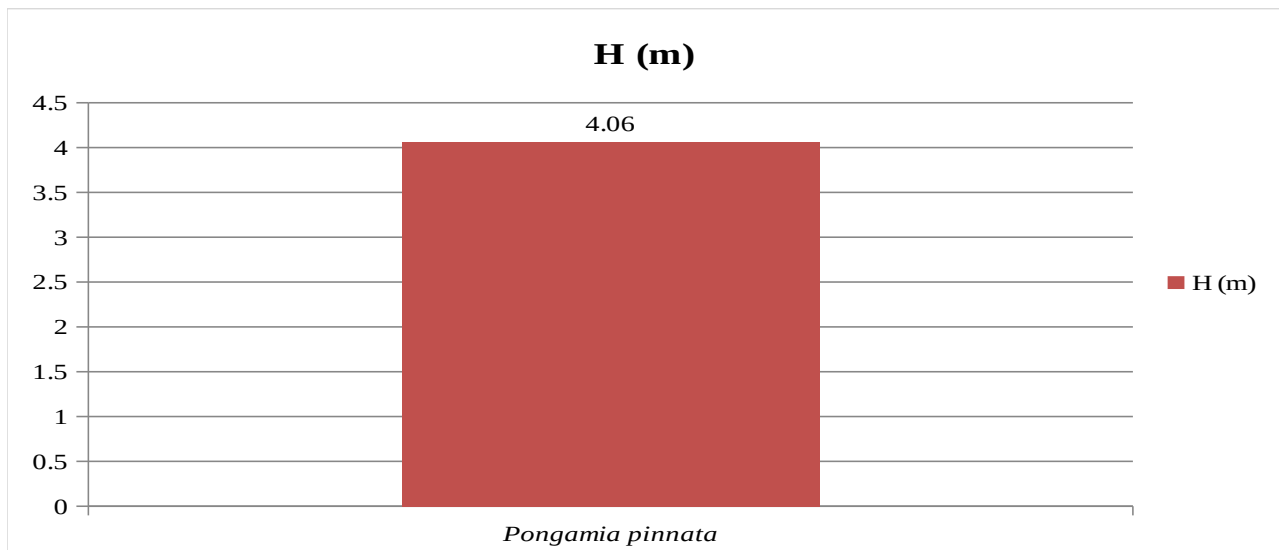




Figure 3.14: Plantation height growth under Chandigarh CAMPA in, Hallomajra beat, Nepali range.





# CAMPA PLANTATION



**Year of plantation:**  
2015-16

**Total area 0.034 Ha.**  
**Cost: Rs. 13180.00**

**No. of plants : 21**  
**G.P.S. Reading : N 30° 41' 21.90"**  
**E 76° 48' 36.80"**

**CAMPA Plantation done in Sukhna Choe Forest area in Hallomajra Block in Nepli Range in lieu of diversion of 0.0337 Ha. of forest land for producing street light at Makhan majra Daria road. The Department has done the plantation to increase the forest cover and its quality along with improving the habitat for the existing wildlife and increasing species richness.**

**SPECIES OF PLANTS**

Botanical Name	Common Name
<b><i>Pongamia pinnata</i></b>	<b>Papri</b>

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### Site 8: Manimajra beat, Nepali range

The average survival of 93.57 % was observed in plantation site at Manimajra beat, in Nepali range. The maximum diameter (229 mm) was recorded for *Ficus virens* followed by *Ficus religiosa* (112 mm) and minimum diameter (63.33 mm) for *Dalbergia sissoo* and *Pongamia pinnata* (82 mm).

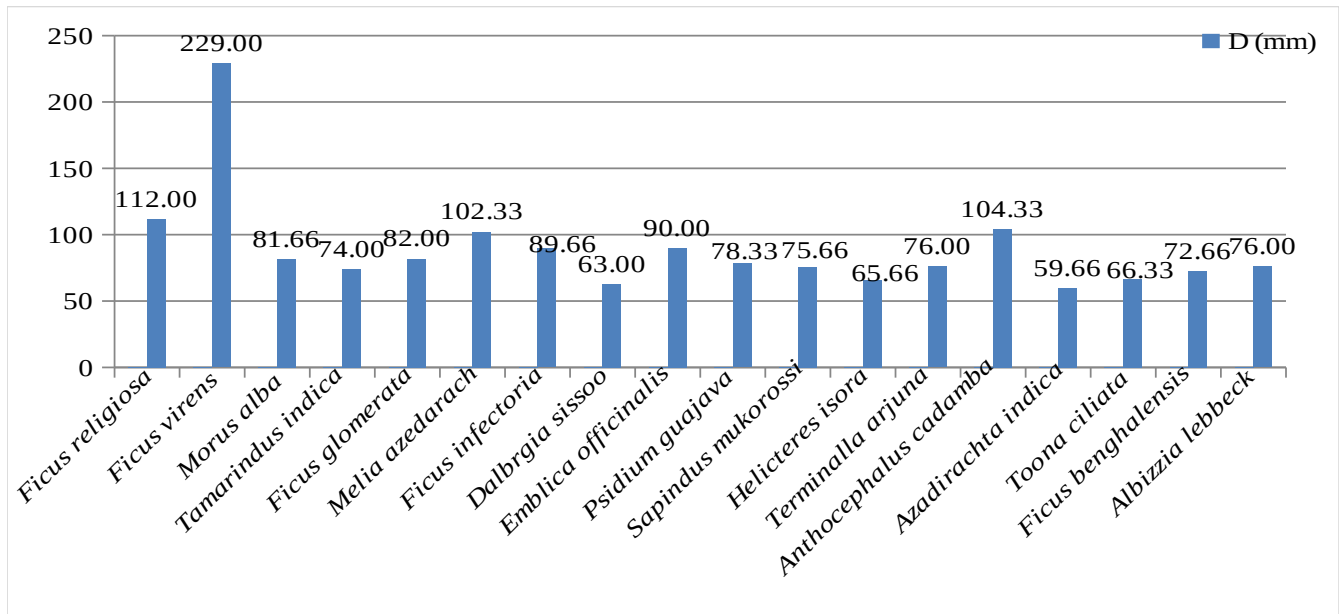


Figure 3.15: Plantation diameter growth under Chandigarh CAMPA in, Manimajra beat, Nepali range.

The maximum height (5.23 m) was recorded for *Anthocephalus cadamba* followed by (4.66 m) for *Melia azedarach* and minimum height (2.76 m) was recorded for *Helicteres isora* and *Ficus religiosa* (2.86 m).

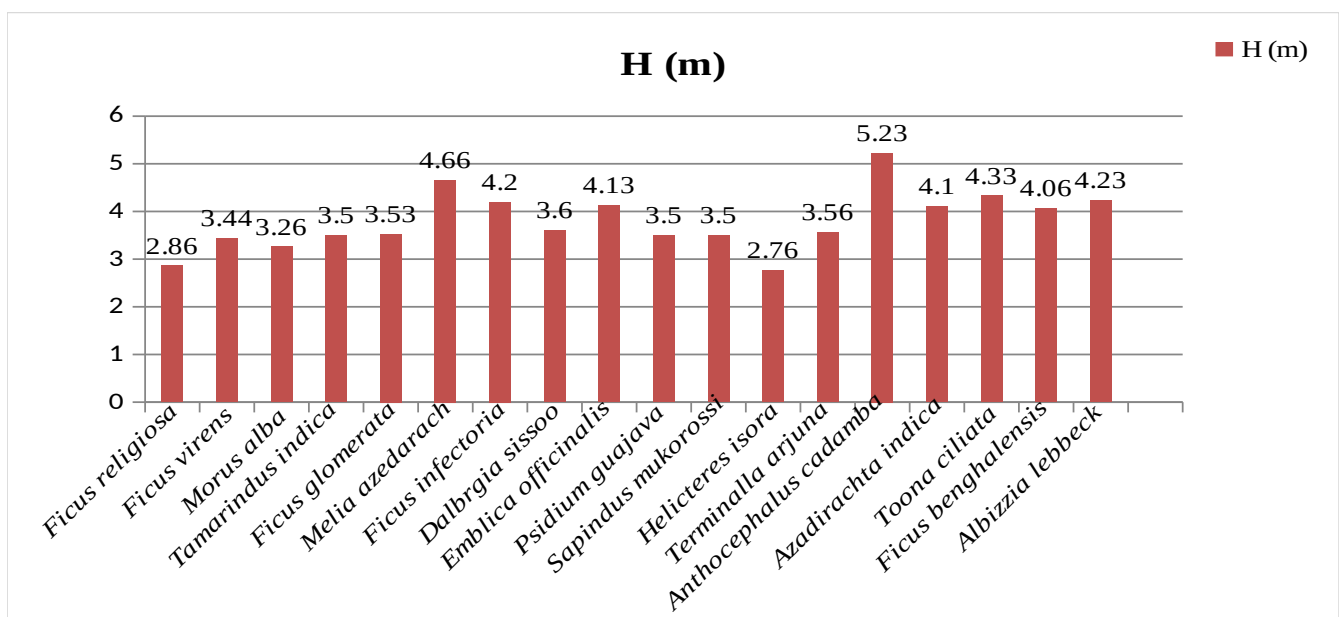
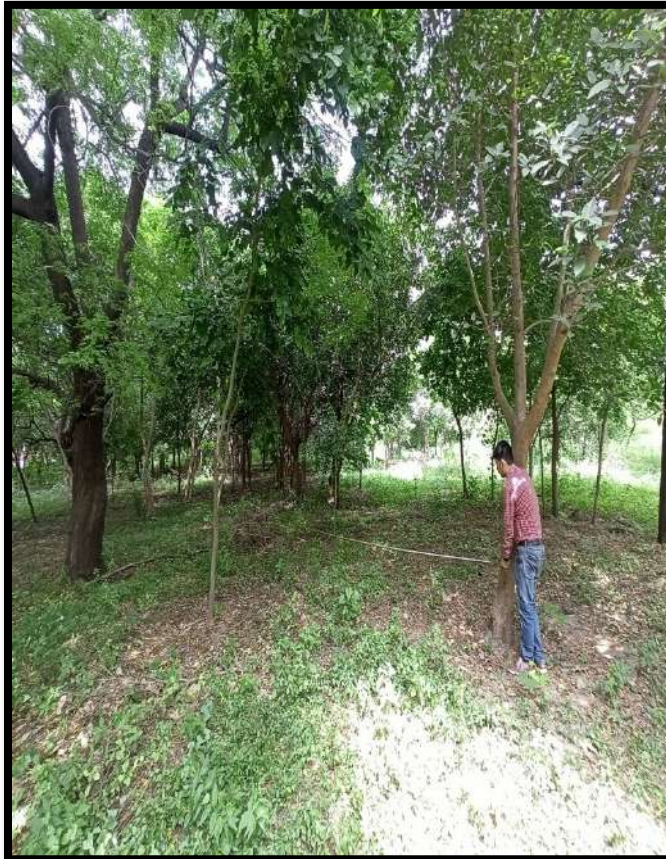


Figure 3.16: Plantation height growth under Chandigarh CAMPA in, Manimajra beat, Nepali range.



### Site 9: Manimajra beat, Nepali range

The average survival of 95.13 % was observed in plantation site at Manimajra beat, in Nepali range. The maximum diameter (155.66 mm) was recorded for *Melia azedarach* followed by *Syzygium cumini* (131 mm) and minimum diameter (55.66 mm) for *Azadirachta indica* and *Ficus glomerata* and *Helicteres isora* (57.66 mm).

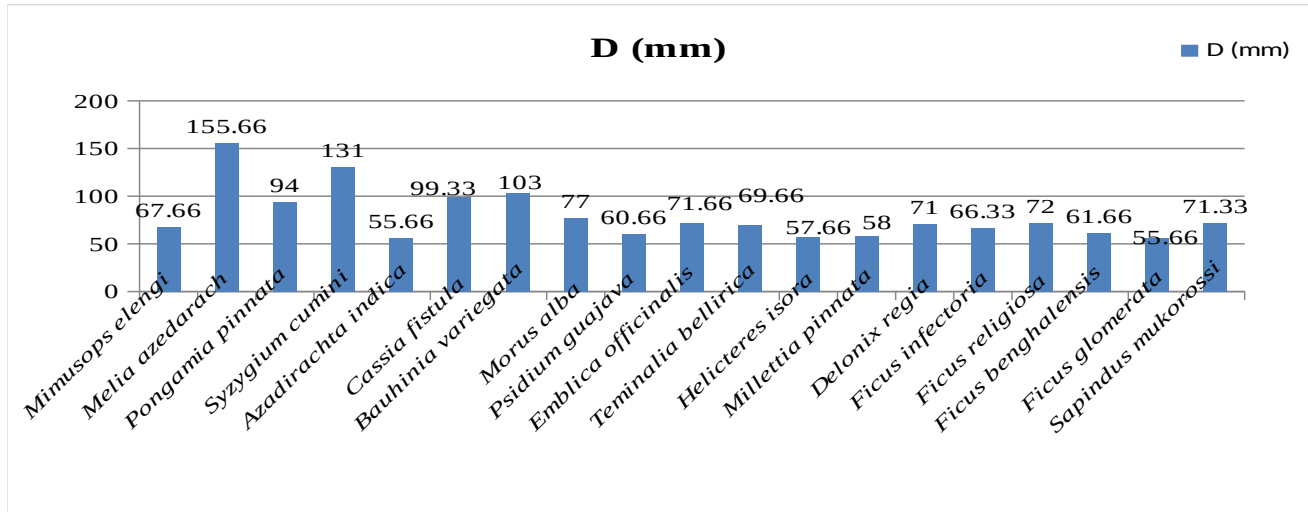


Figure 3.17: Plantation diameter growth under Chandigarh CAMPA in, Manimajra beat, Nepali range.

The maximum height (5.66 m) was recorded for *Melia azedarach* followed by (3.66 m) for *Pongamia pinnata* and *Ficus religiosa*. Minimum height (2.46 m) was recorded for *Azadirachta indica*.

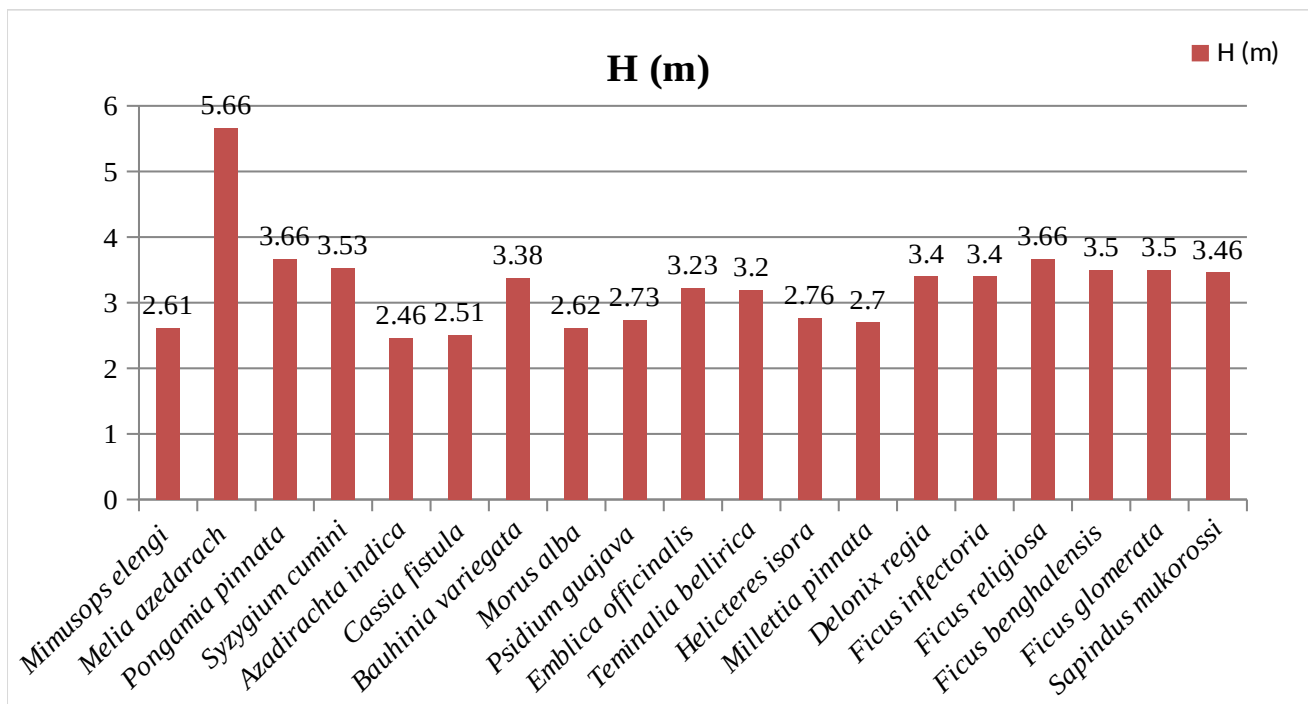
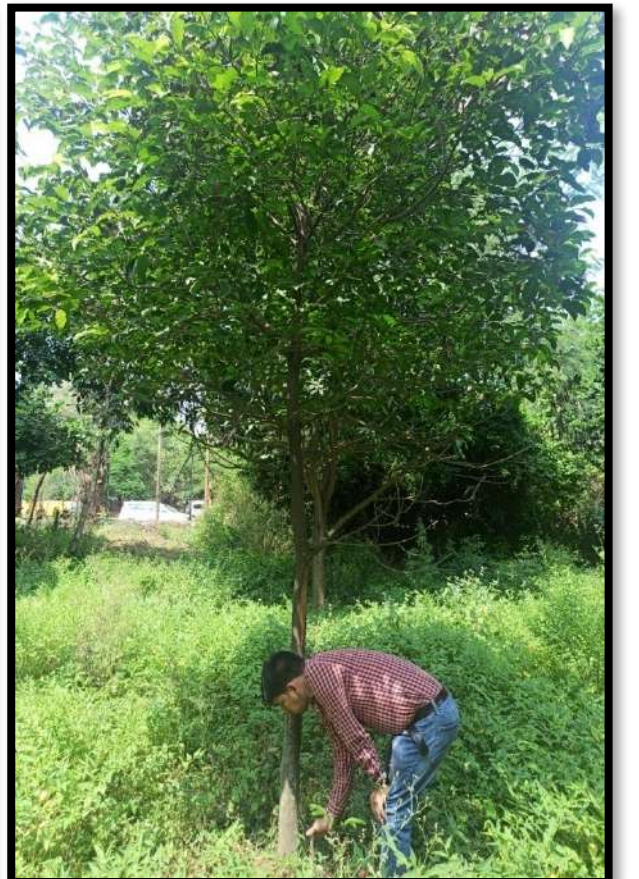


Figure 3.18: Plantation height growth under Chandigarh CAMPA in, Manimajra beat, Nepali range.



### Site 10: Hallomajra beat, Nepali range

The average survival of 81.22 % was observed in plantation site at Manimajra beat, in Nepali range. The maximum diameter (102.66 mm) was recorded for *Grevillea robusta* followed by *Koelreuteria apiculata* (99.33 mm) and minimum diameter (10.33 mm) for *Pithecellobium dulce* and *Holoptelia integrifolia* (33.5 mm). The maximum height (4.56 m) was recorded for *Grevillea robusta* followed by (4.32 m) for *Toona ciliata* and minimum height (0.85 m) was recorded for *Pithecellobium dulce* and *Holoptelia integrifolia* (2.04 m).

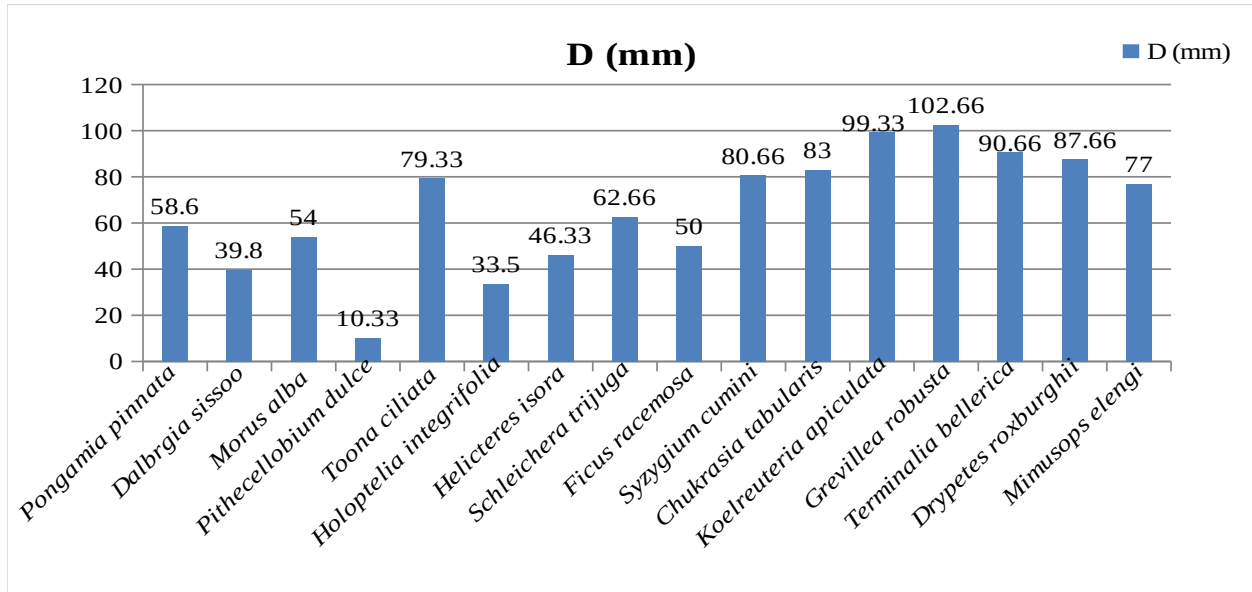


Figure 3.19: Plantation diameter growth under Chandigarh CAMPA in, Hallomajra beat, Nepali range.

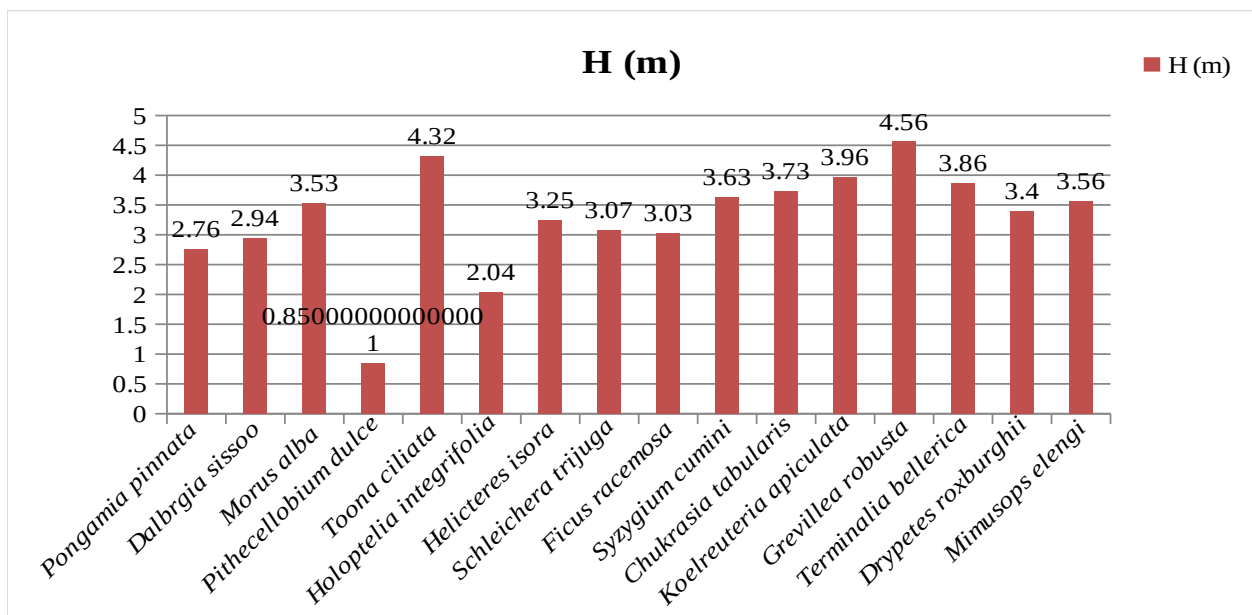


Figure 3.20: Plantation height growth under Chandigarh CAMPA in, Hallomajra beat, Nepali range.

## CAMPA PLANTATION, U.T. CHANDIGARH

Name of Scheme : CAMPA | Total Area : 8 Ha. | Total No. of Plants : 8000  
 Year of Plantation : 2015-16 | Cost of work : Rs. 23.17 Lac | G.P.S. Reading : N 30° 40' 27.4"  
 E 076° 48' 54.9"

CAMPA Plantation is one of the important element embodied in the Forest Conservation Act, 1980. Which aims at having plantation of trees in lieu of the felling carried out in Chandigarh.

This 8 ha. of Plantation work has been done during 2015-16 in the Shukhna Choe reserve Forest area near village Raipur Khurd in Hallomajra Beat in lieu of permission granted to remove 108 nos. trees for P.G.I. project during 2013-14. The Department of Forests & Wildlife has under taken plantation in this land so as to green the land on one hand & to improve the habitat for the wildlife on the other

### SPECIES DETAILS

Botanical Name	Com. Name	Botanical Name	Com. Name
<i>Syzygium cumini</i>	Jamun	<i>Pithecellobium dulce</i>	Jungle Jalebi
<i>Chakrasia tabularis</i>	Chakrasia	<i>Schleichera trijuga</i>	Kusum
<i>Pongamia pinnata</i>	Papri	<i>Grevillea robusta</i>	Silver Oak
<i>Ficus infectoria</i>	Pilkhan	<i>Dalbergia sissoo</i>	Shisham
<i>Koelreuteria apiculata</i>	Kelotaria	<i>Terminalia bellerica</i>	Bahera
<i>Morus alba</i>	Shahoot	<i>Drypetes roxburghii</i>	Puttarjiva
<i>Kigelia pinnata</i>	Balamkhira	<i>Mimuspos elengii</i>	Maulisiri

DEPARTMENT OF FORESTS & WILDLIFE, CHANDIGARH ADMINISTRATION



### Site 11: Patiala ki Rao beat, Chandigarh range

The average survival of 82.85 % was observed in plantation site at Patiala ki Rao beat, Chandigarh range. The maximum diameter (105.66 mm) was recorded for *Populus nigra* followed by *Azadirachta indica* (94.66 mm) and minimum diameter (10.33 mm) for *Phyllanthus emblica* and *Bauhinia variegata* and *Syzygium cumini* (12.66 mm).

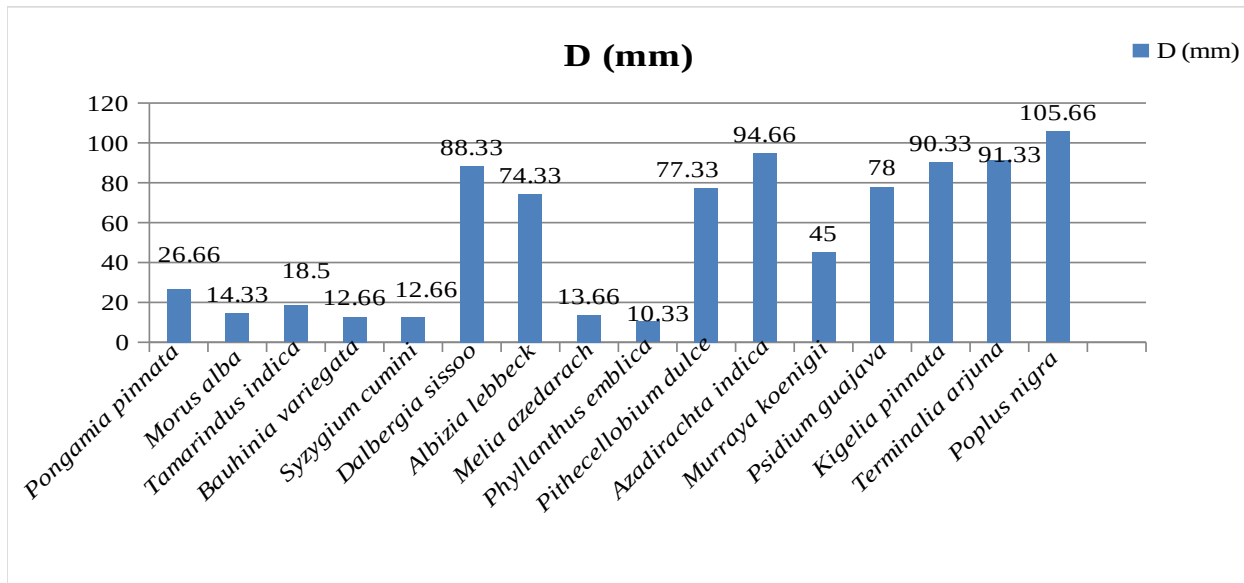


Figure 3.21: Plantation diameter growth under Chandigarh CAMPA in, Patiala ki Rao beat, Chandigarh range.

The maximum height (6.08 m) was recorded for *Dalbergia sissoo* followed by (5.3 m) for *Albizia lebbek* and minimum height (0.83 m) was recorded for *Phyllanthus emblica* and *Bauhinia variegata* (0.9 m).

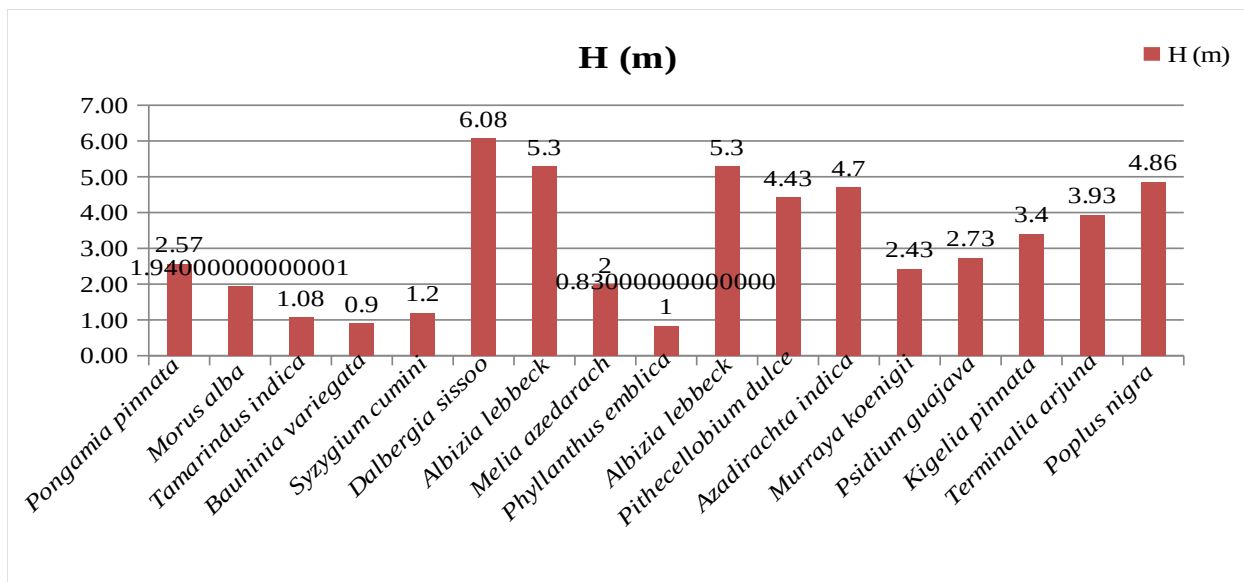
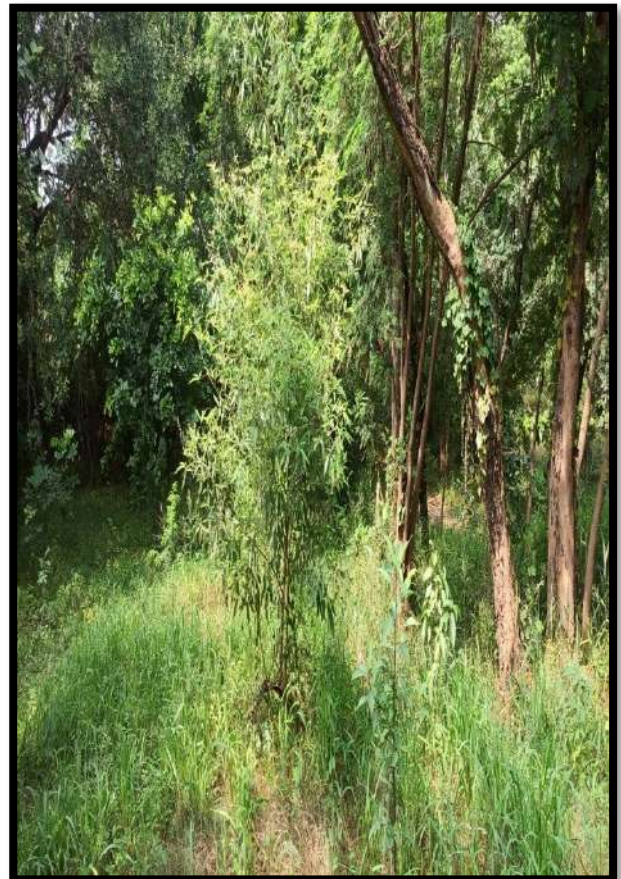
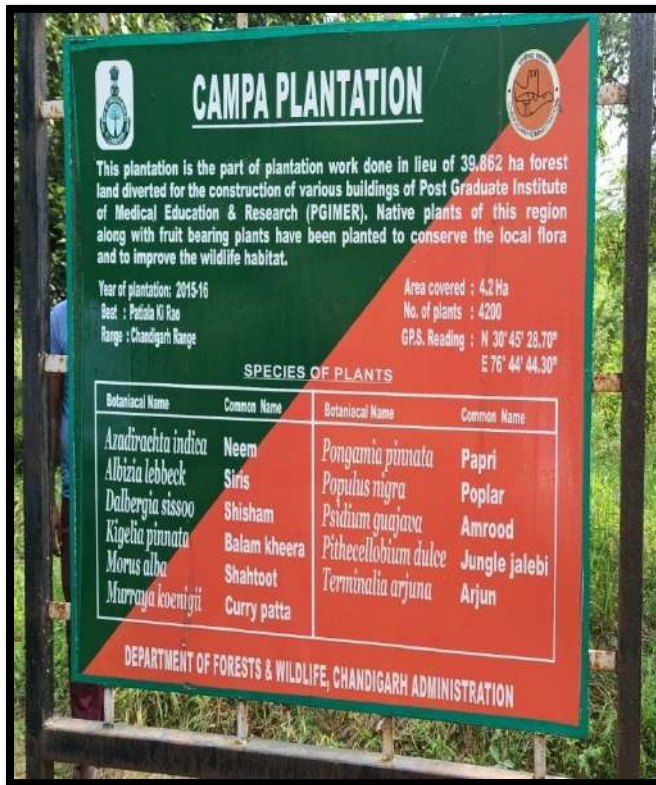


Figure 3.22: Plantation height growth under Chandigarh CAMPA in, Patiala ki Rao beat, Chandigarh range.





## Site 12: Ghareri beat, Nepali range

The average survival of 80.83% was observed in plantation site at Ghareri beat, Nepali range. The maximum diameter (114 mm) was recorded for *Terminalia arjuna* followed by *Syzygium cumini* (92 mm) and minimum diameter (12.5 mm) for *Mangifera indica* and *Bauhinia variegata* and *Pongamia pinnata* (50.66 mm).

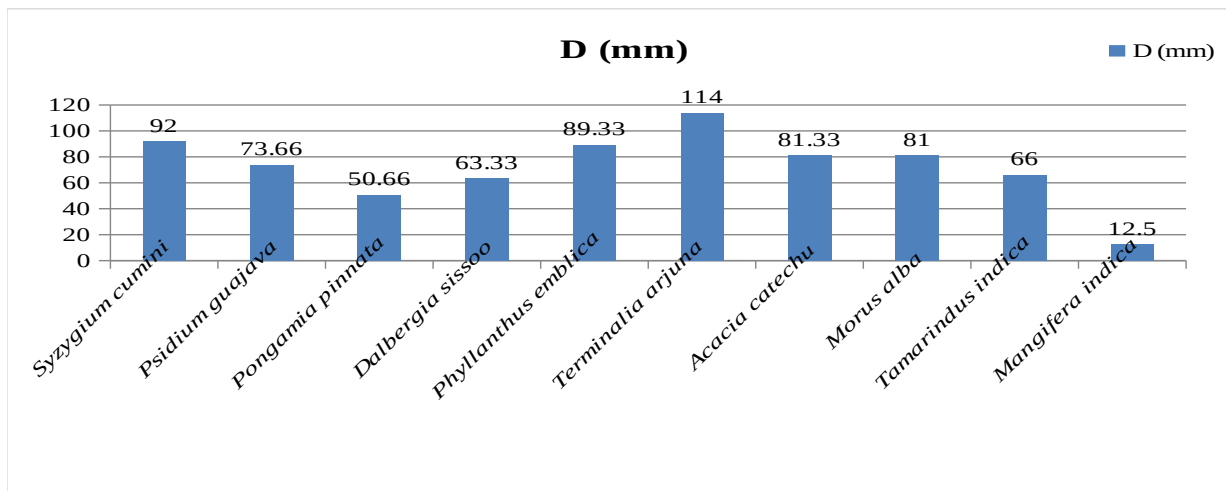


Figure 3.23: Plantation diameter growth under Chandigarh CAMPA in, Ghareri beat, Nepali range.

The maximum height (4.55 m) was recorded for *Terminalia arjuna* followed by (5.3 m) for *Acacia catechu* and *Morus alba* (4.08 m) and minimum height (1.07 m) was recorded for *Mangifera indica* and *Pongamia pinnata* (2.16 m).

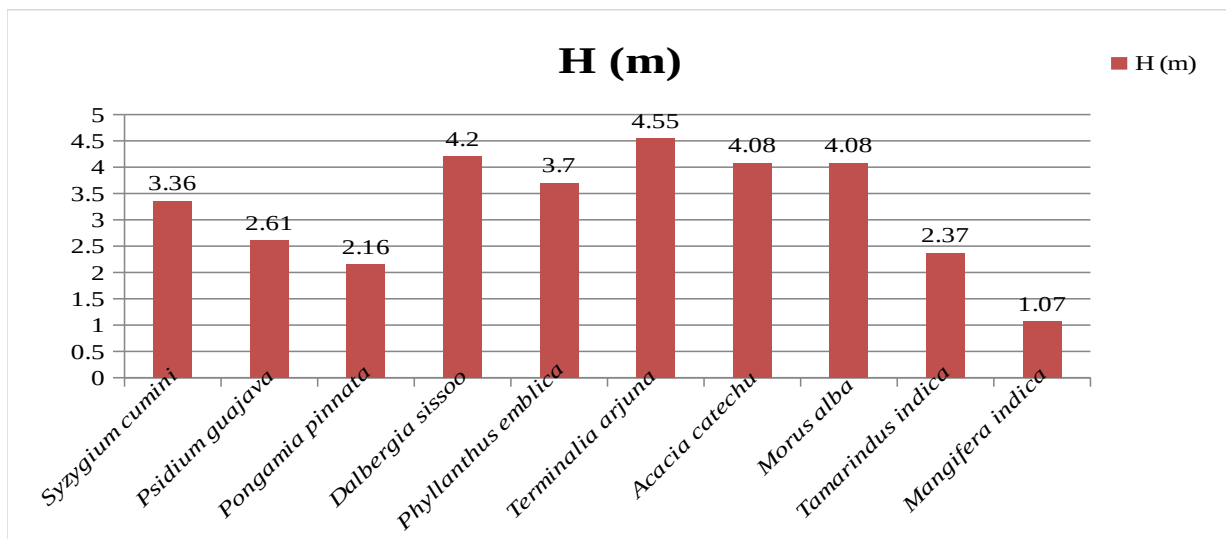
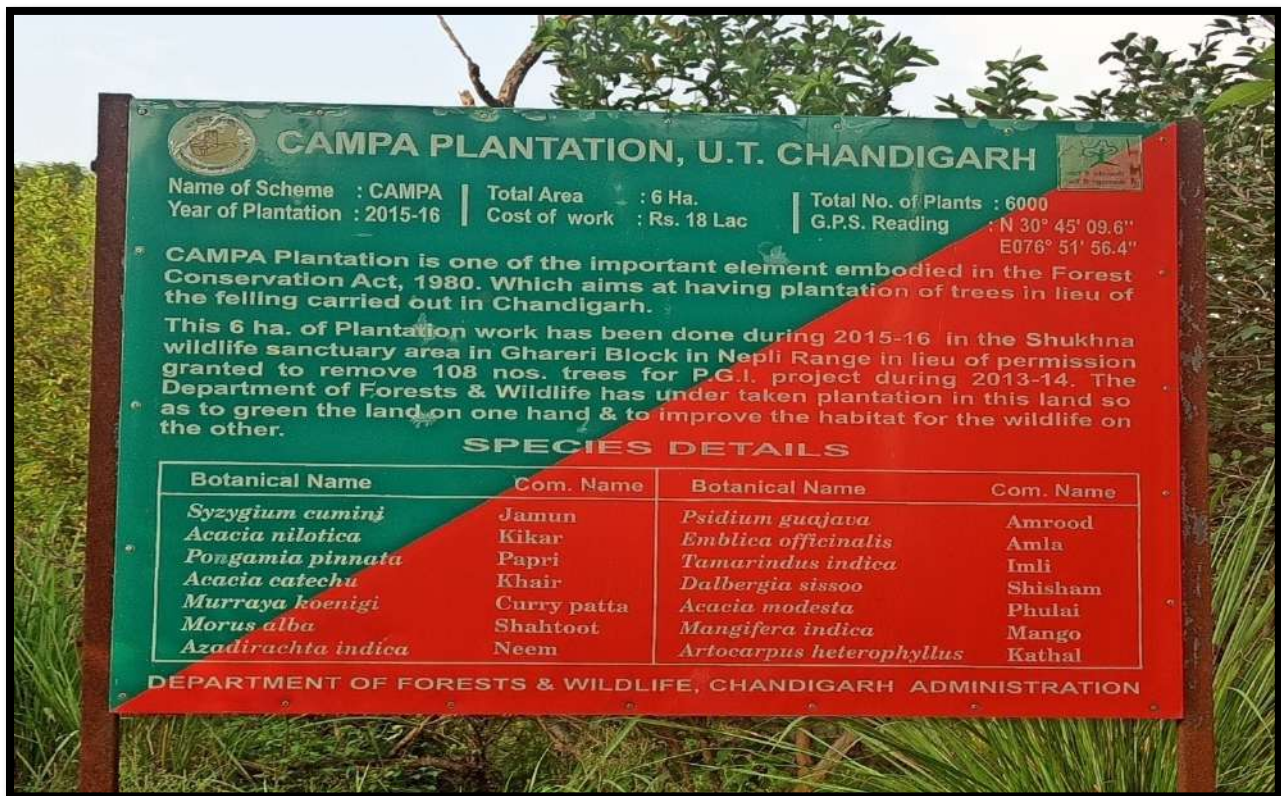


Figure 3.24: Plantation height growth under Chandigarh CAMPA in, Ghareri beat, Nepali range.



### Site 13: Barotiwala beat, Chandigarh range

The average survival of 82.58% was observed in plantation site at Barotiwala beat, Chandigarh range. The maximum diameter (75 mm) was recorded for *Psidium guajava* followed by *Tamarindus indica* (64.33 mm) and minimum diameter (16 mm) for *Terminalia arjuna* and *Bauhinia variegata* and *Pongamia pinnata* (16.66 mm).

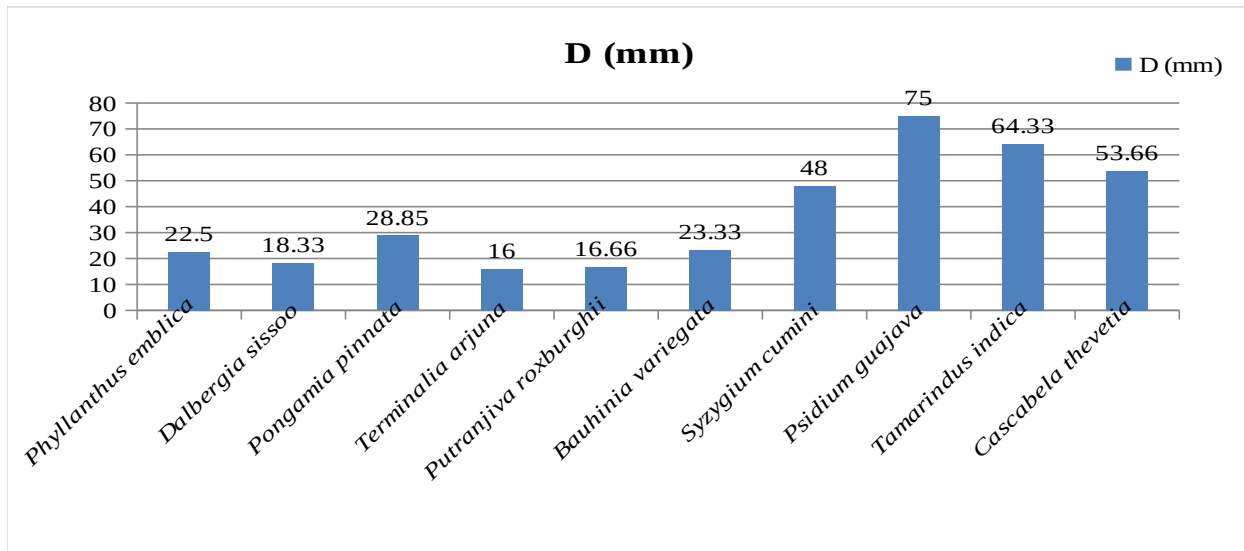


Figure 3.25: Plantation diameter growth under Chandigarh CAMPA in, Barotiwala beat, Chandigarh range.

The maximum height (6.53 m) was recorded for *Psidium guajava* followed by (4.66 m) for *Tamarindus indica* and minimum height (1.26 m) was recorded for *Terminalia arjuna* and *Putranjiva roxburghii* (1.38 m).

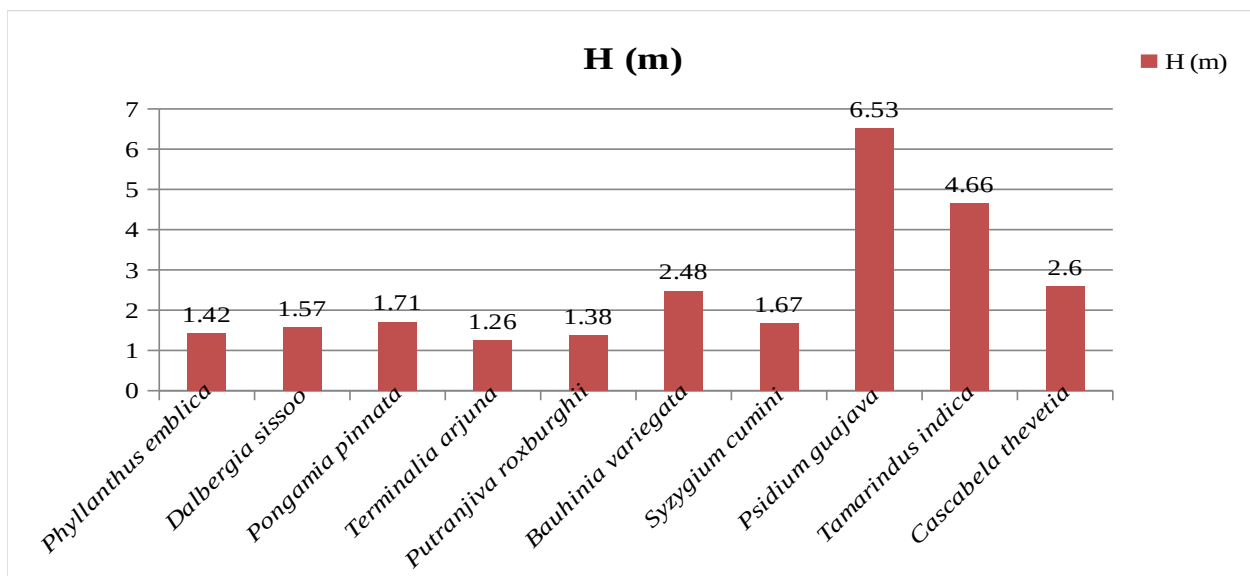
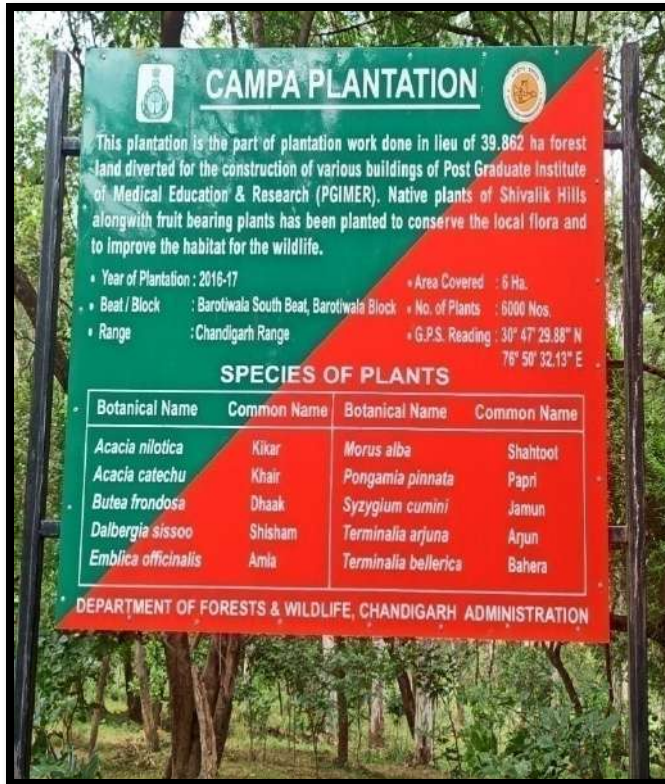


Figure 3.26: Plantation height growth under Chandigarh CAMPA in, Barotiwala beat, Chandigarh range.



### Site 14: Lower/Nepali beat, Nepali range

The average survival of 81.00 % was observed in plantation site at Lower/Nepali beat, Nepali range. The maximum diameter (164 mm) was recorded for *Jacaranda mimosifolia* followed by *Phyllanthus emblica* (128.66 mm) and minimum diameter (48 mm) for *Vachellia nilotica* and *Citrus limon* (58.5 mm).

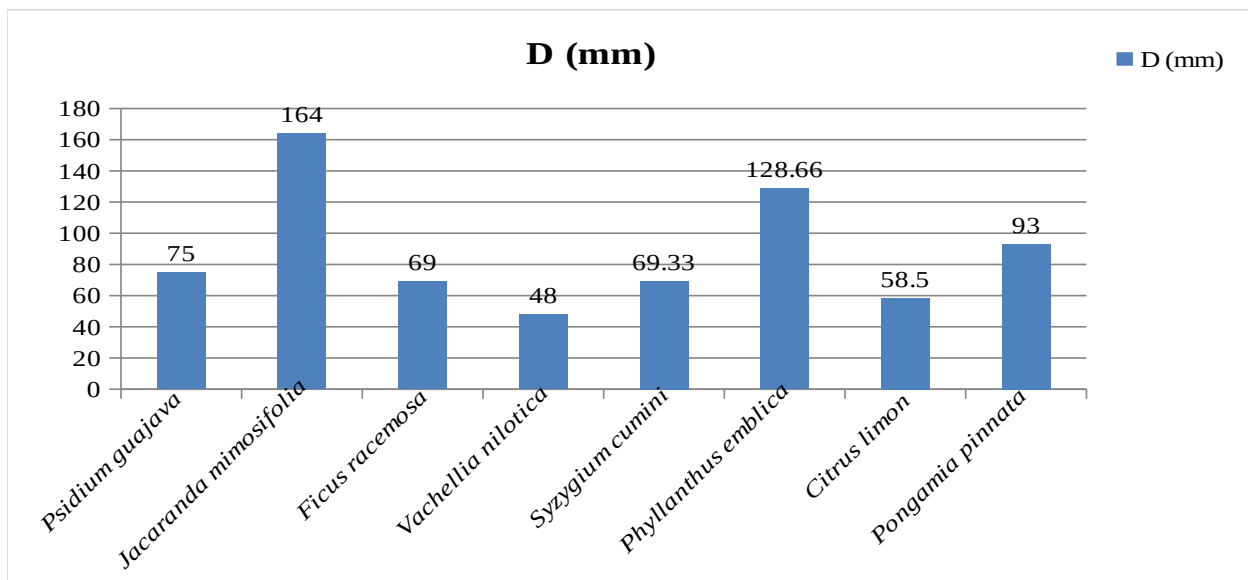


Figure 3.27: Plantation diameter growth under Chandigarh CAMPA in, Lower/Nepali beat, Nepali range.

The maximum height (4.05 m) was recorded for *Jacaranda mimosifolia* followed by (3.84 m) for *Pongamia pinnata* and minimum height (1.39 m) was recorded for *Citrus limon* and *Vachellia nilotica* (1.7 m).

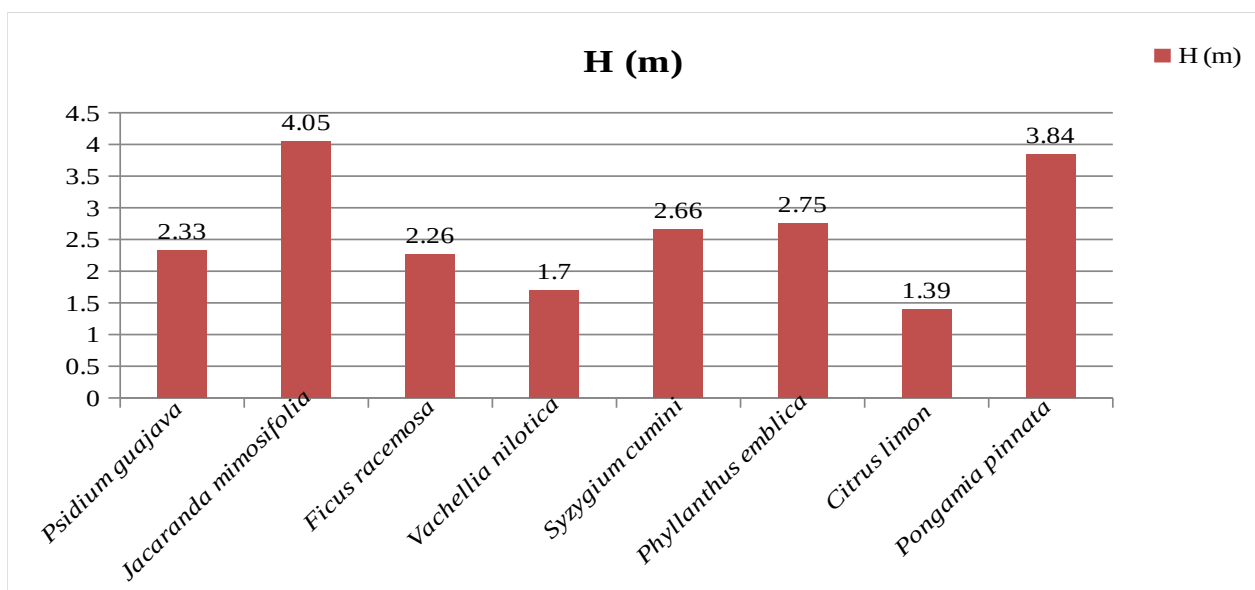
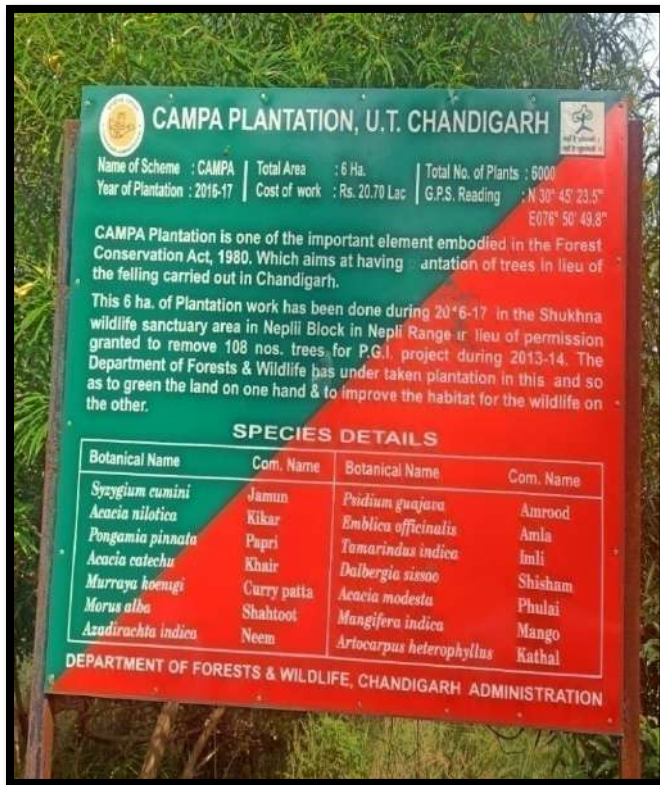
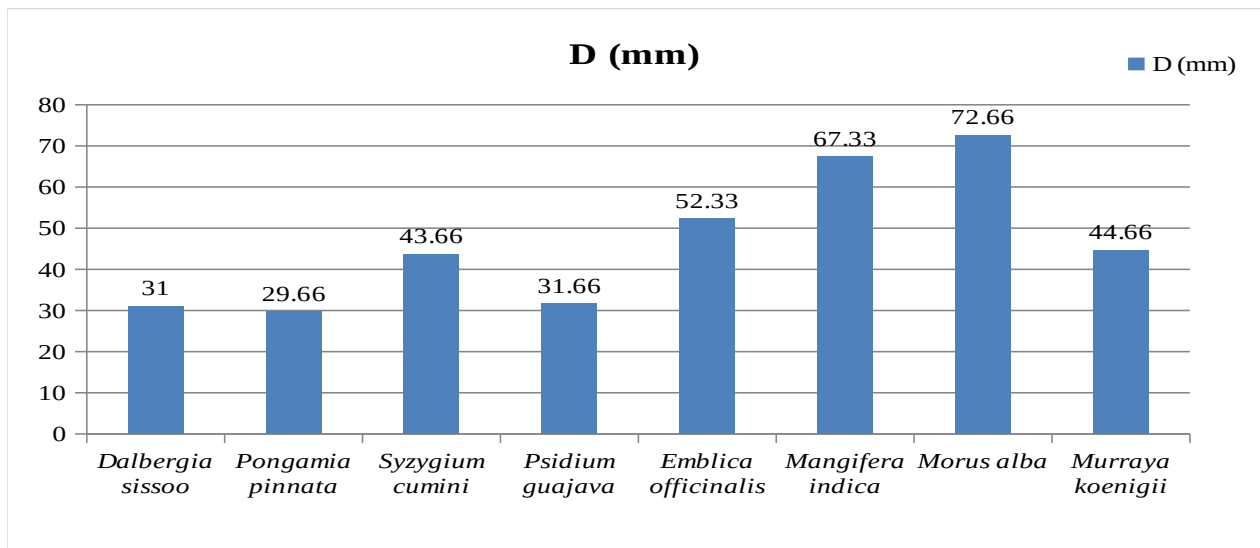


Figure 3.28: Plantation height growth under Chandigarh CAMPA in, Lower/Nepali beat, Nepali range.



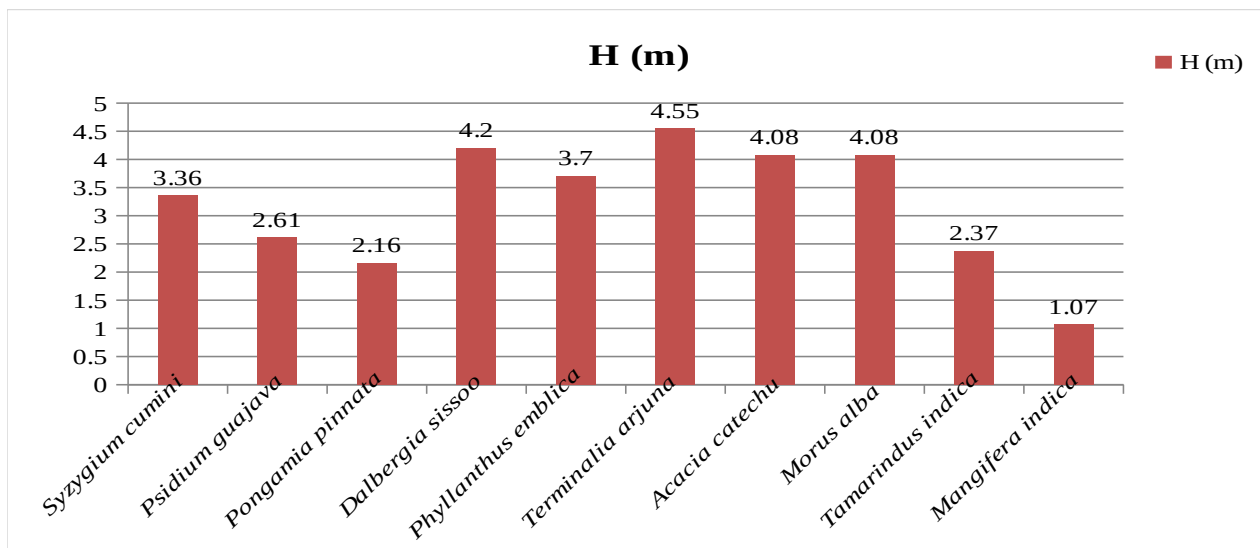
**Site 15: (Plot-A) Kansal beat, Chandigarh range**

The average survival (Plot A+ Plot B) 85.10 % was observed in the plantation site. Plot-A; Kansal beat, Chandigarh range. The maximum diameter (72.66 mm) was recorded for *Morus alba* followed by *Mangifera indica* (67.33 mm) and minimum diameter (29.66 mm) for *Pongamia pinnata* and *Dalbergia sissoo* (31 mm).



**Figure 3.29: Plantation diameter growth under Chandigarh CAMPA in, (Plot- A) Kansal beat, Chandigarh range.**

The maximum height (4.55 m) was recorded for *Terminalia arjuna* followed by (4.08 m) for *Acacia catechu* and *Morus alba* and minimum height (1.07 m) was recorded for *Mangifera indica* and *Pongamia pinnata* (2.16 m).



**Figure 3.30: Plantation height growth under Chandigarh CAMPA in, (Plot- A) Kansal beat, Chandigarh range.**

### (Plot- B) Kansal beat, Chandigarh range

For Plot-B; Kansal beat, Chandigarh range the maximum diameter (67.33 mm) was recorded for *Syzygium cumini* followed by *Morus alba* (64.33 mm) and minimum diameter (29.5 mm) for *Dalbergia sissoo* and *Murraya koenigii* (42 mm).

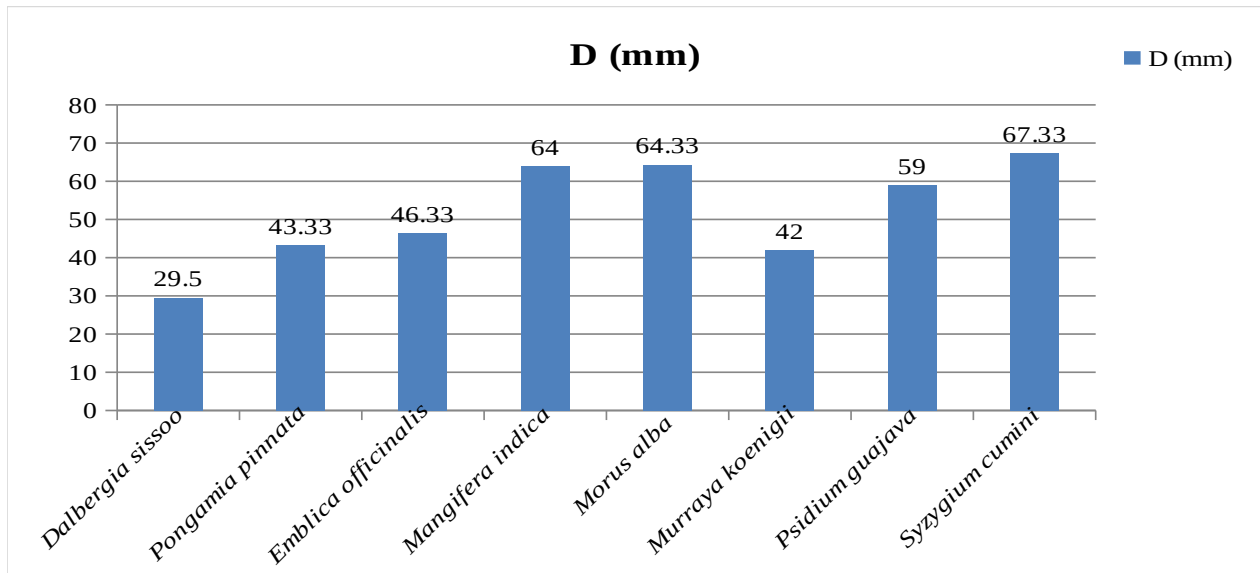


Figure 3.31: Plantation diameter growth under Chandigarh CAMPA in, (Plot- B) Kansal beat, Chandigarh range.

The maximum height (3.6 m) was recorded for *Emblica officinalis* followed by *Morus alba* (3.4 m) and minimum height (2.15 m) was recorded for *Murraya koenigii* and *Pongamia pinnata* (2.43 m).

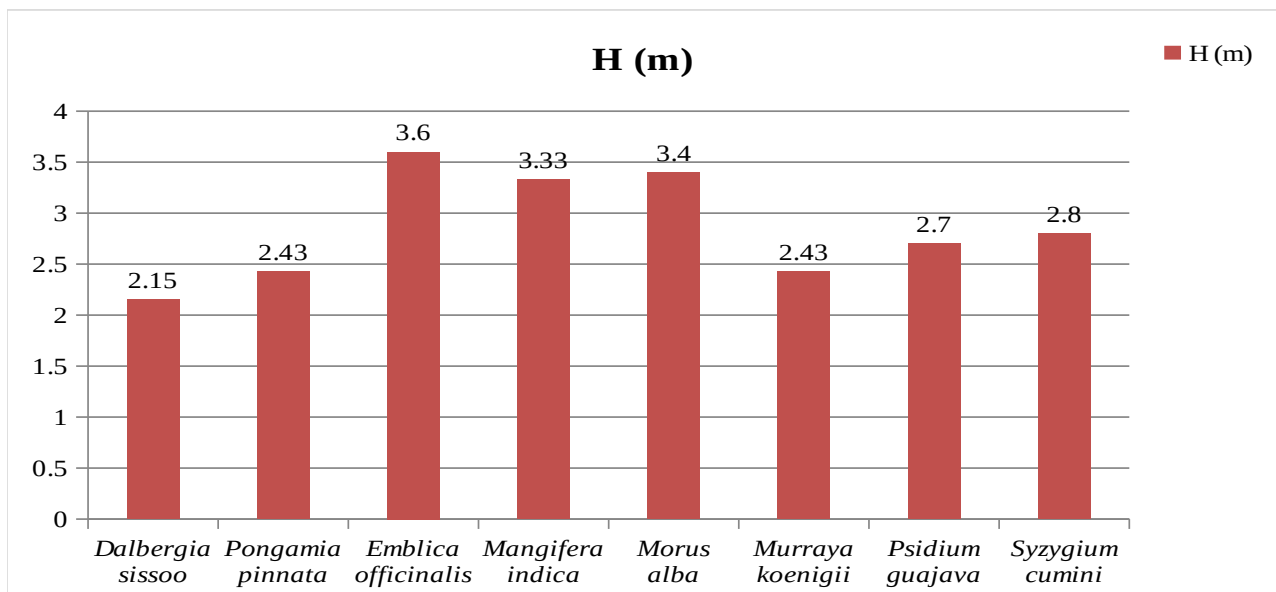


Figure 3.32: Plantation height growth under Chandigarh CAMPA in, (Plot- B) Kansal beat, Chandigarh range.





### Site 16: Manimajra beat, Nepali range

The average survival of 80.72 % was observed in plantation site at Manimajra beat, Nepali range. The maximum diameter (91.33 mm) was recorded for *Azadirachta indica* followed by *Pterospermum acerifolium* (62 mm) and minimum diameter (9.66 mm) for *Psidium guajava* and *Terminalia bellerica* (11 mm).

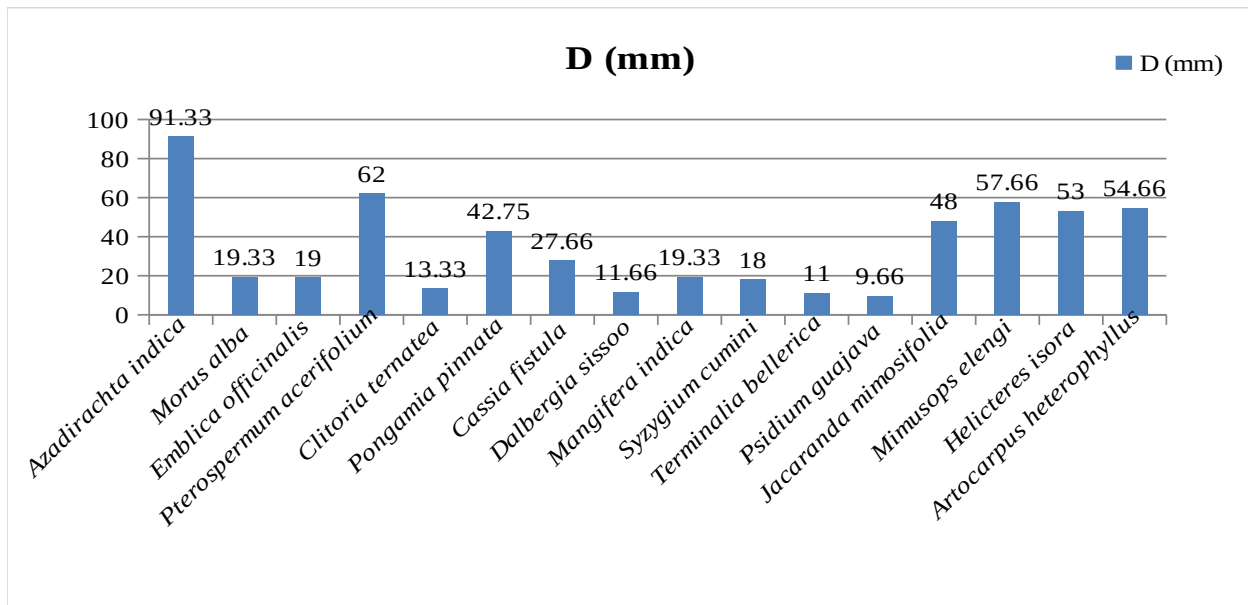


Figure 3.33: Plantation diameter growth under Chandigarh CAMPA in, Manimajra beat, Nepali range.

The maximum height (6.79 m) was recorded for *Azadirachta indica* followed by *Pterospermum acerifolium* (5.87 m) and minimum height (1.2 m) was recorded for *Psidium guajava* and *Terminalia bellerica* (1.3 m).

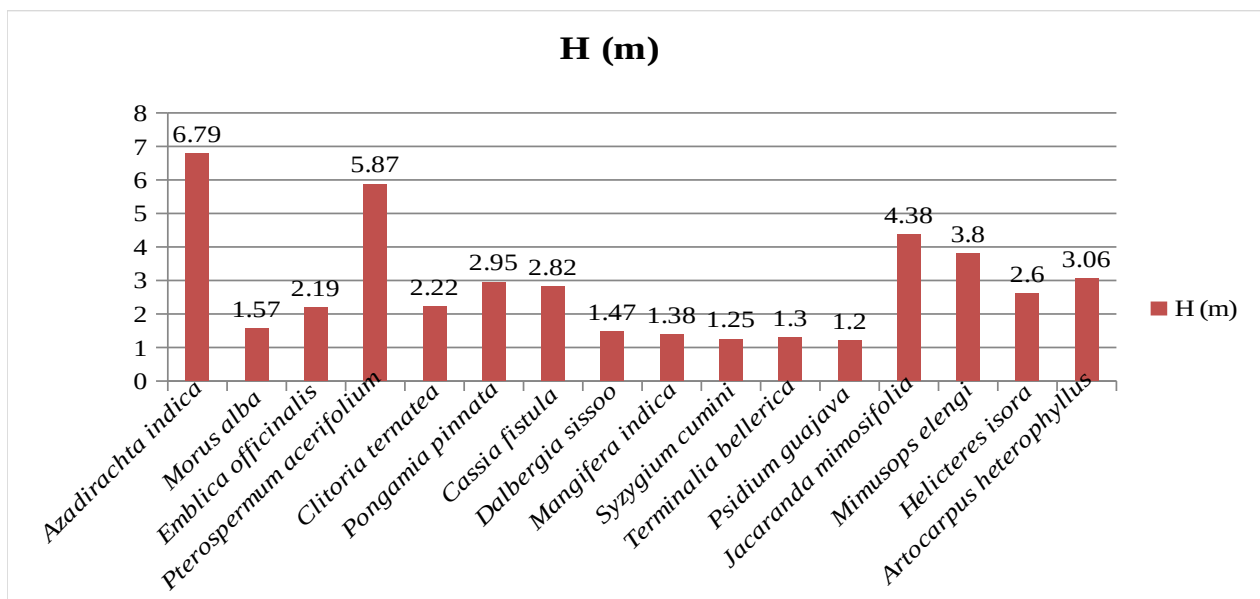
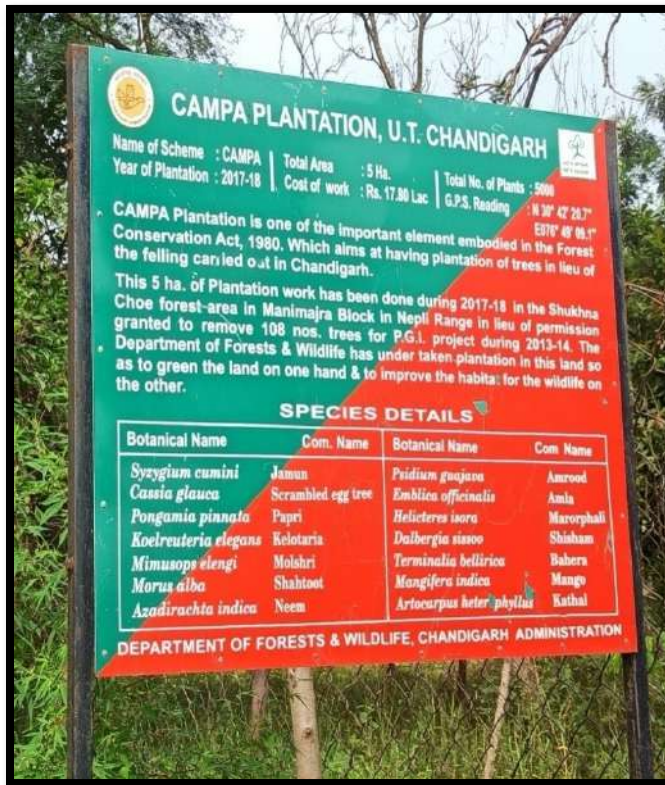


Figure 3.34: Plantation height growth under Chandigarh CAMPA in, Manimajra beat, Nepali range.



### Site 17: Kansal beat, Chandigarh range

The average survival of 88.19 % was observed in plantation site at Kansal beat, Chandigarh range. The maximum diameter (74 mm) was recorded for *Terminalia bellerica* followed by *Pithecellobium dulce* (64.33 mm) and minimum diameter (24 mm) for *Grevillea robusta* and *Morus alba* (27.33 mm).

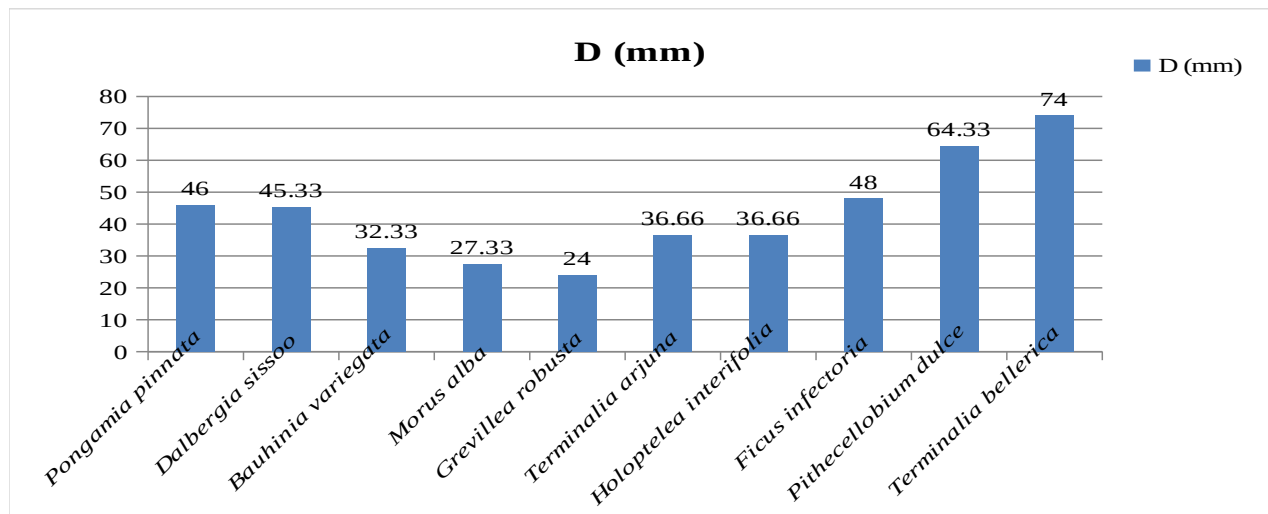


Figure 3.35: Plantation diameter growth under Chandigarh CAMPA in, Kansal beat, Chandigarh range.

The maximum height (4.96 m) was recorded for *Dalbergia sissoo* followed by (4.13 m) for *Pongamia pinnata* and minimum height (1.53 m) was recorded for *Bauhinia variegata* and *Terminalia arjuna* (1.75 m).

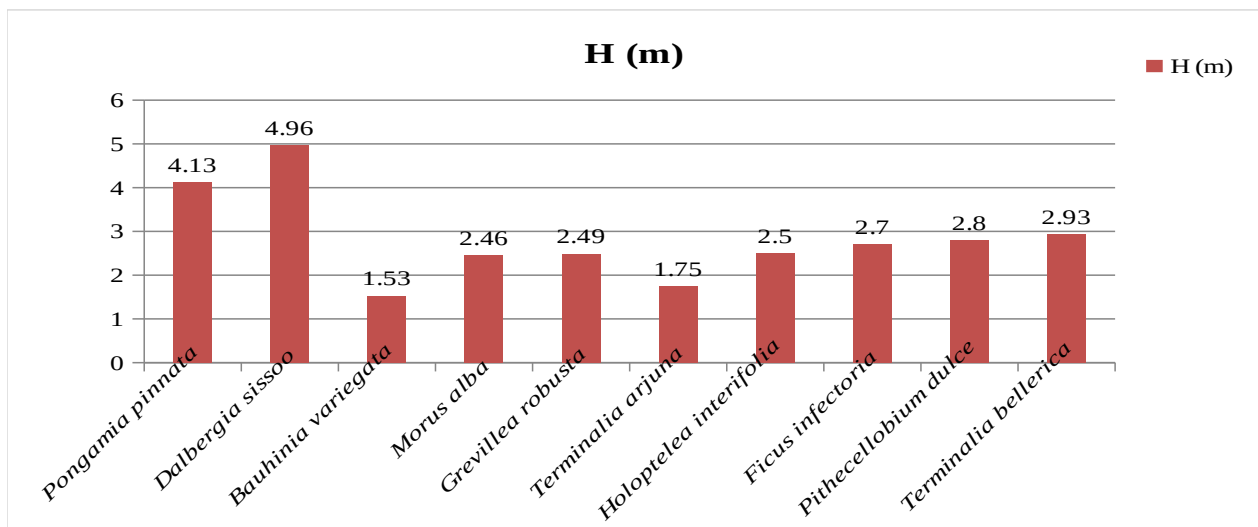


Figure 3.36: Plantation height growth under Chandigarh CAMPA in, Kansal beat, Chandigarh range.



## CANOPY PLANTATION



This plantation is the part of plantation work done in lieu of 39.862 ha forest land diverted for the construction of various buildings of Post Graduate Institute of Medical Education & Research (PGIMER). Native plants of Shivalik Hills alongwith fruit bearing plants has been planted to conserve the local flora and to improve the habitat for the wildlife.

- Year of Plantation : 2018-19
- Beat / Block : Kansal Beat, Kansal Block
- Range : Chandigarh Range
- Area Covered : 4.82 Ha.
- No. of Plants : 4820 Nos.
- G.P.S. Reading : 30° 47' 03.17" N  
076° 50' 11.38" E

### SPECIES OF PLANTS

Botanical Name	Common Name	Botanical Name	Common Name
<i>Bauhinia variegata</i>	Kachnar	<i>Pithecellobium dulce</i>	Jungle jalebi
<i>Dalbergia sissoo</i>	Shisham	<i>Pongamia pinnata</i>	Papri
<i>Harpatelea integrifolia</i>	Pahari papri	<i>Terminalia bellirica</i>	Bahera
<i>Ficus infectoria</i>	Pilkhan		

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### Site 18: Lower/Nepali beat, Nepali range

The average survival of 81.35 % was observed in plantation site at Lower/Nepali beat, Nepali range. The maximum diameter (58 mm) was recorded for *Pongamia pinnata* followed by *Ficus virens* and *Holoptelea integrifolia* (52.66 mm) and minimum diameter (12 mm) for *Ficus religiosa* and *Psidium guajava* (15.33 mm).

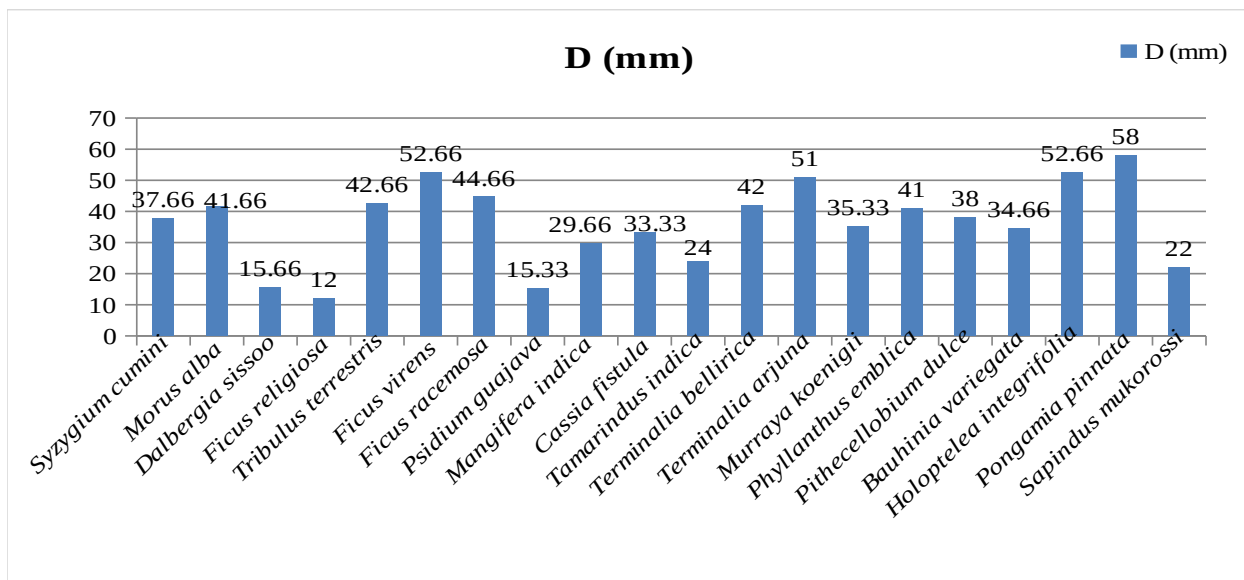


Figure 3.37: Plantation diameter growth under Chandigarh CAMPA in, Lower/Nepali beat, Nepali range.

The maximum height (4.44 m) was recorded for *Pithecellobium dulce* followed by *Ficus virens* (3.06 m) and minimum height (0.56) was recorded for *Ficus religiosa* and *Psidium guajava* (1.25 m).

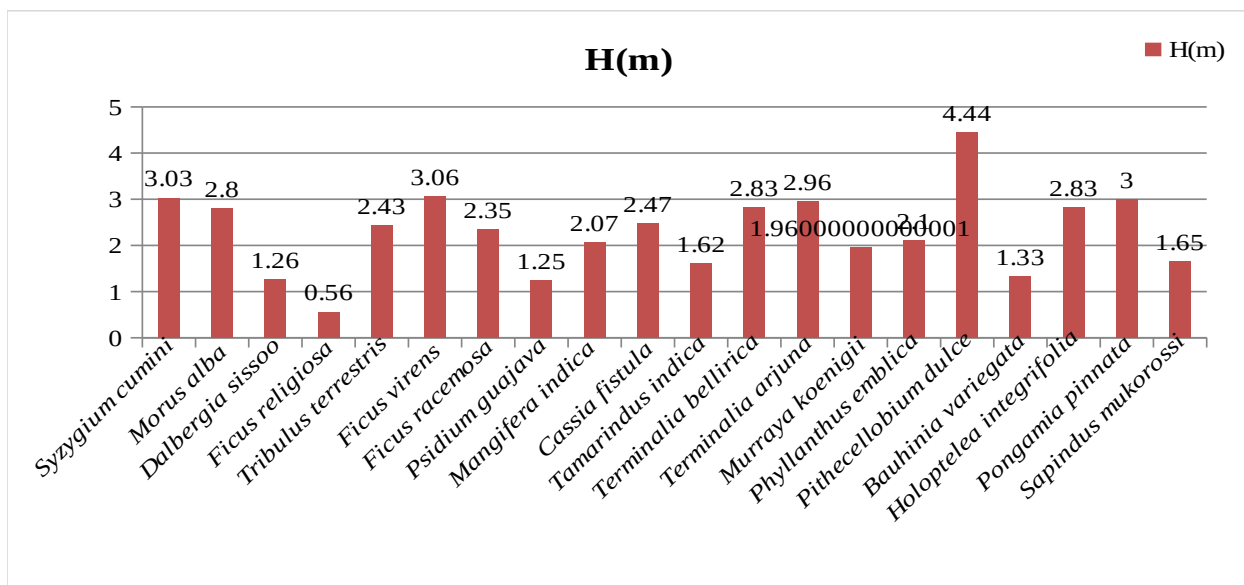


Figure 3.38: Plantation height growth under Chandigarh CAMPA in, Lower/Nepali beat, Nepali range.

**CAMPA PLANTATION, U.T. CHANDIGARH**

Year of Plantation: 2018-19  
 Total Area: 4 Ha.  
 Cost : Rs.14,32,741 Lac  
 Total No. of Plants: 4000  
 G.P.S. Reading N-30°45'13.00"  
 E-76°50'23.00"

CAMPA Plantation done in the Sukhna Wildlife Sanctuary area in Nepli Block in Nepli Range to compensate the removal of 108 Nos. trees for R.G.I. Project during 2013-14 in Lower Nepli West. The Department has done the plantation to increase the Forest cover and its quality alongwith improving the habitat for the existing wildlife & increasing species richness.

**SPECIES DETAILS**

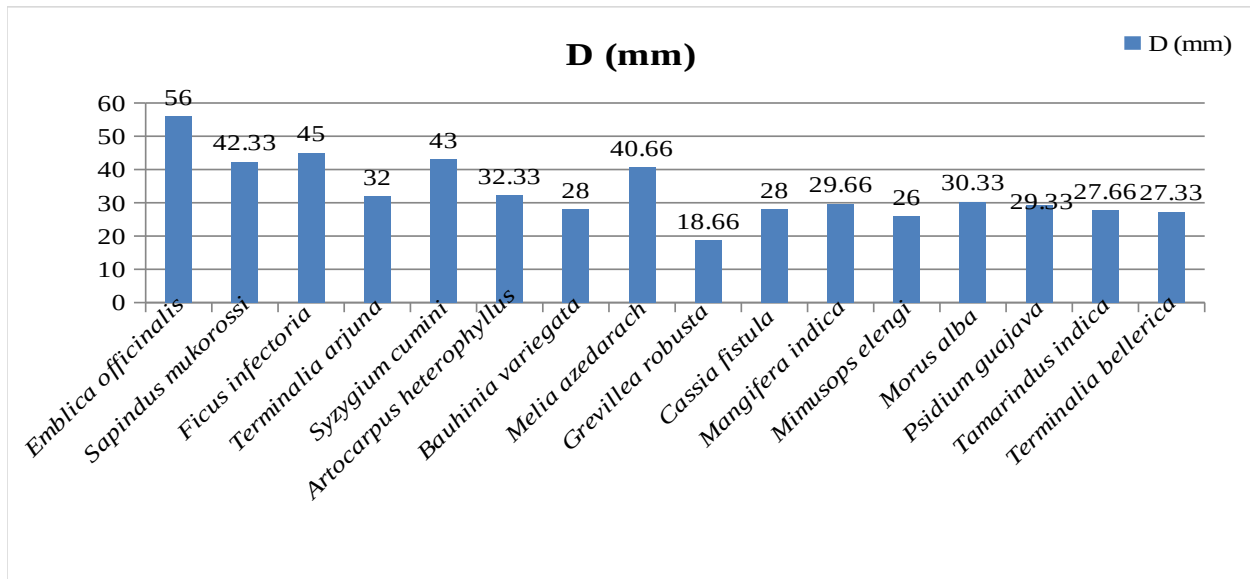
BOTANICAL NAME	COMMON NAME	BOTANICAL NAME	COMMON NAME
<i>Syzygium cumini</i>	Jamun	<i>Tamarindus indica</i>	Imli
<i>Morus alba</i>	Shahtoot	<i>Terminalia bellerica</i>	Bahera
<i>Dalbergia sisoo</i>	Shisham	<i>Terminalia arjuna</i>	Arjun
<i>Ficus religiosa</i>	Peepal	<i>Murraya koenigii</i>	Curry patta
<i>Ficus bengalensis</i>	Burr	<i>Emblica officinalis</i>	Amla
<i>Ficus infectoria</i>	Piikhan	<i>Pithecolobium dulce</i>	Jungli Jalebi
<i>Ficus glomerata</i>	Gullar	<i>Bauhinia variegata</i>	Kachnar
<i>Psidium guajava</i>	Amrood	<i>Holoptelia integrifolia</i>	Pahari Papri
<i>Mangifera indica</i>	Mango	<i>Pongamia pinnata</i>	Papri
<i>Cassia fistula</i>	Amaltas		

DEPARTMENT OF FORESTS & WILDLIFE, CHANDIGARH ADMINISTRATION



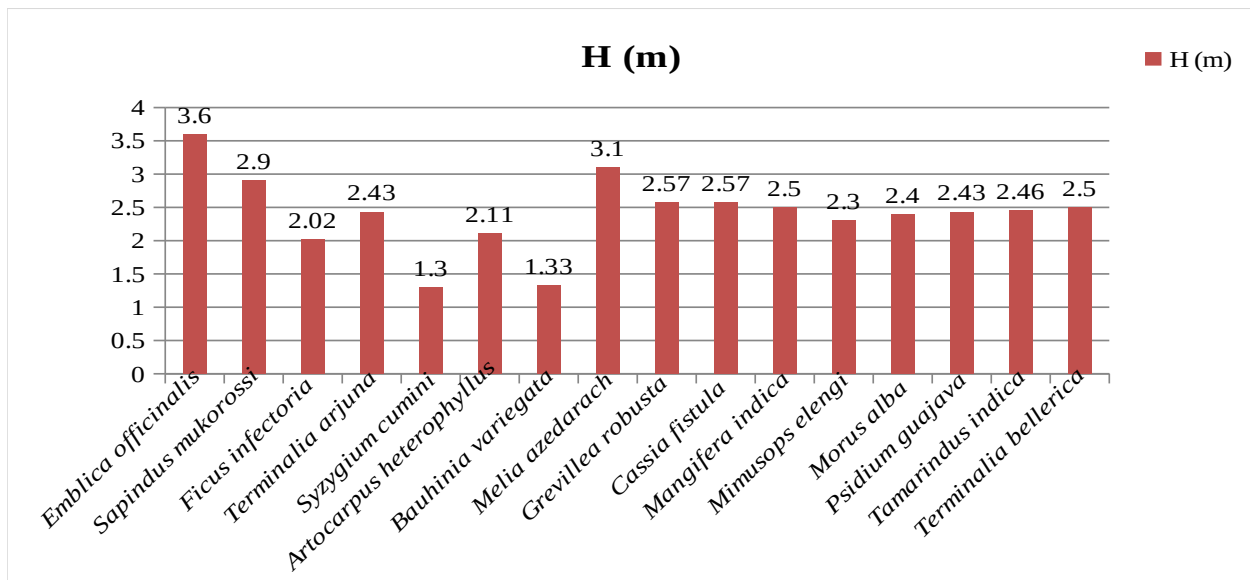
**Site 19: Khuda Ali Sher beat, Chandigarh range**

The average survival of 87.36 % was observed in plantation site at Khuda Ali Sher beat, Chandigarh range. The maximum diameter (56 mm) was recorded for *Emblica officinalis* followed by *Ficus infectoria* (45 mm) and minimum diameter (18.66 mm) for *Grevillea robusta* and *Mimusops elengi* (26 mm).



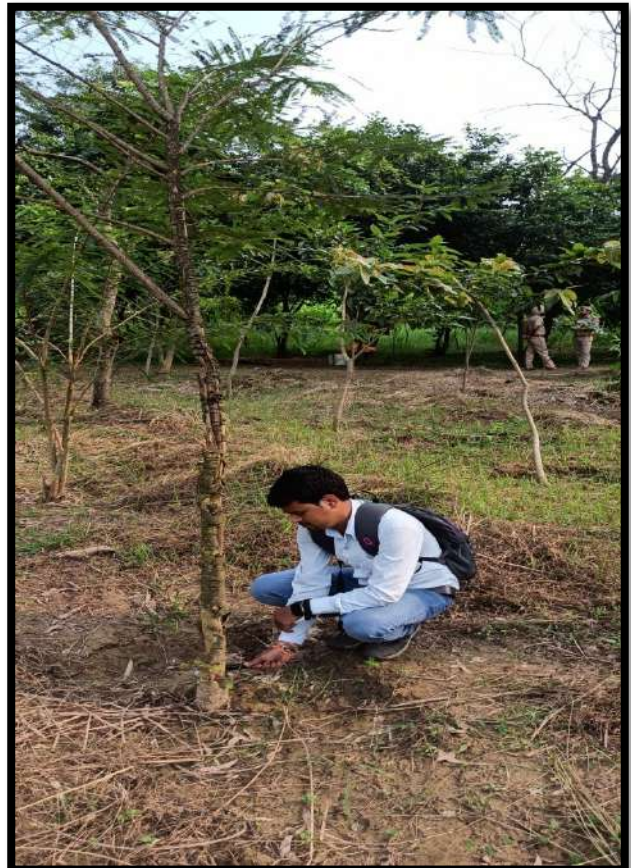
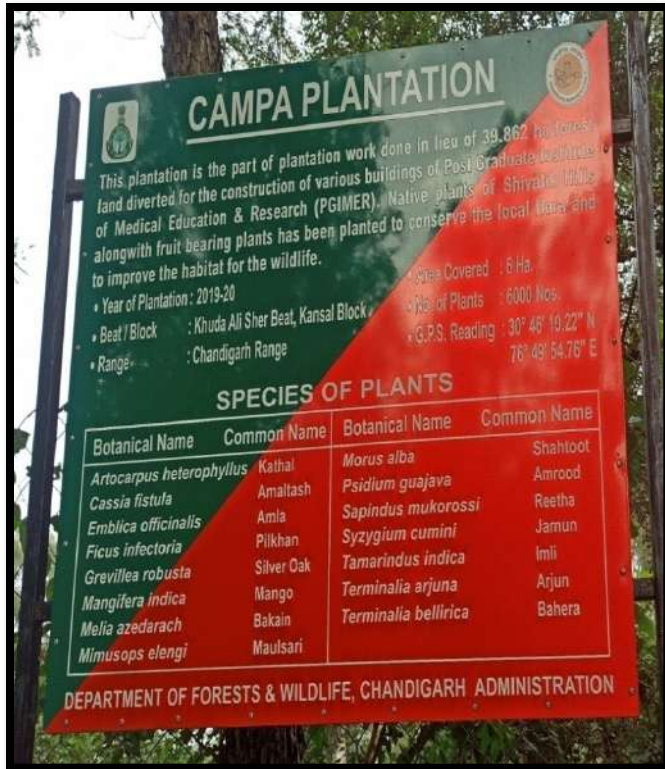
**Figure 3.39: Plantation diameter growth under Chandigarh CAMPA in, Khuda Ali Sher beat, Chandigarh range.**

The maximum height (3.6 m) was recorded for *Emblica officinalis* followed by *Melia azedarach* (3.1 m) and minimum height (1.3) was recorded for *Syzygium cumini* and *Bauhinia variegata* (1.33 m).



**Figure 3.40: Plantation height growth under Chandigarh CAMPA in, Khuda Ali Sher beat, Chandigarh range.**





## Site 20: Piplanwali beat, Nepali range

The average survival of 84.71 % was observed in plantation site at Piplanwali beat, Nepali range. The maximum diameter (85.66 mm) was recorded for *Delonix regia* followed by *Melia azedarach* (68 mm) and minimum diameter (12 mm) for *Dalbergia sissoo* and *Morus alba* (16.66 mm).

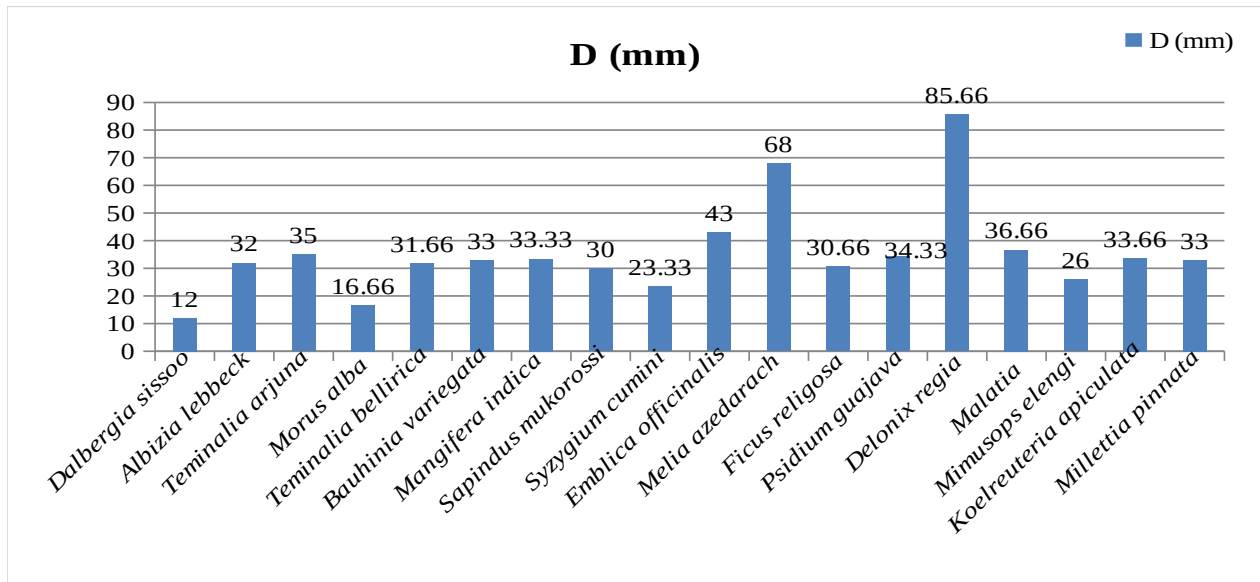


Figure 3.41: Plantation diameter growth under Chandigarh CAMPA in, Piplanwali beat, Nepali range.

The maximum height (4.13 m) was recorded for *Delonix regia* followed by *Melia azedarach* (3.86 m) and minimum height (1.23) was recorded for *Morus alba* and *Dalbergia sissoo* (1.49 m).

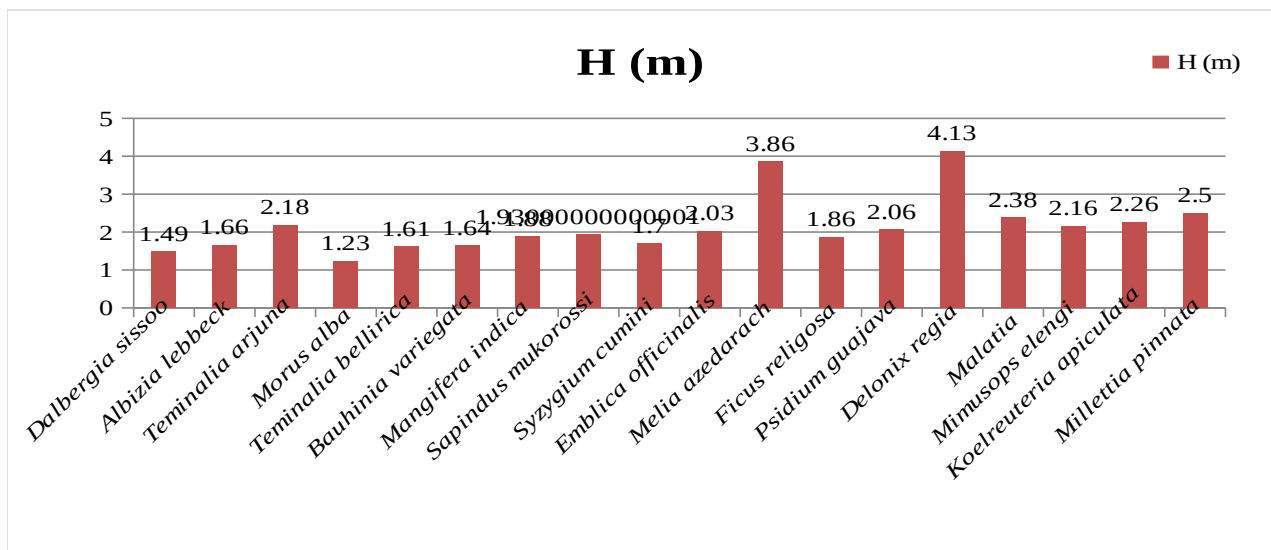


Figure 3.42: Plantation height growth under Chandigarh CAMPA in, Piplanwali beat, Nepali range.

## CAMPA PLANTATION, U.T. CHANDIGARH

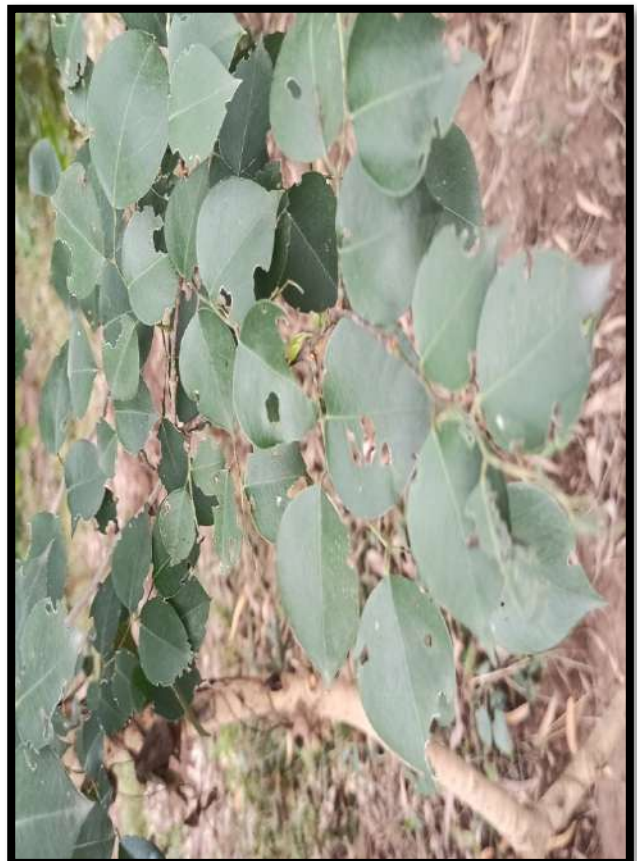
Year of Plantation: 2019-20      Total Area: 4.5 Ha.      Total No. of plants: 4500  
 Cost : Rs.1259810 Lac      G.P.S. Reading N:30°48'53.30"      E:76°51'31.71"

Campa Plantation done in the Sukhna Wildlife Sanctuary area in Mathewala Block in Nephli Range to compensate the felling of 100 trees for diversion of 39.862 ha. of forest land for P.G.I. Project during 2013-14. The Department has done the plantation to increase the forest cover and its quality along with improving the habitat for the existing wildlife & increasing species richness.

### SPECIES DETAILS

BOTANICAL NAME	COMMON NAME	BOTANICAL NAME	COMMON NAME
<i>Dalbergia sisoo</i>	Shisham	<i>Emblica officinalis</i>	Amla
<i>Albizia lebbek</i>	Siris	<i>Melia azedarach</i>	Dek
<i>Terminalia arjuna</i>	Arjun	<i>Ficus religiosa</i>	Peepal
<i>Morus alba</i>	Shahtoot	<i>Psidium guajava</i>	Amrood
<i>Terminalia bellerica</i>	Bahera	<i>Delonix regia</i>	Gulmohar
<i>Bauhinia variegata</i>	Kachnar	<i>Millettia pinnata</i>	Malatia
<i>Mangifera indica</i>	Mango	<i>Mimusops elengi</i>	Maulsiri
<i>Sapindus mukorossi</i>	Ritha	<i>Koelreuteria apiculata</i>	Koelreuteria
<i>Syzygium cumini</i>	Jamun		

**DEPARTMENT OF FORESTS & WILDLIFE, CHANDIGARH ADMINISTRATION**



### Site 21: Lake beat, Chandigarh range

The average survival of 91.06 % was observed in plantation site at Lake beat, Chandigarh range. The maximum diameter (37 mm) was recorded for *Tectona grandis* followed by *Cordia dichotoma* (29.66 mm) and minimum diameter (11 mm) for *Lagerstroemia Spp.* and *Mimusops elengi* (11.33 mm).

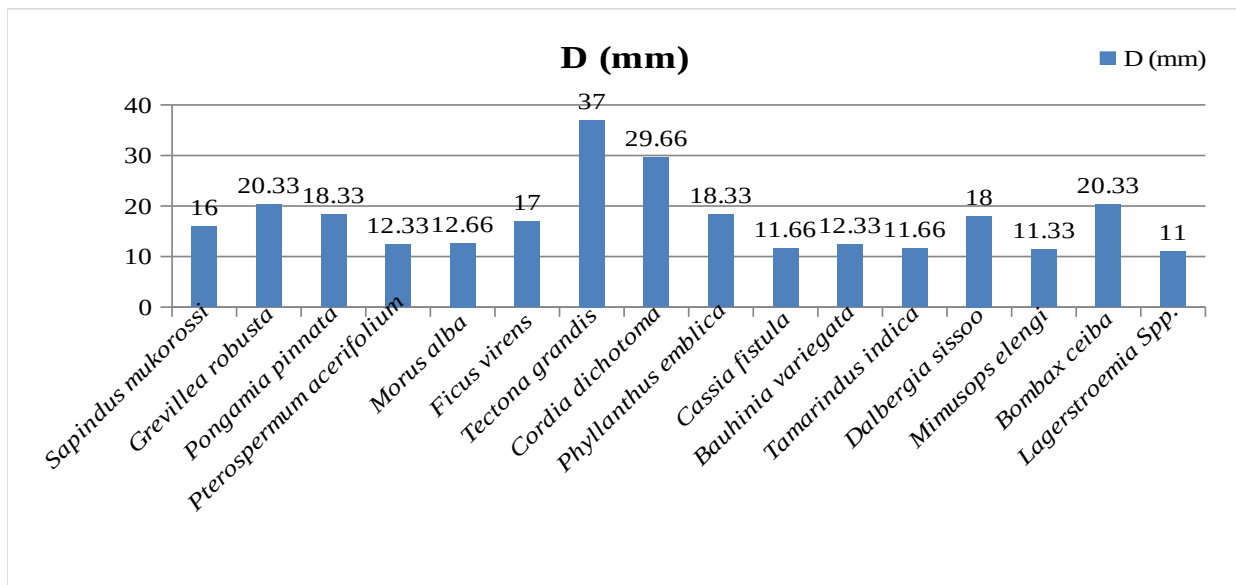


Figure 3.43: Plantation diameter growth under Chandigarh CAMPA in, Lake beat, Chandigarh range.

The maximum height (3.53 m) was recorded for *Tectona grandis* followed by for *Cordia dichotoma* (3.09 m) and minimum height (0.95) was recorded for *Mimusops elengi* and *Lagerstroemia spp.*, *Sapindus mukorossi* and *Tamarindus indica* (1.13 m).

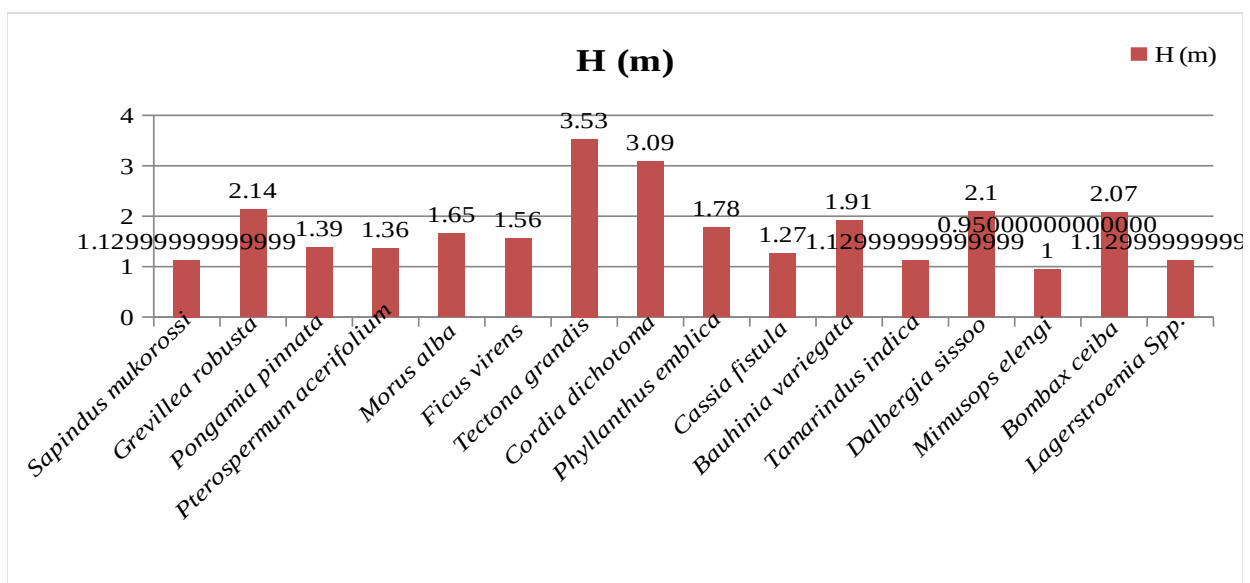


Figure 3.44: Plantation height growth under Chandigarh CAMPA in, Lake beat, Chandigarh range.

**CAMPA PLANTATION**

This plantation is the part of plantation work done in lieu of 39.862 ha. forest land diverted for the construction of various buildings of Post Graduate Institute of Medical Education & Research (PGIMER). Native plants of this region along with fruit bearing plants have been planted to conserve the local flora, to improve the wildlife habitat and the air quality of area.

- Year of Plantation : 2020-21
- Beat : Lake Beat
- Range : Chandigarh Range
- Area Covered : 7.78 Ha.
- No. of Plants : 7780 Nos.
- GPS Reading : N 30° 44' 45.67" E 76° 49' 48.70"

**SPECIES OF PLANTS**

Botanical Name	Common Name	Botanical Name	Common Name
<i>Aegle marmelos</i>	Bael	<i>Ficus infectona</i>	Pliktan
<i>Artocarpus heterophyllus</i>	Kathal	<i>Jacaranda mimosifolia</i>	Jakaranda
<i>Azadirachta indica</i>	Neem	<i>Mimusops elengi</i>	Mausari
<i>Acacia nilotica</i>	Kikar	<i>Moringa oleifera</i>	Sohanjana
<i>Acacia catechu</i>	Khair	<i>Madhuca indica</i>	Mahua
<i>Bombax ceiba</i>	Semal	<i>Mangifera indica</i>	Mango
<i>Butea frondosa</i>	Dhaak	<i>Morus alba</i>	Shahtoot
<i>Cassia fistula</i>	Amaltash	<i>Pongamia pinnata</i>	Papri
<i>Chukrasia tabularis</i>	Chakrasia	<i>Syzygium cumini</i>	Jamun
<i>Delonix regia</i>	Gulmohar	<i>Swietenia macrophylla</i>	Mahogany
<i>Dalbergia sissoo</i>	Shisham	<i>Terminalia arjuna</i>	Arjun
<i>Emblca officinalis</i>	Amla	<i>Terminalia bellerica</i>	Bahera
<i>Ficus religiosa</i>	Peepal	<i>Toona ciliata</i>	Toona
<i>Ficus benghalensis</i>	Bargad	<i>Tectona grandis</i>	Sagwaan
<i>Ficus glomerata</i>	Gullar	<i>Terminalia chebula</i>	Harad

DEPARTMENT OF FORESTS & WILDLIFE CHANDIGARH ADMINISTRATION



## Site 22: Manimajra beat, Nepali range

The average survival of 84.02 % was observed in plantation site at Manimajra beat, Nepali range. The maximum diameter (40 mm) was recorded for *Azadirachta indica* followed by *Cassia fistula* (34 mm) and minimum diameter (9 mm) for *Aegle marmelos* and *Butea frondosa* (12.33 mm).

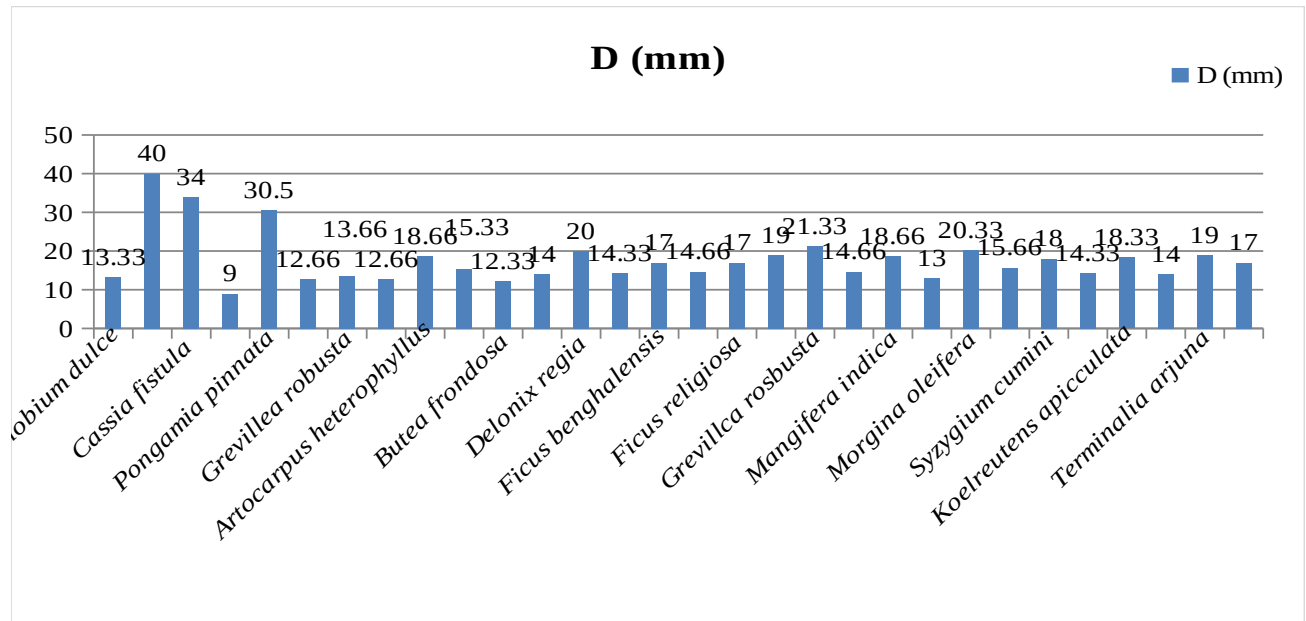


Figure 3.45: Plantation diameter growth under Chandigarh CAMPA in, Manimajra beat, Nepali range.

The maximum height (2.7 m) was recorded for *Azadirachta indica* followed by *Cassia fistula* (2.41 m) and minimum height (0.5) was recorded for *Aegle marmelos* and *Pithecellobium dulce* (1.1 m).

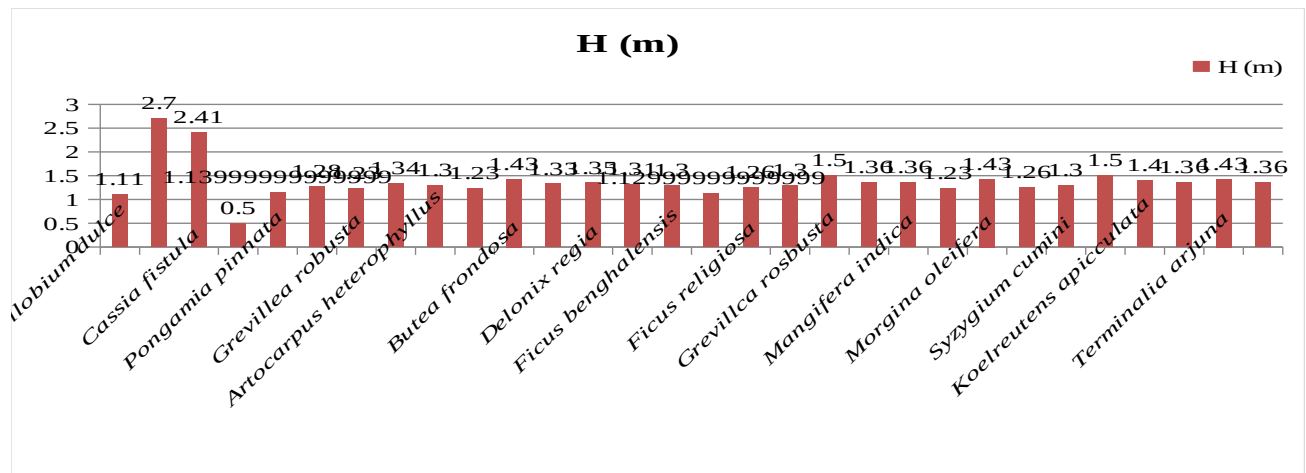


Figure 3.46: Plantation height growth under Chandigarh CAMPA in, Lake beat, Chandigarh range.

## CAMPA PLANTATION, U.T. CHANDIGARH

Year of Plantation: 2020-21  
Distance: 300 mtr

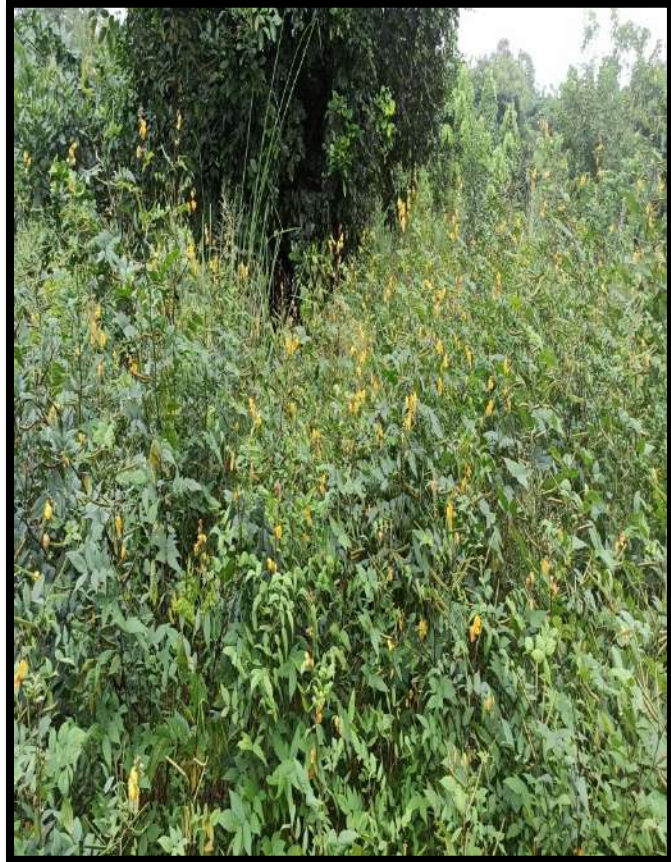
Total No. of Plants: 6220  
G.P.S. Reading

Campa plantation done in the Sukhna Choe forest area in Manimajra Block in Nepali Range for compensatory afforestation in lieu of diversion of 39.862 ha. of forest land for construction of various type of building in PGIMER for Wildlife habitat. The department has done the plantation to increase the forest cover and its quality alongwith improving the habitat for the existing wildlife & increasing species richness.

### SPECIES DETAILS

BOTANICAL NAME	COMMON NAME	BOTANICAL NAME	COMMON NAME
<i>Aegle marmelos</i>	Bel	<i>Gacvilleta robusta</i>	Silver oak
<i>Antocarpus heterophyllus</i>	Kathal	<i>Morus alba</i>	Shehtoot
<i>Azadirachta indica</i>	Neem	<i>Mangifera indica</i>	Mango
<i>Bauhinia variegata</i>	Kachnar	<i>Mimusops elengi</i>	Moulsari
<i>Butea frondosa</i>	Dhak	<i>Momonga oleifera</i>	Sohanjana
<i>Cassia fistula</i>	Amaltas	<i>Melia azadirach</i>	Dek
<i>Cordia dichotoma</i>	Lasura	<i>Psidium guajava</i>	Amrood
<i>Delonix regia</i>	Gulmohar	<i>Pongamia pinnata</i>	Papri
<i>Dalbergia sisoo</i>	Shisham	<i>Syzygium cumini</i>	Jamun
<i>Emblia officinalis</i>	Amla	<i>Swietenia mahagoniy</i>	Mahogany
<i>Ficus bengalensis</i>	Burr	<i>Koelreuteria apiculata</i>	Koelreuteria
<i>Ficus glomerata</i>	Gullar	<i>Tamarindus indica</i>	Imli
<i>Ficus religiosa</i>	Peepal	<i>Terminalia arjuna</i>	Arjun
<i>Ficus infectoria</i>	Pilkhan	<i>Terminalia bellerica</i>	Bahera

**DEPARTMENT OF FORESTS & WILDLIFE, CHANDIGARH ADMINISTRATION**



### Site 23: Patiala ki Rao, Chandigarh range

The average survival of 84.32 % was observed in plantation site at Patiala ki Rao, Chandigarh range. The maximum diameter (317.96 mm) was recorded for *Syzygium cumini* followed by *Psidium guajava* (278.29 mm) and minimum diameter (110.66 mm) for *Thuja compacta* and *Morus alba* (140 mm). The maximum height (7.5 m) was recorded for *Terminalia bellerica* followed by (6.45 m) for *Syzygium cumini* and minimum height (3.03) was recorded for *Thuja compacta* and *Punica granatum* (3.6 m).

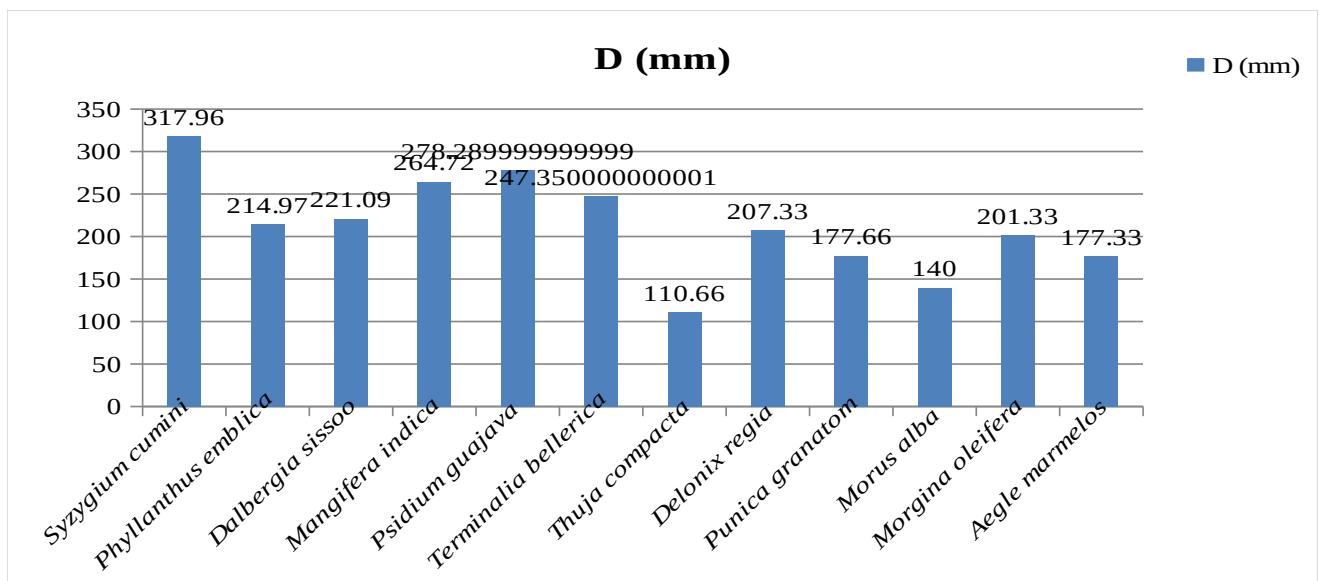


Figure 3.47: Plantation diameter growth under Chandigarh CAMPA in, Patiala ki Rao, Chandigarh range.

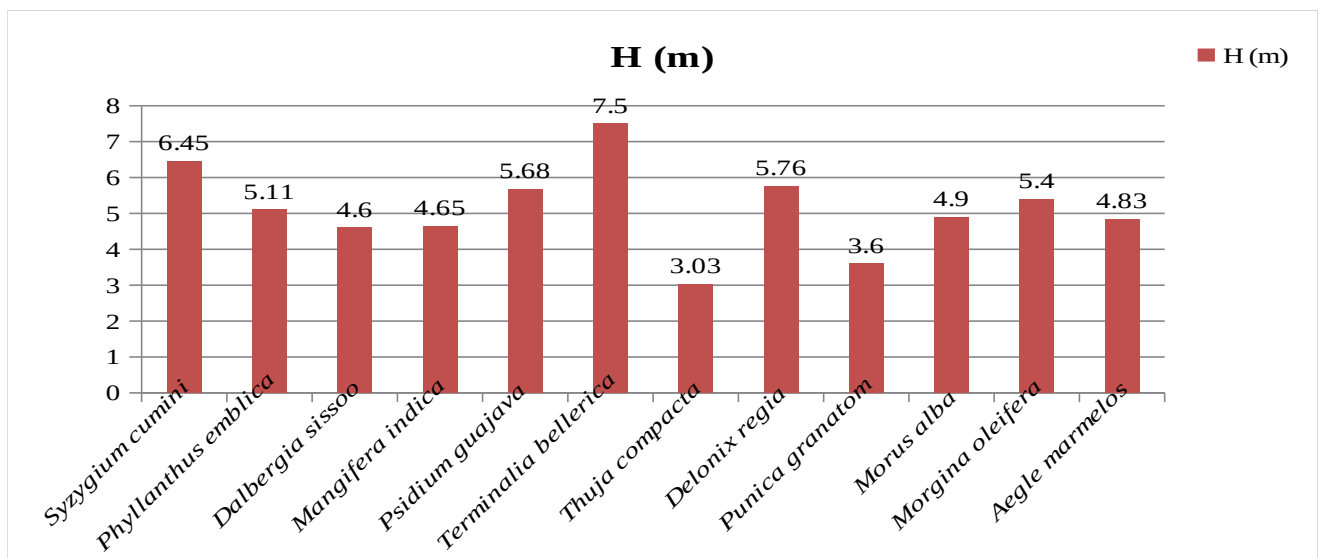


Figure 3.48: Plantation height growth under Chandigarh CAMPA in, Patiala ki Rao, Chandigarh range.





# CAMPA - U T CHANDIGARH



Compensatory Afforestation is one of the important element embodied in the Forest Conservation Act, 1980, Which aims at having plantation of trees in lieu of the felling carried out elsewhere when the Forest land stands diverted for non-Forestry purposes.

This 3.31 acre land in village KHUDA LAHORA, UT, Chandigarh has been allotted to the Department of Forest & Wildlife UT Chandigarh in lieu of forest land diverted for various developmental(Non-Forestry) works. The Department of Forests & Wildlife had undertaken Plantation of Fruit Bearing Species in this land so as to green the land on one hand and to improve the habitat for the Wildlife on the other hand.

Name of Scheme - Greening City Beautiful  
Year of Plantation - 2014  
Total Area - 3.31 acres  
Cost of total CA works - Rs 14.60 lacs

### SPECIES DETAILS

Botanical Name	Com. Name	No.
<i>Thuja compacta</i>	Morpankhi	98
<i>Mangifera indica</i>	Mango	70
<i>Delonix regia</i>	Gulmohari	97
<i>Psidium guajava</i>	Amrood	50
<i>Syzygium cumini</i>	Jamun	41
<i>Punica granatom</i>	Anaar	45
<i>Emblca officinalis</i>	Amla	39
<i>Morus alba</i>	Shahtoot	40
<i>Morgina oleifera</i>	Sohanjana	22
<i>Terminalia bellerica</i>	Bahera	32
<i>Aegle marmelos</i>	Bael	2
<b>TOTAL</b>		<b>536</b>

### BEFORE PLANTATION

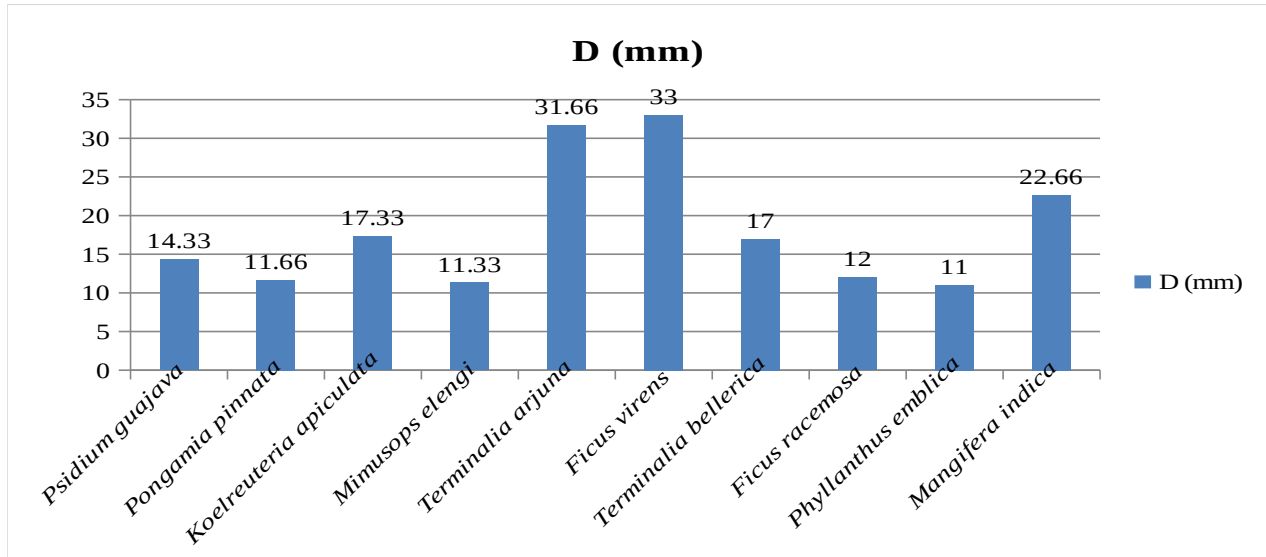


**DEPARTMENT OF FORESTS & WILDLIFE  
CHANDIGARH ADMINISTRATION**

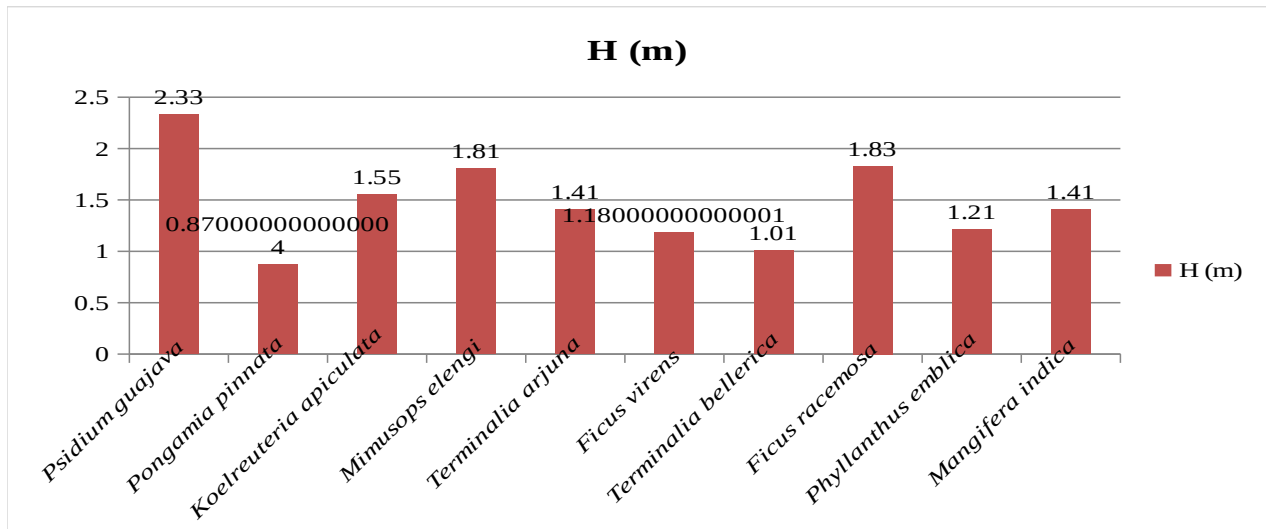


**Site 24: Hallomajra Beat beat, Nepali range**

The average survival of 94.32 % was observed in plantation site at Hallomajra beat, Nepali range. The maximum diameter (33 mm) was recorded for *Ficus virens* followed by *Terminalia arjuna* (31.66 mm) and minimum diameter (11 mm) for *Phyllanthus emblica* and *Ficus racemosa* (12 mm). The maximum height (2.33 m) was recorded for *Psidium guajava* followed by *Ficus racemosa* (1.83 m) and minimum height (0.87 m) was recorded for *Pongamia pinnata* and *Terminalia bellerica* (1.01 m).



**Figure 3.49: Plantation diameter growth under Chandigarh CAMPA in, Hallomajra beat, Nepali range.**

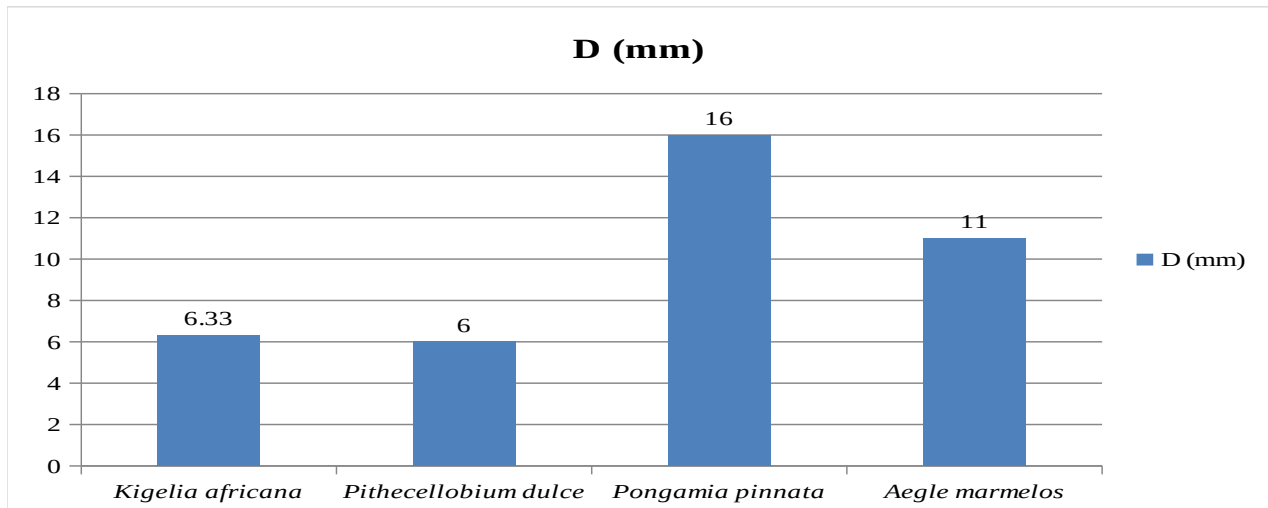


**Figure 3.50: Plantation height growth under Chandigarh CAMPA in, Hallomajra beat, Nepali range.**

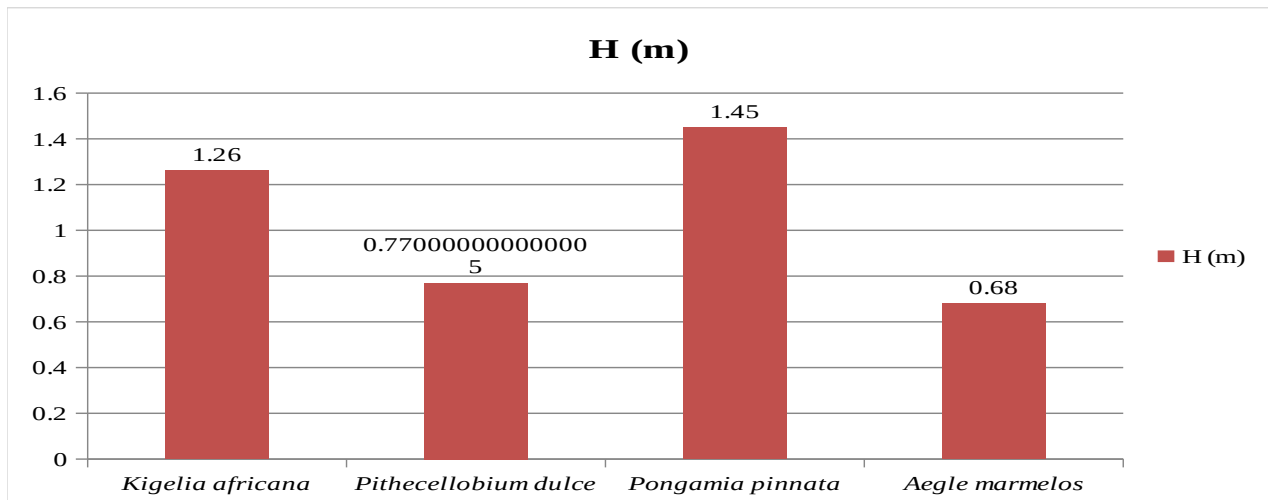


**Site 25: Manimajra beat (Near Dariya Forest Guest House), Nepali range**

The average survival of 96.00 % was observed in plantation site at Manimajra beat (Near Dariya Forest Guest House), Nepali range. The maximum diameter (16 mm) was recorded for *Pongamia pinnata* followed by *Aegle marmelos* (11 mm) and minimum diameter (6 mm) for *Pithecellobium dulce*.



**Figure 3.51: Plantation diameter growth under Chandigarh CAMPA in, Manimajra beat (Near Dariya Forest Guest House), Nepali range.**



**Figure 3.52: Plantation height growth under Chandigarh CAMPA in, Manimajra beat (Near Dariya Forest Guest House), Nepali range.**

The maximum height (1.45 m) was recorded for *Pongamia pinnata* followed by *Kigelia africana* (1.26 m) for and minimum height (0.68 m) was recorded for *Aegle marmelos*.



#### 4. Observations

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1. Mixed species plantations are being carried out in each site.
2. The plantations were carried out in patches and in the degraded areas on existing forest land.
3. It was observed that the plantations were infested by weeds like *Parthenium hysterophorus*, *Cannabis sativa*, *Lantana camara*, *Saccharum ravennae*, *Murraya koenigii* and *Adhatoda vasica*.
4. The Plantation sites were found to be suitable for the planted species.
5. It was found that, the fencing in few plantation sites was broken and protection was solely done by watchers. It may render ineffective protection due to biotic pressure.
6. Forest fire control provisions were not found in the plantations sites. Some plantation sites were observed partially damaged due to forest fire, however replacement have been done on effected sites and the growth is satisfactory. Fire protection measures like fire control line and fire control tools may be provided for combating fire.
7. Barbed wire fencing is done in most plantations sites, except few sites where brush wood fencing was observed. Latter is not an effective measure for preventing browsing in few sites frequented by neelgai and sambhar.
8. The plantations were done in a grid of 3 m x 3 m or 4 m x 4 m, but in some sites the spacing was not maintained properly. The pit size for planting was observed to be 60 cm x 60 cm x 60 cm.
9. Soil working and weeding activities were observed in most plantation sites.
10. Some plantations were done near the existing trees, which will have a negative bearing on the growth of plants. Pruning and lopping of trees are required in such sites for achieving better growth and survival.
11. Plantation journals of sites are maintained properly but record of inspections by senior Forest Officer are not found in the journal.
12. Plants are watered during dry season with the help of water tanker.
13. Proper funds are allotted for maintenance and protection of the plantations.
14. Regenerations of some species, like *D. sissoo* and *Albizia lebbeck* are observed in some plantations sites. There is a need to adopt these naturally regenerating plants by way of weeding, hoeing and pruning etc.
15. It is suggested to retain only the major stem in case of multiple branching of plants, remove the weaker branches for getting good growth. Thinning/lopping should be carried out in such sites and this practice may be applied in sites with 3 m x 3m spacing.
16. It was observed that garbage was dumped in a few sites hence damaging the plantation.

## 5. Lesson Learned and Recommendations

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From the available evidence, the monitoring of the plantations conducted by FRI, Dehradun concluded that the schemes viz., CAMPA was able to contribute substantially towards the state and central government goal of enhancing forest cover and reclamation of degraded lands. 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. Protection of plantations:** The field data indicate that at many sites the plants were found damaged due to wild animals and stray cattle. The protection measures like effective fencing need to be enhanced in providing protection to the newly planted samplings.

**2. 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.

**3. Geographical Information System (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 Operation (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 Silviculture 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 silviculture 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 these trees produce 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.



- 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:** Aided natural regeneration 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, Khajoor (Date palm), Shisham and Burma drek.

## 1. Geo-Coordinates of Chandigarh Forest Division

### Site No.1: Lake Beat, 2015-2016, 0.4 ha.

Plot No.	Latitude		Longitude	
	North		East	
1.	30° 44' 56.35"		76° 49' 32.26"	
2.	30° 44' 54.33"		76° 49' 32.27"	
3.	30° 44' 54.44"		76° 49' 34.30"	
4.	30° 44' 56.71"		76° 49' 34.63"	

### Site No. 2: Patiala ki Rao 2015-2016, 1.0 ha.

Plot No.	Latitude		Longitude	
	North		East	
1.	30° 45' 30.51"		76° 45' 17.75"	
2.	30° 45' 26.74"		76° 45' 13.87"	
3.	30° 45' 25.32"		76° 45' 15.27"	
4.	30° 45' 27.60"		76° 45' 18.98"	

### Site No. 3: Patiala ki Rao, 2015-2016, 0.675 ha.

Plot No.	Latitude		Longitude	
	North		East	
1.	30° 46' 23.47"		76° 45' 40.58"	
2.	30° 46' 20.96"		76° 45' 39.21"	
3.	30° 46' 18.65"		76° 45' 39.21"	
4.	30° 46' 18.66"		76° 45' 44.10"	
5.	30° 46' 24.64"		76° 45' 42.81"	

**Site No. 4: Khuda Ali Sher, 2015-2016, 4.5 ha.**

Plot No.	Latitude	Longitude
	North	East
1.	30° 46' 23.47"	76° 45' 40.58"
2.	30° 46' 15.33"	76° 49' 51.96"
3.	30° 46' 19.65"	76° 49' 54.51"
4.	30° 46' 23.05"	76° 49' 57.55"
5.	30° 46' 24.31"	76° 50' 01.80"
6.	30° 46' 22.78"	76° 50' 03.74"
7.	30° 46' 20.05"	76° 50' 03.19"

**Site No. 5: Patiala ki Rao, 2015-2016, 1.70 ha.**

Plot No.	Latitude	Longitude
	North	East
1.	30° 46' 05.30"	76° 45' 47.56"
2.	30° 46' 04.14"	76° 45' 43.42"
3.	30° 46' 08.95"	76° 45' 39.96"

**Site No. 6: Manimajra Beat, 2015-2016, 0.06 ha.**

Plot No.	Latitude	Longitude
	North	East
1.	30° 42' 08.95"	76° 48' 56.74"
2.	30° 42' 55.80"	76° 48' 55.68"
3.	30° 42' 57.81"	76° 48' 58.3"
4.	30° 42' 56.64"	76° 48' 59.55"

**Site No. 7: Makhenmajra Beat Dariya Road, 2015-2016, 0.021 ha.**

Plot No.	Latitude	Longitude
	North	East
1.	31° 41' 21.42"	76° 48' 36.65''
2.	31° 41' 20.83"	76° 48' 37.50''
3.	31° 41' 20.67"	76° 48' 37.16''
4.	31° 41' 20.90"	76° 48' 35.58''
5.	31° 41' 22.13"	76° 48' 35.87''
6.	31° 41' 22.19"	76° 48' 36.37''
7.	31° 41' 21.64"	76° 48' 36.97''

**Site No. 8: Manimajra Beat, Village- Behlana, Nepali range, 2020-2021, 0.14 ha.**

Plot No.	Latitude	Longitude
	North	East
1.	30° 43' 23.4"	76° 49' 05.03''
2.	30° 43' 25.25"	76° 49' 07.23''
3.	30° 43' 27.04"	76° 49' 05.16''
4.	30° 43' 25.04"	76° 49' 02.95''

**Site No. 9: Manimajra Beat, Nepali range, 2020-2021, 0.144 ha.**

Plot No.	Latitude	Longitude
	North	East
1.	30° 43' 41.32"	76° 48' 52.12''
2.	30° 43' 38.78"	76° 48' 48.54''
3.	30° 43' 36.82"	76° 48' 50.62''
4.	30° 43' 38.95"	76° 48' 52.87''
5.	30° 43' 38.96"	76° 48' 52.76''

6.	30° 43' 39. 15"	76° 48' 53.45''
7.	30° 43' 40. 50"	76° 48' 54.45''
8.	30° 43' 39. 68"	76° 48' 56.17''
9.	30° 43' 42. 20"	76° 48' 57.36''
10.	30° 43' 42. 25"	76° 48' 57.35''
11.	30° 43' 43. 20"	76° 48' 56.48''

**Site No. 10: Hallomajra Beat, Manimajra Block, Nepali range, 2015-2016, 8.00 ha.**

Plot No.	Latitude		Longitude	
	North		East	
1.	30° 40' 17. 28"		76° 48' 51.87''	
2.	30° 40' 18. 04"		76° 48' 58.22''	
3.	30° 40' 20. 20"		76° 48' 58.11''	
4.	30° 40' 22. 09"		76° 48' 59.03''	
5.	30° 40' 24. 26"		76° 49' 1.20''	
6.	30° 40' 25. 74"		76° 48' 58.51''	
7.	30° 40' 29. 21"		76° 48' 57.50''	
8.	30° 40' 32. 99"		76° 48' 52.38''	
9.	30° 40' 25. 85"		76° 48' 51.99''	

**Site No. 11: Patiala ki Rao Beat, Chandigarh range, 2015-2016, 4.2 ha.**

Plot No.	Latitude		Longitude	
	North		East	
1.	30° 45' 28.95"		76° 44' 44.19''	
2.	30° 45' 23.36"		76° 44' 46.52''	
3.	30° 45' 29.65"		76° 44' 54.31''	
4.	30° 45' 32.68"		76° 44' 51.58''	

**Site No. 12: Ghareri Beat, Ghareri Block, Nepali range, 2015-2016, 4.2 ha.**

Plot No.	Latitude		Longitude	
	North		East	
1.	30° 45' 11.37"		76° 51' 54.82"	
2.	30° 45' 12.46"		76° 51' 53.21"	
3.	30° 45' 12.83"		76° 51' 52.14"	
4.	30° 45' 12.62"		76° 51' 51.33"	
5.	30° 45' 12.28"		76° 51' 51.04"	
6.	30° 45' 10.22"		76° 51' 50.04"	
7.	30° 45' 08.16"		76° 51' 48.94"	
8.	30° 45' 07.71"		76° 51' 51.32"	
9.	30° 45' 07.22"		76° 51' 52.00"	
10.	30° 45' 05.60"		76° 51' 53.71"	
11.	30° 45' 05.49"		76° 51' 55.06"	
12.	30° 45' 05.02"		76° 51' 56.48"	
13.	30° 45' 05.45"		76° 51' 57.30"	
14.	30° 45' 06.12"		76° 51' 58.52"	
15.	30° 45' 05.08"		76° 51' 57.74"	
16.	30° 45' 08.52"		76° 51' 56.59"	
17.	30° 45' 09.13"		76° 51' 56.76"	

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**Site No. 13: Barotiwala Beat, Chandigarh range, 2016-2017, 6.0 ha.**

Plot No.	Latitude		Longitude
	North		East
1.	30° 47' 28. 63"		76° 50' 26. 30"
2.	30° 47' 30. 53"		76° 50' 31. 30"
3.	30° 47' 33. 42"		76° 50' 24. 33"
4.	30° 47' 35. 48"		76° 50' 36. 18"
5.	30° 47' 37. 60"		76° 50' 31. 98"
6.	30° 47' 37. 39"		76° 50' 27. 82"
7.	30° 47' 33. 61"		76° 50' 26. 30"
8.	30° 47' 32. 51"		76° 50' 25. 87"
9.	30° 47' 32. 03"		76° 50' 26. 38"
10.	30° 47' 29. 85"		76° 50' 25. 05"

**Site No. 14: Lower Nepali Beat, Nepali range, 2016-2017, 6.0 ha.**

Plot No.	Latitude		Longitude
	North		East
1.	30° 45' 29. 47"		76° 50' 56. 22"
2.	30° 45' 31. 31"		76° 50' 52. 10"
3.	30° 45' 30. 53"		76° 50' 51. 61"
4.	30° 45' 28. 60"		76° 50' 50. 72"
5.	30°45' 26. 28"		76° 50' 50. 26"
6.	30° 45' 24. 02"		76° 50' 50. 29"
7.	30° 45' 23. 66"		76° 50' 51. 47"
8.	30° 45' 23. 12"		76° 50' 51. 18"

9.	30° 45' 24. 42"	76° 50' 55. 90"
10.	30° 45' 23. 59"	76° 50' 56. 05"
11.	30° 45' 26. 29"	76° 50' 56. 18"

**Site No. 15: Kansal Beat, Kansal Block, Chandigarh range, 2017-2018, 5.0 (2.5 + 2.5) ha.**

**Plot-A**

Plot No.	Latitude		Longitude	
	North		East	
1.	30° 47' 01. 37"		76° 50' 10. 12"	
2.	30° 47' 01. 47"		76° 50' 10. 23"	
3.	30° 47' 02. 95"		76° 50' 09. 52"	
4.	30° 47' 01. 37"		76° 50' 10. 12"	
5.	30° 47' 01. 42"		76° 50' 05. 10"	
6.	30° 46' 58. 58"		76° 50' 06. 04"	
7.	30° 46' 59. 12"		76° 50' 04. 63"	
8.	30° 46' 57. 17"		76° 50' 07. 09"	
9.	30° 46' 56. 72"		76° 50' 10. 62"	
10.	30° 46' 57. 52"		76° 50' 12. 62"	
11.	30° 46' 58. 37"		76° 50' 12. 75"	

**Plot-B**

Plot No.	Latitude		Longitude	
	North		East	
1.	30° 47' 12. 47"		76° 50' 20. 04"	
2.	30° 47' 13. 37"		76° 50' 27. 36"	
3.	30° 47' 17. 65"		76° 50' 27. 38"	



**Site No. 16: Manimajra Beat, Manimajra Block, Nepali range, 2017-2018, 5.0 ha.**

Plot No.	Latitude		Longitude	
	North		East	
1.	30° 42' 19. 33"		76° 48' 58. 72"	
2.	30° 42' 13. 33"		76° 48' 0. 42"	
3.	30° 42' 13. 85"		76° 49' 6. 06"	
4.	30° 42' 21. 43"		76° 49' 8. 71"	
5.	30° 42' 23. 60"		76° 49' 5. 61"	
6.	30° 42' 20. 69"		76° 49' 3. 19"	

**Site No. 17: Kansal Beat, Chandigarh range, 2018-2019, 4.82 ha.**

Plot No.	Latitude		Longitude	
	North		East	
1.	30° 47' 09. 97"		76° 50' 15. 12"	
2.	30° 47' 03.77"		76° 50' 12. 23"	
3.	30° 47' 03. 30"		76° 50' 11. 27"	
4.	30° 47' 03. 72"		76° 50' 04. 91"	
5.	30° 47' 05. 02"		76° 50' 04. 60"	
6.	30° 47' 08. 33"		76° 50' 08. 90"	
7.	30° 47' 11. 29"		76° 50' 06. 13"	
8.	30° 46' 12. 18"		76° 50' 07. 97"	
9.	30° 47' 10. 02"		76° 50' 11. 52"	
10.	30° 46' 10. 95"		76° 50' 13. 92"	

**Site No. 18: Lower Nepali Beat, Nepali range, 2018-2019, 4.00 ha.**

Plot No.	Latitude		Longitude	
	North		East	
1.	30° 45' 06. 12"		76° 50' 40. 42"	
2.	30° 45' 06. 67"		76° 50' 39. 48"	
3.	30° 45' 07. 46"		76° 50' 38. 55"	
4.	30° 45' 08. 40"		76° 50' 37. 42"	
5.	30° 45' 09. 12"		76° 50' 36. 92"	
6.	30° 45' 09. 92"		76° 50' 35. 75"	
7.	30° 45' 10. 62"		76° 50' 34. 92"	
8.	30° 45' 11. 12"		76° 50' 33. 72"	
9.	30° 45' 11. 72"		76° 50' 32. 79"	
10.	30° 45' 12. 92"		76° 50' 31. 82"	
11.	30° 45' 13. 67"		76° 50' 31. 62"	
12.	30° 45' 14. 19"		76° 50' 30. 52"	
13.	30° 45' 14. 92"		76° 50' 33. 47"	
14.	30° 45' 15. 59"		76° 50' 34. 72"	
15.	30° 45' 15. 97"		76° 50' 36. 61"	
16.	30° 45' 15. 72"		76° 50' 40. 04"	

**Site No. 19: Khuda Ali Sher Beat, Kansal Block, Chandigarh range, 2019-2020, 6.00 ha.**

Plot No.	Latitude		Longitude	
	North		East	
1.	30° 46' 08. 12"		76° 49' 55. 48"	
2.	30° 46' 13. 02"		76° 49' 53. 43"	
3.	30° 46' 15. 53"		76° 49' 57. 72"	
4.	30° 46' 15. 55"		76° 50' 04. 12"	
5.	30° 46' 12. 62"		76° 50' 04. 48"	

6.	30° 46' 08. 66"	76° 50' 01. 12"

**Site No. 20: Piplanwali Beat, Nathewala Block, Chandigarh range, 2019-2020, 4.5 ha.**

Plot No.	Latitude		Longitude	
	North		East	
1.	30° 46' 54. 48"		76° 51' 30. 22"	
2.	30° 46' 52. 65"		76° 51' 28. 77"	
3.	30° 46' 10. 11"		76° 51' 31. 92"	
4.	30° 46' 51. 06"		76° 51' 34. 42"	
5.	30° 46' 52. 18"		76° 51' 35. 76"	
6.	30° 46' 53. 90"		76° 51' 33. 82"	
7.	30° 46' 56. 81"		76° 51' 34. 83"	
8.	30° 46' 56. 82"		76° 51' 31. 82"	

**Site No. 21: Lake Beat, Chandigarh range, 2020-2021, 7.78 ha.**

**Plot -A**

Plot No.	Latitude		Longitude	
	North		East	
1.	30° 44' 44. 96"		76° 49' 46. 23"	
2.	30° 44' 44. 43"		76° 49' 48. 73"	
3.	30° 44' 40. 62"		76° 49' 51. 96"	
4.	30° 44' 39. 33"		76° 49' 47. 13"	
5.	30° 44' 43. 85"		76° 49' 42. 31"	
6.	30° 44' 40. 86"		76° 49' 37. 84"	
7.	30° 44' 43. 64"		76° 49' 35. 03"	

8.	30° 44' 48. 14"	76° 49' 43. 58"
9.	30° 44' 46. 23"	76° 49' 48. 03"
10.	30° 44' 46. 32"	76° 49' 49. 23"
11.	30° 44' 44. 68"	76° 49' 50. 03"

**Plot -B**

Plot No.	Latitude		Longitude	
	North		East	
1.	30° 44' 54. 22"		76° 49' 46. 23"	
2.	30° 44' 52. 37"		76° 49' 51. 06"	

**Site No. 22: Manimajra Beat, Manimajra Block, Nepali range, 2020-2021, 6.22 ha.**

Plot No.	Latitude		Longitude	
	North		East	
1.	30° 42' 32. 9"		76° 48' 42. 23"	
2.	30° 42' 32. 32"		76° 48' 41. 05"	
3.	30° 42' 30. 53"		76° 48' 39. 73"	
4.	30° 42' 27. 37"		76° 48' 37. 75"	
5.	30° 42' 25. 48"		76° 48' 39. 39"	
6.	30° 42' 23. 64"		76° 48' 38. 46"	
7.	30° 42' 20. 26"		76° 48' 38. 23"	
8.	30° 42' 18. 35"		76° 48' 41. 59"	
9.	30° 42' 30. 93"		76° 48' 44. 60"	
10.	30° 42' 32. 75"		76° 48' 45. 68"	
11.	30° 42' 32. 9"		76° 48' 45. 34"	
12.	30° 42' 32. 9"		76° 48' 44. 26"	

13.	30° 42' 32. 9"	76° 48' 44. 75"
14.	30° 42' 32. 9"	76° 48' 45. 13"
15.	30° 42' 32. 9"	76° 48' 42. 55"

**Site No. 23:Patiala ki Rao Beat, Chandigarh range, 2014-2015, 0.536 ha.**

Plot No.	Latitude		Longitude	
	North		East	
1.	30° 46' 32. 26"		76° 46' 05. 28"	

**Site No. 24:Hallomajra Beat, Nepali range, 2021-2022, 0.74 ha.**

Plot No.	Latitude		Longitude	
	North		East	
1.	30° 41' 19. 24"		76° 48' 35. 85"	

**Site No. 25:Mamimajra Beat, Nepali range, 2021-2022, 0.05 ha.**

Plot No.	Latitude		Longitude	
	North		East	
1.	30° 42' 09. 18"		76° 48' 58. 23"	

## Format for Data Collection

### Field form for Monitoring & Evaluation of Plantations under Delhi CAMPA

<b>1.</b>	<b>General</b>		
	Name of Forest Circle		
	Name of Forest Division		
	Name of Forest Range		
	Name of Forest Beat		
	Name of Plantation Site		
<b>2.</b>	<b>GPS Location of the Sample Plots</b>		
	Plot No.	Latitude (in Degree Minute Second)	Longitude (in Degree Minute Second)
	1.		
	2.		
	3.		
	4.		
	5.		
	6.		
	7.		
	8.		
	9.		
	10.		
<b>3.</b>	<b>Observation of area of plantation as per GPS (ha)</b>		
<b>4.</b>	<b>Type of Forest Plantation (Tick <math>\checkmark</math>)</b>		
	i. Degraded Forest		ii. Enrichment Planting
	iii. Assisted Natural		iv. Saline/Alkaline

	Regeneration			
	v. SMC		vi Others	
5.	<b>Technique of planting (Tick ✓)</b>			
	i) Pit Planting		ii) Ridge Planting	
	iii) Auger Hole Planting		iv) Trench-cum-Pit Planting	
	v) Others			
6.	<b>Area of Forest Plantation as per plantation journal (ha)</b>			
7.	<b>Species planted on site</b>			
	1.		3.	
	2.		4.	
8.	<b>Species planted as per plantation journal/record</b>			
	1.		3.	
	2.		4.	
9.	<b>Suitability of species to sites</b>			
10.	<b>Fencing and Protection works</b>			
	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.	<b>Suitability of selected plantation area with respect to objectives</b>			

	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.	<b>Assessment of work as seen in the field</b>				
	Criteria		Indicator		
	i) Spacing of plants ii) Size of pit iii) Trench-Ridge iv) Terracing v) Soil working vi) Hoeing vii) Weeding				
13.	<b>Species composition</b>	i) Mixed		ii) Monoculture	
14.	<b>Age, Height and Survival percentage of the plants (species wise)</b>				
	S.N.	Species	Age (years)	Height (m)	Survival %
	1.				
	2.				
	3.				
	4.				
	5.				
15.	<b>Soil and moisture conservation works (Tick √)</b>				



	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.	<b>Health of the plants</b>			
	Criteria	Indicator		
	<ul style="list-style-type: none"> <li>i) Good/Bad</li> <li>ii) Insect attack</li> <li>iii) Disease attack</li> <li>iv) Water stress</li> <li>v) Lodging of plants</li> <li>vi) Plant competition</li> <li>vii) Browsing</li> <li>viii) Lopping</li> <li>ix) Illegal felling</li> </ul>			
17.	<b>Increase in availability of biomass</b>			
	Criteria	Indicator		
	<ul style="list-style-type: none"> <li>i) Fuel wood</li> <li>ii) Fodder</li> <li>iii) Small timber</li> <li>iv) NTFPs</li> <li>v) Carbon sequestration</li> </ul>			
18.	<b>Maintenance of records</b>			
	Criteria	Indicator		
	<ul style="list-style-type: none"> <li>i) Availability of plantation journal</li> <li>ii) Posting of up to date information and survey sketch</li> </ul>			

	map of plantation iii) Records of visits of officers like DFOs, CFs or CCFs etc. iv) Records of officers	
19.	<b>Suggestion for improvement from evaluating agency</b>	
	Criteria	Indicator
	i) Improvement in plantation ii) Protection iii) Record maintenance iv) Reasons for modification/ discontinuation of project.	
20.	Name and signature of the Forest Officials present during the visit	
21.	Name and signature of the field evaluators	